



OPEN

Compute Project

Cooling Environments: Cold Plate Sub-Project
Design Specification
Universal Quick Disconnect (UQD)
v2.0.0
Effective September 22, 2026

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1. License

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1.2. Acknowledgments

Version 1 Author(s): Mark Sprenger (Intel), Jordan Johnson (Intel), Bret Henkel (Intel)

Version 2 Author(s): Travis Gaskill (Individual), Elizabeth Langer (CPC), Paul Artman (AMD)

The Authors of this Specification would like to acknowledge the following companies for their significant collaboration:

AMD	Cejn	CoolIT	CPC	Danfoss	Etched	Nvidia	Staubli	Parker
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Auras	Dell	Intel	Jonhon	Lotes	Nidec	Amphenol
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2. Compliance with OCP Tenets

This contribution complies with the OCP Tenets of Openness, Efficiency, Impact, Scale, and Sustainability.

2.1. Openness

This specification outlines the design and test criteria for any willing supplier to build and validate a supplier interchangeable fluid quick disconnect. The specification has been developed with input from suppliers and end users. The openness of the specification allows users to work with their preferred suppliers, and enables opportunities for liquid adoption in adjacent market segments.

2.2. Efficiency

This specification combines the previously separate specifications:

- Universal Quick Disconnect (UQD) Specification, Revision 1.0
- Universal Quick Disconnect Blind-Mate (UQDB) Specification, Revision 1.0

Consolidation of the specifications into a singular document streamlines accessibility and ease of adoption, while also ensuring parity of key performance parameters across the multiple sizes and configurations.

2.3. Impact

Through establishing and improving upon a supplier interchangeable fluid quick disconnect, this specification significantly lowers the barriers to adoption of liquid cooled compute, and enables liquid cooling at scale.

2.4. Scale

Universality of this specification enables a more robust and resilient global supply chain in support of scaling liquid cooling infrastructure for compute.

2.5. Sustainability

By lowering the barriers to mass adoption of liquid cooled computing, the world moves more quickly towards a more energy efficient mode of cooling and enables a more sustainable datacenter PUE compared to air cooling. By ensuring this version of the specification maintains a degree of backwards compatibility, reuse is encouraged and waste mitigated.

3. Version Table

Date	Version #	Author	Description
June 2026	V2.0.0	See Authors	Version Release

4. Terms & Definitions

TERM	DEFINITION
UQD	Universal Quick Disconnect - Handmate
UQDB	Universal Quick Disconnect – Blindmate
HANDMATE	Direct manual intervention required to couple and de-couple QD pair
BLINDMATE	Indirect (blind, remote) coupling and de-coupling of QD pair via alternate mechanism(s)
HYBRID	Blindmate coupling of UQD plug and UQDB socket
PLUG	QD half with exterior mating geometry (AKA: male, insert)
SOCKET	QD half with interior mating geometry (AKA: female, body)
TERMINATION	QD end features to connect a tube, pipe or port
COUPLED	State when plug and socket are fully engaged
HARD-STOP	Condition in which the QD pair are coupled to the point of, and limited by, mechanical contact

5. Scope

This document defines the technical specifications for the Universal Quick Disconnect (UQD) and Universal Quick Disconnect Blind-Mate (UQDB) used in non-combustible single-phase (water/glycol) systems for liquid cooling of electronics.

6. Overview

In liquid cooled systems, fluid is transported under pressure within a Technology Cooling System (TCS) fluid loop [1]. The IT equipment loop is joined to the TCS using a fluid connector.

This specification defines interface dimensions and performance criteria for supplier interoperability across UQD configurations used in liquid cooling systems. Coupling configurations include handmate (**Figure 2**), blindmate (**Figure 1**), and hybrid (**Figure 3**).

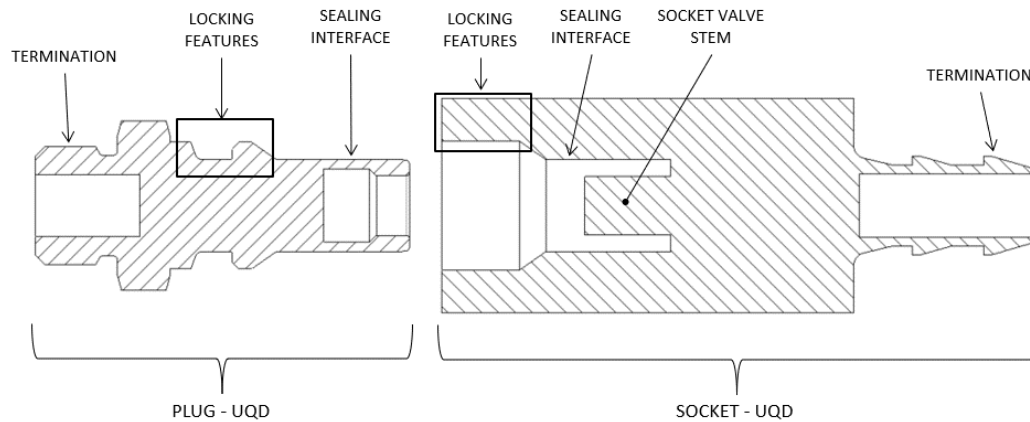


Figure 2 - UQD Configuration

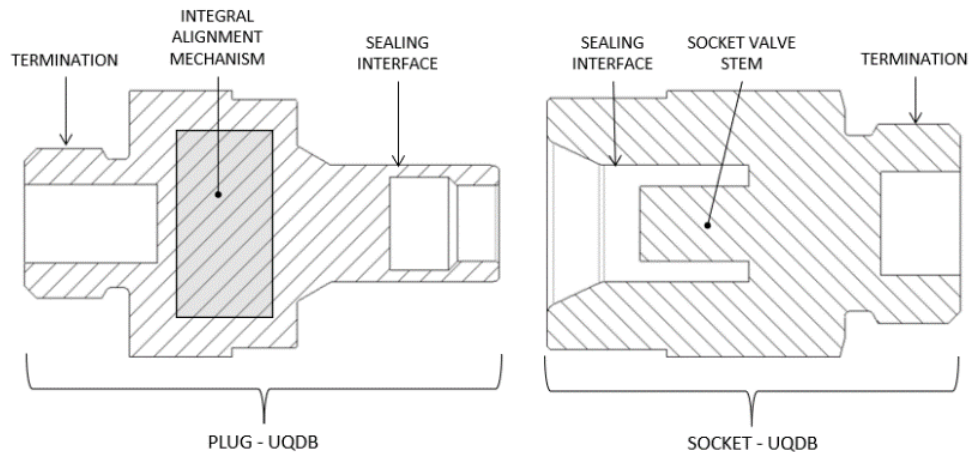


Figure 1 - UQDB Configuration

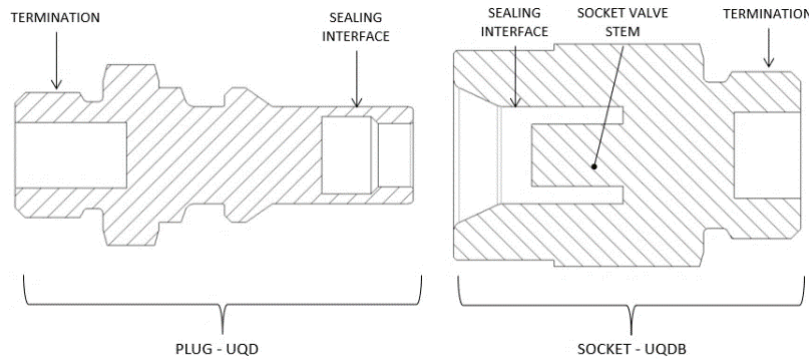


Figure 3 – Hybrid Configuration

6.1. Interchangeability with Previous Versions

UQD Specification Version 2 is designed to be backwards compatible with the previously separate Version 1 Specifications for UQD and UQDB, and end user deployment assessment is encouraged. Risks and considerations for interchanging or co-deploying v1 and v2 components are outlined in the appendix (15.1).

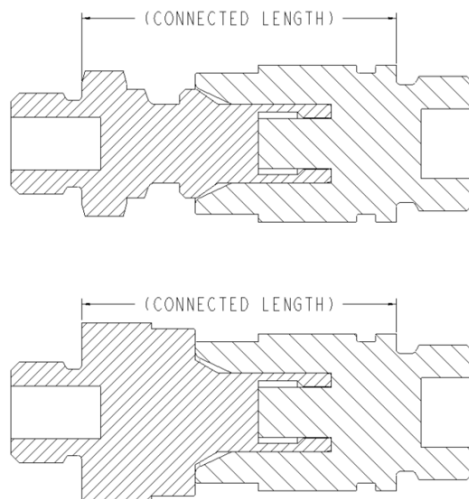
6.2. Connected Length Coupled State

Overall connected lengths of coupled QD sets are reported as a “panel to panel” dimension, not including length associated with terminations (ie ORB stud or hosebarb length). Connected lengths are reference (driven) dimensions derived from component level dimensions and tolerances as outlined in Section 7.

