Low Cost, Reliable Detection for Difficult-to-Measure Gases

Thursday, January 29, 2015

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Problem

- We spilled something
- Something is giving me a headache
- We may have a leak
- Something smells funny

Do we know what it is? How do we find out?

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Pump and tube sampling

- Applications for pump and tube sampling
- The right and wrong ways to use gas detection tubes
- Common issues and how to avoid them
- How to verify sample reading and interpret them correctly
- Open Q& A: Your Questions Answered

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Why use tubes?

- Measure a wide variety of organic and inorganic gases and vapors in air
- Intrinsically safe
- Pre-calibrated
- Simple
- Inexpensive
- Easy to use

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How do they work?

Common reaction types:

- Acid-base reactions
- Reduction-oxidation (Red-ox) reactions
- Ligand-exchange reactions
- Pre-layers or Pre-tubes

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Applications

- Protecting workers from toxic vapors
- Clean-up of spills
- Hazardous waste sites
- Refineries
- Pulp and paper plants
- Leak detection

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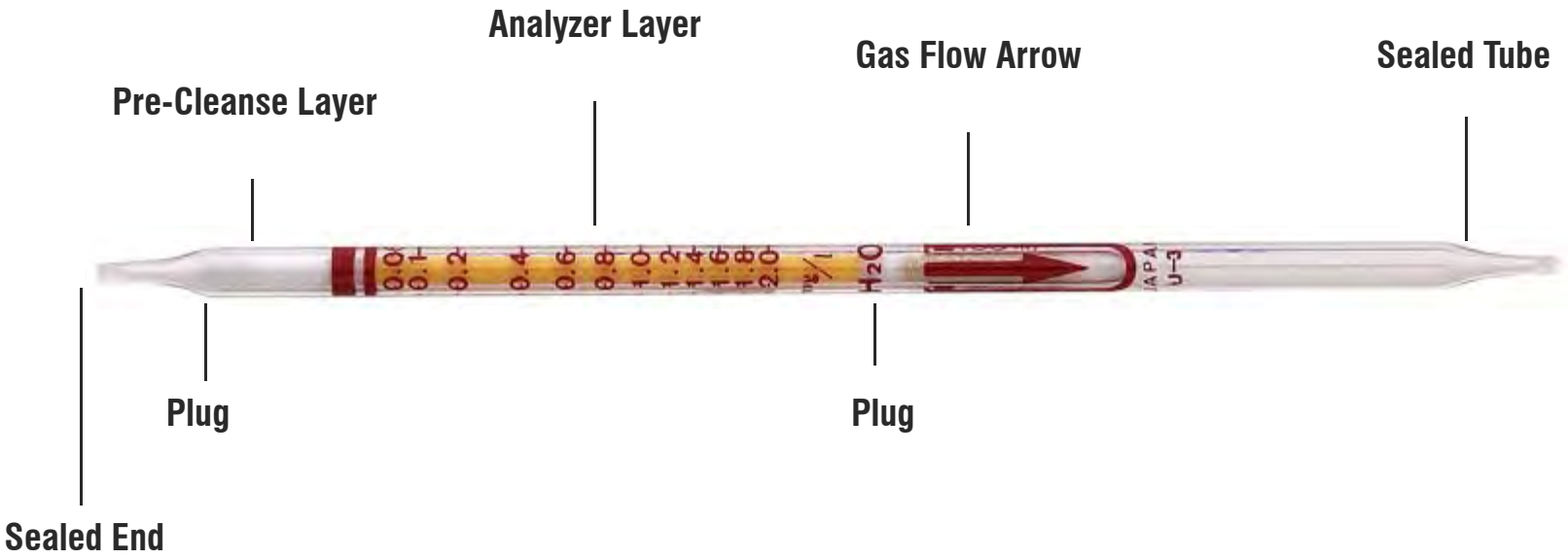
Detector Tube



