

# TENNESSEE DEPARTMENT OF HEALTH



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## RESPIRATORY PROTECTION PLAN

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**I. PURPOSE:**

The purpose of this program is to set forth standard operating guidelines governing the selection and use of respirators. Appropriate respirators shall be used in accordance with this program to control adverse health effects caused by breathing harmful air contaminants. Though the primary objective shall be to prevent atmospheric contamination, respirators shall be used when effective engineering controls are not feasible, or while they are being implemented.

**DEFINITIONS:**

**Air Purifying Respirator:** a type of respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

**Atmosphere-supplying respirator:** a respirator that supplies the user with breathing air from a source independent of the ambient atmosphere. They include Supplied Air Respirators (SARs) and Self-Contained Breathing Apparatus (SCBA) units.

**Canister or Cartridge:** a container with a filter, sorbant, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

**Employee Exposure:** exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

**Filter:** a component used in respirators to remove solid or liquid aerosols from the inspired air.

**Fit Test:** a protocol to quantitatively or qualitatively evaluate the fit of a tight- fitting respirator on an individual.

**Immediately Dangerous to Life or Health (IDLH):** 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.

**Loose Fitting Face Piece:** a respiratory inlet covering that is designed to form a partial seal with the face.

**NIOSH approval:** the approval of a respirator for worker protection by the National Institute for Occupational Safety and Health (NIOSH).

**Powered Air Purifying Respirator (PAPR):** an air purifying respirator that uses a blower to force ambient air through air-purifying elements to the inlet covering.

**Respiratory Inlet Covering:** 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.

**Self-Contained Breathing Apparatus (SCBA):** an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

**Supplied Air Respirator (SAR) or Airline Respirator:** an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

**Tight-fitting Face Piece:** a respiratory inlet covering that forms a complete seal with the face.

## II. SCOPE

The following program establishes for safe practice in the use of respiratory protection devices to ensure the safety and health of Tennessee Department of Health (TDH) staff using these devices under routine and emergency conditions.

The provisions of this document were established per the requirements listed in the Federal Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.134, as enforced at the TDH by the Tennessee Occupational Safety and Health Administration.

**Team Members will be defined and identified for respirator use by the RPA: Examples include PHIT Team, CD Staff, Emergency Preparedness Staff, and TB staff. Other TDH Employees would be fit tested “just-in-time” as needed/required.**

**Team Members of TDH are NOT certified for respirator use in IDLH Conditions**

## III. RESPONSIBILITIES

### 1. Program Administrator

- a. The **Medical Director/Regional Health Officer (RHO)** will designate a non-supervising person with appropriate clinical background to serve as the **“Respiratory Program Administrator” (RPA)**.
- b. The Respiratory Program Administrator or designee will serve as the first contact for employees concerned with respiratory protection.
- c. Administrative duties of the RPA include:
  - i. Identifies work area, processes, or task that require respiratory protection
  - ii. Monitors OSHA policy and standards for changes, and advises regarding changes to comply with current regulations and guidelines.
  - iii. Selects appropriate respiratory protection products in consultation with appropriate specialist
  - iv. Monitors respirator use to ensure that respirators are used in accordance with their certification
  - v. Distributes education/medical questionnaires
  - vi. Coordinates medical questionnaire evaluation per attached decision algorithm.
  - vii. Evaluates any feedback information or surveys
  - viii. Arranges for and conducts training and fit testing
  - ix. Ensures proper storage and maintenance of resp. protection

equipment.

- d. The Respiratory Program Administrator or designee shall be responsible for assuring that training is given to the user initially. An appropriate manufacturer's representative or other qualified individual (such as Respiratory Program Administrator or EP Nurse) may present this training.  
Training shall include:
  - i. Proper cleaning and disinfecting of respirators
  - ii. Proper inspection procedures
  - iii. Proper storing of respirator
  - iv. Instruction in actual use
  - v. Instruction of positive and negative pressure fit checks
- e. The Respiratory Program Administrator or designee will institute annual inspections and evaluations to determine the continued effectiveness of the Respirator Program.
- f. The Respiratory Program Administrator or designee will coordinate annual retraining and fit testing.

## **2. Employees**

- a. Each employee of the TDH has the responsibility to wear their respirator when and where required and in the manner in which they were trained.
- b. The employee shall be instructed and trained in the proper use of respirators and their limitations.
- c. The employee shall inform the Respiratory Program Administrator about changes in their physical health or about any other condition that may affect respirator fit and use, and request a new one that fits properly.
- d. The employee shall inform the Respiratory Program Administrator of any respiratory hazards that they feel are not adequately addressed in the performance of their work duties and of any other concerns regarding the program.
- e. Appropriate surveillance of work area conditions and degree of employee exposure shall be reviewed by the RPA and referred to the Regional Health officer as needed.

#### IV. PROGRAM ELEMENTS

##### 1. Selection Procedures

In order to select the proper respirator against a specific hazard, respiratory hazards are classified as either:

- a. Oxygen deficiency
- b. Air contamination by particulate, vapors or gases
- c. Air contamination by combination of particulate, vapors and gases
- d. Infectious disease protection

A hazardous atmosphere is one that is oxygen-deficient or contains a toxic or disease-producing particulate, vapor or gas in a concentration immediately or ultimately dangerous to life or health. **TDH Employees are NOT certified to work/enter IDLH atmospheres.**

An atmosphere not immediately hazardous to life or health may cause immediate physical discomfort or irritation. It may produce harm after prolonged exposure or cause chronic poisoning after repeated short exposures, but it does not cause irreversible damage during a single exposure.

An oxygen-deficient atmosphere is one that does not contain sufficient oxygen to support metabolism for an unlimited period. The precise description is important for strictly physiological reasons and for proper respirator selection. If an atmosphere is oxygen-deficient, only atmosphere-supplying, not air-purifying respirators may be used. Making this selection would appear to be a simple matter of applying the description of an oxygen-deficient atmosphere. Unfortunately, no one value for oxygen deficiency is universally accepted. **TDH Employees are NOT certified on SAR or SCBA Respirator use.**

The Respiratory Program Administrator shall select respirators with technical assistance from the appropriate experts as needed. Selection shall be made based on:

- a. The type of hazards to which the worker will be exposed
  - b. The estimated concentration of the contaminant
  - c. Pertinent OSHA standards (substance-specific health standards)
- Only OSHA or NIOSH approved respirators shall be used. Currently in use are the N-95 Respirator and the PAPR
  - Only respirators approved by the National Institute for Occupational Safety and Health (NIOSH) will be selected and used.
    - N-95 respirators are available for contact tracing, disease investigation and patient contact/care. (Airborne Precautions)

- A powered air-purifying respirator (PAPR) is available for contact tracing, disease investigation and patient contact/care. (Airborne Precautions) Requests for use of a PAPR will be made to the RPA or Designee
  - ❖ A PAPR may be selected for use if:
    1. The N-95 respirator choice(s) does not fit.
    2. Employee has facial hair or facial deformity that would interfere with mask-to-face seal.
    3. The N-95 respirator choice(s) are unsuitable (i.e. claustrophobic).
    4. Desired for high-risk aerosol-generating procedures.

**Program Scope and Application**

This program applies to all employees who could potentially be exposed to airborne respiratory illnesses during normal work operations, and during non-routine or emergency situations. TDH employees required to wear respirators are outlined in the table below:

Work Process	Location	Type of Respirator
Contact tracing/disease investigation: PHIT (Public Health Investigation Team) (Airborne Precautions)	Community Settings	*N-95 *PAPR (powered air-purifying respirator)
Patient contact/care (Airborne Precautions)	CD Clinic Specific to TB Or airborne infectious disease contacts investigation	N-95

**\*NOTE:** PHIT team members will only be required to wear respirators based on the type of hazard associated with the contact tracing/disease investigation. This will include PAPRS as necessary and just-in time training will be conducted on proper use of a PAPR.

**\*\*Emergency Situations:** In the event of situations such as a Bioterrorism Event or Pandemic Illness requiring the use of a respirator, the TDH RHO or Medical Director will determine TDH’s appropriate emergency response and all TDH employees (currently not listed on the above table) requiring the use of a respirator will receive Just-In-Time training and fit testing.

**2. Voluntary Respirator Use**

Voluntary use of respirators by employees or voluntary use of respirators other than those selected by the Program Administrator will be permitted if such use does not create a hazard to the employee. A copy of “Information for Employees Using Respirators When Not Required Under the Standard” will be provided by the Program Administrator to employees who voluntarily wear respirators (Appendix D). This document details the requirements for voluntary use of respirators by employees. Employees who voluntarily choose to wear a respirator

must comply with the procedures for cleaning, maintenance and storage of the device

### 3. Medical Evaluation

**Team Members identified for respirator use: such as PHIT Team, CD Staff, and Emergency Preparedness Staff, etc. will complete the medical evaluation. Other TDH Employees would be fit tested “just-in-time” as needed/required.**

- a. Identified employees will complete the OSHA Medical Questionnaire for N-95 or Powered Air Purifying Respirator (PAPR) and will be fitted and trained annually with N-95 and/or APRs (Appendix A and C). Newly hired employees, in the above identified areas, will also complete the OSHA Medical Questionnaire form and will be trained and fitted with N-95/APR upon employment and annually. The Medical Questionnaire is to remain confidential between the employee and the reviewer (RPA, Medical Officer, or designee). It is to be completed one time unless one of the following circumstances occurs:
  - i. Employee reports symptoms that are related to the ability to use a respirator (wheezing, shortness of breath, chest pain, etc.)
  - ii. It is identified that an employee is having a problem during respirator use.
  - iii. The healthcare professional performing the evaluation determines an employee needs to be re-evaluated.
  - iv. A significant change occurs in the workplace conditions or employee health that may result in an increased physiological burden on the employee.
  - v. Employee facial size/shape/structure has changed significantly.
- b. Follow-up medical review will be provided to employees who give a positive response to any questions number 1-9 in section 2 on the medical evaluation questionnaire or if the employee experiences medical difficulties when wearing the respirator.
- c. Instructions for air purifying respirators (APRs) will be given to employees that cannot pass N-95 fit testing.
- d. The Regional Health Officer, Respiratory Program Administrator, or their designee will determine individual medical clearance following the employee's completion of the Medical Questionnaire. After review of the Medical Questionnaire by the designee, the employee may be referred to the Medical Officer for further evaluation. (See Decision Algorithm contained in Appendix C.)

- e. All examinations and questionnaires are to remain confidential between the employee and the Employee Health Nurse, Physician, outside consultant, RPA and/or other personnel in the medical evaluation process. The medical evaluation questionnaire form will be kept in a locked filing cabinet maintained by the RPA, separate from personnel record. Work limitations or restrictions, are not considered confidential and will be provided only on a need to know basis.

#### 4. Fit Testing

Before any employee may be required to use a respirator with a negative or positive tight-fitting face piece, the employee must be fit tested with the same make, model, style and size respirator that will be used. Employees volunteering to don a respirator may ask to be fit tested. A Qualitative (saccharine or bitrex) or Quantitative (Portacount) fit test procedure must be performed (Appendix A and H).

#### 5. Respirator Use

- a. Before respirator use in the work environment, each employee must successfully complete medical evaluation, respirator training and pass the respirator fit test. To document these activities, the fit test form must be completed in its entirety (Appendix E).
- b. Respirators in use should be inspected by the Program Administrator to ensure that those selected for the job are being used and that they are in good condition. Respiratory protection is no better than the respirator in use. Periodic monitoring of respirator use should include:
  - i. Determine that the proper respirators are being used
  - ii. Determine that respirators are being worn properly
  - iii. Consultation with wearers about:
    - 1 Discomfort
    - 2 Resistance to breathing
    - 3 Fatigue
    - 4 Interference with vision
    - 5 Interference with communications
    - 6 Restriction of movement
    - 7 Interference with job performance
    - 8 Confidence in the respirator
  - iv. Problems discovered during the random inspections must be rectified immediately

- c. Employee's responsibility:
  - i. Proper supervision of respirator use should ensure that each worker understands that he has the following responsibilities.
    - 1 Shall use the respirator as instructed
    - 2 Shall guard against damaging the respirator
    - 3 Shall go immediately to an area having breathable/clean air if the respirator fails to provide proper protection
    - 4 Shall report any respirator malfunction to a person responsible for the respirator program

## 6. General Use Procedures

- a. Respirators shall be assigned to individual workers for their exclusive use
- b. Employees will use their respirators under conditions specified by this program, and in accordance with the training they received on the use of each particular model. In addition, the respirator shall not be used in a manner for which it is not certified by NIOSH or by its manufacturer.
- c. All employees shall conduct user seal checks each time that they wear their respirator by conducting a positive/negative pressure check (Appendix B-1).
- d. Respirator considered for selection and routine use should consider basic industrial hygiene practices. The following basic information is required before selecting a respirator for use:
  - i. What is the contaminant?
  - ii. What is the toxicity of the containment?
  - iii. What are the biological effects of the contaminant?
  - iv. What is the threshold limit value?
  - v. Is there a ceiling value for the contaminant?
  - vi. Is the contaminant a gas, liquid or solid, dust or mist or fume?
  - vii. What is the concentration of the contaminant in the workplace?
  - viii. Will the contaminant irritate the eyes?
  - ix. Does the contaminant have adequate warning properties?
  - x. Can the contaminant be absorbed through the skin? If so, will it cause serious injury?

## 7. Cleaning

Scrupulous respiratory maintenance must be made an integral part of the overall respirator program. Wearing a poorly maintained or malfunctioning respirator is, in

one sense, more dangerous than not wearing a respirator at all. The worker wearing a defective device thinks they are protected when, in reality, they are not.

- a. Cleaning is not required for disposable respirators.
- b. If reusable respirators are used, they shall be cleaned and disinfected (by the user) after each use, when used, or as often as necessary to ensure sanitary use of the respirator.
  - i. Any good detergent may be used, but cleaner and sanitizer solution that clean effectively and contain a bactericide are available. The bactericide is generally a quaternary ammonium compound, which has some disadvantages, because its concentration must be adjusted to the composition of the local water to provide a constant degree of disinfection. Also, there is a possibility of dermatitis if the quaternary ammonium salts are not completely rinsed from the respirator.
  - ii. An alternative is to wash the respirator in detergent, followed by a disinfecting rinse. Disinfection is not necessary if the respirator is reused by the same worker. However, where individual issue is not practiced, disinfecting is recommended. Reliable, effective disinfectants maybe made from readily available household solutions, including:
    - Hypochlorite solution (50 ppm of chloride) made by adding approximately 2 ml of bleach to 1 liter of water or, in kitchen language, 2 tablespoons per gallon. A 2-minute immersion disinfects the respirators.
    - Aqueous solution of iodine (50 ppm of iodine) made by adding approximately 0.8 ml tincture of iodine per liter of water. The iodine is approximately 7% ammonium and potassium iodide, 45% alcohol, and 48% water. An equivalent expression is approximately 1 teaspoon of tincture of iodine per gallon of water. Again, a 2-minute immersion is sufficient.
- c. The cleaned and disinfected respirators should be rinsed thoroughly in clean water (140° F maximum) to remove all traces of detergent, cleaner, sanitizer and disinfectant. This is very important to prevent dermatitis (does not include the N-95).
- d. The respirators may be allowed to air dry on a clean surface. They also may be hung from a horizontal wire, like drying clothes, but care must be taken not to damage the face pieces.

## 8. Maintenance

- a. Probably the most important part of a respirator maintenance program is continual inspection of the devices. If conscientiously performed, inspections will identify damage or malfunctioning respirator before they can be used. The OSHA requirements outline two primary types of inspection 1) while the respirator is in use and 2) while it is being cleaned. In a small operation where the worker probably maintains their own respirator, the two types of inspection become essentially the same.
- b. Respirators are to be properly maintained at all times in order to ensure that they function properly and adequately protect the employee. Maintenance involves a thorough visual inspection for cleanliness and defects. Respirators shall be inspected by the user before and after each use routinely.

Inspection shall include:

- i. Face piece
  - Check for cracks, tears or holes
  - Check for any distortion in the facemask
- ii. Straps
  - Breaks or tears
- iii. Inhalation and exhalation valves (if applicable)
- iv. Filters or cartridges (if applicable)

## 9. Storage

Care that has gone into cleaning and maintaining of a respirator can be negated by improper storage. OSHA requires that respirators be stored to prevent against:

- Dust
- Sunlight
- Heat
- Extreme cold
- Excessive moisture
- Damaging chemicals

The RPA shall ensure that workers are provided a storage area for respirators that are in a convenient, clean and sanitary location. The respirators should be stored as to not damage the integrity of the mask

Routinely used respirators may be stored in a variety of ways if they are protected against the substances and conditions listed at the beginning of this section. If the worker is trained adequately, they should develop a respect for their respirator which will automatically give them incentive to protect it from damage.

## **10. Change Schedules**

Disposable filtering face pieces (e.g. N-95's) worn once in the presence of a patient with a respiratory infectious disease, should be considered potentially contaminated with infectious material. Touching the outside of the respirator should be avoided and the respirator should be placed in a biohazard bag and discarded as infectious waste.

If sufficient quantities of respirators are not available, then respirators may be reused if they are not known to be soiled or damaged in accordance with CDC guidelines (Centers for Disease Control and Prevention, 2005).

