



## **Respiratory Protection Manual**

**Environmental Health, Safety and Risk Management  
Respiratory Protection Program**

November 10, 2023

## **Forward**

The University of Texas Rio Grande Valley (UTRGV) has a fundamental commitment and responsibility to protect the health and safety of its faculty, students, employees, and the visiting public when participating in official activities. Many occupational diseases can be effectively prevented by minimizing or eliminating the breathing of air that may be contaminated with harmful dusts, fogs, fumes, mist, gases, smokes, sprays, or vapors. This shall be accomplished as far as feasible by accepted engineering control measures such as enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials. When effective engineering controls are not feasible, or while they are being instituted, it is the aim of this program to ensure that respiratory protection is provided, utilized, and maintained in an appropriate and safe manner.

### **I. Purpose**

The purpose of this program is to ensure the protection of all UTRGV personnel and students from respiratory hazards through the proper use of approved respirators. Job-specific respirators shall be provided by UTRGV and are to be used when engineering controls for respiratory hazards are not feasible or ineffective, while engineering controls are being installed or repaired, and for emergency or other temporary situations.

Voluntary respirator use (when exposures are below the permissible exposure limit) is permitted at the request of the employee or student and upon review by Environmental Health, Safety, & Risk Management and subsequent to a medical evaluation if necessary (See Appendix D). The procedures set forth in this program comply fully with the requirements of the Occupational Safety and Health Administration's (OSHA) 29 CFR 1910.134 (Respiratory Protection Standard, revised April 8, 1998). Procedures apply to all UTRGV faculty, staff, and students. Non-UTRGV personnel working at the University of Texas Rio Grande Valley must observe procedures that are equivalent to or exceed the requirements of the UTRGV Respiratory Protection Program.

### **II. Responsibilities**

A. Environmental Health, Safety, & Risk Management will:

- a. Manage the Respiratory Protection Program
- b. Provide training
- c. Conduct fit testing
- d. Maintain documentation of training and fit testing
- e. Recommend appropriate respirators and cartridges
- f. Conduct periodic inspections of respirator storage and use, and ensure that these inspections are properly documented
- g. Perform and document initial and subsequent medical surveillance of all respirator wearers at no cost to the student/employee
- h. Purchase appropriate respirators, cartridges, and approved replacement parts at no cost to student/employee

B. Employee Supervisors will:

- a. Identify personnel who may need to utilize respiratory protection
- b. Ensure that employees have had medical surveillance as required by this program
- c. Ensure that employees are properly trained before utilizing respiratory protection, and that employees receive any required refresher training

- (at least annually)
  - d. Contact ESHRM to perform any initial or follow-up monitoring
  - e. Report any problems with respiratory protection to ESHRM
  - f. Ensure that employees are up-to-date for fit testing (annual requirement)
  - g. Ensure that employees who are required to wear a respirator because of potential exposure, do so, as a condition of employment
  - h. Ensure that any SCBA tanks have had hydrostatic testing as per manufacturer's recommendations, and that this has been properly documented
- C. Respirator Wearer will:
- a. Clean / inspect respirator before and after each use. Document using Appendix F.
  - b. Store respirator in a re-sealable plastic bag in a clean area away from possible contaminants
  - c. Use respirator in accordance with manufacturer's recommendations
  - d. Properly wear respirator and all related equipment as trained
  - e. Report any problems with respiratory protection to the department supervisor

### **III. References**

- A. Occupational Safety and Health Administration (OSHA) 29 CFR 1910.134, Respiratory Protection Standard

### **IV. Determination of Need for Respiratory Protection**

It is each supervisor's responsibility to ensure that ESHRM is notified of all practices that may present the need for students or employees to wear respiratory protection. If engineering controls for achieving respiratory protection are neither technologically nor economically feasible, the use of respiratory protection is required for tasks such as, but not limited to:

- A. Those that liberate harmful dusts, mists, fumes, vapors, or gases.
- B. Those that occur in areas in which unacceptable levels of exposure could result from the processing, handling, storing, or disposing of hazardous substances.
- C. Those that require entry into oxygen-deficient or potentially oxygen-deficient environments.

Exposure determinations will be conducted by ESHRM to confirm or justify the need for, or continued use of, respiratory protection. ESHRM must also be notified when engineering or procedural changes occur, which could affect employee or student exposures, or when new hazards are introduced into the workplace, to allow for subsequent exposure determinations to be initiated.

### **V. Medical Surveillance**

Employees and/or students will not be assigned to tasks requiring use of respirators unless it has been determined that their health and physical condition will enable them to do so safely. UTRGV Employee Health Services will determine this at no cost to the employee/student before fit testing or use of a respirator. It is possible, if requested, that an employee or student may use his or her personal health care practitioner to provide a medical evaluation. In this case, however, the employer is required to contact the physician or other licensed health care professional (PLHCP)

and provide him/her with a copy of the respiratory protection standard and other required supplemental information, such as any workplace variables that may increase pulmonary and cardiovascular stress during respirator use. The employer shall bear the costs of the evaluation, and periodic updates may also be required. The physician or PLHCP will conduct a medical evaluation. The physician or PLHCP will be asked to sign a respirator user's approval document stating that the user is physically able to work while wearing a respirator (Appendix B). The respirator user's medical status will be reviewed periodically as determined by the health care practitioner in his written medical opinion.

## **VI. Types of Respirators**

There are three primary types of respiratory protective equipment one may utilize when appropriate engineering controls are not feasible. These types of respirators are referred to as air-purifying respirators and atmosphere supplying respirators. The following is a description of air purifying and atmosphere supplying respirators and their limitations for use:

### **A. Air-Purifying Respirators**

#### **a. Description**

Air-purifying respirators remove particulate, vapor, and gas contaminants from the air we breathe prior to inhalation. Some common examples of these contaminants include welding fumes, asbestos fibers, solvent vapors, and pesticide mists. Contaminants of this type are removed by a cartridge or canister, which is fixed to the respirator face piece. The cartridges and canisters remove contaminants by various filtering and absorption mechanisms.