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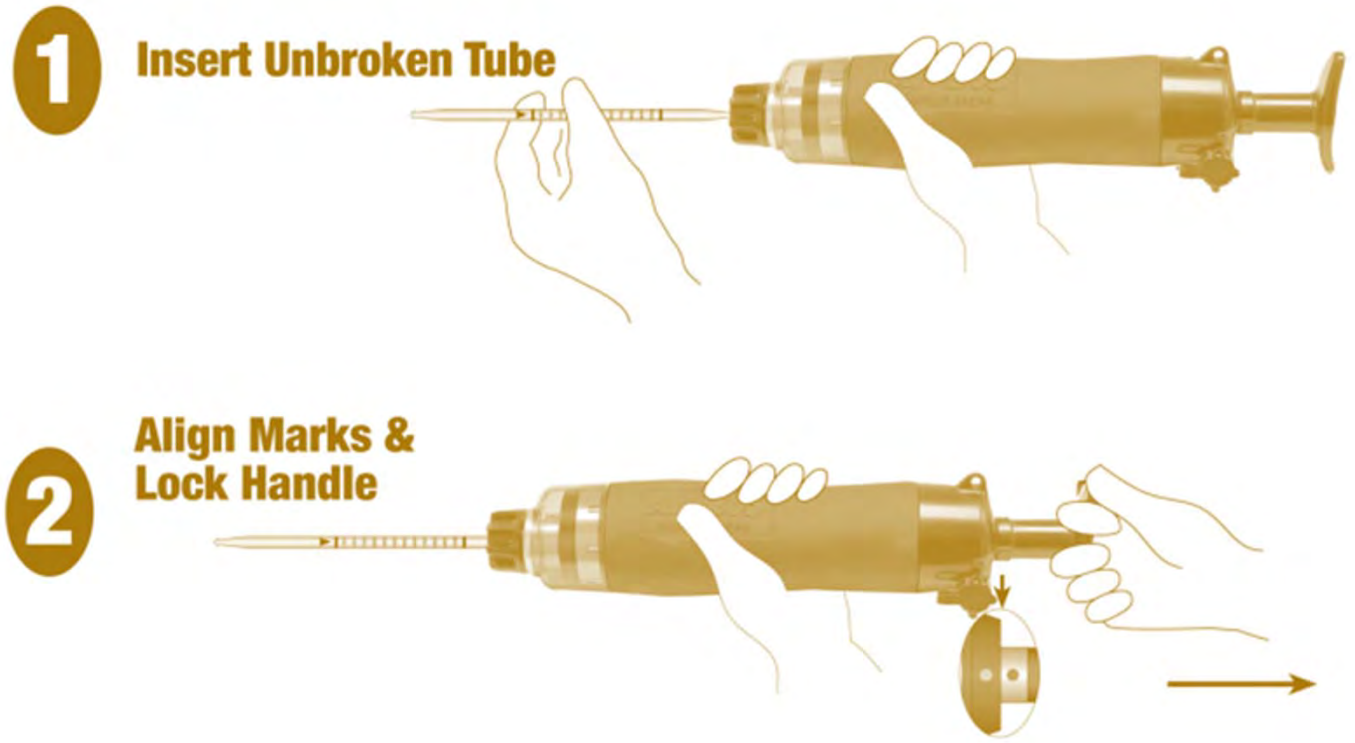
Field Leak Check



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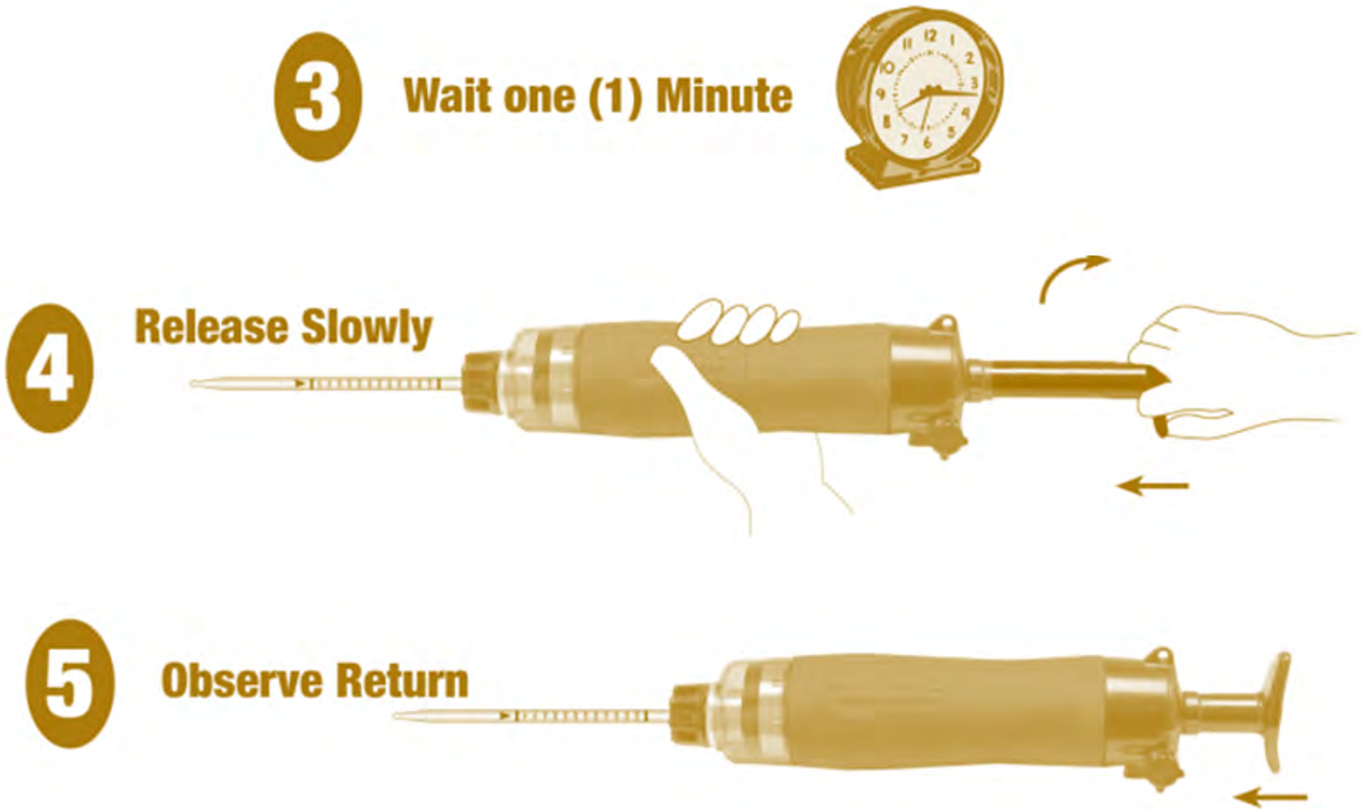
Field Leak Check Continued



