GL Sciences

PFAS Testing Solution Guide

LC/MS/MS Applications
GC/MS/MS Applications
Chromatography Products for PFAS Analysis

CONTENTS

Workflow 03

PFAS Analytical Methods 04

PFAS Analysis using FM4 06

Products 08

Applications

- Water Analysis by LC/MS/MS Sample Preparation Workflow 10
- Water Analysis by LC/MS/MS 12
- Air Analysis by LC/MS/MS and GC/MS/MS 14

SPE Cartridges 18

Analytical Columns 20

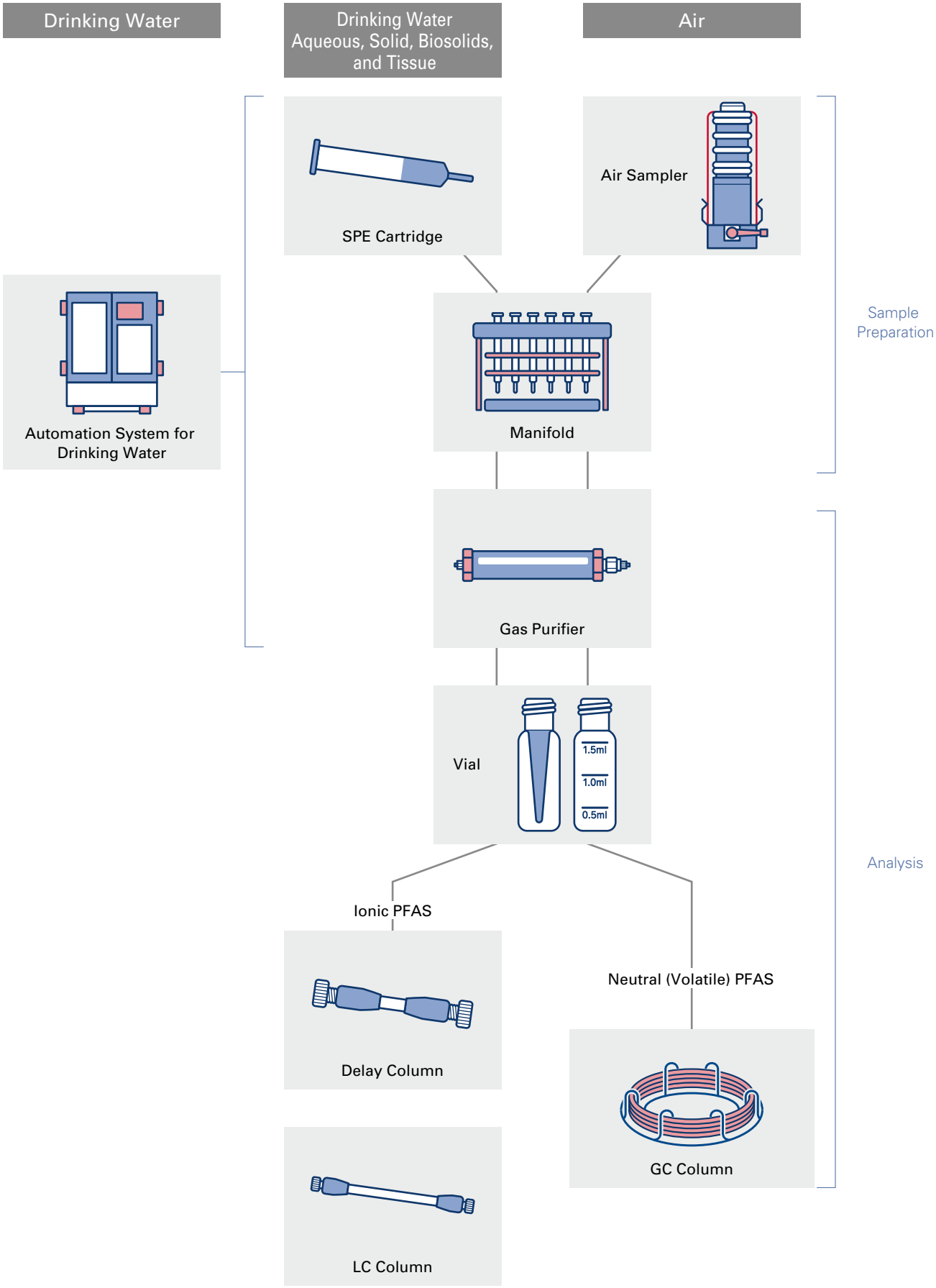
Consumables 22

Automation 23

Air Sampler for PFAS 24

Product List 26

Workflow


Drinking Water
Drinking Water Aqueous, Solid, Biosolids, and Tissue
Air
SPE Cartridge
Air Sampler
Automation System for Drinking Water
Manifold
Sample Preparation
Gas Purifier
Vial
1.5ml
1.0ml
0.5ml
Analysis
Ionic PFAS
Neutral (Volatile) PFAS
Delay Column
GC Column
LC Column

PFAS Analytical Methods and Compounds

No.	Abbreviation	Compounds	CAS Number	ISO 21675:2019
				Water
SPE Cartridge				InertSep WAX
Detection				LC/MS/MS
1	PFBA	Perfluorobutanoic acid	375-22-4	x
2	PFPeA	Perfluoropentanoic acid	2706-90-3	x
3	PFHxA	Perfluorohexanoic acid	307-24-4	x
4	PFHpA	Perfluoroheptanoic acid	375-85-9	x
5	PFOA	Perfluorooctanoic acid	335-67-1	x
6	PFNA	Perfluorononanoic acid	375-95-1	x
7	PFDA	Perfluorodecanoic acid	335-76-2	x
8	PFUnDA (PFUnA)	Perfluoroundecanoic acid	2058-94-8	x
9	PFDoDA (PFDoA)	Perfluorododecanoic acid	307-55-1	x
10	PFTrDA (PFTrA)	Perfluorotridecanoic acid	72629-94-8	x
11	PFTeDA (PFeTA)	Perfluorotetradecanoic acid	376-06-7	x
12	PFHxDA	Perfluoro-n-hexadecanoic acid	67905-19-5	x
13	PFOcDA (PFODA)	Perfluoro-n-octadecanoic acid	16517-11-6	x
14	PFBS	Perfluorobutanesulfonic acid	375-73-5	x
15	PFPeS	Perfluoropentanesulfonic acid	2706-91-4	
16	PFHxS	Perfluorohexanesulfonic acid	355-46-4	x
17	PFHpS	Perfluoroheptanesulfonic acid	375-92-8	x
18	PFOS	Perfluorooctanesulfonic acid	1763-23-1	x
19	PFNS	Perfluorononanesulfonic acid	68259-12-1	
20	PFDS	Perfluorodecanesulfonic acid	335-77-3	x
21	PFDoDS (PFDoS)	Perfluorododecanesulfonic acid	79780-39-5	
22	FOSA (PFOSA)	Perfluorooctanesulfonamide	754-91-6	x
23	N-MeFOSA	N-methylperfluoro-1-octanesulfonamide	31506-32-8	x
24	N-EtFOSA	N-ethylperfluoro-1-octanesulfonamide	4151-50-2	x
25	N-MeFOSAA	N-methylperfluoro-1-octanesulfonamidoacetic acid	2355-31-9	x
26	N-EtFOSAA	N-ethylperfluoro-1-octanesulfonamidoacetic acid	2991-50-6	x
27	N-MeFOSE	2- (N-methylperfluoro-1-octanesulfonamido) -ethanol	24448-09-7	
28	N-EtFOSE	2- (N-ethylperfluoro-1-octanesulfonamide) -ethanol	1691-99-2	
29	4:2 FTS (4:2 FTSA)	4:2 Fluorotelomer sulfonic acid	757124-72-4 (27619-93-8)	
30	6:2 FTS (6:2 FTSA)	6:2 Fluorotelomer sulfonic acid	27619-97-2 (27619-94-9)	x
31	8:2 FTS (8:2 FTSA)	8:2 Fluorotelomer sulfonic acid	39108-34-4 (27619-96-1)	x
32	ADONA (DONA)	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4	x
33	HFPO-DA (Gen X)	Hexafluoropropylene oxide dimer acid (GenX)	13252-13-6	x
34	9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	756426-58-1 (73606-19-6)	x
35	11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	763051-92-9	
36	8:2 FTUCA (FOUEA)	8:2 Fluorotelomer unsaturated carboxylic acid	70887-84-2	x
37	NFDHA (PFDHA)	Perfluoro-3,6-dioxaheptanoic acid	151772-58-6	
38	PFMPA	Perfluoro-3-methoxypropanoic acid	377-73-1	
39	PFMBA	Perfluoro-4-methocybutanoic acid	863090-89-5	
40	PFEESA	Perfluoro(2-ethoxyethane)sulfonic acid	113507-82-7	
41	8:2 diPAP	8:2 Polyfluoroalkyl phosphate diester	678-41-1	x
42	3:3FTCA	3:3 Fluorotelomer carboxylic acid	356-02-5	
43	5:3FTCA	5:3 Fluorotelomer carboxylic acid	914637-49-3	
44	7:3FTCA	7:3 Fluorotelomer carboxylic acid	812-70-4	

ISO 25101	EPA Method 533	EPA Method 537.1	EPA Method 8327*	EPA Method 8328*	EPA Method 8329*	EPA Method 1633
Drinking Water Ground Water Surface Water	Drinking Water	Drinking Water	Surface Water Ground Water Waste Water	Surface Water Ground Water Waste Water Solids	Solids	Aqueous Solid Biosolids Tissue Samples
InertSep PLS-2	InertSep WAX InertSep MA-2	InertSep PLS-2	—	—	—	InertSep WAX FF/GCB InertSep GCB/WAX FF InertSep WAX InertSep MA-2 InertSep GC
LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS
	x		x	x	x	x
	x		x	x	x	x
	x	x	x	x	x	x
	x	x	x	x	x	x
x	x	x	x	x	x	x
	x	x	x	x	x	x
	x	x	x	x	x	x
	x	x	x	x	x	x
	x	x	x	x	x	x
		x	x	x	x	x
		x	x	x	x	x
	x	x	x	x	x	x
	x		x	x	x	x
	x	x	x	x	x	x
	x		x	x	x	x
x	x	x	x	x	x	x
			x	x	x	x
			x	x	x	x
						x
			x	x	x	x
						x
						x
		x	x	x	x	x
		x	x	x	x	x
						x
						x
	x		x	x	x	x
	x		x	x	x	x
	x		x	x	x	x
	x	x				x
	x	x		x		x
	x	x				x
	x	x				x
	x					x
	x					x
	x					x
	x					x
						x
						x
						x

