

Detector Tubes and Badges



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Detector Tubes



- Elements of detector tube system
- Types of tubes
 - Active (short- and long-term)
multi-level
 - Passive (diffusion controlled)

References: pp. 692-708 in Perkins
Overview of Available Devices

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Volumes drawn through tube

- Generally manually powered pumps (like bicycle pump) with highly precise volume -- usually 1 Liter.
- Often a single stroke but can be multiple strokes
- Multiple strokes to detect lower concentrations and for some chemicals



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Detector tube pumps

- Piston-type (MSA, Gastec)
- Bellows-type (Draeger)
- Continuous, battery-operated



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Long-term sampling

- Use battery-powered pump drawing air at a slow rate

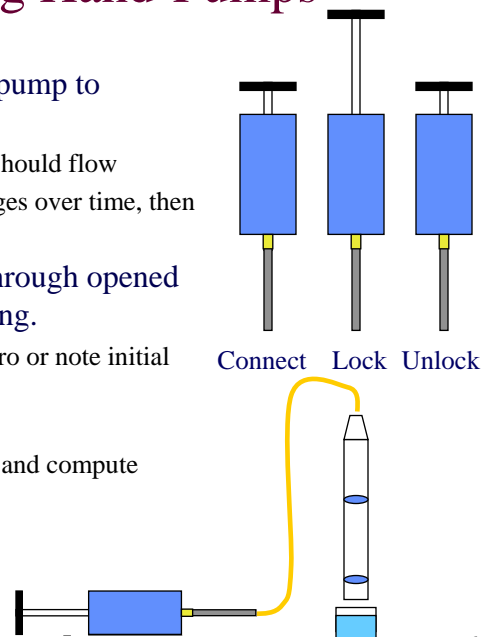


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Calibrating Hand-Pumps

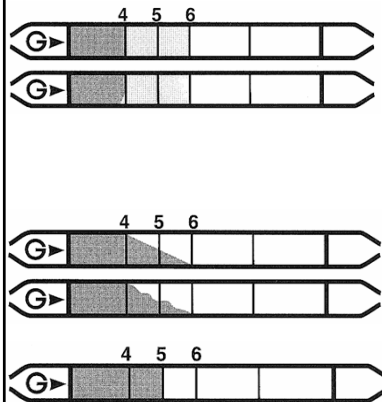
- Check for leaks by connecting pump to unbroken detector tube.
 - When attempt to pump air, none should flow
 - If pump fills or the pressure changes over time, then there is a leak.
- Or, connect to bubble burette through opened detector tube and length of tubing.
 - Manipulate so that bubble is at zero or note initial bubble height
 - Draw volume through pump
 - Note burette bubble new location and compute volume
 - Compare to specified value



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Reading stain length



- The correct reading in all cases is 5%.
- When the color change is pale, read the value in the middle between the end of the dark layer and the end of the pale layer.
- When the end of color change is slanted, read the value in the middle of the slant, here 5%
- If even stain length, just interpolate.

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Sensitivities for Various Detector Tubes

PART # (50/pack)	ANALYTE	THRES- HOLD LEVEL	MINIMUM DETECTABLE CONC. IN 8 HOURS (PPM)	MRST* (HRS)	SRST* (MINS)	CROSS SENSI- TIVITY
382010	Ammonia	4.0 ppm/hr	0.50 ppm	48	15	Aliphatic amines
382017	Carbon Dioxide	8,000 ppm/hr	1 ppm	10	15	Acid vapors
382012	Carbon Monoxide	7 ppm/hr	1 ppm	10	15	Alkenes, H ₂ , H ₂ S
382009	Chlorine	0.2 ppm/hr	0.025 ppm	48	15	Br ₂ , HCl, I ₂
382003	Chlorine/Chlorine Dioxide	Cl ₂ : 0.18 ppm/hr ClO ₂ : 0.2 ppm/hr	Cl ₂ : 0.025 ppm ClO ₂ : 0.025 ppm	48 10	15 15	Cl ₂ : Br ₂ , HCl, I ₂ ClO ₂ : NO ₂ , high conc. O ₃ R ₂ NH
382019	Dimethyl Amine	5 ppm/hr	0.625 ppm	48	15	
382018	1,1-Dimethyl Hydrazine	Front: 30 ppb/hr Back: 10 ppb/hr	Front: 3.75 ppb Back: 1.25 ppb	48	5	High conc. N ₂ H ₄
382002	Hydrazine	8.0 ppb/hr	1.0 ppb	48	15	MMH

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Detector Tubes Issues

- Specificity
- Flow rate and behavior (interchangeability)
- Shelf life
- Performance limitations: pressure, temperature, relative humidity
- Certification of Detector Tubes
NIOSH Specifications (pre-1985)
Safety Equipment Institute (SEI)

Safety Equipment Institute

What is SEI?

