TELEDYNE INSTRUMENTS
Tekmar
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Product Information Bulletin

Bulletin Number PT0801

Analytical Trap Choices for Stratum PTC and Velocity XPT Purge and Trap Concentrators.

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Background

Purge and Trap concentration is a typical technique used for the analysis of Volatile Organic Compounds (VOCs). The major component of any Purge and Trap system is the analytical trap. It is responsible for retaining the VOCs during the extraction or purge step and then releasing them upon heating. An analytical trap choice for Purge and Trap concentration offers specific challenges for end users. While most standard methods define the dimensions of the trap as well as recommended packing materials, there are multiple packing choices that can be substituted, provided they meet the analytical requirements of the method. This bulletin is intended to describe the characteristics of the traps, compounds they retain, and the ideal operating conditions for the particular trap. In some cases a trap choice can be as specific as a single agent for one particular class of compounds or as diverse as multiple agents for several compound classes.

Trapping and Adsorption

An analytical trap is a short gas chromatography column. Compounds entering the trap will slowly elute with a measurable retention volume. Retention volume is the amount of purge gas that passes through the trap before elution of the analytes begins to occur.

The requirements of a trap are as follows:

1. At low temperatures, it must retain the analytes while allowing oxygen and water to pass through unimpeded.
2. Upon heating, it must release the analytes quickly and efficiently.
3. When heated, it must show stability and not contribute any volatiles.
4. It must operate without causing any catalytic reactions.
5. It should have a reasonable price and lifetime.

At lower trap temperatures, retention volumes are high. At higher desorption temperatures, retention volumes are much smaller, allowing rapid transfer to the GC. In this context, the use of retention time is not correct. The correct parameter is retention volume.

When elution does occur it is usually referred to as breakthrough, and the retention volume at which breakthrough occurs is often referred to as breakthrough volume. Sorbent materials are usually chosen so that the breakthrough volume is high for analytes and low for water. Care must be taken so that the sorbent chosen does not retain the analytes too strongly or efficient desorption may not be possible. Traps containing combinations of sorbents are often used to enhance performance.

The trap is packed with the weaker sorbent on top. The stronger sorbent is placed below the weaker sorbent. Less volatile analytes that are not effectively desorbed by the stronger sorbent are retained by the weaker sorbent. In other words, the less volatile analytes fail to reach the stronger sorbent, only the more volatile analytes reach the stronger sorbent. Because of their volatility, these analytes can be efficiently desorbed. Desorption is carried out by backflushing the trap, ensuring that heavier compounds never come into contact with the stronger sorbent.

Common Purge and Trap Terms

1. **Purge Ready** – Achieved when the trap is at the temperature required to start analysis.
2. **Purge Time** – The amount of time used to extract the analytes from the sample matrix and deposit them onto the trap via an inert gas stream.
3. **Purge Temperature** – The desired temperature of the trap during the purging process. This is typically set as low as the ambient environment allows.
4. **Purge Flow** – The flow rate at which the inert gas is controlled for extraction and compound delivery.
5. **Dry Purge Time** – The time after analytes have been deposited onto the trap that dry gas, which has not been passed through the sample, is delivered to the trap. This is used to remove any excess water that has been pushed through the trap during the extraction process.
6. **Dry Purge Temperature** – The trap temperature setpoint during the Dry Purge step.

7. **Dry Purge Flow** – The flow rate at which the inert gas is controlled for the Dry Purging process.
8. **Desorb Preheat Temperature** – Trap temperature setting prior to desorption. This is usually 10 degrees below the actual desorption temperature. The function of this mode is to release the analytes from the sorbents prior to sweeping them to the GC system.
9. **Desorb Temperature** – The temperature required to backflush the trap with GC carrier gas and deliver analytes to the column for separation and detection.
10. **Bake Temperature** – Trap temperature required for clean up and reconditioning of the trap.
11. **Bake Time** – Time during which the trap is cleaned up and conditioned.
12. **Bake Flow** – Amount of inert gas flow that is passed through the trap during the Bake Cycle.

EPA Methods and Tekmar Recommended Trap Choices

EPA Method	Stratum Preferred	Stratum optional	Velocity Preferred	Velocity optional
502.1	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
502.2	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
503.1	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
524.2	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
601	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
602	#9	Vocarbs, #10, BTEX	Vocarb 3000	#9, #10, Vocarb 4000, BTEX
603	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
624	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
1624	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
8010	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
8015	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
8020	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
8021	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
8030	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
8031	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
8240	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
8260	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000
CLP (Contract Laboratory Program)	#9	Vocarbs and #10	Vocarb 3000	#9, #10, Vocarb 4000

Preferred Method Parameters for Stratum PTC (Trap #9) and Velocity XPT (Trap Vocarb 3000)

