

PBMC Reference Test Guideline

PBMC Development Team

Rev. 01

Revised 03/17/26

Scope:

This document is a reference document for the PBMC Design Specification and provides an example of a test plan with test order, force measurements, and test combinations used for testing of the valves. This test order was developed during development of the PBMC to minimize test fixture adjustments for the different tests and also allow for spot checking of various tests as the cycle count grows. The grouping of tests reflects the PBMC spec sample count as well as mate cycle and/or measurement requirements.

Test Order and Sample Details:

This section provides an example of test order and combinations used for testing of the valves. The plan below assumes three unique supplier designs and the test combinations, if there are more suppliers, the number of combinations would need to be adjusted. Refer to the PBMC Design Specification Section 7 for details pertaining to interoperability guidance.

Each pair will be subjected to a set of tests in an order designed to minimize:

1. The number of samples required to complete testing.
2. The risk of dependencies in subsequent tests.
3. Note that each combination for a given test group shall be the same serial number for each valve.
4. In the table below, the testing was shared among the different suppliers to share the testing effort. The strategy was that each supplier tested all the combinations with their plug and the other combinations would be shared with the other suppliers to ensure the two sample pairs were tested at two different test sites with the exception of spillage. This test requires 3 samples and every vendor tested all 9 combos for that test.

Table 11.2 Valve Combinations & Test Sites

	Plug	Socket	Site 1	Site 2
Combination 1	Vendor A	Vendor A	Vendor A	Vendor C
Combination 2	Vendor A	Vendor B	Vendor A	Vendor B
Combination 3	Vendor A	Vendor C	Vendor A	Vendor C
Combination 4	Vendor B	Vendor A	Vendor A	Vendor B
Combination 5	Vendor B	Vendor B	Vendor A	Vendor B
Combination 6	Vendor B	Vendor C	Vendor B	Vendor C
Combination 7	Vendor C	Vendor A	Vendor A	Vendor C
Combination 8	Vendor C	Vendor B	Vendor B	Vendor C

Combination 9	Vendor C	Vendor C	Vendor B	Vendor C
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Each of the combinations listed in Table 11.2 in the 1st group shall be subjected to the test regimen listed below, or similar. Testing listed in Table 11.3 - 11.5 are to be run with the exact same unique serial number set (pair). Two samples of each combination are to be tested, with the exception of spillage, which requires 3 samples. The third spillage valve combinations were only tested for spillage. The development team shared testing at different sites to gain confidence in not only sample size, but also to account for fixture variation.

For Table 11.6, one unique serialized pair of each combination shown in Table 11.2 needs to be tested to the tests listed. Two samples of each combo are to be tested. Test sites for each combination are listed above as well.

For Table 11.7, one unique serialized pair of each combination shown in Table 11.2 needs to be tested to the tests listed. See that section for more details.

For Table 11.8, the tests are not considered interoperability tests and shall be the same supplier only. The test order is left to the supplier to determine. See table for sample size requirements.

For all mate cycle testing at 40mm/s, the mate and radial forces all shall be recorded (at intervals and quantities listed in the Table 7.1) and analyzed to ensure conformance to requirements in the PBMC design specification. For mate cycle testing at 330mm/s, the peak connect and disconnect forces must be recorded and verified that they do not exceed the limits in Section 6.5.1 of the PBMC Specification.

Note A: For all tests that have a force boundary curve requirement, it is required to report plots depicting the worst-case force vs. mate distance for each combination in the test report. See Table 7.1 in the PBMC specification for more details.

Note B: All centering measurements/verification to meet zone and using a tool as outlined in Section 6.3 in the PBMC Design Specification. Measurement frequency during a particular test is outlined in the notes for that test in Table 7.1 of PBMC Specification. Prior to beginning any test sequence, the test sample shall be reset to its centered position. This may be done manually as necessary.

Note C: Radial forces to be measured during testing as outlined in Table 7.1 of the PBMC specification.