- Private, nonprofit organization established in 1981
- Third-party certification programs to test and certify a broad range of safety and protective products.
- Certification program accredited by the American National Standards Institute (ANSI) in accordance with the Standard ANSI Z34.1-1993, *Third Party Certification Programs for Products, Processes, and Services*.
 - Policy decisions are handled by SEI's Board of Directors which includes representation from organized labor, users of safety equipment, the insurance industry, the fire service, and a safety equipment manufacturer.

What Does SEI Do?

- Assist government agencies along with users and manufacturers of safety equipment in meeting their mutual goal of protecting the workers and consumers with safety equipment in keeping with recognized standards and the current state of the art.

Who Can Participate in SEI Certification Program?

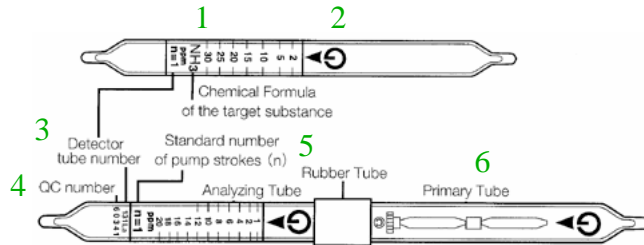
- Certification programs are voluntary and available to any manufacturer of safety equipment seeking to have product models certified by SEI.

What Are the SEI Certification Programs?

- SEI certification programs include on-going product testing and quality assurance audits which qualify a product model for SEI Certification.
- SEI will certify the manufacturer's product model and grant the right to use the SEI certification label when (1) the testing lab has determined that the product model has been tested and successfully meets the appropriate product standard, and (2) the quality assurance auditor has determined that the manufacturer complies with SEI quality assurance requirements.

Information on the tubes

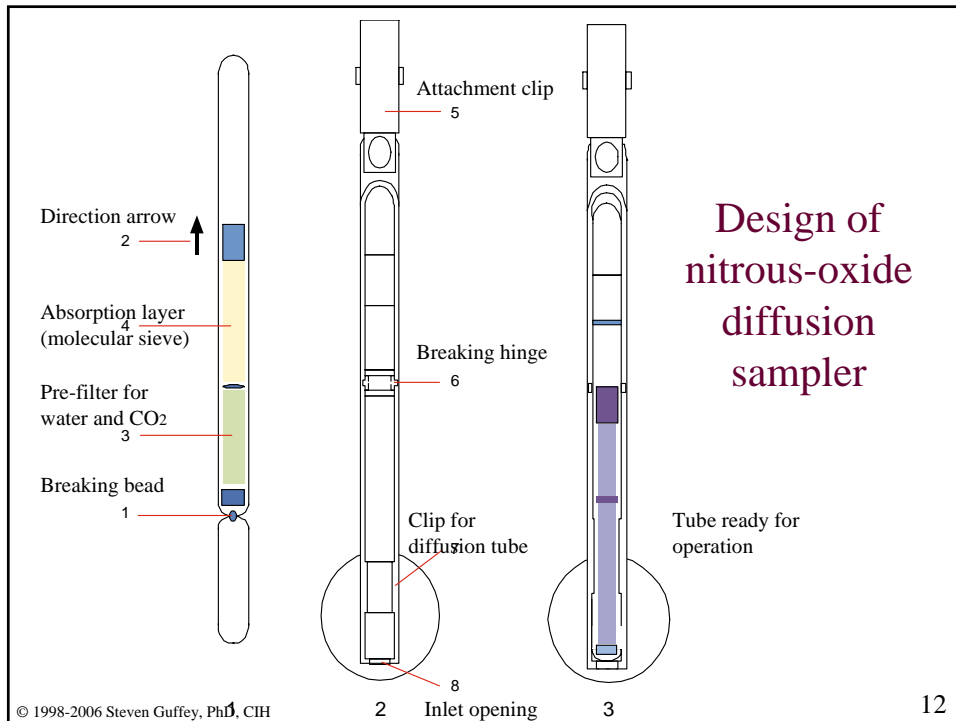
- See folded sheet inside box
- Instructions and info on tube, itself