## **11. Employee Training**

No employee will be permitted to work with a respirator until he or she has received training in respiratory protection (Appendix F and G). The training will be coordinated by the Respiratory Program Administrator or designee annually and will cover the following topics:

- a. Explanation of the workplace hazards and what would happen if respiratory protection was not used
- b. Elements of the Respiratory Protection Program
- c. Employee's responsibilities
- d. Selection of respiratory protection and who is authorized to modify the selection
- e. Medical Evaluation program and the Respirator Fitting Forms
- f. Function, capabilities and limitations of the selected respiratory protection
- g. Explanation of the operation of the respiratory protection, including procedures for donning and doffing, seal check, fit and proper wear of the respirator
- h. Respirator maintenance including cleaning, inspection and storage
- i. Recognition and handling of emergency situations

## **12. Documentation and Recordkeeping**

- a. A written copy of this program will be kept in the RPA's office and is available to all employees who wish to review it.

- b. Medical questionnaire records shall be maintained by the RPA and are not to be located with Personnel Files
- c. Training records shall be maintained by the RPA or the Program Director's designated trainer.

## V. PROGRAM EVALUATION

### 1. Surveillance Evaluation

Two important aspects of the respirator program are the periodic surveillance of the work areas requiring usage of respirators, and an evaluation of the overall respirator program for effectiveness.

### 2. Surveillance of Work Area Conditions and Worker Exposure

Many things such as changes in operation or process, implementation of engineering controls, temperature, and air movement can affect the concentration of the substance(s) which originally required the use of respirators.

### 3. Program Administration

- a. Is program responsibility vested in one individual who is knowledgeable and who can coordinate all aspects of the program?
- b. What in the present status of the implementation of engineering controls, if feasible, to alleviate the need of respirators?
- c. Are there written procedures/statements covering the various aspects of the respirator program?
  - i. Designation of administrator
  - ii. Respirator selection
  - iii. Purchase of approved equipment
  - iv. Medical aspects of respirator usage
  - v. Issuance of equipment
  - vi. Fitting
- d. Program Operation
  - i. Maintenance, storage, repair
  - ii. Inspection
  - iii. Use under special condition

### 4. Program Operation

- a. Respiratory protective equipment selection
  - i. Are work area conditions and employee exposures properly surveyed?
  - ii. Are respirators selected on the basis of hazards to which the employee is exposed?
  - iii. Are selection made by individuals knowledgeable of selection procedures?
- b. Are only approved respirators purchased and used, and do they provide adequate protection for the specific hazard and concentration of the contaminant?
- c. Has a Medical Questionnaire of the prospective user been made to determine the employee's physical and psychological ability to wear respiratory protective equipment?
- d. Where practical, have respirators been issued to the users for their exclusive use, and their records covering issuance?
- e. Respiratory protection equipment fitting
  - i. Are the users given the opportunity to try on several respirators to determine whether the respirators they will subsequently be wearing are the best fitting one?
  - ii. Is the fit test at appropriate intervals?
  - iii. Are those users who require corrective lenses properly fitted?
  - iv. Are users prohibited from wearing contact lenses when using respirators?
  - v. Is the face piece to face seal tested in a test atmosphere?
- f. Maintenance of respiratory equipment
  - i. Cleaning and disinfecting
    - 1. Are respirators cleaned and disinfected after each use when different people use the same device, or as frequently as necessary for devices issued to the individual users?
    - 2. Are proper methods of cleaning and disinfecting utilized?
  - ii. Storage

- 1 Are respirators stored in a manner so as to protect them from dust, sunlight, heat, excessive cold, or moisture, or damaging chemicals?
  - 2 Are respirators stored properly in a storage facility so as to prevent them from deforming?
- iii. Inspection
- 1 Are respirators inspected before, after each use, and during cleanup?
- iv. Training
- 1 Are users trained in proper respirator usage?
  - 2 Are users trained in the basis for selection of respirators?

## VI. SPECIAL SITUATIONS IN RESPIRATOR USE

### 1. Facial Hair

Facial hair lying between the sealing surface of a respirator face piece and the wearer's skin will prevent a good seal. If the respirator permits negative air pressure inside the face piece during inhalation, there will be excessive penetration by an air contaminant. Even a few days growth of stubble will permit excessive contaminant penetration. Respirators shall not be worn when conditions prevent a good seal of the face piece to the face. Items such as beards and sideburns prevent satisfactory dealing. Therefore, anyone who has stubble, a mustache, sideburns or a beard that passes between his face and the sealing surface shall not wear a respirator that allows negative pressure inside the face piece during inhalation.

### 2. Corrective Lens

Those who must wear spectacles present a problem in respiratory protection. Spectacle temple bars or straps that pass between the sealing surface of a full-face piece and the wearer's face prevent a good seal. Therefore, spectacles that have temple bars or straps shall not be used when a full-face piece respirator must be worn. Spectacles with short temple bars that do not protrude between the sealing surface and the wearer's face, or protrude between the sealing surface and the wearer's face or spectacles without temple bars which are taped to the wearer's face may be used temporarily. Special corrective lens to be mounted inside full-face piece are available and should be used by those who need them. These lenses shall be mounted in the full-face piece only by qualified persons to ensure good vision, comfort and proper sealing of the face piece.

Spectacles or goggles may also interfere with quarter or half-masks. They shall be worn so as not to interfere with the seal of the face piece. If there is interference, a full face-piece respirator should be worn to avoid sealing problems. It is the employer's responsibility to supply the correct lens.

### **3. Miscellaneous Sealing Problems**

Scars, hollow temples, very prominent cheekbones, deep skin creases, and lack of teeth or dentures may cause respirator face-piece sealing problems. Dentures or missing teeth may cause problems in sealing a mouthpiece in a person's mouth. Full dentures should be retained when wearing a respirator, but partial dentures may or may not have to be removed, depending upon the possibility of swallowing them. With full lower denture, problems in fitting quarter-masks can be expected, as the lower part of the mask tends to unseat the denture. The employee cannot perform work if there are any sealing problems. This should be reported to their supervisor immediately.

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[Regulations \(Standards - 29 CFR\) - Table of Contents](#)

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- Part Number: 1910
  - Part Title: Occupational Safety and Health Standards
  - Subpart: I
  - Subpart Title: Personal Protective Equipment
  - Standard Number: [1910.134 App A](#)
  - Title: Fit Testing Procedures (Mandatory).
  
  - GPO Source: [e-CFR](#)
- 

### **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 facepiece up to the face and eliminate those that obviously do not give an acceptable fit.
5. The more acceptable facepieces 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 facepiece 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 facepiece 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. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

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) Employers must perform the following test exercises for all fit testing methods prescribed in this appendix, except for the CNP quantitative fit testing protocol and the CNP REDON quantitative fit testing protocol. For these two protocols, employers must ensure that the test subjects (*i.e.*, employees) perform the exercise procedure specified in Part I.C.4(b) of this appendix for the CNP quantitative fit testing protocol, or the exercise procedure described in Part I.C.5(b) of this appendix for the CNP REDON quantitative fit-testing protocol. For the remaining fit testing methods, employers must ensure that employees perform the test exercises in the appropriate 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.

### ***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. Isoamyl Acetate Protocol

**Note:** This protocol is not appropriate to use for the fit testing of particulate respirators. If used to fit test particulate respirators, the respirator must be equipped with an organic vapor filter.

##### (a) Odor Threshold Screening

Odor threshold screening, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate at low levels.

(1) Three 1 liter glass jars with metal lids are required.

(2) Odor-free water (e.g., distilled or spring water) at approximately 25 deg. C (77 deg. F) shall be used for the solutions.

(3) The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 ml of pure IAA to 800 ml of odor-free water in a 1 liter jar, closing the lid and shaking for 30 seconds. A

new solution shall be prepared at least weekly.

(4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well-ventilated to prevent the odor of IAA from becoming evident in the general room air where testing takes place.

(5) The odor test solution is prepared in a second jar by placing 0.4 ml of the stock solution into 500 ml of odor-free water using a clean dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution shall be used for only one day.

(6) A test blank shall be prepared in a third jar by adding 500 cc of odor-free water.

(7) The odor test and test blank jar lids shall be labeled (e.g., 1 and 2) for jar identification. Labels shall be placed on the lids so that they can be peeled off periodically and switched to maintain the integrity of the test.

(8) The following instruction shall be typed on a card and placed on the table in front of the two test jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

(9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

(10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.

(11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

**(b) Isoamyl Acetate Fit Test**

(1) The fit test chamber shall be a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. If no drum liner is available, a similar chamber shall be constructed using plastic sheeting. The inside top center of the chamber shall have a small hook attached.

(2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors.

(3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit

testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well-ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.

(5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 ml of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber. An IAA test swab or ampule may be substituted for the IAA wetted paper towel provided it has been demonstrated that the alternative IAA source will generate an IAA test atmosphere with a concentration equivalent to that generated by the paper towel method.

(6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the test exercises; or to demonstrate some of the exercises.

(7) If at any time during the test, the subject detects the banana-like odor of IAA, the test is failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

(8) If the test is failed, the subject shall return to the selection room and remove the respirator. The test subject shall repeat the odor sensitivity test, select and put on another respirator, return to the test area and again begin the fit test procedure described in (b) (1) through (7) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait at least 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(9) If the subject passes the test, the efficiency of the test procedure shall be demonstrated by having the subject break the respirator face seal and take a breath before exiting the chamber.

(10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test, so that there is no significant IAA concentration buildup in the chamber during subsequent tests. The used towels shall be kept in a self-sealing plastic bag to keep the test area from being contaminated.

### 3. 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.

#### 4. 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).

#### 5. Irritant Smoke (Stannic Chloride) Protocol

This qualitative fit test uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

##### (a) General Requirements and Precautions

(1) The respirator to be tested shall be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).

(2) Only stannic chloride smoke tubes shall be used for this protocol.

(3) No form of test enclosure or hood for the test subject shall be used.

(4) The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the test subject can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the test subject.

(5) The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

(b) Sensitivity Screening Check

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

(1) The test operator shall break both ends of a ventilation smoke tube containing stannic chloride, and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute, or an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.

(2) The test operator shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his/her eyes closed while the test is performed.

(3) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine that he/she can detect it.

(c) Irritant Smoke Fit Test Procedure

(1) The person being fit tested shall don the respirator without assistance, and perform the required user seal check(s).

(2) The test subject shall be instructed to keep his/her eyes closed.

(3) The test operator shall direct the stream of irritant smoke from the smoke tube toward the faceseal area of the test subject, using the low flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make two more passes around the perimeter of the mask, moving to within six inches of the respirator.

(4) If the person being tested has not had an involuntary response and/or detected the irritant smoke, proceed with the test exercises.

(5) The exercises identified in section I.A. 14. of this appendix shall be performed by the test subject while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of six inches.

(6) If the person being fit tested reports detecting the irritant smoke at any time, the test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.

(7) Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to

the smoke. Failure to evoke a response shall void the fit test.

(8) If a response is produced during this second sensitivity check, then the fit test is passed.

### 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 facepiece 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 facepiece 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 facepiece 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 facepiece 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  $ff_1, ff_2, ff_3$ , 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 facepiece respirator unless a minimum fit factor of 100 is obtained, or a full facepiece 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 facepiece 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. (Portacount Pro 8030/8038, Appendix H)

(1) Check the respirator to make sure the sampling probe and line are properly attached to the facepiece 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 facepiece, 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 facepiece to generate and then maintain a constant negative pressure inside the facepiece. 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 facepiece as a method for determining the facepiece fit for negative pressure respirators. The CNP instrument manufacturer Occupational Health Dynamics of Birmingham, Alabama 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 facepiece at a

pre-selected constant pressure. The facepiece fit is expressed as the leak rate through the facepiece, 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 facepiece 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 employer must train the test subject to hold his or her breath for at least 10 seconds.
- (6) The test subject must don the test respirator without any assistance from the test administrator who is conducting the CNP fit test. The respirator must not be adjusted once the fit-test exercises begin. Any adjustment voids the test, and the test subject must repeat the 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 must have an effective audio-warning device, or a visual-warning device in the form of a 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 fails to hold his or her breath during the test. The test subject then 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

FFN = 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.

[63 FR 20098, April 23, 1998; 69 FR 46993, August 4, 2004]

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### **Appendix B-1 User Seal Check Procedures (29CFR 1910.134 App B-1)**

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 methods shall be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

#### **I. Face piece Positive and / or Negative Pressure Checks**

**Positive pressure check:** If the respirator has an exhalation valve, close off the exhalation valve. 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 outward leakage of air at the seal.

**Negative pressure check:** Inhale gently so that the face piece collapses slightly, and hold breath for ten seconds. If the face piece 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 above positive and /or negative pressure check procedures provided that the employer demonstrates that the manufacturer’s procedures are equally effective.

## Appendix B-2 Respirator Cleaning Procedures

### [Regulations \(Standards - 29 CFR\) - Table of Contents](#)

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- Part Number: 1910
  - Part Title: Occupational Safety and Health Standards
  - Subpart: I
  - Subpart Title: Personal Protective Equipment
  - Standard Number: 1910.134 App B-2
  - Title: Respirator Cleaning Procedures (Mandatory).
  - GPO Source: [e-CFR](#)
- 

### **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.

[63 FR 1152, Jan. 8, 1998]

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[Next Standard \(1910.134 App C\)](#)

[Regulations \(Standards - 29 CFR\) - Table of Contents](#)



**Section 2 (MANDATORY)**

**Questions 1 through 10 below must be answered by every employee who has been selected to use any type of respirator. Please circle "yes" or "no" to the following.**

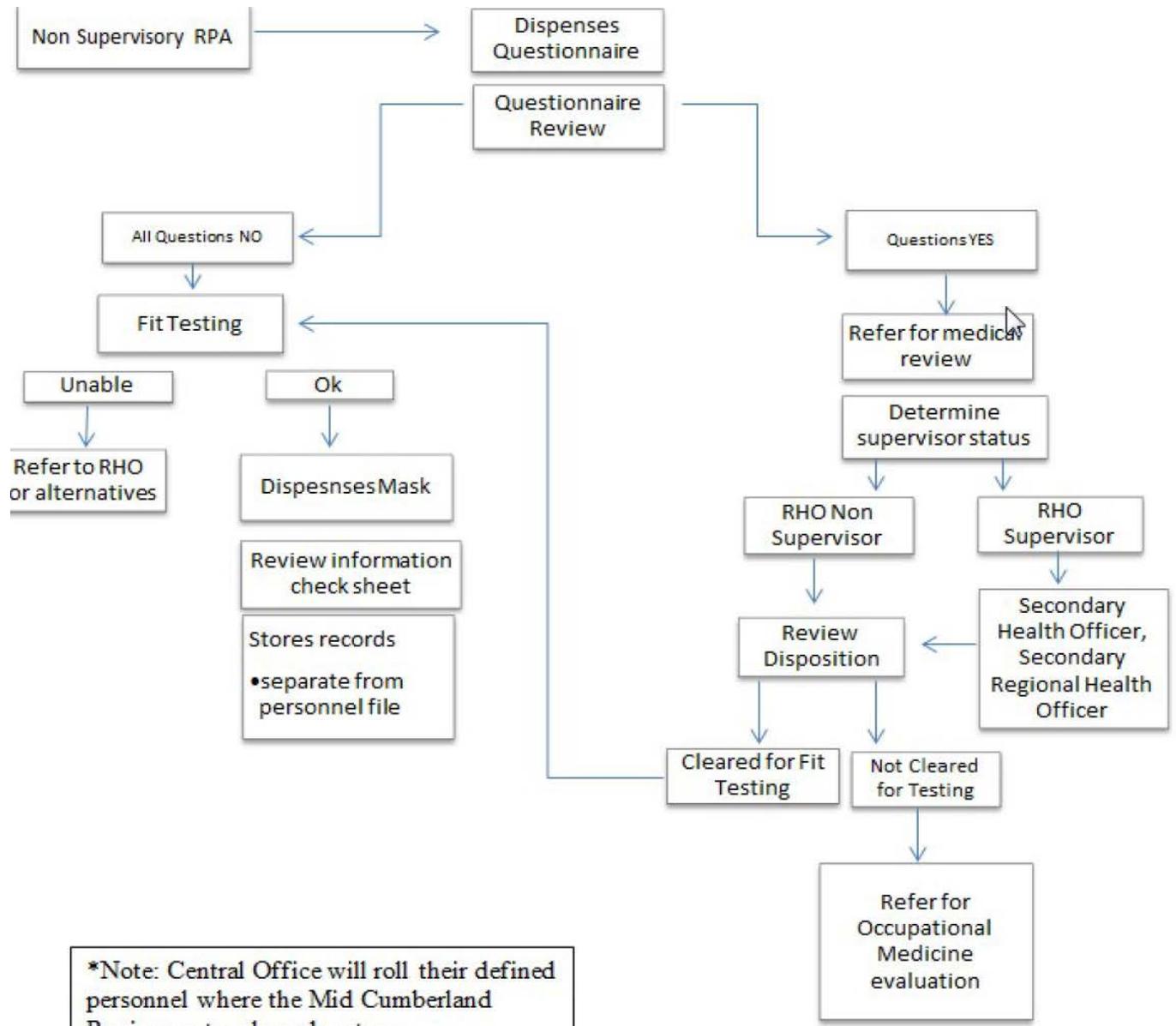
- |  |     |    |
|--|-----|----|
| 1. Do you currently smoke tobacco, or have you smoked tobacco in the last month:                 | Yes | No |
| 2. Are you allergic to latex?  | Yes | No |
| 3. Have you <b>ever had</b> any of the following conditions?                                     |     |    |
| a. Seizures (fits):  | Yes | No |
| b. Diabetes (sugar disease):   | Yes | No |
| c. Allergic reactions that interfere with your breathing:  | Yes | No |
| d. Claustrophobia (fear of closed-in places):  | Yes | No |
| e. Trouble smelling odors:   | Yes | No |
| 4. Have you <b>ever had</b> any of the following pulmonary or lung problems?                     |     |    |
| a. Asbestosis:   | Yes | No |
| b. Asthma:   | Yes | No |
| c. Chronic bronchitis:   | Yes | No |
| d. Emphysema:  | Yes | No |
| e. Pneumonia:  | Yes | No |
| f. Tuberculosis:   | Yes | No |
| g. Silicosis:  | Yes | No |
| h. Pneumothorax (collapsed lung):  | Yes | No |
| i. Lung cancer:  | Yes | No |
| j. Broken ribs:  | Yes | No |
| k. Any chest injuries or surgeries:  | Yes | No |
| l. Any other lung problem that you've been told about:   | Yes | No |
| 5. Do you <b>currently</b> have any of the following symptoms of pulmonary or lung illness?      |     |    |
| a. Shortness of breath:  | Yes | No |
| b. Shortness of breath when walking fast on level ground or walking up a slight hill or incline: | Yes | No |
| c. Shortness of breath when walking with other people at an ordinary pace on level ground:       | Yes | No |
| d. Have to stop for breath when walking at your own pace on level ground:                        | Yes | No |
| e. Shortness of breath when washing or dressing yourself:  | Yes | No |
| f. Shortness of breath that interferes with your job   | Yes | No |
| g. Coughing that produces phlegm (thick sputum) not associated with a cold:                      | Yes | No |
| h. Coughing that wakes you early in the morning:   | Yes | No |
| i. Coughing that occurs mostly when you are lying down:  | Yes | No |
| j. Coughing up blood in the last month:  | Yes | No |
| k. Wheezing:   | Yes | No |
| l. Wheezing that interferes with your job:   | Yes | No |
| m. Chest pain when you breathe deeply:   | Yes | No |
| n. Any other symptoms that you think may be related to lung problems:                            | Yes | No |

