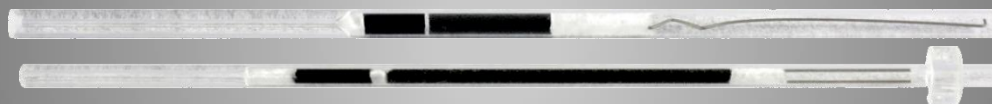


Cold Traps for Automated Thermal Desorption



Dual-bed cold traps for PerkinElmer (top) and Markes (bottom) thermal desorbers

Introduction



Cold trap performance is critical for modern TD-GC/MS instruments. Either working in conjunction with sorbent tubes to form a two-stage thermal desorption system, or by itself similar to the way implemented in PAMS (Photochemical Assessment Monitoring Stations), a cold trap needs to be replaced periodically to ensure repeatability.



Camsco produces cold traps for PerkinElmer ATD, Markes Unity 2 /TD-100 and DANI MasterTD instruments. Tenax TA trap is the most popular cold trap, and often the default type that comes with a thermal desorber. However, dual-bed cold traps can be built in a similar fashion to sorbent tubes, with the weaker sorbent on the sampling end for high boilers and the stronger sorbent on the distal end to avoid breakthrough of smaller analytes.

After repeated use, the sorbent bed in the cold trap may become contaminated, decomposed, or shifted. This will cause the retentive properties of the trap to diminish, indicated by decreased output, increased background, sample carry-over, skewed peaks, or tailing peaks. Replacing the cold trap will restore the performance.

Cold Trap configuration

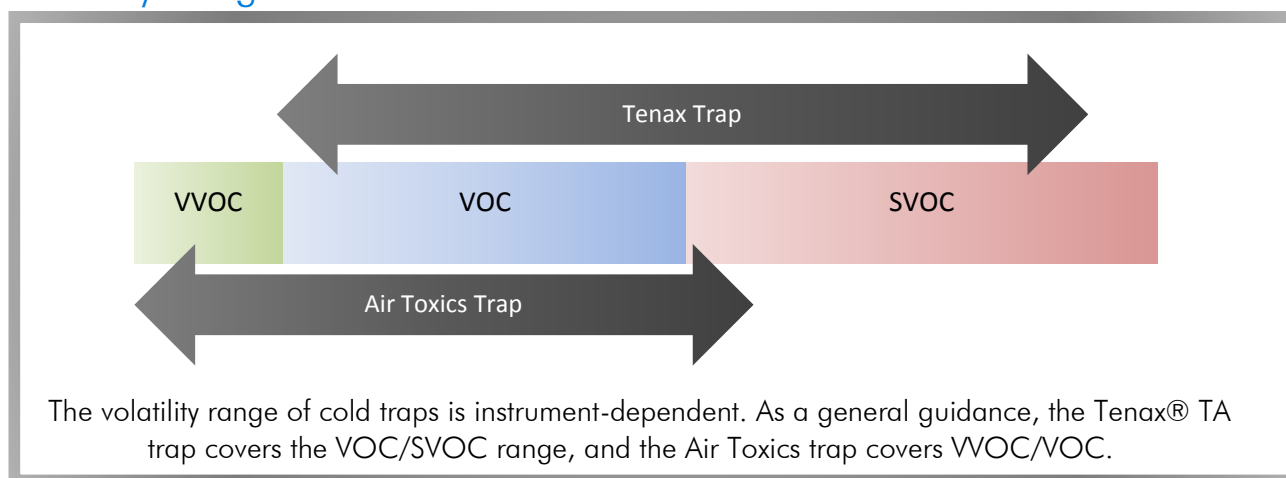
- Empty Cold Trap for PerkinElmer ATD, Markes Unity 2 / TD-100, and DANI Master TD
- Tenax TA Cold Trap for PerkinElmer ATD, Markes Unity 2 / TD-100, and DANI Master TD
- Air Toxics Cold Trap for PerkinElmer ATD, Markes Unity 2 / TD-100, and DANI Master TD

Camsco Equivalent Part Numbers

Cold Traps	Part #
PerkinElmer™; Empty	CTP60400
PerkinElmer™; Tenax™	CTP60420
PerkinElmer™; Air Toxics	CTP60401
Markes™; Empty	CTM60400
Markes™; Tenax™	CTM60420
Markes™; Air Toxics	CTM60401

Custom cold trap design available.

Volatility Range



Temperatures

Adsorption Temperature:	-40 ~ -30°C, depending on instrument
Conditioning Temperature:	same as desorption temperature
Desorption Temperature:	300 ~ 350°C, depending on sorbents

Most modern instruments electronically cool the cold trap to -40°C ~ -30°C, where sorbents have better strength to adsorb than they normally do at ambient temperatures. For desorption, traps are instantly heated to >300°C, and held at the temperature for a few minutes after.

