18. In addition, because the sealing of the respirator may be affected, qualitative fit testing shall be repeated immediately when the test subject has a:

(1) Weight change of 20 pounds or more,

(2) Significant facial scarring in the area of the facepiece seal,

(3) Significant dental changes; i.e.; multiple extractions without prothesis, or acquiring dentures,

(4) Reconstructive or cosmestic surgery, or

(5) Any other condition that may interfere with facepiece sealing.

C. Recordkeeping

A summary of all test results shall be maintained in each office for 3 years. The summary shall include:

(1) Name of test subject.

(2) Date of testing.

(3) Name of test conductor.

(4) Respirators selected (indicate manufacturer, model, size and approval number).

(5) Testing agent

Quantitative Fit Test Procedures

1. General.

a. The method applies to the negative-pressure nonpowered air-purifying respirators only.

b. The employer shall assign one individual who shall assume the full responsibility for implementing the respirator quantitative fit test program.

2. *Definition.*

a. "Quantitative Fit Test" means the measurement of the effectiveness of a respirator seal in excluding the ambient atmosphere. The test is performed by dividing the measured concentration of challenge agent in a test chamber by the measured concentration of the challenge agent inside the respirator facepiece when the normal air purifying element has been replaced by an essentially perfect purifying element.

b. "Challenge Agent" means the air contaminant introduced into a test chamber so that its concentration inside and outside the respirator may be compared.

c. "Test Subject" means the person wearing the respirator for quantitative fit testing.

d. "Normal Standing Position" means standing erect and straight with arms down along the sides and looking straight ahead.

e. "Fit Factor" means the ratio of challenge agent concentration outside with respect to the inside of a respirator inlet covering (facepiece or enclosure).

3. *Apparatus.*

a. *Instrumentation.* Corn oil, sodium chloride or other appropriate aerosol generation, dilution, and measurement systems shall be used for quantitative fit test.

b. *Test chamber.* The test chamber shall be large enough to permit all test subjects to freely perform all required exercises without distributing the challenge agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the challenge agent is effectively isolated from the ambient air yet uniform in concentration throughout the chamber.

c. When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high-efficiency particular filter supplied by the same manufacturer.

d. The sampling instrument shall be selected so that a strip chart record may be made of the test showing the rise and fall of challenge agent concentration with each inspiration and expiration at fit factors of at least 2,000.

e. The combination of substitute air-purifying elements (if any), challenge agent, and challenge agent concentration in the test chamber shall be such that the test subject is not exposed in excess of PEL to the challenge agent at any time during the testing process.

f. The sampling port on the test specimen respirator shall be placed and constructed so that there is no detectable leak around the port, a free air flow, is allowed into the sampling line at all times and so there is no interference with the fit or performance of the respirator.

g. The test chamber and test set-up shall permit the person administering the test to observe one test subject inside the chamber during the test.

h. The equipment generating the challenge atmosphere shall maintain the concentration of challenge agent constant within a 10 percent variation for the duration of the test.

i. The time lag (interval between an event and its being recorded on the strip chart) of the instrumentation may not exceed 2 seconds.

j. The tubing for the test chamber atmosphere and for the respirator sampling port shall be the same diameter, length and material. It shall be kept as short as possible. The smallest diameter tubing recommended by the manufacturer shall be used.

k. The exhaust flow from the test chamber shall pass through a high-efficiency filter before release to the room.

l. When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

4. *Procedural Requirements.*

a. The fitting of half-mask respirators should be started with those having multiple sizes and a variety of interchangeable cartridges and canisters such as the MSA Comfo II-M, Norton M. Survivair M, A-O M, or Scott-M. Use either of the tests outlined below to assure that the facepiece is properly adjusted.

(1) *Positive pressure test.* With the exhaust port(s) blocked, the negative pressure of slight inhalation should remain constant for several seconds.

(2) *Negative pressure test.* With the intake port(s) blocked, the negative pressure slight inhalation should remain constant for several seconds.

b. After a facepiece is adjusted, the test subject shall wear the facepiece for at least 5 minutes before conducting a qualitive test by using either of the methods described below and using the exercise regime described in 5.a., b., c., d, and e.

(1) *Isoamyl acetate test.* When using organic vapor cartridges, the test subject who can smell the odor should be unable to detect the odor of isoamyl acetate squirted into the air near the most vulnerable portions of the facepiece seal. In a location which is separated from the test area, the test subject shall be instructed to close her/his eyes during the test period. A combination cartridge or canister with organic vapor and high-efficiency filters shall be used when available for the particular mask being tested. The test subject shall be given an opportunity to smell the odor of isoamyl acetate before the test is conducted.

(2) *Irritant fume test.* When using high-efficiency filters, the test subject should be unable to detect the odor of irritant fume (stannic chloride or titanium tetrachloride ventilation smoke tubes) squirted into the air near the most vulnerable portions of the facepiece seal. The test subject shall be instructed to close her/his eyes during the test period.

c. The test subject may enter the quantitative testing chamber only if she or he has obtained a satisfactory fit as stated in 4.b. of this Appendix.

d. Before the subject enters the test chamber, a reasonably stable challenge agent concentration shall be measured in the test chamber.

e. Immediately after the subject enters the test chamber, the challenge agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half-mask and 1 percent for a full facepiece.

f. A stable challenge agent concentration shall be obtained prior to the actual start of testing.

(1) Respirator restraining straps may not be overtightened for testing. The straps shall be adjusted by the wearer to give a reasonably comfortable fit typical of normal use.

5. *Exercise Regime.* Prior to entering the test chamber, the test subject shall be given complete instructions as to her/his part in the test procedures. The test subject shall perform the following exercises, in the order given, for each independent test.

a. *Normal Breathing (NB).* In the normal standing position, without talking, the subject shall breathe normally for at least one minute.

b. *Deep Breathing (DB).* In the normal standing position the subject shall do deep breathing for at least one minute pausing so as not to hyperventilate.

c. *Turning head side to side (SS).* Standing in place the subject shall slowly turn his/her head from side between the extreme positions to each side. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.

d. *Moving head up and down (UD).* Standing in place, the subject shall slowly move his/her head up and down between the extreme position straight up and the extreme position straight down. The head shall be held at each extreme position for at least 5 seconds. Perform for at least three complete cycles.

e. *Reading (R).* The subject shall read out slowly and loud so as to be heard clearly by the test conductor or monitor. The test subject shall read the "rainbow passage" at the end of this section.

f. *Grimace (G).* The test subject shall grimace, smile, frown, and generally contort the face using the facial muscles. Continue for at least 15 seconds.

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