- |  |     |    |
|--|-----|----|
| 6. Have you <b>ever had</b> any of the following cardiovascular or heart problems?   |     |    |
| a. Heart attack:   | Yes | No |
| b. Stroke:   | Yes | No |
| c. Angina:   | Yes | No |
| d. Heart failure:  | Yes | No |
| e. Swelling in your legs or feet (not caused by walking):  | Yes | No |
| f. Heart arrhythmia (heart beating irregularly):   | Yes | No |
| g. High blood pressure:  | Yes | No |
| h. Any other heart problem that you've been told about:  | Yes | No |
| 7. Have you <b>ever had</b> any of the following cardiovascular or heart symptoms?   |     |    |
| a. Frequent pain or tightness in your chest:   | Yes | No |
| b. Pain or tightness in your chest during physical activity:   | Yes | No |
| c. Pain or tightness in your chest that interferes with your job:  | Yes | No |
| d. In the past two years, have you noticed your heart skipping or missing a beat:  | Yes | No |
| e. Heartburn or indigestion that is not related to eating:   | Yes | No |
| f. Any other symptoms that you think may be related to heart or circulation problems:  | Yes | No |
| 8. Do you <b>currently</b> take medication for any of the following problems?  |     |    |
| a. Breathing or lung problems:   | Yes | No |
| b. Heart trouble:  | Yes | No |
| c. Blood pressure:   | Yes | No |
| d. Seizures (fits):  | Yes | No |
| e. Other _____   |     |    |
| 9. If you've used a respirator, have you <b>ever had</b> any of the following problems?<br>(If you've never used a respirator, check the following space and go to question 9) |     |    |
| a. Eye irritation:   | Yes | No |
| b. Skin allergies or rashes:   | Yes | No |
| c. Anxiety:  | Yes | No |
| d. General weakness or fatigue:  | Yes | No |
| e. Any other problem that interferes with your use of a respirator:  | Yes | No |
| 10. Would you like to talk to the health care professional about your answers to this questionnaire?:  | Yes | No |

Questions 11-16 below must be answered by every employee who has been selected to use either a full-face piece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators (**e.g.-N-95 respirators**), answering these questions is voluntary.

- |  |     |    |
|--|-----|----|
| 11. Have you <b>ever lost</b> vision in either eye (temporarily or permanently): | Yes | No |
| 12. Do you <b>currently</b> have any of the following vision problems?           |     |    |
| a. Wear contact lenses:  | Yes | No |
| b. Wear glasses:   | Yes | No |
| c. Color blind:  | Yes | No |
| d. Any other eye or vision problem:  | Yes | No |
| 13. Have you <b>ever had</b> an injury to your ears, including a broken eardrum? | Yes | No |

- |  |     |    |
|--|-----|----|
| 14. Do you <b>currently</b> have any of the following hearing problems?          |     |    |
| a. Difficulty hearing:   | Yes | No |
| b. Wear a hearing aid:   | Yes | No |
| c. Any other hearing or ear problem:   | Yes | No |
| 15. Have you <b>ever had</b> a back injury?                                      | Yes | No |
| 16. Do you <b>currently</b> have any of the following musculoskeletal problems?  |     |    |
| a. Weakness in any of your arms, hands, legs, or feet:                           | Yes | No |
| b. Back pain:  | Yes | No |
| c. Difficulty fully moving your arms and legs:                                   | Yes | No |
| d. Pain or stiffness when you lean forward or backward at the waist:             | Yes | No |
| e. Difficulties fully moving your head up or down:                               | Yes | No |
| f. Difficulty fully moving your head side to side:                               | Yes | No |
| g. Difficulty bending at your knees:   | Yes | No |
| h. Difficulty squatting to the ground:   | Yes | No |
| i. Climbing a flight of stairs or a ladder carrying more than 25 lbs:            | Yes | No |
| j. Any other muscle or skeletal problem that interferes with using a respirator: | Yes | No |
| 17. Has your health changed within the past year? If “yes”, describe:            | Yes | No |



## Appendix D

### Voluntary Respirator Use

#### Information for Employees Using Respirators When Not Required Under the Standard

Respirators are an effective method 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.

**Appendix E**  
**Working Environment, Medical Approval and Fit Testing Forms**

(To be completed by a licensed health care professional and given to Program Administrator and employee)

**Employee:** \_\_\_\_\_ **Department:** \_\_\_\_\_

**Working Environment Form**

Categorization of Workload\*                      Light                      Moderate                      Heavy

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

Will the user be working under hot conditions (temperature exceeding 77° F (circle one):    Yes    No

Hazards to be protected against (e.g., infectious diseases, dust, fumes, vapors): \_\_\_\_\_

Type of respirator to be assigned: \_\_\_\_\_

Special Considerations: \_\_\_\_\_

**Medical Approval Form**

\_\_\_\_\_ This person can wear a respirator without restrictions

\_\_\_\_\_ This person can wear a respirator subject to the following restrictions:

\_\_\_\_\_ This person cannot use a respirator of the type described above.

\_\_\_\_\_  
*Physician's Signature*

\_\_\_\_\_  
*Date*

**Fit Testing Form**

Respirator Selected:

Type \_\_\_\_\_ Manufacturer \_\_\_\_\_ Model \_\_\_\_\_

NIOSH Approval Number \_\_\_\_\_ Size \_\_\_\_\_

Sensitivity:                      (circle # of squeezes)

Saccharin (# Squeezes 10, 20, 30)

Bitrx (#Squeezes 10, 20, 30)

Results:

Pass \_\_\_\_\_ Fail \_\_\_\_\_

Pass \_\_\_\_\_ Fail \_\_\_\_\_

Fit Test Agent:

Filters/ Cartridges:

Saccharin

Particulate HEPA Filters

Bitrex

Particulate HEPA Filters

Portacount (CNC)

Results:

Pass \_\_\_\_\_ Fail \_\_\_\_\_

Pass \_\_\_\_\_ Fail \_\_\_\_\_

Pass \_\_\_\_\_ Fail \_\_\_\_\_

\_\_\_\_\_  
*Test Conductor's Signature*

\_\_\_\_\_  
*Date*

**Appendix F**  
**Respiratory Fit Testing Educational Talking Points**

1. Medical Evaluations must be conducted before you can be fitted for a respirator
2. Medical Evaluations are a one-time requirement unless the following occurs:
  - a. Employee has had symptoms that are related to the ability to use a respirator. (Wheezing, shortness of breath, chest pain, etc.)
  - b. Employee has had a problem during respirator use
  - c. A significant change has occurred in employee health or workplace conditions that may result in an increased physiological burden on the employee
  - d. Employee facial/size/shape/structure has change significantly. (Cosmetic surgery, dental work, weight changes [+/- 10 lbs])
3. Report any changes to Regional Program Administrator
4. Wash hands with soap and water or an alcohol based hand sanitizer before donning respirator
5. Inspect respirator before each use for the following:
  - a. Structural integrity: no nicks, abrasions, cuts, or creases in seal area
  - b. No tears, holes, or soilage in filter material
  - c. Filter material is free from soiling, dirt and is dry
  - d. Ensure metal nose clip is in place and functions properly (if applicable)
  - e. Respirator straps are not cut or otherwise damaged
6. Ensure face is clean shaven before use and nothing will interfere with the seal of the respirator to your skin
7. Proper donning technique of respirator
  - a. Always use two hands to mold the respirator to your face
  - b. Push inward while moving your fingers down the side of the nose piece
  - c. Use caution not to pinch the bridge of the nose which can create puckering and lead to an improper fit
  - d. Ensure respirator straps are in the proper position to create the best seal based on your type of respirator (ensuring long or thick hair does not interfere with the seal or straps)
8. Perform a Seal Check as described below or following manufacturer's recommended procedures
  - a. Close off the exhalation valve 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 outward leakage of air at the seal
  - b. If air leaks around the nose readjust the nosepiece and repeat seal check; if air leaks around the edges, adjust the position on the face and the straps along the side of the head. Repeat seal check
9. Understand when to discard your respirator:
  - a. Soiled, contaminated, wet respirator (blood, sputum)

- b. After using with a patient in Airborne Precautions and also Contact Precautions (SARS, smallpox, TB), or during any aerosol-generating procedure
  - c. Breathing becomes difficult during use
10. Proper doffing of a respirator
- a. Do not touch the facepiece
  - b. Slowly lift the bottom strap from around your neck up and over your head, while keeping the respirator seated against your face
  - c. Lift off the top strap
  - d. Carefully remove your respirator without allowing the outside of the respirator to come in contact with your body
11. Wash hands with soap and water or an alcohol based hand sanitizer after removing respirator.
12. Proper Storage of respirator
- a. Prevent deformation of the face piece and exhalation valve
  - b. Protect from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, chemicals.
- You may wish to store your mask in a paper bag when not in use.

Appendix G - TN DOH Annual Fit Testing and/or Training Form

I have received annual fit testing and training on the proper use, maintenance, storage and employee responsibilities for: (Circle all that apply)

N95 respirator PAPR (Powered Air-Purifying Respirator)

I have been given the opportunity to ask questions about respiratory protection program. I understand that as an employee I am responsible for the following:

- 1. Participating in all training (asking questions when needed).
2. Wearing the respirator when indicated and refraining from using the respirator in a manner not approved by National Institute for Occupational Safety and Health (NIOSH).
3. Conducting a positive pressure seal check each time I wear the respirator.
4. Maintaining assigned respiratory equipment: N95 Respirator
o Examine the face piece of the disposable respirator to determine if it has structural integrity. Discard if there are nicks, abrasions, cuts, or creases in seal area or if the filter material is physically damaged or soiled.
o Check the respirator straps to be sure they are not cut or otherwise damaged.
o Make sure the metal nose clip is in place and functions properly (if applicable).
o No cleaning required. Disposable respirators are not to be stored after becoming soiled or damaged, if breathing becomes labored, and/or structural integrity is compromised.
o Discard disposable respirator after use if patient is in both Airborne and Contact precautions (due to potential for contamination in a contact isolation environment).
5. Reporting malfunctions or concerns to my Respiratory Program Administrator (RPA).
6. Leaving a potentially contaminated work area if my respirator (either N95 or PAPR) is damaged, soiled or if breathing becomes difficult.
7. Contacting the Respiratory Program Administrator (RPA) for medical re-evaluation for any of the following circumstances:
o I develop symptoms that are related to my ability to use a respirator (wheezing, shortness of breath, chest pain, etc.).
o I have a problem during respirator use.
o I have a change in my physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes (e.g., wearing new dentures), cosmetic surgery, or an obvious change in body weight.
o A significant change occurs in my workplace conditions or my health that may result in an increased physiological burden on me.
o The healthcare professional performing the evaluation determines that I need to be more frequently re-evaluated.

Employee Name (Please Print)

Employee Signature

Date

Fit Tester/Trainer

Date

Original Copy - Fit Tester; Copy - Employee

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**Appendix H**  
**OSHA Standard 1910.134**

- Part Number: 1910
  - Part Title: Occupational Safety and Health Standards
  - Subpart: I
  - Subpart Title: Personal Protective Equipment
  - Standard Number: [1910.134](#)
  - Title: Respiratory Protection.
  - Appendix: [A](#), [B-1](#), [B-2](#), [C](#), [D](#)
  - GPO Source: [e-CFR](#)
- 

This section applies to General Industry (part 1910), Shipyards (part 1915), Marine Terminals (part 1917), Longshoring (part 1918), and Construction (part 1926).

**[1910.134\(a\)](#)**

*Permissible practice.*

**[1910.134\(a\)\(1\)](#)**

In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, 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, appropriate respirators shall be used pursuant to this section.

**[1910.134\(a\)\(2\)](#)**

A respirator shall be provided to each employee when such equipment is necessary to protect the health of such employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program, which shall include the requirements outlined in paragraph (c) of this section. The program shall cover each employee required by this section to use a respirator.

**[1910.134\(b\)](#)**

*Definitions.* The following definitions are important terms used in the respiratory protection standard in this section.

*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.

*Assigned protection factor (APF)* means the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program as specified by this section.

*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.

**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.

**Demand respirator** means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

**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.

**Employee exposure** means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

**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.

**Escape-only respirator** means a respirator intended to be used only for emergency exit.

**Filter or air purifying element** means a component used in respirators to remove solid or liquid aerosols from the inspired air.

**Filtering facepiece (dust mask)** means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

**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.

**Fit test** means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

**Helmet** means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

**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.

**Hood** means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

**Immediately dangerous to life or 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.

***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)

***Loose-fitting facepiece*** means a respiratory inlet covering that is designed to form a partial seal with the face.

***Maximum use concentration (MUC)*** means the maximum atmospheric concentration of a hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance. The MUC can be determined mathematically by multiplying the assigned protection factor specified for a respirator by the required OSHA permissible exposure limit, short-term exposure limit, or ceiling limit. When no OSHA exposure limit is available for a hazardous substance, an employer must determine an MUC on the basis of relevant available information and informed professional judgment.

***Negative pressure respirator (tight fitting)*** means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

***Oxygen deficient atmosphere*** means an atmosphere with an oxygen content below 19.5% by volume.

***Physician or other licensed health care professional (PLHCP)*** means an individual whose legally permitted scope of practice (i.e., 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.

***Positive pressure respirator*** means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

***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.

***Pressure demand respirator*** means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

***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.

***Quantitative fit test (QNFT)*** means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

***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 facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

*Self-contained breathing apparatus (SCBA)* means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

*Service life* means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

*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.

*This section* means this respiratory protection standard.

*Tight-fitting facepiece* means a respiratory inlet covering that forms a complete seal with the face.

*User seal check* means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

**1910.134(c)**

***Respiratory protection program.*** This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator. The Small Entity Compliance Guide contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the Small Entity Compliance Guide will be available on or about April 8, 1998 from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210 (202-219-4667).

**1910.134(c)(1)**

In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

**1910.134(c)(1)(i)**

Procedures for selecting respirators for use in the workplace;

**1910.134(c)(1)(ii)**

Medical evaluations of employees required to use respirators;

**1910.134(c)(1)(iii)**

Fit testing procedures for tight-fitting respirators;

**1910.134(c)(1)(iv)**

Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;

**1910.134(c)(1)(v)**

Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;

**1910.134(c)(1)(vi)**

Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;

**1910.134(c)(1)(vii)**

Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;

**1910.134(c)(1)(viii)**

Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance; and

**1910.134(c)(1)(ix)**

Procedures for regularly evaluating the effectiveness of the program.

**1910.134(c)(2)**

Where respirator use is not required:

**1910.134(c)(2)(i)**

An employer may provide respirators at the request of employees or permit employees to use their own respirators, if the employer determines that such respirator use will not in itself create a hazard. If the employer determines that any voluntary respirator use is permissible, the employer shall provide the respirator users with the information contained in Appendix D to this section ("Information for Employees Using Respirators When Not Required Under the Standard"); and

**1910.134(c)(2)(ii)**

In addition, the employer must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that respirator, and that the respirator is cleaned, stored, and maintained so that its use does not present a health hazard to the user. Exception: Employers are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).

