

CALIBRATION AND USE OF PERSONAL SAMPLING PUMPS

Purpose: To become familiar with the use of filter media and personal sampling pumps as tools for sampling airborne particulates and other aerosols and to calibrate a personal sampling pump using primary and secondary calibration standards.

Equipment: Personal Sampling Pump (Filter Type)
 Millipore 37 mm dia. filter 0.8 μ m pore size in plastic
 aerosol monitor cassette
 Tubing
 1 Liter Burette
 Soap Solution
 Stopwatch
 Precision Rotometer

- Procedure:**
- I. Review calculations and equipment.
 - II. Perform pump calibration using precision rotometer and observe pump calibration using soap bubble meter.
 - III. Use pump and filter to simulate a field measurement.

PART I

Introduction: Sampling and Sampling Equipment

In most cases, sampling is conducted in order to determine the concentration of a contaminant to which an employee may be exposed while performing a specific job. The airborne concentration of a contaminant is determined by measuring the amount of contaminant in a given volume of air sampled and calculated using the equation listed below:

$$\text{Airborne Contaminant Concentration} = \frac{\text{Amount of Contaminant Collected}}{\text{Volume of Air Sampled}}$$

Filtration is the most widely used technique for particulate or other aerosol sampling because of its low cost and simplicity. Using this sampling method, the amount of contaminant collected is determined by chemical and/or physical analyses of the filter. Laboratory results will provide this data.

The volume of air sampled can be determined only if the flow rate of the pump and the sampling time are known. The pump flow rate refers to the volume of air the pump draws through the filter each minute it is operating. The total volume of air sampled is calculated using the following equation:

$$\text{Volume of Air Sampled} = \text{Flow Rate} \times \text{Sampling Time}$$

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Calibration and Use of Personal Sampling Pumps

The flow rate can be determined only through calibration of the sampling pump.

The common instrumentation and supplies used for aerosol sampling by filtration are described below.

A. Filter Cassette

The filter cassette is an assembly with three basic components:

- Sampling Filter
- Back Up Pad
- Filter Holder (Cassette)

The sampling filter may be one of several material types including:

- Mixed Cellulose Ester Filters (MCEF)
- Glass Fiber Filters
- Polyvinyl Chloride (PVC) Filters
- Silver Membrane Filters

They may also be of various pore sizes and diameters.

The cassette may have two or three parts or stages. The two stage cassette is used only for closed face sampling; the three stage cassette may be used either closed or open face mode.

The selection of the type of filter, the filter pore size, and the sampling mode (open or closed face) will depend on the contaminant sampled.

For sampling lead and asbestos, a mixed cellulose ester filter with a diameter of 37 mm is required. The filter is mounted in a cassette with a back up pad. Sampling must be conducted closed face for lead (2 or 3 stage cassette) and open face for asbestos (3 stage cassette only).

B. Sampling Pump

Battery operated diaphragm pumps called personal sampling pumps, are used to draw air through the filter which then traps the particles. Most personal sampling pumps will operate for up to 8 hours sampling time before needing recharging. Recharging time is usually overnight (16 hours). The pump must be capable of pulling at least 2 liters of air per minute through the filter. A rotameter (or flowmeter) on the side of most pumps can be used to determine the flow rate at which the pump is operating.

PART II

Calibration of Sampling Pumps

Calibration is the process by which the flow rate corresponding to each pump rotameter setting is determined. The pump rotameter may be calibrated using primary or secondary standard. The soap bubble meter is a primary standard, and calibration using this method involves direct measurements of volume and time. Secondary standards such as precision rotameters are reference instruments which must be periodically calibrated against a primary standard.

Abbreviations

AL	- Action level. - A concentration that is 50% of the TLV.
Bq/d	- Background radiation level in d/m or mR/hr.
d/m	- Counts per minute.
dB(A)	- Decibels measured by a sound level meter set on the A scale.
d/m	- Disintegrations per minute.
Fibers/ cm^3	- Number of fibers per cubic centimeters of air. Asbestos concentrations in air are usually expressed in fibers/cm^3. Equivalently, it is sometimes written as fibers/cc.
GM Counter	- Geiger-Mueller radiation counter tube.
Hz	- Hertz. 1 Hz = 1 cycle per second.
LEL	- Lower Explosive Limit.
LFL	- Lower Flammable Limit. The lower limit of flammability of a gas or vapor. Expressed as percent of substance in air.
L_p	- Sound Pressure Level.
mg/m^3	- Milligrams contaminating substance per cubic meter air. Liquids and toxic solid concentration in air are usually expressed as mg/m^3. For some substances (e.g. lead) $\mu\text{g/m}^3$ is used. 1,000 $\mu\text{g/m}^3$ equals mg/m^3.
MPCCL	- Maximum Permissible Contamination Level.
mR/hr	- Millirontgens per hour.
$\mu\text{g/m}^3$	- Micrograms contaminating substance per cubic meter air. See also mg/m^3.
mW/cm^2	- Milliwatts per square centimeter. Power density term used in the field of microwave radiation.
PEL	- Permissible Exposure Limit as defined by OSHA regulations.
ppm	- Parts of contaminating substance per million parts of air by volume. Gas and vapor concentrations in air are usually expressed in ppm.
SLM	- Sound Level Meter.
TLV	- Threshold limit value. It refers to airborne concentrations of substances and represents conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect.

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