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ANALYTICAL SERVICES

ADVANTAGES IN THE APPLICATION OF THERMAL DESORPTION TUBES IN SOIL VAPOUR INVESTIGATIONS

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AGENDA

- Application of vapour data?
- How is it tested?
- TD tube advantages
- Sampling Tips
- FAQ

WHY TEST VAPOUR

- As part of human health risk assessment, the soil vapour intrusion pathway is now commonly evaluated at contaminated sites where buildings are located near to subsurface volatiles chemicals.

- 2009 the BC Contaminated Sites Regulations introduced vapour as a regulated environmental medium.

- Alberta Tier 2 – Requirements for Exposure Control

For Volatile contaminants where the risks are potentially associated with soil vapour concentrations, soil vapour must also be delineated for the site.

- Commonly associated with dry cleaning, waste oil, diesel or gasoline site history.

1)BC MOE Technical Guidance 4 (2010)
2)CSAP Soil Vapour Advice and Practice Guidelines Development - Stage 1 (2009)
3)Alberta Tier 2 Soil and Groundwater Remediation Guidelines (2016)
4) Guidance on Site Characterization for Evaluation of Soil Vapour Intrusion into Buildings (SABCS, 2010)

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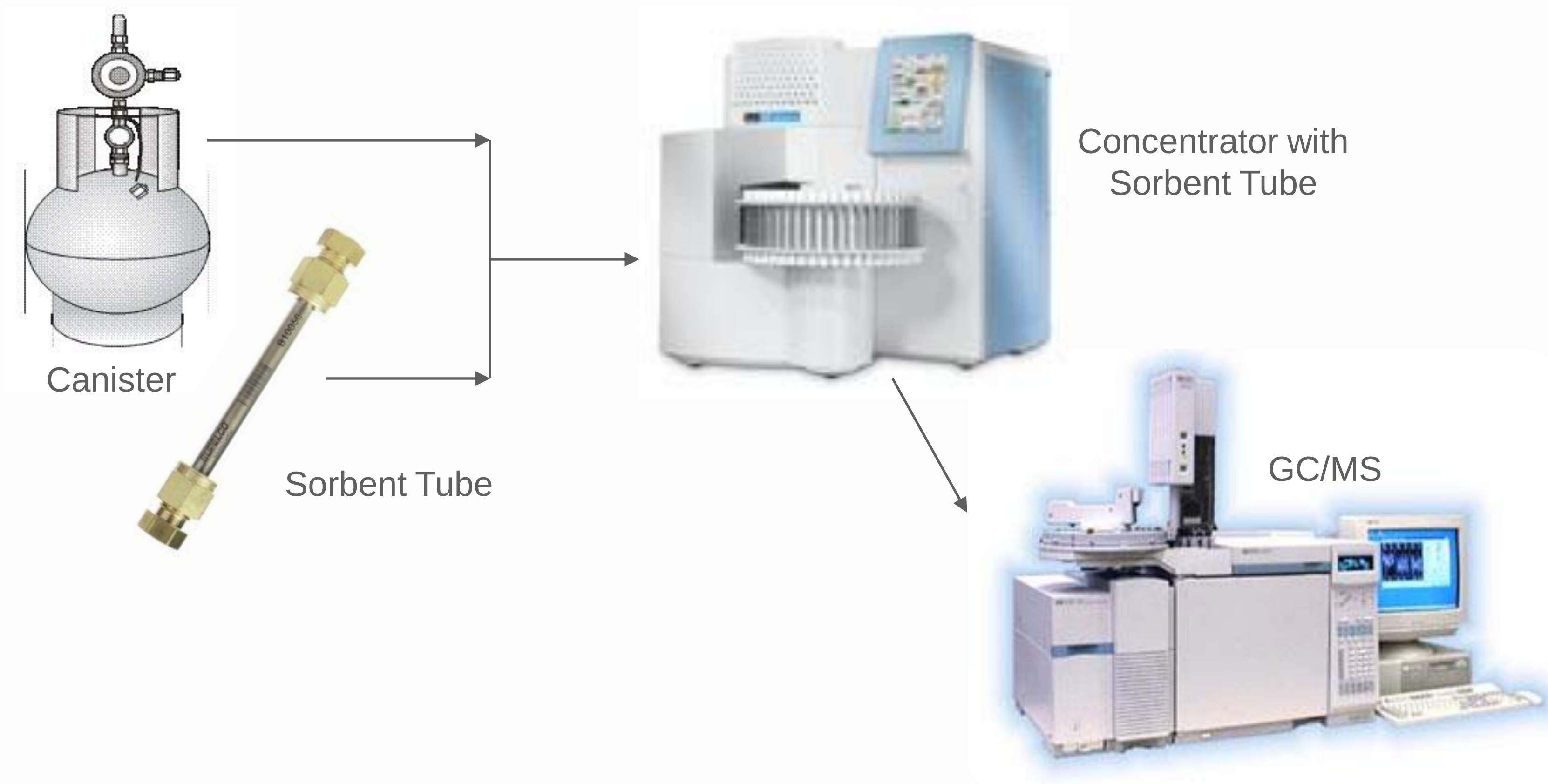
VAPOUR ANALYSIS