Parameter	Stratum PTC	Velocity XPT
Purge Ready Temperature	35	35
Purge Temperature	Ambient	Ambient
Purge Time	11 minutes	11 minutes
Purge Flow	40 ml/min	40 ml/min
Dry Purge Temperature	Ambient	Ambient
Dry Purge Time	1-3 minutes **(matrix dependant)**	2-5 minutes **(matrix dependant)**
Dry Purge Flow	100 ml/min	100 ml/min
Desorb Preheat Temperature	245 degrees C	245 degrees C
Desorb Temperature	250 degrees C	250 degrees C
Desorb Time	2 minutes	2 minutes
Desorb Flow **(Controlled by GC or external regulator and flow controller)**	10-100 ml/min **(Column dependant)**	10-100 ml/min **(Column dependant)**
Bake Temperature	260 degrees C	260 degrees C
Bake Time	4 minutes	4 minutes
Bake Flow	400 ml/min	400 ml/min

Trap Selection Table

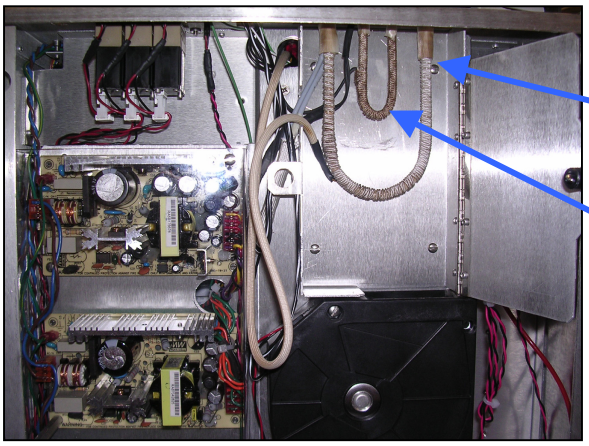
Velocity XPT PN	Stratum PTC PN	Trap No.	What adsorbents it contains	What it traps	Able to be dry purged	Desorb preheat temp	Desorb temp	Bake temp	Condition time & temp for new traps	Common problems with trap
12-0083-003	12-0083-403	1	Tenax	Everything from methylene chloride and heavier	Yes	220° C	225° C	230° C	225° C 180 min	-Low response on brominated compounds -High back pressure -Outgassing of benzene, toluene and ethyl benzene
12-0084-003	12-0084-403	2	Tenax Silica Gel	Everything except freons	No	220° C	225° C	230° C	225° C 180 min	-Low response on brominated compounds -High back pressure -Outgassing of benzene, toluene and ethyl benzene
14-0124-003	14-0124-403	3	Tenax Silica Gel Charcoal	Everything including freons	No	220° C	225° C	230° C	225° C 180 min	-Low response on brominated compounds -High back pressure -Outgassing of benzene, toluene and ethyl benzene
14-2366-003	14-2366-403	5	OV-1 Tenax Silica Gel Charcoal	Everything including freons	No	220° C	225° C	230° C	225° C 180 min	-Low response on brominated compounds -High back pressure -Outgassing of benzene, toluene and ethyl benzene
14-3347-003	14-3347-403	7	OV-1 Tenax	Everything from methylene chloride and heavier	Yes	220° C	225° C	230° C	225° C 180 min	-Low response on brominated compounds -High back pressure -Outgassing of benzene and toluene
14-3928-003	14-3928-403	8	Carbopak B Carbosieve S III	Everything including freons	Yes	245° C	250° C	260° C	260° C 90 min	-Loss of carbon tetrachloride -Trap may need up to 11 min of dry purge time to remove water
14-9908-003	14-9908-403	9	Proprietary	Everything including freons	Yes	245° C	250° C	260° C	260° C 90 min	-Unknown
14-9909-003	14-9909-403	10	Tenax Silica Gel Carbo Sieve III	Everything including freons	Yes	245° C	240° C – 250° C	260° C	270° C 120 min	-Unknown
14-5864-003	14-5864-403	Supelco Vocarb 3000	Carbopak B Carboxen 1000 Carboxen 1001	Everything including freons	Yes	245° C	240° C – 250° C	260° C	270° C 120 min	-Decomposition of bromoform can occur -To prevent this, reduce desorb temp to 240° C
14-5865-003	14-5865-403	Supelco Vocarb 4000	Carbopak C Carbopak B Carboxen 1000 Carboxen 1001	Everything except 2-chloro-ethyl-vinyl-ether	Yes	245° C	250° C	260° C	270° C 120 min	-High back pressure -Low response on chlorinated compounds
14-5866-003	14-5866-403	Supelco BTEX	Carbopak B Carbopak C	Everything down to benzene (does not trap MeOH)	Yes	245° C	250° C	260° C	270° C 120 min	-Unknown