PFAS Analytical Compounds using FM4

–Air Analysis–

Analysis by LC/MS/MS

No.	Abbreviation	Compounds	CAS Number
1	PFBA	Perfluorobutanoic acid	375-22-4
2	PFPeA	Perfluoropentanoic acid	2706-90-3
3	PFHxA	Perfluorohexanoic acid	307-24-4
4	PFHpA	Perfluoroheptanoic acid	375-85-9
5	PFOA	Perfluorooctanoic acid	335-67-1
6	PFNA	Perfluorononanoic acid	375-95-1
7	PFDA	Perfluorodecanoic acid	335-76-2
8	PFUnDA (PFUnA)	Perfluoroundecanoic acid	2058-94-8
9	PFDoDA (PFDoA)	Perfluorododecanoic acid	307-55-1
10	PFTrDA (PFTrA)	Perfluorotridecanoic acid	72629-94-8
11	PFTeDA (PFTA)	Perfluorotetradecanoic acid	376-06-7
12	PFHxDA	Perfluoro-n-hexadecanoic acid	67905-19-5
13	PFOcDA	Perfluoro-n-octadecanoic acid	16517-11-6
14	PFBS	Perfluorobutanesulfonic acid	375-73-5
15	PFHxS	Perfluorohexanesulfonic acid	355-46-4
16	PFHpS	Perfluoroheptanesulfonic acid	375-92-8
17	PFOS	Perfluorooctanesulfonic acid	1763-23-1
18	PFDS	Perfluorodecanesulfonic acid	335-77-3
19	FOSA (PFOSA)	Perfluorooctanesulfonamide	754-91-6
20	N-MeFOSA	N-methylperfluoro-1-octanesulfonamide	31506-32-8
21	N-EtFOSA	N-ethylperfluoro-1-octanesulfonamide	4151-50-2
22	N-MeFOSAA	N-methylperfluoro-1-octanesulfonamidoacetic acid	2355-31-9
23	N-EtFOSAA	N-ethylperfluoro-1-octanesulfonamidoacetic acid	2991-50-6
24	6:2 FTS (6:2 FTSA)	6:2 Fluorotelomer sulfonic acid	H:27619-97-2 Na:27619-94-9
25	8:2 FTS (8:2 FTSA)	8:2 Fluorotelomer sulfonic acid	H:39108-34-4 Na:27619-96-1
26	ADONA (DONA)	4,8-Dioxa-3H-perfluorononanoic acid	919005-14-4
27	HFPO-DA	Hexafluoropropylene oxide dimer acid (GenX)	13252-13-6
28	9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	Na:73606-19-6 K:756426-58-1
29	8:2 FTUCA (FOUEA)	8:2 Fluorotelomer unsaturated carboxylic acid	70887-84-2
30	8:2 diPAP	8:2 Polyfluoroalkyl phosphate diester	678-41-1
31	PFEtS	Perfluoroethane sulfonic acid	354-88-1
32	PFPrS	Sodium prefluoro-1-propanesulfanate Perfluoropropane sulfonic acid	423-41-6
33	PFPrA	Perfluoropropane sulfonic acid	422-64-0
34	10:2 FTUCA	10:2 Fluorotelomer unsaturated carboxylic acid	70887-94-4

Analysis by GC/MS/MS

No.	Abbreviation	Compounds	CAS Number
1	N-MeFOSA	N-methylperfluoro-1-octanesulfonamide	31506-32-8
2	N-EtFOSA	N-ethylperfluoro-1-octanesulfonamide	4151-50-2
3	N-MeFOSE	2- (N-methylperfluoro-1-octanesulfonamido) -ethanol	24448-09-7
4	N-EtFOSE	2- (N-ethylperfluoro-1-octanesulfonamide) -ethanol	1691-99-2
5	4:2 FTOH	2-Perfluorobutyl ethanol (4:2) FBET	2043-47-2
6	6:2 FTOH	2-Perfluorohexyl ethanol (6:2) FHET	647-42-7
7	8:2 FTOH	2-Perfluorooctyl ethanol (8:2) FOET	678-39-7
8	10:2 FTOH	2-Perfluorodecyl ethanol (10:2) FDET	865-86-1
9	4:3 FTOH	4:3 Fluorotelomer alcohol	83310-97-8
10	6:3 FTOH	6:3 Fluorotelomer alcohol	80806-68-4
11	8:3 FTOH	8:3 Fluorotelomer alcohol	1651-41-8
12	6:2FTI	6:2 Fluorotelomer Iodide	2043-57-4
13	8:2FTI	8:2 Fluorotelomer Iodide	2043-53-0
14	10:2FTI	10:2 Fluorotelomer Iodide	2043-54-1
15	PFDoI	Perfluorododecyl iodide	507-63-1
16	PFBuDiI	Octafluoro-1,4-diiodobutane	375-50-8
17	PFHxDiI	Dodecafluoro-1,6-diiodohexane	375-80-4
18	PFODiI	Hexadecafluoro-1,8-diiodooctane	335-70-6
19	BTFBB	1,3-Bis (trifluoromethyl) - 5-bromo-benzene	328-70-1
20	BPFB	Bromopentafluorobenzene	344-04-7

Analytical Methods and Related Products

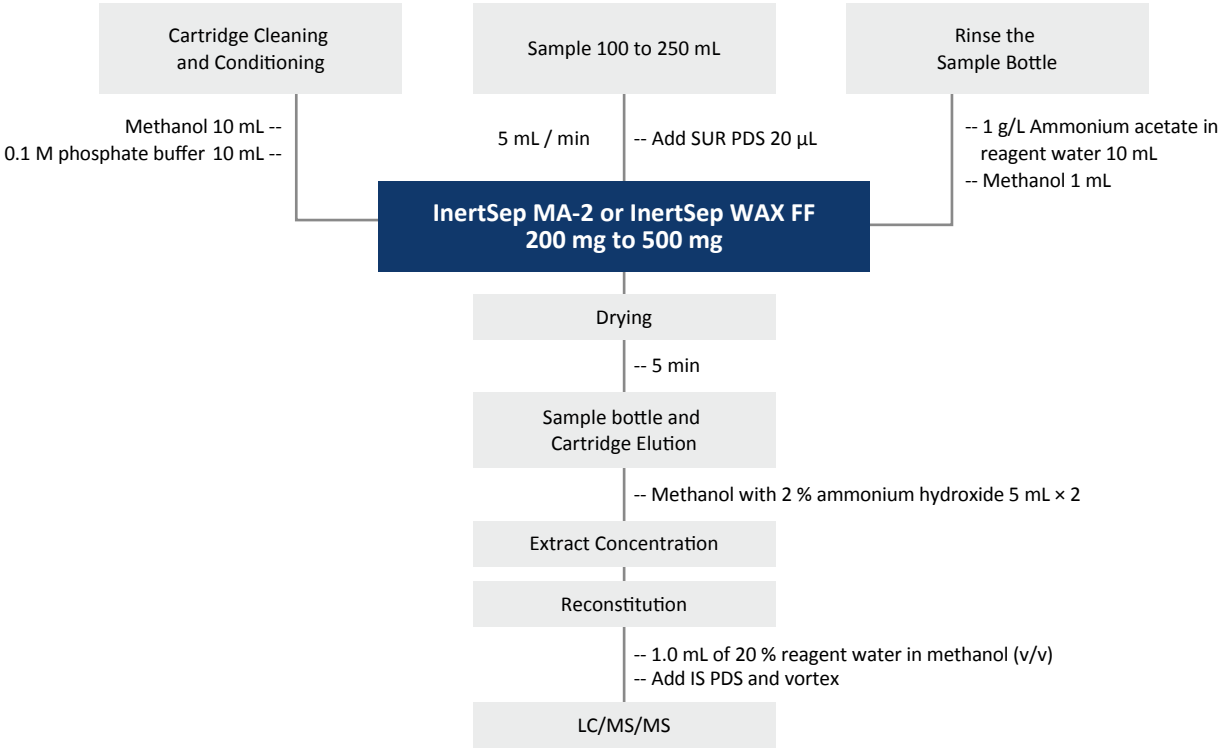
Method	ISO 25101: 2009	ISO21675: 2019	EPA Method 533	EPA Method 537.1	EPA Draft Method 8327	EPA Draft Method 8328
Compounds	2	30	25	14	24	25
Instrument	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS
Sample	Drinking Water Ground Water Surface Water	Drinking Water Natural Water (fresh water and sea water) Waste Water containing less than 2 g/ l solid particulate material (SPM)	Drinking Water	Drinking Water	Surface Water, Ground Water, Waste Water Matrices	Surface Water Ground Water Waste Water Solids
Sample Preparation (SPE Cartridge)	InertSep PLS-2	InertSep WAX	InertSep WAX InertSep MA-2	InertSep PLS-2	-	-
Delay Column	Delay Column for PFAS					
HPLC Column	InertSustain AQ-C18					
GC Column	-					
Vial	Polypropylene Vial, Cap with Aluminum / Silicone Septa					