Table 11.3 Group 1 Test Sequence (see table 11.2 for combination details)

Test Sequence	Test Description	Offset Condition	Notes
1	7.1-10 Mate Cycles (Dry), 330mm/s	Aligned	Run 12 cycles, See Notes A, B, C
2	7.1-8 Static Mate Force vs. Mate Distance, (Dry)	Aligned	1 cycle, Notes A, B, C
3	7.1-13 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, (Dry)	Aligned	1 cycle, may be collected during 7.1-8 testing
4	7.1-10 Mate Cycles (Dry), 330mm/s	5.xmm + 2.x° (Combined-P)	Run 12 cycles, See Notes A, B, C
5	7.1-8 Static Mate Force vs. Mate Distance, (Dry)	5.xmm + 2.x° (Combined-P)	1 cycle, Notes A, B, C

6	7.1-13 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, (Dry)	5.xmm + 2.x° (Combined-P)	1 cycle, may be collected during 7.1-8 testing
7	7.1-10 Mate Cycles (Dry), 330mm/s	5.xmm + 2.x° (Combined-S)	Run 12 cycles, See Notes A, B, C
8	7.1-8 Static Mate Force vs. Mate Distance, (Dry)	5.xmm + 2.x° (Combined-S)	1 cycle, Notes A, B, C
9	7.1-13 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, (Dry)	5.xmm + 2.x° (Combined-S)	1 cycle, may be collected during 7.1-8 testing
10	7.1-10 Mate Cycles (Dry), 330mm/s	5.xmm radial	Run 12 cycles, See Notes A, B, C
11	7.1-8 Static Mate Force vs. Mate Distance, (Dry)	5.xmm radial	1 cycle, Notes A, B, C
12	7.1-13 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, (Dry)	5.xmm radial	1 cycle, may be collected during 7.1-8 testing
13	7.1-9 Static Mate Force vs. Mate Distance, no fluid flow (Wet),	5.xmm radial	2 cycles, Notes A, B, C
14	7.1-14 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, Static, no fluid flow (Wet)	5.xmm radial	2 cycles, See Notes A, B, C
15	7.1-11 Mate Cycles, Dynamic Mate Force, Mated Pair, no fluid flow (Wet), 40mm/s	5.xmm radial	1 cycle, Notes A, B, C
16	7.1-15 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, no fluid flow (Wet), 40mm/s	5.xmm radial	2 cycles, Notes A, B, C
17	7.1-9 Static Mate Force vs. Mate Distance ,no fluid flow (Wet), plug pivoted/offset	5.xmm +2.x° (Combined-P)	1 cycle, measure forces per Table 7.1
18	7.1-14 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, Static, no fluid flow (Wet), plug pivoted/offset	5.xmm +2.x° (Combined-P)	2 cycles, measure forces per table 7.1
19	7.1-11 Mate Cycles, Dynamic Mate Force, Mate Cycles, Mated Pair, no fluid flow (Wet), 40mm/s, plug pivoted/offset	5.xmm +2.x° (Combined-P)	1 cycle, measure forces per Table 7.1
20	7.1-15 Mate Cycles, <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, no fluid flow (Wet), 40mm/s, plug pivoted	5.xmm +2.x° (Combined-P)	2 cycles, measure forces per table 7.1
21	7.1-9 Static Mate Force vs. Mate Distance, socket pivoted/offset	5.xmm +2.x° (Combined-S)	1 cycle, measure forces per Table 7.1
22	7.1-14 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, Static, no fluid flow (Wet), socket pivoted/offset	5.xmm+2.x° (Combined-S)	1 cycle, measure forces per Table 7.1
23	7.1-11 Mate Cycles, Dynamic Mate Force, Mated Pair, no fluid flow (Wet), 40mm/s 40mm/s, plug pivoted/offset	5.xmm +2.x° (Combined-S)	1 cycle, measure forces per Table 7.1
24	7.1-15 Mate Cycles, <i>Dynamic Radial</i> Force, Mate Cycles, Mated	5.xmm+2.x° (Combined-S)	1 cycle, measure forces per Table 7.1

