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Global EHS & Sustainability Services
Engineers • Scientists • Planners

# INDUSTRIAL HYGIENE AIR SAMPLING PROGRAM AND STRATEGY PLAN

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## Emergency Procedures

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- Exits
- Shelters
- Emergency Equipment

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## Industrial Hygiene Program Review Agenda

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- Why Industrial Hygiene (IH) Air Sampling is a Crucial Element to your Overall Health & Safety (HS) Program
  - Impact and coordination with additional HS elements
- Key Elements of an Air Sampling Program
  - Qualitative air sampling assessment
  - Sampling methods and protocols
- Review of Exposure Controls
  - Hierarchy of controls to reduce employee exposure levels

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## Impact and Coordination with Other Health & Safety Programs

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- Your Industrial Hygiene Program Can Serve as the Foundation for Additional Programs
  - Personal Protective Equipment
    - Hearing Conservation Program
  - Respiratory Protection
    - Selection of Respirator Based Upon Assigned Protection Factor
  - Medical Surveillance
  - Engineering Controls
    - Ventilation
    - Process Isolation
    - Process Modifications

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## Elements of an Industrial Hygiene Program

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- Exposure Evaluation
  - 1910.134(d)(1)(iii) ***The employer shall identify and evaluate the respiratory hazard(s) in the workplace***; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be immediately dangerous to life and health (IDLH).

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## Qualitative IH Assessment

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- A Qualitative IH Assessment is an Evaluation of Potential Personal Exposure to Workplace Chemical and Physical Agents Based on Personal Experience and Professional Judgment
- Listing of All Significant Work Tasks Including:
  - Work Task Frequency
  - Duration
  - Workplace Conditions
- Potential Chemicals Involved for Each Task
  - Safety Data Sheets (SDS's)
  - Process Chemistry

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## Qualitative IH Assessment

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## Qualitative IH Assessment

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- Consolidate Work Tasks into Similar Exposure Groups
- Develop Exposure Groups Based on Exposure Potential and Chemical / Physical Hazards
  - Installed Process Controls
  - Volatility of Chemicals
- Develop a Risk Matrix to Identify High Risk vs. Low Risk Task Activities
- Utilize This Information to Conduct a Quantitative Assessment (Actually Conducting the Air Sampling)

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# Qualitative IH Assessment

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# Qualitative IH Assessment

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- Additional Items to Consider:
  - Seasonal Variation Impact Upon Operations
    - Are outside doors normally open in summer and closed in the winter?
    - Are ventilation units idle in winter?
  - Equipment or Process Modifications
    - New or Significantly Modified Equipment
    - Process Utilization Rate
  - Work Practices Across All Shifts

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## Qualitative IH Assessment

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- Characterizing Risk Level is Based Upon Severity and Likelihood of Exposure
- Severity Rankings:
  - A – Serious Permanent Harm, Death, or Reproductive Hazard
  - B – Serious Harm but not Permanent
  - C – Other than Serious
- Likelihood Rankings
  - 1 – Long, Frequent Exposure
  - 2 – Medium Frequency, Medium Duration
  - 3 – Short, Infrequent Exposure

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## Qualitative IH Assessment

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# Example Risk Matrix

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Exposure Group 1 Shakeout Operators 4 Operators (8 hour shifts)

| Hazardous Agent | Task/Activity | Freq. of Exposure | Exposure Duration | Primary Exposure | # of Workers Exposed | Severity | Likelihood | Risk Ranking | Control Method |
|---|---|---|---|---|---|---|---|---|---|
| Carbon Monoxide | Forklift Operation | Daily | > 2 hours | Inhalation | 4 | A | 1 | High | Administrative |
| Noise > 85 dBA | Forklift Operation | Daily | > 2 hours | Physical | 3 | B | 1 | Medium | PPE |
| | Shakeout Operation | Daily | > 2 hours | Physical | 3 | B | 1 | Medium | PPE |
| | Cleaning Equipment | Daily | 15 min- 1 hr | Physical | 1 | B | 2 | Medium | PPE |
| Crystalline Silica | Shakeout Operation | Daily | > 2 hours | Inhalation | 4 | A | 1 | High | PPE |

