

reverberatory furnace, and casting and warehouse areas of a lead smelter while the authors sampled lead dust and fumes inside and outside the respirator. The authors found a fifth percentile protection factor of 95 for the combined samples, but concluded that the respirator provided reliable protection at protection factors in excess of 50.

Skaggs, Loibl, Carter, and Hyatt (Ex. 1-38-3) completed the only SWPF study on a full facepiece air-purifying respirator at LANL; this study measured the protection afforded by the MSA Ultra Twin with a HEPA filter. Ten members of the respirator test panel used the respirator under varying temperature and humidity conditions in a test chamber while performing simulated work tasks. The authors reported fit factors with geometric means ranging from 1,000 to 5,300 for this respirator. However, 23 of the 60 measurements reported were less than 1,000, 7 were less than 100, and 3 of these measurements were less than 50.

After carefully reviewing these studies, OSHA is proposing an APF of 50 for full facepiece air-purifying respirators. The proposed APF agrees with the conclusion of Colton, Johnston, Mullins, and Rhoe (Ex. 1-64-14) that this class of respirators provides reliable protection at an APF of 50. Additionally, the geometric mean simulated work fit factors reported by Skaggs, Loibl, Carter, and Hyatt (Ex. 1-38-3) were low for a SWPF study, and a few of the individual measurements were below an APF of 50; in the workplace, the fifth percentile APF for this respirator may fall well below 100. Therefore, in view of the paucity of data reported for this class of respirators, and the constraints imposed by the available studies, the Agency is proposing a conservative APF that it believes would

afford employees an adequate and consistent level of respirator protection in the workplace.

Importantly, an APF of 50 corresponds with the APF assigned to full facepiece air-purifying respirators by OSHA in its substance specific standards, and by NIOSH in its 1987 RDL. In determining that an APF of 50 was appropriate for protecting employees against the contaminants identified in its substance specific standards, the Agency reviewed the existing scientific and technical information, and carefully considered comments in the records. OSHA believes that the information now available does not justify revising the previous APF determined for its substance specific standards. To ensure that the final APF for this class of respirators provides employees with appropriate protection, the Agency requests that commenters submit to the record any additional WPF and SWPF studies that may be available on full facepiece air-purifying respirators.

4. Powered Air-Purifying Respirators (PAPRs)

Historical development of APFs for PAPRs. In 1976, Ed Hyatt of LANL gave PAPRs equipped with high efficiency filters, regardless of facepiece type, a protection factor of 1,000. In doing so, Hyatt assumed, based on quantitative fit tests, that both tight-fitting and loose-fitting facepiece PAPRs would always maintain a positive pressure inside the facepiece.

The committee responsible for drafting the 1980 ANSI standard assigned an APF of 3,000 to PAPRs equipped with high efficiency filters. When the respirators used DFM filters, they received an APF of 100. The ANSI committee did not require fit testing for

PAPRs because it assumed, as did Hyatt, that these respirators would maintain positive pressure during use.

The 1987 NIOSH RDL assigned an APF of 25 to half-mask PAPRs after NIOSH reviewed the results of two WPF studies that it conducted on these respirators (Ex. 1-64-42 and 1-64-46). The RDL also gave loose-fitting PAPRs with hoods or helmet an APF of 25 based on data from two studies performed by Myers, Peach, Cutright, and Iskander (Exs. 1-64-47 and 1-64-48). However, the RDL recommended an APF of 50 for other PAPRs equipped with a tight-fitting facepiece or a hood or helmet, as well as high efficiency filters or gas-vapor cartridges used in combination with high efficiency filters.

The committee developing the 1992 ANSI standard updated the APFs specified in the 1980 ANSI standard. Accordingly, the committee recommended an APF of 50 for tight-fitting half-mask PAPRs based on the same WPF studies used by NIOSH in developing the 1987 RDL. Tight-fitting full facepiece PAPRs received an APF of 100 when equipped with dust filters (based on performance limitations of the filters), and an APF of 1,000 when used with HEPA filters. While the ANSI committee retained an APF of 25 for loose-fitting facepiece PAPRs, including loose-fitting hoods and helmets, it treated tight-fitting PAPRs with hoods or helmets much as it did tight-fitting full facepiece PAPRs (*i.e.*, by assigning them an APF of 100 when used with a dust filter, and an APF of 1,000 when equipped with a HEPA filter).

The following table summarizes the previous APFs assigned to PAPRs, beginning with Hyatt's studies at LANL in 1976 through the 1992 ANSI standard.

Powered air-purifying respirators (PAPRs)	APFs			
	LANL (1976)	1980 ANSI standard	NIOSH RDL (1987)	1992 ANSI standard
Half-mask	1,000	100 (with DFM filter), 3,000 max. (with HEPA filters).	50 (with HEPA filter) ..	50.
Full facepiece	1,000	100 (with DFM filter), 3,000 max. (with HEPA filters).	50 (with HEPA filter) ..	100 (with dust filter), 1,000 (with HEPA filter).
Hoods or helmets	1,000	100 (with DFM filter), 3,000 max. (with HEPA filters).	50 (with HEPA filter) ..	100 (with dust filter), 1,000 (with HEPA filter).
Loose-fitting facepiece	1,000	100 (with DFM filter), 3,000 max. (with HEPA filters).	25 (with any filter)	25.

OSHA's proposed APFs for half-mask PAPRs. In 1983, Meyers and Peach performed a WPF study on tight-fitting half-mask and full facepiece PAPRs in a silica-bagging operation (Ex. 1-64-46). The geometric mean protection factors for each of the seven employees who

used the half-mask PAPRs ranged from 19 to 193, with a geometric mean protection factor of 54 for the entire sample. The authors attributed the poor performance of the half-mask PAPRs to leakage around the filter assembly connection where it attached to the

PAPR blower housing, as well as to inadequate facepiece fit.

Lenhart and Campbell of NIOSH in 1984 conducted another WPF study of tight-fitting half-mask PAPRs used by employees in the sinter plant and furnace areas of a primary lead smelter