EPA Draft Method 8329	EPA Method 1633	ASTM D7979-20	ASTM D7968-17a	DIN 38407-42:2011	ASTM D8421-22	Air sampling using FM4*	
24	40	21	30	10	44	-	-
LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	LC/MS/MS	GC/MS/MS
Soil	Aqueous, Solid, Biosolids, and Tissue Samples	Water, Sludge, Influent, Effluent, and Wastewater	Environmental Solids: Soil, Sediment, Sludge	Water, Waste Water and Sludge	Aqueous Matrices	Air	Air
-	InertSep WAX FF/GCB InertSep GCB/WAX FF InertSep WAX InertSep MA-2 InertSep GC	-	Solvent Extraction	InertSep WAX InertSep MA-2	-	FM4	FM4
Delay Column for PFAS							-
InertSustain AQ-C18							-
-						-	InertCap Pure-WAX
Polypropylene Vial, Cap with Aluminum / Silicone Septa							Glass Vial Cap with Aluminum / Silicone Septa

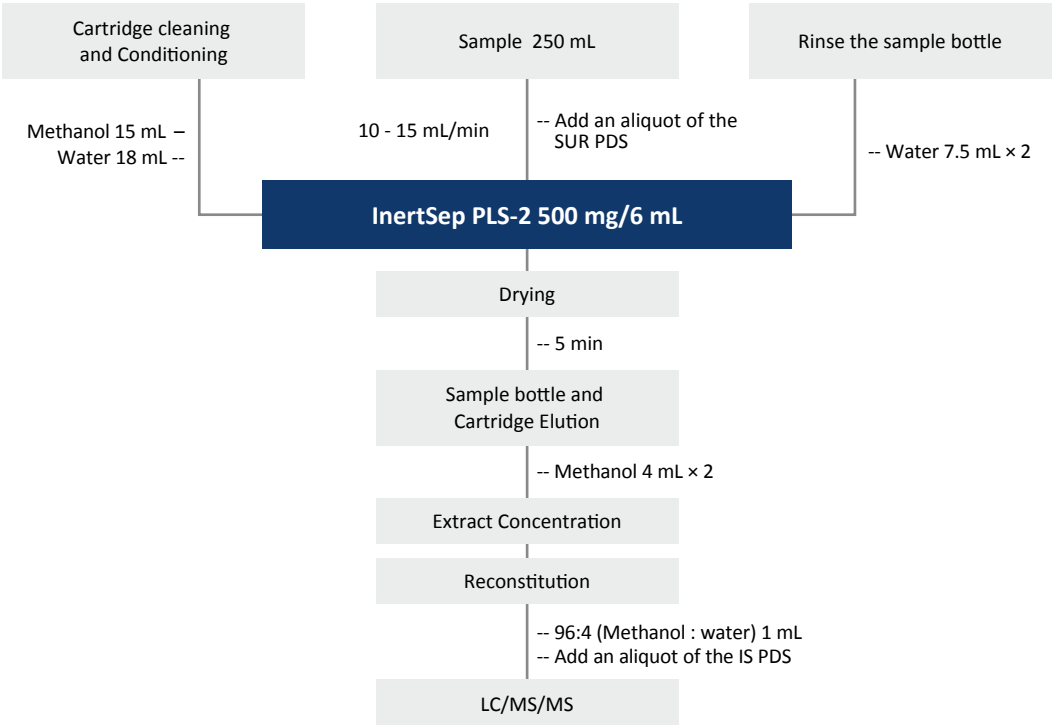
*Reference:
Wu R.; Lin H.; Yamazaki E.; Taniyasu S.; Sörengård M.; Ahrens L.; Lam P.; Eun H.; Yamashita N. Simultaneous Analysis of neutral and ionizable per- and poly fluoroalkyl substances in air. Chemosphere. 2021, 280, 130607

Water Analysis by LC/MS/MS
Sample Preparation Workflow

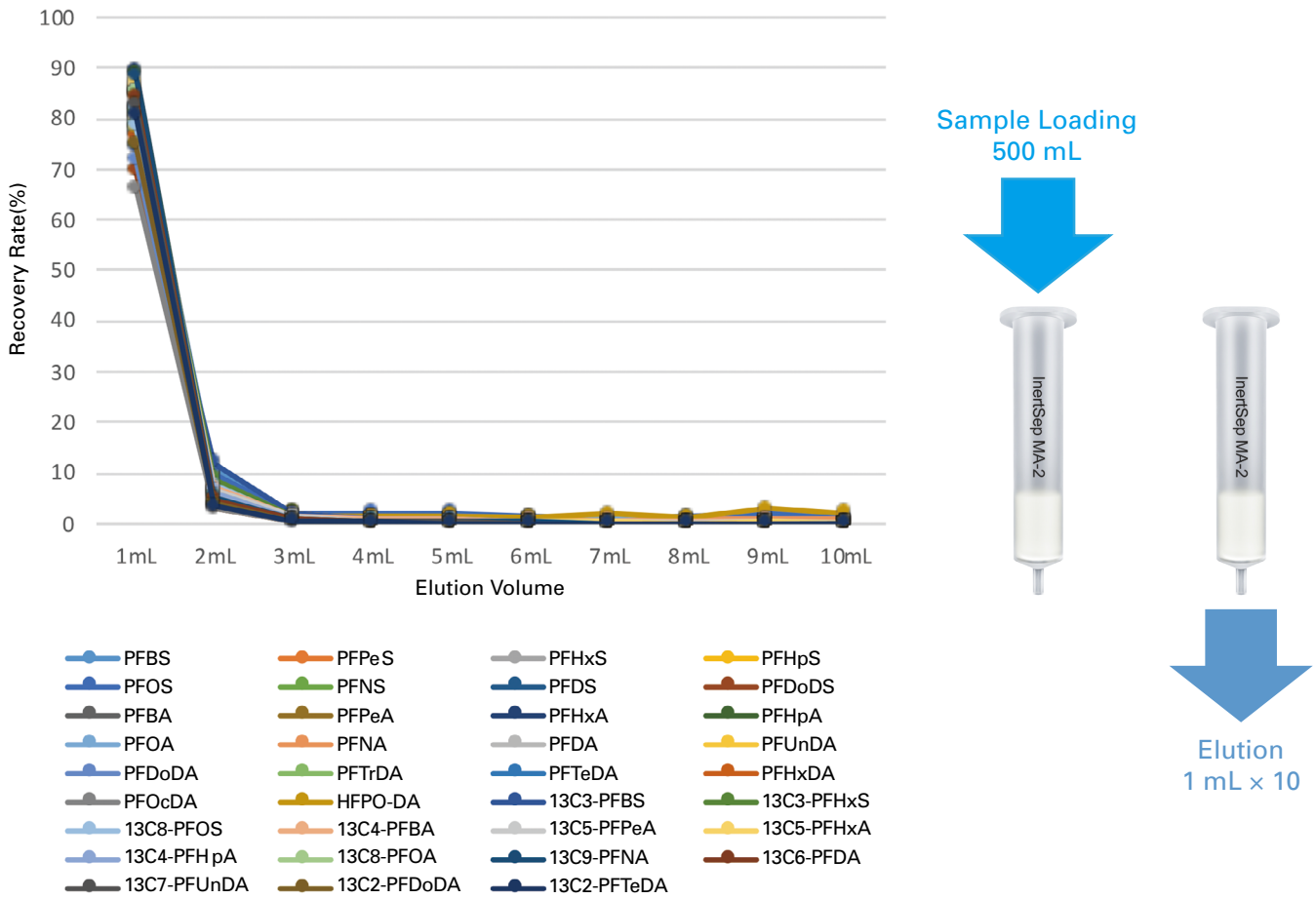
-EPA Method 533-



-EPA Method 537.1-



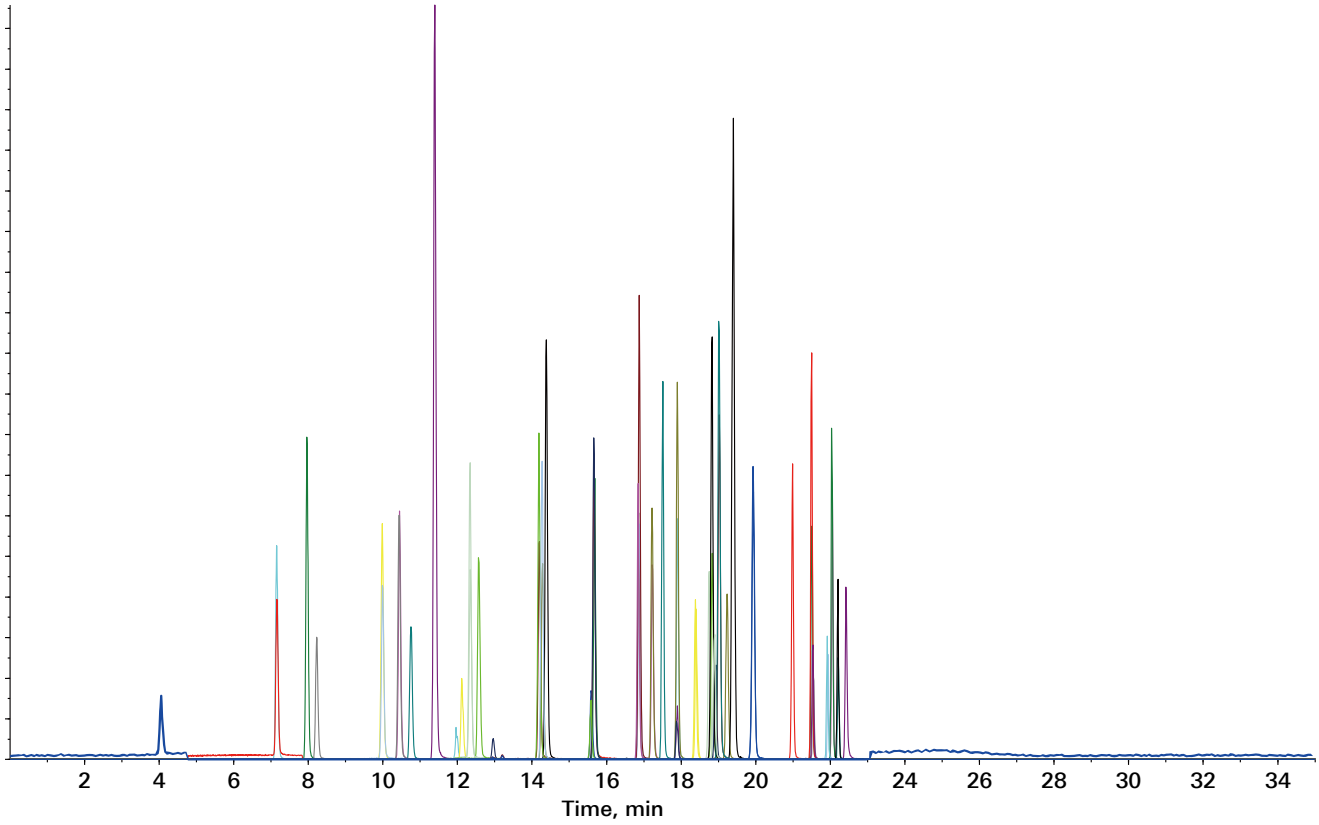
Elution profile of the InertSep MA-2 SPE cartridge. The sample is water containing PFAS 21, and the recovery rates are shown for 1-mL aliquots of the elution. Because the InertSep MA-2 is purely ion exchange mode with minimal reverse-phase behavior, hydrophobic PFAS, such as PFOcDA (C18), eluted with minimal of solvent.