Air-purifying respirators may be powered or non-powered units. The use of a non-powered air-purifying respirator may result in additional physical stress due to an increased difficulty in breathing. A powered air-purifying respirator is equipped with a blower, which passes ambient air through the air-purification unit and the supplies the purified air to the respirator face piece.

#### **b. Limitations**

Air-purifying respirators must not be used in oxygen-deficient atmospheres (<19.5%) or in atmospheres that are Immediately Dangerous to Life and Health (IDLH). Examples of work place situations that may be oxygen-deficient or IDLH include confined spaces and work areas that have high air-borne concentrations of toxic chemicals. Work environments such as this will require a higher level of protection (see Atmosphere- Supplying Respirators).

The Maximum Use Concentration (MUC) may be determined with a simple calculation if the concentration of the air-borne contaminant is known. The MUC is calculated by determining the OSHA Permissible Exposure Limit (PEL) for a specific hazard and multiplying it by the Assigned Protection Factor (APF) for the respirator. The assigned protection factor is the level of protection a respirator provides if worn properly. The greater the number, the greater the protection. (See Tables 1 and 2). In order to ensure that the appropriate cartridge or canister is being used with your

respirator, ESHRM will recommend one specific to the particular hazards of your job.

B. Atmosphere-Supplying Respirators

a. Description

Atmosphere-Supplying respirators provide the user with breathable air independent of the ambient air. These types of respirators may be used to provide protection in oxygen-deficient atmospheres and in highly toxic atmospheres. There are several different types of atmosphere-supplying respirators that offer a superior degree of protection against atmospheric contaminants and require specialized training for use:

1. Self-Contained Breathing Apparatus (SCBA)

The self-contained breathing apparatus (SCBA) is a unit that allows the user to carry their breathing atmosphere with them. SCBA's are normally used when there is a short-term need to enter and escape from atmospheres that are or may be immediately dangerous to life and health (IDLH). The most important limitation associated with using the SCBA is the oxygen capacity of the device. Most SCBA's only have a 15-30 minute oxygen supply, which may be rapidly depleted if the work rate increases or if the atmospheric pressure changes.

2. Supplied Air Respirator (SAR)

The supplied air respirator (SAR) is a unit whose use is not limited to the amount of oxygen one can carry with them into a hazardous atmosphere. SAR's are typically in line with a high-volume/high pressure breathing air cylinder cascade. Alternatively, these respirators may be in line with an air blower, which blows uncontaminated ambient air into the face piece. These types of respirators, regardless of mode of operation, allow the user to remain in the contaminated atmosphere much longer than would be possible with an SCBA. These units are lightweight but limit the range of user mobility. They are normally used when there are extended work periods required in atmospheres that are not IDLH.

3. Combination Respirators

A combination air-line respirator with auxiliary SCBA is available which provides users with the highest degree of protection possible. These units allow the wearer to escape dangerous atmospheres if the SAR fails during use. These respirators are used when there are extended work periods required in atmospheres that are or may be IDLH.

C. N95 Respirator

a. Description

An N95 respirator is a respiratory protective device designed to achieve a very close facial fit and very efficient filtration of airborne particles. Note that the edges of the respirator are designed to form a seal around the nose and mouth. Masks and

respirators (i.e., specialized filtering masks such as “N95s”) can provide different levels of protection depending on the type of mask and how they are used. Loosely woven cloth products provide the least protection, layered finely woven products offer more protection, well-fitting disposable surgical masks and KN95s offer even more protection, and well-fitting NIOSH-approved respirators (including N95s) offer the highest level of protection. NIOSH approves many types of filtering facepiece respirators. The most widely available are N95 respirators, but other types (N99, N100, P95, P99, P100, R95, R99, and R100) offer the same or better protection as an N95 respirator.

**Table 1: OSHA Assigned Protection Factors (APF)**

<b><u>Type of Respirator</u></b>	<b><u>APF</u></b>
<b>Air-Purifying</b>	
Filtering Face piece	10
Half-Mask	10
Full-Face piece	50
<b>Powered Air-Purifying</b>	
Half-Mask	50
Full-Face piece	1000
Loose-Fitting Face piece	25
Helmet	25
Hood	1000
<b>Air-Line: Demand mode</b>	
Half-Mask	10
Full Facepiece	50
Continuous Flow	50
Pressure Demand	50
<b>Air-Line: Continuous Flow mode</b>	
Half-Mask	50
Full Facepiece	1000
Loose-Fitting Face piece	25
Helmet	25
Hood	1000
<b>Air-Line: Pressure Demand</b>	
Half-Mask	50
Full Facepiece	1000
<b>SCBA: Demand</b>	
Full Facepiece	50
Helmet or Hood	50
<b>SCBA: Pressure Demand</b>	
Full Facepiece	10000
Helmet or Hood	10000

**Table 2: Maximum Use Concentration (MUC) Calculations**

<b>Assigned Protection Factor (APF)</b>	<b>Permissible Exposure Limit (PEL)</b>	<b>Maximum Use Concentration (MUC)</b>
1.) 10	10 mg/m <sup>3</sup> (8 hr. TWA)	100 mg/m <sup>3</sup>
2.) 50	0.75 ppm (8 hr. TWA)	37.5 ppm
3.) 1000	1.0 ppm (8 hr. TWA)	1000 ppm

- 1) APF for Half Mask Non-Powered Air Purifying respirator & PEL for Grain Dust from OSHA 1910.1000
- 2) APF for Full Face Air-Purifying respirator and PEL for Formaldehyde from OSHA 1910.1048
- 3) APF for Air-Line respirator with a full face piece in pressure demand mode and PEL for Benzene from OSHA 1910.1028

## **VII. Selection of Respirators**

Only respirators that have been certified by the National Institute for Occupational Safety and Health (NIOSH) will be used in the UTRGV Respirator Program. Respirators are certified as an assembly, and substitution of parts from other manufacturers or models is strictly prohibited. The respirator shall be used in compliance with the conditions of its certification, and the NIOSH label on the cartridge or filter must not be obscured, removed, or defaced while it is in service. A respirator will be issued to an individual for his or her exclusive use and shall not be used by another employee or student.

