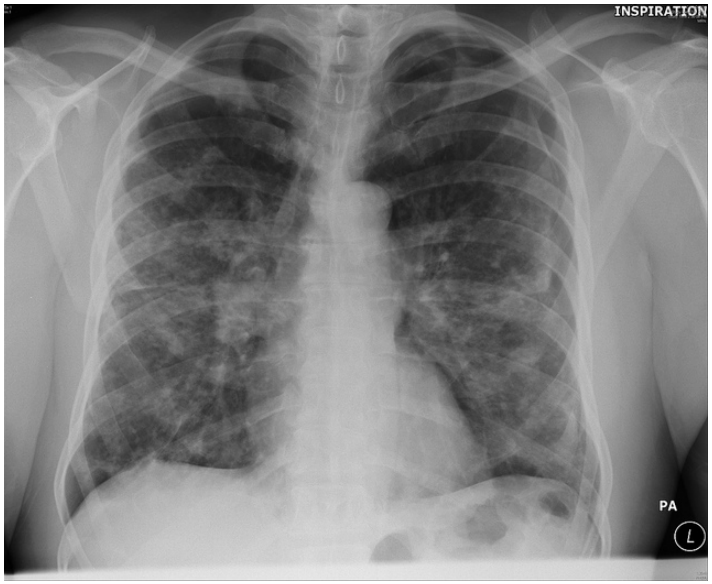
SCIENCE. SERVING PEOPLE.

RESPIRABLE DUST SAMPLERS

PERFORMANCE CRITERIA AND AVAILABLE SAMPLERS

RESPIRABLE DUST
DEFINED

Respirable dust consists of small particles which may penetrate down to the lower gas exchange region of the lung and contribute to lung disease.



WHY USE A RESPIRABLE DUST SAMPLER?

- Because the occupational exposure limit is issued as respirable dust and the published sampling method specifies respirable dust samplers.
- Technically, respirable dust samplers enable size-selective separation and collection of the respirable size fraction from the dust cloud.
- Collecting larger, non-respirable particulates would inflate results of the sample, overestimating exposure.

PERFORMANCE CRITERIA
FOR RESPIRABLE DUST SAMPLERS

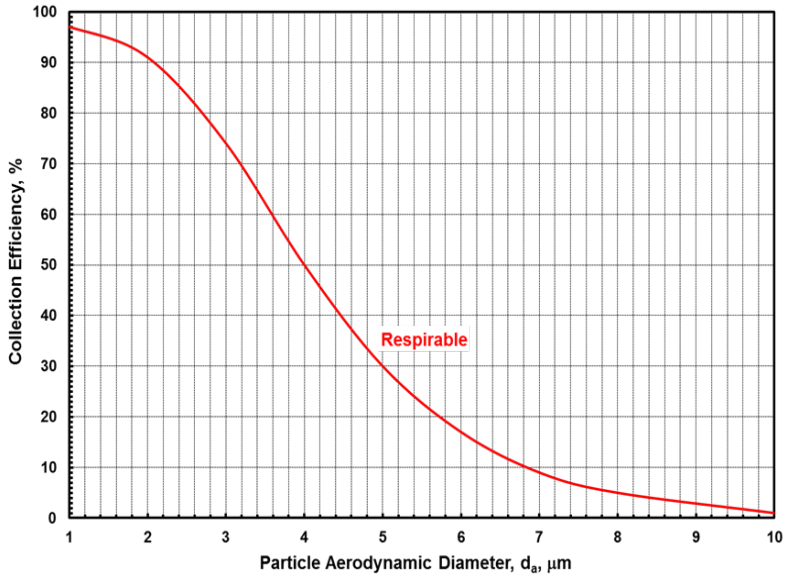
- Most industrial hygiene organizations and standard setting bodies around the world have adopted the performance criteria specified in ISO 7708.
- ISO 7708 is also known as the ISO/CEN convention.
- ISO=International Standards Organization.
- CEN=Committee for European Normalization.

PERFORMANCE CRITERIA
FOR RESPIRABLE DUST SAMPLERS

- In the U.S.A., ISO 7708 has been adopted by ACGIH and is described in the TLV booklet.
- U.S. NIOSH also specifies ISO 7708 performance criteria in their respirable dust methods.
- U.S. OSHA has adopted ISO 7708 in the 2016 final rule on respirable crystalline silica.