SPE Cartridge : InertSep MA-2 250 mg
Solvent : 0.1% Methanolic Ammonium Hydroxide
Elution Volume : 1 mL × 10

Water Analysis by LC/MS/MS

40 PFAS with 24 Surrogate Analysis by LC/MS/MS (each 1 ng/mL)

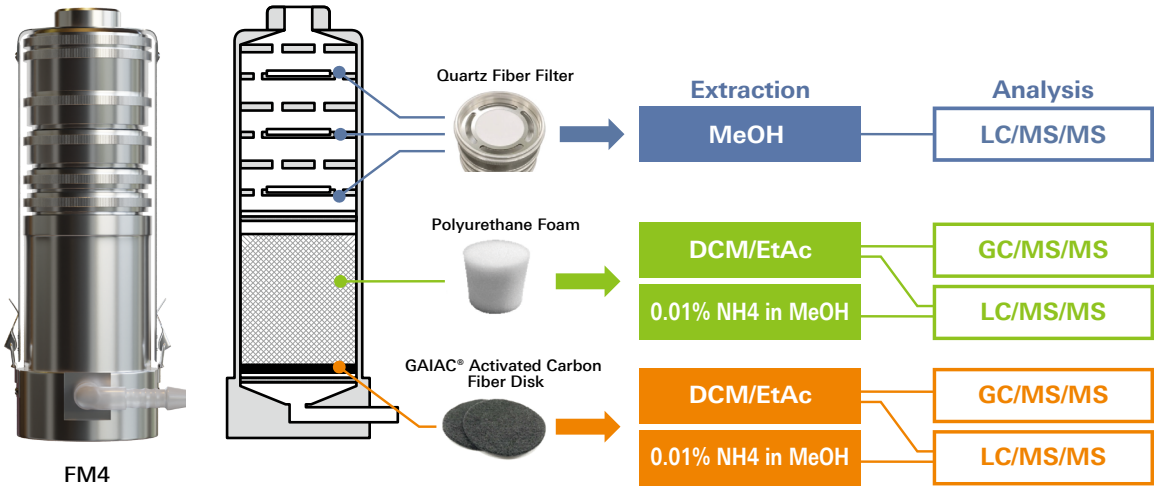


HPLC	Column		InertSustain AQ-C18 1.9 µm 2.1 × 100 mm (GL Science Inc.)								
	Delay Column		Delay Column for PFAS 3.0 × 30 mm (GL Science Inc.)								
	Mobile Phase: A		20 mmol/L aqueous ammonium acetate solution								
	: B		Methanol								
	Flow Program	min	0	0.5	3.0	16.0	18.0	20.0	22.0	25.0	35.0
		A %	95	95	60	20	20	5	5	95	95
		B %	5	5	40	80	80	95	95	5	5
	Flow Rate (mL/min)		0.25			Column Temp. (°C)			40		
	Injection Vol. (µL)		2			Sample Cooler (°C)			10		
MS	Ion Source		ESI								
	Mode		MRM								
	Polarity		Negative								
	CUR		40			TEM				300	
	CAD		12			Ion Source Gas1				50	
	IS		-4500			Source Gas2				30	

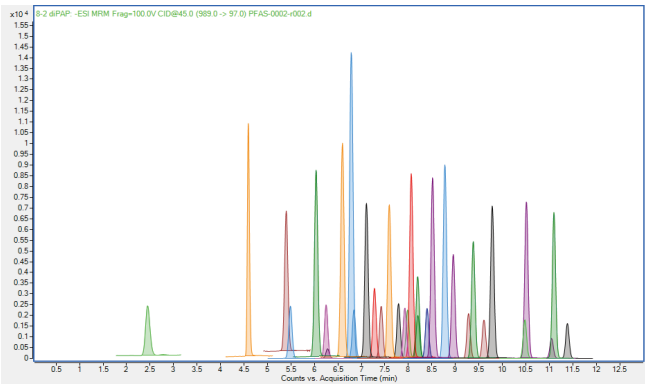
No.	Compounds	R.T.(min)	Transition 1			Transition 2		
			Q1	Q3	CE	Q1	Q3	CE
1	PFPrA	4.06	163	119	-16			
2	PFBA	7.15	213	169	-14			
3	$^{13}C_4$-PFBA	7.16	217	172	-6			
4	PFPrS	7.97	249	80	-52	249	99	-34
5	PFMBA	8.23	229	85	-16			
6	$^{13}C_5$-PFPeA	9.99	268	223	-4			
7	PFPeA	9.99	263	219	-11			
8	$^{13}C_3$-PFBS	10.44	302	80	40			
9	PFBS	10.45	299	80	-59	299	99	-44
10	PFMPA	10.76	279	85	-14			
11	PFEESA	11.39	315	135	-30	315	83	-24
12	NFDHA	11.97	295	201	-12	295	85	-30
13	4:2 FTS (4:2 FTSA)	12.12	327	307	-28	327	81	-54
14	$^{13}C_4$-PFHpA	12.34	367	322	8			
15	PFHxA	12.35	313	269	-15	313	119	-30
16	PFPeS	12.57	349	80	-88	349	99	-38
17	$^{13}C_3$-HFPO-DA ($^{13}C_3$-GenX)	12.94	287	169	4			
18	HFPO-DA (GenX)	12.96	329	169	-16	329	285	-8
19	PFHpA	14.19	363	319	-14	363	169	-26
20	$^{13}C_4$-PFHpA	14.19	367	322	8			
21	$^{13}C_3$-PFHxS	14.27	402	80	65			
22	PFHxS	14.28	399	80	-80	399	99	-80
23	ADONA (DONA)	14.38	377	251	-14	377	85	-56
24	$^{13}C_2$-6:2 FTS ($^{13}C_2$-6:2 FTSA)	15.58	429	409	24			
25	6:2 FTS (6:2 FTSA)	15.59	427	407	-32	427	81	-72
26	PFOA	15.66	413	369	-14	413	169	-26
27	$^{13}C_8$-PFOA	15.66	421	376	8			
28	PFHpS	15.68	449	80	-104	449	99	-70
29	$^{13}C_8$-PFOS	16.85	507	80	58			
30	PFOS	16.86	499	80	-97	499	99	-77
31	$^{13}C_9$-PFNA	16.88	472	427	8			
32	PFNA	16.89	463	419	-16	463	219	-26
33	$^{13}C_2$-8:2 FTUCA ($^{13}C_3$-FOUEA)	17.22	459	394	-16			
34	8:2 FTUCA (FOUEA)	17.23	457	393	-18	457	343	-52
35	9Cl-PF3ONS	17.51	531	351	-40	531	83	-56
36	$^{13}C_2$-8:2 FTS ($^{13}C_2$-8:2 FTSA)	17.88	529	509	27			
37	8:2 FTSA	17.90	527	507	-40	527	81	-82
38	PFDA	17.90	513	469	-19	513	219	-27
39	$^{13}C_6$-PFDA	17.90	519	474	8			
40	d_3-N-MeFOSAA	18.38	573	419	20			
41	N-MeFOSAA	18.40	570	419	-28	570	483	-22
42	PFDS	18.75	599	80	-94	599	99	-91
43	PFUnDA (PFUnA)	18.83	563	519	-19	563	269	-28
44	$^{13}C_7$-PFUnDA ($^{13}C_7$-PFUnA)	18.83	570	525	8			
45	d_5-N-EtFOSAA	18.90	589	419	20			
46	N-EtFOSAA	18.93	584	419	-28	584	526	
47	$^{13}C_8$-FOSA	19.01	506	78	49			
48	FOSA (PFOSA)	19.02	498	78	-85	498	169	-40
49	10:2 FTUCA	19.23	557	493	-20	557	243	-52
50	11Cl-PF3OUdS	19.40	631	451	-40	631	83	-90
51	$^{13}C_2$-PFDoDA ($^{13}C_2$-PFDoA)	19.93	615	570	8			
52	PFDoDA (PFDoA)	19.94	613	569	-17	613	269	-29
53	PFTrDA (PFTrA)	20.99	663	619	-19	663	269	-32
54	$^{13}C_2$-PFTeDA ($^{13}C_2$-PFTeA)	21.50	715	670	7			
55	PFTeDA (PFTeA)	21.51	713	669	-19	713	319	-36
56	d_3-N-MeFOSA	21.53	515	169	30			
57	N-MeFOSA	21.55	512	169	-37	512	219	-34
58	d_5-N-EtFOSA	21.92	531	169	30			
59	N-EtFOSA	21.94	526	169	-37	526	219	-34
60	$^{13}C_2$-PFHxDA	22.04	815	770	12			
61	PFHxDA	22.06	813	769	-20	813	319	-34
62	8:2 diPAP	22.21	989	97	-88	989	543	-35
63	$^{13}C_4$-8:2 diPAP	22.21	993	545	19			
64	PFOcDA (PFODA)	22.42	913	869	-20	913	369	-40

Air Analysis by LC/MS/MS and GC/MS/MS

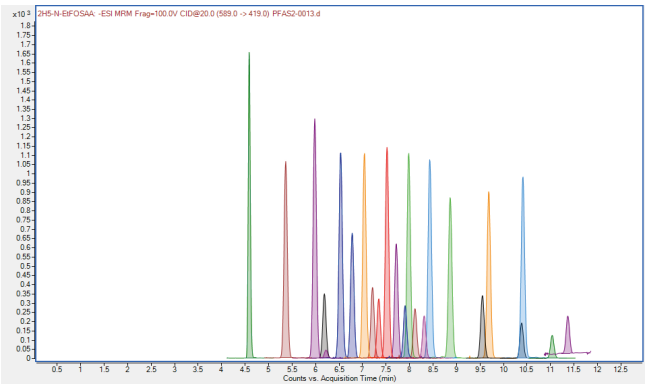
FM4 is a groundbreaking air sampler that was designed with an impactor that minimizes contact between airborne particulates, gaseous substances, and the and three types of adsorbents, thus enabling simultaneous collection of ionic and neutral/volatile PFAS.