SUMMA CANISTER

Developed in **1965**:

More reliable than the alternative (Tedlar)

Multiple applications, including ambient air, soil vapour, exhaust streams...
(optimal: C2 to C10)

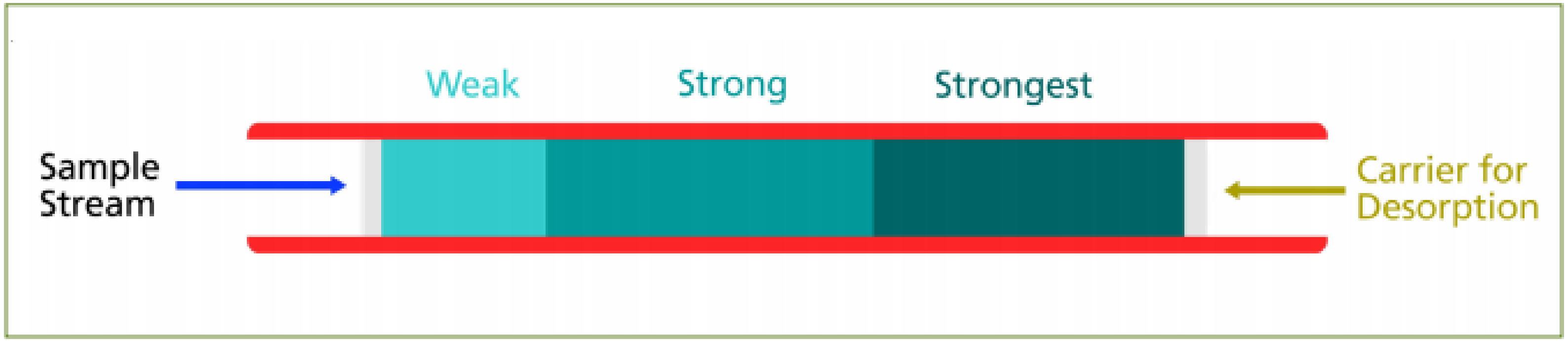
Range in size: 1L to 6L common

Ideal for grab sampling; time weighted sampling is controlled by a valve

Whole air sample

THERMAL DESORPTION

TD Takes the Lab into the Field!



Based on tested and true technology: Hydrocarbon Traps

SVI™ Developed in **2009** by CARO and Perkin Elmer!

Versatile due to size and analytical range (nC3 to nC22+)

Active Sampling (pump, manual, etc)

Multiple Adsorb/Desorb events possible (dilutions, rechecks..)

TD TUBE ADVANTAGE

Broadest Analytical Range

- Extend the current analyte range C3 – C24

Optimize Sampling Volumes

- Increase sampling volumes to achieve regulatory detection limits while enabling the re-collection of the sample if re-injection is required.