6.2.1. Blindmate Couplings

Connected length of blindmate configurations are referenced in Figure 4. Mechanical hard-stop location for the UQDB is parallel face to face, and hybrid is conical surface of socket to tangent diameter of plug flange. Hybrid applications should include additional compliance mechanisms to account for overdrive and radial offset of the mating pair. Additional detail is provided below:

- Definition – Overdrive (Floating Device): A device which allows for radial and axial movement of one coupling half. The floating device accepts the overall tolerances of the hybrid connection in the fully connected position.
- Incorporation of overdrive devices are out of scope for any cross-verification testing outlined in this document.



TOP: Hybrid Configuration			
QD Size	MIN	Nominal	MAX
02	35.85	36.30	36.75
04	43.6	44.1	44.5
06	47.1	47.6	48.0
08	51.1	51.6	52.0
BOTTOM: UQDB Configuration			
QD Size	MIN	Nominal	MAX
02	35.6	36.1	36.6
04	43.8	44.3	44.8
06	47.1	47.6	48.1
08	50.9	51.4	51.9

Figure 4 - Blindmate Connected Length

In addition to axial compensation, the overdrive mechanism may include degrees of freedom that account for an angled approach during connection (example shown in **Figure 5**). To mitigate excess wear or damage to the plug and socket housings, or socket sealing, consideration should be given to controlling the approach angle to a minimum.

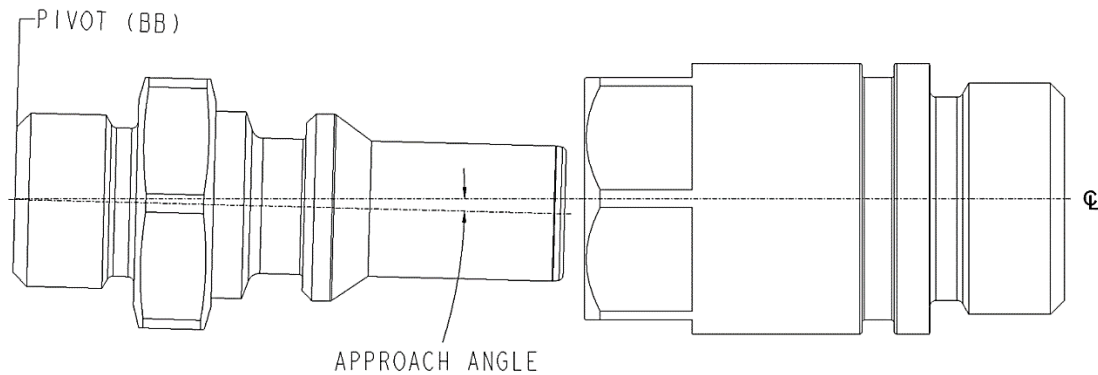


Figure 5 - Blindmating Angular Approach

6.2.2. Handmate Couplings

Connected length portion of handmate configurations are referenced in **Figure 6**. Socket length is defined as a maximum keep-in value (**Table 1**) and relative position of plug varies depending on the style of latching mechanism per supplier.

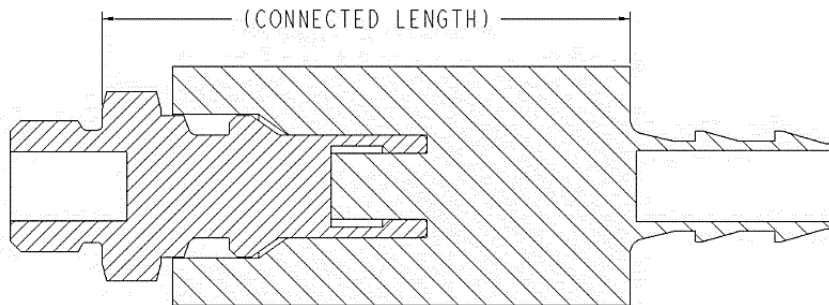


Figure 6 - Handmate Connected Length

7. Feature & Dimensional Requirements

Configuration specific features and dimensions are outlined below, all dimensions are shown in millimeters unless otherwise specified. Where no dimension is given, the geometry is left to the discretion of the supplier and should consider end user (datacenter environment) requirements for fit and function.

7.1. UQD Socket Dimensions

Physical features of the UQD socket shall conform to those outlined in **Figure 7**, and dimensions specified in **Table 1**.

Dimension 'CC' is a maximum keep-in-zone, which includes latching mechanism. In order to preserve a more compact outer housing diameter, UQD sockets with asymmetric latching mechanisms may exceed the 'CC' boundary. UQD supplier shall provide more detail on request. Dimensions 'DD' is a maximum overall length keep-in-zone. Reference dimension 'S' carries through to all socket/plug and UQD/UQDB configurations.

7.1.1. UQD Latching Requirements

The UQD socket shall include a mechanism that latches and locks the socket to the plug (**Figure 8**), bounded by mating UQD plug dimensions 'R', 'G', 'P', 'Q' (**Table 2**). This locking mechanism must be utilized to meet the pressure and durability requirements specified in this document in its coupled state. Suppliers should minimize the size of the latch volume to save space in IT systems. In addition, latching mechanisms should provide visual, tactile, and or audible feedback to users.

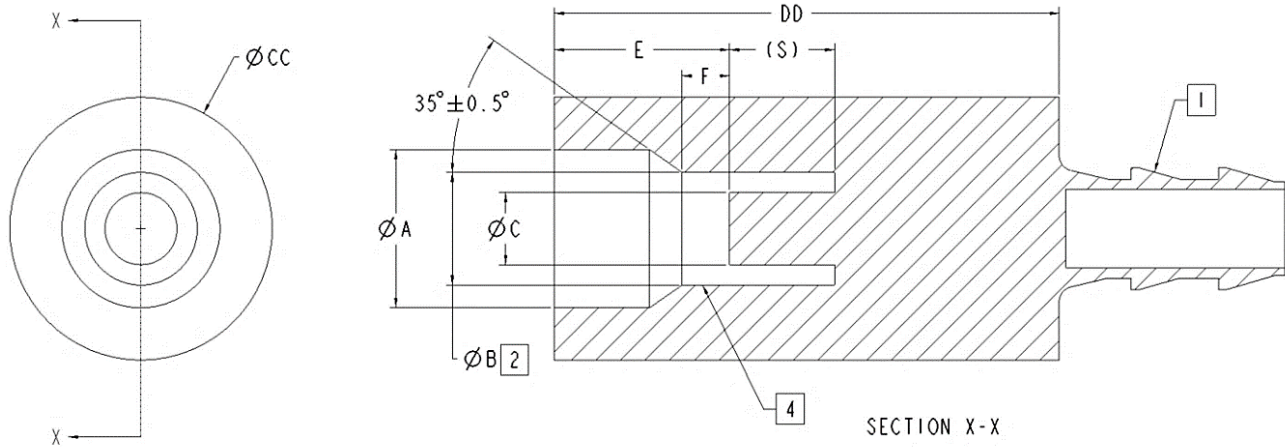


Figure 7 - UQD Socket Dimensions

Table 1 - UQD Socket Dimensions

Dimension	A	B	C*	E		F	S _{max}	CC	DD
Tolerance	MIN	± 0.025	± 0.025	MIN	MAX	± 0.10	REF	MAX	MAX
UQD02	11.25	6.71	3.63	12.8	13.7	3.3	8.0	21.0	50.0
UQD04	15.65	11.15	7.14	16.6	18.1	4.7	11.7	26.0	60.0
UQD06	18.85	14.38	[9.45, 9.65]	17.3	18.8	5.4	14.5	30.0	65.0
UQD08	22.05	17.56	[10.73, 11.07]	18.5	20.0	6.6	17.3	37.0	75.0
NOTE 1	Termination location - see Table 5 for details								
NOTE 2	Sealing / Interoperability surface – machine to 32Ra MAX								
NOTE 4	Seal gland(s) located on this surface - QD supplier defined								

**Dimension C adjusted to [MIN, MAX] for UQD06 and UQD08 sizes to reduce extrusion gap, and allow for supplier geometry flexibility to mitigate seal washout, future versions may consider realignment to an agreed upon nominal*

7.2. UQD Plug Dimensions

Physical features of the UQD plug shall conform to the features outlined in **Figure 8**, and dimensions specified in **Table 2**. In the locking mechanism contact area, identified in **Figure 8 – Detail A**.