**1910.134(c)(3)**

The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

**1910.134(c)(4)**

The employer shall provide respirators, training, and medical evaluations at no cost to the employee.

**1910.134(d)**

***Selection of respirators.*** This paragraph requires the employer to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. The paragraph also specifies appropriately protective respirators for use in IDLH atmospheres, and limits the selection and use of air-purifying respirators.

**1910.134(d)(1)**

***General requirements.***

**1910.134(d)(1)(i)**

The employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability.

**1910.134(d)(1)(ii)**

The employer shall select a NIOSH-certified respirator. The respirator shall be used in compliance with the conditions of its certification.

**1910.134(d)(1)(iii)**

The employer shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH.

**1910.134(d)(1)(iv)**

The employer shall select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

**1910.134(d)(2)*****Respirators for IDLH atmospheres.*****1910.134(d)(2)(i)**

The employer shall provide the following respirators for employee use in IDLH atmospheres:

**1910.134(d)(2)(i)(A)**

A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or

**1910.134(d)(2)(i)(B)**

A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

**1910.134(d)(2)(ii)**

Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

**1910.134(d)(2)(iii)**

All oxygen-deficient atmospheres shall be considered IDLH. Exception: If the employer demonstrates that, under all foreseeable conditions, the oxygen concentration can be maintained within the ranges specified in Table II of this section (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.

**1910.134(d)(3)*****Respirators for atmospheres that are not IDLH.*****1910.134(d)(3)(i)**

The employer shall provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.

**1910.134(d)(3)(i)(A)**

***Assigned Protection Factors (APFs)*** Employers must use the assigned protection factors listed in Table 1 to select a respirator that meets or exceeds the required level of employee protection. When using a combination respirator (e.g., airline respirators with an air-purifying filter), employers must ensure that the assigned protection factor is appropriate to the mode of operation in which the respirator is being used.

Table 1. -- Assigned Protection Factors<sup>5</sup>

Type of respirator <sup>1, 2</sup>	Quarter mask	Half mask	Full facepiece	Helmet/hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	<sup>3</sup> 10	50	.....	.....
2. Powered Air-Purifying Respirator (PAPR)	.....	50	1,000	<sup>4</sup> 25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	.....	10	50	.....	.....
• Continuous flow mode	.....	50	1,000	<sup>4</sup> 25/1,000	25
• Pressure-demand or other positive-pressure mode	.....	50	1,000	.....	.....
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	.....	10	50	50	.....
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	.....	.....	10,000	10,000	.....

**Notes:**

<sup>1</sup>Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

<sup>2</sup>The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this section (29 CFR 1910.134), including training, fit testing, maintenance, and use requirements.

<sup>3</sup>This APF category includes filtering facepieces, and half masks with elastomeric facepieces.

<sup>4</sup>The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25.

<sup>5</sup>These APFs do not apply to respirators used solely for escape. For escape respirators used in association with specific substances covered by 29 CFR 1910 subpart Z, employers must refer to the appropriate substance-specific standards in that subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).

**1910.134(d)(3)(i)(B)**

**Maximum Use Concentration (MUC)**

**1910.134(d)(3)(i)(B)(1)**

The employer must select a respirator for employee use that maintains the employee's exposure to the hazardous substance, when measured outside the respirator, at or below the MUC.

**1910.134(d)(3)(i)(B)(2)**

Employers must not apply MUCs to conditions that are immediately dangerous to life or health (IDLH); instead, they must use respirators listed for IDLH conditions in paragraph (d)(2) of this standard.

**1910.134(d)(3)(i)(B)(3)**

When the calculated MUC exceeds the IDLH level for a hazardous substance, or the performance limits of the cartridge or canister, then employers must set the maximum MUC at that lower limit.

**1910.134(d)(3)(ii)**

The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

**1910.134(d)(3)(iii)**

For protection against gases and vapors, the employer shall provide:

**1910.134(d)(3)(iii)(A)**

An atmosphere-supplying respirator, or

**1910.134(d)(3)(iii)(B)**

An air-purifying respirator, provided that:

**1910.134(d)(3)(iii)(B)(1)**

The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or

**1910.134(d)(3)(iii)(B)(2)**

If there is no ESLI appropriate for conditions in the employer's workplace, the employer implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis for the canister and cartridge change schedule and the basis for reliance on the data.

**1910.134(d)(3)(iv)**

For protection against particulates, the employer shall provide:

**1910.134(d)(3)(iv)(A)**

An atmosphere-supplying respirator; or

**1910.134(d)(3)(iv)(B)**

An air-purifying respirator equipped with a filter certified by NIOSH under 30 CFR part 11 as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH under 42 CFR part 84; or

**1910.134(d)(3)(iv)(C)**

For contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers, an air-purifying respirator equipped with any filter certified for particulates by NIOSH.

TABLE I. -- ASSIGNED PROTECTION FACTORS  
[RESERVED]

TABLE II

Altitude (ft.)	Oxygen deficient Atmospheres (% O <sub>2</sub> ) for which the employer atmosphere may rely on supplying respirators
Less than 3,001	16.0-19.5
3,001-4,000	16.4-19.5
4,001-5,000	17.1-19.5
5,001-6,000	17.8-19.5
6,001-7,000	18.5-19.5
7,001-8,000 <sup>1</sup>	19.3-19.5.

<sup>1</sup>Above 8,000 feet the exception does not apply. Oxygen-enriched breathing air must be supplied above 14,000 feet.

**1910.134(e)**

**Medical evaluation.** Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. Accordingly, this paragraph specifies the minimum requirements for medical evaluation that employers must implement to determine the employee's ability to use a respirator.

**1910.134(e)(1)**

**General.** The employer shall provide a medical evaluation to determine the employee's ability to use a respirator, before the employee is fit tested or required to use the respirator in the workplace. The employer may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.

**1910.134(e)(2)**

**Medical evaluation procedures.**

**1910.134(e)(2)(i)**

The employer shall identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.

**1910.134(e)(2)(ii)**

The medical evaluation shall obtain the information requested by the questionnaire in Sections 1 and 2, Part A of Appendix C of this section.

**1910.134(e)(3)*****Follow-up medical examination.*****1910.134(e)(3)(i)**

The employer shall ensure that a follow-up medical examination is provided for an employee who gives a positive response to any question among questions 1 through 8 in Section 2, Part A of Appendix C or whose initial medical examination demonstrates the need for a follow-up medical examination.

**1910.134(e)(3)(ii)**

The follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the PLHCP deems necessary to make a final determination.

**1910.134(e)(4)*****Administration of the medical questionnaire and examinations.*****1910.134(e)(4)(i)**

The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content.

**1910.134(e)(4)(ii)**

The employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.

**1910.134(e)(5)*****Supplemental information for the PLHCP.*****1910.134(e)(5)(i)**

The following information must be provided to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:

**1910.134(e)(5)(i)(A)**

(A) The type and weight of the respirator to be used by the employee;

**1910.134(e)(5)(i)(B)**

The duration and frequency of respirator use (including use for rescue and escape);

**1910.134(e)(5)(i)(C)**

The expected physical work effort;

**1910.134(e)(5)(i)(D)**

Additional protective clothing and equipment to be worn; and

**1910.134(e)(5)(i)(E)**

Temperature and humidity extremes that may be encountered.

**1910.134(e)(5)(ii)**

Any supplemental information provided previously to the PLHCP regarding an employee need not be provided for a subsequent medical evaluation if the information and the PLHCP remain the same.

**1910.134(e)(5)(iii)**

The employer shall provide the PLHCP with a copy of the written respiratory protection program and a copy of this section.

**Note to Paragraph (e)(5)(iii):** When the employer replaces a PLHCP, the employer must ensure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having

the documents transferred from the former PLHCP to the new PLHCP. However, OSHA does not expect employers to have employees medically reevaluated solely because a new PLHCP has been selected.

**1910.134(e)(6)**

**Medical determination.** In determining the employee's ability to use a respirator, the employer shall:

**1910.134(e)(6)(i)**

Obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP.

The recommendation shall provide only the following information:

**1910.134(e)(6)(i)(A)**

Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator;

**1910.134(e)(6)(i)(B)**

The need, if any, for follow-up medical evaluations; and

**1910.134(e)(6)(i)(C)**

A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

**1910.134(e)(6)(ii)**

If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used, the employer shall provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator; if a subsequent medical evaluation finds that the employee is medically able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.

**1910.134(e)(7)**

**Additional medical evaluations.** At a minimum, the employer shall provide additional medical evaluations that comply with the requirements of this section if:

**1910.134(e)(7)(i)**

An employee reports medical signs or symptoms that are related to ability to use a respirator;

**1910.134(e)(7)(ii)**

A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated;

**1910.134(e)(7)(iii)**

Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or

**1910.134(e)(7)(iv)**

A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

**1910.134(f)**

**Fit testing.** This paragraph requires that, before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. This paragraph specifies the kinds of fit tests allowed, the procedures for conducting them, and how the results of the fit tests must be used.

**1910.134(f)(1)**

The employer shall ensure that employees using a tight-fitting facepiece respirator pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT) as stated in this paragraph.

**1910.134(f)(2)**

The employer shall ensure that an employee using a tight-fitting facepiece respirator is fit tested prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.

**1910.134(f)(3)**

The employer shall conduct an additional fit test whenever the employee reports, or the employer, PLHCP, supervisor, or program administrator makes visual observations of, changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

**1910.134(f)(4)**

If after passing a QLFT or QNFT, the employee subsequently notifies the employer, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable, the employee shall be given a reasonable opportunity to select a different respirator facepiece and to be retested.

**1910.134(f)(5)**

The fit test shall be administered using an OSHA-accepted QLFT or QNFT protocol. The OSHA-accepted QLFT and QNFT protocols and procedures are contained in Appendix A of this section.

**1910.134(f)(6)**

QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

**1910.134(f)(7)**

If the fit factor, as determined through an OSHA-accepted QNFT protocol, is equal to or greater than 100 for tight-fitting half facepieces, or equal to or greater than 500 for tight-fitting full facepieces, the QNFT has been passed with that respirator.

**1910.134(f)(8)**

Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.

**1910.134(f)(8)(i)**

Qualitative fit testing of these respirators shall be accomplished by temporarily converting the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.

**1910.134(f)(8)(ii)**

Quantitative fit testing of these respirators shall be accomplished by modifying the facepiece to allow sampling inside the facepiece in the breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.

**1910.134(f)(8)(iii)**

Any modifications to the respirator facepiece for fit testing shall be completely removed, and the facepiece restored to NIOSH-approved configuration, before that facepiece can be used in the workplace.

**1910.134(g)**

*Use of respirators.* This paragraph requires employers to establish and implement procedures for the proper use of respirators. These requirements include prohibiting conditions that may result in facepiece

seal leakage, preventing employees from removing respirators in hazardous environments, taking actions to ensure continued effective respirator operation throughout the work shift, and establishing procedures for the use of respirators in IDLH atmospheres or in interior structural firefighting situations.

**1910.134(g)(1)*****Facepiece seal protection.*****1910.134(g)(1)(i)**

The employer shall not permit respirators with tight-fitting facepieces to be worn by employees who have:

**1910.134(g)(1)(i)(A)**

Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or

**1910.134(g)(1)(i)(B)**

Any condition that interferes with the face-to-facepiece seal or valve function.

**1910.134(g)(1)(ii)**

If an employee wears corrective glasses or goggles or other personal protective equipment, the employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

**1910.134(g)(1)(iii)**

For all tight-fitting respirators, the employer shall ensure that employees perform a user seal check each time they put on the respirator using the procedures in Appendix B-1 or procedures recommended by the respirator manufacturer that the employer demonstrates are as effective as those in Appendix B-1 of this section.

**1910.134(g)(2)*****Continuing respirator effectiveness.*****1910.134(g)(2)(i)**

Appropriate surveillance shall be maintained of work area conditions and degree of employee exposure or stress. When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, the employer shall reevaluate the continued effectiveness of the respirator.

**1910.134(g)(2)(ii)**

The employer shall ensure that employees leave the respirator use area:

**1910.134(g)(2)(ii)(A)**

To wash their faces and respirator facepieces as necessary to prevent eye or skin irritation associated with respirator use; or

**1910.134(g)(2)(ii)(B)**

If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece; or

**1910.134(g)(2)(ii)(C)**

To replace the respirator or the filter, cartridge, or canister elements.

**1910.134(g)(2)(iii)**

If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, the employer must replace or repair the respirator before allowing the employee to return to the work area.

**1910.134(g)(3)**

***Procedures for IDLH atmospheres.*** For all IDLH atmospheres, the employer shall ensure that:

**1910.134(g)(3)(i)**

One employee or, when needed, more than one employee is located outside the IDLH atmosphere;

**1910.134(g)(3)(ii)**

Visual, voice, or signal line communication is maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere;

**1910.134(g)(3)(iii)**

The employee(s) located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue;

**1910.134(g)(3)(iv)**

The employer or designee is notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue;

**1910.134(g)(3)(v)**

The employer or designee authorized to do so by the employer, once notified, provides necessary assistance appropriate to the situation;

**1910.134(g)(3)(vi)**

Employee(s) located outside the IDLH atmospheres are equipped with:

**1910.134(g)(3)(vi)(A)**

Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either

**1910.134(g)(3)(vi)(B)**

Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or

**1910.134(g)(3)(vi)(C)**

Equivalent means for rescue where retrieval equipment is not required under paragraph (g)(3)(vi)(B).

**1910.134(g)(4)**

***Procedures for interior structural firefighting.*** In addition to the requirements set forth under paragraph (g)(3), in interior structural fires, the employer shall ensure that:

**1910.134(g)(4)(i)**

At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;

**1910.134(g)(4)(ii)**

At least two employees are located outside the IDLH atmosphere; and

**1910.134(g)(4)(iii)**

All employees engaged in interior structural firefighting use SCBAs.

**Note 1 to paragraph (g):** One of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

**Note 2 to paragraph (g):** Nothing in this section is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.

**1910.134(h)**

***Maintenance and care of respirators.*** This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.

**1910.134(h)(1)**

***Cleaning and disinfecting.*** The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The employer shall ensure that respirators are cleaned and disinfected using the procedures in Appendix B-2 of this section, or procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness. The respirators shall be cleaned and disinfected at the following intervals:

**1910.134(h)(1)(i)**

Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition;

**1910.134(h)(1)(ii)**

Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals;

**1910.134(h)(1)(iii)**

Respirators maintained for emergency use shall be cleaned and disinfected after each use; and

**1910.134(h)(1)(iv)**

Respirators used in fit testing and training shall be cleaned and disinfected after each use.

**1910.134(h)(2)**

***Storage.*** The employer shall ensure that respirators are stored as follows:

**1910.134(h)(2)(i)**

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 facepiece and exhalation valve.

**1910.134(h)(2)(ii)**

In addition to the requirements of paragraph (h)(2)(i) of this section, emergency respirators shall be:

**1910.134(h)(2)(ii)(A)**

Kept accessible to the work area;

**1910.134(h)(2)(ii)(B)**

Stored in compartments or in covers that are clearly marked as containing emergency respirators; and

**1910.134(h)(2)(ii)(C)**

Stored in accordance with any applicable manufacturer instructions.

**1910.134(h)(3)*****Inspection.*****1910.134(h)(3)(i)**

The employer shall ensure that respirators are inspected as follows:

**1910.134(h)(3)(i)(A)**

All respirators used in routine situations shall be inspected before each use and during cleaning;

**1910.134(h)(3)(i)(B)**

All respirators maintained for use in emergency situations shall be inspected at least monthly and in accordance with the manufacturer's recommendations, and shall be checked for proper function before and after each use; and

**1910.134(h)(3)(i)(C)**

Emergency escape-only respirators shall be inspected before being carried into the workplace for use.

**1910.134(h)(3)(ii)**

The employer shall ensure that respirator inspections include the following:

**1910.134(h)(3)(ii)(A)**

A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters or filters; and

**1910.134(h)(3)(ii)(B)**

A check of elastomeric parts for pliability and signs of deterioration.

**1910.134(h)(3)(iii)**

In addition to the requirements of paragraphs (h)(3)(i) and (ii) of this section, self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be maintained in a fully charged state and shall be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The employer shall determine that the regulator and warning devices function properly.

**1910.134(h)(3)(iv)**

For respirators maintained for emergency use, the employer shall:

**1910.134(h)(3)(iv)(A)**

Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and

**1910.134(h)(3)(iv)(B)**

Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports stored as paper or electronic files. This information shall be maintained until replaced following a subsequent certification.

**1910.134(h)(4)**

**Repairs.** The employer shall ensure that respirators that fail an inspection or are otherwise found to be defective are removed from service, and are discarded or repaired or adjusted in accordance with the following procedures:

**1910.134(h)(4)(i)**

Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;

**1910.134(h)(4)(ii)**

Repairs shall be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and

**1910.134(h)(4)(iii)**

Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.

