

December 1981 Comments from the ANSI Z88 Committee

No. 84-026

American National Standards Institute-Z88 Committee for Respiratory
Protection Ad Hoc Subcommittee for Respirator Test and Approval

Alan Hack, Respiratory Protection Section
Industrial Hygiene Group

12/15/81

8

December 15, 1981

Donald P. Wilmes
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Dear Don:

Enclosed is the proposal of the Quantitative Fit Test Working Group of the ANSI Ad Hoc Respirator Committee. Carol Dupraz and I have agreed that this is the official version voted on December 11 at Los Alamos.

There are several additional items, not voted on or discussed by the Committee, that I would like to add.

The first concerns fit factors for powered helmets, hoods and suits, that we failed to agree on. I suggest the following:

Class 2 and 3: Tested either in atmosphere supplying or powered air purifying service (with high efficiency filter) as appropriate, fit factor = 1000, or higher as suggested by the applicant.

The second suggestion concerns body sizes for subjects to test Class 3 devices, hoods and suits. The suit test procedure used for testing DOE suits (LA-5958-MS) calls for three subjects of body heights a) 5' 6" - 5' 8", b) 5' 11" - 6' 1", and c) 6' 3" - 6' 5". These dimensions are quite large and exclude females. For example the 96 percentile female height is 5' 8", so that most females cannot be included in the panel. Also 6' 4" is a 99 percentile male, far too extreme for use in an anthropometric panel.

Two possible solutions would be either to adjust the heights to include females and exclude the very tall males. An alternate is to use another measurement that more closely indicates body bulk, Vertical Trunk Circumference is suggested. I will discuss these problems with John McConville and suggest size ranges for three individuals shortly.

Sincerely,

Alan Hack
Respiratory Protection Section
Industrial Hygiene Group

AMERICAN NATIONAL STANDARDS INSTITUTE

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Proposal for Certification of Respiratory Inlet Coverings by Quantitative Fit Testing

As agreed to by members of the ANSI Ad Hoc Subcommittee for Respirator Test and Approval, December 8-11, 1981

Report prepared by Alan Hack, Los Alamos National Laboratory, Chairman, Quantitative Respirator Fitting Test Working Group, December 14, 1981.

Respiratory inlet coverings (RIC) are classified as:

1. Class 1: Tight fitting including Full Face (FF) and half or quarter masks. Class 2: Loose fitting helmet/faceshield combinations with face seals. Protection against inward contamination of the breathing zone for Class 1 and 2 is accomplished by sealing to the wearer's body, or by a combination of sealing and positive pressure or outward flow of air.
2. Class 3: Loose fitting coverings, that are not designed with a particulate or gas tight seal, including hoods, helmets, and suits. These depend only on positive pressure or outward flow of air to prevent contamination of the breathing zone.

3. The protection provided by RICs will be determined by measuring breathing zone leakage quantitatively while the device is worn by members of an anthropometrically selected test panel.

4. Class 1 and 2 RICs will be tested on a panel of persons, as shown in figure 1. At the request of the applicant, the RICs of respirators submitted for test will be worn by:

- a) the entire 25 person panel, or
- b) individuals in any one box of the panel, or
- c) individuals in any number of contiguous boxes of the panel.

5. Class 3 RICs will be tested on three subjects of appropriate head or body dimensions specified by the applicant or by NIOSH.

Pre testing

6. Prior to the first fit testing on Class 1 RICs, each subject will don and wear the facepiece as specified by the applicant for at least 60 minutes, unless the device is to be worn in the workplace for less than 60 minutes, in which case the shorter time will be used. The facepiece shall not cause undue discomfort in the opinion of the testing agency.

7. Standard safety spectacles will be worn during all tests with half masks. The mask shall not interfere with the use of the spectacles, nor shall the spectacles interfere with the seal of the mask, as determined by the testing agency.

Quantitative Fit Testing

8. Each test subject shall wear the RIC under test once. All donning and fitting of RICs is to be done by the subject according to the applicant's written directions.

9. The test atmosphere to be used for fit testing will consist of polydisperse solid sodium chloride, or polydisperse liquid oil mist. The aerosol concentration shall be sufficient to allow detection of penetrations listed in paragraph 15. The aerosol fit test system shall in general conform to ASTM *.
10. The size of the fit testing enclosure shall permit the respirator wearer to carry out all designated exercises. Removal or dilution of aerosol caused by use of supplied air or powered air purifying equipment shall not so dilute the challenge aerosol concentration as to seriously affect the accuracy of the fit test.
11. The RIC to be tested shall be modified as little as possible.
 - a. A probe to permit removal of a sample of the atmosphere inside the RIC is permissible.
 - b. Class 1 RICs shall be worn for purposes of sizing in negative pressure mode, either air purifying or atmosphere supplying.
 - c. Class 2 and 3 RICS shall be tested with the minimum required air flow.
 - d. In the case of a respirator with a facepiece and filter element that are inseparable, such shall be tested without modification.
12. Selection shall be made by NIOSH from the following list of exercises appropriate to the configuration of RIC being tested.
 - Normal breathing
 - Deep breathing
 - Turning head from side to side
 - Nodding head up and down
 - Talking
 - Grimacing (HM) or frowning (FF)
 - Standing still, arms hanging down, normal breathing
 - Bending forward at waist and touching toes
 - Running in place

Raising arms above head while looking upward
Bending knees and squatting
Crawling on hands and knees
Crossing arms in front of chest and twisting torso from side to side

