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**An Evaluation of Particle Shedding from a New Levitronix BPS-3 Pump
During the Initial Flush with Ultrapure Water**

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INTRODUCTION

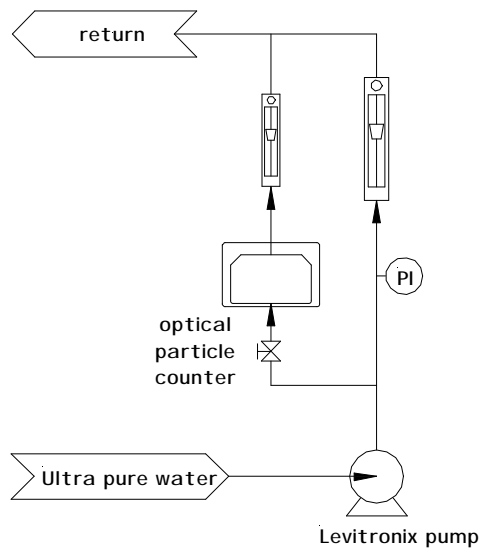
A new Levitronix BPS-3 pump was obtained for evaluation of particle-shedding characteristics and trace metal extraction performance. The BPS-3 pump system consisted of a LC72 controller, a BSM 3.1.C motor, and a CP-3 pump head. The wetted parts of the pump included the pump head, which was fabricated from high purity PVDF, and the impeller, which consisted of a magnet encapsulated in high-purity ECTFE. The initial particle shedding from this pump was measured in ultrapure water with the pump energized to levitate the impeller but not operating. The pump was flushed with ultrapure water at a flow rate of 1.0 liters/min for 48 hours to determine the particle flush up curve under passive pump conditions.

TEST PROCEDURE

The pump was flushed in a standard particle test system shown schematically in Figure 1. This system is located in a Class 100 cleanroom. The main components of the test unit included:

- an ultrapure water system (TOC < 1 ppm, resistivity > 18.1 mohms, cumulative particle ($\geq 0.10 \mu\text{m}$) concentration < 0.05 particles /ml)
- the BPS-3 test pump
- a flow meter to measure the flow rate through the pump
- a Particle Measuring Systems Liquistat LS-100 optical particle counter (5 size channels, ≥ 0.10 , ≥ 0.15 , ≥ 0.20 , ≥ 0.30 , and $\geq 0.50 \mu\text{m}$) to measure the concentration of particles downstream of the test pump

Figure 1. Passive Pump Particle Test Stand



The system was initially started up with a short length of tubing (spool piece) in place of the test pump. The particle counter was connected and the system was operated under constant flow conditions at 1.05 liters/min until a steady particle count was observed. At this point the test system was qualified to begin testing.

For this test program, the spool piece was replaced with the test pump. The pump was connected into the test system with two PFA female adapters (1" FNPT x 3/4" Flaretek) that had been preconditioned earlier in the same test system. The isolation valve was opened and a passive flush of the as-received pump was conducted at 1.05 liters/min for 48 hours. Particle concentrations downstream of the pump were recorded continuously during this flushup test.

PARTICLE SHEDDING ANALYSIS

Background particle levels in the test system prior to testing the pump are shown in Table 1.

Table 1. Background Particle Concentrations

	Cumulative Particle Concentration (#/ml)				
	≥0.10	≥0.15	≥0.20	≥0.30	≥0.50
test loop without pump	0.028	0.007	0.002	0.000	0.000

The passive pump shedding curve for particles ≥0.10 μm added (background subtracted) are shown in Figure 2. The pump cleaned up rapidly. It achieved a particle addition level of <0.10 particle/ml at a flush volume of 420 liters. Complete test results are shown in Figure 3.

Figure 2. Passive Flush Up Curve, Levitronix BPS-3 Pump

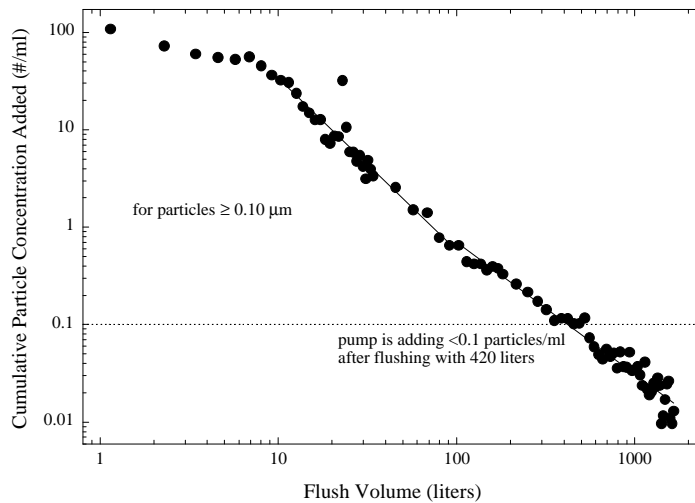
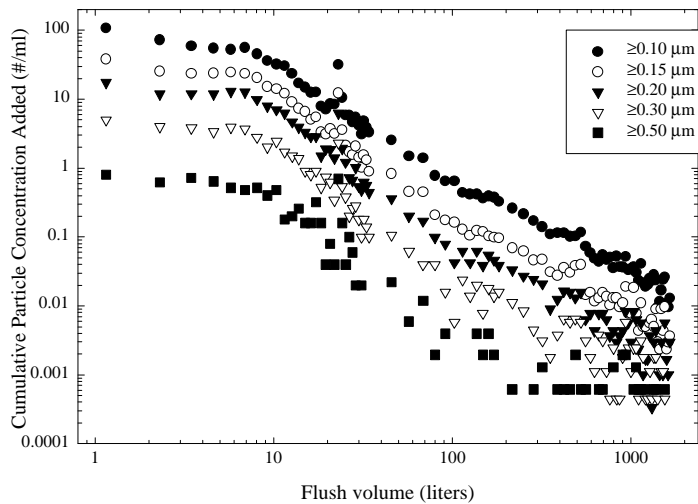


Figure 3. Passive Flush Up Curves, Levitronix BPS-3 Pump



For active components such as valves, a major semiconductor equipment manufacturer uses a component cleanliness specification of < 0.1 particles/ml ($\geq 0.10 \mu\text{m}$) added within 300 liters of flushing. The flush up curve for the Levitronix pump suggests that a simple precleaning step should be sufficient to meet this criterion.

At the end of 48 hours of testing, the pump was adding particles at the level shown in Table 2.

Table 2. Particle Concentration Added by Pump after 48 hours of Flushing

	Cumulative Particle Concentration Added (#/ml)				
	>0.1	>0.15	>0.20	>0.30	>0.5
ten-hour average	0.0077	0.0007	0.0001	0.0003	0.0000

SUMMARY

A new Levitronix BPS-3 pump was tested for particle shedding under passive conditions. The pump was connected to a source of ultrapure water and flushed for 48 hours. The particle concentration in the water downstream of the pump was monitored continuously during this test. The pump cleaned up rapidly, and was adding < 0.1 particle/ml after being flushed with 420 liters of water. The clean-up quality of this pump was excellent.