Chromatogram of Reference Standard



Chromatogram of Surrogate



Conditions

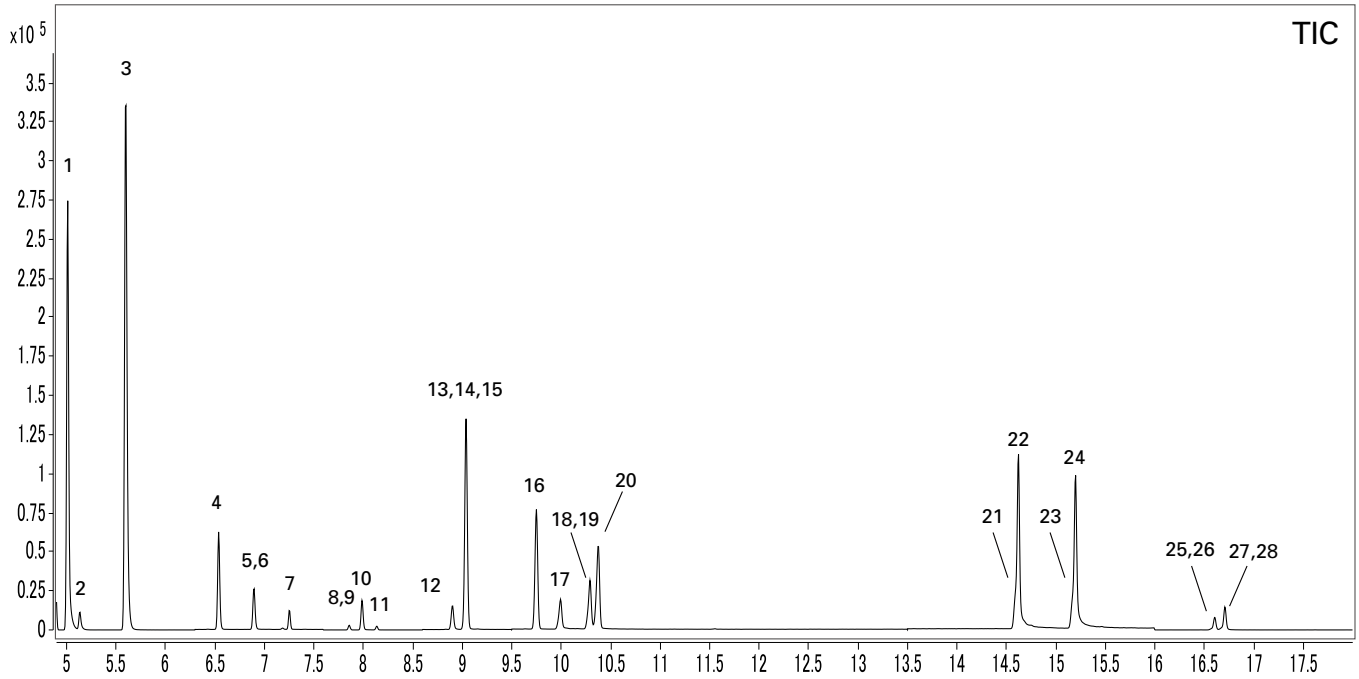
System		Agilent 1260 Infinity II Prime LC System　Agilent Ultivo Triple Quadrupole LC/MS/MS system					
Column		InertSustain AQ-C18　1.9 µm, 2.1 mm I.D. × 100 mm (GL Sciences Inc.)					
Delay Column		Delay Column for PFAS　3.0 × 30 mm (GL Science Inc.)					
Mobile Phase (A)		10 mmol/L Aqueous ammonium acetate					
Mobile Phase (B)		Acetonitrile					
Column Temperature		40 °C					
Gradient	Time (min)	0	1.5	10	11	11.1	15
	A %	90	70	0	0	90	90
	B %	10	30	100	100	10	10
Flow Rate		0.3 mL/min					
Injection Volume		2 µL					
Sample Cooler		10 °C					
Ionization Mode		AJS (Negative)					
Drying Gas Temp.		300 °C					
Drying Gas Flow Rate		10 L/min					
Sheath Gas Temp.		400 °C					
Sheath Gas Flow Rate		12 L/min					
Nozzle Voltage		0 V					
Nebulizer Gas Pressure		50 psi					

Retention Times and Transitions

No.	Compounds	R.T. (min)	Transition 1			Transition 2		
			Q1	Q3	CE	Q1	Q3	CE
1	PFPrA	2.46	163	119	10	-	-	-
2	$^{13}C_4$-PFBA	4.61	217	172	6	-	-	-
3	PFBA	4.61	213	169	6	-	-	-
4	$^{13}C_5$-PFPeA	5.41	268	223	4	-	-	-
5	PFPeA	5.41	263	219	6	-	-	-
6	PFPrS	5.50	249	99	30	249	80	45
7	$^{13}C_5$-PFHxA	6.04	318	273	4	-	-	-
8	PFHxA	6.04	313	269	6	313	119	22
9	$^{13}C_3$-PFBS	6.27	302	80	40	-	-	-
10	PFBS	6.27	299	80	40	299	99	34
11	$^{13}C_3$-HFPO-DA ($^{13}C_3$-Gen X)	6.29	287	169	4	-	-	-
12	HFPO-DA (Gen X)	6.29	285	169	4	285	185	16
13	$^{13}C_4$-PFHpA	6.60	367	322	8	-	-	-
14	PFHpA	6.61	363	319	6	363	169	18
15	ADONA (DONA)	6.81	377	251	8	377	85	40
16	6:2 FTS (6:2 FTSA)	6.85	427	407	23	427	81	44
17	$^{13}C_2$-6:2 FTS ($^{13}C_2$-6:2 FTSA)	6.86	429	409	24	-	-	-
18	$^{13}C_8$-PFOA	7.12	421	376	8	-	-	-
19	PFOA	7.12	413	369	10	413	169	15
20	$^{13}C_2$-8:2 FTUCA ($^{13}C_2$-FOUEA)	7.29	459	394	16	-	-	-
21	8:2 FTUCA (FOUEA)	7.29	457	393	12	457	343	44
22	PFHxS	7.40	399	80	53	399	99	45
23	$^{13}C_3$-PFHxS	7.43	402	80	65	-	-	-
24	$^{13}C_9$-PFNA	7.61	472	427	8	-	-	-
25	PFNA	7.61	463	419	10	463	219	18
26	$^{13}C_2$-8:2 FTS ($^{13}C_2$-8:2 FTSA)	7.79	529	509	27	-	-	-
27	8:2 FTS (8:2 FTSA)	7.80	527	507	28	527	81	55
28	PFHpS	7.94	449	80	55	449	99	51
29	d_3-N-MeFOSAA	7.99	573	419	20	-	-	-
30	N-MeFOSAA	8.00	570	419	20	570	483	16
31	$^{13}C_6$-PFDA	8.07	519	474	8	-	-	-
32	PFDA	8.08	513	469	6	513	269	18
33	d_5-N-EtFOSAA	8.21	589	419	20	-	-	-
34	10:2 FTUCA	8.21	557	493	16	557	243	44
35	N-EtFOSAA	8.23	584	419	20	584	483	16
36	$^{13}C_8$-PFOS	8.41	507	80	58	-	-	-
37	PFOS	8.41	499	80	60	499	99	55
38	$^{13}C_7$-PFUnDA ($^{13}C_7$-PFUnA)	8.51	570	525	8	-	-	-
39	PFUnDA (PFUnA)	8.51	563	519	7	563	269	16
40	9Cl-PF3ONS	8.78	531	351	28	531	83	32
41	$^{13}C_2$-PFDoDA ($^{13}C_2$-PFDoA)	8.94	615	570	8	-	-	-
42	PFDoDA (PFDoA)	8.95	613	569	9	613	319	22
43	PFDS	9.26	599	80	65	599	99	60
44	PFTrDA (PFTrA)	9.36	663	619	9	663	169	29
45	FOSA (PFOSA)	9.61	498	78	75	498	169	30
46	$^{13}C_8$-FOSA ($^{13}C_8$-PFOSA)	9.74	506	78	49	-	-	-
47	$^{13}C_2$-PFTeDA ($^{13}C_2$-PFTeA)	9.76	715	670	7	-	-	-
48	PFTeDA (PFTeA)	9.76	713	669	10	713	169	33
49	$^{13}C_4$-8:2 diPAP	10.42	993	545	19	-	-	-
50	8:2 diPAP	10.43	989	97	45	989	543	28
51	$^{13}C_2$-PFHxDA	10.46	815	770	12	-	-	-
52	PFHxDA	10.46	813	769	12	813	219	32
53	PFOcDA (PFODA)	11.02	913	869	11	913	169	39
54	d_3-N-MeFOSA	11.03	515	169	30	-	-	-
55	N-MeFOSA	11.04	512	169	27	512	219	23
56	d_5-N-EtFOSA	11.36	531	169	30	-	-	-
57	N-EtFOSA	11.37	526	219	23	526	169	27