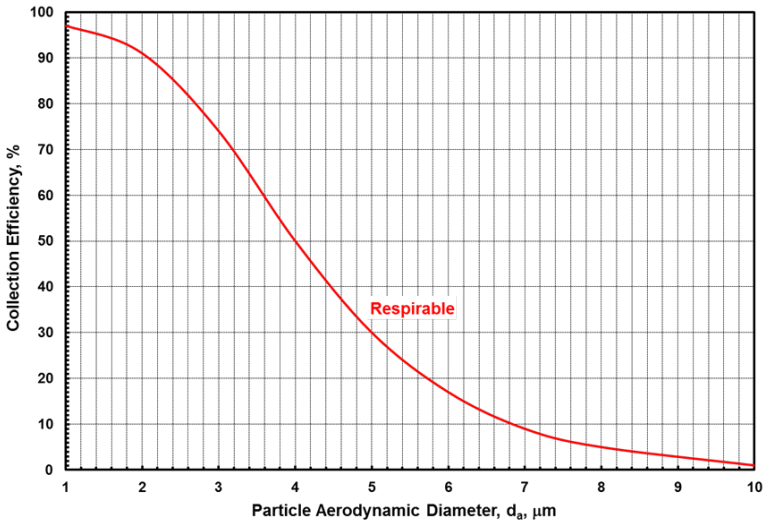
ISO 7708 CRITERIA
FOR RESPIRABLE DUST SAMPLERS

The ISO 7708 performance criteria is essentially a collection efficiency curve that specifies the efficiency of the sampler for particles of designated sizes.

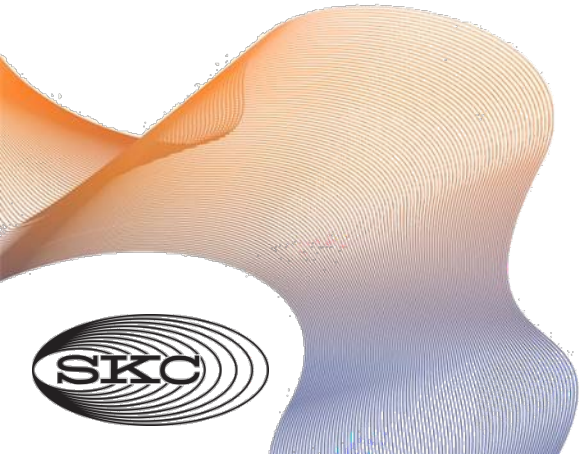


A FREQUENTLY USED SPECIFICATION: 50% CUT-POINT

- The 50% cut-point is the particle size that the sampler collects with 50% efficiency.
- Looking at the ISO 7708 curve shown, you can see that the size of dust that the samplers must collect with 50% efficiency is 4 um.
- Particles smaller than 4 um are collected with an efficiency greater than 50%.



TYPES OF RESPIRABLE DUST SAMPLERS: TRADITIONAL



CYCLONES

- Function on the same principle as a centrifuge
- Use rapid circulation of air to separate particles according to their aerodynamic diameter when connected to a sampling pump at the designated flowrate.

CYCLONE OPERATION

- Air enters through a slit on the side of the sampler which creates cyclonic action.
- Large particles fall into the cap (grit pot) at the bottom and are discarded.
- Small particles are thrown up onto the filter for analysis.

Cap (grit pot) must be in place during sampling.

OLDER CYCLONE:
10-mm NYLON DORR-OLIVER

- U.S. OSHA inspectors have been using this cyclone since the 1970s.
- Cyclone suffers from orientation bias and electrostatic charge issues that may cause particles to stick to the side of the cyclone.
- Not available from SKC.
- Used at 1.7 L/min to meet ISO 7708 criteria

SKC ALUMINUM CYCLONE
DESIGN FEATURES

- Metal construction eliminates electrostatic effects.
- Larger collection area. The cyclone is inserted into the middle ring of a 3-piece filter cassette.
- Calibration adapter offers user convenience.
- Used at 2.5 L/min to meet ISO 7708 criteria

SKC 225-01-01/02

SKC GS-3 CYCLONE
DESIGN FEATURES

SKC 225-100/103

- Conductive plastic construction eliminates adverse electrostatic effects
- Not a spark hazard for underground mines
- Three inlet slits overcomes orientation bias seen in Dorr-Oliver cyclone
- Used at 2.75 L/min to meet ISO 7708 criteria

GS-1 CYCLONE

FOR U.S. MSHA REQUIREMENTS

SKC 225-105

- As of 2018, U.S. MSHA has not adopted the ISO 7708 criteria.
- SKC offers this single inlet GS cyclone as a Dorr-Oliver equivalent for existing MSHA requirements.
- Used at 3 L/min to achieve the 3.5 µm cut-point specified by U.S. MSHA in their silica standard.

