Performance Verification
Data Sheet

1/4" UPM 1000 Diaphragm Valve Particle Shedding and Reliability

Furon's UPM 1000 diaphragm valve has been designed primarily for use in the semiconductor industry for transfer of highly aggressive ultrapure chemicals and deionized water. The 1/4" UPM 1000 valves were evaluated by an independent test lab to verify that they meet the industry's rigorous standards for reliability and do not add particles to process chemicals.

Particle Shedding Tests

A series of tests was conducted to measure particle shedding during initial use and during valve cycling. A PMS HSLIS M65 particle monitor was used to count particles shed into ultrapure water (UPW). Four particle sizes ranging from ≥ 0.065 µm to ≥ 0.20 µm were monitored. All tests were run in a Class 100 cleanroom.

Test methods: Particle shedding from newly installed valves was measured under steady flow conditions. Test valves were flushed with UPW at a flow rate of 230 mL / min, for a face velocity of 12 cm / sec. Valves were tested with flow through their normally open ports for one day or until particle concentrations fell to background levels. The valves were then actuated once and data were collected for the normally closed ports.

A cycling test was used to measure particle shedding during valve actuation. A programmable controller actuated the valves once each minute until background particle concentrations were achieved.

Results: Because the valve-to-valve repeatability in the steady flow tests was high, all the data were combined. Cleanup curves for particles ≥ 0.1 µm and ≥ 0.2 µm are shown in Figure 1. The data are plotted as particles added as a function of the volume of UPW passed through the valve. A log-log regression curve has been fit to the data. The concentration of particles ≥ 0.10 µm decreased to < 1 particle / ml added after being flushed with only 9 liters of UPW. For particles ≥ 0.2 µm, the cleanup volume to < 1 / ml added was only 3 liters.

Figure 1: Particle cleanliness under steady flow conditions

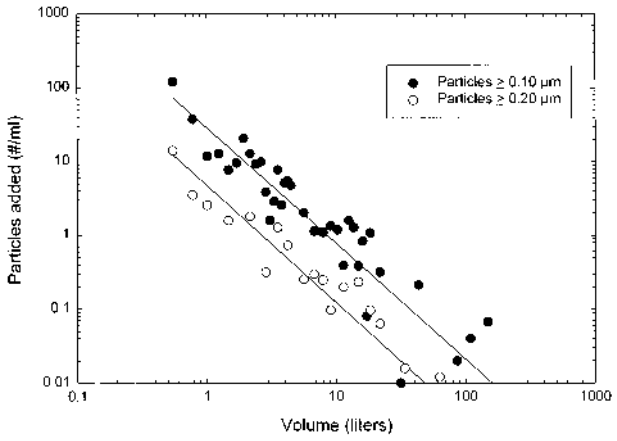
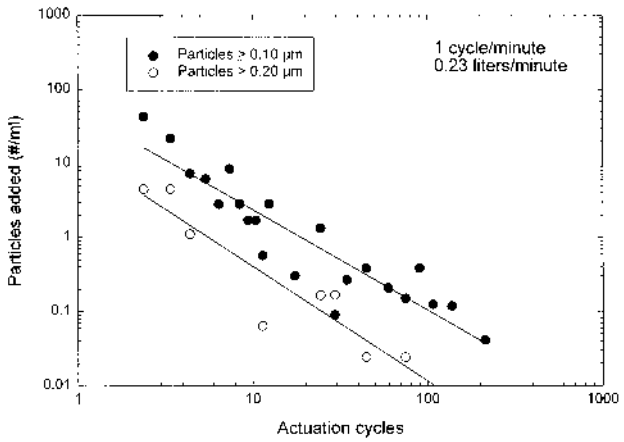


Figure 2: Particle cleanliness of cycled valves



The results of the cycling tests are shown in Figure 2. Particle concentration increases were less than 1/ml after 19 and 6 cycles for the ≥ 0.1 µm and ≥ 0.2 µm particles, respectively.

Valve cleanup times measured in the constant flow and cycling tests are shown in Table 1.

Reliability

UPM valves have been tested for reliability in harsh chemical environments. The valves were cycled more than 1,000,000 times in 37% HCl and tested regularly for leaks through the valve seats.

Cycling test method: Ten valves were installed in a continuous circulation loop containing 37% HCl at 40 ± 5 psig. The flow into the common port of each valve was 1.0 ± 0.3 L/min. The valves were cycled from the normally open to the normally closed position at one second intervals. The actuation pressure was 70 or 90 psig. Valves were inspected periodically for leakage from the valve body.

Seat integrity test method: Each valve was tested for seat integrity upon installation and after every 200,000 cycles until 1,000,000 cycles. Integrity was tested by measuring the rate at which nitrogen leaked through the valve seat. The differential pressure across the seat was 100 psig. Four flow paths were tested: common to normally open, common to normally closed, normally closed to common, and normally open to common. Water leak rates of 0.0001 ml/min could be detected.

Results: The UPM valves were cycled 1,003,451 times. No leaks were detected.

Summary

Furon's 1/4 inch UPM valves have been tested for particle shedding and reliability by an independent test lab. Each valve adds < 1 particle ≥ 0.1 µm/ml to UPW after flushing with only 9 liters. For particles ≥ 0.2 µm, only 3 liters of UPW are required to reduce the particle addition to < 1/ml. During valve cycling, increases in particle concentrations for ≥ 0.1 µm and ≥ 0.2 µm particles were < 1/ml after 19 and 6 cycles, respectively. Even after the valves were cycled 1,003,451 times, no leaks were detected.

Reference

Grant, DC, W Kelly, G Van Schooneveld, D Carrieri, D Smith, A Rodemeyer and D Henderson, "The Effect of Fluid Dynamics on Particle Shedding from Semiconductor Fluid-Handling Components," presented at the Fine Particle Society Meeting, Dallas, TX, 1998.

The data provided here were obtained under defined test conditions. The tests were designed to mimic use or worst case conditions. However, Furon makes no specific claims about the performance of the valves in other chemicals or systems.

Table 1: Flush volume and valve cycles required to reach selected particle shedding rates

	Particles ≥ 0.1 µm			***Particles ≥ 0.2 µm***		
	< 10/ml added	*< 1/ml added*	*< 0.1/ml added*	*< 10/ml added*	*< 1/ml added*	*< 0.1/ml added*
Volume under constant flow conditions (liters)	*2*	*9*	*37*	*<1*	*3*	*11*
# Cycles at 1/min	*4*	*19*	*102*	*1*	*6*	*24*

For Technical Information or Customer Support ***1.800.833.5661*** *(USA)*

3501 Orangewood Avenue
Garden Grove, California 92841-1411
USA
Phone: 714.630.5818
Fax: 714.688.2614
www.plastics.saint-gobain.com

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