Minimize Moisture Effects

- Hydrophobic media : Lack of water retention minimizes sampling volumes while maintaining regulated DLs

Contamination Prevention

- Enable quick clean-up of the tubes with no carry-over for re-sampling purposes

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TARGET ANALYTES

BCMOE CSR Schedule 3.3 Substance	MRL	General Numerical Vapour Standards: Ag, UP, Res		Commercial		Industrial		Parkade	
	µg	µg/m³	min vol (L)	µg/m³	min vol (L)	µg/m³	min vol (L)	µg/m³	min vol (L)
Volatile Organic Compounds (VOCs) – Thermal Desorption (TD) Tube[1]									
Acetone	0.01	2,500	0.5	7,000	0.5	25,000	0.5	20,000	0.5
Acrylonitrile	0.001	0.5	2	0.5	2	1.5	0.7	1	1
Allyl chloride	0.001	1	1	3	0.5	9	0.5	8	0.5
Benzene	0.002	1.5	1.4	4	0.5	10	0.5	10	0.5
Bromobenzene	0.001	60	0.5	200	0.5	550	0.5	500	0.5
Bromodichloromethane	0.001	50	0.5	150	0.5	550	0.5	400	0.5
Bromoform	0.001	9	0.5	30	0.5	85	0.5	75	0.5
1,3-Butadiene	0.004	2	2	2	2	3	1.4	2.5	1.6
Carbon disulfide	0.01	700	0.5	2,000	0.5	6,500	0.5	5,500	0.5
Carbon tetrachloride	0.001	1.5	0.7	5	0.5	15	0.5	15	0.5
Chlorobenzene	0.001	10	0.5	30	0.5	90	0.5	80	0.5
Chloroethane	0.005	10,000	0.5	30,000	0.5	90,000	0.5	80,000	0.5
Chloroform	0.001	100	0.5	300	0.5	900	0.5	800	0.5
2-Chlorotoluene	0.002	50	0.5	150	0.5	550	0.5	400	0.5
n-Decane	0.003	2,500	0.5	8,000	0.5	25,000	0.5	20,000	0.5
1,2-Dibromo-3-chloropropane	0.001	1	1	1	1	2	0.5	1.5	0.7
Dibromochloromethane	0.001	50	0.5	150	0.5	550	0.5	400	0.5
1,2-Dibromoethane	0.0005	0.5	1	0.5	1	0.5	1	0.5	1
Dibromomethane	0.001	4	0.5	10	0.5	35	0.5	30	0.5
1,2-Dichlorobenzene	0.001	200	0.5	600	0.5	2,000	0.5	1,500	0.5
1,3-Dichlorobenzene	0.001	80	0.5	250	0.5	850	0.5	600	0.5
1,4-Dichlorobenzene	0.001	800	0.5	2,500	0.5	7,500	0.5	6,500	0.5
Dichlorodifluoromethane	0.002	100	0.5	300	0.5	900	0.5	800	0.5
1,1-Dichloroethane	0.001	500	0.5	1,500	0.5	4,500	0.5	4,000	0.5
1,2-Dichloroethane	0.001	5	0.5	15	0.5	45	0.5	40	0.5
1,1-Dichloroethylene	0.001	200	0.5	600	0.5	2,000	0.5	1,500	0.5
cis-1,2-Dichloroethylene	0.001	60	0.5	200	0.5	550	0.5	500	0.5
trans-1,2-Dichloroethylene	0.001	60	0.5	200	0.5	550	0.5	500	0.5
Dichloromethane	0.01	600	0.5	2,000	0.5	5,500	0.5	5,000	0.5
1,2-Dichloropropane	0.001	4	0.5	10	0.5	35	0.5	30	0.5
1,3-Dichloropropane	0.001	1.5	0.7	4	0.5	15	0.5	10	0.5
1,3-Dichloropropene, cis+trans	0.002	2.5	0.8	7.5	0.5	25	0.5	20	0.5
Diethyl ether	0.002	500	0.5	1,500	0.5	5,500	0.5	4,000	0.5
Ethyl acetate	0.005	70	0.5	200	0.5	650	0.5	550	0.5
Ethylbenzene	0.005	1,000	0.5	3,000	0.5	9,000	0.5	8,000	0.5
Ethyl methacrylate	0.001	300	0.5	900	0.5	2,500	0.5	2,500	0.5
Hexachlorobutadiene	0.001	1	1	1.5	0.7	4	0.5	3.5	0.5
Hexachloroethane	0.004	30	0.5	90	0.5	250	0.5	250	0.5
n-Hexane	0.01	700	0.5	2,000	0.5	6,500	0.5	5,500	0.5
Isopropylbenzene	0.001	400	0.5	1,000	0.5	3,500	0.5	3,000	0.5
Methacrylonitrile	0.001	30	0.5	90	0.5	250	0.5	250	0.5

