

Technical Concept for Half-Mask Respirator Total Inward Leakage (TIL) Performance Requirements and Test Methods

1.0 Draft Concept Development

The half-mask TIL project involved evaluating 101 respirator models. The results were analyzed and a proposed criterion developed.

1.1 Test Panel

The modified LLNL face width / face length bivariate panel, herein referred to as the NPPTL Respirator Fit Test Panel (NRFTP) will be used for evaluating the respirator fit. The panel will consist of 35 test subjects, distributed as shown below.

		Face Width (mm)			
		120.5	134.5	146.5	158.5
Face Length (mm)	138.5	#6 (2)	#9 (2)	#10 (2)	
	128.5		#7 (7)	#8 (3)	
	118.5	#3 (4)	#4 (9)	#5 (2)	
	108.5	#1 (2)	#2 (2)		
98.5					

NPPTL Respirator Fit Test Panel

The frequencies within each cell of the NRFTP were chosen to reflect, as close as possible, the corresponding relative frequencies from the NIOSH anthropometric survey, with the constraint of having at least two subjects within each cell of the NRFTP.

Technical Concept for Half-Mask Respirator Total Inward Leakage (TIL) Performance Requirements and Test Methods

The NRFTP will be used as shown for any respirator that is designated as a single un-sized respirator (one-size-fits-all designation or no size designation) or a family of respirators. A family is defined as two or more respirators of the same basic design and construction, varying only in size; which is designed to fit the entire wearer population represented by the NRFTP.

Respirators that are not members of a respirator family or that are designed and designated for sub-populations within the overall worker population defined by the NRFTP will be tested using 35 subjects having the facial dimensions corresponding to the manufacturer designated population.

1.2 Test Method / Equipment

The TIL will be determined by measuring ratio of the average challenge concentration inside the facepiece to the challenge concentration outside the facepiece, and expressing that ratio as a percentage.

That is, $TIL = [C_{in}/C_{out}] 100\%$.

The instrumentation used to measure the concentration inside and outside the facepiece shall:

- i) utilize a condensation nuclei counter,
- ii) measure only aerosol in the approximate (mass median aerodynamic diameter) size range of 0.02 to 0.06 micrometer, and
- iii) respond linearly, within $\pm 5\%$, over the approximate concentration range of 0.1 to 10,000 particles/cm³

1.3 Respirator preparation

Each respirator will be probed as close as possible to place mid way between the wearer's nose and mouth.

1.4 Test Exercises

Each test subject will be required to don the respirator according to the manufacturer's instructions and perform a series of exercises as described in OSHA 29CFR 1910.134, Appendix A except that the exercise time shall be 30 seconds.

Technical Concept for Half-Mask Respirator Total Inward Leakage (TIL) Performance Requirements and Test Methods

The exercises include:

- iv) Normal Breathing
- v) Deep Breathing
- vi) Turn Head Side to Side while pausing for two normal inhalations at each side
- vii) Move Head Up and Down while pausing for two normal inhalations in the head up position and in the head down position
- viii) Recite the Rainbow Passage
- ix) Reach for the Floor and Ceiling while pausing for two normal inhalations in the arms-up position and in the arms-down position
- x) Grimace¹ (not included in the TIL determination)
- xi) Normal Breathing

Each TIL test will be repeated three times and the individual and average fit factors for the three donnings recorded.

1.5 Pass/ Fail Criteria

Each respirator or family of respirators will be required to have an average TIL of $\leq 5.0\%$ for a minimum of 26 out of the 35 test subjects.

1.6 Applicability / Schedule

This requirement will be applicable to any respirator approved under 42 CFR Part 84, Subpart K, and will become effective 30 days from the date of codification. All half-mask respirators currently approved under Subpart K must be tested and meet this criteria within 3 years of the effective date or their approval will terminate.

¹ The grimace is done to attempt to momentarily break the seal and to allow the facepiece to re-seal and therefore is not included in the TIL measurement.