	Pair, no fluid flow (Wet), 40mm/s, socket pivoted/offset		
25	7.1-9 Mate Force vs. Mate Distance, Static	Aligned	1 cycle
26	7.1-14 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, Static, no fluid flow (Wet)	Aligned	2 cycles, measure forces per table 7.1
27	7.1-11 Mate Cycles, Dynamic Mate Force, Mated Pair, no fluid flow (Wet), 40mm/s	Aligned	1 cycle, measure forces per Table 7.1
28	7.1-15 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, no fluid flow (Wet), 40mm/s	Aligned	2 cycles, measure forces per table 7.1
28	7.1-11 Mate Cycles no fluid flow (Wet), 330mm/s	Aligned	Run 40 cycles, then stop, Centering Verification prior to starting, during test and after the last cycle per Note B.
30	7.1-11 Mate/De-mate Force, 330mm/s, no fluid flow (Wet),	Aligned	Assumed to collect during Mate Cycles (wet) test per req.
31	7.1-11 Mate Cycles, no fluid flow (Wet), 330mm/s	5.xmm radial	Run 40 cycles, then stop, Centering Verification prior to starting, during test and after the last cycle per Note B.
32	7.1-11 Mate/De-mate Force, 330mm/s, no fluid flow (Wet)	5.xmm radial	Assumed to collect during Mate Cycles (wet) test per req.
33	7.1-11 Mate Cycles, no fluid flow (Wet), 330mm/s, plug pivoted/offset	5.xmm+2.x° (Combined-P)	Run 40 cycles, then stop, Centering Verification prior to starting, during test and after the last cycle per Note B.
34	7.1-11 Mate/De-mate Force, 330mm/s, no fluid flow (Wet), plug pivoted/offset	5.xmm+2.x° (Combined-P)	Assumed to collect during Mate Cycles (wet) test per req.
35	7.1-11 Mate Cycles, no fluid flow (Wet), 330mm/s, socket pivoted/offset	5.xmm+2.x° (Combined-S)	Run 40 cycles, then stop, Centering Verification prior to starting, during test and after the last cycle per Note B.
36	7.1-11 Mate/De-mate Force, 330mm/s, no fluid flow (Wet),	5.xmm+2.x° (Combined-S)	Assumed to collect during Mate Cycles (wet) test per req.

Table 11.4 Group 2 Test Sequence (see table 11.2 for combination details)

Test Sequence	Test Description	Condition	Notes
37	7.1-11 Dynamic Mate Cycles, 40mm/s, no fluid flow (Wet)	Aligned	Run 314 cycles, Notes A, B, C
38	7.1-11 Dynamic Mate Cycles, 40mm/s, plug pivoted/offset, no fluid flow (Wet)	5.xmm + 2.x° (Combined-P)	Run 314 cycles, Notes A, B, C
39	7.1-11 Dynamic Mate Cycles, 40mm/s, socket pivoted/offset, no fluid flow (Wet)	5.xmm + 2.x° (Combined-S)	Run 314 cycles, Notes A, B, C

40	7.1-11 Dynamic Mate Cycles, 40mm/s, no fluid flow (Wet)	5.xmm radial Offset	Run 314 cycles, Notes A, B, C
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Table 11.5 Group 3 Test Sequence (new, see table 11.2 for combination details)