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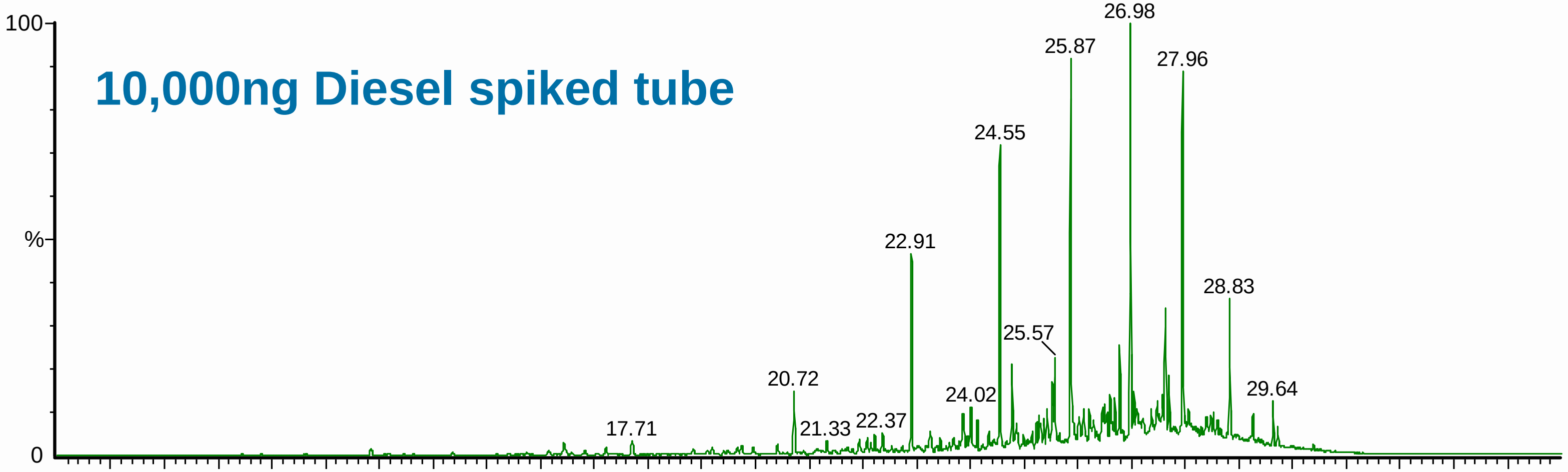
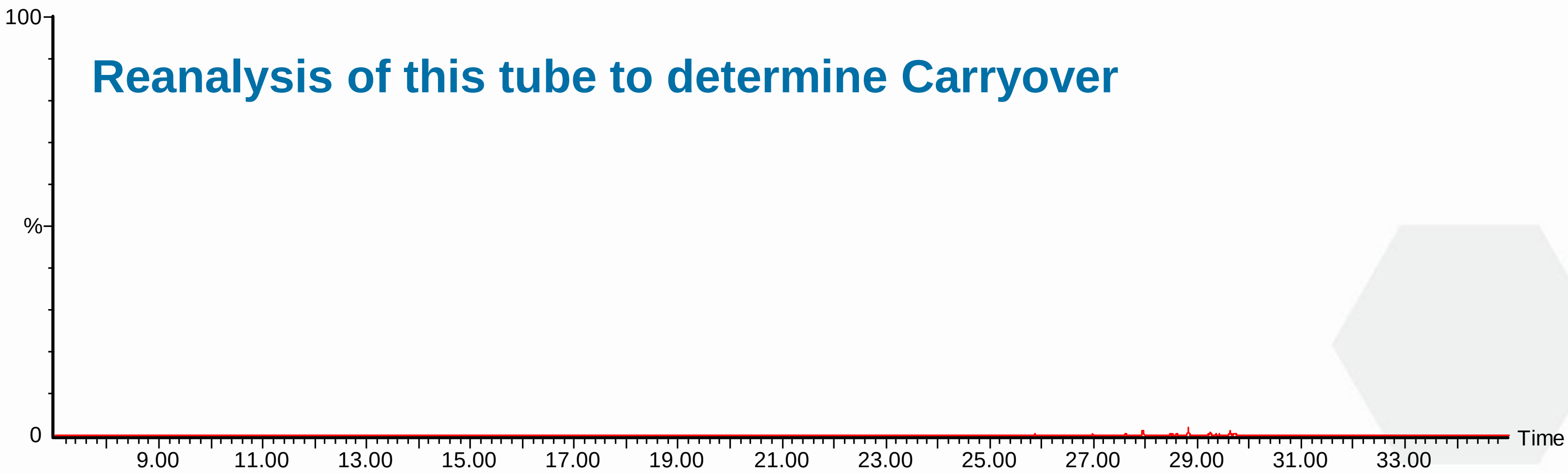
Volatile Organic Compounds (VOCs) – Thermal Desorption (TD) Tube[1]									
(CONTINUED FROM PAGE 1)									
Methyl acrylate	0.005	20	0.5	60	0.5	200	0.5	150	0.5
Methyl cyclohexane	0.005	2,000	0.5	7,000	0.5	25,000	0.5	20,000	0.5
Methyl ethyl ketone (MEK)	0.005	5,000	0.5	15,000	0.5	45,000	0.5	40,000	0.5
Methyl isobutyl ketone (MIBK)	0.002	3,000	0.5	9,000	0.5	25,000	0.5	25,000	0.5
Methyl methacrylate	0.002	700	0.5	2,000	0.5	6,500	0.5	5,500	0.5
Methyl tert-butyl ether (MTBE)	0.002	3,000	0.5	9,000	0.5	25,000	0.5	25,000	0.5
Naphthalene	0.001	3	0.5	9	0.5	25	0.5	25	0.5
Nitrobenzene	0.001	1	1	1	1	2.5	0.5	2	0.5
Styrene	0.001	1,000	0.5	3,000	0.5	9,000	0.5	8,000	0.5
1,1,1,2-Tetrachloroethane	0.001	1.5	0.7	4	0.5	10	0.5	10	0.5
1,1,2,2-Tetrachloroethane	0.001	50	0.5	150	0.5	550	0.5	400	0.5
