

ceiling limit (CL), peak limit, or any other exposure limit used for the hazardous substance." The exposure limits are consistent with the terms used in the Z tables in 29 CFR 1910.1000 and the substance-specific standards in 29 CFR parts 1910, 1915, and 1926.

The phrase "any other exposure limit used for the hazardous substance" refers to exposure limits other than the exposure limits specified in the OSHA Z tables or in its substance-specific standards; employers use the other exposure limits to provide additional protection to employees or to comply with OSHA's general-duty clause (Section 5(a)(1) of the OSH Act; 29 U.S.C. 654 where OSHA has no standard). Employers may adopt such exposure limits from existing consensus standards (e.g., the ACGIH TLVs), or develop them specifically for the unique hazardous substances found in their workplaces.

#### Paragraph (d)(3)(i)(A)—APF Provisions

##### 1. Introduction

As early as 1976, respirator scientists were classifying respirators into distinct groups based on the level of protection they provided. These early respirator classes are similar to the classes now in use, as well as the classes developed by OSHA for this proposal. In the following parts of this section, the Agency describes the historical development of APFs for specific classes of respirators, and then explains OSHA's proposed APF for each of these respirator classes.

In addition to basing the APFs proposed in this rulemaking on the studies and previous APF standards described in this section, the Agency contracted with Dr. Kenneth Brown to conduct statistical analyses of the

original data reported in most of the WPF studies reported below. Dr. Brown's quantitative analyses justify combining data for filtering facepiece and elastomeric half-mask respirators in determining an APF for these two respirator classes, and using a qualitative analysis of the data for identifying APFs separately for powered air-purifying respirators, supplied-air respirators, and self-contained breathing apparatuses. (Note that insufficient WPF data were available for Brown to include full facepiece air-purifying respirators in his analyses.) OSHA discusses the procedures and results of these statistical analyses in section IV of this preamble. The Agency believes that the APFs developed through the procedures discussed below are consistent with the results of the analyses performed by Dr. Brown.

##### 2. Half-Mask Air-Purifying Respirators

*Historical development of APFs for half-mask air-purifying respirators.* In 1976, Ed Hyatt of LANL tested eight commercially available Bureau of Mines (the Federal agency then designated to approve respirators) half-mask respirators (Ex. 2). Based on quantitative fit testing results obtained from a respirator test panel,<sup>9</sup> Hyatt assigned six of these respirators an APF of 10; the remaining two respirators performed less effectively than the other six, thereby achieving an APF of less than 10. Hyatt did not use data from the two poor performing respirators to set the APF of 10 for the class because, as he stated in his report, "For practical purposes, the remaining two models are not available."

In 1980, the ANSI Z88.2 Respiratory Protection Standard (i.e., "the 1980

ANSI standard;" Ex. 10, Docket H049) required fit testing to identify grossly misfitting half-mask respirators. That standard assigned an APF of 10 to half-mask air-purifying respirators when employers performed qualitative fit testing, and an APF as high as 100 when they performed quantitative fit testing (Ex. 10, Table 5, p. 21, Docket H049). ANSI based the latter APF on the results of studies that quantitatively fit tested a panel of respirator users, much as Hyatt did in 1976 (Ex. 2).

NIOSH developed its RDL in 1987 (Ex. 1–54–437Q), which assigned an APF of 5 to single-use and quarter mask air-purifying respirators, and an APF of 10 to half-mask respirators, including disposable half-mask respirators. In developing these APFs, NIOSH used results from quantitative fit-test studies performed on its own respirator test panel, several LANL quantitative fit-test studies (including Hyatt's 1976 study), and several WPF studies that it conducted in the early 1980s (Exs. 1–64–42, 1–64–47).

The 1992 Z88.2 ANSI Respiratory Protection Standard (i.e., "the 1992 ANSI standard"; Ex. 1–50) retained an APF of 10 for half-mask air-purifying respirators, including quarter masks, disposable half-masks, and half-masks with elastomeric facepieces. In determining these APFs, a committee of respirator experts convened by ANSI reviewed and discussed available APF studies, and then arrived at a final decision using a consensus process.

The following table summarizes the previous APFs assigned to half-mask air-purifying respirators, beginning with Hyatt's studies at LLNL in 1976 through the 1992 ANSI standard.

Half-mask air-purifying respirators	APFs			
	LANL (1976)	1980 ANSI standard	NIOSH RDL (1987)	1992 ANSI standard
Single use (no longer available) <sup>1</sup> ..	5	.....	5 .....	.....
Filtering facepiece .....	.....	.....	10 (disposable) .....	10
Half-mask (elastomeric) .....	10	10 (with QLFT) 100 max. (with QNFT).	10 .....	10

<sup>1</sup> Filtering facepieces replaced single-use respirators.

*OSHA's proposed APFs for half-mask air-purifying respirators.* Respirator manufacturers construct elastomeric half-masks using malleable compounds (e.g., silicon, natural or synthetic rubber) that readily conform to the respirator user's face, thereby effectively sealing the inside of the mask against

penetration by airborne hazardous substances. Filtering facepieces also are available in a variety of designs and materials that affect their fit to a user's face. For example, the design of the "fold flat" filtering facepiece allows employees to fold them for easy carrying and storage; when employees need this

respirator for protection, they unfold the mask and place the fabric filter over their mouth and nose and then position the attached elastic headbands or straps around their head.

Half-mask respirators, including the subclasses of elastomeric and filtering facepiece respirators, vary widely in

<sup>9</sup> LANL developed a respirator test panel consisting of 25 men and women selected to have

face sizes representing about 95% of the U.S. working population (Ex. 7, docket H049).