Test Sequence	Test Description	Condition	Notes
41	7.1-12 Mate Cycles, (Wet) 40mm/s, plug to socket fluid flow, 36 LPM	Aligned	Run 157 cycles, Notes A, B, C
42	7.1-16 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, w/flow - 36LPM (Wet), 40mm/s	Aligned	3 cycles minimum, may collect during 7.1-12 testing
43	7.1-12 Mate Cycles, (Wet) 40mm/s, socket to plug fluid flow, 36 LPM	Aligned	Run 157 cycles, Notes A, B, C
44	7.1-16 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, w/flow - 36LPM (Wet), 40mm/s	Aligned	3 cycles minimum, may collect during 7.1-12 testing
45	7.1-12 Mate Cycles, (Wet) 40mm/s, plug to socket fluid flow, 36 LPM	5.xmm Radial	Run 157 cycles, Notes A, B, C
46	7.1-16 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, w/flow - 36LPM (Wet), 40mm/s	5.xmm Radial	3 cycles minimum, may collect during 7.1-12 testing
47	7.1-12 Mate Cycles, (Wet) 40mm/s, socket to plug fluid flow, 36 LPM	5.xmm Radial	Run 157cycles, Notes A, B, C
48	7.1-16 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, w/flow - 36LPM (Wet), 40mm/s	5.xmm Radial	3 cycles minimum, may collect during 7.1-12 testing
49	7.1-12 Mate Cycles, (Wet) 40mm/s, plug to socket fluid flow, 36 LPM	5.xmm + 2.x° Combined, plug pivoted	Run 157 cycles, Notes A, B, C
50	7.1-16 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, w/flow - 36LPM (Wet), 40mm/s	5.xmm + 2.x° Combined, plug pivoted	3 cycles minimum, may collect during 7.1-12 testing
51	7.1-12 Mate Cycles, (Wet) 40mm/s, socket to plug fluid flow, 36 LPM	5.xmm + 2.x° Combined, plug pivoted	Run 157 cycles, Notes A, B, C
52	7.1-16 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, w/flow - 36LPM (Wet), 40mm/s	5.xmm + 2.x° Combined, plug pivoted	3 cycles minimum, may collect during 7.1-12 testing
53	7.1-12 Mate Cycles, (Wet) 40mm/s, plug to socket fluid flow, 36 LPM	5.xmm + 2.x° Combined, socket pivoted	Run 157 cycles, Notes A, B, C

54	7.1-16 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, w/flow - 36LPM (Wet), 40mm/s	5.xmm + 2.x° Combined, socket pivoted	3 cycles minimum, may collect during 7.1-12 testing
55	7.1-12 Mate Cycles, (Wet) 40mm/s, socket to plug fluid flow, 36 LPM	5.xmm + 2.x° Combined, socket pivoted	Run 157 cycles, Notes A, B, C
56	7.1-16 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, w/flow - 36LPM (Wet), 40mm/s	5.xmm + 2.x° Combined, socket pivoted	3 cycles minimum, may collect during 7.1-12 testing
57	7.1-9 Mate Force vs. Mate Distance, Static.	5.xmm + 2.x° Combined, socket pivoted	2 cycles, Notes A, B, C
58	7.1-14 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, Static, no fluid flow (Wet)	5.xmm + 2.x° Combined, socket pivoted	2 cycles, Notes A, B, C
59	7.1-11 Mate Cycles, Dynamic Mate Force, Mated Pair, no fluid flow (Wet), 40mm/s	5.xmm + 2.x° Combined, socket pivoted	1 cycle, Notes A, B, C
60	7.1-15 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, no fluid flow (Wet), 40mm/s	5.xmm + 2.x° Combined, socket pivoted	2 cycles, Notes A, B, C
61	7.1-9 Mate Force vs. Mate Distance, Static, wet	5.xmm + 2.x° Combined, plug pivoted	2 cycles, Notes A, B, C
62	7.1-14 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, Static, no fluid flow (Wet)	5.xmm + 2.x° Combined, plug pivoted	2 cycles, Notes A, B, C
63	7.1-11 Mate Cycles, Dynamic Mate Force, Mated Pair, no fluid flow (Wet), 40mm/s	5.xmm + 2.x° Combined, plug pivoted	1 cycle, measure forces per Table 7.1
64	7.1-15 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, no fluid flow (Wet), 40mm/s	5.xmm + 2.x° Combined, plug pivoted	2 cycles, Notes A, B, C
65	7.1-9 Mate Force vs. Mate Distance, Static.	5.xmm radial	2 cycles, Notes A, B, C
66	7.1-14 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, Static, no fluid flow (Wet)	5.xmm radial	2 cycles, measure forces per table 7.1
67	7.1-11 Mate Cycles, Dynamic Mate Force, Mated Pair, no fluid flow (Wet), 40mm/s	5.xmm radial	1 cycle, measure forces per Table 7.1
68	7.1-15 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, no fluid flow (Wet), 40mm/s	5.xmm radial	2 cycles, Notes A, B, C
69	7.1-9 Mate Force vs. Mate Distance, Static, Wet	Aligned	2 cycles, Notes A, B, C
70	7.1-14 Static <i>Radial</i> Force vs. Mate Distance, Mated Pair, Static, no fluid flow (Wet)	Aligned	2 cycles, Notes A, B, C
71	7.1-11 Mate Cycles, Dynamic Mate Force, Mated Pair, no fluid flow (Wet), 40mm/s	Aligned	2 cycles, Notes A, B, C

