

ULTRA HIGH PURITY PFA TUBING & PIPE

UHP PFA (ultra high purity perfluoroalkoxy) tubing and pipe are the products of choice for applications such as semiconductor and pharmaceutical process that require extreme chemical resistance while maintaining highest purity levels. UHP PFA tubing and pipe are made exclusively from a high molecular weight, high purity resin that provides excellent chemical resistance, (even to common fluorosurfactants), highest purity levels, low permeation levels and smoothest surface finish.

Features:

- 100% virgin grade high performance resins used to resist stress cracking
- Chemically inert to nearly all industrial chemicals and solvents
- Highest thermal stability
- Lower permeation over standard PFA Tubing & Pipe
- Translucent
- Smoothest surface finish resulting in less area of particle entrapment
- Moisture absorption nearly zero
- FDA compliant for food contact
- Non-flammable
- Suitable for use with flare or conventional fittings
- Tubing is available in coiled hose and convoluted constructions

Applications:

- Scientific
- Insulation
- Air sampling
- Gas analyzing
- Chemical process
- Heat exchangers
- Laboratory applications
- Semiconductor
- Flow monitoring
- Emissions monitoring
- Pharmaceutical

Specifications

General: meets or exceeds the requirements listed in ASTM D6867-03 and ASTM D3307 meets or exceeds the requirements listed in Semi F57

Temperature: -320 °F to 500 °F

Flammability: UL 94 VO rated. UHP PFA resists combustion and does not promote flame spread

FDA: Our tubing is approved for use in food contact applications in compliance with FDA regulation: 21 CFR 177.1550

USP CLASS VI: Our tubing meets the requirements of USP Class VI

In the semiconductor and pharmaceutical industries, PFA HP (High Purity) Tubing is used for fluid handling applications requiring an extremely low level of chemical extractables.

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Overview

Our new line of ultra-high purity (UHP) PFA tubing and pipe that offers significant improvements over standard high purity materials. Made with 100% virgin-grade Daikin AP-231 SH resin, UHP-PFA tubing meets or exceeds key SEMI F57 requirements, helping semifab operators reduce contamination, increase wafer yields and maximize system uptime.

Key Properties

CT Associates and Balazs Analytical Services analyzed samples of UHP-PFA according to the SEMI F57 specification, performing additional hydrochloric acid (HCl) extraction tests for trace metal contamination. Key results demonstrate that UHP-PFA tubing exhibits:

- Ultra-low total organic carbon (TOC) contamination at 0.2% of the SEMI F57 limit
- Minimal ionic contamination, with nearly all ions measured below reportable limits
- Extremely low trace metal extractables, including an HCl mass extraction rate roughly 2% of a major semiconductor equipment manufacturer's specification

Daikin's high performance AP-231 SH resin also provides UHP-PFA tubing a high degree of chemical resistance and mechanical reliability, including:

- Upper service temperature of 500°F (260°C)
- Enhanced resistance to aggressive fluorosurfactants to minimize stress cracking
- Extended flex life comparable to that of PTFE

Production

UHP-PFA tubing and pipe is produced and packaged in a clean room manufacturing facility. Our proprietary production process is designed to protect products from outside contaminants, from the point where raw material is introduced to extrusion to final packaging.

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Total Organic Carbon (TOC) Contamination

TOC contamination in liquid chemical distribution systems can impact many stages of semiconductor manufacturing, including oxidation, etching, cleaning, epitaxy, and thin film deposition. When present in ultra-pure water systems, TOC promotes bacterial growth, a problem that can cause manufacturing delays.

Testing indicates UHP-PFA tubing contains exceptionally low levels of TOC, just slightly higher than the reportable limit and far exceeding the SEMI F57 limit.

Surface extractable TOC, $\mu\text{g}/\text{m}^2$ Leached at $85 \pm 5^\circ$, 7 days	RL	UHP-PFA tubing	SEMI F57 limit
Total	40	100	$\leq 60,000$

RL = Reporting limit

Ionic Contamination

Ionic contamination is problematic in fluid-handling systems because it exerts a corrosive effect on microelectronic devices. Furthermore, evaporation of contaminated solutions may result in surface residues that degrade device quality and performance. With the exception of fluoride, leach tests performed on UHP-PFA tubing indicate all measured anions test below the reporting limit. The level of fluoride extraction from the tubing is far below the SEMI F57 limit, at only 1%.

