

function of reducing employee exposures to airborne contaminants by being in correct working order. Accordingly, employers must maintain the respirator properly, with no defects such as cracked or distorted facepiece seals, missing exhalation valves, broken straps, or any other defect that would cause leakage into the respirator or prevent proper operation. For air-purifying respirators, the filters must be appropriate for the airborne contaminant, and provide an adequate service life.

Employers must properly fit and train employees for respirator use, which addresses the requirements in paragraphs (f) and (k) of the Respiratory Protection Standard. Therefore, employers must fit employees with the size and model of respirator they will be using in the workplace. They must then wear that same size and model of respirator in the workplace, and follow the training they receive for performing respirator seal checks, inspections for correct respirator operation, and proper donning and wearing the respirator.

## 2. Maximum Use Concentration

Employers use MUCs to select appropriate respirators, especially for use against organic vapors and gases since the MUC specifies the maximum atmospheric concentration of a hazardous substance against which a specific respirator or class of respirators with a known APF can protect employees who use these respirators. MUCs are a function of the assigned protection factor (APF) determined for a respirator (or class of respirators) and the exposure limit of the hazardous substance.

Ed Hyatt in the 1976 LASL report on Respiratory Protection Factors (Ex. 2) recounted the early history of maximum use concentration (MUC), starting with the MUC recommendations of the joint American Industrial Hygiene Association and American Conference of Governmental Industrial Hygienists committee in 1961. This committee recommended that, for highly toxic compounds, full facepiece respirators with high-efficiency filters should use a maximum limit of 100 x the threshold limit value (TLV). In 1961, in the United Kingdom, Hyatt noted that Letts recommended that half-mask dust respirators provided effective protection against airborne contaminants no greater than 10 x the TLV.

In 1974, NIOSH and OSHA started the Standards Completion Program to develop standards for substances with existing permissible exposure limits (PELs). This process resulted in the development of NIOSH Criteria

Documents, each of which provided technical information and recommendations for specific airborne contaminants. These documents also recommended MUCs for different types of respirators; NIOSH obtained the information for these MUCs from various sources, including NIOSH Current Intelligence Bulletins and recognized industrial hygiene references. NIOSH later published this information in its Pocket Guide to Chemical Hazards. Other source documents for MUC definitions and regulations include the 1987 NIOSH RDL, and the ANSI Z88.2-1980 and ANSI Z88.2-1992 respiratory protection standards.

OSHA's 1994 proposed Respiratory Protection Standard contained the following definition for MUC:

*Maximum use concentration (MUC)* means the maximum concentration of an air contaminant in which a particular respirator can be used, based on the respirator's assigned protection factor. The MUC cannot exceed the use limitations specified on the NIOSH approval label for the cartridge, canister, or filter. The MUC can be determined by multiplying the assigned protection factor for the respirator by the permissible exposure limit for the air contaminant for which the respirator will be used.

Several commenters to the 1994 proposal recommended alternatives to this definition. Reynolds Metal Company recommended defining MUC as "the maximum concentration of an air contaminant in which a particular respirator can be used, based on the respirator's assigned protection factor" (Ex. 1-54-222). The American Petroleum Institute (API) noted NIOSH developed the term "MUC," and that, to avoid confusion, OSHA should not use the term (Ex. 1-54-330). API proposed using the term "assigned use concentration" to replace "MUC"; API defined "assigned use concentration" as "the maximum concentration of an air contaminant in which a particular respirator can be used, based on the respirator's assigned protection factor" (Ex. 1-54-330). However, when the Agency published the final Respiratory Protection Standard in 1998, it reserved the definition of MUC in paragraph (b) and MUC requirements in paragraph (d)(3)(i)(B) for future rulemaking.

Employers use MUCs to select appropriate respirators, especially for use against organic vapors and gases. In this regard, the MUC specifies the maximum concentration of a toxic vapor or gas at which a respirator will provide protection to an employee who uses the respirator. Accordingly, in this

proposed rulemaking, OSHA defines MUC as follows:

*Maximum use concentration (MUC)* means the maximum atmospheric concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance. The MUC usually can be determined mathematically by multiplying the assigned protection factor specified for a respirator by the permissible exposure limit, short-term exposure limit, ceiling limit, peak limit, or any other exposure limit used for the hazardous substance.

Under this proposed definition, MUC represents the maximum atmospheric concentration of a hazardous substance against which a specific respirator or class of respirators with a known APF can protect employees who use these respirators. Accordingly, MUCs are a function of the assigned protection factor (APF) determined for a respirator (or class of respirators) and the exposure limit of the hazardous substance.

The last sentence in the proposed definition describes this function in terms of a mathematical calculation, *i.e.*, that employers can "usually" determine the MUC by multiplying the APF for the respirator by the exposure limit used for the hazardous substance.<sup>8</sup> The term "usually" in this sentence is consistent with paragraph (d)(3)(i)(B)(2), which is part of the proposed MUC requirements (see section below titled "Regulatory Text for Maximum Use Concentrations.") This proposed paragraph reads, "Employers must comply with the respirator manufacturer's MUC for a hazardous substance when the manufacturer's MUC is lower than the calculated MUC specified by this standard." Therefore, while employers would use the proposed calculation to determine most MUCs, they would have to use MUCs determined by respirator manufacturers when these MUCs are lower than the MUCs determined using the proposed calculation. As noted below in the explanation of proposed paragraph (d)(3)(i)(B)(2), OSHA believes that this requirement would provide employees with a necessary added measure of protection from hazardous substances in the workplace.

Importantly, the last part of the proposed definition specifies exposure limits as "permissible exposure limit (PEL), short-term exposure limit (STEL),

<sup>8</sup>For example, when the hazardous substance is nitrobenzene (with a PEL of 1 ppm), and the respirator used by employees has an APF of 10, then the calculated MUC is 10 ppm (*i.e.*, 1ppm x 10).