

design and construction; these characteristics could result in different fitting characteristics which, in turn, can affect the level of employee protection afforded by the respirators. In this regard, an important question is whether available WPF and SWPF studies demonstrate sufficient variability in protection between and among filtering facepiece and elastomeric respirators to warrant different APF levels.

OSHA reviewed available WPF and SWPF studies that determined APFs for separate models of half-mask respirators based on each respirator's performance. These studies usually determine a protection factor for each respirator user (e.g., an employee in a WPF study, or a member of a panel of respirator users in a SWPF study) who participates in the study, with each of these values expressed as the concentration of challenge agent outside the respirator

( $C_o$ ) divided by the concentration of that agent inside the respirator ( $C_i$ ), i.e.,  $C_o/C_i$ . After collecting these values, a statistical analysis determines the geometric distribution of the values; the overall APF for the respirator is the estimated value that lies at the fifth percentile of the geometric distribution. Listed in the table below are the WPF studies on filtering facepiece and elastomeric respirators reviewed by the Agency.

WPF studies for filtering facepieces (by name of authors and model of respirator tested)	Sample size	Geometric mean	Geometric standard deviation	5th percentile WPF
Cohen (Ex. 1-64-11): Prototype Mercury (disposable respirator) .....	26	28		5
Albrecht <i>et al.</i> (Ex. 1-64-23): 3M 8710 .....	13	81	1.99	25
3M 9910 .....	13	107	2.50	20
3M 9920 .....	10	223	2.38	45
Nelson and Dixon (Ex. 1-64-54): 3M 8710 .....	18	310	5.3	20
3M 9910 .....	14	580	4.2	55
AO R1050 .....	7	52	4.2	5
Reed <i>et al.</i> (Ex. 1-64-61): 3M 9910 .....	19	18	3.1	3
Johnston and Mullins (Ex. 1-64-34): 3M 8715 (with aluminum particulate) .....	10	145	2.3	32
3M 8715 (with titanium particulate) .....	14	59	1.7	24
3M 8715 (with silicon particulate) .....	14	172	3.1	24
Colton <i>et al.</i> (Ex. 1-64-15): 3M 9906 .....	23	27	1.5	13
Colton <i>et al.</i> (Ex. 1-64-16): 3M 9970 (with lead particulate) .....	62	415	4.4	36
3M 9970 (with zinc particulate) .....	62	681	5.6	40
Myers and Zhuang (Ex. 1-64-51) (conducted in a brass foundry): 3M 9920 (with zinc particulate) .....	20	108	5.2	7
Myers and Zhuang (Ex. 3-14) (conducted in a steel mill): 3M 8710 (with iron particulate) .....	10	377	3.7	44
Gerson 1710 (with iron particulate) .....	11	123	2.7	24
Colton and Mullins (Ex. 1-146): 3M 9920 and 3M 9925 .....	32	147	2.5	33
Wallis <i>et al.</i> (Ex. 1-64-70): 3M 8710 .....	70	50	3.5	7.5
Lenhart and Decker (Ex. 1-64-56): 3M 9920 .....	5			12
3M 9970 (two separate studies) .....	2			86 and 98
Gaboury and Burd (Ex. 1-64-24): AO, Willson, Survivair .....	18	47	2.5	9
Gavin <i>et al.</i> (Ex. 1-64-22): North 7709 (with OV cartridge) .....	63	75	3.1	11.7
Weber and Mullins (Ex. 3-15): 3M 5000 (with OV cartridge) .....	46	39.7	2.14	11
Myers and Zhuang (Ex. 1-64-51) (conducted in a brass foundry): AO 5-Star (with DFM filter) .....	6	98	5.8	5
MSA Combo II (with DFM filter) .....	9	163	3.1	26
Scott 65 (with DFM filter) .....	6	94	4.8	7
Myers and Zhuang (Ex. 3-14) (conducted in a steel mill): AO 5-Star (with DM filter) .....	11	280	2.7	56
MSA Combo II (with DM filter) .....	8	427	4.3	39
Scott 65 (with DM filter) .....	11	252	2.9	45
Myers and Zhuang (Ex. 1-64-52) (conducted in a paint-spraying facility): AO 5-Star (with HEPA or OV filter) .....	38	2,211		171
MSA Combo II (with HEPA or OV filter) .....	38	4,580		437
Scott 65 (with HEPA or OV filter) .....	38	6,630		1,121
Lenhart and Campbell (Ex. 1-64-42): MSA Combo (with HEPA filter) .....	25	180	4.1	18
Albrecht <i>et al.</i> (Ex. 1-64-23): 3M Easi-Air 7000 (with HEPA filter) .....	8	56	1.35	31
3M Easi-Air 7000 (with DM filter) .....	6	68	1.66	28
Dixon and Nelson (Ex. 1-64-54): Survivair 2000 and MSA Combo II (with DFM filter) .....	17	240	6.3	12