**1910.134(i)**

**Breathing air quality and use.** This paragraph requires the employer to provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

**1910.134(i)(1)**

The employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:

**1910.134(i)(1)(i)**

Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

**1910.134(i)(1)(ii)**

Compressed breathing air shall meet at least the requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989, to include:

**1910.134(i)(1)(ii)(A)**

Oxygen content (v/v) of 19.5-23.5%;

**1910.134(i)(1)(ii)(B)**

Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

**1910.134(i)(1)(ii)(C)**

Carbon monoxide (CO) content of 10 ppm or less;

**1910.134(i)(1)(ii)(D)**

Carbon dioxide content of 1,000 ppm or less; and

**1910.134(i)(1)(ii)(E)**

Lack of noticeable odor.

**1910.134(i)(2)**

The employer shall ensure that compressed oxygen is not used in atmosphere-supplying respirators that have previously used compressed air.

**1910.134(i)(3)**

The employer shall ensure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.

**1910.134(i)(4)**

The employer shall ensure that cylinders used to supply breathing air to respirators meet the following requirements:

**1910.134(i)(4)(i)**

Cylinders are tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR part 180);

**1910.134(i)(4)(ii)**

Cylinders of purchased breathing air have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air; and

**1910.134(i)(4)(iii)**

The moisture content in the cylinder does not exceed a dew point of -50 deg.F (-45.6 deg.C) at 1 atmosphere pressure.

**1910.134(i)(5)**

The employer shall ensure that compressors used to supply breathing air to respirators are constructed and situated so as to:

**1910.134(i)(5)(i)**

Prevent entry of contaminated air into the air-supply system;

**1910.134(i)(5)(ii)**

Minimize moisture content so that the dew point at 1 atmosphere pressure is 10 degrees F (5.56 deg.C) below the ambient temperature;

**1910.134(i)(5)(iii)**

Have suitable in-line air-purifying sorbent beds and filters to further ensure breathing air quality. Sorbent beds and filters shall be maintained and replaced or refurbished periodically following the manufacturer's instructions.

**1910.134(i)(5)(iv)**

Have a tag containing the most recent change date and the signature of the person authorized by the employer to perform the change. The tag shall be maintained at the compressor.

**1910.134(i)(6)**

For compressors that are not oil-lubricated, the employer shall ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm.

**1910.134(i)(7)**

For oil-lubricated compressors, the employer shall use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.

**1910.134(i)(8)**

The employer shall ensure that breathing air couplings are incompatible with outlets for nonrespirable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines.

**1910.134(i)(9)**

The employer shall use only the respirator manufacturer's NIOSH-approved breathing-gas containers, marked and maintained in accordance with the Quality Assurance provisions of the NIOSH approval for the SCBA as issued in accordance with the NIOSH respirator-certification standard at 42 CFR part 84.

**1910.134(j)**

***Identification of filters, cartridges, and canisters.*** The employer shall ensure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.

**1910.134(k)**

***Training and information.*** This paragraph requires the employer to provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually, and more often if necessary. This paragraph also requires the employer to provide the basic information on respirators in Appendix D of this section to employees who wear respirators when not required by this section or by the employer to do so.

**1910.134(k)(1)**

The employer shall ensure that each employee can demonstrate knowledge of at least the following:

**1910.134(k)(1)(i)**

Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

**1910.134(k)(1)(ii)**

What the limitations and capabilities of the respirator are;

**1910.134(k)(1)(iii)**

How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;

**1910.134(k)(1)(iv)**

How to inspect, put on and remove, use, and check the seals of the respirator;

**1910.134(k)(1)(v)**

What the procedures are for maintenance and storage of the respirator;

**1910.134(k)(1)(vi)**

How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and

**1910.134(k)(1)(vii)**

The general requirements of this section.

**1910.134(k)(2)**

The training shall be conducted in a manner that is understandable to the employee.

**1910.134(k)(3)**

The employer shall provide the training prior to requiring the employee to use a respirator in the workplace.

**1910.134(k)(4)**

An employer who is able to demonstrate that a new employee has received training within the last 12 months that addresses the elements specified in paragraph (k)(1)(i) through (vii) is not required to repeat such training provided that, as required by paragraph (k)(1), the employee can demonstrate knowledge of those element(s). Previous training not repeated initially by the employer must be provided no later than 12 months from the date of the previous training.

**1910.134(k)(5)**

Retraining shall be administered annually, and when the following situations occur:

**1910.134(k)(5)(i)**

Changes in the workplace or the type of respirator render previous training obsolete;

**1910.134(k)(5)(ii)**

Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill; or

**1910.134(k)(5)(iii)**

Any other situation arises in which retraining appears necessary to ensure safe respirator use.

**1910.134(k)(6)**

The basic advisory information on respirators, as presented in Appendix D of this section, shall be provided by the employer in any written or oral format, to employees who wear respirators when such use is not required by this section or by the employer.

**1910.134(l)**

***Program evaluation.*** This section requires the employer to conduct evaluations of the workplace to ensure that the written respiratory protection program is being properly implemented, and to consult employees to ensure that they are using the respirators properly.

**1910.134(l)(1)**

The employer shall conduct evaluations of the workplace as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.

**1910.134(l)(2)**

The employer shall regularly consult employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:

**1910.134(l)(2)(i)**

Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);

**1910.134(l)(2)(ii)**

Appropriate respirator selection for the hazards to which the employee is exposed;

**1910.134(l)(2)(iii)**

Proper respirator use under the workplace conditions the employee encounters; and

**1910.134(l)(2)(iv)**

Proper respirator maintenance.

**1910.134(m)**

**Recordkeeping.** This section requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. This information will facilitate employee involvement in the respirator program, assist the employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

**1910.134(m)(1)**

**Medical evaluation.** Records of medical evaluations required by this section must be retained and made available in accordance with 29 CFR 1910.1020.

**1910.134(m)(2)**

**Fit testing.**

**1910.134(m)(2)(i)**

The employer shall establish a record of the qualitative and quantitative fit tests administered to an employee including:

**1910.134(m)(2)(i)(A)**

The name or identification of the employee tested;

**1910.134(m)(2)(i)(B)**

Type of fit test performed;

**1910.134(m)(2)(i)(C)**

Specific make, model, style, and size of respirator tested;

**1910.134(m)(2)(i)(D)**

Date of test; and

**1910.134(m)(2)(i)(E)**

The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.

**1910.134(m)(2)(ii)**

Fit test records shall be retained for respirator users until the next fit test is administered.

**1910.134(m)(3)**

A written copy of the current respirator program shall be retained by the employer.

**1910.134(m)(4)**

Written materials required to be retained under this paragraph shall be made available upon request to affected employees and to the Assistant Secretary or designee for examination and copying.

**1910.134(n)**

**Effective date.** Paragraphs (d)(3)(i)(A) and (d)(3)(i)(B) of this section become effective November 22, 2006.

**1910.134(o)**

Appendices. Compliance with Appendix A, Appendix B-1, Appendix B-2, Appendix C, and Appendix D to this section are mandatory.

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998; 71 FR 16672, April 3, 2006; 71 FR 50187, August 24, 2006; 73 FR 75584, Dec. 12, 2008; 76 FR 33606, June 8, 2011]

[Next Standard \(1910.134 App A\)](#)

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## Appendix I

# MAJOR REQUIREMENTS OF OSHA'S RESPIRATORY PROTECTION STANDARD 29 CFR 1910.134

OSHA Office of Training and Education  
Rev. December 2006

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This document discusses the major requirements of OSHA's Respiratory Protection Standard, 29 CFR 1910.134.

No attempt has been made to discuss every detail of the standard. Readers are encouraged to consult OSHA's Respiratory Protection web page for the complete text.

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## MAJOR REQUIREMENTS OF 29 CFR 1910.134

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### Introduction

- This standard applies to General Industry (Part 1910), Shipyards (Part 1915), Marine Terminals (Part 1917), Longshoring (Part 1918), and Construction (Part 1926).

### (a) Permissible Practice

- Paragraph (a)(1) establishes OSHA's hierarchy of controls by requiring the use of feasible engineering controls as the primary means to control air contaminants. Respirators are required when "effective engineering controls are not feasible, or while they are being instituted."
- Paragraph (a)(2) requires employers to provide employees with respirators that are "applicable and suitable" for the purpose intended "when such equipment is necessary to protect the health of the employee."

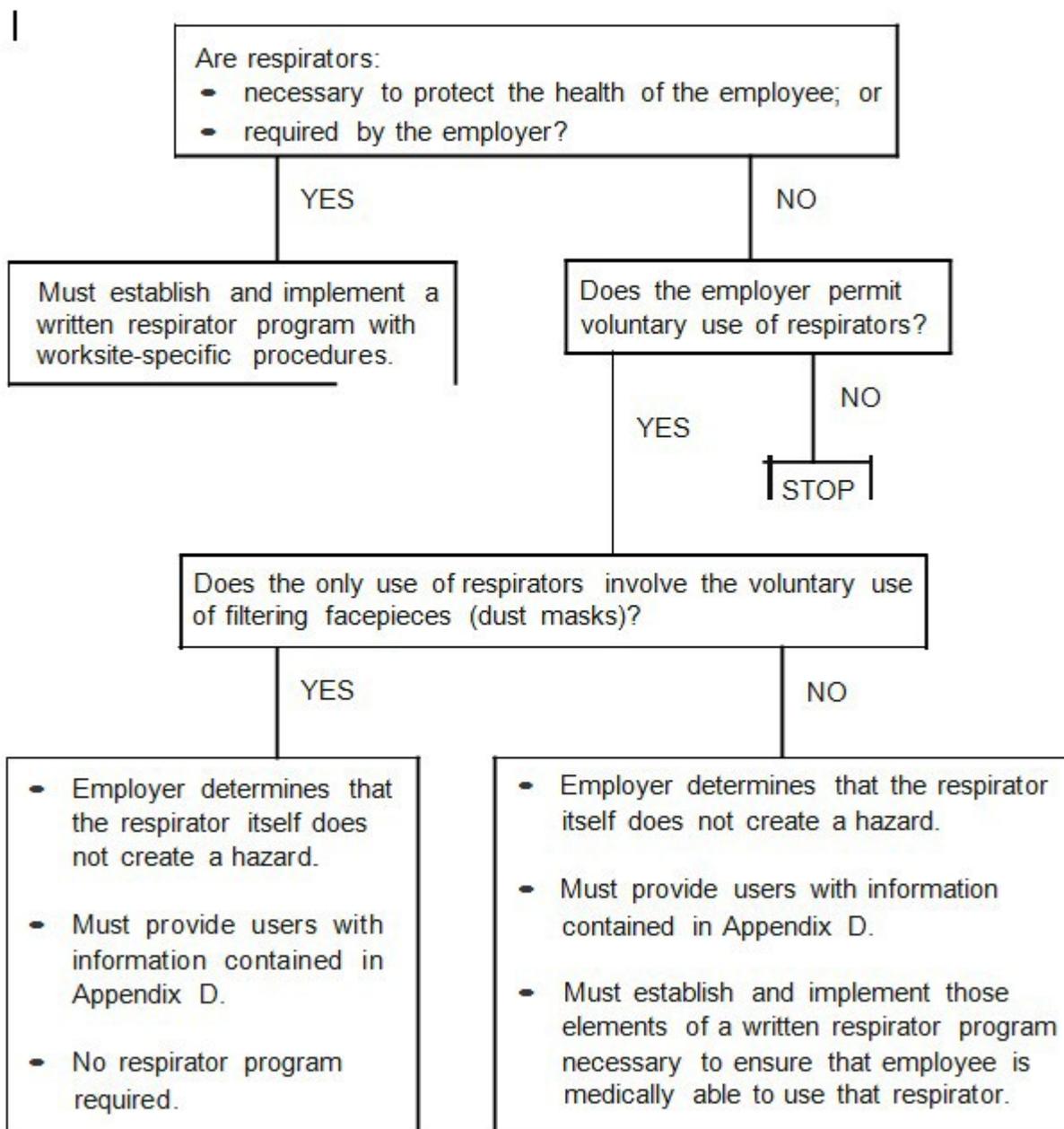
### (b) Definitions

This paragraph contains definitions of important terms used in the regulatory text.

### (c) Respiratory Protection Program

- Must designate a qualified program administrator to oversee the program.
- Must provide respirators, training, and medical evaluations at no cost to the employee.
- OSHA has prepared a *Small Entity Compliance Guide* that contains criteria for selection of a program administrator and a sample program.

## Respirator-Use Requirements Flow Chart 29 CFR 1910.134(c)



## (d) Selection of Respirators

- Must select a respirator certified by the National Institute for Occupational Safety and Health (NIOSH) which must be used in compliance with the conditions of its certification.
- Must identify and evaluate the respiratory hazards in the workplace, including a reasonable estimate of employee exposures and identification of the contaminant's chemical state and physical form.
- Where exposure cannot be identified or reasonably estimated, the atmosphere shall be considered immediately dangerous to life or health (IDLH).

- Respirators for IDLH atmospheres:

- .. Approved respirators:

- full facepiece pressure demand self-contained breathing apparatus (SCBA) certified by NIOSH for a minimum service life of thirty minutes, or

- combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

- .)> All oxygen-deficient atmospheres (less than 19.5% O<sub>2</sub> by volume) shall be considered IDLH.

Exception: If the employer can demonstrate that, under all foreseeable conditions, oxygen levels in the work area can be maintained within the ranges specified in Table II (i.e., between 19.5% and a lower value that corresponds to an altitude-adjusted oxygen partial pressure equivalent to 16% oxygen at sea level), then *any* atmosphere- supplying respirator may be used.

- Respirators for non-IDLH atmospheres:

- .)> Employers must use the assigned protection factors (APFs) listed in Table 1 to select a respirator that meets or exceeds the required level of employee protection.

- When using a combination respirator (e.g., airline respirators with an air-purifying filter), employers must ensure that the assigned protection factor is appropriate to the mode of operation in which the respirator is being used.

- .. Must select a respirator for employee use that maintains the employee's exposure to the hazardous substance, when measured outside the respirator, at or below the maximum use concentration (MUC).

- Must not apply MUCs to conditions that are IDLH; instead must use respirators listed for IDLH conditions in paragraph (d)(2) of this standard.

- When the calculated MUC exceeds the IDLH level or the performance limits of the cartridge or canister, then employers must set the maximum MUC at that lower limit.

- The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

- .. For protection against gases and vapors, the employer shall provide:
- an atmosphere-supplying respirator, or
  - an air-purifying respirator, provided that:  
the respirator is equipped with an **end-of-service-life indicator (ESLI)** certified by NIOSH for the contaminant; or  
if there is no ESLI appropriate for conditions of the employer's workplace, the employer implements a **change schedule** for canisters and cartridges that will ensure that they are changed before the end of their service life and describes in the respirator program the information and data relied upon and basis for the change schedule and reliance on the data.
- )r For protection against particulates, the employer shall provide:
- an atmosphere-supplying respirator; or
  - an air-purifying respirator equipped with high efficiency particulate air (HEPA) filters certified by NIOSH under 30 CFR Part II or with filters certified for particulates under 42 CFR Part 84; or
  - an air-purifying respirator equipped with any filter certified for particulates by NIOSH for contaminants consisting primarily of particles with mass median aerodynamic diameters of at least 2 micrometers.

## (e) Medical Evaluation

- Must provide a medical evaluation to determine employee's ability to use a respirator, before fit testing and use.
- Must identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire (information required is contained in mandatory Appendix C).
- Must obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP.
- Additional medical evaluations are required under certain circumstances, e.g.:
  - )> employee reports medical signs or symptoms related to ability to use respirator;
  - PLHCP, program administrator, or supervisor recommends reevaluation;
  - )> information from the respirator program, including observations made during fit testing and program evaluation, indicates a need; or
  - change occurs in workplace conditions that may substantially increase the physiological burden on an employee.
- Annual review of medical status is not required.

## (f) Fit Testing

- All employees using a negative or positive pressure tight-fitting facepiece respirator must pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT).
- Fit testing is required prior to initial use, whenever a different respirator facepiece is used, and at least annually thereafter. An additional fit test is required whenever the employee reports, or the employer or PLHCP makes visual observations of, changes in the employee's physical condition that could affect respirator fit (e.g., facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight).
- The fit test shall be administered using an OSHA-accepted QLFT or QNFT protocol, as contained in mandatory Appendix A.
  - )> QLFT Protocols:
    - Isoamyl acetate
    - Saccharin
    - Bitrex
    - Irritant smoke
  - )> QNFT Protocols:
    - Generated Aerosol (corn oil, salt, DEHP)
    - Condensation Nuclei Counter (PortaCount)
    - Controlled Negative Pressure (Dynatech FitTester 3000)
    - Controlled Negative Pressure (CNP) REDON

- QLFT may only be used to fit test negative pressure air-purifying respirators (APRs) that must achieve a fit factor of 100 or less.
  - If the fit factor determined through QNFT is 100 for tight-fitting half facepieces, or 500 for tight-fitting full facepieces, the QNFT has been passed with that respirator.
- 

Note: If a particular OSHA standard (e.g., 29 CFR 1910.1001 Asbestos) requires the use of a full facepiece APR capable of providing protection in concentrations up to 50 times the Permissible Exposure Limit (PEL), this respirator must be QNFT. This is because a protection factor of 50 (50 X PEL) multiplied by a standard safety factor of 10 is equivalent to a fit factor of 500.

The safety factor of 10 is used because protection factors in the workplace tend to be much lower than the fit factors achieved during fit testing. The use of a safety factor is a standard practice supported by most experts to offset this limitation. This is discussed in the record at 63 FR 1225.