Selection of appropriate respirators will be based on the specific respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability (29CFR 1910.134 (d)(1)(i)). Half-face and full-face air-purifying respirators equipped with the appropriate respirator filters/cartridges will be used to provide protection against specific hazards in atmospheres that are NOT:

- Oxygen deficient
- Immediately dangerous to life and health (IDLH)
- Exceeding the limitations of the selected respirator filters or cartridges

When exposure cannot be identified or reasonably estimated, the atmosphere shall be considered IDLH. In atmospheres where any of the aforementioned hazards exist, employees shall use either a self-contained breathing apparatus (SCBA) or a positive pressure supplied air respirator equipped with an emergency escape pack.

## **VIII. Training**

To ensure the proper and safe use of a respirator, each user will be thoroughly trained at the time of initial fit testing and annually thereafter. The training will be conducted by a member of ESHRM or via a UTRGV-approved computer-based training course. This training will be documented and information retained by ESHRM. The training will include, but not necessarily be limited to:

- A. Why a respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
- B. What the limitations and capabilities of the respirator are;
- C. How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- D. How to inspect, don and doff, use, and check the seals of the respirator;
- E. What the procedures are for maintenance and storage of the respirator;
- F. How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators;
- G. The nature, extent, and effects of respiratory hazards in the workplace;
- H. The need to inform their supervisors of any problems experienced by them or their coworkers;
- I. An explanation of why a particular type of respirator and cartridge has been selected for a specific respiratory hazard;
- J. Successful completion of a fit test;
- K. An opportunity to handle a respirator;
- L. Demonstrate knowledge of the above training elements;

- M. Employees who voluntarily use respirators will be given the advisory information from Appendix D.

## **IX. Respirator Fit Testing**

All UTRGV employees or students required to wear a respirator that has a tight-fitting face piece must be properly fit tested according to OSHA approved procedures. These fit testing procedures shall be performed before the first use of the respirator using the same make, model, style, and size respirator that will be used on the job. Additional fit testing will be performed if a different face piece is to be used or if a supervisor notices a change in the user's physical condition that may compromise the fit of the respirator face piece. Although quantitative fit testing is the preferred and more complete method of verifying the adequacy of the seal, situations may arise where it is not feasible to perform a quantitative fit test (i.e. emergencies, test equipment malfunctions). In the latter situations, qualitative fit testing is an acceptable alternative.

UTRGV prohibits the use of respirators with tight-fitting face pieces to be worn by students or employees who have facial hair that comes between the sealing surface of the face piece and the face or that which interferes with valve function (i.e. beards, "handlebar" mustaches, sideburns). Other conditions that may prohibit tight-fitting respirator use include, but are not limited to; missing dentures, facial scars, severe acne, or the use of headgear or eyewear that projects under the face piece seal. Respirator use is permitted as long as a condition does not prevent an adequate seal.

Fit testing is performed before initial use of the respirator and at least annually thereafter, and will be conducted by a trained member of Environmental Health, Safety, & Risk Management. Complete fit-testing procedures are given in Appendix E.

## **XI. Use and Maintenance of Respirators**

### **A. Visual Inspection**

Without regular respirator inspection, users cannot be sure that they are receiving adequate protection from airborne hazards. In fact, wearing poorly maintained or malfunctioning respirators may be more dangerous than not wearing a respirator at all. UTRGV must replace, repair, or discard a respirator that is not functioning properly, and a defective respirator must, with no exceptions, be replaced or repaired before the user enters or returns to any possibly contaminated area. All respirator users should closely inspect and document (Appendix F) the following parts of the respirator before and after each use and during cleaning:

- a. Rubber Face Piece:
  - 1. Cracked or broken air-purifying element holder(s)
  - 2. Excessive dirt
  - 3. Cracks, tears, or holes
  - 4. Distortion
  - 5. Cracked, scratched, or loose-fitting lens (full face)
  - 6. Incorrectly mounted full face piece lens or broken/missing mounting clips
- b. Head Strap:
  - 1. Breaks or tears
  - 2. Loss of elasticity

3. Broken or malfunctioning buckles/attachments
  4. Excessively worn serrations on head piece
  5. Harness which might allow the face piece to slip
- c. Inhalation/Exhalation Valves:
1. Detergent residue, dust particles, dirt, or hair on valve or valve seat
  2. Cracks, tears, distortion in valve material or valve seat
  3. Improper insertion of the valve body in the face piece
  4. Cracks, breaks, or chips in the valve body, particularly in the sealing surface
  5. Improper installation of the valve in the valve body
- d. Filter Elements:
1. Incorrect cartridge, canister, or filter for the hazard
  2. Missing or worn gaskets
  3. Worn threads
  4. Cracks or dents in filter housing
  5. Incorrect installation, loose connections, or cross-threading in holder
  6. Outdated use of cartridge or canister (see Section XI: Change-out Schedule)
- e. SCBA's
1. Require an inspection of the air and oxygen cylinders to assure that the cylinder pressure is maintained at or above 90% of the manufacturer's recommended pressure level and that the regulator and low pressure warning devices function properly. The warning device must be activated and heard by the person performing the inspection.