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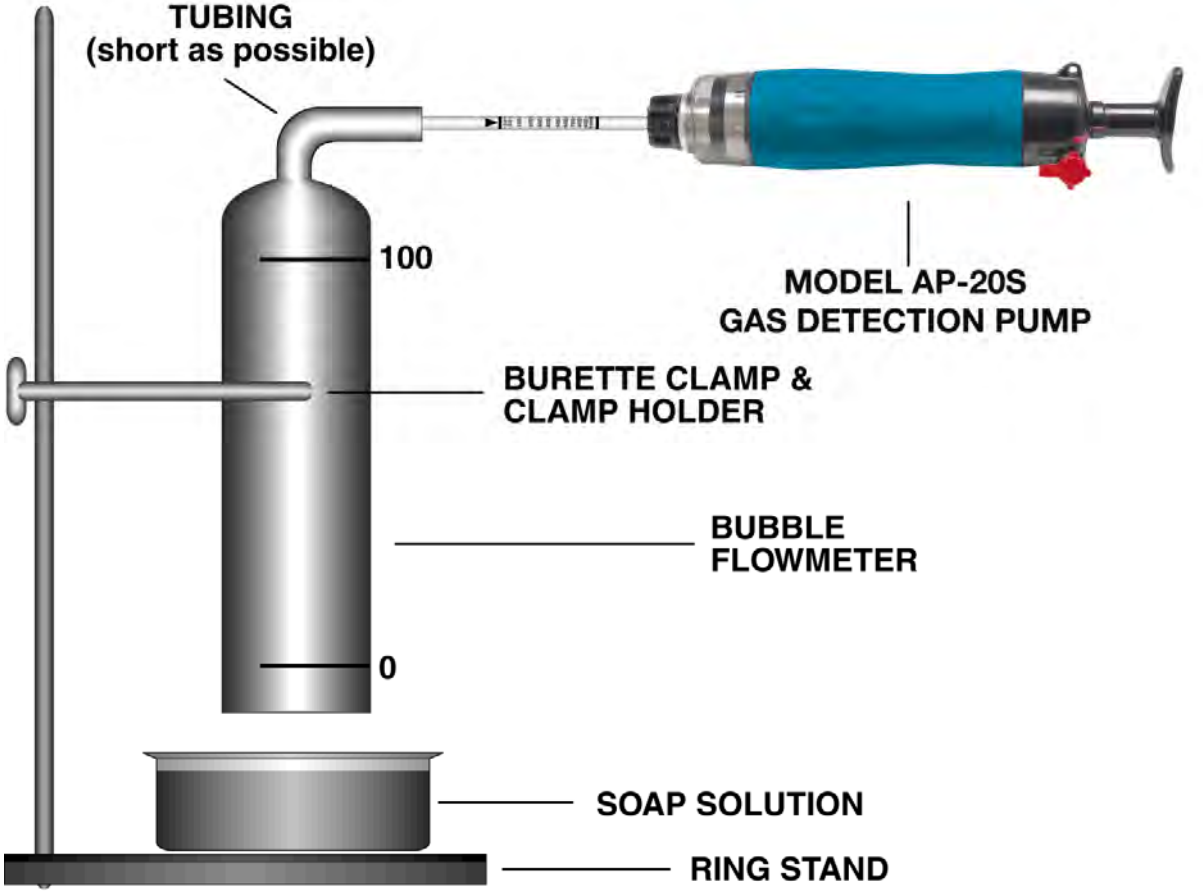
LABORATORY LEAK CHECK