---

### (g) Use of Respirators

- Tight-fitting respirators shall not be worn by employees who have facial hair or any condition that interferes with the face-to-facepiece seal or valve function.
- Personal protective equipment shall be worn in such a manner that does not interfere with the seal of the facepiece to the face of the user.
- Employees shall perform a user seal check **each time they put on a tight-fitting respirator** using the procedures in mandatory Appendix B-1 or equally effective manufacturer's procedures.
- Procedures for respirator use in IDLH atmospheres are stated. In addition to these requirements, interior structural firefighting requires the use of SCBAs and a protective practice known as "2-in/2-out"-at least two employees must enter and remain in visual or voice contact with one another at all times, and at least two employees must be located outside. (Note that this is not meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.)

**(h) Maintenance and Care of Respirators**

Must clean and disinfect respirators using the procedures in Appendix B-2, or equally effective manufacturer's procedures at the following intervals:

- as often as necessary to maintain a sanitary condition for exclusive use respirators,
- before being worn by different individuals when issued to more than one employee, and
- after each use for emergency use respirators **and those used in fit testing and training.**

**(i) Breathing Air Quality and Use**

Compressed breathing air shall meet the requirements for Type 1-Grade D breathing air as described in ANSI/CGA *Commodity Specification for Air*, G-7.1-1989.

**(j) Identification of Filters, Cartridges, and Canisters**

- All filters, cartridges, and canisters used in the workplace must be labeled and color coded with the NIOSH approval label.
- The label must not be removed and must remain legible.

**(k) Training and Information**

- Must provide effective training to respirator users, including:
  - 'r why the respirator is necessary and how improper fit, use, or maintenance can compromise the protective effect of the respirator
  - j> limitations and capabilities of the respirator
  - ▼ use in emergency situations
  - , how to inspect, put on and remove, use and check the seals
  - )> procedures for maintenance and storage
  - ., recognition of medical signs and symptoms that may limit or prevent effective use
  - , general requirements of this standard
- Training required prior to initial use, unless acceptable training has been provided by another employer within the past 12 months.
- **Retraining required annually** and when:
  - ., workplace conditions change,
  - 'r new types of respirator are used, or
  - ., inadequacies in the employee's knowledge or use indicates need.

- The basic advisory information in Appendix D shall be provided to employees who wear respirators when their use is not required.

**(l) Program Evaluation**

Employer must conduct evaluations of the workplace as necessary to ensure proper implementation of the program, and consult with employees to ensure proper use.

**(m) Recordkeeping**

- Records of medical evaluations must be retained and made available per 29 CFR 1910.1020.
- A record of fit tests must be established and retained until the next fit test.
- A written copy of the current program must be retained.

**APPENDIX J**

**PORTACOUNT PRO 8030 AND PRO+ 8038 OPERATION AND SERVICE MANUAL**

# PORTACOUNT<sup>®</sup> PRO 8030 AND PORTACOUNT PRO+ 8038 RESPIRATOR FIT TESTERS

---

OPERATION AND SERVICE MANUAL



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**Part Number**

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Seller warrants the goods sold hereunder, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for **24 months**, or if less, the length of time specified in the operator's manual, from the date of shipment to the customer. This warranty period is inclusive of any statutory warranty. This limited warranty is subject to the following exclusions and exceptions:

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- b. Pumps are warranted for hours of operation as set forth in product or operator's manuals;
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### **Caution**

This instrument is a Class I laser device. Adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.



### **W A R N I N G**

This instrument contains (1) non-rechargeable Lithium battery which is not user serviceable. Return to factory  
f o r r e p l a c e m e n t .

**Disclaimer:** The measurement provided by the PORTACOUNT® PRO Respirator Fit Tester is an assessment of respirator fit during a fit test only. Respirator fit at other times will vary. The fit factor value is not intended for use in calculating an individual's actual exposure to hazardous substances.

#### **Patents**

Model 8038 PORTACOUNT® PRO+Respirator Fit Tester is patented under U.S. Patent No. 6,125,845.

#### **Service Policy**

Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call TSI's Customer Service department at (800) 874-2811 (USA) or (001 651) 490-2811 (International) or visit [www.tsi.com](http://www.tsi.com).

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## Introduction and Overview

This manual describes both the Model 8030 PORTACOUNT® PRO and 8038 PORTACOUNT® PRO+ Respirator Fit Tester hardware and operation of the tester *without* the use of FITPRO™ Fit Test Software.

The Model 8030 is designed to measure fit factors of masks with an efficiency of 99% or greater. The Model 8038 includes N95-Companion™ technology, which lets you measure any tight-fitting respirator including N95, P2, and P1 disposables.

Regardless of whether you intend to use the PORTACOUNT® PRO Respirator Fit Tester with or without the FITPRO™ Fit Test software, you should become familiar with this manual first. Many of the details in this manual that concern PORTACOUNT® PRO fit test operations are not repeated in the FITPRO™ Fit Test Software Manual.

### **Database Operation When Operating in Stand-Alone Demo Mode**

The PORTACOUNT® PRO Respirator Fit Tester has an on-board (Demo-Training) database that lets you perform all available operations, including adding data. Any changes you make to this Demo-Training database, however, are lost when you power off the PORTACOUNT® PRO fit tester, unless you manually save them using the new [Advanced Database Tools](#) (introduced in firmware version 2.0).

If you want to save fit test results or other data when using the PORTACOUNT® PRO Respirator Fit Tester in stand-alone mode (not controlled by the FITPRO™ Fit Test Software), you must have a USB flash drive containing a valid database attached to one of the USB ports. (See the *FITPRO™ Fit Test Software User Manual* for instructions on how to configure the USB flash drive.)

### **Registration**

Please fill out and mail the registration card that came with your instrument or register it online at <http://register.tsi.com>. You may re-register at any time to update our records. You will need your instrument model number and serial number.

Registration allows TSI to keep in-touch with you regarding important information concerning the TSI instrument(s) and software you own.

## **Why Fit Test**

There are two primary reasons for respirator fit testing:

- **Verification of Training.** After the individual has received respirator training, a fit test checks that the person has learned how to properly put on and wear a respirator without assistance.
- **Sizing.** It is important to make sure that the individual is issued a respirator that is capable of providing protection when worn properly, that is, it is the right size.

## **Preparations for Fit Testing**

### **Training the Trainer**

The person conducting the fit test must have a clear understanding of respiratory protection, respirators, and fit testing to be effective. Anyone can master the operation of the PORTACOUNT® PRO Respirator Fit Tester simply by studying this manual, but the background knowledge required to proficiently fit test cannot be obtained from here. Consider attending a one-, two- or three-day seminar on fit testing provided by various consultants. Contact TSI for references.

### **Respirator Training**

Respirator training is critical for any respiratory protection program. All employees who wear respirators must be taught how and why they are used. This training should be done prior to the fit test, not during the fit test. Consult the regulations or standards that pertain to your industry for information on training requirements. The PORTACOUNT® PRO Respirator Fit Tester includes a Real-time Fit Factor display that allows the user to see the results of changes he or she makes to the mask.

### **Precautions for Fit Testing**

The following is a discussion of several precautions that should be considered prior to conducting a fit test:

**Fit Testing People Who Smoke Cigarettes or Cigars** Smokers exhale particles for at least 30 minutes after they have smoked a cigarette or cigar. The PORTACOUNT® PRO fit tester can count these particles and will interpret them as if they were caused by face seal leakage. It is very important to instruct individuals not to smoke for at least 30 minutes prior to fit testing. Fit factors for anyone who has smoked recently will be lower than

that individual deserves and may even cause him or her to fail the fit test entirely.

#### **Fit Testing with Generated Aerosols**

The PORTACOUNT® PRO fit tester is designed to operate using the microscopic particles in the ambient air. It can measure particle concentrations and fit factors when generated aerosols (like corn oil, salt or DOP) are used, however, these aerosols may cause the PORTACOUNT® PRO fit tester to need more frequent cleaning and calibration.

#### **Fit Testing Near Irritant Smoke**

Do **not** conduct fit tests in close proximity to sources of irritant smoke like those used for qualitative fit testing. The irritant smoke is corrosive and can damage the PORTACOUNT® PRO Respirator Fit Tester. Fit testing near sources of amyl-acetate (banana oil) is not a problem.

The TSI Web site <http://fittest.tsi.com> contains additional resources that you may find useful.

---

**Disclaimer:** The measurement provided by the PORTACOUNT® PRO Respirator Fit Tester is an assessment of respirator fit during a fit test only. Respirator fit at other times will vary. The fit factor value is not intended for use in calculating an individual's actual exposure to hazardous substances.

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# Chapter 1

## Unpack and Verify Shipment

The following items are included with the PORTACOUNT® PRO/PRO+ Respirator Fit Tester. If any are missing or damaged, please notify TSI immediately. Refer to [Chapter 2](#) for photos and descriptions of each item.



### Standard Items PORTACOUNT® PRO (Models 8030 and 8038)

Qty	Description	
1	PORTACOUNT® PRO Respirator Fit Tester Model 8030/8038	
1	Stylus	
1	Alcohol Cartridge	
1	Alcohol Fill Capsule	
1	Storage Cap	
2	Zero Check Filter	
2	Spare Alcohol Wicks	
1	5 ft (1.5 m) Twin Tube Assembly	
1	1/8 to 3/16 Tube Adapter	
1	1/8 to 1/4 Tube Adapter	
1	AC Adapter	
16	30 ml Alcohol Bottles (480 ml total)	
1	Operation & Service Manual (this manual)	
1	FitPro™ Fit Test Software Installation Guide	

**Standard Items PORTACOUNT® PRO (Models 8030 and 8038)**

<b>Qty</b>	<b>Description</b>	
1	Carrying Case	
1	FitPRO™ Fit Test Software CD and case	
1	PORTACOUNT® Fit Tester Interactive Tutorial CD and case	
1	USB Cable	
1	USB Flash Drive	
1	Container of Silicone Grease	

**Additional Items PORTACOUNT® PRO\* (Model 8038 onl**

<b>Qty</b>	<b>Description</b>	
1	Probe Assembly Tool	
1	Probe Kit (100 pieces)	
1	Neck Strap	
1	Package of 100 Salt Tablets (100 mg)	
1	Model 8026 Particle Generator Operation and Service Manual	

## Chapter 2

### Getting To Know The PORTACOUNT® PRO Respirator Fit Tester

---

Use the numbered paragraphs and correspondingly numbered arrows to identify the touch screen display, connectors, parts, and accessories of the PORTACOUNT® PRO fit tester. You need to be familiar with these items when following the instructions in this manual.

#### The Touch Screen Display

The touch screen display provides the interface to all operations. You can select items on the touch screen using your finger or the stylus that is provided. Do **not** use a pen, pencil or other sharp instrument, as this may damage the screen.



#### Sampling Ports

Sampling ports permit air to flow into and out of the PORTACOUNT® PRO fit tester.



**1** The Sample Port is used when sampling air from a respirator during a fit test. The clear tube marked "SAMPLE" of the Twin Tube Assembly (**3**) connects here. The Sample Port fitting is silver and marked with the letter "S".

**2** The Ambient Port is used to sample ambient air during a fit test. The blue tube marked "AMBIENT" of the Twin Tube Assembly (**3**) connects here. The Ambient Port fitting is blue and marked with the letter "A".

**3** The Twin Tube Assembly consists of a pair of tubes: the Sample Tube and the Ambient Tube. The Twin Tube Assembly is about 5.5 feet (1.7 meters) long. The Sample Tube is 7 inches (18 cm) longer than the Ambient Tube.

The Twin Tube must **not** be lengthened except for the few inches added by a Tube Adapter. **Never** split the ambient and sample tube, they must remain together and the two sample tubes must be nearly the same length for accurate fit testing.

## Electrical Connections

**4** The USB Series “B” receptacle provides for communication



between the PORTACOUNT® PRO fit tester and a USB port on the PC. The USB cable provided with the PORTACOUNT® PRO fit tester connects here.

**5** Two USB Series “A” receptacles let you connect a USB mouse, USB keyboard, compatible USB printer, or a USB flash drive (thumb drive).

**6** The External Power Connector connects the AC Adapter to the PORTACOUNT® PRO fit tester.



7 The AC Adapter plugs into the External Power Connector on the PORTACOUNT® PRO fit tester and an AC wall outlet. The AC Adapter senses the input voltage automatically.

## Alcohol Related Parts



**8** The Alcohol Cartridge holds the isopropyl alcohol consumed by the PORTACOUNT® PRO fit tester. A porous wick inside is soaked with alcohol.

**9** The Cartridge Cavity is where the Alcohol Cartridge is inserted during use. **Make certain dirt and lint do not enter the Cartridge Cavity.** Cover the Cartridge Cavity with the Storage Cap (**10**) when the instrument is not being used.

**10** The Storage Cap is used to cover either the Cartridge Cavity of the PORTACOUNT® PRO fit tester or the Alcohol Fill Capsule, whichever does not currently hold the Alcohol Cartridge.

**11** Two spare Alcohol Wicks are included with the PORTACOUNT® PRO fit tester.

**12** The Alcohol Fill Capsule is used to store and fill the Alcohol Cartridge.

**13** The PORTACOUNT® PRO fit tester is shipped with 16 bottles of reagent grade (99.5% or better) isopropyl alcohol. Each bottle contains 30 ml. The instrument consumes alcohol at approximately 2 ml per hour and the alcohol wick holds approximately 13 ml of alcohol. Do **not** use isopropyl alcohol that is less than 99.5% pure.

**Miscellaneous Parts**

**14** Spare Sampling Port Inlet Screens. These screens are used to



help keep the PORTACOUNT<sup>®</sup> PRO fit tester internal flow path clean by capturing large or fibrous particles.

**15** Two Tube Adapters are shipped with each PORTACOUNT<sup>®</sup> PRO fit tester. The adapters are used to connect the Sample Tube to a respirator sample fitting (or probe) that is larger than the 1/8 inch (3 mm) inside diameter of the Sample Tube. One of the Tube Adapters fits 3/16 inch (4.7 mm) fittings and the other fits 1/4 inch (6.3 mm) fittings. An adapter is not needed for respirators equipped with a 1/8 inch (3 mm) fitting.

**16** The Zero Check Filter is provided for the Zero Check and Max FitFactor Check on the PORTACOUNT® PRO fit tester to make sure it is working properly. A spare filter is also provided.

**Note:** TSI recommends that the Zero Check Filter be left attached to the sample line whenever the PORTACOUNT® PRO fit tester is turned on but not in use. This prevents lint and debris from being drawn into the instrument and blocking the airflow.

**17** The PORTACOUNT® PRO/PRO+ Respirator Fit Tester Operation & Service Manual (this manual). Visit the TSI Web site <http://fittest.tsi.com> to download the current version of most TSI manuals.

**18** The FITPROTM Fit Test Software Installation Guide. Visit the TSI Web site <http://fittest.tsi.com> to download the current version of most TSI manuals.

**19** The Compact Disc (CD) contains FITPROTM Fit Test Software for Windows in addition to manuals and other information related to TSI fit testing products and fit testing in general. There is no printed FITPROTM software manual in lieu of the online help. The CD is located in a convenient storage case.

**20** The Compact Disc (CD) contains the PORTACOUNT® fit tester Interactive Tutorial. The CD is located in a convenient storage case.

**21** The Carrying Case provides protection and convenience. The case is designed to hold the PORTACOUNT® PRO fit tester and standard accessories.

**22** USB Cable. The USB Cable is used to connect the PORTACOUNT® PRO fit tester to a computer. It is needed whenever the FITPROTM Software is used to interface and control the PORTACOUNT® PRO fit tester.

**23** Grease for lubricating the O-ring on the Alcohol Cartridge. Periodic application of grease to the Alcohol Cartridge O-ring nearest the handle ensures that the cartridge is easy to install and remove. Instructions can be found in Chapter 6, "[Applying O-ring Grease to the Alcohol Cartridge](#)". It is important that grease is used sparingly and is not allowed to get into the two particle passages (holes) found near the O-ring.

**24** USB Flash Drive. The flash drive holds active databases and lets you select and use the active database in the PORTACOUNT® PRO

fit tester in stand-alone mode. Without a flash drive, you cannot store information and test data collected or updated when using the PORTACOUNT® PRO fit tester in stand-alone mode. The flash drive is used to exchange database data between the PORTACOUNT® PRO fit tester and the FITPRO™ software. (See the *FITPRO™ Fit Test Software User Manual* for instructions on how to configure the USB flash drive.)

**Additional Items (Model 8038 only)**



**25** Probe Assembly Tool. Used to install the sampling probes in filtering-facepiece (disposable) respirators.

**26** Probe Kit. Includes 100 disposable probes.

**27** Neck Strap. Supports the Twin Tube assembly when sampling running fit tests on filtering-facepiece (disposable) respirators.



28

**28** Model 8026 Particle Generator. If you do not have the minimum ambient particle concentration needed for the PORTACOUNT® PRO fit tester to do a fit test, this optional particle generator supplements naturally occurring room concentration with nontoxic salt (NaCl) particles in the appropriate size range for the PORTACOUNT® PRO fit tester. Refer to the Model 8026 Particle Generator information on the TSI Web site <http://software.tsi.com>.

#### Important Considerations

The Particle Generator or any other sources of particle generation should be kept at least 6 feet from the PORTACOUNT PRO fit tester during operations.