- Risk Ranking
  - HIGH
  - MEDIUM
  - LOW

| | | |
|---|---|---|
| A1 | A2 | A3 |
| B1 | B2 | B3 |
| C1 | C2 | C3 |

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# Air Sampling Plan

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- Develop Strategy for Conducting Air Sampling
  - Baseline Versus Routine Follow-up Sampling
  - Type of Sampling (Area or Personal)
  - Follow-up Frequency for Elevated Results May Vary:
    - Above Action Levels (As included in the Proposed Silica Rule of 25 micrograms per cubic meter) – Every 6 months
    - Above PEL – Every 3 months
  - Review Applicable Established Permissible Exposure Limits and Threshold Limit Values

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## Sampling Non-Routine Tasks

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- Don't Forget to Evaluate Non-Routine Tasks That May Present an Elevated Exposure to Employees
  - Off-shift Operations
  - Plant Shut-downs
  - Clean-up Tasks
  - Dust Collector Maintenance
  - Breakdown Maintenance

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## Established Exposure Limits

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- OSHA Permissible Exposure Limits (PEL) – An 8-hour Time Weighted Average (TWA) that is the level of exposure established as the highest level of exposure an employee may be exposed to without incurring the risk of adverse health effects.
- ACGIH Threshold Limit Values (TLV) – Developed as *Recommended* Guidelines to Assist in the Control of Health Hazards.

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## Established Exposure Limits

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- The General Duty Clause
  - **Section 5(a)(1):** Employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm.

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## Air Sampling Methods

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**SILICA, CRYSTALLINE, by XRD (filter redeposition) 7500**

$SiO_2$ MW: 60.08 CAS: 14808-60-7 (quartz) RTECS: VV7330000 (quartz)
14464-46-1 (cristobalite) VV7325000 (cristobalite)
15468-32-3 (tridymite) VV7335000 (tridymite)

**METHOD: 7500, Issue 4** **EVALUATION: FULL** **Issue 1: 15 August 1990**
**Issue 4: 15 March 2003**

**OSHA :** quartz (respirable) 10 mg/m³/(%$SiO_2$+2); cristobalite and tridymite (respirable) ½ the above
**NIOSH:** 0.05 mg/m³; carcinogen
**ACGIH:** quartz (respirable) 0.1 mg/m³
cristobalite (respirable) 0.05 mg/m³
tridymite (respirable) 0.05 mg/m³

**PROPERTIES:** solid; d 2.65 g/cm³ @ 0 °C; crystalline transformations: quartz to tridymite @ 867 °C; tridymite to cristobalite @ 1470 °C; α-quartz to ß-quartz @ 573 °C

**SYNONYMS:** free crystalline silica; silicon dioxide

| SAMPLING | | MEASUREMENT | |
|---|---|---|---|
| **SAMPLER:** | CYCLONE + FILTER | **TECHNIQUE:** | X-RAY POWDER DIFFRACTION |

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# Air Sampling Methods

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| SAMPLING | | MEASUREMENT | |
|---|---|---|---|
| **SAMPLER:** | CYCLONE + FILTER (10-mm nylon cyclone, Higgins-Dewell (HD) cyclone, or aluminum cyclone + 5-µm PVC membrane) *see sampling section | **TECHNIQUE:** | X-RAY POWDER DIFFRACTION |
| **FLOW RATE:** | Nylon cyclone: 1.7 L/min; HD cyclone: 2.2 L/min; aluminum cyclone: 2.5 L/min | **ANALYTE:** | Crystalline $SiO_2$ |
| **VOL-MIN:** | 400 L | **ASH:** | Muffle furnace or RF plasma asher or dissolve in tetrahydrofuran |
| **-MAX:** | 1000 L | **REDEPOSIT:** | On 0.45-µm Ag membrane filter |
| **SHIPMENT:** | Routine | **XRD:** | Cu target X-ray tube, graphite monochromator<br>Optimize for intensity; 1° slit<br>Slow step scan, 0.02°/10 sec<br>Integrated intensity with background subtraction |
| **SAMPLE STABILITY:** | Stable | **CALIBRATION:** | NIST SRM 1878a quartz, NIST SRM 1879a cristobalite, USGS 210-75-0043 tridymite suspensions in 2-propanol. |
| **BLANKS:** | 2 to 10 per set (see step 13.g.) | **RANGE:** | 0.02 to 2 mg $SiO_2$ per sample [2] |
| **BULK SAMPLE:** | High-volume or settled dust; to identify interferences | **ESTIMATED LOD:** | 0.005 mg $SiO_2$ per sample [2] |

