

# Sampling Essentials: Cassettes, Compliance & Sampling Techniques

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# Objectives

- Clarify roles of labs vs rental companies
- Ensuring proper coordination with the lab
- Basic sampling setup & practices
- Client - Lab communication and interpreting results
- Common pitfalls and new regulations

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# Lab vs Equipment Rental— When to Use Each

## Rental Services

Ideal for real-time monitoring equipment:



- Noise dosimeters and sound level meters
- Direct-reading gas monitors
- Particle counters and dust monitors
- Heat stress monitors

## Analytical Labs

Essential for sample analysis:



- Air, wipe, and bulk sampling filters and media
- TWA exposure assessments
- Complex analyses (metals, VOCs, pesticides)
- Specialized testing protocols

# What to Look for in a Lab

## Essential Qualifications

When selecting a laboratory for your industrial hygiene testing needs, verify they have the technical capability to perform your specific analyses. Always confirm:

- Appropriate accreditation – AIHA/ISO 17025 certification is the industry standard
- Project-specific certifications that may be required by regulations or clients
- Capability and methods that support analysis for contaminants of concern
- Understand the limitations of what a laboratory can support
- Reach out to a Project Manager who can facilitate coordination between your sampling site and the laboratory



Proper accreditation ensures labs meet rigorous quality standards and technical competence requirements for specific analyses.

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# Things to know before talking to lab

1. Identify hazards
  - SDS Sheets
  - Site Specific Processes
  - Talk to Employees
2. Identify Available Methods
  - CDC or OSHA websites
  - NIOSH Pocket Guide
3. Identify Exposure Limit



# Lab Needs: General Project Info

When working with an analytical laboratory, providing complete project information upfront ensures accurate results and prevents costly rework.

## Analytical Parameters

Specify reporting limits and OELs.

Target compounds (CAS numbers preferred)

## Sampling Approach

Preferred sampling method and confirm it is supported by the lab

Appropriate sampling media

Sampling duration and flow rate



# Analytical Parameters

- PEL-TWA (1 ppm) -- Passive Badge is the preferred sampling option in this example
- Question #1 for lab:  
"Can the method detect Benzene at 1ppm?"
- Question #2 for the lab:  
"How long do I need to sample for to ensure a <RL result is below the PEL-TWA?"
- In this case:
  - RL is 0.0010 mg/sample
  - Published POVM uptake rate (16 mL/min)
  - Minimum sample time is 20 min
  - 15-minute STEL is raised to 5ppm

## Exposure Limits

<b>OSHA PEL</b> 8-hour TWA (ST) STEL (C) Ceiling Peak	
<b>PEL-TWA</b>	1 ppm
<b>PEL-STEL</b>	5 ppm

<b>Method:</b> SKC 575-00X POVM by GC-FID		<b>Media:</b> SKC 575-001, Sorbent Charcoal, 350mg		<b>Instrument:</b> GCI47	
<b>Dilution:</b> 1		<b>Sampling Parameter:</b> Exposure 455 Minutes		<b>Analyzed:</b> 06/09/2025 (328759)	
Analyte	Result (mg/sample)	Result (mg/m <sup>3</sup> )	Result (ppm)	RL (mg/sample)	
Benzene	<0.0010	<0.14	<0.043	0.0010	

See [29 CFR 1910.1000 Table Z-2](#) for any operations or sectors where the exposure limits in 1910.1028 are stayed or otherwise not in effect.

**Health factors:** See NIH-NLM [PubChem](#).

**Carcinogenic classifications:** EPA-A; K, IARC-1, NIOSH-Ca, NTP-K, OSHA-Ca, TLV-A1

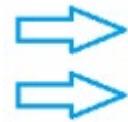
**AIHA emergency response planning guidelines:**  
50 ppm/150 ppm/1000 ppm

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# Sampling Approach

- First review the reference method
- Review sampling parameters
- Check for specific shipping/storage stability requirements