For the Particle Generator to function properly, you must operate the generator and conduct the fit tests in an enclosed area. A room smaller than 400 sq. ft. would provide the best conditions. Particle generation will not function as efficiently in an open cubicle area or a very large room.

The Particle Generator and other forms of particle generation should only be used sparingly, when needed. Often they are only needed in the morning hours or at the beginning of fit testing. Do **not** operate any form of particle generation if ambient particle concentrations are above 8,000 pt/cc (as per use with full- & half-mask, P100 fit testing) or 800 pt/cc (as per use with N95 fit testing).

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## Chapter 3

### About Respirators and Fit Testing

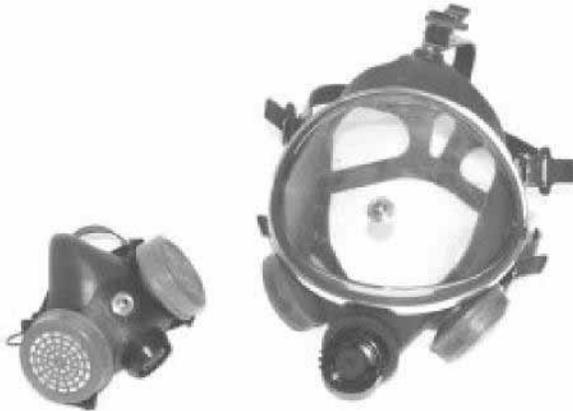
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The conventional way to quantitatively fit test is through the use of probed test respirators, but fit tests can also be performed on disposable respirators and positive pressure respirators. This chapter discusses the types of respirators and provides instructions on installing a sampling port to a disposable filtering-facepiece.

#### Probed Test Respirators

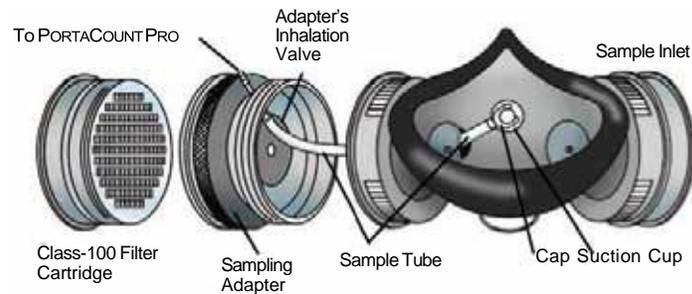
A probed respirator has a fitting (probe) installed that allows air from inside the respirator to be sampled by an instrument like the PORTACOUNT® PRO fit tester. The probed respirator is only used for fit testing and cannot legally be used in a hazardous environment. You will need at least one respirator of each make, model and size your company issues. After the fit test, the individual should be issued a respirator with the identical facepiece, only without the probe.

Most probed respirators are obtained from the respirator manufacturer or distributor. You should be able to buy probed versions of most if not all models. Be sure to buy class-100 or class-99 filters also if you do not already stock them. You must use class-100, class-99, or P3 filters for fit testing even if you use another type of cartridge in the workplace.



### ***Fit Testing with the Person's Own Assigned Respirator***

Some respirators, especially older models, do not have fit test adapters available. In that case, a permanently probed test respirator is the only option.



### ***Respirator Manufacturers' Technique***

There are a growing number of respirator manufacturers who provide sampling adapters that permit fit testing in one's own respirator. Contact your distributor or call the manufacturer direct and ask if such accessories are available.

### ***TSI Fit Test Adapter Kits***

TSI Sampling Adapters allow you to fit test using the respirator that is actually used by that individual. Sampling Adapters for most major brands of respirator are available. A complete list of fit test adapters available from TSI and from respirator manufacturers is posted on the TSI Web site <http://fittest.tsi.com>.

### ***Homemade Adapters***

A sampling adapter can be made by modifying a respirator cartridge. This usually involves running a tube through the cartridge and into the respirator. TSI recommends that you avoid this option because it is so easy to do poorly. The most fundamental mistake that is often made is to not extend the sampling tube through the inhalation valve and into the breathing zone. This combined with problems sealing around the outside of the tube make this option unattractive.

### ***Probes for Filtering-Facepiece (Disposable) Respirators***

Disposable respirators can be fit tested by inserting a test probe through the filter material. The optional TSI Model 8025-N95 Probe Kit includes disposable probes and insertion tools. Order TSI Model 8025-N95R Probe Refill Kit for additional probes (no tools).

**Note:** The PORTACOUNT® PRO Model 8030 can successfully fit test class-100, class-99, and P3 disposable respirators. Lower efficiency disposable respirators such as class 95, P2, and P1 will usually require use of the PORTACOUNT® PRO+ Model 8038.

### Inserting a Test Probe in a Disposable Respirator with the TSI Model 8025-N95 Probe Kit

To perform a quantitative fit test, the PORTACOUNT® PRO fit tester must draw an air sample from inside the respirator while it is being worn by the person being fit tested. The tools, sampling probes and push nuts contained in the probe kit lets you install a sampling port onto any disposable filtering-facepiece respirator.

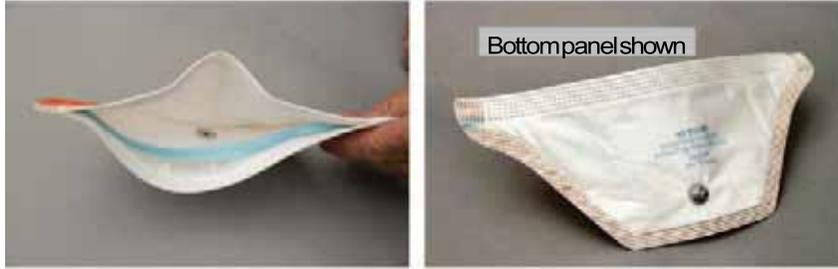
<b>WARNING</b>	
	Once a sampling probe has been installed, the respirator cannot be used for respiratory protection. Ported respirators are for quantitative fit testing only. Discard (or sanitize) the respirator after each fit test is completed. (Follow the respirator manufacturer's recommendations.)

1. Choose a location to install the sample probe.

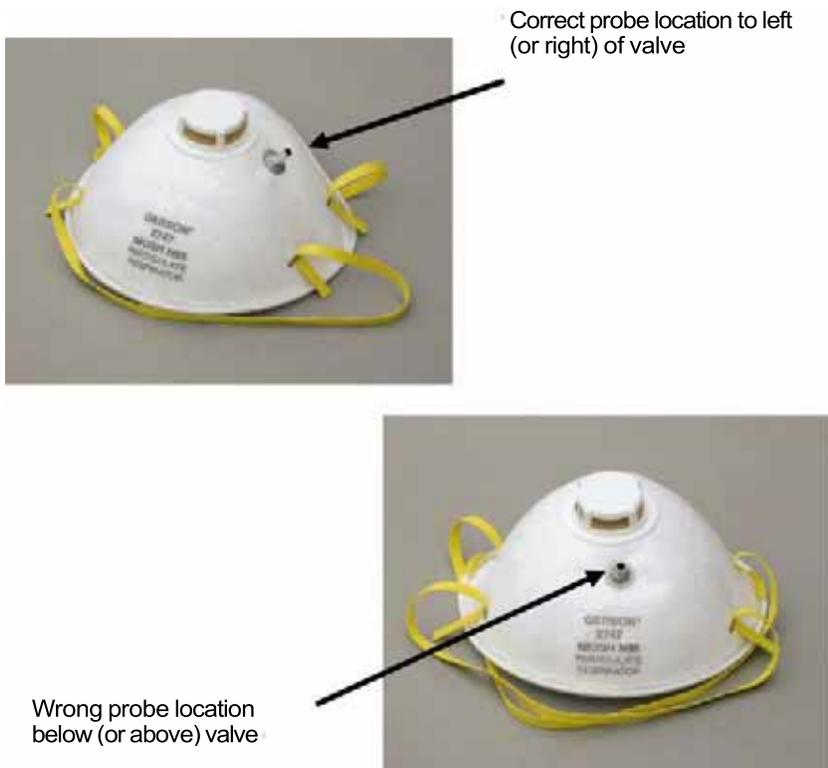
For proper fit testing, the sampling point must be in the “breathing zone” of the respirator user. For most respirators, this is in the center of the respirator between the person’s nose and mouth.



**For flat “duckbill” style respirators**, install the probe near the outer edge of the **bottom panel** where it cannot be blocked by the person’s chin.



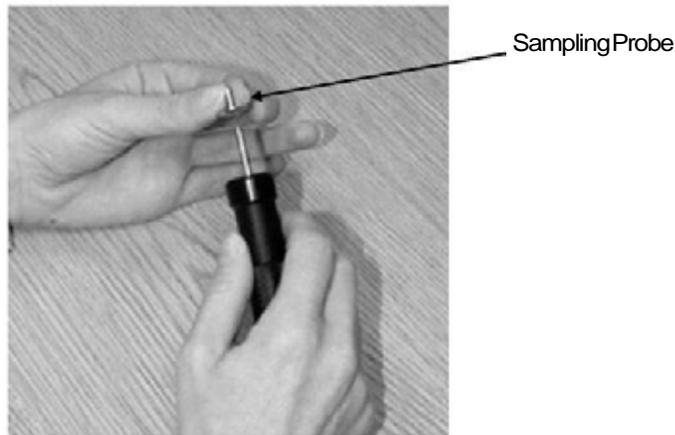
**For respirators with center-mounted exhalation valves**, install the probe to the left or right of the valve. Do **not** install the probe above or below the valve because this risks having the probe blocked by the person’s nose or chin.



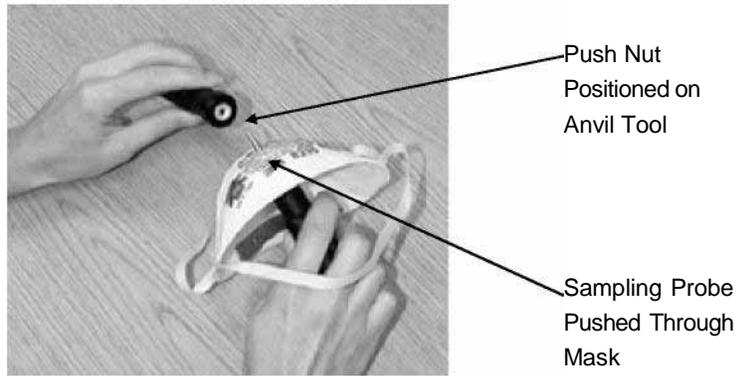
**For respirators with an outer mesh**, install the probe normally as if the mesh was not present. The sampling probe and push nut will seal properly right through the mesh.



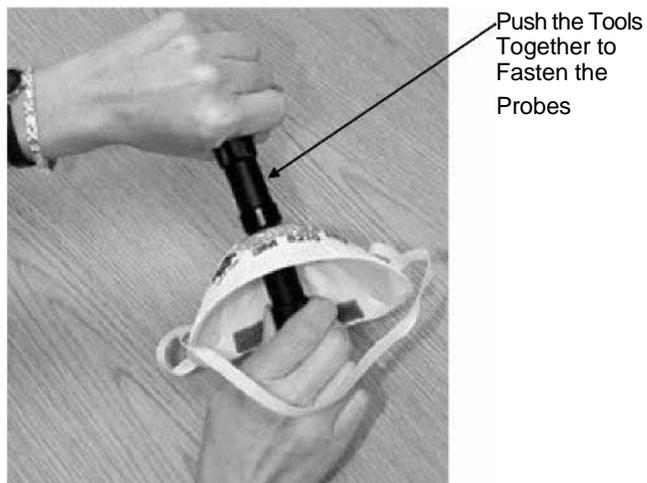
2. Slide the sampling probe onto the piercing tool. **As the pointed end of the piercing tool is very sharp, be extremely careful when handling it!**



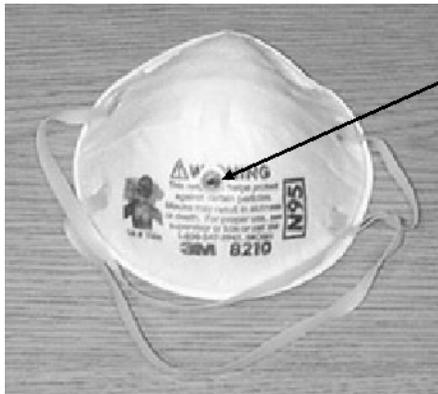
3. Choose a location on the mask that is in front of the person's nose/mouth region. Avoid seams and folds in the mask.
4. Pierce the mask at the selected location, using the piercing tool with the loaded sampling probe. **Be sure to pierce the mask from the inside!**



5. Push the sampling probe through the mask until the end of the tool point is visible from the outside of the mask. Leave a few millimeters of the tool point visible.
6. Place the push nut on the anvil tool with the "dished" side up. A magnet prevents the push nut from falling off.
7. Position the anvil tool, with the loaded push nut, over the protruding point. The mask should now be pinched between the two tools.
8. Press the two tools firmly together to force the push nut as far as possible onto the probe. The mask material should be tightly pinched and the mask, sampling probe, and push nut should be joined together as illustrated.



9. Inspect the sampling probe to be sure it is not plugged. Try to rotate the probe with your fingers. If it moves freely, use the probe insertion tool kit to press the push nut firmly onto the sampling probe and pinch the mask material more tightly.



Correctly  
Positioned  
Sampling Probe

**Note:** Once you install a sampling probe into a disposable mask, the mask cannot be used for respiratory protection. **Probed masks are to be used for quantitative fit testing only.** Discard each probed disposable mask after a fit test is completed.

#### Positive Pressure Respirators

Refer to [Appendix F](#) for a discussion on Fit Testing positive pressure respirators with the PORTACOUNT® PRO Respirator Fit Tester.

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## Chapter 4

# Conducting a Fit Test with the PORTACOUNT® PRO Respirator Fit Tester

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This chapter describes how to use the PORTACOUNT® PRO fit tester as a stand-alone instrument to conduct a quantitative respirator fit test. You should learn to operate the PORTACOUNT® PRO fit tester in this manner even if you plan to use the FITPRO™ software. After becoming familiar with manual operation, if you want to automate fit testing with a computer and the fit test software, refer to the FITPRO™ software online help for detailed instructions.

**Note:** *The PORTACOUNT® PRO Respirator Fit Tester has an on-board Demo database that lets you perform all available operations, including adding data. However, any changes you make to this Demo database are lost when you power off the PORTACOUNT® PRO fit tester and must be manually recorded if a permanent record is desired.*

*If you want to save fit test results or other data when using the PORTACOUNT® PRO Respirator Fit Tester in Stand-Alone mode (not controlled by the FITPRO™ Fit Test Software), you must have a flash drive containing a valid database attached to one of the USB ports.*

**The fit test procedure<sup>1</sup> is broken down into the following steps.**

1. [Prepare the PORTACOUNT® PRO Respirator Fit Tester](#) for testing by filling the Alcohol Cartridge.
2. [Attach a flash drive and select a database](#) (optional). If you do **not** select a database from the flash drive, the Demo database is used by default.
3. [Perform daily checks.](#)

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<sup>1</sup> The procedure assumes that the mask being tested is a negative-pressure air-purifying respirator or a positive-pressure mask temporarily converted to function like a negative-pressure air-purifying respirator.

For additional details see [Appendix F](#) of this manual and Application Note ITI070 *Introduction to Respirator Fit Testing* located on the TSI Web site <http://fittest.tsi.com>.

4. [Perform the fit tests.](#)
5. [Record the results.](#)
6. [Using a Printer with the PORTACOUNT® Fit Tester.](#)
7. [Stand-Alone Fit Testing.](#)
8. [Advanced Database Tools.](#)

### Step 1—Prepare the PORTACOUNT® PRO Respirator Fit Tester for Fit Testing

Follow the steps below to setup the PORTACOUNT® PRO fit tester for fit testing without using the FITPRO™ Fit Test Software (stand-alone mode).

#### Fill the Alcohol Cartridge



#### **W A R N I N G**

Isopropyl alcohol is hazardous material. Do **not** ingest or allow alcohol to contact your eyes or skin. Refer to the Material Safety Data Sheet (MSDS) located in the box of alcohol for handling precautions and first aid procedures.

Always recap alcohol fill capsule and other containers immediately to prevent absorption of moisture and the escape of alcohol vapors.

Dispose of any alcohol with visible contamination.

Because the Alcohol Cartridge is inserted into the Cartridge Cavity of the instrument, it is critically important to keep it clean. Any dirt or debris that gets into the PORTACOUNT® PRO fit tester can plug the small internal nozzle and prevent operation. Do **not** allow the black part of the Alcohol Cartridge to make contact with any surface that may be dirty. Keep the storage cap and alcohol cartridge clean.

Maintaining an adequate alcohol supply inside the PORTACOUNT® PRO fit tester is critical to its operation and requires strict adherence to the directions that follow.

1. Make sure the PORTACOUNT® PRO fit tester is turned off.
2. Remove the Alcohol Cartridge from the PORTACOUNT® PRO fit tester by twisting it counter-clockwise.
3. Open the Alcohol Fill Capsule by twisting the Storage Cap off (counter-clockwise).

4. Set the Storage Cap and Alcohol Cartridge down on a clean surface to prevent contamination.



5. Open a bottle of alcohol. Invert the bottle and insert the nozzle end into the Alcohol Fill Capsule as far as possible to make certain you do not inadvertently spray alcohol anywhere except into the Capsule.