Air Analysis by LC/MS/MS and GC/MS/MS

Chromatogram of Neutral PFAS with Surrogates (5 ng/mL)



System	8890/7010B Triple quadrupole GC/MS/MS (Agilent Technologies, Inc)		
Column	InertCap Pure-WAX (GL Science Inc.) 0.25 mm I.D. × 30 m, df = 0.25 µm		
Injection	Splitless		
Injection Vol.	2 µL, 200 °C		
Carrier Gas	He, 1.2 mL/min		
Column Temp.	Rate (°C/min)	Temp (°C)	Hold (min)
	0	40	2
	10	200	0
	20	250	20
Ion Source Temp.	320 °C		
Ion Mode	EI		
Mode	MRM		

No.	Compounds	R.T. (min)	Transition 1			Transition 2		
			Q1	Q3	CE	Q1	Q3	CE
1	BTFBB	5	292	213	26	294	213	18
2	6:2 FTI	5.13	474	263	28	327	181	16
3	BPFB	5.6	248	167	24	248	117	22
4	8:2 FTI	6.53	574	427	8	547	313	20
5	d_4-4:2 FTOH	6.83	199	130	6	248	130	8
6	4:2 FTOH	6.9	196	127	10	196	77	26
7	PFDoI	7.25	219	69	28	169	69	16
8	$^{13}C_2$-d_2-6:2 FTOH	7.82	298	129	6	248	130	8
9	6:2 FTOH	7.86	296	77	26	344	95	24
10	4:3 FTOH	7.99	195	175	8	195	95	24
11	10:2 FTI	8.13	527	481	8	527	145	10
12	6:3 FTOH	8.9	295	275	8	295	181	24
13	$^{13}C_2$-d_2-8:2 FTOH	8.99	409	69	60	448	129	4
14	8:2 FTOH	9.02	396	127	12	131	69	22
15	PFBuDiI	9.05	327	181	8	327	69	60
16	PFHxDiI	9.75	177	127	28	281	181	22
17	8:3 FTOH	9.98	395	95	12	131	69	20
18	$^{13}C_2$-d_2-10:2 FTOH	10.25	515	96	19	495	69	60
19	10:2 FTOH	10.28	505	669	60	131	69	60
20	PFODiI	10.38	527	127	14	381	69	60
21	d_5-N-EtFOSA	14.57	450	430	12	450	380	18
22	N-EtFOSA	14.61	448	69	60	131	69	28
23	d_3-N-MeFOSA	15.16	433	114	28	433	413	16
24	N-MeFOSA	15.19	448	428	12	131	69	28
25	d_7-N-MeFOSE	16.57	465	415	14	530	465	16
26	N-MeFOSE	16.59	526	462	18	462	93	28
27	d_9-N-EtFOSE	16.66	449	428	14	449	378	20
28	N-EtFOSE	16.69	540	69	54	540	448	20

SPE Cartridges

InertSep WAX FF/GCB and GCB/WAX FF

InertSep WAX FF/GCB and GCB/WAX FF are stacked SPE cartridges, designed to simplify and streamline sample preparation procedures. InertSep WAX FF/GCB is suitable for non-potable water samples, whereas InertSep GCB/WAX FF is applicable for solids, biosolids, and tissue samples. The Graphite Carbon Black (GCB) sorbent within the two-phase cartridges boasts high purity with precisely controlled particles, facilitating both efficient sample flow-through and effective cleanup, thereby optimizing the the subsequent LC-MS/MS analysis.

InertSep WAX / InertSep WAX FF

InertSep WAX is a mixed-mode SPE sorbent based on styrene divinylbenzene polymer modified with a weak anion-exchange group. It has hydrophobic and anion-exchange interactions, making it suitable for the pretention of strong acidic compounds.

InertSep MA-2

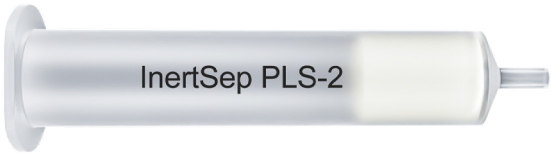
InertSep MA-2 is a methacrylate polymer-based sorbent modified weak anion exchange functional groups. Because the methacrylate polymer polymer base has minimal secondary interactions anion exchange interaction is the dominant retention mode with this sorbent.

InertSep HLB / InertSep HLB FF

InertSep HLB is a reversed phase sorbent made of styrene-divinylbenzene (SDB) and a nitrogen-containing vinyl monomer.

InertSep PLS-2

InertSep PLS-2 is a SDB (Styrene divinylbenzene) polymer based reversed phase mode sorbent.



InertSep GC

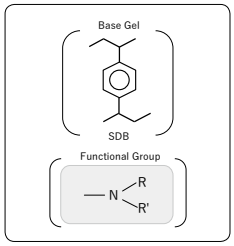
InertSep GC is packed with planar graphite carbon particles. In conjunction with other normal phase and ion exchange sorbents, these cartridges can be used for a wide variety of applications as a cleanup sorbent.

Weak anion Exchange

InertSep WAX / InertSep WAX FF

(Combination of Weak Anion Exchange and Reversed Phase)

SDVB polymer with Diethyl amine
pH Range : 1 - 14

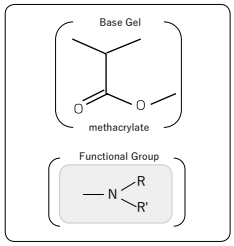


	Column Dimension	Qty.	Cat.No.
InertSep WAX FF (70 um)	30 mg / 3 mL	50 pcs	5010-62766
	60 mg / 3 mL	50 pcs	5010-62760
	150 mg / 6 mL	30 pcs	5010-62761
	500 mg / 6 mL	30 pcs	5010-62762
	150 mg / 12 mL	20 pcs	5010-62763
	500 mg / 20 mL	20 pcs	5010-62764
	225 mg / Slim-J*	50 pcs	5010-65835
InertSep WAX (30 um)	30 mg / 3 mL	50 pcs	5010-62766
	60 mg / 3 mL	50 pcs	5010-62752
	150 mg / 6 mL	30 pcs	5010-62753
	200 mg / 6 mL	30 pcs	5010-62754
	500 mg / 6 mL	30 pcs	5010-62755

InertSep MA-2

(Weak Anion Exchange)

Methacrylate polymer with Diethyl amine
Average Particle Size : 70 µm
pH Range : 1 - 14
Remark : Cl^- Ion Pair



Column Dimension	Qty.	Cat.No.
30 mg / 1 mL	100 pcs	5010-27324
60 mg / 3 mL	100 pcs	5010-27325
100 mg / 3 mL	50 pcs	5010-27320
150 mg / 3 mL	50 pcs	5010-27319
250 mg / 6 mL	30 pcs	5010-27321
500 mg / 6 mL	30 pcs	5010-27322
1 g / 20 mL	20 pcs	5010-27326
2 g / 20 mL	20 pcs	5010-27327
280 mg / Slim-J*	50 pcs	5010-65785

Reversed Phase

InertSep PLS-2

Styrene-Divinylbenzene (SDVB)
Average Particle Size : 70 µm
pH Range : 1 - 14

Column Dimension	Qty.	Cat.No.
270 mg / 6 mL	50 pcs	5010-25020
500 mg / 6 mL	30 pcs	5010-25025
270 mg / 20 mL	20 pcs	5010-25035
500 mg / 20 mL	20 pcs	5010-25036
230 mg / Slim-J*	50 pcs	5010-65720
265 mg / Slim-J*	50 pcs	5010-65721

InertSep HLB / InertSep HLB FF

Styrene-Divinylbenzene (SDVB) and a nitrogen-containing vinyl monomer
pH Range : 1 - 14

	Column Dimension	Qty.	Cat.No.
InertSep HLB FF (60 um)	150 mg / 6 mL	30 pcs	5010-27539
	200 mg / 6 mL	30 pcs	5010-27533
	500 mg / 6 mL	30 pcs	5010-27534
	225 mg / Slim-J*	50 pcs	5010-65795
InertSep HLB (30 um)	150 mg / 6 mL	30 pcs	5010-27525
	200 mg / 6 mL	30 pcs	5010-27523
	500 mg / 6 mL	30 pcs	5010-27524

Graphite Carbon

InertSep GC

Base Gel : Graphite Carbon Black
Average Particle Size : 120 / 400 mesh
Surface Area : 85 m^2/g
Pore Size : 45 nm

Column Dimension	Qty.	Cat.No.
150 mg / 3 mL	50 pcs	5010-68000
300 mg / 6 mL	30 pcs	5010-68001
400 mg / Slim*	50 pcs	5010-65710
2 g / 6 mL	30 pcs	5010-68008
Bulk 100 g	100 g	5010-69051