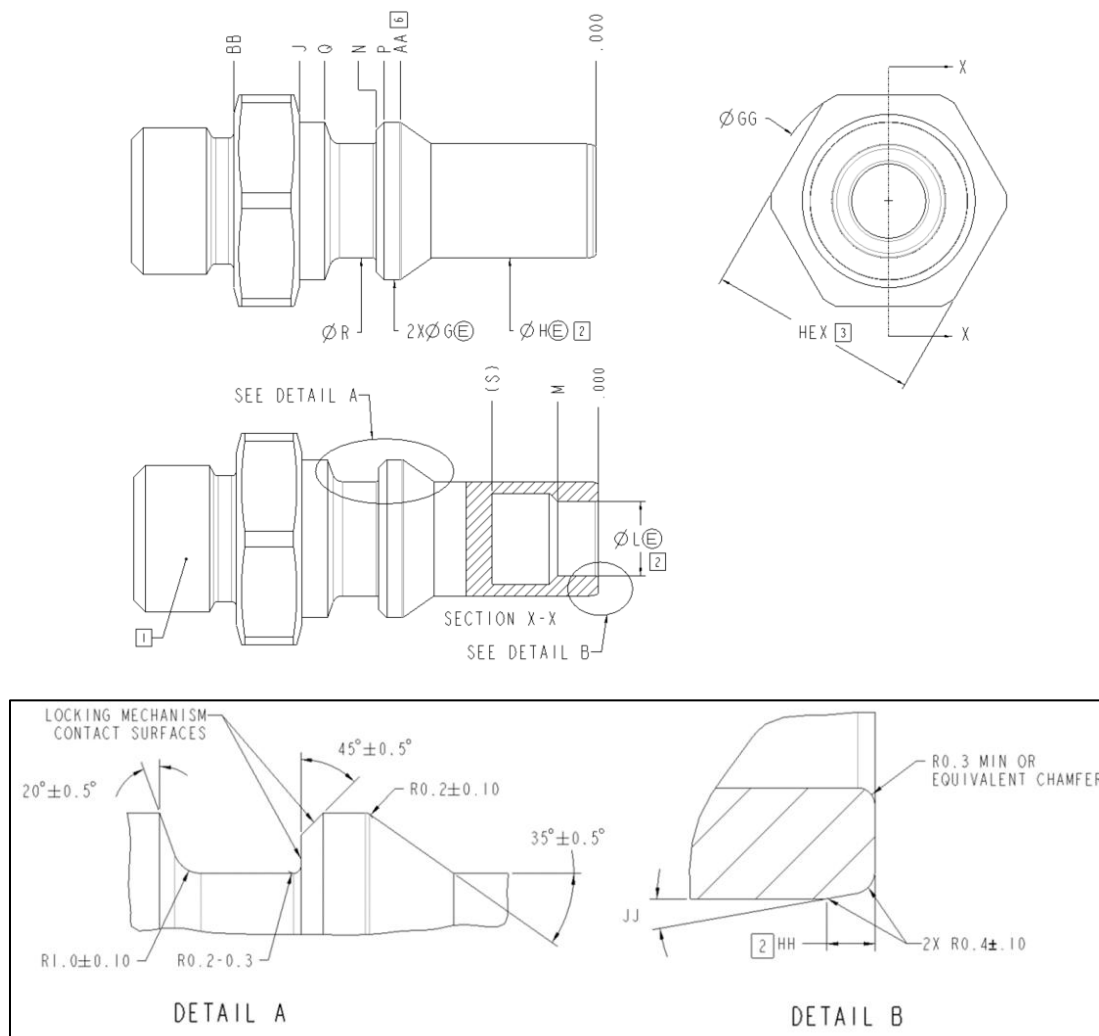


Figure 8 - UQD Plug Dimensions

Table 2 - UQD Plug Dimensions

Dimension	G	H	J	L	M	N	P	Q	R	AA	BB	GG	HH	JJ
Tolerance	±0.025	±0.025	MIN	±0.025	MIN MAX	±0.1	±0.06	±0.3	MAX	±0.10	±0.10	MAX	±0.10	±1.0°
UQD02	11.0	6.65	21.0	3.73	2.4 3.0	15.5	14.8	19.4	6.8	14.10	27.0	16.5	0.50	15°
UQD04	15.4	11.07	29.0	7.24	3.0 3.8	21.5	20.7	26.5	11.2	19.20	35.4	19.8	0.85	10°
UQD06	18.6	14.30	32.5	9.75	3.5 4.8	25.0	24.2	30.0	14.2	22.67	38.9	25.5	0.85	10°
UQD08	21.8	17.48	36.5	11.17	3.8 5.8	29.0	28.2	34.0	17.4	26.69	42.9	30.0	0.85	10°
NOTE 1	Termination location - see Table 5 for details													
NOTE 2	Sealing / Interoperability surface - machine to 32Ra MAX													
NOTE 3	Hex feature for installation to be on this surface - see Table 5 for details													
NOTE 6	Dimension to theoretical sharp corner (TSC)													

7.3. UQDB Socket Dimensions

Physical features of the UQDB socket shall conform to the features outlined in **Figure 9**, and dimensions specified in **Table 3**. Detail C does not have any utility relative to the performance of this specification, but is provided as an intentional mating feature for customer accessories, or locating during manufacturing and assembly processes.

