# PHOTOMETRIC CALIBRATION FACTOR (PCF) PROCEDURES FOR RESPIRABLE SILICA

APPLICATION NOTE EXPMN-014 (A4)

## Background

Exposure monitoring for respirable silica is conducted in various industries using NIOSH Analytical Method 7500, 7501, 7601, and 7603. All four of these methods involve using a 4 µm cut-point cyclone before a filter attached to a personal sample pump to collect respirable fraction of silica dust on the filter media for analysis at a laboratory.

Permissible Exposure Level (PEL) for Respirable Crystalline (quartz) Silica is 50 µg/m³.

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| Crystalline Silica, Respirable | $\text{PEL} = 50\ \frac{\mu g}{m^3}$ |

After collecting respirable silica samples, the filter cassettes are sent to a laboratory for analysis. These NIOSH reference sampling methods have a time gap between sample collection and receiving results from the analytical lab.

There is a need for a real time sample methods to reduce this time gap. Using real-time, direct reading instruments that provide immediate access to measurement information enables health and safety professionals to quickly recognize exposure and respond promptly to protect workers.

Real-time, light scattering photometric instruments are not considered as reference methods for respirable silica sampling. These instruments are calibrated to a known test aerosol, typically called Arizona Road Dust or A1 Test Dust. Photometric instrument response is precise and very repeatable; however, respirable silica has different light scattering properties than that of the test aerosol. Therefore, a light scattering photometric instrument response will not agree with reference sampling methods until a photometric calibration factor has been developed. The steps below summarize the process for conducting a series of co-located, paired sample sets to collect the necessary data to develop a photometric calibration factor.

# Photometric Calibration Factor (PCF)

Photometric Calibration Factors (PCF) can be developed and used for light scattering photometric instruments for specific aerosols when the aerosol being measured is expected to remain consistent. Using these photometric calibration factors will help photometric measurements align closer to comparable gravimetric reference sample methods.

The steps below outline a procedure to determine a photometric calibration factor for respirable silica using a co-located, paired sample set consisting of a reference method sampler along with a photometric instrument such as a TSI DustTrak™ II Aerosol Monitor or a SidePak™ AM520/AM520i Personal Aerosol Monitor.

## Equipment Needed

- DustTrak II Aerosol Monitor equipped with equipped with Dorr-Oliver cyclone, *or* SidePak AM520/AM520i Personal Aerosol Monitor equipped with Dorr-Oliver cyclone.
- Personal sampling pump with a Dorr-Oliver Cyclone (or other NIOSH approved respirable cyclone) and a 37-mm filter cassette.

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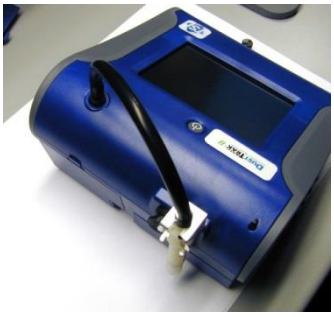
<td>  <br>TSI DustTrak II Aerosol Monitor<br>with Dorr-Oliver Respirable Cyclone</td>
<td>  <br>TSI Handheld DustTrak II with<br>Dorr-Oliver Respirable Cyclone</td>
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<td>  <br>TSI AM520/AM520i Personal Aerosol Monitor and<br>Dorr-Oliver Cyclone</td>
<td>  <br>Sample Pump with<br>Respirable Silica Sampling Train</td>
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## Procedure to Develop Respirable Silica PCF

1. Select work area where respirable silica is generated.
2. Set up photometer and sampling pump in similar manner.
   - DustTrak II or SidePak™ AM520/AM520i/AM510 with a Dorr-Oliver Cyclone.
   - Sample pump with a Dorr-Oliver cyclone before the sampling cassette.
3. Adjust flow rate for appropriate inlet conditioner in use.

   Flow rate set to 1.7 L/min for either instrument using Dorr-Oliver Cyclone.
4. Zero the photometer prior to sampling.

5. Calibrate the sample pump prior to sampling using a respirable cyclone and sacrificial sampling cassette.
6. Co-locate both samplers side-by-side either in a work area or on a worker in the breathing zone.
7. Start photometer and sampling pump at same time, sample for same duration.
    - Data log aerosol measurements with photometer.
    - Collect gravimetric sample with sample pump.
    - Sample time does not need to be full shift like compliance monitoring. The key is to collect at least the minimum volume necessary for valid analysis with the analytical method being used.
8. Sample a few locations to gather data. (***Note**: Ideally use a statistically significant number of samples to properly represent the worker population*.)
    - Review gravimetric data as it becomes available.
    - Conduct more sampling if considerable data variability is found.
9. Send gravimetric samples to an accredited analytical lab.
10. Compare photometric and gravimetric data.
    - Calculate averages for each from representative number of samples.
    - If sample variability is high, collect more samples to improve the representation of the sample population.
11. Calculate new photometric calibration factor using the formula below.

*PCF* = Photometric Calibration Factor
*Reference Concentration* = Average Gravimetric Concentration
*Data Log Concentration* = Average Photometric Concentration
*ECF* = Existing Calibration Factor (by default Factory calibration is 1.0)

$$PCF = \frac{Reference\ Concentration}{Data\ Log\ Concentration} \times ECF$$

12. Enter new Photometric Calibration Factor into the photometer.
13. Repeat the co-located, paired sampling process using new PCF setting in photometer.

    ***Note**: Conducting at least one additional paired sample set using the new PCF will help to verify the photometric calibration factor is applicable to the reference aerosol.*

13. Compare gravimetric and PCF photometric sample data.
    - Results should be closer, "more accurate," using the new PCF.

Using this procedure, photometric calibration factors can be developed for different workplace aerosols. Using gravimetric sampling data as a base line, a photometer programmed with a photometric calibration factor can be used to quickly identify potential workplace exposures with greater accuracy in real time.

  