SKC LTD PLASTIC CYCLONE FROM U.K.

NOTE: IMPORTANT CHANGE IN FLOWRATE FOR 225-69 SERIES CYCLONES

- Higgins-Dewell style cyclone available in 25- or 37-mm options.
- A flowrate of 2.2 L/min was previously specified by SKC.
- But a 2018 study by the HSL in the UK indicates the sampler oversamples at this flowrate.
- A flowrate of 3.0 L/min is a match to the ISO 7708 criteria. Report available upon request.

IMPORTANT NOTE ON FLOWRATE

- All cyclones are not created equal!
- Be sure you know the flow rate specified for the cyclone being used.

DESIGNATED FLOWRATES
TO MEET ISO 7708

1.7 L/min
Nylon
Dorr-Oliver

2.5 L/min
Aluminum

2.75 L/min
GS-3

NOW 3.0 L/min
SKC Plastic
from UK

TIPS FOR SAMPLING
WITH SKC AL OR GS CYCLONES

- Load filter into a 3-piece filter cassette.
- Remove entire inlet piece (not just the plugs) and insert the cyclone into the middle ring of the cassette.
- Calibrate the pump with the sampler in-line at the designated flowrate to meet the criteria.
- Remove the device from the workers and remove the cyclone from the filter cassette being careful not to invert the cyclone.
- Recap the cassette with the inlet piece and send to the lab. Clean cyclone before reuse.

TIPS FOR CALIBRATION

SKC ALUMINUM CYCLONE

- A handy calibration adapter fits over the cyclone and allows standard tubing to be attached for connection to the pump calibrator.
- The calibration adapter fits both the 25-mm and the 37-mm aluminum cyclones.

SKC 225-01-02
(37-mm)

SKC 225-01-03

TIPS FOR CALIBRATION

SKC GS CYCLONES

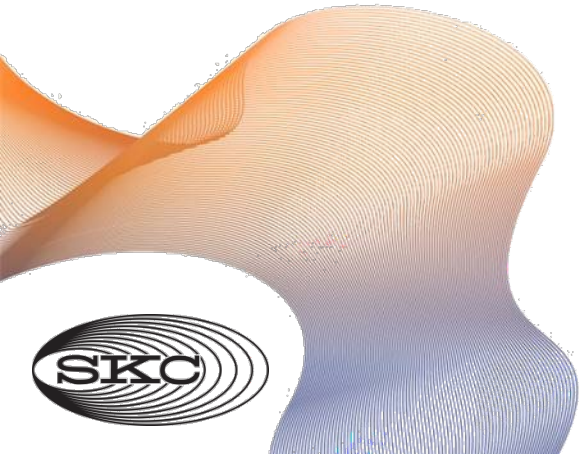
Calibration Jar
SKC 225-111/112

- The SKC GS cyclones and the nylon Dorr-Oliver cyclones (not sold by SKC) do not have a calibration adapter.
- You will need to place these cyclones into a calibration jar to measure the flowrate.

TIPS FOR POST-SAMPLE CLEANING

- After sampling, clean all parts of the cyclone, with mild soapy water.
- Do not use strong solvents to clean plastic cyclones.
- Don’t forget to clean the grit pot.
- Dry the cyclone. (Air-dry or blow-dry)

TYPES OF RESPIRABLE DUST SAMPLERS: NEWER DEVICES



MULTI-DUST FOAM DISCS

SKC 225-772

- Developed by the UK Health and Safety Laboratory
- Inserted into the IOM inlet
- Foam discs scrub out larger particles.
- Dust collected onto filter is respirable.
- Dust on foam PLUS filter is inhalable.