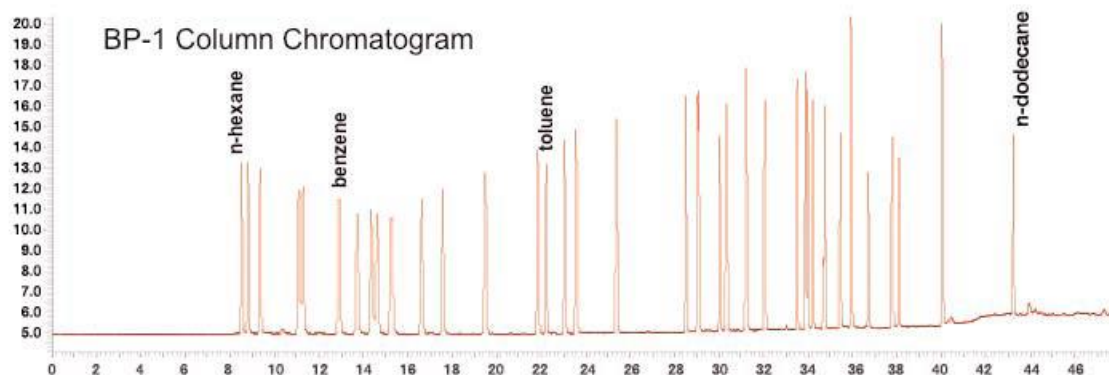
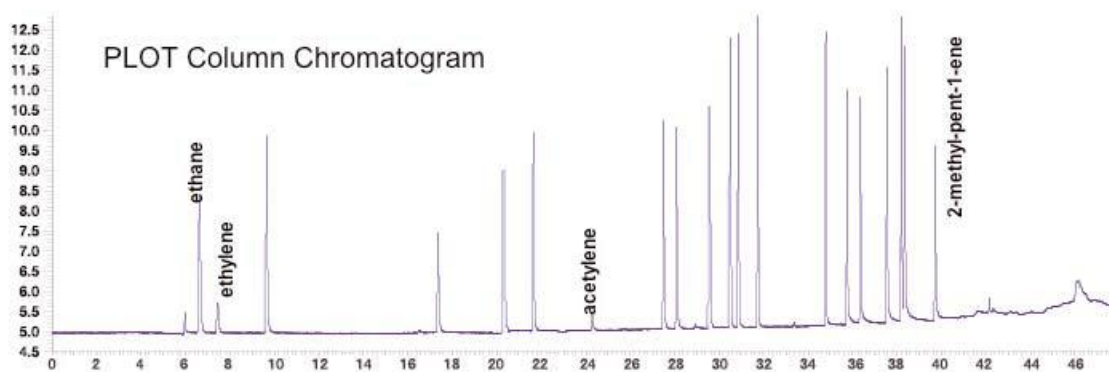
Eluting adsorbed analytes from the cold trap thoroughly and introducing them to GC in a narrow band is critical for sharp peaks on chromatograms. Therefore, it is desirable to choose the highest desorption temperature with respect to sorbent limitations, instrument limitations, and the thermal stability of the analytes.

Technical Guide



Dual-bed cold traps for PerkinElmer (top) and Markes (bottom) thermal desorbers

- Multi-bed cold traps are configured for backflush operations: the sample is drawn into the cooled trap from the left-hand side in the pictures above. When the trap is heated, the carrier gas flow reverses and the desorbed vapors exit again from the left-hand side. This section of the trap normally has reduced inner diameter to minimize axial diffusion, which would result in chromatographic peak broadening and degradation in detection limits.
- Most modern instruments use a Peltier cooler to bring the cold trap temperature down to $-40^{\circ}\text{C} \sim -30^{\circ}\text{C}$, which is adequate for most applications with the right trap. In some rare cases additional cryogen, such as liquid nitrogen, can be introduced to further cool the cold trap to -100°C .
- Dry purge is often necessary before desorption, especially when ambient air sample is directly introduced to the trap without de-moisturization.
- To avoid overloading the trap, adjust inlet split instead of outlet split.



PAMS use thermal desorbers equipped with cold traps to analyze ozone precursors which are either too volatile or too labile to be sampled/stored by a primary sorbent tube. The chromatograms above (courtesy of PerkinElmer, Inc.) show the dual-column separation of a 2-ppb standard of ozone-precursor target compounds

Comparison to other Tubes

- A single-bed, Tenax® TA cold trap is often the default cold trap that comes with a new thermal desorption instrument.
- Tenax® TA may be replaced by Tenax® GR for higher packing density, more break through volume, and higher hydrophobicity. Actually some manufacturers prefer Tenax® GR over Tenax® TA as the default cold trap sorbent.
- For trace analysis, carbon-based sorbents have lower background than Tenax®. A popular replacement would be Carbograph™ 2, which is equivalent to Carbopack™ C.
- When a multi-bed trap is needed, the configuration of the primary sorbent tube is often a good start point to the cold trap design. Consult Camsco experts for assistance.

References

U.S. EPA "Technical Assistance Document for Sampling and Analysis of Ozone Precursors", EPA/600-R-98/161, September 1998

PerkinElmer Product Note (2006): On-line Ozone Precursor Analyzers

PerkinElmer White Paper (2009-2012): Ozone Precursor Analysis Using a Thermal Desorption-GC System

Alan Braithwaite and Frank J. Smith, Chromatographic Methods Fifth Edition, Glasgow, 1996, page 205.