Stacked Cartridge

InertSep WAX FF / GCB and GCB / WAX FF

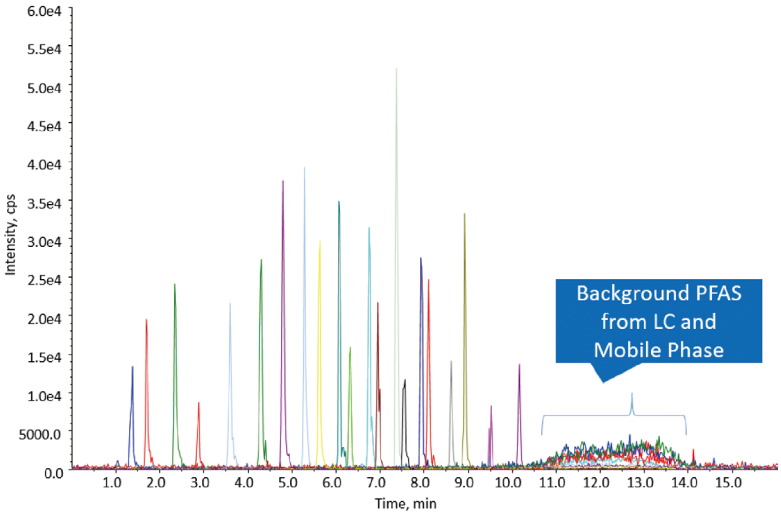
Descriptions	Size	Qty.	Cat.No.
InertSep WAX FF / GCB	200 mg / 50 mg / 6mL	30 pcs	5010-68063
		300 pcs	5010-68064
InertSep GCB / WAX FF	50 mg / 200 mg / 6mL	30 pcs	5010-68065
		300 pcs	5010-68066

*Slim and Slim-J: Luer Compatible

Delay Column for PFAS

The Delay column for PFAS is packed with high purity activated carbon beads, which strongly retain the background PFAS from the LC system and mobile phase. The retained PFAS compounds are subsequently eluted with 100% acetonitrile, allowing for maximum separation from the analytes on the chromatogram.
Maximum operating pressure: 80 MPa

Particle	I.D.	Length	Qty.	Cat.No.
Activated Carbon	3.0 mm	30 mm	1 pc	5020-90005



In contrast to ODS-type delay columns that afford only small shifts in retention times, GL Sciences' Delay column for PFAS offers complete separation.

Delay Column	Analytical Column	System Pressure
None	InertSustain AQ-C18 (2.1 × 150 mm 3 µm-HP)	**19.8 MPa**
Delay Column for PFAS (3.0 × 30 mm)		**19.8 MPa**
General ODS column (2.1 × 50 mm 3 µm)		23 MPa

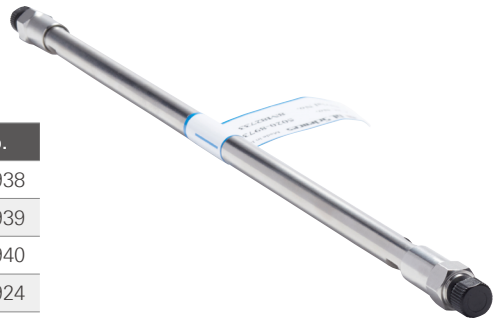
*System: LC (Nexera, Shimadzu), MS/MS (4000 QTRAP, SCIEX)

Compared to ODS-type delay columns, GLSciences' Delay Column for PFAS allows for longer analytical columns due to tis low backpressure.

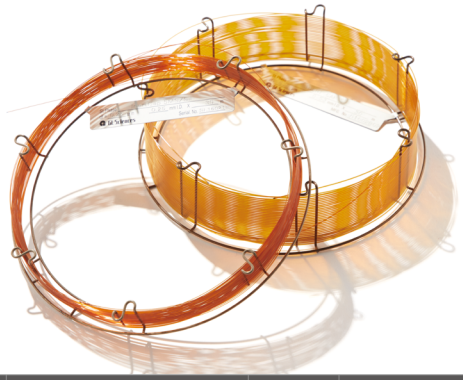
LC Column

InertSustain AQ-C18

Base Material	: High Purity ES Silica Gel	Functional Group	: Octadecyl
Surface Area	: 350 m^2/g	End-capping	: Yes
Pore Size	: 100 Å (10 nm)	Carbon Loading	: 13.0 %
Pore Volume	: 0.85 mL/g	pH Range	: 1 - 10



Particle Size	I.D.	Length	Max. Pressure	Qty.	Cat.No.
1.9 µm	2.1 mm	50 mm	80 MPa	1 pc	5020-89938
1.9 µm	2.1 mm	100 mm	80 MPa	1 pc	5020-89939
1.9 µm	2.1 mm	150 mm	80 MPa	1 pc	5020-89940
3µm HP	2.1 mm	150 mm	50 MPa	1 pc	5020-89924



GC Column

InertCap Pure-WAX

- Polyethylene Glycol (PEG)
- USP Phase G16
- High Polarity
- Cross-Linked

I.D.	Length	Film Thickness	Guard Column Length	Transfer Line Length	Max. Temperature	Qty.	Cat.No.
0.25 mm	30 m	0.25 µm	-	-	iso.260 °C-prog.260 °C	1 pc	1010-68142
			2 m (ProGuard)	-	iso.260 °C-prog.260 °C	1 pc	1010-68490
			-	2 m (T.L.)	iso.260 °C-prog.260 °C	1 pc	1010-68492

Consumables

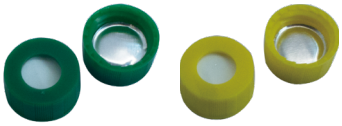
Vial (Screw)

Size : 11.6 × 32 mm
Cap size : 9-425

Material	Volume	Qty.	Cat.No.
Polypropylene	1.5 mL	100 pcs	1030-72122
	0.3 mL	100 pcs	1030-14000
		1000 pcs	1030-14004
Glass	1.5 mL	100 pcs	1030-72100

Cap with Aluminum / Silicone Septa

Cap size : 9-425
Material : Polypropylene (Cap)
: Aluminum Foil/
Silicone (Septa)



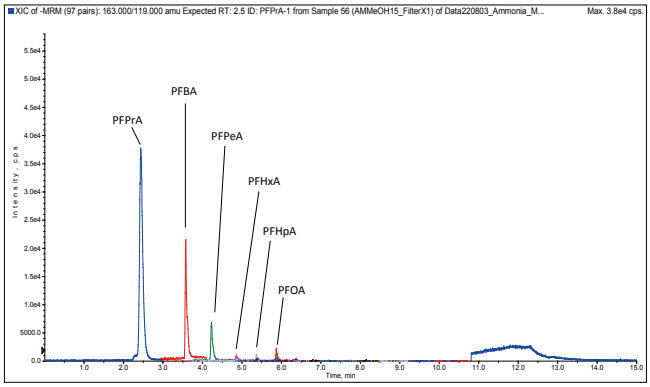
Cap Color	Qty.	Cat.No.
Green	100 pcs	1030-72000
Yellow	100 pcs	1030-72001

Pre-Conditioned Gas Purifier

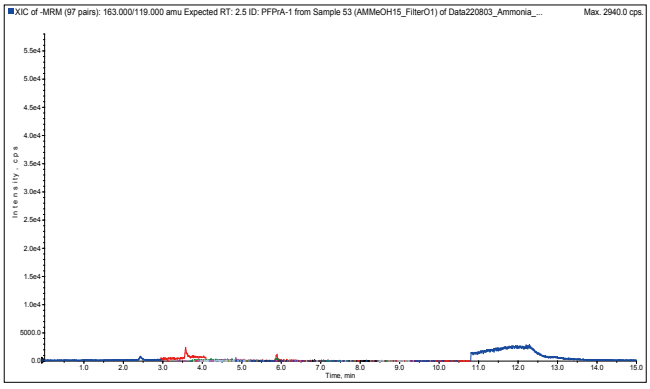
A pre-conditioned, activated carbon filter that is made without the use of fluororesin sealing coating for fitting.
When evaporating the extract using nitrogen gas, this filter can clean the gas and avoid contamination.

Description	Qty	Cat.No.
Pre-Conditioned HC Filter, PTFE tape free, 1/8"	1 pcs	3001-17005
Pre-Conditioned HC Filter, PTFE tape free, 1/4"	1 pcs	3001-17006

Without Filter



With Filter



5 ml of methanol with 0.1 % ammonium hydroxide is evaporated under a stream of nitrogen and analyzed by LC/MS/MS.

Gravity-Flow Manifold for PFAS

Gravity-Flow Manifold for PFAS is specially designed for PFAS, in which solid-phase extraction is performed without vacuum.
Conditioning and elution can be performed on 10 samples simultaneously.

Descriptions	Qty	Cat.No.
Gravity-Flow MANIFOLD for PFAS	1 set	5010-50465

Automation

Automated Solid Phase Extraction System

AquaTrace

AquaTrace is an automated sample preparation system that capable of processing up to 6 samples simultaneously.

Automated Solid Phase Extraction (SPE) Elution Unit

EL870

An automated elution system for solid-phase extraction, equipped with a high-precision syringe pump, which improves efficiency and accuracy through automation.

Air Sampler for PFAS

FM4

FM4 Air Sampler is with an impactor that minimizes the contact between airbome particulates, gaseous substances, and the three types of adsorbents, which enable simultaneous collection of ionic and neutral/volatile PFAS.

Comprehensive Sampling Device

Both airbome particulates and gaseous substances can be collected simultaneously using one compact sampler. Because it is possible to determine the collection amount for each material, comprehensive PFAS evaluation is possible.

Capable of Collecting Gaseous PFAS (FTOH, etc.)

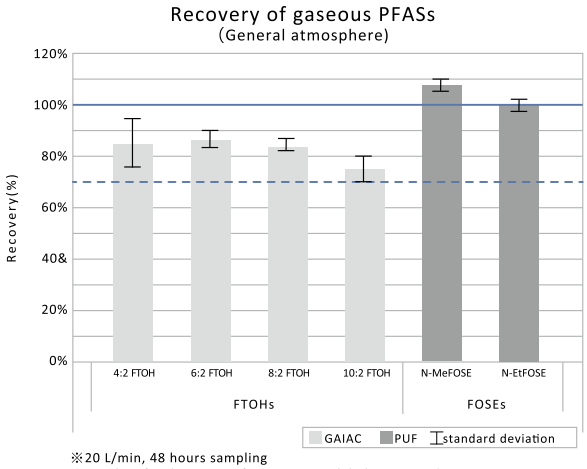
The challenging task of capturing of gaseous PFAS in air samples, is now possible with the novel activated carbon desorption material.