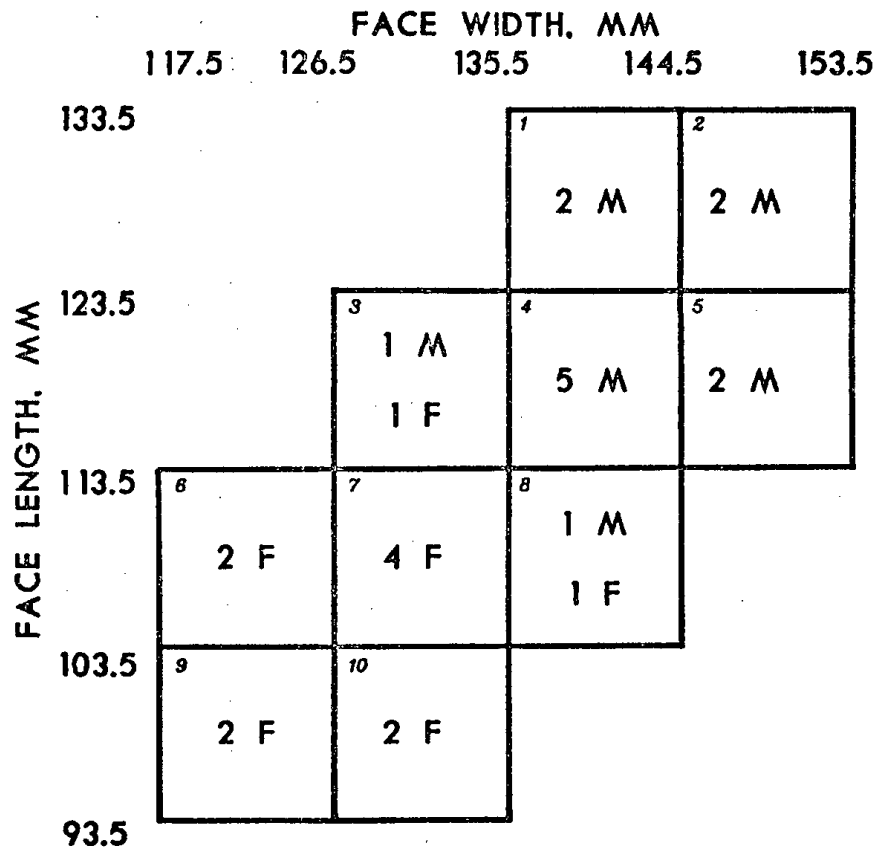
13. The test operator shall observe and communicate with the test subject during all test activities.

14. As described in ASTM * the reported value of aerosol penetration into the RIC shall be recorded for each exercise. Values for each exercise may be reported, or an overall test value for the entire test series may be reported. Regardless of the method of computation used, a strip chart recording of each entire test shall be made.

15. A RIC is considered to fit satisfactorily either the entire panel, or some portion of it, when there is 95% confidence that 90% of test subjects shall achieve the following fit factor:

Class 1:	Fullface piece	Fit factor = 100
	Half mask	" " 10

ASTM * refers to a pending American Society for Testing and Materials Standard Specification for Quantitative Respirator Fit Testing.



DRAFT

December 21, 1981

Donald P. Wilmes
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Dear Don:

This letter contains suggested body dimensions to be used to select test subjects who will be used by NIOSH for fit testing class 3 respiratory inlet coverings, which are loose fitting hoods, helmets and supplied-air suits. There are two suggested body dimensions to be used. The first one is Vertical Trunk Circumference (VTC), a single measurement that can be used to describe body bulk. Three subjects are suggested: a) small, b) medium, and c) large.

Test Subject	Vertical Trunk Circumference, cm
a) small	144 - 152
b) medium	157 - 165
c) large	171 - 179

The source for this data is: For males "U.S. Air Force Flying Personnel 1967 - total series," unpublished U.S.A.F. Systems Command Anthropometric data. For females "Anthropometry of Air Force Women," technical report 70-5, Aerospace Medical Research Laboratories, Wright Patterson Air Force Base, Ohio, 1972.

The dimensions for the small subject are calculated from the female mean 154.4 cm, minus 1 standard deviation (SD) 6.9, yielding 148 cm. The range for small individuals is plus and minus approximately one-half SD, or 4 cm, for a range of 144 - 152 cm.

VTC for the medium subject is half way between the male and female means (168 and 154 cm respectively) or 161 cm. Again a 4 cm range greater and lesser than the mean is used or 157 - 165 cm.

VTC for the large subject is calculated by adding 1 SD to the male mean of 168.1 cm. The SD is 7.2. Adding these two values yields a VTC of 175 cm for large subjects. The range is plus and minus 4 cm or 171 - 179 cm.

Should you desire to use stature (height) instead of VTC, the original values proposed in the Los Alamos suit test procedure appear to

be very large, and exclude women. As now proposed the three subjects
small 5' 6" - 5' 8", medium 5' 11" - 6' 1", and large 6' 3" - 6'
5". I would propose the following three sizes:

Test Subject	Height	
a) small	153 - 159 cm	5' 0" - 5' 3"
b) medium	167 - 173	5' 6" - 5' 8"
c) large	181 - 187	5' 11" - 6' 2"

These heights are calculated by the same means as the VTC measurements, using the means and standard deviations from the military anthropometry.

I realize that these proposed body sizes are only theoretical, but perhaps they can serve until Los Alamos or others have the time and funding to study the matter further.

Sincerely,

Alan Hack