Tetrachloroethylene (PERC)	0.005	40	0.5	100	0.5	350	0.5	300	0.5
Tetrahydrofuran	0.001	3.5	0.5	10	0.5	30	0.5	25	0.5
Toluene	0.01	5,000	0.5	15,000	0.5	45,000	0.5	40,000	0.5
1,2,4-Trichlorobenzene	0.001	7	0.5	20	0.5	65	0.5	55	0.5
1,1,1-Trichloroethane	0.001	5,000	0.5	15,000	0.5	45,000	0.5	40,000	0.5
1,1,2-Trichloro-1,2,2-trifluoroethane	0.002	30,000	0.5	90,000	0.5	250,000	0.5	250,000	0.5
1,1,2-Trichloroethane	0.001	0.5	2	0.6	1.7	2	0.5	1.5	0.7
Trichloroethylene (TCE)	0.001	2	0.5	6	0.5	20	0.5	15	0.5
Trichlorofluoromethane	0.001	700	0.5	2,000	0.5	6,500	0.5	5,500	0.5
1,2,3-Trichloropropane	0.001	0.5	2	0.9	1.2	2.5	0.5	2.5	0.5
1,2,4-Trimethylbenzene	0.005	7	0.8	20	0.5	65	0.5	55	0.5
1,3,5-Trimethylbenzene	0.005	4.5	1.2	15	0.5	45	0.5	35	0.5
Vinyl Chloride	0.002	1	2	3.5	0.6	10	0.5	9	0.5
Xylenes, total	0.015	100	0.5	300	0.5	900	0.5	800	0.5
VPHv *	2	1,000	2	3,000	0.7	11,500	0.5	8,000	0.5