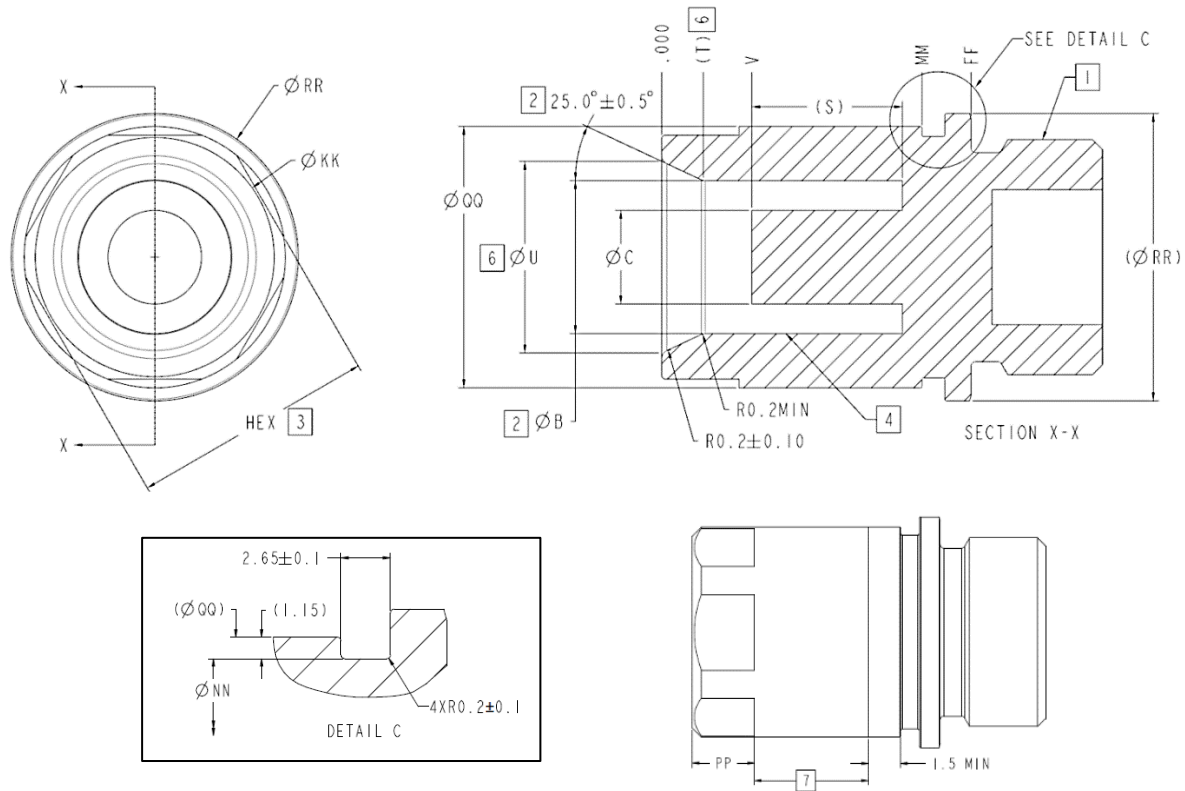


Figure 9 - UQDB Socket Dimensions

Table 3 - UQDB Socket Dimensions

Dimension	B	C	T	U	V	FF	KK	MM	NN	PP	QQ	RR
Tolerance	±0.025	±0.025	REF	±0.1	±0.3	±0.1	MIN	±0.15	±0.2	MIN	±0.15	±0.15
UQD02	6.71	3.63	4.81	11.2	7.11	23.62	15.5	18.0	15.2	5.3	17.5	17.5
UQD04	11.15	7.14	5.20	16.0	8.90	28.50	19.5	22.9	20.0	6.7	22.3	22.3
UQD06	14.38	[9.45, 9.65]	4.95	19.0	9.35	31.75	24.5	26.1	25.2	8.3	27.5	27.5
UQD08	17.56	[10.73, 11.07]	4.76	22.0	10.36	35.56	26.5	29.9	27.5	9.0	29.8	33.0
NOTE 1	Termination location - see Table 5 for details											
NOTE 2	Sealing / Interoperability surface - machine to 32Ra MAX											
NOTE 3	Hex feature for installation to be on this surface - see Table 5 for details											
NOTE 4	Seal gland(s) located on this surface - QD supplier defined											
NOTE 6	Dimension to theoretical sharp corner (TSC)											
NOTE 7	Non-standard zone – QD manufacturing specific											

*Dimension C adjusted to [MIN, MAX] for UQD06 and UQD08 sizes to reduce extrusion gap, and allow for supplier geometry flexibility to mitigate seal washout, future versions may consider realignment to an agreed upon nominal

7.4. UQDB Plug Dimensions

Physical features of the UQDB socket shall conform to the features outlined in **Figure 10**, and dimensions specified in **Table 4**.

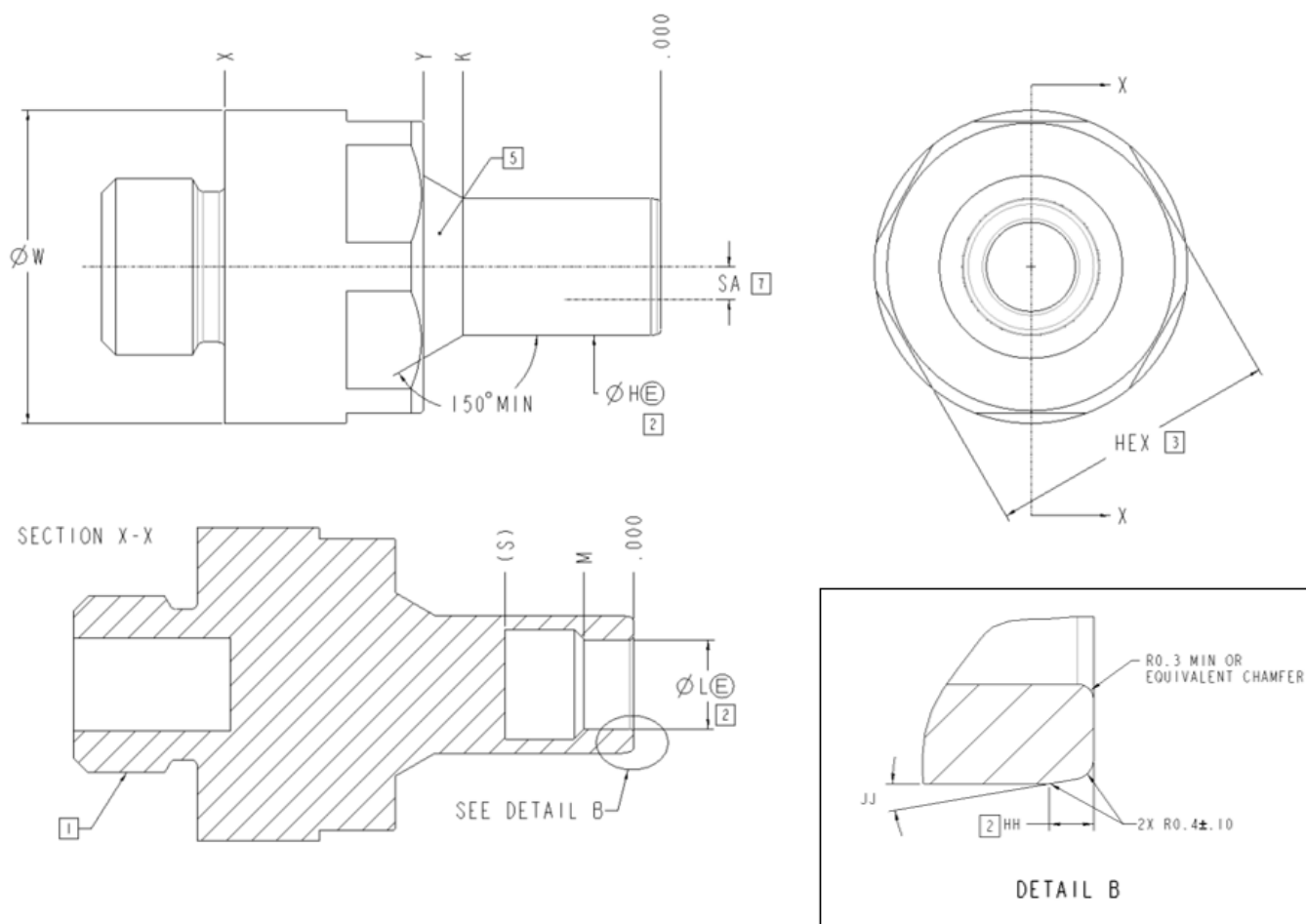


Figure 10 - UQDB Plug Dimensions

Table 4 - UQDB Plug Dimensions

Dimension	H	K	L	M		X	Y	W	SA	HH	JJ
Tolerance	±0.025	±0.3	±0.025	MIN	MAX	±0.1	±0.3	±0.15	+0.30 / -0.00	±0.10	±1.0°
UQD02	6.65	11.0	3.73	2.4	3.0	27.0	14.50	21.4	1.00	0.50	15°
UQD04	11.07	16.1	7.24	3.0	3.8	35.4	19.60	25.4	1.00	0.85	10°
UQD06	14.30	19.6	9.75	3.5	4.8	38.9	23.10	28.4	1.00	0.85	10°
UQD08	17.48	23.6	11.17	3.8	5.8	42.9	27.10	31.4	1.00	0.85	10°
NOTE 1	Termination location - see Table 5 for details										
NOTE 2	Sealing / Interoperability surface - machine to 32Ra MAX										
NOTE 3	Hex feature for installation to be on this surface - see Table 5 for details										
NOTE 5	QD supplier defined area, keep-in-zone bounded by dimension 'Y', 'K' and MIN angle										
NOTE 7	Self-alignment (SA) shall be incorporated into plug assembly, dimension is a radial allowance										

7.5. Terminations

Terminations are subject to the performance requirements specified in this document. Minimum product offering should reflect the terminations outlined in the table below. For barbed terminations, barb design and number of barbs are at the discretion of the QD supplier. Additional termination offerings are at the discretion of the QD supplier.

Table 5 - Terminations

Plug Terminations - UQD & UQDB

Description	Stud End ISO11926-3 [2] ¹			
QD Size	02	04	06	08
Stud Size	ORB-04	ORB-06	ORB-08	ORB-10
Reference Thread	7/16-20 UNF-2A	9/16-18 UNF-2A	3/4-16 UNF-2A	7/8-14 UNF-2A
Recommended Hex - UQD	14mm	17mm	22mm	27mm
Recommended Hex - UQDB	19mm	24mm	27mm	30mm
Suggested Torque ²	9 Nm	15 Nm	25 Nm	30 Nm
¹ Reference ISO11926-1 [3] for mating port geometry				
² Torque values should consider mating geometry, material, lubrication and any other application specific variables				

Socket Terminations - UQDB

Description	Stud End ISO11926-3 [2] ¹			
QD Size	02	04	06	08
Stud Size	ORB-06	ORB-08	ORB-10	ORB-12
Reference Thread	9/16-18 UNF-2A	3/4-16 UNF-2A	7/8-14 UNF-2A	1-1/16-12 UN-2A
Recommended Hex	16mm	20mm	25mm	27mm
Suggested Torque ²	15 Nm	25 Nm	30 Nm	48 Nm
¹ Reference ISO11926-1 [3] for mating port geometry				
² Torque values should consider mating geometry, material, lubrication and any other application specific variables				

Socket Terminations - UQD

Description	Hosebarb ¹ (Push-Lock)			
QD Size	02	04	06	08
Hosebarb Size	1/4" HB	3/8" HB	1/2" HB	5/8" HB
¹ Hosebarb intended for use with reinforced EPDM hose, consult QD supplier/Tube supplier for additional information and installation guidance				

8. Performance Requirements

To comply with this document, the product shall meet or exceed the performance requirements listed in **Table 6**.