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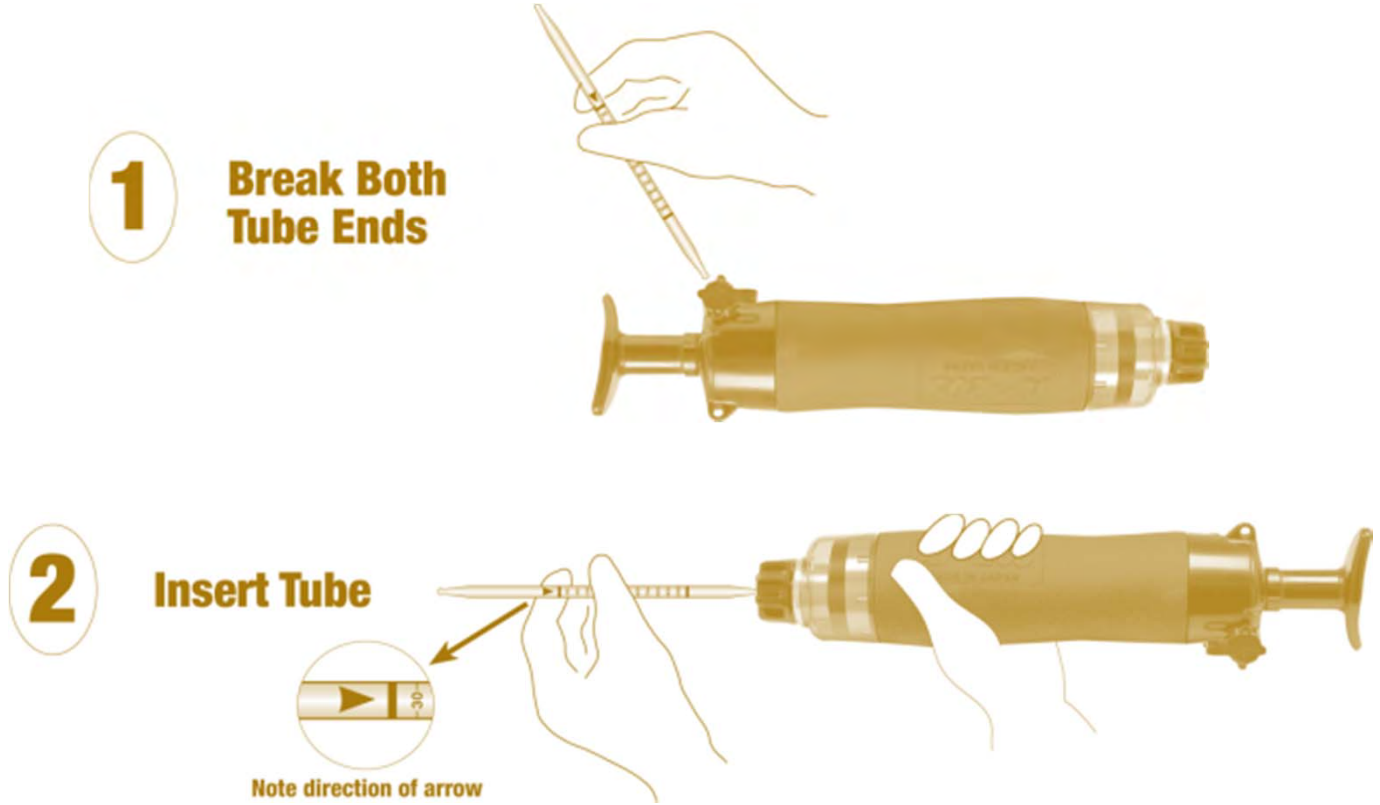
Taking A Sample



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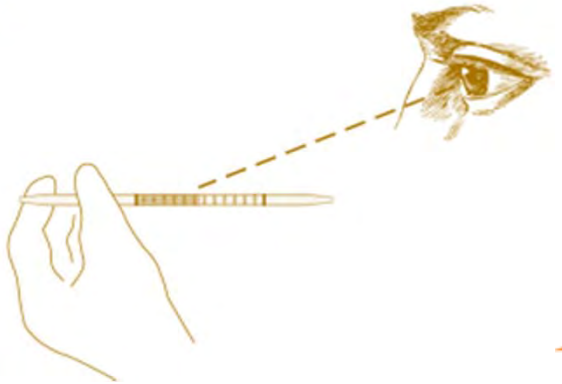
Taking A Sample Continued

3 **Align Marks & Lock Handle**

4 **Wait Allotted Time**

5 **Read Stain Against Scale**



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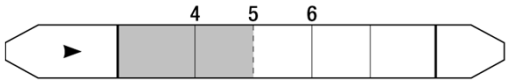
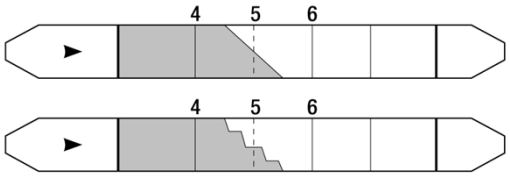
Reading the tube

NORMAL

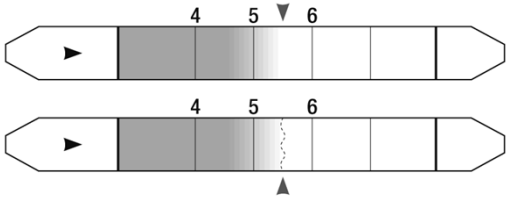


CHANNELING



Add the Lower and Higher readings, then divide by 2

FEATHERING



Use the end of the faint stain as the reading

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System Specifications

- Accuracy: ± 25% of Reading
- Temperature: 0 to 40°C (32 to 104°F)
- Humidity: 10 to 90% RH
- Shelf Life: Two Years (Most Tubes)