 <b>NMAM</b>		<b>FORMALDEHYDE</b>		<b>2016</b>
<chem>H2C=O</chem>		MW: 30.03	CAS: 50-00-0	RTECS: LP8925000
<b>METHOD:</b> 2016, Issue 3		<b>EVALUATION:</b> FULL		<b>Issue 1:</b> 15 January 1998 <b>Issue 3:</b> 25 February 2016
<b>OSHA:</b> 0.75 ppm; 2 ppm STEL <b>NIOSH:</b> 0.016 ppm; C 0.1 ppm; carcinogen (1 ppm = 1.23 mg/m <sup>3</sup> @ NTP)			<b>PROPERTIES:</b> Gas; BP -19.5 °C; specific gravity 1.067 (air = 1); explosive range 7 to 73% (v/v) in air	
<b>SYNONYMS:</b> methanal; formalin (aqueous 30 to 60% w/v formaldehyde); methylene oxide				
SAMPLING			MEASUREMENT	
<b>SAMPLER:</b>	CARTRIDGE (Cartridge containing silica gel coated with 2,4-dinitrophenylhydrazine)		<b>TECHNIQUE:</b>	HPLC, UV DETECTION
<b>FLOW RATE:</b>	0.03 to 1.5 L/min		<b>ANALYTE:</b>	2,4-dinitrophenylhydrazone of formaldehyde
<b>VOL-MIN:</b>	1 L @ 0.25 mg/m <sup>3</sup>		<b>EXTRACTION:</b>	Elution with 10 mL of carbonyl-free acetonitrile
<b>-MAX:</b>	15 L @ 2.5 mg/m <sup>3</sup>		<b>INJECTION VOLUME:</b>	20 µL
<b>SHIPMENT:</b>	Place caps onto cartridge. Ship on ice.		<b>MOBILE PHASE:</b>	45% acetonitrile/55% water (v/v), 1.3 mL/min
<b>SAMPLE STABILITY:</b>	34 days @ 5 °C [1]		<b>COLUMN:</b>	3.9 x 150-mm, stainless steel, packed with 5-µm C18
<b>BLANKS:</b>	2 to 10 field blanks per set; 6 to 10 media blanks per set		<b>DETECTOR:</b>	UV @ 360 nm
ACCURACY			<b>CALIBRATION:</b>	Samplers fortified with standard solutions of formaldehyde in water
<b>RANGE STUDIED:</b>	0.025 to 2.45 mg/m <sup>3</sup> (22-L samples) [2]		<b>RANGE:</b>	0.23 to 37 µg per sample [1, 2]
<b>BIAS:</b>	+4.4%		<b>ESTIMATED LOD:</b>	0.07 µg/sample [1]
<b>OVERALL PRECISION (<math>S_{PT}</math>):</b>	0.057 [1, 2]		<b>PRECISION (<math>S_r</math>):</b>	0.032 @ 1.0 to 20.0 µg/sample [1]
<b>ACCURACY:</b>	±19.0%			

# Sampling Approach

- In addition, it's important to review sampling protocols in the reference method

## **SAMPLING:**

1. Calibrate each personal sampling pump with a representative sampler (and ozone scrubber, if used) in line.
2. Open sampler packet and remove end caps.
3. Attach sampler to the sampling pump with flexible tubing. Bi-directional samplers can be connected at either end.  
NOTE: The sampler does not have a backup section for determination of breakthrough. If high concentrations of aldehydes and ketones are anticipated, connect two samplers in series. The back pressure of the sampling train will be higher and a lower flow rate may be required.
4. Sample 1 to 15 L of air at 0.03 to 1.5 L/min.  
NOTE: To protect from intense light, such as bright sunlight, the sampler can be wrapped with aluminum foil or electrical tape.
5. Place end caps onto the sampler and seal sampler in an envelope. Protect samples from heat.
6. Ship samples on ice (0 °C).

# Sampling Approach

- In addition, it's important to review sampling protocols in the reference method
- Some additional key information is often provided here
- Consult with the lab with questions on the media used and how it can best be shipped