> 75 reportable analytes

CLEANING

Carryover <1%



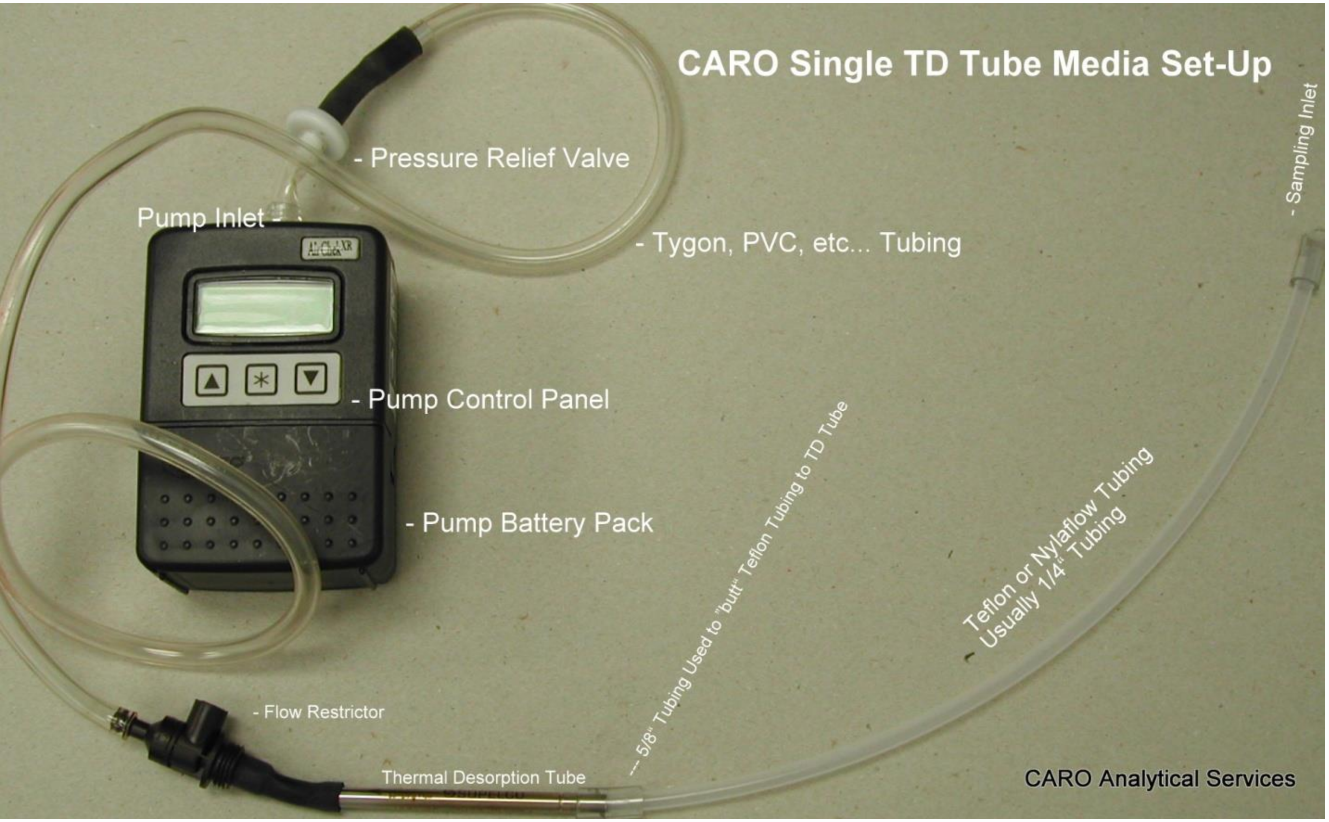


CANISTER VS. TD CLEANING

	SUMMA CANISTERS			TD TUBES		
Chemical	Number Detects	Avg. Conc. (ug/m3)	Max. Conc. (ug/m3)	Number Detects	Avg. Conc. (ug/m3)	Max. Conc. (ug/m3)
Benzene	100	0.046	0.52	59	<.001	0.0017
PCE	30	0.063	0.3	81	<.001	0.0038
TCE	79	0.055	1.43	11	<.001	0.0004
VC	0	non detect	non detect	17	<.001	0.001

Electric Power Research Institute. Reference Handbook for Site-Specific Assessment of Subsurface Vapor Intrusion in Indoor Air. (2005)

