

SUBJECT: Citation Guidelines for Air Contaminant Overexposures

Purpose: This instruction provides guidelines to promote uniform enforcement of Subpart Z, and to provide guidance on the use of the mixture formula, 1910.1000(d).

Scope: This instruction applies MNOSHA-wide

References:

- a. MNOSHA Instruction Field Compliance Manual.
- b. CPL 2-2.120, Respiratory Protection Enforcement Guidelines
- c. Technical Manual (Section II, Ch. 1, SAEs for chemical mixtures)
- d. Federal OSHA's email interp, dated February 4, 2011 (silica PEL for construction)

Cancellation: This instruction supersedes MNOSHA Instruction STD 1-4.1, Citation Guidelines for Air Contaminant Overexposures, dated October 20, 2011.

Background: One OSHA standard, 1910.1000, contains permissible exposure limits (PELs) for several hundred contaminants. The remainder of Subpart Z contains substance-specific standards. PELs include 8-hour averages, ceiling, and short term limits. Employees may be exposed to any combination of chemicals and for any exposure durations. Paragraph 1910.1000(d) allows for the calculation of a combined 8-hour TWA dose when an employee is exposed to multiple contaminants in Subpart Z which have the same health effects. Similar language is not found in the Construction standard, 1926.55.

When an employee has been exposed to more than one such contaminant and one or more concentration is already above its PEL, questions arise as to whether to include the results of a combined dose calculation. Reduction of one contaminant concentration does not guarantee a similar reduction in all other concentrations, nor does it guarantee that after all concentrations are individually reduced below their respective PEL, that the mixture dose will also be below 1.0.

In addition, employees may be exposed to contaminants which have multiple PELs, such as 8-hour and short term, and exposure may exceed each PEL. These are found in 1910.1000, or in substance specific standards.

The following mention of overexposures also assumes concentrations exceed any relevant sampling and analytical errors (SAEs).

Action:

A. One Substance

1. **Substance Specific**
Consult each standard for appropriate paragraphs to cite. Many requirements are triggered by exposure level or number of days exposed.
2. **Single Limit Overexposures**
 - a. One instance: Overexposures to an 8-hour TWA, Ceiling, Peak or STEL limit for one substance shall be cited and grouped with 1910.1000(e), engineering controls (or 1910.252(c)(1)(iii) in place of 1910.1000(e) in the case of welding fume overexposures in general industry). 1910.134(a)(2) will be cited separately if respirators were not provided, or if respirators were provided but there were one or more deficiencies in the respiratory protection program (e.g. lack of fit testing, damaged respirator).

- b. Multiple instances: all occurrences (including more than one employee) of a violation of a PEL (ceiling, peak, STEL or 8-hour TWA) shall be grouped and cited separately (i.e., once) for each PEL that was violated. Each occurrence is listed as a separate instance in the AVD. Engineering controls shall be grouped with the violation. 1910.134(a)(2) will be cited separately one time (for all instances) if respirators were not provided, or if respirators were provided but there were one of more deficiencies in the respiratory protection program (e.g. lack of fit testing, damaged respirator). In the 1910.134 (a)(2) AVD, list the respirator deficiencies as they pertain to each substance.

3. Multiple Limits

Overexposures to 8-hour and Ceiling, Peak or STEL limits for the same contaminant may not be combined and shall be cited and penalized separately. Each item should be grouped with engineering controls, and cite respiratory protection as outlined in A.2. The abatement guidelines for any 1910.134(a)(2) citation should include the full respiratory protection guidelines, if necessary.

4. Exposures to contaminants with no PEL, but REL or TLV exists

Exposures at concentrations above a recommended limit does not prove that a hazard exists. OSHIs must document that a hazardous exposure is occurring or has occurred at the workplace and also include the basis for using a NIOSH REL or an ACGIH TLV, or a manufacturer's recommended limit. A general duty citation may be issued in these circumstances. The OSHI should consider a citation for 1910.134(a)(2) which requires respiratory protection when necessary to protect an individual and is not necessarily tied to a limit.

B. Two or More Substances

1. Dissimilar Health Effects.

Each limit listed in subpart Z is to be considered a separate standard for purposes of determining appropriate citations. Overexposures to the 8-hour TWA of two or more air contaminants with dissimilar health effects shall be cited separately (do not use the mixture formula). Each item should be grouped with engineering controls, and cite respiratory protection as outlined in A.2 (with one 1910.134(a)(2) citation for all instances). The abatement guidelines for any 1910.134(a)(2) citation should include the full respiratory protection guidelines, if necessary.

2. Similar Health Effects (Use of the Mixture Formula)

a. General Guidelines

- i. The mixture formula may only be used for 8-hour TWA exposures, not Ceiling, Peak or STEL.
- ii. The mixture formula may only be used when contaminants affect the same target organs.
- iii. The mixture formula may be used with contaminants which have their own specific standard.

