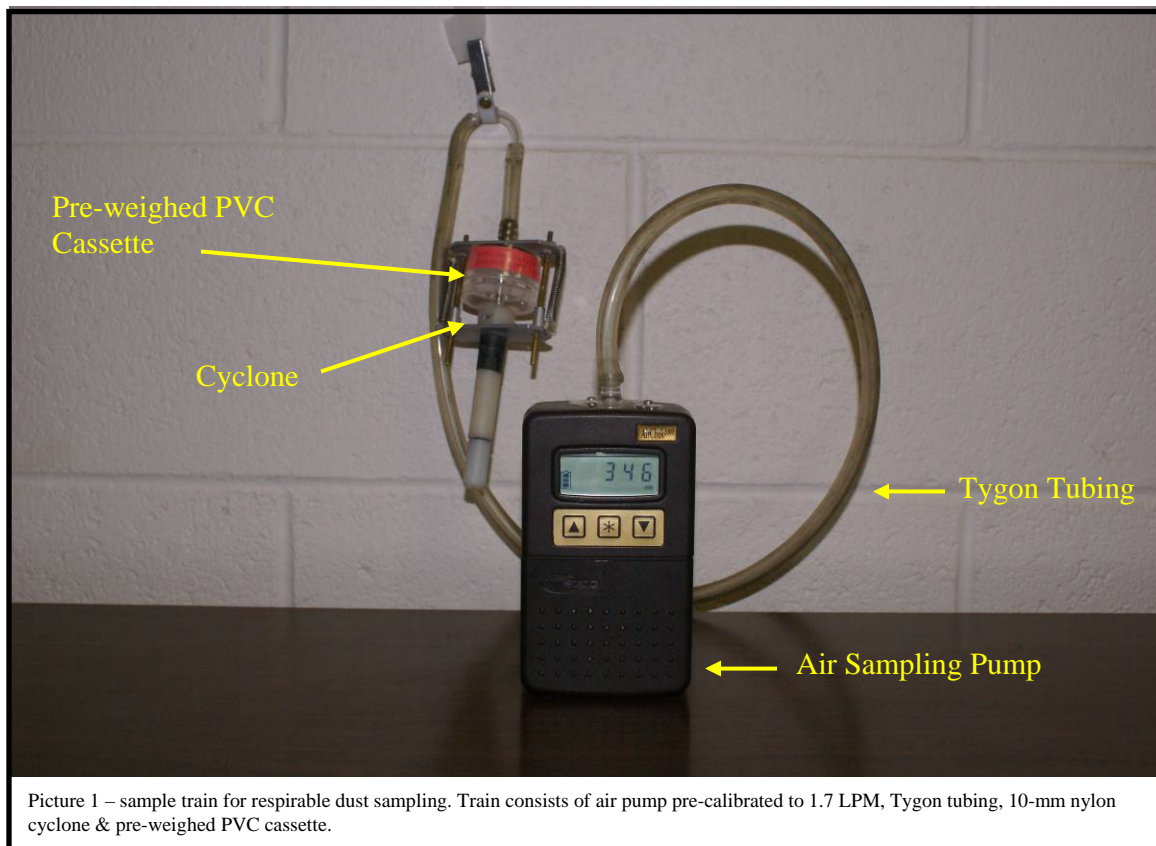


## Chapter 4 Respirable Dust Sampling Procedures

This chapter will demonstrate how to measure respirable dust exposures. Respirable dust is dust that is smaller than 10-microns in size. Respirable dust is sampled using a Dorr-Oliver 10-millimeter nylon cyclone. Picture 1 shows the sampling train needed to sample respirable dust.

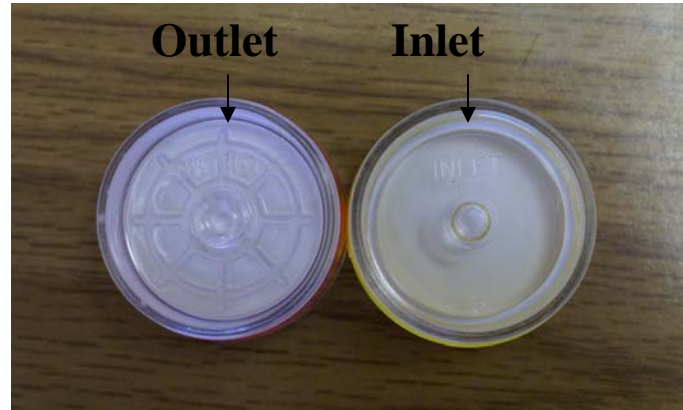
Since free crystalline silica is the most abundant element in the earth's crust, exposures to silica dust are quite prevalent in mining operations. Respirable silica dust is typically produced when drilling, blasting, or cutting silica-containing rock. When crystalline silica enters the lung, fibrotic nodules and scarring can occur around the trapped silica particles. This fibrotic condition of the lung is called silicosis. If the nodules grow too large, breathing becomes difficult and death may result. Silicosis victims are also at high risk of developing active tuberculosis.



The sampling train will consist of:

- Personal sampling pump – There are several different brands of personal sampling pumps available. The sample pump must be calibrated to 1.7 liters per minute (LPM) in order for the 10-mm cyclone to work properly.