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DUAL TUBE

Pretreat Tube

Detector Tube

To Pump

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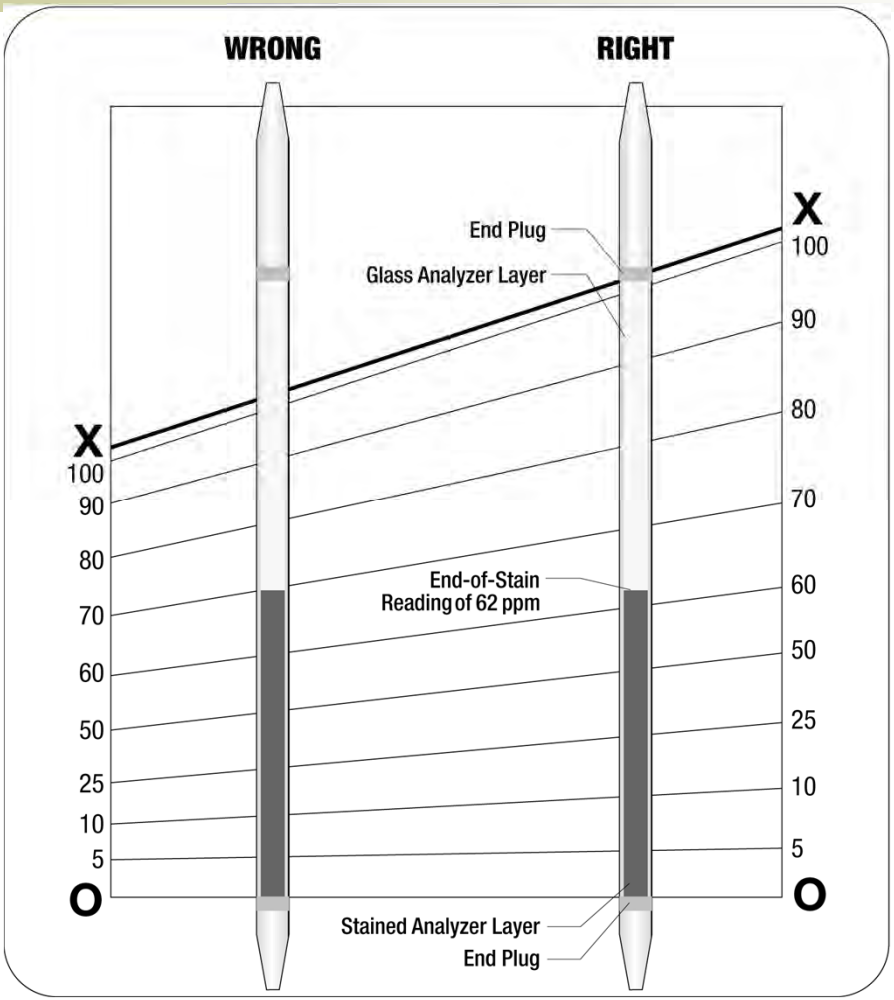
CONCENTRATION CHART TUBES



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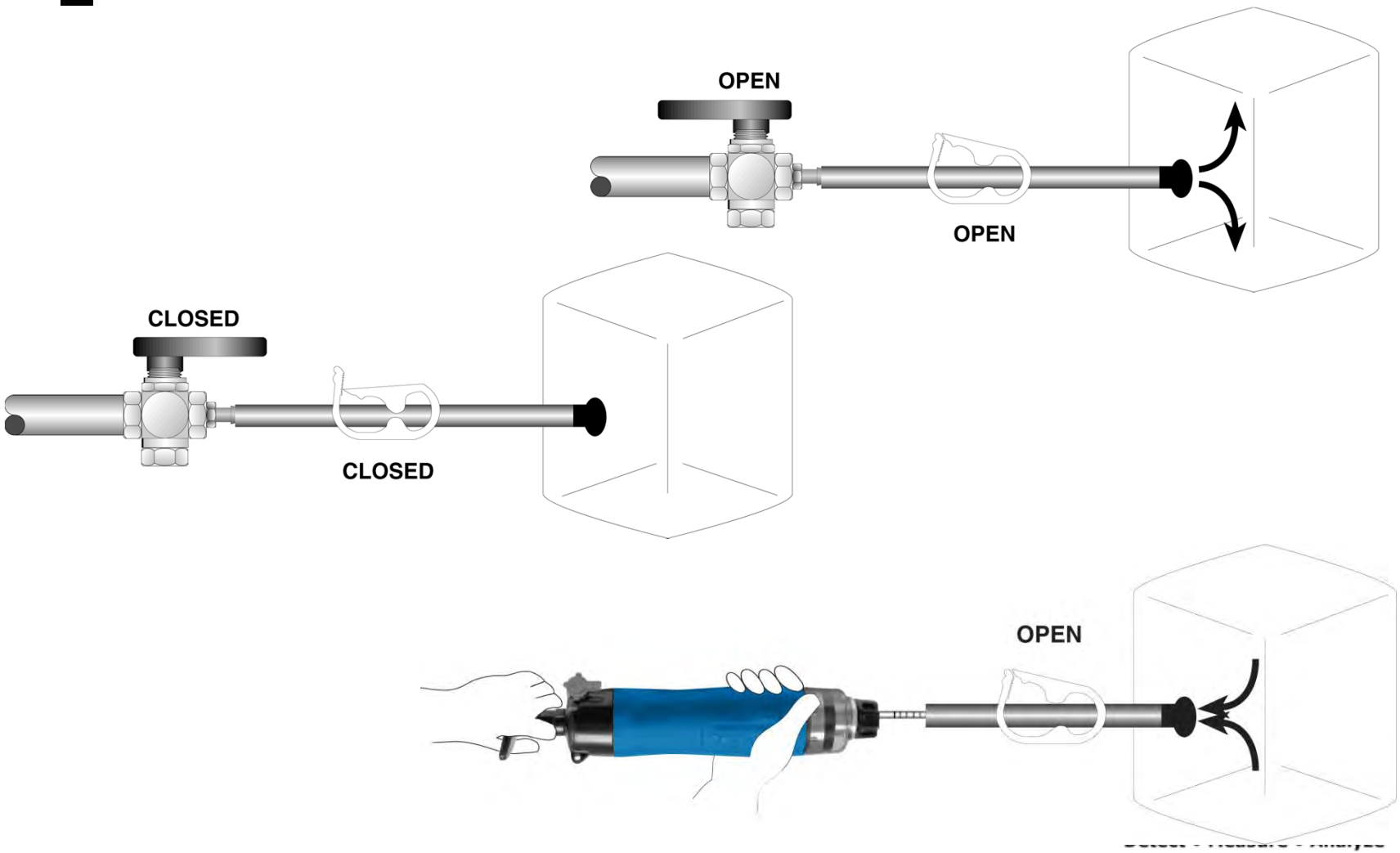
PRESSURIZED SYSTEMS: BAG METHOD