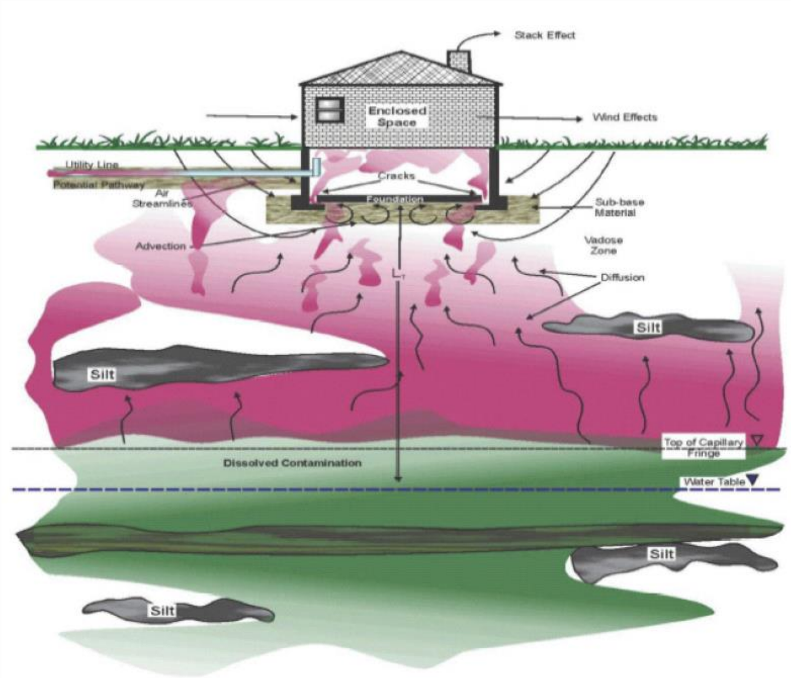
SAMPLING



- ❑ Flow Rates: 20 - 200mL/min
- ❑ Flow Δ > 10s cause pump to shutoff
- ❑ Sample flow in the direction indicated on the tube
- ❑ Purge tubes available upon request
- ❑ Max. Volume: 10L

SAMPLING BASICS

- How many times to samples, account for temperature, pressure, moisture. Seasonal variation
- Bottom-up approach recommended, deeper near contamination followed by subslab and then indoor if required.
- Leak testing/vacuum, Flow rate
- Inert material for well
- Well purging
- Field duplicates



Guidance on Site Characterization for Evaluation of Soil Vapour Intrusion into Buildings (SABCS, 2010)

GETTING STARTED

1. What Do I Test For?

Defining PCOCs

- Dry Cleaning, Gas/Diesel/Solvents
- Aromatic/Aliphatic Fractionation

2. Site Conditions & Expected Levels

- Trace → High Level

3. Sampling Volumes – based on Reg. Limits

- Typically 2 L or less
- Flow rate typically 100-200 mL/min

GETTING STARTED

4. Field Records

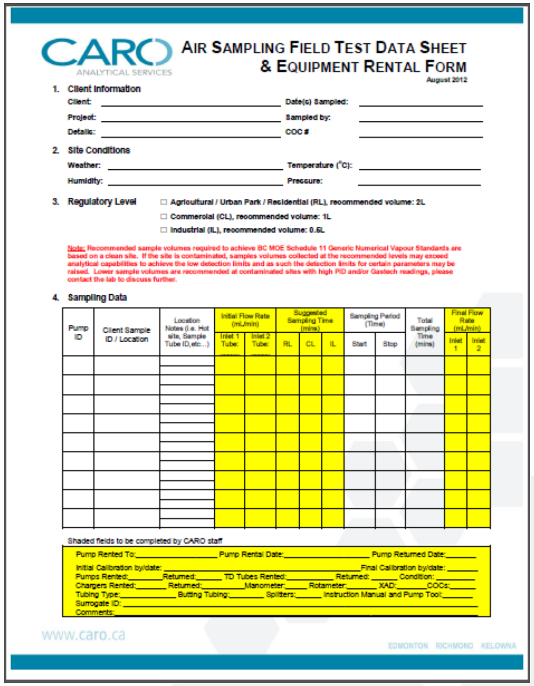
- Sampling Information: Sample ID’s, Pump ID’s, **TD Tube ID’s**, Flow data, Sampling Time
- Units: ug, ug/m3, ppmv (IH)

5. QC & Contingency

- Precision - field duplicates
- Contamination - ambient, field blank
- Breakthrough – series sampling