## B. Seal Checks

The wearer of a respirator equipped with a tight fitting face piece must check the seal of the face piece routinely prior to each entry into a potentially contaminated area. The seal may also be checked during use if the user questions the fit. Either the positive and negative pressure checks listed below or the respirator manufacturer's recommended user seal check method shall be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

- a. Positive Pressure Check
- Close off the exhalation valve with the palm of the hand and exhale gently into the face piece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the face piece without any evidence of air leakage at the seal.
- b. Negative Pressure Check
- Close off the inlet opening of the canister(s) or cartridge(s) by covering with the palms of the hands and inhale gently so that the face piece collapses slightly. Hold the breath for ten seconds. The face piece should remain slightly collapsed with no inward leakage.

C. Cleaning and Disinfection

The individual user should clean respirators following each use.

Procedures recommended by the respirator manufacturer or those set forth in the following description may be used: (29CFR 1910.134 App B-2)

- a. Remove filters, cartridges, or canisters. Disassemble face pieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.
- b. Wash components in warm (43°C/110°F maximum) water with a mild detergent or a disinfectant cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.
- c. Rinse components thoroughly in clean, warm (43°C/110°F maximum) water, preferably running water. Drain.
- d. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:
  1. Hypochlorite solution (50ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43°C/110°F; or
  2. Aqueous solution of iodine (50ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43° C / 110° F; or
  3. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.
  4. Rinse components thoroughly in clean, warm (43°C/110°F maximum) water, preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on face pieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.
  5. Components should be hand-dried with a clean, lint-free cloth or air-dried.
  6. Reassemble face piece, replacing filters, cartridges, and canisters where necessary.
  7. Test the respirator to ensure that all components work properly.

D. Storage

“All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they shall be packed or stored to prevent deformation of the face piece and exhalation valve.” (29CFR (h)(2)(i)) Respirators should be stored in sealable plastic bags or in containers with tight fitting lids. Respirators should not be hung by their straps as this could cause distortion of the mask area and damage to the straps. Follow the manufacturer’s directions for specific storage requirements.

## **XII.**

### **Change-out Schedule**

Respirator users may no longer rely on warning properties as the sole basis for determining change schedules, however, respirator users should be trained to understand that abnormal odor or irritation is evidence that respirator cartridges need to be replaced. When there is a mix of contaminants, the service life will be based on the contaminant with the shortest breakthrough time. Many manufacturers are now installing End of Service Life Indicators (ESLI's) on respirator cartridges. An ESLI is a system that changes color, therefore alerting the user that the cartridge must be replaced. The respirator user must strictly follow the manufacturer's guidelines to prevent health risks. The following tables contain current examples:

**Table 3: Particulate Filter Change-Out Schedule**

<p><b>N-series:</b> use for protection against solid and water based particles</p> <ul style="list-style-type: none"><li>- N95</li><li>- N99</li><li>- N100</li></ul>	<p>All N series filters have no specific service time. They may be used multiple shifts and may continue until a breathing resistance is noted or become visibly soiled.</p> <p style="text-align: center;"><b>OR</b></p> <p>At the first sign of physical damage.</p>
<p><b>R-series:</b> use for protection against any particles (including oil aerosols).</p> <ul style="list-style-type: none"><li>- R95</li><li>- R99</li><li>- R100</li></ul>	<p>All R series filters have a useful service time of an 8-hour shift.</p>
<p><b>P-series:</b> use for protection against any particles (including oil aerosols).</p> <ul style="list-style-type: none"><li>- P95</li><li>- P99</li><li>- P 100</li></ul>	<p>All P series filters have varying service times. See manufacturer's time use limitations for more information.</p>

### XIII.

#### **Recordkeeping**

UTRGV will record and maintain appropriate documentation of this Respiratory Protection Program. The following is a list of those items that will be documented and who is responsible for each:

- A. **Medical Evaluation** – all documentation will be maintained by UTRGV Employee Health Services .
- B. **Fit testing** – all fit testing documentation will be maintained by ESHRM.
- C. **Training** – all initial and follow up training documentation will be maintained by ESHRM.
- D. **Inspection** – all routine respirator use and inspection shall be documented (see Appendix F) and maintained by the user, and will be checked periodically by ESHRM.

### XIV.

#### **Program Surveillance**

Periodic inspections and program evaluations will be conducted by ESHRM to determine the continued effectiveness of the Respiratory Protection Plan. Program updates will be implemented as deemed appropriate by ESHRM.

### XV.

#### **OSHA Definitions**

The following definitions are important terms used in the respiratory protection standard:

- A. ***Air-purifying respirator*** means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element
- B. ***Atmosphere-supplying respirator*** means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units
- C. ***Canister or cartridge*** means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.
- D. ***Demand respirator*** means an atmosphere-supplying respirator that admits breathing air to the face piece only when negative pressure is created inside the face piece by inhalation.
- E. ***Emergency situation*** means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.
- F. ***Employee exposure*** means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.
- G. ***End-of-service-life indicator (ESLI)*** means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

- H. ***Escape-only respirator*** means a respirator intended to be used only for emergency exit.
- I. ***Filter or air purifying element*** means a component used in respirators to remove solid or liquid aerosols from the inspired air.
- J. ***Filtering face piece (dust mask)*** means a negative pressure particulate respirator with a filter as an integral part of the face piece or with the entire face piece composed of the filtering medium.
- K. ***Fit factor*** means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.
- L. ***Fit test*** means the use of a protocol to qualitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)
- M. ***Helmet*** means a rigid respiratory inlet covering that also provides head protection against impact and penetration.
- N. ***High efficiency particulate air (HEPA) filter*** means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.
- O. ***Hood*** means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.
- P. ***Immediately dangerous to life and health (IDLH)*** means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.
- Q. ***Interior structural firefighting*** means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures, which are involved in a fire situation beyond the incipient stage. (See 29 CFR 1910.155)
- R. ***Loose-fitting face piece*** means a respiratory inlet covering that is designed to form a partial seal with the face.
- S. ***Negative Pressure Respirator (tight fitting)*** means a respirator in which the air pressure inside the face piece is negative during inhalation with respect to the ambient air pressure outside the respirator.
- T. ***Oxygen Deficient Atmosphere*** means an atmosphere with the oxygen content below 19.5% by volume.
- U. ***Physician or other licensed health care professional (PLHCP)*** means an

individual whose legally permitted scope of practice (ie, license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