PRESSURIZED SYSTEMS: FLOW THROUGH SAMPLING

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Volume Correction

$$\text{Concentration} = \text{Reading} \times \frac{\text{Specified No. of Strokes}}{\text{Actual No. of Strokes}}$$

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Units Conversion

$$1\% = 10{,}000 \text{ ppm}$$

$$\text{mg/L} = \frac{\text{ppm} \times \text{MW}}{24{,}450}$$

MW = Molecular Weight
L = Liters of air
24,450 = Ideal Gas Law Constant (Molar Volume of Air)

$$\text{ppm} = \frac{\text{mg/L} \times 24{,}450}{\text{MW}}$$

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Tube Selection Guide

Gas or Vapor to be measured	TLV TWA (STEL/Ceiling)	Tube No.	Detector Tube to be used	Measuring Range	No. of Strokes	Notes
Acetaldehyde	(C 25 ppm)	133A	Acetaldehyde	0.004-1.0 %v	1	Store 40-50° F
		133SB	Acetaldehyde	5-140 ppm	1	Store 40-50° F
Acetic Acid	10 ppm (15 ppm)	216S	Acetic Acid	1-50 ppm	1	
Acetic Anhydride	5 ppm	216S	Acetic Acid	1-15 ppm	1	Conversion chart
Acetone	500 ppm (750 ppm)	102SA	Acetone	0.1-5.0 %v	1/2-1	
		102SC	Acetone	0.01-4.0 %v	1	Store 40-50° F
		102SD	Acetone	40-5000 ppm	1/2-2	
Acetylene	asphyx	101S	Acetylene	50-1,000 ppm	1	
Acetylene & Ethylene (separate measure)		280S	Acetylene & Ethylene	A: 20-300 ppm, E: 200-2000 ppm	1	Twin tubes
Acetylene Dichloride (see 1,2 Dichloroethylene)						
Acrolein	(C 0.1 ppm)	136	Acrolein	0.005-1.8 %v	1	Store 40-50° F
Acrylic Acid	2 ppm	216S	Acetic Acid	1-50 ppm	1	Conversion chart
Acrylonitrile (Vinyl Cyanide)	2 ppm	128SA	Acrylonitrile	0.1-3.5 %v	1	
		128SC	Acrylonitrile	1-120 ppm	2	Store 40-50° F, Twin tubes
		128SD	Acrylonitrile	0.25-20 ppm	1-4	Store 40-50° F, Twin tubes
Air (Breathing Air) Tubes (see Separate Listing)						
Allyl Alcohol (Propenyl Alcohol)		184S	Methyl Methacrylate & Allyl Alcohol	20-500 ppm	1	Conversion chart
Allyl Chloride (3-Chloropropene)	1 ppm (2 ppm)	132SC	Vinyl Chloride	1-40 ppm	3	Twin tubes, Conversion chart
Amines (see specific Amines)						
Aminobenzene (see Aniline)						
2-Aminoethanol (see Monoethanol Amine)						
2-Aminopropane (see Isopropyl Amine)						
Ammonia	25 ppm (35 ppm)	105SA	Ammonia	0.5-10 %v	1	
		105SB	Ammonia	50-900 ppm	1	Tested
		105SC	Ammonia	5-260 ppm	1-2	Tested
		105SD	Ammonia	0.2-20 ppm	1-5	Tested
		105SH	Ammonia	0.5-30 %v	1	
		105SM	Ammonia	0.1-1.0 %v	1	
Amyl Acetate (see Pentyl Acetate)						
Aniline (Aminobenzene)	2 ppm	181S	Aniline	1-30 ppm	1-2	
Arsine	0.05 ppm	140SA	Arsine	5-160 ppm	1	
		121U	Phosphine & Arsine	0.05-2.0 ppm	1-2	
Benzene	0.5 ppm (2.5 ppm)	118SC	Benzene	1-100 ppm	1-4	Tested
Benzene (in presence of gasoline and/or other aromatic HCs)	0.5 ppm (2.5 ppm)	118SB	Benzene-in presence of Hydrocarbons	5-200 ppm	1	Twin tubes, Tested
Benzyl Chloride	1 ppm	132SC	Vinyl Chloride	1-16 ppm	1	Twin tubes, Conversion chart
Breathing Air Tubes (see Separate Listing)						
Bromine	0.1 ppm	114	Bromine	1-20 ppm	1	
Bromochloromethane (Chlorobromomethane)	200 ppm	157SB	Methyl Bromide	5-400 ppm	1/2-1	Store 40-50° F, Twin tubes, Conversion chart
Bromoform (Tribromomethane)	0.5 ppm	157SB	Methyl Bromide	0.5-20 ppm	1-2	Store 40-50° F, Twin tubes, Conversion chart
Bromomethane (see Methyl Bromide)						