MULTI-DUST PERFORMANCE
RELATIVE TO THE CRITERIA

Certificate of Conformity

Testing carried out according to BSEN 13205 (2002)
Foam insert for the respirable fraction EN481 (1993)
Tested at the Health and Safety Laboratory,
Harpur Hill, Buxton, SK17 9JN

19th October 2017

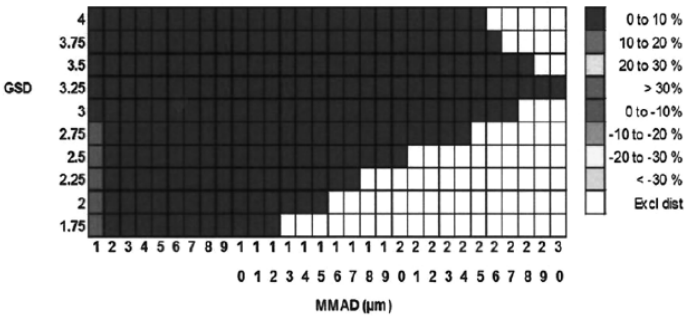
HEALTH & SAFETY LABORATORY
www.hsl.gov.uk

D50 Cut off Particle Size

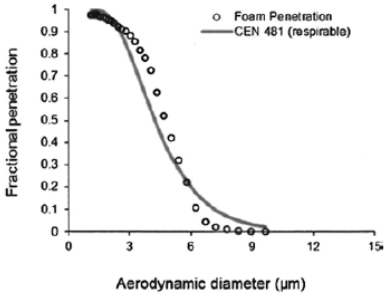
I.D.	D50 (µm)	Dia (mm)	Len (mm)
REC1	4.83	15.63	12.14
REC2	4.73	15.82	12.29
REC3	4.94	15.70	12.00
REC4	4.93	15.76	12.05
REC5	4.87	15.73	11.79
REC6	4.63	15.87	12.20
REC7	4.80	15.50	12.40
REC8	4.87	15.86	11.77
REC9	4.76	15.40	12.45
REC10	4.87	15.58	11.97
Mean	**4.82**	**15.69**	**12.11**
SD	0.10	0.16	0.23
Target	4.25		

Sample flow rate: 2 l/min

Bias Map
Foam Insert Batch Reference:
Batch 1



Measured Mean Penetration



Bias Performance Criteria (BPC): 85% or more of all the calculated biases are within ± 10%
CONFORMS

Signed: a Thorpe
Date: 26/10/2017

This certificate of conformity indicates that the above foam inserts were tested at the above establishment on the designated date and that the foam inserts complied with the Bias Performance Criteria of BSEN 13205 in which 85% of the calculated biases are within ± 10%

NEW RESPIRABLE DUST IMPACTORS FROM SKC IN U.S.

PARALLEL PARTICLE IMPACTORS (PPIs)

Reusable aluminum

Single-use disposable plastic

SKC PPI SAMPLERS
DESCRIBED IN 2016 U.S. OSHA FINAL RULE ON SILICA

The *Federal Register* notes on page 16439 that in addition to traditional cyclones:

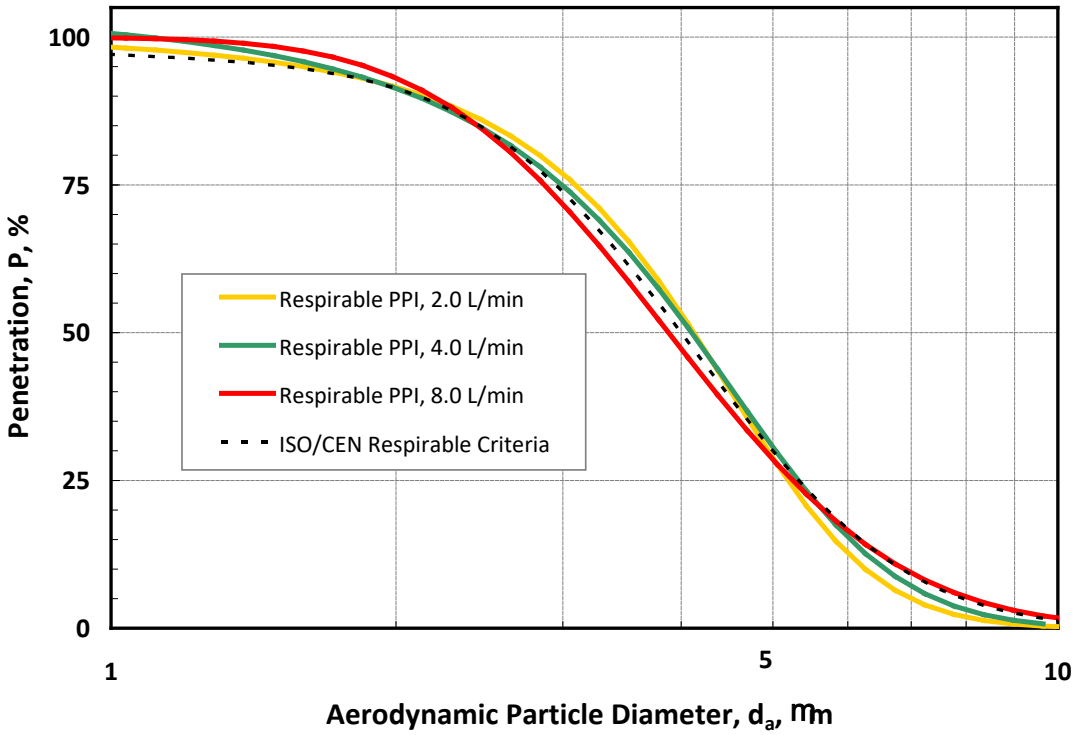
- "There are also personal impactors available for use at flowrates from 2 to 8 L/min that have been shown to conform closely with the ISO/CEN convention".
- These personal impactors are SKC PPI samplers.