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# Conducting Air Sampling

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## Conducting Air Sampling

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- Representative Sampling for Employees in Each of the Established Exposure Groups
  - Capture as Much of the Workshift as Possible to Account for Potential Variations in Exposures (Start-up; Clean-up; Etc.)
- Sampling is Conducting Without Regard to Respiratory Protection
- Personal Sampling is Conducted in the Employee's Breathing Zone
- Send Media to Laboratory for Analysis

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## Exposure Controls

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- Hierarchy of Controls to Decrease Employee Exposure Levels
  - Engineering
    - Substitution
    - Isolation
    - Ventilation
  - Administrative
    - Work Practice Controls Such as Procedures
  - Personal Protection Equipment (PPE)

**PPE is the <u>LAST</u> Line of Defense, Not the First!**

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# Engineering Controls

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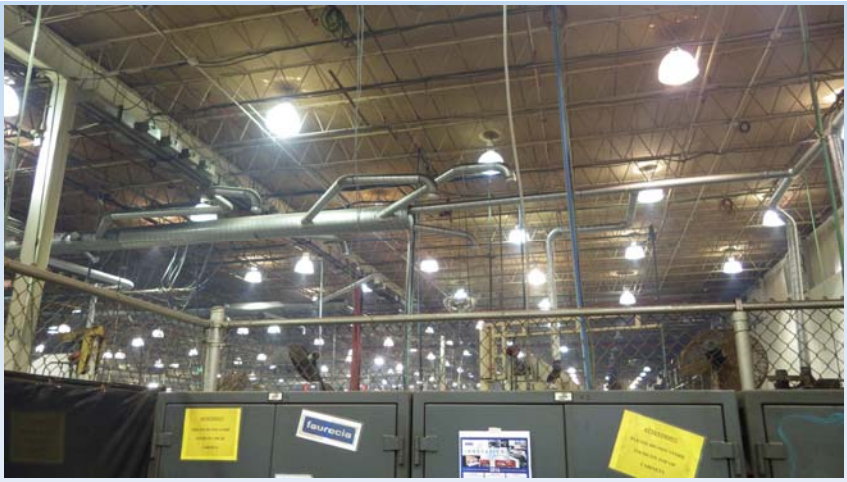


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# Engineering Controls

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- Substitution
  - Replacement of Products Based Upon Hazard to Employees
    - Carcinogens / Teratogens / Mutagens
    - Mixture Composition (Reducing the Amount of Hazardous Chemicals in the Mixture)
  - Example: Use of Low or No Silica Sands
- Isolation
  - Installing a Barrier Between the Worker and the Hazard
  - Example: Placing a Solid Box with Sound Reducing Materials Over a Noisy Pump

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## Engineering Controls Cont.

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- Ventilation
  - General Ventilation
    - Roof Fans
    - Open Doors and Pedestal Fans
  - Local Exhaust Ventilation
    - Installed At or Near the Source of the Contaminant
  - Conduct Performance Testing on a Routine Basis for Air Handling Equipment
    - Control or Capture Velocity
    - Assess Integrity of Ducting
    - Baffle Placement and Utilization (System Balancing)
    - Open Ducts

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## Engineering Controls Cont.

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- Ventilation

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## Administrative Controls

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- Work Practice Controls
  - Good Housekeeping
    - Minimizing Sand Spillage from Conveyors
    - Routine Floor Cleaning to Minimize Impact of Forklift Traffic
  - Established Work Procedures to Conduct a Task
  - Employee Training on Methods to Reduce Exposure
  - Appropriate Supervision to Ensure that Procedures are Being Followed

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## Personal Protective Equipment (PPE)

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## Personal Protective Equipment (PPE)

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- Why is PPE the last line of defense?


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## Personal Protective Equipment (PPE)

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- PPE is only as effective as the user and if anything goes wrong…

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## Summary

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- Prepare a Qualitative Industrial Hygiene Air Sampling Program to Ensure that the Appropriate Representative Sampling will be Conducted and at an Appropriate Frequency
- Perform Air Sampling to Assess Employee Exposure to Contaminants
  - Use the Data to Assess if an Improvement is Necessary
  - Utilize Follow-up Sampling to Measure Improvement upon Employee Exposure Levels
- Implement Effective Exposure Controls

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## Questions

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# One Final Thought….

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