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Tube Selection Guide

1999 ACGIH
TWA = 8 hour Time Weighted Avg.
STEL = 15 minute exposure limit
C = Ceiling Limit
1 ppm = 0.0001 %v
1 %v = 10,000 ppm

Range shown corresponds to all pump stroke combinations. Range on box label may show only the printed scale. *Measuring ranges subject to change without notice.*

1/2 stroke = 50 ml air
1 stroke = 100 ml air
2 strokes = 200 ml air

Gas or Vapor to be measured	TLV TWA (STEL/Ceiling)	Tube No.	Detector Tube to be used	Measuring Range	No. of Strokes	Notes
Diisobutyl Ketone	25 ppm	139U	Methyl Ethyl Ketone	20-1000 ppm	1	Conversion chart
Diisopropyl Amine	5 ppm	105SD	Ammonia	1-16 ppm	1–5	Conversion chart
Dimethyl Amine	5 ppm (15 ppm)	227S	Dimethyl & Ethyl & Methyl amine	1-20 ppm		
n,n-Dimethyl Aniline	5 ppm (10 ppm)	105SD	Ammonia	0.5-9 ppm	1	Conversion chart
Dimethyl Benzene (see Xylene)						
Dimethyl Ether (Methyl Ether)		123S	Dimethyl Ether	0.01-1.2 %v	1/2–2	
N,N-Dimethylacetamide		229S	N,N-Dimethylacetamide	5-70 ppm	2	
N,N-Dimethylformamide		196S	N,N-Dimethyl Formamide	1-30 ppm	1-2	
1,4 Dioxane (Diethylene Dioxide)	20 ppm	119U	Methyl Alcohol	20-500 ppm	1/2–1	Conversion chart
		139SB	Methyl Ethyl Ketone	0.05-2.5 %v	2	Conversion chart
		154U	Dioxane	20-500 ppm	1-3	

Examples
5 ppm (15 ppm): TLV = 5 ppm, STEL = 15 ppm
(C 7 ppm): Ceiling = 7 ppm
(25 ppm): STEL = 25 ppm

"Store 40-50°F"
must store tube between 40–50°F (5–10°C)

"Twin tubes"
uses primary and analyzer tubes (5 tests per box)

"Conversion chart"
tube requires the use of a conversion chart to interpret the length of the stain

"Color intensity"
gas concentration is determined by the intensity of of the tube stain and not by its length

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Tube selection guide

What if we have a true unknown?

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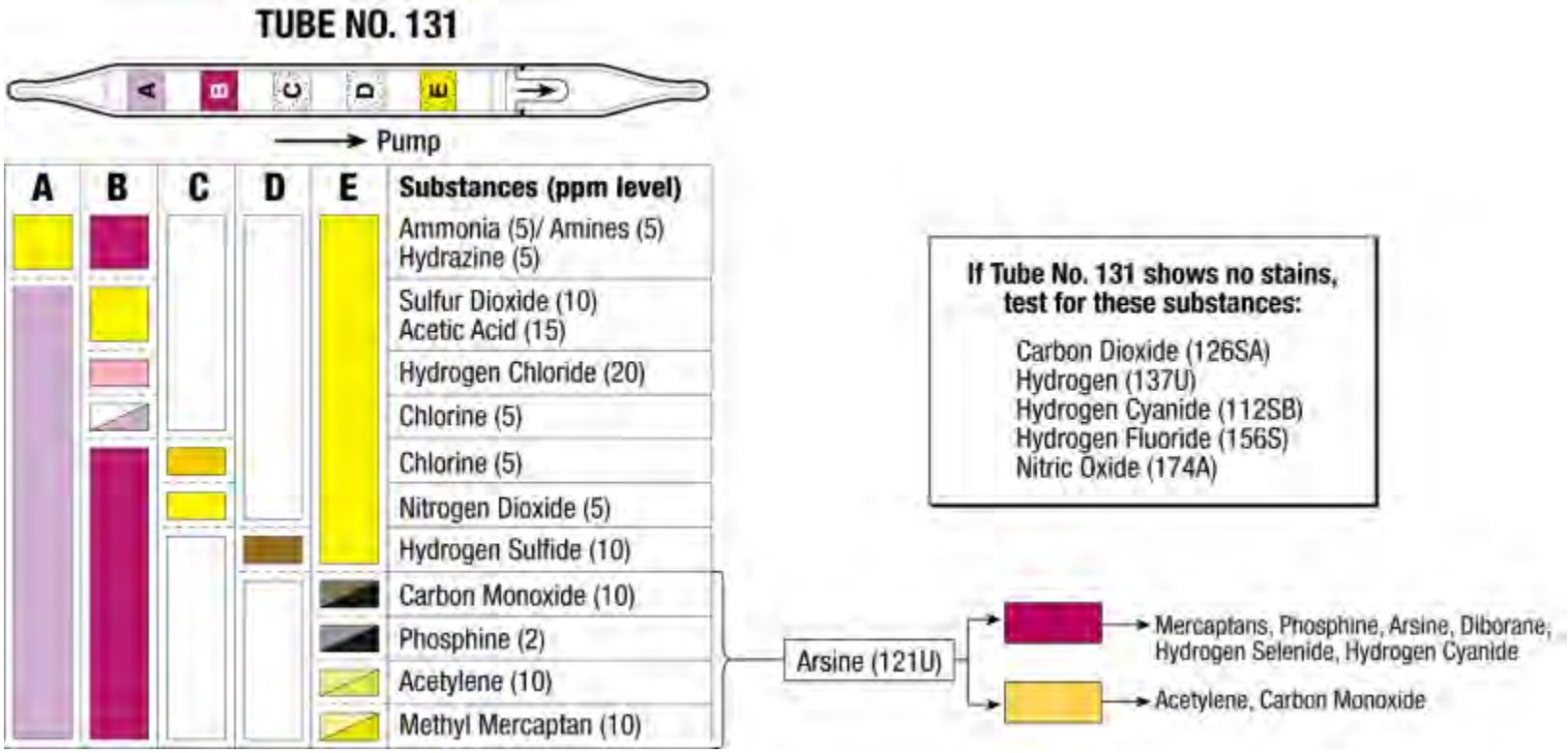
Inorganic gases