DISPOSABLE PPI SAMPLERS

Same filter and same analysis as with cyclones. One time use.

- Instead of a cyclone, PPI impactors have 4 internal, pre-oiled plates that scrub out larger particles. The impactor plates are sonically welded into place and require no assembly.
- The pump draws the air into the PPI. Larger particles are scrubbed out onto the plates and the smaller respirable dust is collected onto the PVC filter for analysis as usual.

PPI SAMPLER PERFORMANCE
COMPARED TO ISO 7708



Data is published in the *Journal of Physics* and is available upon request.

FLOWRATE OPTIONS

DISPOSABLE PPI

2 L/min
225-3851

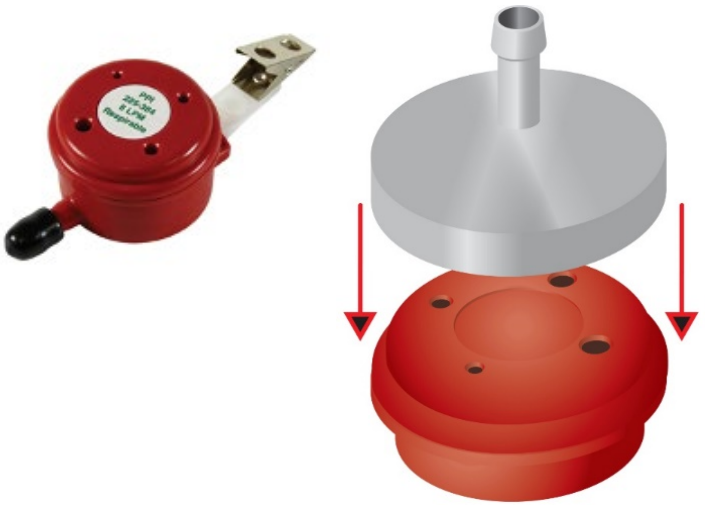
8 L/min
225-3841

4 L/min
225-3871

- Single-use, disposable PPI models are available for use at either 2, 4, or 8 L/min.
- Most popular model is 2 L/min.
- Higher flows allow for quantitative analysis even for shorter sample durations.

ADVANTAGE OF PPI

- A handy calibration adapter is available to attach the disposable PPI to the calibrator.
- No calibration jar is needed.



BIGGEST ADVANTAGE OF PPI

No tipping hazard! You can invert the sampler without causing large particles to land on the filter invalidating the sample.

PPI: NOT JUST FOR SILICA

FOR SAMPLING ANY RESPIRABLE DUST

- Like a cyclone, the PPI can be used for sampling any type of respirable dust.
- For sampling respirable dust followed by gravimetric analysis, you will need to use a PPI with PRE-WEIGHED filters now available from SKC or your lab.

THANK YOU FOR YOUR INTEREST

- Please visit the SKC website for more training options and details on SKC samplers.
- Email skctech@skcinc.com with questions or contact your local SKC representative.