VOC Property Table

Compound Density & Boiling Point

Compound	Density (g/ml)	Boiling Pt. (°C)	Primary Ion	Secondary Ions	CAS #
Acetone	0.788	56.3	43	58	67-64-1
Acetonitrile	0.786	81.6	41	40	75-05-8
Acetophenone	1.03	202.1	105	120,77,51	98-86-2
Acrolein	0.839	52.5	27	56,55	107-02-8
Acrylonitrile	0.806	77.4	53	26,52	107-13-1
Benzaldehyde	1.044	178.9	77	51,105,106	100-52-7
Benzene	0.879	80.1	78	77	71-43-2
Benzyl Alcohol	1.042	205.5	79	91,107,108	100-51-6
Bromobenzene	1.49	156.2	77	156,158	108-86-1
Bromochloromethane	1.991	67.8	130	128	74-97-5
Bromodichloromethane	1.98	89.2	83	85	75-27-4
Bromofluorobenzene	1.6302	196	192	111	1073-06-9
Bromoform	2.894	149	173	171,175	75-25-2
Bromomethane	1.73	3.6	94	96	74-83-9
Butanol-2	0.807	99.6	45	59,73	78-92-2
n-Butyl Acetate	0.883	126.1	43	56,73	123-86-4
n-Butylbenzene	0.8604	183.1	91	92,134	104-51-8
sec-Butylbenzene	0.8608	173.5	105	134	135-98-8
tert-Butylbenzene	0.8669	168.5	119	91,134	98-06-6
n-Butyl Chloride	0.887	78.4	56	27,41	109-69-3
Carbon Disulfide	1.2632	46.5	76	78	75-15-0
Carbon Tetrachloride	1.589	76.8	119	117,121	56-23-5
Chlorobenzene	1.107	131.7	112	77,114	108-90-7
Chloroethane	0.9214	12.3	64	66	75-00-3
2-Chloroethylvinylether	1.053	109	63	27,43	110-75-8
Chloroform	1.484	61.2	83	47,85	67-66-3
Chloromethane	1.3712	-23.7	50	52	74-87-4
2-Chlorotoluene	1.0826	159	91	126,128	95-49-8
4-Chlorotoluene	1.0697	162	91	126,128	106-43-4
Crotonaldehyde	0.853	104.1	41	70,39	4170-30-3
Cyclohexane	0.779	80.7	56	41,84	110-85-7
Cyclopentane	0.746	49.3	42	55,70	287-92-3
Dibromochloromethane	2.42	150.2	129	127	124-48-1
1,2-Dibromo-3 chloropropane	1.553	196	75	155,157	96-12-8
1,2-Dibromoethane	2.18	131	107	109	106-93-4
Dibromomethane	1.5419	97	174	172,176	74-95-3
m-Dichlorobenzene	1.306	173	146	111,148	95-50-1
p-Dichlorobenzene	1.241	174.1	146	111,148	541-73-1
o-Dichlorobenzene	1.306	180.5	146	111,148	106-46-7
Dichlorodifluoromethane	N/A	-29.8	85	50,101	75-71-8
1,1-Dichloroethane	1.168	57.3	63	65	75-34-3
1,2-Dichloroethane	1.256	83.5	62	64	107-06-2
1,1-Dichloroethene	1.2129	31.7	96	98	75-35-4
cis-1,2-Dichloroethene	1.4435	60	96	98	156-59-4
trans-1,2-Dichloroethene	1.28	47.2	96	98	156-60-5
1,2-Dichloropropane	1.159	95	63	65	78-87-5
1,3-Dichloropropane	1.156	96	76	78	142-28-9
2,2-Dichloropropane	1.143	87	77	97,99	590-20-7
1,1-Dichloropropene	1.22	108	75	77,110	563-58-6
cis-1,3-Dichloropropene	1.224	104.3	75	77,110	10061-01-5
trans-1,3-Dichloropropene	1.217	112	75	77,110	10061-01-6
Diethyl Carbonate	0.976	126.8	29	45	105-58-8
Dimethyl Acetamide	0.937	165.5	44	87	127-19-5
Dimethyl Formamide	0.945	153	73	44	68-12-2
Dimethyl Sulfoxide	1.1	189	63	45,78	77-78-1
1,3-Dioxane	1.033	101.3	87	28	505-22-6
1,4-Dioxane	1.0329	101.1	88	58	123-91-1
2-Ethoxyethanol	0.93	135.6	31	59	110-80-5
Ethyl Acetate	0.901	77.1	43	29	141-78-6
Ethylbenzene	0.867	136.2	91	106	100-41-4
Ethyl Ether	0.713	34.6	31	45,59,74	60-29-7
Fluorobenzene	1.022	84.7	96	70	462-06-6
Heptane	0.684	98.4	43	57,72	142-82-5
Hexachlorobutadiene	1.556	215	225	223,227	87-68-3
Hexadecane	0.773	287	57	43,71	544-76-3
Hexanal	0.814	131	44	41,56	66-25-1
Hexane	0.967	68.7	57	41,43	110-54-3
2-Hexanone	0.83	127	43	58	591-78-6
Hexyl Alcohol	0.814	157	56	43	111-27-3
Isobutyl Alcohol	0.806	107.7	43	31	78-83-1
Isopropylbenzene	0.862	152	105	120	98-82-8
p-Isopropyltoluene	0.8573	177.1	119	91,134	99-87-6
Methanol	0.791	64.7	31	28,32	67-56-1
2-Methoxyethanol	0.965	124.6	45	29,15	111-77-3
2-Methoxyethyl Acetate	1.005	144.5	43	31	110-49-6
Methylene Chloride	1.326	39.8	84	86	75-09-2
Methyl Ethyl Ketone	0.805	79.6	43	72	78-93-3
Methyl Isobutyl Ketone	0.801	116.5	43	45	108-10-1
4-Methyl-2-pentanone	0.801	117	43	58,85	108-10-1
Methyl n-Propyl Ketone	0.809	102.4	43	86	107-87-9
n-Methylpyrrolidone	0.819	202	99	44,98	872-50-4
Naphthalene	1.162	217.9	128	129	91-20-3
Nonane	0.718	150.8	43	57	111-84-2
Pentane	0.626	36.1	43	86	109-66-0
beta-Phenethylamine	0.964	194.5	91	148	64-04-0
Phenol	1.071	181.8	94	39,66	108-95-2
1-Propanol	0.804	97.2	31	27,29	71-23-8
2-Propanol	0.786	82.3	45	--	67-32-0
n-Propylbenzene	0.8621	159.2	91	120,121	103-65-1
Pyridine	0.978	115.3	79	52	110-86-1
Styrene	0.9059	145	104	78,103	100-42-5
1,1,1,2-Tetrachloroethane	1.5406	130.5	131	119,133	630-20-6
1,1,2,2 Tetrachloroethane	1.587	146.3	83	85	79-34-5
Tetrachloroethene	1.6311	121	166	168,170	127-18-4
Tetrahydrofuran	0.889	66	42	41,71,72	109-99-9
Toluene	0.867	110.6	91	92	108-88-3
1,2,3-Trichlorobenzene	1.5776	221	180	145,182	87-61-6
1,2,4-Trichlorobenzene	1.454	214	180	145,182	120-82-1
1,1,1-Trichloroethane	1.3376	74.1	97	61,99	71-55-6
1,1,2-Trichloroethane	1.4416	113	132	134	79-00-5
Trichloroethene	1.338	87.2	130	95,97	79-01-6
1,2,3-Trichloropropane	1.3889	157	75	61,110	75-01-4
1,2,4-Trimethylbenzene	0.8761	169	105	120	95-63-6
1,3,5-Trimethylbenzene	0.8637	164.7	105	120	108-67-8
Trimethylpentane	0.692	99.2	57	56	540-84-1
Vinyl Chloride	0.9106	-13.4	62	64	75-01-4
o-Xylene	0.88	144.4	91	106	95-47-6
m-Xylene	0.8684	139.3	91	105,106	108-38-3
p-Xylene	0.861	138.4	91	105,106	106-42-3