6. Logistics & Equipment

- Timing: 24hr. – 48hr. to prep
- Equipment needs: TD tubes, tubing.
- Flow and vacuum check



AIR SAMPLING FIELD TEST DATA SHEET
& EQUIPMENT RENTAL FORM
August 2012

1. Client Information
Client: ____________ Date(s) Sampled: ____________
Project: ____________ Sampled by: ____________
Details: ____________ COC # ____________

2. Site Conditions
Weather: ____________ Temperature (°C): ____________
Humidity: ____________ Pressure: ____________

3. Regulatory Level
☐ Agricultural / Urban Park / Residential (RL), recommended volume: 2L
☐ Commercial (CL), recommended volume: 1L
☐ Industrial (IL), recommended volume: 0.5L

Note: Recommended sample volumes required to achieve BC MOE Schedule 11 Generic Numerical Vapour Standards are based on a clean site. If the site is contaminated, samples volumes collected at the recommended levels may exceed analytical capabilities to achieve the low detection limits and as such the detection limits for certain parameters may be raised. Lower sample volumes are recommended at contaminated sites with high PID and/or Gastech readings, please contact the lab to discuss further.

4. Sampling Data

Pump ID	Client Sample ID / Location	Location Notes (i.e. Hot site, Sample Tube ID,etc...)	Initial Flow Rate (mL/min)		Suggested Sampling Time (mins)			Sampling Period (Time)		Total Sampling Time (mins)	Final Flow Rate (mL/min)	
			Inlet 1 Tube:	Inlet 2 Tube:	RL	CL	IL	Start	Stop		Inlet 1	Inlet 2

Shaded fields to be completed by CARO staff

Pump Rented To:________ Pump Rental Date:________ Pump Returned Date:________
Initial Calibration by/date: ________ Final Calibration by/date: ________
Pumps Rented:________ Returned:________ TD Tubes Rented:________ Returned: ________ Condition: ________
Chargers Rented:________ Returned:________ Manometer:________ Rotameter:________ XAD:________ COCs:________
Tubing Type:________ Butting Tubing:________ Splitters:________ Instruction Manual and Pump Tool:________
Surrogate ID: ________
Comments:________

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OVERVIEW

Feature	TD Tubes
Active Sampling (Requires pump)	
Optimize water management	
Passive Sampling	
VOC and sVOC suitability	
Reliable RPDs	
Flow rate monitoring	
Simple transportation	
Easy to clean	
Surrogates as field QC	

FAQ

1. What detection limits can you achieve?

   Designed for common regulatory requirements, can be fine tuned with increased volume.

2. Can I double check the reported data?

   Yes, the our process allows for recollection onto the tube post analysis.

3. Where do I get a pump?

   We can supply pumps or you can supply your own.

4. Can the TD tube support indoor air sampling?

   Yes, we will lower the flow rate to allow for increased sampling times.

Q1: Ease of Use

1. Size and Weight
   - **TD:** Small and compact.
   - **Summa:** ↑Carbon Footprint. Transportation ↑lining-related issues
2. Flow Monitoring
   - **TD:** Field and laboratory checks
   - **Summa:** Relying on valve integrity (leaks)
3. RPD Challenges
   - **TD:** Cleaned & Monitored

Q2: QUALITY OF DATA

1. Range of Quality Data

- **Summa**: Optimal between nC2 – nC10
  **Challenges with heavier & polar analytes
- **TD**: Optimal between nC3 – nC22+

2. Dynamic Range

- **TD:** Recollection and dilutions from full sample

3. Carryover/Contamination

- **Summa**: Condensation on Inner Walls: Affects Fuel Gases in particular & heavier analytes
- **TD:** Simple QC process to ensure tube quality

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Q3: Quality Control

1. Surrogates

- **TD:** Added to tube prior to sampling.

  **Assessment of potential BT

2. Vessel Cleaning & Proofing

- **TD:** Cleaned using high temp & flow as a part of the analysis

3. Blank Spike Duplicates

- **TD:** monitors ability to adsorb, release and re-adsorb

Contact Info
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QUESTIONS

Caring About Results... Obviously!

Richmond, BC | Burnaby, BC | Kelowna, BC | Edmonton, AB

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