Table 6 - Performance Requirements

		UQD & UQDB Size				
Parameter	Units	02	04	06	08	Test(s)
Pressure - Maximum Operating	-	6.89 bar(g) / 100 psi(g)				9.1.1
Pressure - Minimum Burst	-	20.68 bar(g) / 300 psi(g)				
Rated Flow	L/min	2.27	6.44	11.36	17.79	9.1.4
	GPM	0.6	1.7	3.0	4.7	9.1.5
Maximum Flow ¹	Contact QD supplier for guidance – general recommendation limit to equivalent volumetric flow derived from minimum cross-sectional area and maximum velocity of 5m/s.					
Flow Performance – Pressure Drop Coefficients {A,B}	MIN	Planned review for definition in subsequent revisions				9.1.4
	MAX					
	-	Reference Equation: $\Delta P(Q) = AQ^2 + BQ$ (ΔP in psi, Q in L/min)				
Minimum Cv ⁷	-	0.30	1.1	2.2	3.6	9.1.4
Maximum Cv ⁷	-	0.43	1.6	3.3	5.6	
Maximum Coupling Force @0psi ² Force / Pressure Scaling Factor ⁴	N	55.0	65.0	90.0	135.0	9.1.3
	lbf	12	15	20	30	
	N(bar)	3.47	9.62	16.06	24.00	
	lbf(psi)	0.054	0.164	0.274	0.409	
Coupling Cycles – Minimum ³	# cycles	5000				9.2.3
Maximum Fluid Loss per Cycle	mL	0.02	0.03	0.04	0.07	9.1.2
Temperature Range – Non-Op / Shipping ⁵	[MIN, MAX]	[-40°C, 70°C] / [-40°F, 158°F]				9.2.1
Temperature Range - Operating	[MIN, MAX]	[5°C, 65°C] / [41°F, 149°F]				9.2.2
Storage Life (from T ₀) ⁶	-	5 years				-
Service Life (from storage life)	-	10 years				-

Notes

¹ Limiting factors include mitigating seal washout during coupling cycles under flow, which must currently sustain min 2x rated flow.

² Applies to UQDB only (ie valving), the locking mechanism of handmate socket is expected to marginally increase the force to connect

³ Cycle requirement considers high-cycle count applications such as factory test-equipment

⁴ Use to derive coupling force at discrete pressure; Maximum coupling force + (target pressure)*scaling factor; $y=mx+b$

⁵ Thermal effects on QD packaging (i.e. PET trays, protective caps) must not adversely affect the performance or function of the UQD. Exposures at low temperatures charged with fluid (i.e. L10) may warrant additional considerations – contact QD supplier for guidance.

⁶ T₀ (time zero) is defined as date of UQD manufacture

⁷ Flow coefficient reported relative to water, apply correction factors or perform additional testing to evaluate dP with alternative liquids

9. Performance Verification Tests

The tests in this section are reflective of the requirements in **Table 6**. The tests are broken down into the following groups:

1. QD Property Tests
2. Thermal / Mechanical Cycling Tests

Time Zero QD property tests can be run in parallel using different samples for each test. Thermal / Mechanical Cycle Tests must be run sequentially with the same set of samples. An overview of both groups of tests can be seen in **Figure 11** and **Figure 12**.

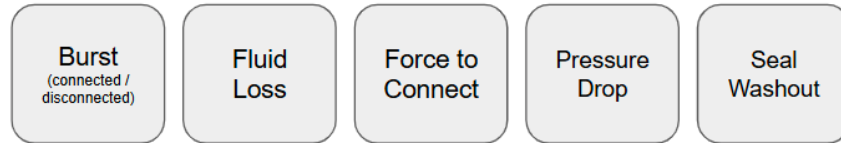


Figure 11 - QD Property Tests

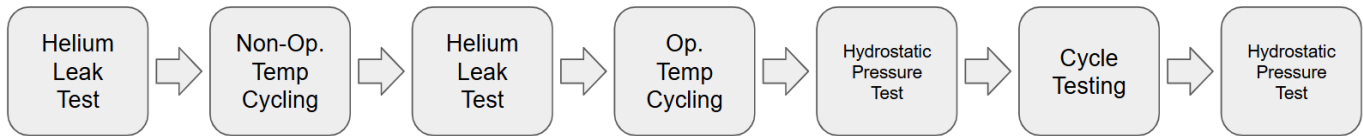


Figure 12 - Thermal / Mechanical Cycling Tests

Each test shall be conducted and the test data collated in a test report. A “QD Verification Report Template” is provided with this specification as the preferred template for reporting (see 15.3). The supplier verification test report shall be provided to customers upon request, and as part of submission packet for listing on OCP Marketplace.

In accordance with ISO 18869 [4], the required sample size per test is 5, at minimum. In accordance with ISO 18869:2017 Section 6.3, the instruments must meet certain accuracy requirements. All helium leak tests conducted shall be in accordance with ASTM E493. Unless otherwise noted, sample populations may be run in parallel where tests require multiple configurations to be evaluated.

9.1. QD Property Tests

9.1.1. Burst Pressure

Test Description	Conduct a burst pressure test on the plug, socket, and mated pair.
Test Position	Fully mated (UQD configuration only) and disconnected (all plug / socket)
Test Pressure	Test to failure, or pressure 3x minimum proof pressure – whichever is lower. Reference ISO 18869 for rise rate.
Acceptance Criteria	Burst pressure is above Minimum Burst Pressure (Table 6)

9.1.2. Fluid Loss

Test Description	Conduct the test according to ISO 18869 Section 12
Test Fluid	Water

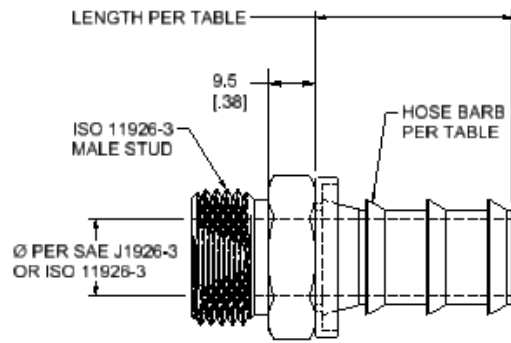
9.1.3. Force to Connect

It is recommended to minimize coupling and decoupling forces for both UQD and UQDB applications.

Test Description	Conduct the test according to ISO 18869 Section 7. Repeat the test for a total of five times per sample. Use the maximum force found per test and average the results from all the tests and all the samples to determine the connect force. Report the average (of the maximums) in the test report. Unless otherwise requested, the test shall be conducted while fully aligned radially and angularly.
Test Temperature	Ambient
Test Pressures	Conduct the test at 3 pressure levels: 0/2.76/6.89 bar(g) (0/40/100 psi(g)). Pressure to be present on both plug and socket, no additional lubrication or alignment beyond expected use
Test Fluid	Air or water; pressurized
Connection Speed	40 mm/s $\pm$ 10mm/s
Specific to UQDB	Conduct the test at maximum radial misalignment (SA), resetting the misalignment to maximum after each cycle.

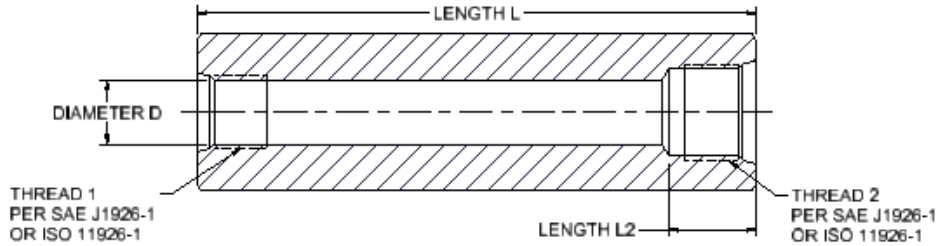
9.1.4. Pressure Drop

Test Description	
Conduct the test according to ISO 18869, Section 13 [4] except as indicated below.	
Key 1 coupling under test 2 pressure tap 3 differential pressure measuring device 4 controlled fluid supply NOTE Dimensions L_1 to L_5 are minimum lengths: L_1 = 10 times the inside diameter of the coupling tube or pipe; L_2 = 5 times the inside diameter of the coupling tube or pipe; L_3 = length of the coupling plus end fittings; L_4 = 10 times the inside diameter of the coupling tube or pipe; L_5 = 5 times the inside diameter of the coupling tube or pipe.	Figure 13 - ISO 18869 reference flow diagram [4]
The test apparatus shall use hose or tubing of inside diameter corresponding to the default hose diameter per Table 5 of this standard (for example, UQD04 has 3/8" barb, therefore all UQD/UQDB04 should be tested with .375" $\pm$ 10% ID hose/tube). The connections to the QD shall be made with minimal adapter fittings, example as shown in the image below. This image represents the section from L2 through L4 of ISO 18869 Figure 13 as shown above. ISO 18869, Section 13.3 – Remove the test coupling from the test apparatus and connect the tubes or hoses using a connector per the images below. All hose, tubing, or fittings connected between pressure taps (2) and coupling under test (1) shall be the same in test and tare setup.	