- V. ***Positive Pressure Respirator*** means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.
- W. ***Powered Air-purifying Respirator (PAPR)*** means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.
- X. ***Pressure Demand Respirator*** means a positive pressure atmosphere-supplying respirator that admits breathing air to the face piece when the positive pressure is reduced inside the face piece by inhalation.
- Y. ***Qualitative Fit Test (QLFT)*** means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.
- Z. ***Quantitative Fit Test (QNFT)*** means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.
- AA. ***Respiratory Inlet Covering*** means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device  
or breathing air source, or both. It may be a face piece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.
- BB. ***Self-Contained Breathing Apparatus (SCBA)*** means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.
- CC. ***Service Life*** means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.
- DD. ***Supplied-Air Respirator (SAR) or Airline Respirator*** means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.
- EE. ***Tight-Fitting Face Piece*** means a respiratory inlet covering that forms a complete seal with the face.
- FF. ***User Seal Check*** means an action conducted by the respirator user to determine if the respirator is properly sealed to the face.

# **Appendix A - Fit Test Procedures**

## **Appendix A to § 1910.134: Fit Testing Procedures (Mandatory)**

### ***Part I. OSHA-Accepted Fit Test Protocols***

#### **A. Fit Testing Procedures--General Requirements**

The employer shall conduct fit testing using the following procedures. The requirements in this appendix apply to all OSHA- accepted fit test methods, both QLFT and QNFT.

1. The test subject shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.
2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, because it is only a review.
3. The test subject shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit. Each respirator represents a different size and shape, and if fitted and used properly, will provide adequate protection.
4. The test subject shall be instructed to hold each chosen face piece up to the face and eliminate those that obviously do not give an acceptable fit.
5. The more acceptable face pieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in the following item A.6. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.
6. Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:
  - (a) Position of the mask on the nose
  - (b) Room for eye protection
  - (c) Room to talk
  - (d) Position of mask on face and cheeks

7. The following criteria shall be used to help determine the adequacy of the respirator fit:
  - (a) Chin properly placed;
  - (b) Adequate strap tension, not overly tightened;
  - (c) Fit across nose bridge;
  - (d) Respirator of proper size to span distance from nose to chin;
  - (e) Tendency of respirator to slip;
  - (f) Self-observation in mirror to evaluate fit and respirator position.
8. The test subject shall conduct a user seal check, either the negative and positive pressure seal checks described in Appendix B-1 of this section or those recommended by the respirator manufacturer, which provide equivalent protection to the procedures in Appendix B- 1. Before conducting the negative and positive pressure checks, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another face piece shall be selected and retested if the test subject fails the user seal check tests.
9. The test shall not be conducted if there is any hair growth between the skin and the face piece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.
10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the test subject can wear a respirator while performing her or his duties.
11. If the employee finds the fit of the respirator unacceptable, the test subject shall be given the opportunity to select a different respirator and to be retested.
12. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing.
13. The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use which could interfere with respirator fit.
14. Test Exercises.
  - (a) The following test exercises are to be performed for all fit testing methods prescribed in this appendix, except for the CNP method. A separate fit testing exercise regimen is contained in the CNP protocol. The test subject shall

perform exercises, in the test environment, in the following manner:

- (1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally.
- (2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.
- (3) Turning head side to side. Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.
- (4) Moving head up and down. Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).
- (5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

*Rainbow Passage*

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

- (6) Grimace. The test subject shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT)
- (7) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT or QLFT units that do not permit bending over at the waist.
- (8) Normal breathing. Same as exercise (1).

(b) Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried. The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

(c)

## B. Qualitative Fit Test (QLFT) Protocols

### 1. General

(a) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

### 2. Saccharin Solution Aerosol Protocol

The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste threshold screening. The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4-inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her slightly open

mouth with tongue extended. The subject is instructed to report when he/she detects a sweet taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. The nozzle is directed away from the nose and mouth of the person. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The threshold check solution is prepared by dissolving 0.83 gram of sodium saccharin USP in 100 ml of warm water. It can be prepared by putting 1 ml of the fit test solution (see (b)(5) below) in 100 ml of distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted. If the test subject reports tasting the sweet taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject is unable to taste saccharin and may not perform the saccharin fit test.

**Note to paragraph 3. (a):** If the test subject eats or drinks something sweet before the screening test, he/she may be unable to taste the weak saccharin solution.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Saccharin solution aerosol fit test procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in 3. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected in section I. A. of this appendix. The respirator shall be properly adjusted and equipped with a particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 ml of warm water.

(6) As before, the test subject shall breathe through the slightly open mouth with tongue extended, and report if he/she tastes the sweet taste of saccharin.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of saccharin fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test. A minimum of 10 squeezes is required.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the original number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected. If the test subject does not report tasting the saccharin, the test is passed.

(11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

(12) Since the nebulizer has a tendency to clog during use, the test operator must make periodic checks of the nebulizer to ensure that it is not clogged. If clogging is found at the end of the test session, the test is invalid.