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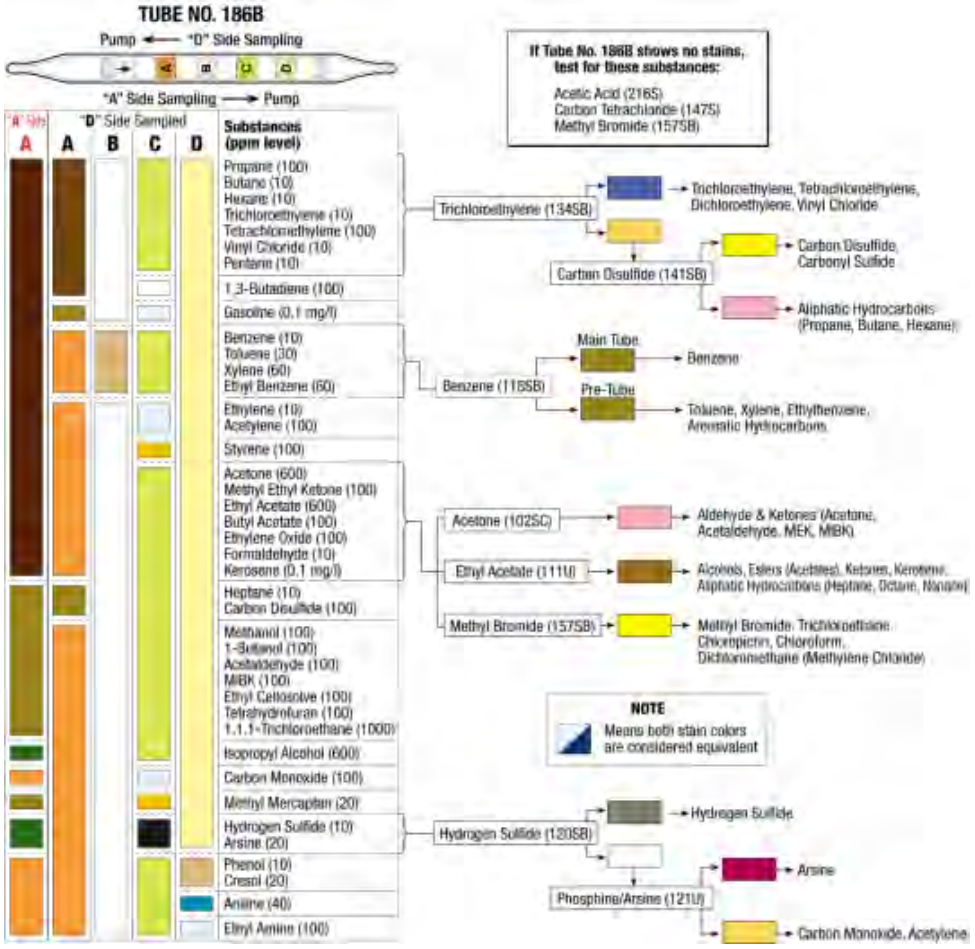
Organic Gases



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Common Issues

Storage Issues

- Using tubes past their expiration date
- Improperly storing tubes
- Storing tubes in freezer

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Common Issues

Set up issues

- Using tubes backwards
- Using ampoule tubes without first breaking the ampoules
- Incorrectly assembled dual tubes
- Mixing brands of tube and pump

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Inter-Brand Compatibility

- In general, mixing brand components is not recommended
- Some combinations can cause significant accuracy loss
- Some brands are made to higher quality standards than others

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Common Issues

Sampling issues

- Too many pump strokes
- Partial strokes

Pump issues

- Leaking pump
- Worn out return springs in bellow pump

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Questions?

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