EXAMPLE - HOSE BARB

	ID, mm	TOLERANCE	LENGTH, mm	TOLERANCE
11926 7/16	4.4	0.08	9.1	0.2
1/4 HB	4.4	0.08	20.5	REF
11926 9/16	7.5	0.1	10	0.2
3/8 HB	7.5	0.1	24.1	REF
11926 3/4	10	0.1	11.1	0.2
1/2 HB	10	0.1	28	REF
11926 7/8	12.5	0.1	12.7	0.2
5/8 HB	12.5	0.1	38	REF
11926 1-1/16	15.5	0.12	15.1	0.2
3/4 HB	15.5	0.12	38	REF



TARE DIMENSIONS					
COUPLING	THREAD 1	DIAMETER D (mm)	LENGTH L (mm)	THREAD 2	LENGTH L2 (mm)
UQDB02/UQDH02	7/16-20	9.88±0.15	96±5	9/16-18	14.5±0.5
UQDB04/UQDH04	9/16-18	12.92±0.17	112±5	3/4-16	16±0.5
UQDB06/UQDH06	3/4-16	17.5±0.18	124±5	7/8-14	18±0.5
UQDB08/UQDH08	7/8-14	20.48±0.21	139±5	1-1/16-2	20.5±0.5

ISO 18869, Section 13.5 – Subtract the pressure drop values collected in section 13.3 from those collected in 13.2.

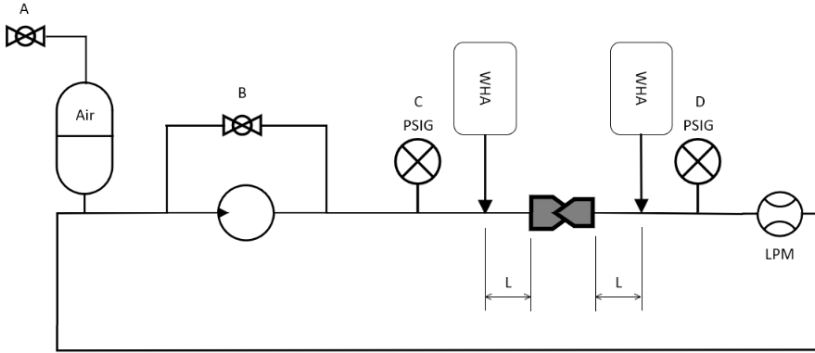
Graphically plot the net pressure drop for each flow direction. Calculate the best fit polynomial and report the curve fit equation for the average pressure drop (n=5 minimum) in each flow direction as well as pressure drop at 100% and 150% of rated flow.

Test Temperature	25±5°C	Test Fluid	Water
Test Flowrates	The 100% rated flowrate is defined by the rated flow parameter herein the specification. Select at least six flow rates from 25 % to 150 % of the rated flow, including 100 % of rated flow.		
UQDB & Hybrid	Test shall be conducted at the fully mated, hard-stop condition		
Reported Value	Report minimum C_v recorded at rated flow for both directions from an equation of the form: $C_v = Q \sqrt{SG/\Delta P}$; where Q is in GPM and ΔP is in psi.		
Additional Characterization	Pressure drop vs. flowrate should be reported using a best fit line with an equation of the form: $dP(Q) = A \cdot Q^2 + B \cdot Q$. Report the coefficients A and B when using the units [L/min] for flowrate and [psi] for pressure. Coefficients for different units may be provided as supplementary information.		

9.1.5. Seal Washout (Closed Loop)

The Seal Washout test is conducted to ensure that the seal geometry of the QD can withstand connection / disconnection under high pressure / flowrate conditions without washing the plug / socket valve seal out of its gland, creating a leak. This test is meant to recreate the real world scenario of connecting / disconnecting a filled server into a filled TCS loop.

For guidance on use in an open loop scenario, such as during filling or draining a server – contact QD supplier for guidance. In an open loop scenario, extreme pressure drop and line velocity across a UQD valve set can induce a seal washout event. As such, fill and drain practices should follow a progressive introduction of flow and pressure within ratings [5].

Test Setup	Using a test setup similar to the below diagram, conduct the following: 1. With QD fully connected, run circulator and adjust pump speed and/or valve B to achieve targeted flow. 2. Turn off circulator and disconnect QD. 3. Turn on circulator. 4. Pressurize test loop through valve A (or other means) to achieve max operating pressure at pressure gauge C. 5. Turn off circulator. 6. Reconnect QD.		
Test Process	1. With QD <u>connected and circulator on</u>, confirm flowrate has not changed. If adjustments were needed, it may be necessary to restart from Test Setup step 2. 2. Turn circulator on and conduct testing by connecting and disconnecting the QD according to the number of cycle specified, at the specified rate. Removing or overriding the locking mechanism of the handmate configuration is acceptable. 3. Pressure spike during disconnect shall be no more than 30psi from pre-disconnect operating pressure. 4. Observe for failure (leakage and/or seal dislodged from valve) until the number of cycles is achieved 5. If no failure is observed in steps 1-4, then reverse the flow direction and repeat steps 1-4.		
A  L: <5 x ID Figure 14 - Seal Washout (Closed Loop) Diagram			
Number of Cycles	20, each flow direction (plug to socket / socket to plug)	Connection Speed	40mm/s ±10mm/s
Test Flowrate	2x the rated flow for the QD	Test Temperature	60°C
Test Pressure	6.9 bar(g) (100 psi(g)) operating (Excludes transient pressure spike).	Test Fluid	Water or PG25
Acceptance Criteria	No observed leakage or seal washout		

9.2. Thermal / Mechanical Cycling Tests

9.2.1. Non-Operational (Shipping) Temperature Cycling

Test Description	Conduct a thermal cycling test with air to simulate shipping environmental exposures. Optional screening - conduct helium leak tests prior to, and after thermal cycling on all samples. The QD should be assembled to an all-metallic enclosure to minimize pressure decay. Test enclosure volume including all connected equipment should be as small as reasonably possible, typically less than or equal to 0.5L Apply pressure at room temperature, perform prescribed temperature cycle, and read pressure after returning to room temperature.
Test Position	Fully Connected (UQD/UQDB) and disconnected (plug/socket). When testing QDs in the fully connected state, connect the mating QD to the QD attached to the enclosure and cap the end to prevent pressure loss.

Test Temperature	-40°C for 72H, and +70°C for 72H, and back to room temperature
Temperature Transition Rate	5-10°C/min
Test Fluid	Air at 28-30psig
Specific to UQDB	Test should be conducted at the fully mated, hard-stop condition
Acceptance Criteria	Pressure decay attributed per individual QD must not exceed 1% of pressure at T_0 (<i>ex. 30psi at T_0, 28psi at test end, overall measured decay = 2psi. 10 QD samples used in test = $2\text{psi}/10\text{QD} = 0.2\text{psi}/\text{QD} < 0.3 (1\% \times 30\text{psi}) = \text{ACCEPT}$</i>)

9.2.2. Operational Temperature Cycling

Test Description	Conduct a thermal cycling test with the test fluid. After testing, conduct a hydrostatic pressure test.
Test Position	Connected with nominal engagement (UQD/UQDB/Hybrid) and disconnected (plug/socket); two distinct populations or same population with tests in series.
Test Temperature	5°C for 72H and +65°C for 72H and back to room temperature
Temperature Transition Rate	5-10°C/min
Test Pressure	6.9 bar(g) (100 psi(g)) at test temperature
Test Fluid	Water or PG25 (consider compensation for evaporation)
Acceptance Criteria	No visible leakage. After testing, conduct a hydrostatic pressure test (see 9.2.4)