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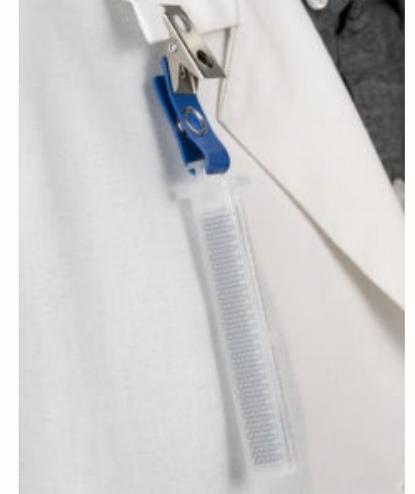
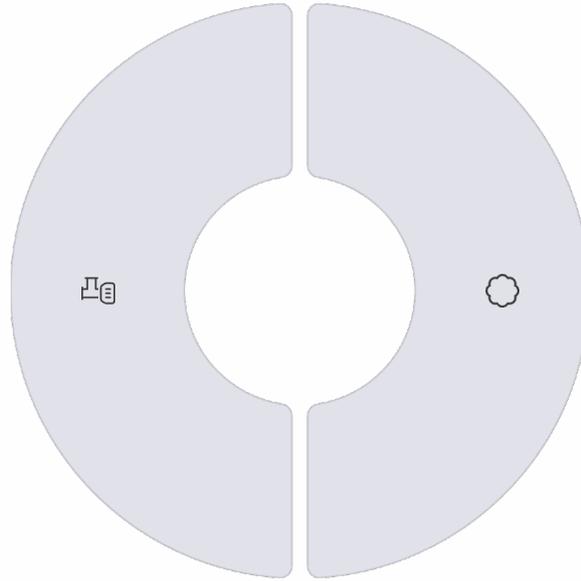
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# Active vs Passive Sampling



## Active Sampling

- Uses pumps to draw air through media
- Precise control of flow rate and volume
- Better for short-term samples
- Higher sensitivity for many compounds

## Passive Sampling

- Diffusion-based collection
- No pumps or calibration needed
- Worker acceptance typically higher
- Better for longer-term averages

Selection between active and passive sampling depends on analyte properties, required detection limits, and practical field considerations.

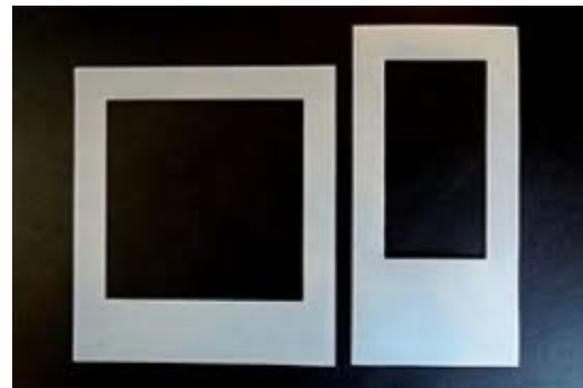
# Air Sampling Basics

- Cassettes
- Sorbent tubes
- Whole air samples



# Wipe Sampling Basics

- Media (gauze, wipe, filter)
- Wetting agent
- Wipe template
- Container



# Proper use of sampling media – Calibration

- Calibration
  - Pumps are calibrated with the intended media in-line
  - A primary calibrator should be used (on-site, or by the rental company). Secondary calibrators are typically available for flow confirmation.
- Calibration check
  - Changes in elevation, humidity, and other factors during pump shipment
  - Calibrator
  - Additional media for calibration



# Basic Sampling Guide

- Ask individuals beforehand
- Place pump on pants/belt
- Wrap tubing around back and clip filter within breathing zone





# Field Blanks – Why and How

## Purpose of Field Blanks

Field blanks identify contamination from media preparation, transport, and handling. They help distinguish between workplace contaminants and sampling artifacts.

## Proper Handling Techniques

Handle blanks with the same care as actual samples but never expose them to the sampled environment. Open and reclose blanks in a clean area.

## Quantity Guidelines

Include at least one field blank per requested analysis<sup>1</sup>. For sensitive analyses, consider additional blanks.

1. OSHA Technical Manual Section 2 Chapter 1 H

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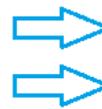


# Shipping Requirements

- Check for specific shipping/storage stability requirements
- Ensure hold-times can be met within requested TAT
- Sampling media can be shipped with coolers/ice packs to ensure faster and easier return to lab



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<b>SYNONYMS:</b> methanal; formalin (aqueous 30 to 60% w/v formaldehyde); methylene oxide		
SAMPLING		MEASUREMENT
<b>SAMPLER:</b>	CARTRIDGE (Cartridge containing silica gel coated with 2,4-dinitrophenylhydrazine)	<b>TECHNIQUE:</b> HPLC, UV DETECTION
<b>FLOW RATE:</b>	0.03 to 1.5 L/min	<b>ANALYTE:</b> 2,4-dinitrophenylhydrazone of formaldehyde
<b>VOL-MIN:</b>	1 L @ 0.25 mg/m <sup>3</sup>	<b>EXTRACTION:</b> Elution with 10 mL of carbonyl-free acetonitrile
<b>-MAX:</b>	15 L @ 2.5 mg/m <sup>3</sup>	<b>INJECTION VOLUME:</b> 20 µL
<b>SHIPMENT:</b>	Place caps onto cartridge. Ship on ice.	<b>MOBILE PHASE:</b> 45% acetonitrile/55% water (v/v), 1.3 mL/min
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# Interpreting Results