- b. Exposures to mixtures with similar health effects when no single concentration is above the PEL.

If no single contaminant is above its 8-hour TWA PEL, but the combined dose calculation determines that a violation exists, cite 1910.1000(d) grouped with

1910.1000(e), engineering controls, and cite respiratory protection as outlined in A.2. Document which health effects were considered the basis for using the mixture formula. Include the contaminants in the AVD of the 1910.1000 citation. See CPL 2-2.120, Respirators, for further discussion on respiratory protection program evaluation and citations.

- c. Exposures to mixtures with similar health effects when only one concentration is above the PEL.

Follow the procedure outlined in d below

- d. Exposures to the 8-hour TWA of two or more air contaminants when both (or more) exceed its PEL.

Cite each contaminant for exceeding the PEL grouping each with 1910.1000(e), engineering controls, or the appropriate paragraphs from the substance specific standard. Also cite respiratory protection as outlined in A.2 as necessary. Also cite separately 1910.1000(d) grouped with 1910.1000(e) but do not propose a penalty for 1910.1000(d). The Abatement Guidelines for any 1910.134(a)(2) citation should include the full respiratory protection guidelines, if necessary. Document which health effects were considered the basis for using the mixture formula.

- e. Exposures to respirable dust and respirable silica from the same operation(s).

Because the silica content is a portion of the dust, only one citation should be written when both respirable dust and respirable silica limits are exceeded. Cite 1910.1000(a) grouped with 1910.1000(e) and include each exposure as a separate instance in the AVD. Also cite respiratory protection as outlined in A.2 as necessary.

3. Specific examples

- a. Exposures to welding fumes

When an overexposure to welding fumes is measured, paragraphs 1910.1000(a), 1910.1000(e) and 1910.252(c)(1)(iii) apply. However, because 1910.1000(e) allows for the use of administrative controls to reduce employee exposure, it is less protective than the language in 1910.252, which requires mechanical ventilation. The welding standard is also the more vertical standard. Therefore, cite 1910.1000(a)(3), grouped with 1910.252(c)(1)(iii) when an overexposure to welding fumes is measured, and remove any mention of administrative controls in the Abatement Guidelines. Also cite respiratory protection as outlined in A.2 as necessary.

b. Exposure to Cristobalite in Construction

The PELs for air contaminants in the Construction Industry are listed in 1926.55. They were derived from the 1970 ACGIH TLV® list and include a table for Mineral Dusts. It is federal OSHA's position that the 1970 TLV for cristobalite was intended to be the same as for quartz, however, the Mineral Dust Table was adopted and/or printed with a typographical error and has never been corrected. Furthermore, the entry in the ManComm version provided to OSHIs is not correct either. Violations of the crystalline cristobalite PEL shall be issued under 1926.55.

C. Sampling and Analytical Error (SAE)

The sampling result is seldom 100% accurate in reflecting the true exposure. The SAE is a combination of errors inherent in sampling, analysis and pump flow. Among the factors affecting the accuracy are: flow rate and sample volume, collection efficiency, sample stability, efficiency of recovery from sampling media, interferences introduced by sampling substrate, and effect of other co-contaminants present during sampling, storage and analysis. (ref: federal OSHA)

The formula for the SAE is:

$$\text{SAE} = \sqrt{(\text{SAMPLE PUMP ERROR})^2 + (\text{ANALYTICAL ERROR})^2} \times 1.645$$

Where Analytical Error is expressed as the Relative Standard Deviation (RSD), which is the same as the Coefficient of Variation (CV) of the analytical process. $\text{RSD} = \text{CV} = \text{STD Dev}/\text{Mean}$

Sample Pump Error should be expressed as an RSD also. A value of 5% (0.05) is considered standard.

Using 1.645 in the formula leaves a 5% one-sided uncertainty tail.

Typical SAE values range from 8-25%, but can be higher.

In all cases where a citation for exceeding a PEL is being considered, the exposures must also exceed the SAE for the sampling and analytical method. For a single sample, if the [Dose minus SAE] is greater than 1.0, then there is a 95% chance that the measured exposure is really over the PEL, and a citation may be proposed. When multiple samples are collected, the SAE calculation is more involved. Consult the federal OSHA technical manual, TED 01-00-015, Section II, Chapter I, Part XI.

The SAE is unique to a given analytical method and laboratory. One cannot rely on previously published data. Therefore, if you need to obtain an SAE, contact the lab that conducted the analysis and request an analytical relative standard deviation (MDH). In the past, the ALS laboratory has provided CV, which they derive from the Standard Deviation/average % recovery.

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