Surface extractable ionic contamination $\mu\text{g}/\text{m}^2$ Leached at $85 \pm 5^\circ$, 7 days	RL	UHP-PFA tubing	SEMI F57 limit
Bromide	1	*	≤ 100
Chloride	.5	*	$\leq 3,000$
Fluoride	20	680	$\leq 60,000$
Nitrate	1	*	≤ 100
Nitrite	.5	*	≤ 100
Phosphate	1	*	≤ 300
Sulfate	1	*	≤ 300

RL = Reporting limit

* = Analysis revealed the analyte was not found at or above the reporting limit.

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Metallic Extractables

The extraction of metallic contaminants from fluoropolymer components presents serious risks to the semiconductor manufacturing process, namely etching of critical surfaces and the alteration of electrical properties of microelectronic devices, both of which can cause device failure.

Lab analysis indicates levels of trace metal extraction below the reportable limit for most elements. Nickel was detected at the acceptable level specified in SEMI F57. All other detected elements were far below the limits specified in the standard.

Surface extractable ionic contamination µg/m ² Leached at 85 ± 5°, 7 days	RL	UHP-PFA tubing	SEMI F57 limit
Aluminum	0.02	0.1	≤ 10
Arsenic	0.5	*	–
Barium	0.02	*	≤ 15
Boron	0.2	3.1	≤ 30
Cadmium	0.07	*	–
Calcium	0.07	*	≤ 20
Chromium	0.1	*	≤ 1
Copper	2	*	≤ 15
Iron	0.1	*	≤ 5
Lead	0.07	*	≤ 1
Lithium	0.05	*	≤ 2
Magnesium	0.07	*	≤ 5
Manganese	0.1	*	≤ 5
Nickel	0.2	1.0	≤ 1
Potassium	0.1	*	≤ 15
Sodium	0.02	*	≤ 15
Strontium	0.1	*	≤ 0.5
Titanium	0.05	*	–
Tin	0.07	*	–
Vanadium	0.1	*	–
Zinc	0.02	0.6	≤ 10

RL = Reporting limit

* = Analysis revealed the analyte was not found at or above the reporting limit.

"–" = Test not currently required by SEMI F57-0314, as limits of acceptance have not yet been established.
SEMI F57-0314 says this value should be reported if available, but not required.

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Hydrochloric Acid (HCl) Extraction

While performance values of tubing in ultrapure water systems are important, it's equally critical to understand tubing behavior in aggressive chemicals like hydrochloric acid (HCl), commonly used in semiconductor manufacturing. CT Associates analyzed ALTAFLUOR 480 UP PFA tubing in a 12-day extraction test, performed in 35% HCl using a dynamic extraction method.

The results demonstrate the tubing is extraordinarily stable in HCl, with area-normalized surface and mass extraction rates far below a major semiconductor equipment manufacturer's specifications (0.7% and 2%, respectively).

Area-normalized extraction rate, ng/cm ² / day 35% HCl, 7 days	UHP-PFA tubing	Major Semiconductor Equipment Manufacturer's Specification
Surface Contamination	0.14	≤ 20
Bulk Contamination	0.012	≤ 0.5

Chemical Resistance

In addition to its high degree of purity, PFA is widely used in the semiconductor industry because of its extreme chemical resistance. Inert to nearly all industrial chemicals, UHPPFA tubing provides added environmental stress crack resistance over standard grade PFA, even when exposed to harsh fluorosurfactants used in semifab wet chemical processes.

Tests performed according to ATM protocols demonstrate the superior flex life and flexural strength of UHP-PFA tubing, durability that helps extend system life and lower the total cost of ownership.

	UHP-PFA tubing	Units	Values
MIT	D 2176	KCycles	1,750,000
Flex Modulus	D 790	PSI	90,000

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Physical Properties

UHP-PFA tubing and pipe are produced exclusively with 100% virgin-grade Daikin AP-231 SH semiconductor-grade resin, recognized by many experts as a material of choice for fluoropolymer components in high-purity applications.

UHP-PFA tubing meets or exceeds the requirements of ASTM D 6867-03 (Standard Specification for PFA Tubing). It also resists combustion and doesn't promote flame spread, with a UL 94 V-0 rating.

Property	ASTM Test Method	Units	Values
Upper Service Temperature			500°F
Specific Gravity	D 792		2.15
Tensile Strength	D 1708	PSI	4500
Elongatipn	D 638	%	400
Hardness	D 2240	Shore D	60

The above information is based on tests performed at 73° F and can vary in individual applications based on parameters such as temperature, chemical concentration, pressure, etc. Please consult factory for details.