FDO Drainability and Cleanability

DRAINABILITY:

Gravity draining is achieved by creating a downward sloping drain path out of the valve. The Equilibar FDO series utilizes one angled "Drainability Orifice" located at the bottom of the drain path near the valve inlet to achieve full drainability, as shown to the right.

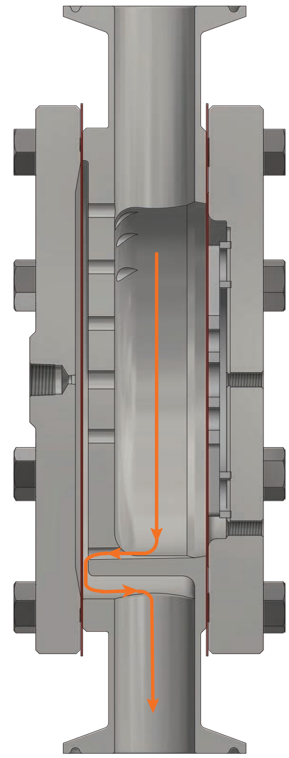

Figure 1: *Cut view, FDO8, with drain path illustrated in orange. Valve Inlet down.*

EQUILBAR DRAINABILITY TESTING METHODS AND EVALUATION

Equilibar characterizes a valve's drainability by performing before/after weight analysis of the valve – with the before state being a completely dry valve and the after being a valve that has been filled with water then allowed to drain at atmospheric pressure. The volumetric holdup that remains is then compared to the holdup that would remain due to surface tension in an equivalent internal surface area[1], vertically oriented sanitary tube.

By calculating the valve's internal surface area, we formulate an expected volumetric holdup based on surface tension alone. The valve shall pass testing if it shows less holdup than the expected holdup of a sanitary tube of equivalent internal surface area. The expected holdup of equivalent internal surface area tubes is shown in Table 1 below.

Valve	Expected holdup of equivalent area sanitary tube (cc)	Test Results[2]
FDO4	1.1	PASS[3]
FDO6	5.4	PASS
FDO8	9.4	PASS
FDO12	15.9	PASS
FDO16	23.6	PASS

Table 1: Volume holdup in the FDO series.
Ref: Test plan 21-50-0360

Note1: The PTFE diaphragm surfaces are included in our Equivalent area surface tension calculations. Due to the hydrophobic nature of PTFE, we expect the valve's holdup to be less than that of an equivalent area stainless tube to be a passing test.

Note2: While our testing is done without the addition of a system air blow down, it is recommended for maximum system draining, as this can negate diaphragm interaction with the control surface during the draining process.

Note3: Passed gravity draining test with Jorlon5 diaphragm. Thicker diaphragms may require supplemental air blow for optimal draining.

CLEANABILITY:

The sanitary valve industry does not have a presented guideline for verifying cleanability. For internal design feedback, Equilibar has created its own cleanability study using the ASME BPE Section SG for guidance to internally validate cleanability for our sanitary valves. This is not to replace customer validation on cleanability, nor is this an industry standard test.

EQUILIBAR CLEANABILITY TESTING DETAILS

The clean and dry valve is installed with the inlet facing downward then filled with a Riboflavin solution (0.08-0.22 g/L concentration). Next, it is allowed to drain and then flushed with water at a flow rate that equates to an average fluid velocity of 5 ft/sec for a period of 30 seconds and allowed to drain again. The water flush cycle is repeated twice more. The valve is taken to a dark room and disassembled under a 365nm black light.

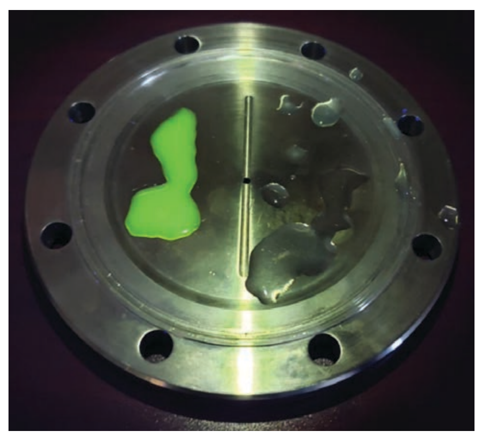

Figure 2: *Example riboflavin test photo. Failure on left. Pass on right.*

It is then inspected for traces of riboflavin and photographed, as the riboflavin will fluoresce under the blacklight indicating a failed test. See Figure 2 for example of passing and failing results.

This test provides insight to the cleanability of a sanitary valve by showing that the originally added riboflavin solution has been fully rinsed using minimum velocity guidelines from the industry. This empirically shows that all internal surfaces of the valve have been fully contacted and have enough turbulence to fully remove the riboflavin from visual detection with a blacklight.

All listed Equilibar FDO series valves have passed the above testing. Reference test plan 21-50-0360.