### 3. Bitrex™ (Denatonium Benzoate) Solution Aerosol Qualitative Fit Test Protocol

The Bitrex™ (Denatonium benzoate) solution aerosol QLFT protocol uses the published saccharin test protocol because that protocol is widely accepted. Bitrex is routinely used as a taste aversion agent in household liquids which children should not be drinking and is endorsed by the American Medical Association, the National Safety Council, and the American Association of Poison Control Centers. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

#### (a) Taste Threshold Screening.

The Bitrex taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of Bitrex.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches (30.5 cm) in diameter by 14 inches (35.6 cm) tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a  $\frac{3}{4}$  inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a bitter taste

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the Threshold Check Solution into the enclosure. This Nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The Threshold Check Solution is prepared by adding 13.5 milligrams of Bitrex to 100 ml of 5% salt (NaCl) solution in distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely, and is then released and allowed to fully expand.

(7) An initial ten squeezes are repeated rapidly and then the test subject is asked whether the Bitrex can be tasted. If the test subject reports tasting the bitter taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the Bitrex is not tasted after 30 squeezes (step 10), the test subject is unable to taste Bitrex and may not perform the Bitrex fit test.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Bitrex Solution Aerosol Fit Test Procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure as that described in 4. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected according to section I. A. of this appendix. The respirator shall be properly adjusted and equipped with any type particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 337.5 mg of Bitrex to 200 ml of a 5% salt (NaCl) solution in warm water.

(6) As before, the test subject shall breathe through his or her slightly open mouth with tongue extended, and be instructed to report if he/she tastes the bitter taste of Bitrex.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of Bitrex is detected. If the test subject does not report tasting the Bitrex, the test is passed.

(11) If the taste of Bitrex is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

### C. Quantitative Fit Test (QNFT) Protocols

The following quantitative fit testing procedures have been demonstrated to be acceptable: Quantitative fit testing using a non- hazardous test aerosol (such as corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS], or sodium chloride) generated in a test chamber, and employing instrumentation to quantify the fit of the respirator; Quantitative fit testing using ambient aerosol as the test agent and appropriate instrumentation (condensation nuclei counter) to quantify the respirator fit; Quantitative fit testing using controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a face piece to quantify the respirator fit.

#### 1. General

(a) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QNFT equipment is kept clean, and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

#### 2. Generated Aerosol Quantitative Fit Testing Protocol

##### (a) Apparatus

(1) Instrumentation. Aerosol generation, dilution, and measurement systems using particulates (corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS] or sodium chloride) as test aerosols shall be used for quantitative fit testing.

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

(3) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high efficiency particulate air (HEPA) or P100 series filter supplied by the same manufacturer.

(4) The sampling instrument shall be selected so that a computer record or strip chart record may be made of the test showing the rise and fall of the test agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.

(5) The combination of substitute air-purifying elements, test agent and test agent concentration shall be such that the test subject is not exposed in excess of an established exposure limit for the test agent at any time during the testing process, based upon the length of the exposure and the exposure limit duration.

(6) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g., where the respirator is probed), a free air flow is allowed into the sampling line at all times, and there is no interference with the fit or performance of the respirator. The in-mask sampling device (probe) shall be designed and used so that the air sample is drawn from the breathing zone of the test subject, midway between the nose and mouth and with the probe extending into the face piece cavity at least 1/4 inch.

(7) The test setup shall permit the person administering the test to observe the test subject inside the chamber during the test.

(8) The equipment generating the test atmosphere shall maintain the concentration of test agent constant to within a 10 percent variation for the duration of the test.

(9) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event and its being recorded.

(10) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.

(11) The exhaust flow from the test chamber shall pass through an appropriate filter (i.e., high efficiency particulate filter) before release.

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

(13) The limitations of instrument detection shall be taken into account when determining the fit factor.

(14) Test respirators shall be maintained in proper working order and be inspected regularly for deficiencies such as cracks or missing valves and gaskets.

(b) Procedural Requirements

(1) When performing the initial user seal check using a positive or negative pressure check, the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these pressure checks.

(2) The use of an abbreviated screening QLFT test is optional. Such a test may be utilized in order to quickly identify poor fitting respirators that passed the positive and/or negative pressure test and reduce the amount of QNFT time. The use of the CNC QNFT instrument in the count mode is another optional method to obtain a quick estimate of fit and eliminate poor fitting respirators before going on to perform a full QNFT.

(3) A reasonably stable test agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain types of test units, the determination of the test agent's stability may be established after the test subject has entered the test environment.

(4) Immediately after the subject enters the test chamber, the test agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full face piece respirator.

(5) A stable test agent concentration shall be obtained prior to the actual start of testing.

(6) Respirator restraining straps shall not be over-tightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonably comfortable fit typical of normal use. The respirator shall not be adjusted once the fit test exercises begin.

(7) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full face piece respirators. The test subject shall be refitted and retested.

(8) Calculation of fit factors.

(i) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration measured inside the respirator for each test exercise except the grimace exercise.

(ii) The average test chamber concentration shall be calculated as the arithmetic average of the concentration measured before and after each test (i.e., 7 exercises) or the arithmetic average of the concentration measured before and after each exercise or the true average measured continuously during the respirator sample.

(iii) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:

(A) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers that calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

(B) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.

(C) Integration by calculation of the area under the individual peak for each exercise except the grimace exercise. This includes computerized integration.

(D) The calculation of the overall fit factor using individual exercise fit factors involves first converting the exercise fit factors to penetration values, determining the average, and then converting that result back to a fit factor. This procedure is described in the following equation:

$$\text{Overall Fit Factor} = \frac{\text{Number of exercises}}{1/ff_1 + 1/ff_2 + 1/ff_3 + 1/ff_4 + 1/ff_5 + 1/ff_6 + 1/ff_7 + 1/ff_8}$$

Where ff1, ff2, ff3, etc. are the fit factors for exercises 1, 2, 3, etc.

(9) The test subject shall not be permitted to wear a half mask or quarter face piece respirator unless a minimum fit factor of 100 is obtained, or a full face piece respirator unless a minimum fit factor of 500 is obtained.