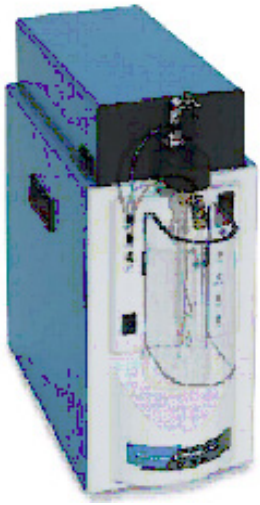
Stratum PTC Model and Trap Location

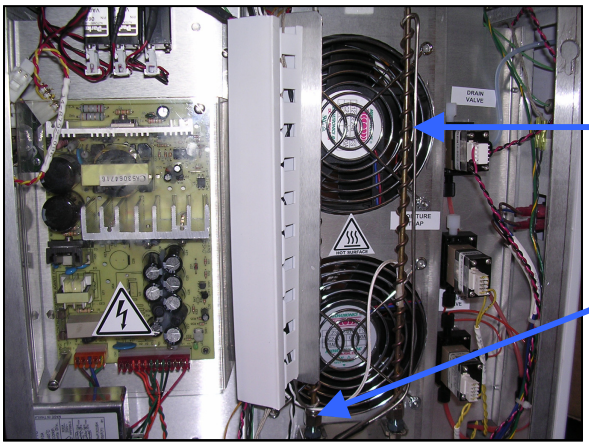


Top of Trap load position indicated with permanent nut and ferrule

Moisture Control

Velocity XPT Model and Trap Location:





Moisture Control

Top of Trap load position indicated with removable nut and ferrule