- What does each value mean?
- RLs, Results, Air Volumes
- Calculating TWAs
- STELs
- Ceiling Limit-

Results in micrograms per meter cubed

Sample ID: Lab ID:		Sampling Location:		Collected: Received:	
Method: NIOSH 7500 Mod. Dilution: 1		Media: PVC Filter Sampling Parameter: Air Volume 930 L		Instrument: XRAY01 Analyzed:	
Analyte	Result (ug/sample)	Result (ug/m <sup>3</sup> )	Result (%)	RL (ug/sample)	Reporting Limit
Quartz	74	80	14	5.0	
Cristobalite	<5.0	<5.4	<0.96	5.0	
Tridymite	<20	<22	<3.8	20	
Total Silica	74	80	14		

3 crystalline silica "polymorphs"

# Interpreting Results

- Lab QC Reports
  - Lab Method Blank
  - Lab Control Sample
  - LCS Duplicate

Blank			
LMB: Analyzed: Units: ug			
Analyte	Result	MDL	RL
Quartz	ND	NA	5.00
Cristobalite	ND	NA	5.00
Tridymite	ND	NA	20.0
Total Silica	0.00	NA	NA

Laboratory Control Sample - Laboratory Control Sample Duplicate									
LCS: Analyzed: Dilution: 1 Units: ug					LCSD: Analyzed: Dilution: 1 Units: ug				
Analyte	Result	Target	% Rec	QC Limits	Result	% Rec	RPD	QC Limits	
Quartz	142	134	106	49.8 117.2	126	94.2	12.1	0.0	20.0

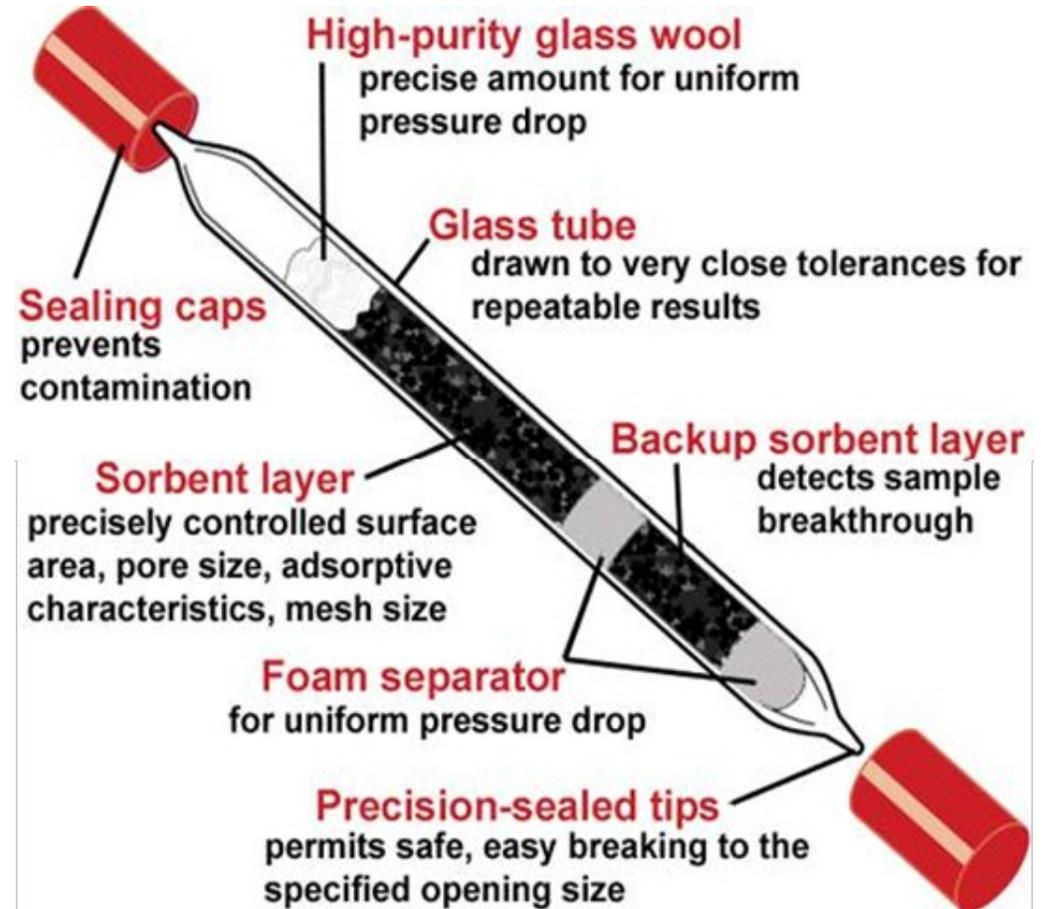
- How is this useful?

