

Sampling for Air Contaminants

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The primary purpose of monitoring airborne contaminants is to determine if employee exposures are in compliance with appropriate Occupational Safety and Health Administration (OSHA) exposure limits. OSHA exposure limits include eight (8) hour Permissible Exposure Limits (PEL), eight (8) hour Action Levels (AL), ceiling limits and peak exposure concentrations. Definitions of these exposure limit terms and exposure limits for potential Bell System air contaminants are attached.

In each case the exposure limit is given in terms of an amount of contaminant per unit volume of air.

The expressions commonly used to denote exposure limits are given in metric units. They include the following:

mg/m^3 - Milligrams of a contaminant per unit volume of air (cubic meters).

$\mu\text{g}/\text{m}^3$ - Micrograms of a contaminant per unit volume of air (cubic meters).

$\text{fibers}/\text{cm}^3$ - Number of fibers per unit volume of air (cubic centimeters). This expression is used almost exclusively for asbestos.

The term mg/m^3 can be converted directly into the expression parts per million (ppm) but only when the contaminant is a gas or vapor. PPM can then be converted into a percent in air value if desired.

In order to obtain results that can be used to assess compliance, we must select a sampling method which will reflect an employee's exposure over the time period specified by the exposure limit. Usually this is accomplished by using a personal sampler, which will sample in the operator breathing zone (OBZ) over a 7-8 hour period.

The personal sampler generally consists of a portable air pump and a contaminant collection device. Using this instrumentation allows one to determine the amount of a contaminant in a given unit volume of air.

The amount of contaminant is obtained from analytical results. It is important that the results are in the units specified in the appropriate exposure limit (e.g., mg or μg or fibers, etc.).

The volume of air sampled can be calculated from the pump flow rate and the total time the pump was operated as shown below:

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

The pump flow rate is determined by prior pump calibration and is generally expressed in liters per minute (Lpm). The time sampled can be easily determined in minutes. Multiplying these values gives the total volume of air sampled in liters.

Once the amount of contaminant collected and the volume of air sampled is determined, the exposure concentration can be calculated readily as shown on the attached sample problems.

An 8-hour integrated sample which can be used to determine compliance with OSHA 8-hour PELs may be obtained by sampling, using one collection device over the full work shift. However, it is sometimes necessary or desirable to break up the sampling period using several collection devices over the full work period. In this case the average 8-hour exposure may be determined by calculating a time weighted average concentration (TWA). An example of a TWA calculation for three samples collected during personal monitoring for lead is also attached.