



ALTAFLUOR 480[®] Ultra-High Purity PFA Tubing

▸ Executive Summary

Overview

Altaflo has developed a 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, ALTAFLUOR 480 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 ALTAFLUOR 480 UHP PFA according to the SEMI F57 specification, performing additional hydrochloric acid (HCl) extraction tests for trace metal contamination. Key results demonstrate that ALTAFLUOR 480 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 ALTAFLUOR 480 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

About the Company

Altaflo is an innovative producer of high performance fluoropolymer and fluoroplastic tubing and pipe. Our exclusive focus on tubing and pipe allows us to use only high-grade, high molecular weight resins, resulting in products that provide the best end-use performance in terms of purity, chemical resistance and overall system reliability.

Our UHP PFA tubing is produced and packaged in a clean room facility, using a proprietary production process designed to ensure product purity and cleanliness. Standard packaging includes a double layer of heat-sealed, anti-static heavy polybags to minimize particulate matter at the tubing surface. We also provide same-day shipping on standard orders and expedited production and shipping for custom extrusions.



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 ultrapure water systems, TOC promotes bacterial growth, a problem that can cause manufacturing delays.

Testing indicates ALTAFLUOR 480 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	ALTAFLUOR 480 UHP PFA tubing	SEMI F57 limit
Total	40	100	$\leq 60,000$

RL = Reporting limit

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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 ALTAFLUOR 480 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	ALTAFLUOR 480 UHP PFA tubing	SEMI F57 limit
Bromide	1	*	≤ 100
Chloride	0.5	*	≤ 3000
Fluoride	20	680	$\leq 60,000$
Nitrate	1	*	≤ 100
Nitrite	0.5	*	≤ 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, $\mu\text{g}/\text{m}^2$ Leached at $85 \pm 5^\circ$, 7 days	RL	ALTAFLUOR 480 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	1	*	≤ 20
Chromium	0.07	*	≤ 1
Copper	0.1	*	≤ 15
Iron	0.2	*	≤ 5
Lead	0.1	*	≤ 1
Lithium	0.07	*	≤ 2
Magnesium	0.05	*	≤ 5
Manganese	0.07	*	≤ 5
Nickel	0.1	1.0	≤ 1
Potassium	0.2	*	≤ 15
Sodium	0.1	*	≤ 15
Strontium	0.02	*	≤ 0.5
Titanium	0.1	*	-
Tin	0.05	*	-
Vanadium	0.07	*	-
Zinc	0.1	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 UHP 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	ALTAFLUOR 480 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, UHP PFA 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 ASTM protocols demonstrate the superior flex life and flexural strength of ALTAFLUOR 480 UHP PFA tubing, durability that helps extend system life and lower the total cost of ownership.

	ASTM Test Method	Units	Values
MIT Flex Life	D 2176	KCycles	1,750,000
Flex Modulus	D 790	PSI	90,000

Physical Properties

ALTAFLUOR 480 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.

ALTAFLUOR 480 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
Elongation	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.

Altaflo's Performance Focus

With even low levels of impurities impacting wafer yield and performance, purity is especially critical for tubing and pipe, which provide the greatest exposed surface area for introducing contaminants. At the same time, strength and chemical resistance are crucial for minimizing system downtime in order to maintain production levels.

By choosing to produce only tubing and pipe, Altaflo can exclusively use resins that offer the best performance for end users. Daikin's AP-231 SH has the lowest melt flow rate of their entire line of PFA resins, making it suitable only for tubing and linings. It's also significantly stronger than less viscous semiconductor-grade resins commonly used for both extruded tubing and injection-molded components. Rather than take a "one size fits all" approach, our focus is on producing exceptionally pure tubing that also provides the highest levels of strength and stress crack resistance.

Production

ALTAFLUOR 480 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.

Tubing is available in coiled configurations manufactured to customer specifications. Precision cutting is available for tubing under 1" using high-speed rotary cutting equipment that ensures consistently straight and smooth cutting of fluoropolymer materials. Altaflo offers custom assembly services such as heat forming, flaring, slitting and sub-assembly packaging. Upon request, we can also provide private labeling services including custom labeling and boxing.

Packaging

Altaflo tubing comes in 25 ft., 50 ft., 100 ft., 500 ft. and 1000 ft. lengths, with longer and custom lengths available. Standard packaging procedures for our UHP PFA tubing include anti-static heavy polyethylene bags that minimize particulate matter at the tubing surface upon opening. Inner polybags are heat-sealed before being placed inside a second polybag, which is also heat-sealed.

Delivery

We understand the importance of maximizing system uptime, which is why we provide same-day shipping on standard orders. Because we maintain such a large in-stock inventory, we're also able to quickly shift production to custom extrusion orders for expedited delivery.





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About the Owners

Mary Hyde and Chris Bishop have extensive experience in the field of fluoropolymers. Having watched large global companies acquire many smaller production facilities, they joined forces in 2006 to create Altaflo. Their goal was to fill the void in the industry for a company focused on customer service and product development.

More Information

For more information on our products, please consult our catalog. If additional information or tubing samples are required, please contact our sales department at sales@altaflo.com or visit our website at www.altaflo.com.

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