Note that some tubes used with pre-filter tube

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Perchloroethylene 10/b

Standard measuring range: 10 to 500 ppm
 Number of strokes (n): 3
 Time for measurement: app. 40 s
 Standard deviation: +/- 15 to 20%
 Color change: grey--orange

Ambient operating conditions

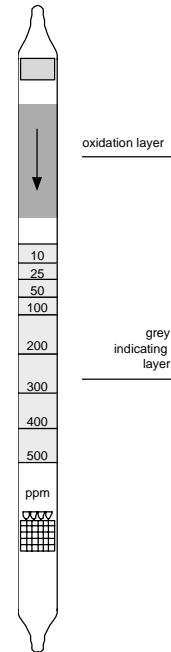
Temperature: 15 to 40° C
 Absolute humidity: 5 to 12 mg H₂O/L

Reaction principle

- a) $\text{CCl}_2=\text{CCl}_2 + \text{MnO}_4^- \rightarrow \text{Cl}_2$
- b) $\text{Cl}_2 + \text{o-Tolidine} \rightarrow \text{orange reaction product}$

Cross sensitivity

Halogenated hydrocarbons and free halogens are indicated.
 Petroleum vapors reduce the perchloroethylene indication.



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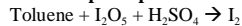
Toluene 5/b

Standard measuring range: 50 to 300 ppm/ 5 to 80 ppm
 Number of strokes (n): 2 / 10
 Time for measurement: app. 1 min / app. 5 min.
 Standard deviation: +/- 10 to 15%
 Color change: white—pale brown

Ambient operating conditions

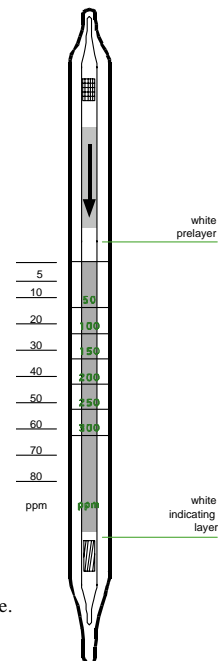
Temperature: 2 to 40° C
 Absolute humidity: max. 20 mg mg H₂O/L

Reaction principle



Cross sensitivity

10 ppm pheno l, 1000 ppm acetone, 1000 ppm ethanol and 500 ppm octane are not indicated.
 Xylene (all isomers) and benzene are indicated with the same sensitivity. The discoloration in the presence of p-xylene is violet, and yellowish-green with benzene.



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Other Direct Reading Devices

Devices based on color development

Passive

Active: GMD Sure-Spot

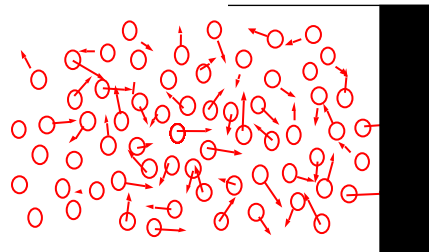
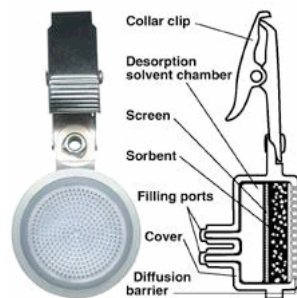
Precision and accuracy issues with inexpensive monitors

When to use indicator tubes/badges

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Diffusion Badges



- Molecular collisions drive flow of contaminant molecules into badges. Activated charcoal adsorbs, so flow is one-way.
- Must have some air movement to avoid depletion. Body movement adequate.

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SafeAir Badges



Slide badge into comparator.
Turn color wheel until scale matches color formed on badge.

Read exposure dose.

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Use of Badges



- Unseal pouch
- Mark id and start time
- Place on worker
- Remove and mark stop time
- Seal with provided o-ring and cap

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Calibrating/Testing

- Using bubble burette or large syringe, inject known amount of clean air into bag.
- Using very small syringe, extract air or liquid having known concentration and inject it into the bag
- Compute expected concentration
- Connect detector tube to exhaust port from bag and draw mfg.'s specified air through the detector tube.
- Note value from detector tube.
- Repeat with larger and larger quantities of contaminant injected and checked with different detector tubes.



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Questions?
The End

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