9.2.3. Mechanical Cycling

Test Description	Cycle the UQD/UQDB/Hybrid. For UQD, the latch must be actuated each cycle. UQD and Hybrid Cycle testing to be assumed on-axis as reasonably possible, discrete floating mechanisms need not be present, but compliance should be accounted for elsewhere in the system to allow for parts to self-align. UQDB should be cycled with offset (SA) included. After testing, conduct a hydrostatic pressure test (see 9.2.4)
Number of Cycles	5000
Connection Speed	40 mm/s $\pm$ 10mm/s
Test Temperature	Standard lab environment
Test Pressure	2.75 bar(g) (40 psi(g))
Test Fluid	Water or PG25
Acceptance Criteria	After testing, no visible leakage. After testing, conduct a hydrostatic pressure test (see 9.2.4)

9.2.4. Hydrostatic Pressure Test

Test Description	Conduct hydrostatic leak test on the plug, socket, and/or mated pair as prescribed by the requirement. Purge air from system and pressurize to 6.9 bar(g)(100 psi(g)). In the case of disconnected plug/socket, apply the test pressure in the direction tending to close the valve. In mated pairs, ensure that internal pressure of 6.9 bar(g)(100 psi(g)) is achieved. Hold pressure for minimum 3 minutes. No visible leakage should be observed.
Test Position	Fully mated and/or disconnected per the requirement applied. When testing QDs in the fully connected state, connect the mating QD to the QD attached to the enclosure and cap the end to prevent pressure loss.
Test Temperature	Standard lab environment
Test Pressure	6.9 bar(g)(100 psi(g))
Test Fluid	Water or PG25
Acceptance Criteria	After testing, no visible leakage.

10. Supplier Cross-Verification Testing

Suppliers shall cross-validate their parts with a minimum of 3 other suppliers. In accordance with the OCP tenet of Openness, UQD suppliers shall make their UQDs available to other UQD suppliers upon request for cross-verification purposes. Likewise, the requesting supplier shall make available their UQDs at the time of request. UQD Suppliers shall publish the supplier list with which their QDs have successfully passed cross-verification testing. The cross-verification test reports shall be made available to customers upon request.

The required cross-verification tests, shown in **Figure 15**, are a subset of the QD Property Tests. These tests are considered critical to ensuring the interoperability of one supplier's QDs with those of a different supplier. The tests may be run in parallel or series, and apply to both the plug and socket of each supplier. In accordance with ISO 18869, the required sample size per test is 3, at minimum. In accordance with ISO 18869:2017 Section 6.3, the instruments must meet certain accuracy requirements.

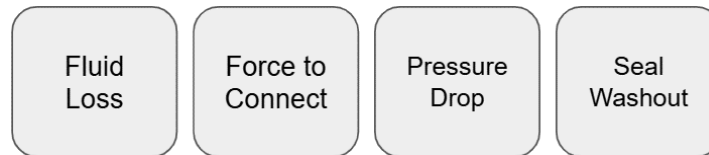


Figure 15 - Cross-Verification Tests

Cross-verification across previous versions of UQDs is not in scope of this specification. Performance, feature or dimensional variations across versions should be evaluated by the end user when considering mixed version deployments.

11. Marking & Packaging Requirements

Visible identification as UQD / UQDB and nominal size are required per **Table 7**. Marking can be positioned per supplier's discretion on any visual external surface of the plug and socket, and must be visible in the unmated condition. Specific to handmate socket and plugs, suppliers shall provide means of color identification – red and blue at a minimum.

Table 7 - Marking Requirements

QD Size	UQD	UQDB
02	UQD02 v2	UQDB02 v2
04	UQD04 v2	UQDB04 v2
06	UQD06 v2	UQDB06 v2
08	UQD08 v2	UQDB08 v2

Protective caps on interfacing surfaces and terminations are recommended for added security during shipping and handling. Caps on plug and/or UQDB socket outer diameter are commonly reused as the QD advances along the supply chain.

11.1. Identification

Within digital or printed catalogs, suppliers shall identify products meeting these requirements as “*Dimensional & performance requirements conform to OCP UQD Specification <current version>.<current revision>*”.

12. Wetted Materials

Supplier to ensure materials used in the construction of UQD / UQDB are compatible with the Acceptable Wetted Materials as identified in OCP's “Guidelines for Using Water-Based Transfer Fluids in Single-Phase Cold Plate-Based Liquid-Cooled Racks” [1] as well as “Guidelines for Using Propylene Glycol Based Heat Transfer Fluids in Single Phase Cold Plate-Based Liquid Cooled Racks” [6].

Furthermore, the UQD / UQDB Plug and Socket must adhere to the following materials in **Table 8**. This is to ensure similar material hardness on components that see forceful contact.

Table 8 - UQD/UQDB Material Requirements

Location	Material Requirement
UQD / UQDB Plug External Tip / Shaft	SUS 303 / 304 / 304L / 316 / 316L
UQD / UQDB Cone and Guide in Area	SUS 303 / 304 / 304L / 316 / 316L

13. Safety & Regulatory Requirements

Supplier to ensure relevant regulatory and safety standards in industry are adhered to. In reference to IEC62368-1 [7], a UQD may feasibly be installed in either a self-contained, or modular liquid-filled-component (LFC) such as a server, or cold plate assembly. General guidance is provided below on translating server-level requirements from IEC62368-1 [7] to relevant UQD performance and test parameters. Determination and acceptance of commutable data is the responsibility of the end user and/or certifying party.

Table 9 - IEC62368 LFC Requirements Cross-Reference Guide

Reference Clause [7]	UQD Guidance / Notes	Reference Test(s)
G15.2.1 – Hydrostatic Test	<i>No additional testing needed, pressure and temperature testing for sustained duration eclipses IEC requirement</i>	9.1.1, 9.2.2
G15.2.2 – Creep Resistance	<i>Refers to non-metallic materials – such as elastomeric oring seals</i>	9.2.2
G15.2.3 – Compatibility	<i>See wetted materials list and OCP coolant guidance [1] [6]</i>	-
G15.2.4 – Vibration	<i>Not relevant at QD level, anticipate installation techniques such as torque of stud-end termination to resist loosening under vibration</i>	-
G15.2.5 – Thermal Cycling	<i>LFC is not energized during this test</i>	9.2.1, 9.2.2
G15.2.6 – Force Test	<i>Steady force test up to 30N, anticipate installation and in-use loads</i>	-
Section 6 – Electrically Caused Fires	<i>Specific to ignition source and power class – for a PS3 circuit, minimum requirement is UL94 V1, or UL94 V2 if contained within a fire enclosure –small components such as o-ring seals may be considered exempt provided they meet specific criteria regarding size, location, and potential to propagate fire. Review selected materials with QD supplier.</i>	-

14. References

- [1] OCP Guideline, "Using Water-Based Transfer Fluids in Single-Phase Cold Plate-Based Liquid-Cooled Racks".
- [2] ISO Standard 11926-3, "Connections for general use and fluid power - Ports and stud ends with ISO 725 threads and O-ring sealing - Part 3: Light duty (L series) stud ends," 1995.
- [3] ISO Standard 11926-1, "Connections for general use and fluid power - Ports and stud ends with ISO 725 threads and O-ring sealing - Part 1: Ports with O-ring seal in truncated housing," 1995.
- [4] ISO Standard 18869, "Hydraulic fluid power - Test methods for couplings actuated with or without tools," 2017.
- [5] OCP Guideline, "Liquid Cooling Integration and Logistics, rev 1.0," 2023.
- [6] OCP Guideline, "Using Propylene Glycol-Based Heat Transfer Fluids in Single-Phase Cold Plate-Based Liquid Cooled Racks," 2025.
- [7] IEC Standard 62368-1, "Audio/video, information and communication technology equipment - Part 1: Safety Requirements, Edition 4.0," 2023.

15. Appendix

15.1. Version Interchangeability

Reference considerations for evaluating co-deployment of v1 and v2 UQDs in application.

Version 1 (V1)	Version 2 (V2)	Interchange Consideration
UQD & UQDB plug end condition <u>undefined</u>	UQD & UQDB plug end conditions <u>defined</u>	<i>V1 plug end with minimal/no chamfer may damage V1 & V2 socket seal(s)</i>
UQD plug & socket overall length <u>undefined</u>	UQD plug & socket overall length <u>defined</u>	<i>V1 lengths may vary from standard V2 length, retain V1 panel/space</i>
UQD plug & socket outer diameter <u>undefined</u>	UQD plug & socket maximum outer diameter <u>defined</u>	<i>V1 outer diameter may vary from standard V2 outer diameter, retain v1 pitch/space</i>
Performance requirement of 'Minimum Cv'	'Minimum Cv' values increased over v1. Adjusted to quadratic {A,B} reporting methodology and Cv REF	<i>V1 pressure drop across QD valves may be higher than V2 (V1 Cv lower than V2)</i>
Minimum 'S' valve stroke defined	Define maximum 'S' valve stroke to account for tolerances as a driven dimension	<i>V1 QD sets may not fully couple due to tolerance stacks of internal valving (issue present in V1)</i>
UQDB minimum & nominal engagement stroke defined, requiring full flow in "under coupled" condition	Tolerance loops do not support minimum engagement requirement without further changes, remove from specification and replace with guidance to ensure full coupling at hard-stop	<i>V1 systems without built in tolerance compliance may see coupling panel distance and flow variation</i>

15.2. Quality Guidelines

Product quality expectations should be communicated and aligned across suppliers, specifiers and end users throughout the ecosystem. Common quality considerations are referenced in this document for reference.