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# Common Pitfalls – Sorbent Tubes

- Breakthrough
  - Flow rate is too high
  - Sampling duration too long
  - Produces in biased-low results
- Front and back sections analyzed separately to evaluate (potential) breakthrough



# Common Pitfalls - Cassettes

- Overloading
  - Flow rate is too high
  - Sampling duration too long
  - Produces biased-low results
- Loose sample material in cassette = “Overloaded”
- Lab cannot recover all sample material for analysis
- Excess sample mass is often beyond what the method can accommodate



# Common Pitfalls - Cassettes

- Overloading cont'd
- Silica (NIOSH 7500)
- Low threshold for overloading (2mg)
- Labs can accommodate by splitting sample material into multiple analyses and combining results
- Exceeding lab's thresholds leads to a bulk analysis (loss of useful information)

## SAMPLING:

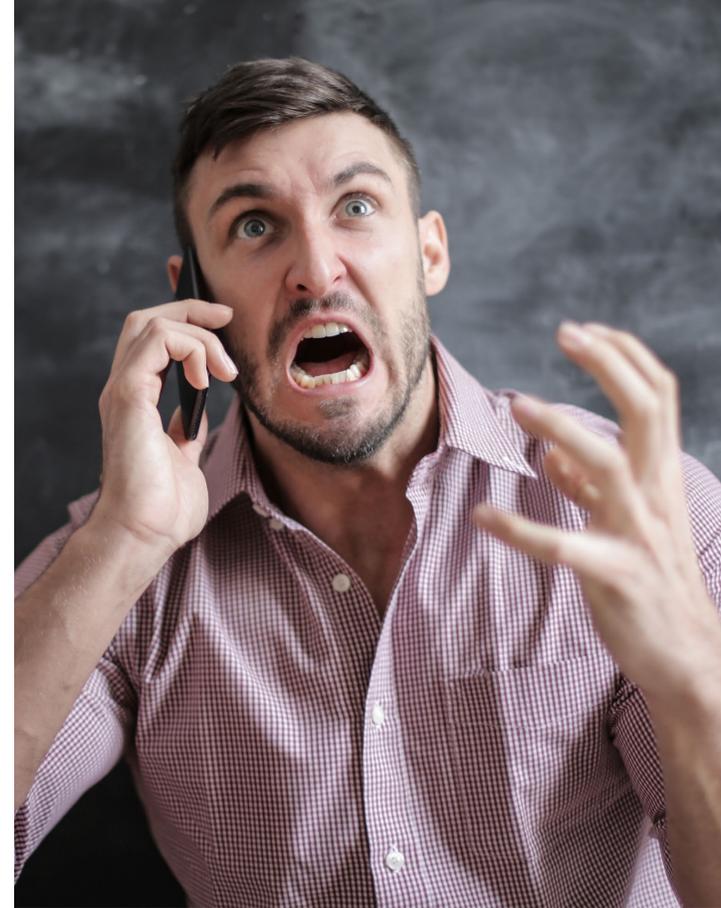
1. Calibrate each personal sampling pump with a representative sampler in line.
2. Sample at  $1.7 \pm 5\%$  L/min with nylon cyclone or  $2.2 \pm 5\%$  L/min with HD cyclone for a total sample size of 400 to 1000 L. Do not exceed 2 mg dust loading on the filter.

