

Metal Extraction From Compact Diaphragm Valves

Furon® compact diaphragm valves (CDV) are designed for use in semiconductor process, high-purity and corrosive chemical applications. The wetted flow path is injection-molded, high-purity PFA with a virgin PTFE diaphragm.

Tests performed by an independent test lab verify that the CDV valves do not release significant amounts of metals into process chemicals. Metal extraction from the valves is within the specification set by a major manufacturer of chemical distribution systems¹.

Metal Extraction Test

The DyconESM dynamic extraction procedure² was used to measure the surface contamination and the rate of metal extraction from CDV valves. The valves were exposed to a continuous flow of 35% hydrochloric acid (HCl) for 13 days.

Test Method

A dynamic extraction system was filled with 1.2 liters of high-purity HCl and a sample was withdrawn for analysis for trace metals. Six valves (PN CDV2-F88NC) were installed in the circulation loop. HCl was circulated through the system at 400 ml/min for one day, after which the flow rate was reduced to 250 ml/min.

An acid sample was taken after 40 minutes to measure metal contamination removed from the surface of the valves. Additional samples, taken at 2 hrs, 8 hrs, 2 days, and 13 days, were used to determine the masses and rates of metal extraction from the valves over time. All samples were analyzed for twenty metals by either inductively coupled plasma-mass spectroscopy (ICP-MS) or graphite furnace atomic absorption (GFAA) spectroscopy.

Results

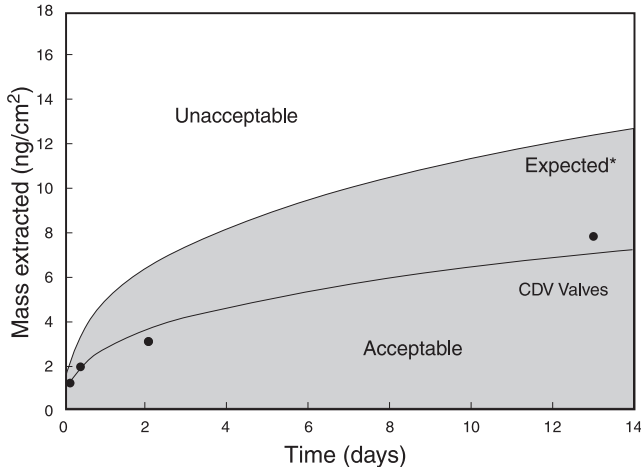
Metal extraction data were normalized to the wetted surface area of a single valve. Table 1 shows the total mass for each metal that was extracted from the valve surfaces in 13 days. Only calcium, iron, sodium, copper, aluminum, chromium, and magnesium had more than 0.02 µg extracted per valve.

Table 1: Masses of individual metals extracted per valve by 35% HCl in 13 days

ELEMENT	MASS EXTRACTED (µg/valve)
Ca	0.61
Fe	0.48
Na	0.08
Cu	0.06
Al	0.04
Cr	0.03
Mg	0.03
Au, B, Ba, Be, Cd, K, Li, Mn, Ni, Pb, Sn, Ti, Zn	≤0.02

Figure 1 shows the total mass of all 20 metals extracted over time. The extraction rate at 7 days calculated from these data was 0.28 ng/cm²-day. This extraction rate was well below the 0.5 ng/cm²-day specification set by a major chemical distribution system manufacturer for delivery system components

Figure 1: Cumulative total metal extraction during a 13-day dynamic extraction test



* for a component meeting semiconductor OEM specifications

Summary

Six CDV valves (PN CDV2-F88NC) were tested for extraction of 20 metals by 35% HCl using the DyconEXSM dynamic extraction procedure. After 13 days of exposure to HCl, only calcium, iron, sodium, copper, aluminum, chromium, and magnesium had more than 0.02 µg extracted from the wetted surface of the valves. The extraction rate at 7 days was 0.28 ng/cm²-day. The mass of metal removed from the valve surface and the extraction rate into 35% HCl were within the specifications set by a major manufacturer of chemical delivery systems.



PERFORMANCE PLASTICS

Saint-Gobain Performance Plastics
 7301 Oranewood Ave.
 Garden Grove, CA 92841-1411
 USA Toll Free: (800) 543-8823
www.plastics.saint-gobain.com
www.furon-asti.com

France
 Tel: 33/(0) 1 55 68 59 59
 Fax: 33/(0) 1 55 68 59 68

Japan
 Tel: 81/(0) 2 6679 6400
 Fax: 81/(0) 2 6670 1001

References

1. Grant DC, T Lemke and D Carrieri, "Specification and verification of metallic extractables in fluid handling components by dynamic extraction," in *Proceedings of the Semicon West Workshop on Contamination in Liquid Chemical Distribution Systems*, July, 1997.
2. Grant DC, T Lemke, G Duepner, D Wilkes, and N Powell, "Measurement of Inorganic Contaminant Extraction from Fluid Handling Components by Dynamic Extraction," *J of the IES*, 39(2): 29-37, 1996.

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

The DyconEXSM procedure is patented by BOC Edwards Chemical Management Division (US patent No. 5,641,895).