Excellent Recovery Rate

High recovery rates for various PFAS have been attained.

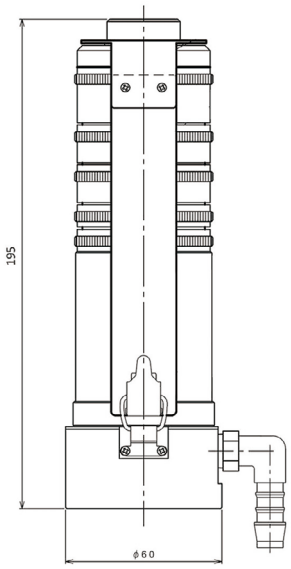
Compact and Portable

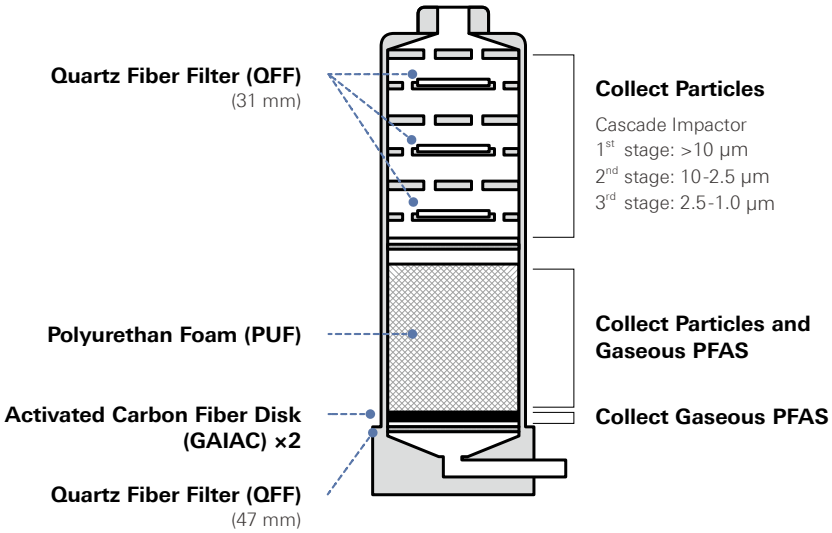
FM4 is a lightweight and compact air sampler that is easy to carry and takes up minimal floor space.



※20 L/min, 48 hours sampling
※Results of spiking 5 ng of various mass label compounds to PUF

▶Confirmed no breakthrogh in the most volatile 4:2 FTOH.





Sampler

Description	Qty.	Cat.No.	Specifications
FM4, Air Sampler for PFAS	1 set	1050-13015	Material : Aluminum (anodizing treatment) Dimension : 60 mm × 195 mm Weight : approx. 900 g Connection : Rc1/4

Quartz Fiber Filter

Polyurethane Foam

GAIAC

Consumables

Description	Qty.	Cat.No.	Number of use per sampling	Specifications
Quartz Fiber Filter QFF31	100 pcs	1050-13022	3 pcs	Impactor section, 31 mm
Quartz Fiber Filter QFF47	100 pcs	1050-13023	1 pc	Backup, 47 mm
Polyurethane Form PUF4750	10 pcs	1050-13021	1 pc	47 mm × 50 mm
Active Carbon Fiber Disk (GAIAC FF047)	20 pcs (2 pcs × 10 pcs)	1050-13020	2 pcs	47 mm × 2 mm

When using outside, position in a place where rain cannot enter inside. This product does not include a sampling pump.
FM4 sampling module was developed by FUTAMURA CHEMICAL
CO., LTD. under a joint research with National Institute of Advanced Industrial Science and Technology (AIST).

Product List

For Drinking Water, Aqueous, Solid, Biosolids, and Tissue Samples

Category	Cat.No.	Descriptions	Qty
SPE Cartridge (Anion Exchange)	5010-65785	InertSep Slim-J MA-2 280 mg	50 pcs
	5010-27319	InertSep MA-2 150 mg / 3 mL	50 pcs
	5010-27321	InertSep MA-2 250 mg / 6 mL	30 pcs
	5010-27645	InertSep LSC MA-2 150 mg	50 pcs
SPE Cartridge (Mix mode Anion Exchange and Reverse phase)	5010-62756	InertSep WAX 30 mg / 3 mL	50 pcs
	5010-62753	InertSep WAX 150 mg / 6 mL	30 pcs
	5010-62754	InertSep WAX 200 mg / 6 mL	30 pcs
	5010-62755	InertSep WAX 500 mg / 6 mL	30 pcs
	5010-62766	InertSep WAX FF 30 mg / 3 mL	50 pcs
	5010-62761	InertSep WAX FF 150 mg / 6 mL	30 pcs
	5010-62762	InertSep WAX FF 500 mg / 6 mL	30 pcs
SPE Cartridge (Reverse Phase)	5010-25200	InertSep Slim-J PLS-3 230 mg	50 pcs
	5010-25205	InertSep Slim-J PLS-3 230 mg	500 pcs
	5010-25025	InertSep PLS-2 500 mg / 6 mL	30 pcs
	5010-65795	InertSep Slim-J HLB FF 225 mg	50 pcs
	5010-27533	InertSep HLB FF 200 mg / 6 mL	30 pcs
SPE Cartridge (Graphite Carbon)	5010-68063	InertSep WAX FF / GCB 200 mg / 50 mg / 6 mL	30 pcs
	5010-68064	InertSep WAX FF / GCB 200 mg / 50 mg / 6 mL	300 pcs
	5010-68065	InertSep GCB / WAX FF 50 mg / 200 mg / 6 mL	30 pcs
	5010-68066	InertSep GCB / WAX FF 50 mg / 200 mg / 6 mL	300 pcs
	5010-68000	InertSep GC 150 mg / 3 mL	50 pcs
	5010-68001	InertSep GC 300 mg / 6 mL	30 pcs
	5010-65710	InertSep Slim GC 400 mg	50 pcs
	5010-69051	InertSep GC Bulk 100 g	100 g
SPE Accessories	5010-50465	Naturally Drop Manifold for PFAS	1 set
	1030-56110	Plastic Disposable Syringe 10 mL	100 pcs
	6030-89850	PE Tube 2.6 mm × 1.6 mm × 1 m (with Luer fitting)	1 pc
	5010-60000	SPE Cartridge Adaptor for 1,3,6 mL (PP)	12 pcs
	6045-11000	Luer flow control valve (PP)	10 pcs
	5010-52012	Male Lure Union (PP)	10 pcs
	5010-52013	Female Lure Union (PP)	10 pcs
	5010-60102	Empty Reservoir 6 mL (PP)	30 pcs
	5010-51015	GL-SPE Graduated Concentration tube 10 mL	10 pcs
Gas Purifier	3001-17005	Pre-Conditioned HC Filter, PTFE tape free, 1/8"	1 pc
	3001-17006	Pre-Conditioned HC Filter, PTFE tape free, 1/4"	1 pc
Automated SPE System	6030-89970	AquaTrace ASPE899 AC220V	-
	6030-89902	ASPE899 Liquid sensor	-
LC Column	5020-89939	InertSustain AQ-C18 1.9 μm 2.1 × 100 mm	1 pc
	5020-89921	InertSustain AQ-C18 HP 3 μm 2.1 × 50 mm	1 pc
	5020-89924	InertSustain AQ-C18 HP 3 μm HP 2.1 × 150 mm	1 pc
	5020-89702	InertSustain AQ-C18 5 μm 2.1 × 50 mm	1 pc
	5020-89706	InertSustain AQ-C18 5 μm 2.1 × 150 mm	1 pc
LC Guard Column	5020-89945	InertSustain AQ-C18 Replacement Cartridge for UHPLC	2 pcs
	5020-89948	InertSustain AQ-C18 Replacement Cartridge (2 pcs) & Holder Set for UHPLC	2 pcs+Holder
Delay Column	5020-90005	Delay Column for PFAS 3.0 × 30 mm	1 pc
Vial	1030-14000	0.3 mL High Purity Polypropylene Short Thread Vial	100 pcs
	1030-72122	1.5 ml PP Short Thread Vial, 32 × 11.6 mm, transparent, with filling lines	100 pcs
	1030-72100	1.5 mL Screw Vial, Clear with Label, 9-425	100 pcs
	1030-72000	Screw Cap with Aluminum / Silicone Septa, green	100 pcs
	1030-72001	Screw Cap with Aluminum / Silicone Septa, yellow	100 pcs

For Air Sample

Category	Cat.No.	Description	Qty
Sampling	1050-13015	FM4, Air Sampler for PFAS	1 set
	1050-13020	GAIAC FF047	20 pcs
	1050-13021	Polyurethane Foam Filter	10 pcs
	1050-13022	Quartz Fiber Filter, 31 mm, QFF31	100 pcs
	1050-13023	Quartz Fiber Filter, 47 mm, QFF47	100 pcs
Gas Purifier	3001-17005	Pre-Conditioned HC Filter, PTFE tape free, 1/8"	1 pc
	3001-17006	Pre-Conditioned HC Filter, PTFE tape free, 1/4"	1 pc
LC Column	5020-89939	InertSustain AQ-C18 1.9 um 2.1 × 100 mm	1 pc
GC Column	1010-68142	InertCap Pure-WAX 0.25 mm I.D × 30 m df=0.25 μm	1 pc
Delay Column	5020-90005	Delay Column for PFAS 3.0 × 30 mm	1 pc
Vial	1030-14000	0.3 mL High Purity Polypropylene Screw Vial	100 pcs
	1030-72122	1.5 ml PP Screw Vial, 32 × 11.6 mm, transparent, with filling lines	100 pcs
	1030-72100	1.5 mL Glass Screw Vial Clear with Label	100 pcs
	1030-72000	Screw Cap with Aluminum/Silicone Septa, green	100 pcs
	1030-72001	Screw Cap with Aluminum/Silicone Septa, yellow	100 pcs

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