- Tygon tubing – the Tygon tubing connects the personal sampling pump to the 10-mm nylon cyclone. The tubing must be long enough that the pump can be worn on the employee’s waist and the cyclone can be mounted on the employee’s collar.
- 10-mm nylon cyclone – There are several different brands of cyclones available. Two most common are MSA & Sensidyne Gillian. (Sensidyne Gillian is shown in picture 1 above).
- PVC preweighed cassette – Preweighed PVC cassettes can be obtained from the lab used to analyze samples. Please note that the cassette outlet says outlet on it. It also has a ‘wagon wheel’ looking air-channel to distribute the air across the filter evenly. This end of the cassette must be connected to the Tygon tubing so air flows into the cassette through the inlet side only.



#### Calibration Procedures:

- Calibrate the air sampling pump following the “Respirable Dust” calibration procedures in the “Pump Calibrations Procedures” chapter.

#### Sampling Procedures:

- Select employee(s) to be sampled. Explain that the purpose of the sampling is to monitor the employee’s exposure to dust over his shift.
- Explain to the employee how the cyclone works and not to tip the cyclone upside down while sampling. (The cyclone works by separating out large particles from the sample stream. The large particles fall to the grit pot at the bottom of the cyclone, and the small particles travel up to the



cassette where they are captured. Tipping the cyclone upside down may cause the large particles to fall to the cassette, contaminating the sample).

- Instruct the employee to wear the sample the entire shift.
- Attach the pump to the employee. This can be done several ways:
  - Attach the pump to the employee's belt
  - Use the carrying case & straps that usually come with a sampling pump
  - Use a vest, such as a fishing vest to carry the pump.
- Attach the cyclone/cassette assembly to the employee's collar. This should be within the employee's breathing zone (within 12-inches around the employee's head).
- Explain to the employee that the sample inlet must face away from clothing, etc. at all times. Do not cover the sample with coat, coveralls, etc.
- Check on the sample every couple of hours to ensure:
  - Pump is still running
  - Sample is still in correct position
  - Employee is still performing same task
  - Etc.

#### Collect Samples When Sampling is Complete:

- Collect sample train
- Record sample run time in minutes
- Perform post calibration as described in the Pump Calibration Procedures chapter
- Shut off pump
- Remove cassette from cyclone and insert plugs into inlet & outlet
- Charge pump for next sampling
- Clean cyclones using soap and water and allow to thoroughly dry
- Send samples to IH-Accredited lab for analysis. Request NIOSH 0600 for respirable dust and NIOSH 7500 for silica analysis. Both analysis will be required to compare to MSHA's TLV.

#### Calculating TLV & Interpreting Results:

- Two results will be received from the lab for each sample:
  - Respirable Dust will be expressed usually in milligrams per sample (mg/sample). This is the total weight of the dust collected on the sample cassette.
  - Silica Weight will be expressed usually in milligrams per sample also. This result expresses the amount of silica contained in the respirable dust. The percent silica must be calculated in order to use MSHA's calculation for determining the TLV for respirable dust containing silica. To calculate the percent silica, divide the weight of the silica by the weight of the respirable dust.
- Calculate TLV by using formula 
$$\frac{10}{(\% \text{silica} + 2)}$$
- Calculate employee exposure
  - Calculate cubic meters of air ran through the sample (average liters per minute (lpm) ran during sampling multiplied by number of minutes the sample ran. For example, if the average of the pre & post calibrations was

1.705 lpm and the sample time was 480 minutes, then use  $1.705 \text{ lpm} * 480 \text{ minutes} * .001 = 0.818 \text{ m}^3$ .

- Please note that if a personal sample is conducted on an employee that works more than an eight-hour shift, then the sample must be shift-weighted (called a Shift-Weighted Average (SWA)) in order to compare the exposure to MSHA's TLV. To shift-weight an exposure, 480 minutes must be used no matter what the sample time was (as long as the sample was more than eight hours). For example, if a full-shift sample was conducted on an employee working a 12-hour shift, then the formula used to calculate the cubic meters would be  $1.700 * 480 * .001$ . Please notice that 480 minutes is used in the SWA, not 720 minutes.
- Calculate exposure:
  - Divide the mg/sample received from the lab by the cubic meters calculated above.

Example, Employee Sampled for Full 12-Hour Shift:

- Respirable dust = ..... 0.24 mg/sample
- Silica = ..... 0.08 mg/sample
- Pre Cal ..... 1.700 LPM
- Post Cal ..... 1.715 LPM
- Shift Duration (12-Hours) ..... 720 Minutes

Calculate Silica Percentage

- % silica =  $(0.08/0.24) = \dots\dots\dots 33\% \text{ silica}$
- TLV =  $10/(33+2) = 10/35 = \dots\dots\dots 0.286 \text{ mg/m}^3$

Calculate Air Volume

- Average Liters per Minute =  $(1.700+1.715)/2 = \dots\dots 1.708 \text{ LPM}$
- Total Liters ( $1.708 \text{ LPM} * 480$ ) = ..... 820 Liters

Please note that 480 minutes is used to Shift Weight the result although the sample time was actually 720 minutes.

- Total cubic meters ( $\text{m}^3$ )  $820 \text{ liters} * .001 = \dots\dots\dots 0.82\text{m}^3$

Calculate Exposure:

- Divide respirable dust by total cubic meters
  - $0.24 \text{ mg per sample} / 0.82\text{m}^3 = \dots\dots\dots 0.29 \text{ mg/ m}^3$
- Exposure compare to TLV
  - $0.29 \text{ mg/ m}^3 / 0.286 \text{ mg/m}^3 = \dots\dots\dots 101\% - \text{Over-exposure}$

In the above example, the employee's exposure was over MSHA's calculated TLV.