



Performance Verification

Data Sheet

Metal Extraction from Flare Grip® II Fine Thread Fittings

Furon Flare Grip II fine thread fittings are specially designed for the transfer of aggressive chemicals and ultrapure fluids. The fittings are made from high-purity fully fluorinated PFA, selected for its structural strength, temperature resistance, and purity.

Metal Extraction

Tests performed by an independent test lab verify that the fittings do not release significant amounts of metals into the process chemicals. Even under conditions more stringent than the SEMI test procedure, the extraction of eighteen out of twenty metals meets or exceeds SEMI recommendations.

Test method: The DyconESM dynamic extraction procedure¹ was used to measure the total amount and rate of metal extraction from FMP fittings. The chemical chosen for the extraction test was one of the most aggressive industrial chemicals, 35% hydrochloric acid (HCl).

A dynamic extraction system was filled with 2.3 liters of high-purity HCl, and a sample was withdrawn for analysis for trace metals. Ten 3/4-inch FMP12SU flare fittings were placed in the extraction chamber. 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 fittings. 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 bulk of the fittings over time. All samples were analyzed for twenty metals by either inductively coupled plasma-mass spec-troscopy (ICP-MS) or graphite furnace atomic absorption (GFAA) spectroscopy.

Results: Mass extraction data were normalized to the wetted internal surface area of a single fitting. Table 1 shows the combined masses, both bulk and surface, that were extracted in 13 days. Only four metals, iron, calcium, aluminum, and zinc, had greater than 0.02 µg extracted per fitting.

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

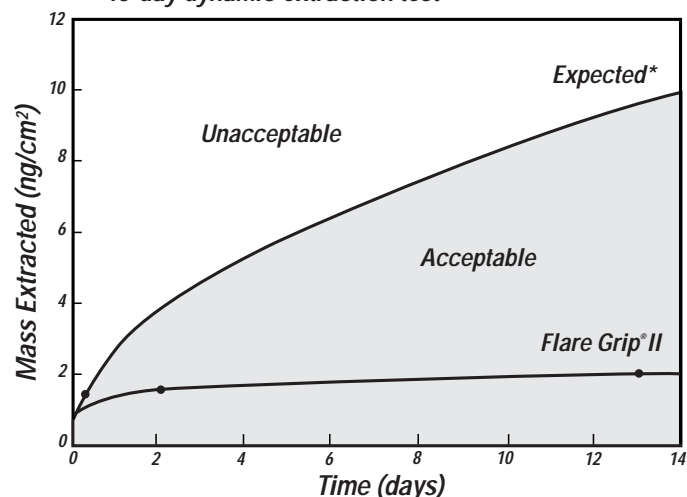
Element	Mass Extracted (µg/fitting)
Fe	0.18
Ca	0.09
Al	0.03
Zn	0.03
Au, B, Ba, Be, Cd, Cr, Cu, Li, Mg, Mn, K, Na, Ni, Pb, Sn, Ti	<=0.02

Figure 1 shows the total mass of all 20 metals extracted over time. The extraction rate at 7 days calculated from these data was 0.04 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 components².

SEMI Standards

The DyconE^X extraction test was more rigorous than the test used by SEMI to measure metal extraction from components³. The limits recommended by SEMI for metal extraction are based on a 7-day extraction in ultrapure water at 85 ± 5°C. The DyconE^X procedure used an aggressive acid for a longer period of time under flow conditions.

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



*for a component meeting semiconductor OEM specifications

Table 2 compares the SEMI recommendations to the extracted masses. Even under dynamic extraction conditions, the FMP fittings met or exceeded all recommendations, except for surface iron and bulk nickel extraction.

Table 2: SEMI recommendations for metal extraction in 80°C water compared to mass extracted from the FMP fittings by 35% HCl

Metal	SEMI (µg/m²)	FMP union (µg/m²) Bulk Surface	
Al	10	3.6	4.5
Ba	15	0.1	<0.1
B	10	0.4	0.2
Ca	30	4.3	17.9
Cr	1	0.7	<0.1
Cu	15	1.3	1.0
Fe	5	4.9	38.8
Pb	1	<0.1	<0.1
Li	2	<0.1	<0.1
Mg	5	2.4	1.2
Mn	5	<0.1	<0.1
Ni	1	1.1	0.7
K	15	<0.1	<0.1
Na	15	0.7	1.1
Sr	0.5	Not Done	Not Done
Zi	10	0.6	6.5

Summary

Flare Grip II FMP12SU fittings were tested for extraction of 20 metals by 35% HCl using the DyconESM dynamic extraction procedure. After 13 days of exposure to HCl, only iron, calcium, aluminum, and zinc had more than 0.02 µg extracted. The extraction from FMP unions into 35% HCl met or exceeded the SEMI recommendations for metal extraction into hot water, except for iron and nickel, and met the specifications set by a major manufacturer of chemical delivery systems.

References

- Grant DC, T Lemke, G Duepner, D Wilkes, and N Powell, "Measurement of inorganic contaminant extraction from fluid handling components by dynamic extraction," JIES, 39(2): 29-37, 1996.
- 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.
- SEMI Draft Document 2840B, "Provisional specification for polymer components used in ultrapure water and liquid chemical distribution systems."

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 fittings in other chemicals or systems.

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

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