(10) Filters used for quantitative fit testing shall be replaced whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media.

3. Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol.

The ambient aerosol condensation nuclei counter (CNC) quantitative fit testing (Portacount™) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for quantitative fit tests. A probed respirator has a special sampling device, installed on the respirator, that allows the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator and a minimum fit factor pass level of at least 500 is required for a full face piece negative pressure respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Portacount Fit Test Requirements

(1) Check the respirator to make sure the sampling probe and line are properly attached to the face piece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., NIOSH 42 CFR 84 series 100, series 99, or series 95 particulate filter) per manufacturer's instruction.

(2) Instruct the person to be tested to don the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This individual shall already have been trained on how to wear the respirator properly.

(3) Check the following conditions for the adequacy of the respirator fit: Chin properly placed; Adequate strap tension, not overly tightened; Fit across nose bridge; Respirator of proper size to span distance from nose to

chin; Tendency of the respirator to slip; Self-observation in a mirror to evaluate fit and respirator position.

(4) Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting face piece, try another size of the same model respirator, or another model of respirator.

(5) Follow the manufacturer's instructions for operating the Portacount and proceed with the test.

(6) The test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(7) After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

(b) Portacount Test Instrument

(1) The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.

(2) Since the pass or fail criterion of the Portacount is user programmable, the test operator shall ensure that the pass or fail criterion meet the requirements for minimum respirator performance in this Appendix.

(3) A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

4. Controlled negative pressure (CNP) quantitative fit testing protocol.

The CNP protocol provides an alternative to aerosol fit test methods. The CNP fit test method technology is based on exhausting air from a temporarily sealed respirator face piece to generate and then maintain a constant negative pressure inside the face piece. The rate of air exhaust is controlled so that a constant negative pressure is maintained in the respirator during the fit test. The level of pressure is selected to replicate the mean inspiratory pressure that causes leakage into the respirator under normal use conditions. With pressure held constant, air flow out of the respirator is equal to air flow into the respirator. Therefore,

measurement of the exhaust stream that is required to hold the pressure in the temporarily sealed respirator constant yields a direct measure of leakage air flow into the respirator. The CNP fit test method measures leak rates through the face piece as a method for determining the face piece fit for negative pressure respirators. The CNP instrument manufacturer Dynatech Nevada also provides attachments (sampling manifolds) that replace the filter cartridges to permit fit testing in an employee's own respirator. To perform the test, the test subject closes his or her mouth and holds his/her breath, after which an air pump removes air from the respirator face piece at a pre-selected constant pressure. The face piece fit is expressed as the leak rate through the face piece, expressed as milliliters per minute. The quality and validity of the CNP fit tests are determined by the degree to which the in-mask pressure tracks the test pressure during the system measurement time of approximately five seconds. Instantaneous feedback in the form of a real-time pressure trace of the in-mask pressure is provided and used to determine test validity and quality. A minimum fit factor pass level of 100 is necessary for a half-mask respirator and a minimum fit factor of at least 500 is required for a full face piece respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) CNP Fit Test Requirements.

(1) The instrument shall have a non-adjustable test pressure of 15.0 mm water pressure.

(2) The CNP system defaults selected for test pressure shall be set at - 15 mm of water (-0.58 inches of water) and the modeled inspiratory flow rate shall be 53.8 liters per minute for performing fit tests.

**(Note:** CNP systems have built-in capability to conduct fit testing that is specific to unique work rate, mask, and gender situations that might apply in a specific workplace. Use of system default values, which were selected to represent respirator wear with medium cartridge resistance at a low- moderate work rate, will allow inter- test comparison of the respirator fit.)

(3) The individual who conducts the CNP fit testing shall be thoroughly trained to perform the test.

(4) The respirator filter or cartridge needs to be replaced with the CNP test manifold. The inhalation valve downstream from the manifold either needs to be temporarily removed or propped open.

(5) The test subject shall be trained to hold his or her breath for at least 20 seconds.

(6) The test subject shall don the test respirator without any assistance from the individual who conducts the CNP fit test.

(7) The QNFT protocol shall be followed according to section I. C. 1. of this appendix with an exception for the CNP test exercises.

(b) CNP Test Exercises

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject needs to hold head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply for 1 minute, being careful not to hyperventilate. After the deep breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during test measurement.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his or her head from side to side between the extreme positions on each side for 1 minute. The head shall be held at each extreme momentarily so the subject can inhale at each side. After the turning head side to side exercise, the subject needs to hold head full left and hold his or her breath for 10 seconds during test measurement. Next, the subject needs to hold head full right and hold his or her breath for 10 seconds during test measurement.

(4) Moving head up and down. Standing in place, the subject shall slowly move his or her head up and down for 1 minute. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling). After the moving head up and down exercise, the subject shall hold his or her head full up and hold his or her breath for 10 seconds during test measurement. Next, the subject shall hold his or her head full down and hold his or her breath for 10 seconds during test measurement.

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song for 1 minute. After the talking exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(6) Grimace. The test subject shall grimace by smiling or frowning for 15 seconds.

(7) Bending Over. The test subject shall bend at the waist as if he or she were to touch his or her toes for 1 minute. Jogging in place shall be substituted for this exercise in those test environments such as shroud-type QNFT units that prohibit bending at the waist. After the bending over exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(8) Normal Breathing. The test subject shall remove and re-don the respirator within a one-minute period. Then, in a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement. After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of a respirator shall be tried.

(c) CNP Test Instrument.

(1) The test instrument shall have an effective audio warning device, or a visual-warning device in the form of screen tracing that indicates when the test subject fails to hold his or her breath during the test. The test must be terminated and restarted from the beginning when the test subject failed to hold his or her breath during the test. The test subject may be refitted and retested.