NOTE 1: Do not allow the sampler assembly to be inverted at any time when using a cyclone. Turning the cyclone to anything other than a horizontal orientation may deposit oversized material from the cyclone body onto the filter.



# Other Common Pitfalls

- Tipping over cyclones
- Proper storage/shipping
- Insufficient sampling time
- What to do with data
- Collecting multiple compounds on sampling media



# Evolving Industry Standards

New EPA Regulations (Workplace Chemical Protection Program WCPP)

- New EPA rule requiring employers to create a formal plan—with exposure limits, monitoring, and controls—for workers exposed to specific high-risk chemicals.

NIOSH vs OSHA – What's the difference?

EPA vs OSHA – Who do you have to follow?

Chemical Name	CAS #	ECEL <sup>a</sup>	EPA STEL <sup>b</sup>
Asbestos (Chrysotile)	132207-32-0	0.005 fibers/cubic centimeter <sup>c</sup>	N/A
Carbon Tetrachloride (CTC)	56-23-5	<ul style="list-style-type: none"> <li>• 0.2 mg/m<sup>3</sup></li> <li>• 0.03 ppm</li> </ul>	N/A
Methylene Chloride	75-09-2	<ul style="list-style-type: none"> <li>• 8 mg/m<sup>3</sup></li> <li>• 2 ppm</li> </ul>	16 ppm
Perchloroethylene (PCE)	127-18-4	<ul style="list-style-type: none"> <li>• 0.98 mg/m<sup>3</sup></li> <li>• 0.14 ppm</li> </ul>	N/A
Trichloroethylene (TCE)	79-01-6	<ul style="list-style-type: none"> <li>• 1.07 mg/m<sup>3</sup></li> <li>• 0.2 ppm<sup>c</sup></li> </ul>	N/A

<sup>a</sup>8-hour time-weighted average.

<sup>b</sup>15-minute time-weighted average.

<sup>c</sup>Interim ECEL

# Evolving Industry Standards

## MSHA-Silica

- Different Cyclone options
- Cyclone vs PPI
- Quick discussion on more confusing aspects of the rule
  - Flow rates
  - Which cyclone to use (conform to ISO 7708:1995 Standard)
  - Which media to use
  - Which method to use (IR vs XRD)



# Which Method to Use?

## ANALYTICAL METHODS FOR SAMPLING

The final rule requires mine operators to ensure that laboratories evaluate all samples using analytical methods for respirable crystalline silica that are specified by MSHA, NIOSH, or OSHA. These are validated methods currently being used by third party accredited laboratories for measuring respirable crystalline silica in mine dust matrices. MSHA expects that samples collected in MNM mines will be analyzed by X-ray diffraction (XRD) and samples collected in coal mines will be analyzed by Fourier transform infrared spectroscopy (FTIR).

<https://www.federalregister.gov/documents/2024/04/18/2024-06920/lowering-miners-exposure-to-respirable-crystalline-silica-and-improving-respiratory-protection>

## Approved Analytical Methods

For respirable crystalline silica analysis, laboratories must use analytical methods specified by: MSHA; the National Institute for Occupational Safety and Health (NIOSH); or the Occupational Safety and Health Administration (OSHA).

Two main analytical techniques are used to measure respirable crystalline silica: **X-ray diffraction (XRD)** and **infrared (IR) spectroscopy**. XRD methods can be used to analyze either respirable coal mine dust (RCMD) or MNM respirable dust samples, whereas IR methods are used only for RCMD samples. This means that respirable dust samples from MNM mines must **not** be sent for analysis by an IR method (MSHA P-7, NIOSH 7602, or NIOSH 7603). Table 1 lists the six analytical methods approved for respirable crystalline silica analysis:

[https://www.msha.gov/sites/default/files/events/Silica/SilicaLabSelection\\_11-1-24.pdf?](https://www.msha.gov/sites/default/files/events/Silica/SilicaLabSelection_11-1-24.pdf?)

# Evolving Industry Standards

## Illicit Drugs

- Fentanyl in air – new ACGIH TWA
- Methamphetamine – state regulations on wipe
- Other possible drugs for analysis:

Amphetamine

Carfentanyl

Cocaine

Ecstasy

Fentanyl

Heroin

LSD

Oxycodone

Phencyclidine (PCP)

Ephedrine/

Pseudoephedrine



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# Thank You

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History – Quality – Flexibility - Reliability