15.2.1. Visual Inspection

Guidance for inspection of performance critical surfaces and visual conditions are provided below, and are in reference to specific zones of UQD plugs and sockets per **Figure 16**. Where no guidance is provided, specification is left to the discretion of the QD supplier. General guidance for visual inspection includes the following:

- Inspect for one full rotation (360°) of part, magnification is recommended.
- Inspection lighting shall be performed under typical office lighting conditions (~700-1200LUX)
- TAPPI/ANSI T 564 chart may be used for defect size estimation
- Prior to inspection, any loose particles present may be removed via compressed filtered air

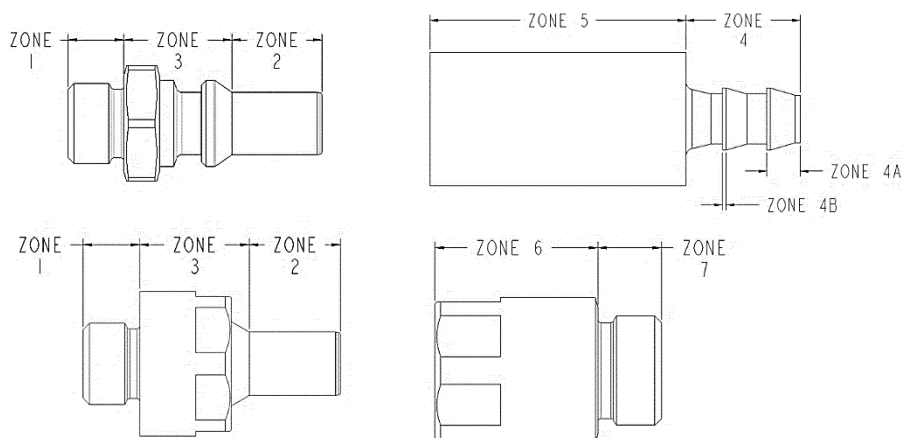


Figure 16 - Inspection Surface Zones

15.2.2. Visual Attribute Criteria

Recommendations for evaluation of common visual attributes is provided below in **Table 10**.

Table 10 - Visual Evaluation

Visual Attribute	Description	Acceptance Criteria	Zone Specific
Surface Imperfections	Minor notch, impression or deformation of surface(s)	All defect sizes $\leq 0.3\text{mm}^2$	1, 2, 4a, 4b, 7
		All defect sizes $\leq 1.0\text{ mm}^2$	3, 4, 5, 6
Manufacturing Artifacts	Resulting surface characteristics from typical fabrication processes, such as machining tool marks	Base material and as manufactured characteristics are acceptable per the prevailing surface (Ra) requirements	All
	Metal or plastic remnants from processing such as shavings or burrs	No residual debris from manufacturing present - loose or attached	All
Compromised Material	Foreign particulate/substance present or evidence of unintended ¹ chemical reaction such as oxidation	No foreign materials, rust or other evidence of corrosion present	All
Thread Profile	Deformation or damage to termination thread that would prevent installation or compromise performance	Evaluate with applicable standard thread/plug gage ² or mating port	1, 7

¹Intentional surface treatments such as passivation may result in a yellowing tint to stainless steel

²Reference termination thread class for appropriate gauging

15.3. Reporting Templates**15.3.1. Supplier Verification Report Template**

Quick Disconnect Verification Report Checklist					
QD Supplier				Date of Report	
QD Type (Plug & Socket)					
Mechanical Spec		OCP UQD Specification v2			
Test Spec		OCP UQD Specification v2			
Supplier Verification Tests					
Test #	Test Type	Unit of Measure	Specification	Result	Notes
9.1.1.	Burst Pressure				
9.1.2.	Fluid Loss				
9.1.3.	Force to Connect				
9.1.4.	Pressure Drop				
9.1.5	Seal Washout - Operational Test				
9.2.1.	Non-Operational Temperature Cycling				
9.2.2.	Operational Temperature Cycling				
9.2.3.	Mechanical Cycling				
Additional Notes:					

15.3.2. Supplier Cross-Verification Report Template

Supplier Cross-Verification Report Checklist					
Main QD Supplier				Date of Report	
Cross-Verification QD Supplier					
QD Type (Plug & Socket)					
Mechanical Spec		OCP UQD Specification v2			
Test Spec		OCP UQD Specification v2			
Supplier Cross-Verification Tests					
Test #	Test Type	Unit of Measure	Specification	Result	Notes
9.1.2.	Fluid Loss				
9.1.3.	Force to Connect				
9.1.4.	Pressure Drop				
9.1.5	Seal Washout - Operational Test				

15.3.3. Test Templates

Test ID	9.1.1.				
Test Description	Burst Pressure				
	Sample ID				
Condition	1	2	3	4	5
Plug	P/F	P/F	P/F	P/F	P/F
Socket	P/F	P/F	P/F	P/F	P/F
Mated	P/F	P/F	P/F	P/F	P/F

Test ID	9.1.2.						
Test Description	Fluid Loss						
	Sample ID					Avg. over Samples	Pass / Fail / NA
	1	2	3	4	5		
Fluid level prior to test (mL)							
Fluid level after test (mL)							
# of Connections							
Fluid loss (mL/cycle)							

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Test ID	9.1.3.							
Test Description	Force to Connect							
		Sample ID						
Pressure (bar (g))	Test	1	2	3	4	5	Avg. over Samples	Pass / Fail / NA
0	1							
0	2							
0	3							
0	4							
0	5							
0	Avg.							
2.76	1							
2.76	2							
2.76	3							
2.76	4							
2.76	5							
2.76	Avg.							
6.89	1							
6.89	2							
6.89	3							
6.89	4							
6.89	5							
6.89	Avg.							

Test ID	9.1.4.						
Test Description	Pressure Drop						
Flowrate (GPM)	Flow Direction (S-P / P-S)	Sample Pair ID					Avg. across Samples
		1	2	3	4	5	
		Pressure Drop (psi(g))					
Flowrate 1	S-P						
Flowrate 2	S-P						

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Flowrate 3	S-P						
Flowrate 4	S-P						
Flowrate 5	S-P						
Flowrate 6	S-P						
Flowrate 1	P-S						
Flowrate 2	P-S						
Flowrate 3	P-S						
Flowrate 4	P-S						
Flowrate 5	P-S						
Flowrate 6	P-S						
	dP at Flow Rating			Curve Fit Quadratic Coefficients (of the form: $dP = A \cdot Q^2 + B \cdot Q$)			
Flow Direction (S-P / P-S)	dP at 100% rated flow (psi(g))	dP at 150% rated flow (psi(g))		A	B	Meets min Cv? (Y/N)	
S-P							
P-S							

Test ID	9.1.5.				
Test Description	Seal Washout				
Subtest	9.1.5.1 - Operational Test				
	Sample ID				
Flow Direction (S-P / P-S)	1	2	3	4	5
S-P	P/F	P/F	P/F	P/F	P/F
P-S	P/F	P/F	P/F	P/F	P/F

Test ID	9.2.				
Test Description	Thermal / Mechanical Cycling Tests				
Subtest	9.2.1. - Non-Operational Temperature Cycling				
	Sample ID				
Condition	1	2	3	4	5
Plug	P/F	P/F	P/F	P/F	P/F

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Socket	P/F	P/F	P/F	P/F	P/F
Mated	P/F	P/F	P/F	P/F	P/F
Subtest	9.2.1. - Operational Temperature Cycling				
	Sample ID				
Condition	1	2	3	4	5
Plug	P/F	P/F	P/F	P/F	P/F
Socket	P/F	P/F	P/F	P/F	P/F
Mated	P/F	P/F	P/F	P/F	P/F
Subtest	9.2.3. - Mechanical Cycling				
	Sample ID				
Condition	1	2	3	4	5
Plug	P/F	P/F	P/F	P/F	P/F
Socket	P/F	P/F	P/F	P/F	P/F