(2) A record of the test shall be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style and size of respirator used; and date tested.

5. Controlled negative pressure (CNP) REDON quantitative fit testing protocol.

(a) When administering this protocol to test subjects, employers must comply with the requirements specified in paragraphs (a) and (c) of Part I.C.4 of this appendix ("Controlled negative pressure (CNP) quantitative fit testing protocol"), as well as use the test exercises described below in paragraph (b) of this protocol instead of the test exercises specified in paragraph (b) of Part I.C.4 of this appendix.

(b) Employers must ensure that each test subject being fit tested using this protocol follows the exercise and measurement procedures, including the order of administration, described below in Table A-1 of this appendix.

**Table A-1. -- CNP REDON Quantitative Fit Testing Protocol**

Exercises <sup>(1)</sup>	Exercise procedure	Measurement procedure
Facing Forward	Stand and breathe normally, without talking, for 30 seconds.	Face forward, while holding breath for 10 seconds.
Bending Over	Bend at the waist, as if going to touch his or her toes, for 30 seconds.	Face parallel to the floor, while holding breath for 10 seconds
Head Shaking	For about three seconds, shake head back and forth vigorously several times while shouting.	Face forward, while holding breath for 10 seconds.
REDON 1	Remove the respirator mask, loosen all facepiece straps, and then redon the respirator mask.	Face forward, while holding breath for 10 seconds.
REDON 2	Remove the respirator mask, loosen all facepiece straps, and then redon the respirator mask again.	Face forward, while holding breath for 10 seconds.

<sup>1</sup> Exercises are listed in the order in which they are to be administered.

(c) After completing the test exercises, the test administrator must question each test subject regarding the comfort of the respirator. When a test subject states that the respirator is unacceptable, the employer must ensure that the test administrator repeats the protocol using another respirator model.

(d) Employers must determine the overall fit factor for each test subject by calculating the harmonic mean of the fit testing exercises as follows:

$$\text{Overall Fit Factor} = \frac{N}{\left[ \frac{1}{FF_1} + \frac{1}{FF_2} + \dots + \frac{1}{FF_N} \right]}$$

Where:

N = The number of exercises;  
 FF1 = The fit factor for the first exercise;  
 FF2 = The fit factor for the second exercise; and FF<sub>N</sub> = The fit factor for the nth exercise.

***Part II. New Fit Test Protocols***

- A. Any person may submit to OSHA an application for approval of a new fit test protocol. If the application meets the following criteria, OSHA will initiate a rulemaking proceeding under section 6(b)(7) of the OSH Act to determine whether to list the new protocol as an approved protocol in this Appendix A.
- B. The application must include a detailed description of the proposed new fit test protocol. This application must be supported by either:

1. A test report prepared by an independent government research laboratory (e.g., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the National Institute for Standards and Technology) stating that the laboratory has tested the protocol and had found it to be accurate and reliable; or
  2. An article that has been published in a peer-reviewed industrial hygiene journal describing the protocol and explaining how test data support the protocol's accuracy and reliability.
- C. If OSHA determines that additional information is required before the Agency commences a rulemaking proceeding under this section, OSHA will so notify the applicant and afford the applicant the opportunity to submit the supplemental information. Initiation of a rulemaking proceeding will be deferred until OSHA has received and evaluated the supplemental information.

# **Appendix B – 1 User Seal Check Procedures**

## **Appendix B – 1 to 1910.134: User Seal Check Procedures: (Mandatory)**

The individual who uses a tight-fitting respirator is to perform a user seal check to ensure that an adequate seal is achieved each time the respirator is put on. Either the positive and negative pressure checks listed in this appendix, or the respirator manufacturer's recommended user seal check method shall be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

### **I. Facepiece Positive and/or Negative Pressure Checks**

- A. *Positive pressure check.* Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.
- B. *Negative pressure check.* Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

### **II. Manufacturer's Recommended User Seal Check Procedures**

The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures provided that the employer demonstrates that the manufacturer's procedures are equally effective.

# **Appendix B – 2 Respiratory Cleaning Procedures**

## **Appendix B – 2 to 1910.134: Respirator Cleaning Procedures (Mandatory)**

These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer as an alternative may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here in Appendix B- 2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in Appendix B-2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

### **I. Procedures for Cleaning Respirators**

- A.** Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure- demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.
- B.** Wash components in warm (43 deg. C [110 deg. F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.
- C.** Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain.
- D.** When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:
  - 1.** Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43 deg. C (110 deg. F); or,
  - 2.** Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43 deg. C (110 deg. F); or,
  - 3.** Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

- E. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.
- F. Components should be hand-dried with a clean lint-free cloth or air-dried.
- G. Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.
- H. Test the respirator to ensure that all components work properly.

# Appendix C – Medical Questionnaire

## Medical Questionnaire for Respiratory Protection

To The Employee:

**Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you.**

**To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.**

# **Appendix D – Information for Voluntary Respirator Use**

(Mandatory) Information for Employees Using Respirators When Not  
Required Under the Standard

## **Appendix D to Sec. 1910.134**

Respirators are an effective means of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.
2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.
3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.
4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

Respirator Users Approval Document

On     /     /     , I do hereby attest that upon reviewing medical questionnaire and based on my \_\_\_\_\_

(date)

best medical judgment, \_\_\_\_\_ is (initial all that apply):

(name)

\_\_\_\_\_ Approved to wear the following respirators:

\_\_\_Filtering Face Piece (N-95)

\_\_\_Escape Only Respirator

\_\_\_Half Mask Respirator

\_\_\_Full Mask Respirator

\_\_\_SCBA

\_\_\_\_\_ Required to come for a medical evaluation before respirator clearance can be given.

\_\_\_\_\_ Are approved with the following conditions.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_ Not approved for respirator use

\_\_\_\_\_  
Signature of PLHCP

\_\_\_\_\_  
Date