72	7.1-15 Mate Cycles. <i>Dynamic Radial</i> Force, Mate Cycles, Mated Pair, no fluid flow (Wet), 40mm/s	Aligned	2 cycles, Notes A, B, C
73	Verify holds 75PSI pressure after all tests		
74	7.1-2 Air Inclusion	Aligned	Per Table 7.1
75	7.1-3 Spillage	Aligned	Per Table 7.1, 3 samples
76	7.1-4 Hydrostatic Pressure, Coupled	N/A	

Table 11.6 Group 4 Test Sequence (new, see table 11.2 for combination details)

Test Sequence	Test Description	Condition	Notes
1	7.1-1 Pressure Drop Test	Aligned	Run in each flow direction & flow rate
2	7.1-6 Elevated Flow Test Connected	Aligned	
3	7.1-7 Elevated Flow Mate Cycle Test	Aligned	

Table 11.7 Valve Combinations

	Plug	Socket	Test Site
Combination 1	Vendor A	Vendor A	Vendor A
Combination 2	Vendor A	Vendor B	Vendor A
Combination 3	Vendor A	Vendor C	Vendor A
Combination 4	Vendor B	Vendor A	Vendor B
Combination 5	Vendor B	Vendor B	Vendor B
Combination 6	Vendor B	Vendor C	Vendor B
Combination 7	Vendor C	Vendor A	Vendor C
Combination 8	Vendor C	Vendor B	Vendor C
Combination 9	Vendor C	Vendor C	Vendor C

1 Sample each., at each test site

Table 11.7 Group 2 Test Sequence

Test Sequence	Test Description	Offset Condition	Notes
1	7.1-22 Operating Temperature Testing	Aligned	
2	7.1-23 Operating Humidity Testing	Aligned	

Table 11.8 Same Supplier Testing

Test Sequence	Test Description	Sample Size	Notes
1	7.1-17 Centering Verification	3	Verify in installed configuration per PBMC spec
2	7.1-18 Valve Rotation	3	Verify movement meets or exceeds minimum mechanical requirement
3	7.1-19 Thread Strength (3)	3	
4	7.1-20 Pivot Movement & External Torque Test	3	
5	7.1-21 Packaging (varies)	See Spec	
6	7.1-5 Hydrostatic pressure, Uncoupled	3	
7	7.1-24 Non-Operating Temperature (1 pr)	1	
8	7.1-25 Non-Operating Humidity (1 pr)	1	
9	7.1-26 Salt Spray (Corrosion resistance) (1pr)	1	
10	First Article Inspection Report	3	First Article Inspection Report to be performed on 3 samples min. - Report to include: - Description of the dimension - Nominal, Min, Max – Per spec - Measured value - Upper/Lower deviation (%) - Measuring Device - Sample size or Measurement frequency (As applicable) - Define process flow
11	Process Capability Study Report (Parts produced using production equipment)		Inspect 32 samples to verify 1.33 min Cpk as specified in drawing