6. Squeeze alcohol into the Alcohol Fill Capsule until it is even with or slightly above the fill-line.
7. Recap the alcohol bottle immediately.
8. Make certain the alcohol cartridge is clean. If it has been contaminated, refer to the Service and Maintenance chapter and

follow the instructions to replace it. If it is clean, insert the Alcohol Cartridge into the Alcohol Fill Capsule and turn the capsule clockwise until it locks in place.



9. Set the Alcohol Fill Capsule down and wait at least 2 minutes while the alcohol wick inside the Alcohol Cartridge soaks up alcohol.
10. Remove the Alcohol Cartridge from the Capsule and gently shake it to allow excess alcohol to drip back into the Alcohol Fill Capsule. Stop when excess alcohol is no longer dripping; it is not necessary to wait until the outside surface of the Alcohol Cartridge is dry.
11. Insert the Alcohol Cartridge into the Cartridge Cavity of the PORTACOUNT® PRO Respirator Fit Tester. It should slide in with little effort. **DO NOT FORCE IT** (see Note below). As you approach full insertion, firmly twist the Alcohol Cartridge clockwise until it locks into position.

**Note:** To ease insertion of the Alcohol Cartridge, apply a bit of supplied silicone vacuum grease to the wick O-ring as described in the section [“Applying O-ring Grease to the Alcohol Cartridge”](#), Chapter 6.

12. Recap the alcohol fill capsule with the storage cap.



Remember: Always recap alcohol fill capsule and other containers immediately to prevent absorption of moisture and the escape of alcohol vapors.

**Note:** Always store the Alcohol Cartridge in the Alcohol Fill Capsule. The Alcohol Fill Capsule is designed to be a safe transportation and storage container for alcohol. The Alcohol Cartridge can be left soaking in alcohol indefinitely. Install the Storage Cap into the Cartridge Cavity to prevent dirt or lint from getting inside the PORTACOUNT® PRO fit tester.

## Step 2—Attach Flash Drive and Select Database (optional)

If you want to save fit test results or other data when using the PORTACOUNT® PRO Respirator Fit Tester in stand-alone mode, you must have a flash drive containing a valid database in the root directory attached to one of the USB ports.

1. Using the FITPRO™ software, load the database or databases you want to use onto the flash drive. (See the *FITPRO™ Fit Test Software User Manual* for instructions on how to configure the USB flash drive.)
2. Insert the flash drive into one of the USB ports of the PORTACOUNT® PRO fit tester.
3. Press the **Database** tab.
4. Press **Select Database** icon.
5. Select the database you want to use as the active database and press **Load**.
6. When the database is loaded, select **Done**. The database you selected is now the active database and will remain the active database until you select another one or remove the flash drive.

## Step 3—Run Daily Checks

TSI recommends maintenance checks be performed once each day before the PORTACOUNT® PRO Respirator Fit Tester is used and whenever a problem is encountered.

These daily checks are:

- Particle Check
- Classifier Check (only for the PORTACOUNT® PRO+ 8038 with N95 enabled)
- Zero Check
- Max FitFactor Check

Completed daily checks provide confidence that the PORTACOUNT® PRO fit tester is working properly. Failure of any of the daily checks requires immediate attention. See [Troubleshooting](#) chapter. If the PORTACOUNT® PRO Respirator Fit Tester passes the daily checks, and you have difficulty fit testing, the problem is probably **NOT** in the PORTACOUNT® PRO fit tester. Examine the respirator carefully for leaks or pinched tubes.

To start the daily checks:

1. Connect the AC Adapter to the instrument and turn on the PORTACOUNT® PRO fit tester using the O/I button. The PORTACOUNT® PRO fit tester goes through a warm-up period before it is ready to use.
2. From the  Activities Tab, select the Daily Checks icon [  ].
3. Press **Yes** with the stylus or your finger tip, and follow the directions on the screen.
4. If you are using a PORTACOUNT® PRO+ 8038 and plan to fit test respirators that are less than 99% efficiency, select the “N95 Enabled” box. This test is only necessary if you will be testing disposable masks with efficiency less than 99% (such as class 95, P2, and P1 respirators)."
5. Click **Settings** if you want to change or view the Daily Check settings, then **Save** or **Cancel** to return to the Test Status dialog.



### Caution

Changing the Daily Checks settings is **not** recommended. Factory settings are optimal.

6. As instructed on the display, remove the HEPA filter or mask (if one is attached to the sample intake hose) and press **START**. The first check is the Particle Check, which determines if the PORTACOUNT® PRO fit tester is working and if the concentration of particles in the ambient air is sufficient to conduct fit testing. When the test begins, progress is shown in the “Test Status” box on the screen. For the Model 8030, the Particle Check passes if the particle concentration is 1000 or above, and fails if the particle concentration is below 1000. For the Model 8038, the Particle Check passes if the particle concentration is 30 or above, and fails if the particle concentration is below 30. If the test fails, refer to the [Troubleshooting](#) chapter.
7. If you selected the “N95 enabled” box, the Particle Check is immediately followed by the Classifier Check. The Classifier Check verifies the classifier is functioning properly.
8. The next check is the Zero Check, which provides assurance that there are no leaks in the system. As instructed on the touch screen, attach the Zero Check filter to the clear Sample Tube and

press **START**. The test begins. The particle concentration should drop to zero (0.00) in less than 30 seconds. An occasional value of 0.60 or 1.20 is acceptable, but it should read 0.00 most of the time. If the Zero Check fails, see the [Troubleshooting](#) chapter. If the PORTACOUNT® PRO fit tester fails the Zero Check, any fit tests you conduct may result in lower fit factors than would be

measured otherwise. The risk is that you may fail people who have good fits, thereby wasting time and effort. There is no possibility that failing the Zero Check could result in overstated fit factors. This is because any particles leaking into the PORTACOUNT® PRO fit tester are interpreted as mask leakage, resulting in lower fit factors.

9. The Max Fit Factor Check is after the Zero Check. This check determines if the PORTACOUNT® PRO is capable of measuring high fit factors and if the internal switching valve is functioning properly. The test is essentially a fit test on a HEPA filter which simulates a perfectly fitting respirator. A very high fit factor should result if the instrument is working properly. The Max FF Check actually measures the maximum fit factor that can be determined by the PORTACOUNT® PRO fit tester given the local ambient particle concentration and the mask sample time programmed into the PORTACOUNT® PRO fit tester. Assuming the Zero Check Filter is perfect, the maximum fit factor will be the local ambient particle concentration divided by a mask concentration equivalent to one particle during the mask sample time. When the PORTACOUNT® PRO fit tester actually measures zero particles during the mask sample, one particle is artificially added to prevent division by zero when calculating the fit factor.

Performing this test is futile if there are leaks in the system. If this test fails refer to the [Troubleshooting](#) chapter.

10. Press **EXIT** when the tests are complete. If the PORTACOUNT® PRO fit tester passed all tests, proceed to [Step 4 – Conducting Fit Tests](#). If the instrument failed any test, refer to the [Troubleshooting](#) chapter to resolve the problem and then run the Daily Checks again.

#### **Step 4—Conducting Fit Tests**

1. Make sure the instrument is turned on, and you have selected the database you want to work with (if you want to save fit test results and other information).
2. Instruct the person being tested to put on the respirator 5 minutes before the fit test starts to purge the particles trapped inside the

respirator and permit the wearer to make certain the respirator is comfortable. Have the subject don the mask **without assistance**. Fit test results depend on the subject knowing how to properly don the mask. All subjects should be trained in proper mask-donning techniques before being fit tested. Do **not** allow the subject to adjust the mask during the exercises, as this invalidates previous results.

If testing a disposable respirator (with the Model 8038), have the fit-test subject hang the tubing support neck strap around his or her neck, adjusting it to a comfortable position. The tubing support neck strap should be positioned so that the tubing does not pull the mask off the person's face. Have the person tilt his or her head up and down, turn side to side, and bend over to see if the tubing pulls the mask away from their face. If it does, readjust the neck strap or the tubing and repeat check the fit again.



Conducting a Fit Test with the PORTACOUNT® PRO Respirator Fit Tester



3. On the Activities tab, press Fit Test [  ]. The People List dialog appears.
4. Select the person to fit test as follows:
  - a. If the person shown on the dialog is the one you want to fit test, press **Next** to select the respirator for the fit test. Press **Next** to continue.
  - b. If the person shown on the dialog is not the one you want to fit test, click the arrow on the **People List** field to display the names in the People Table, click on the name of the person you want, verify the correct name is displayed, then , then press **Next** to select the respirator for the fit test.

**Note:** *If the person you want to fit test is not in the database, press **New** and create a new record by typing in the information required. To add information, press the field you want to enter and an on-screen keyboard appears. Use the stylus to type the information. (Alternatively, you can plug a USB keyboard into one of the available USB ports and enter information using the keyboard.) When you are done, press **Next** and confirm that you want to save the new entry and use it for this fit test.*

5. After you press **Next**, the Respirator List dialog appears.
  - a. If the respirator you want to use is displayed, click **Next**.

b. If you want to select a different respirator, click the arrow on the **Respirator List** field to display a list of all the respirators in the database. Use the stylus to select the respirator you want to use, click **Next** to select the current protocol.

**Note:** You cannot add respirator records to the database here. If the respirator you want to use for fit tests is not in the database, or if no records are in the database, you must exit the Fit Test function and use the Database tab to access the respirator database (see [Chapter 5](#)). You can also use FITPROTM software to update the database to include the respirator.

6. After you press **Next**, the **Current Protocol** dialog box appears, the mask size and operator fields are blank. You must fill in these fields before you can continue.
7. Make certain the exercise protocol shown in the Current Protocol field is the one you want to use. If you want to select a different respirator, click the arrow on the **Current Protocol** field to display a list of all the Protocols in the database. Use the stylus to select the respirator you want to use.

**Note:** You cannot add a protocol to the database here. If the protocol you want to use for fit tests is not in the database, or if no records are in the database, you must exit the Fit Test function and use the Database tab to access the protocol database (see [Chapter 5](#)). You can also use FITPROTM software to update the database to include the respirator.

8. Click on the **Mask Size** field and use the on-screen keyboard to type in the mask size, for example: SMALL, MEDIUM, or LARGE. You can also use abbreviations such as S, M, or L.
9. Click on the **Operator** field and fill in your name or initials.
10. If you want to change the **Due Date** for this person's next fit test, click on the down arrow and select a different date from the calendar.
11. When you have filled in this dialog, click **Next** to proceed.
12. After you click **Next**, the **Run Test: Fit Test Step 4 of 4** dialog appears, and you are ready to begin the fit test. Before you click **START** to begin the test, verify the information at the top left of the screen and make certain the PORTACOUNT® PRO sample tube is connected to the respirator (Use one of the Tube Adapters if

necessary.), and ask the test subject if they are ready to begin the exercise protocol immediately.

13. Press **START**. Fit testing begins immediately, and the first exercise name appears. The elapsed exercise time also appears as a graphic progress bar. As each exercise completes, the result appears in the **Fit Factor** column. The **Ambient** and **Mask Concentration Values** fields show the ambient and mask particle concentrations as they are measured.
14. When a fit test starts, the PORTACOUNT® PRO Respirator Fit Tester begins a preprogrammed test sequence, sampling alternately from the Sample Tube and the Ambient Tube. Each exercise includes an ambient sample, a mask sample, and then another ambient sample. Refer to [Chapter 5](#) for more information on creating a new protocol with altered sampling times. Refer to the Appendixes for technical details on exercise/sample timing, calculating exercise fit factors, and calculating overall fit factors.
15. PORTACOUNT® PRO fit tester beeps to alert the person being tested it is time to begin the next exercise. The exercises proceed one after another without pause. Exercises that pass are highlighted in green. Exercises that fail are highlighted in red.

Have the test subject follow the exercises one after another when prompted by the instrument. Each exercise takes approximately 60 seconds to complete.

Exercise Name	Description
<b>Normal breathing</b>	Remain still and breathe as usual.
<b>Deep breathing</b>	Take long deep breaths as if working hard. Do <b>not</b> overdo it.
<b>Head side to side</b>	Breathe normally while slowly turning the head from side to side. Turn far enough to each side to stretch the neck muscles. Each cycle from left to right should take several seconds, pausing momentarily at each side to take a breath.
<b>Head up and down</b>	Breathe normally while slowly alternating between looking up at the ceiling and down at the floor. Each up and down cycle should take several seconds.

Exercise Name	Description
<b>Talking out loud</b>	Read a prepared paragraph (like the Rainbow Passage located in <a href="#">Appendix G</a> of this manual) or count out loud to simulate the workplace.
<b>Grimace</b>	<p>Grimace by smiling and/or frowning to create a leak in the respirator face seal. This exercise will often result in a failed fit factor, which is why the OSHA standard allows you to exclude that fit factor when computing the overall fit factor. When performing the grimace, you are intentionally creating a break in the face seal in order to see if the mask re-seals itself afterwards. Successful re-sealing is proven by achieving a passing fit factor on the next exercise.</p> <p><b>Notes:</b> <i>The OSHA protocol includes special provisions for the grimace exercise. It is allowed to be 15 seconds long and the resulting fit factor may be discarded (excluded) before calculating the overall fit factor. This is allowed because the grimace exercise is done to intentionally break the face seal in order to make sure the mask reseats itself before the next exercise.</i></p>
<b>Bend and touch toes</b>	Bend at the waist as if you were touching your toes while breathing normally.
<b>Normal breathing</b>	Remain still and breathe as usual.

16. PORTACOUNT® PRO Respirator Fit Tester tells you when the fit test is complete. PORTACOUNT® PRO fit tester beeps three times and calculates and displays the overall fit factor for the set of exercises. The upper section of the dialog box displays either a pass or fail status. Pass or fail is determined by comparing the overall fit factor to the Fit Factor Pass Level. The overall fit factor is displayed at the lower left.

**Note:** *In the USA, OSHA requires a minimum fit factor of 100 for half masks and 500 for full-face masks. If necessary, consult the appropriate regulation or standard.*

If the test was a **Pass**, the fit test is over. You will want to keep a record of the test on file if you are not using a database on the flash drive. Also, if the fit test passed, issue that exact size and model respirator to the test subject.

- If the fit test failed, determine the reason and repeat the test. Some common reasons for failure are described below.
- If you are fit testing with a disposable respirator, discard it when the fit test is complete. Probed respirators are intended for fit testing only and are never to be reused. You may be able to sanitize and reuse other types of respirators. Contact the respirator manufacturer for specific information.
- If the fit test is terminated before the last exercise is completed (by pressing **Stop**), the display indicates the test has stopped. No overall fit factor is displayed.

17. You can now begin to test another person, by pressing **Exit**.

### Step 5—Record Results

If you use the PORTACOUNT® PRO Respirator Fit Tester in stand-alone mode and do not have a active database on the flash drive attached to one of the USB ports, you have to manually record the fit test results and information about the person and respirator being fit tested. If you are using a database from the flash drive, the results are automatically stored in the database. Use FITPRO™ software to view and print the results.

You should record the following information if no database is used.

Ambient concentration Mask concentration Fit factor exercise 1 Fit factor exercise 2 Fit factor exercise 3 Fit factor exercise 4 Fit factor exercise 5  
Fit factor exercise X  
Overall fit factor  
Pass or Fail

The *overall* fit factor is the most important data item. It is the overall result of the fit test and usually the only fit factor value that must be

retained as part of your record keeping. The fit factors for the individual exercises are not as important. It is possible to have a passing overall fit factor even though one of the exercises resulted in a failing fit factor.

The overall fit factor is not simply an average of all the exercise fit factors. It is a weighted average related to the amount of airborne hazard that the person might have inhaled if he or she were in the workplace. One breath at a fit factor of 100 and then another at a fit factor of 1000 is not the same as two breaths at a fit factor near 550, it is the same as two breaths at a fit factor of about 180. This is because the breath at a fit factor of 100 contains 10 times the amount of hypothetical hazard as the breath at a fit factor of 1000. See the appendix on "[Calculating Fit Factors](#)" for more details.

### ***Common Problems Resulting in Low Fit Factors***

Some of the most common problems that result in lower than expected fit factors are described below. *Assuming the PORTACOUNT® PRO fit tester passes the Daily Checks*, explore the following possibilities.

- Not using high efficiency filters

If you are not using high-efficiency class-99 or class-100 filters (P3 for non-USA users) on the respirator, you may never get a high fit factor. Filters such as class-95, P1 and P2 (for non-USA users) allow some ambient air particles to get through and be interpreted as face seal leakage by the PORTACOUNT® PRO Respirator Fit Tester.

**Note:** *The Model 8038 fit tests lower efficiency respirators including class-95, P1, and P2 filtering-facepieces (disposables).*

- Alcohol cartridges is not tightly inserted or an O-ring is missing  
Make sure the alcohol cartridge is installed properly and all O-rings are in position.
- Starting fit test too soon after mask is donned.

When the mask is first donned, ambient air particles are trapped inside. These particles clear out as the person breathes. Half mask respirators clear very quickly; full-face masks can take over one minute. Do not start the fit test too soon.

- Sample tubes too long

No more than the few inches should be added to the Sample tube (use a Tube Adapter). Longer sample tubes prevent proper purging between the ambient and mask sample.

#### Leaking respirator probe or fit test adapter

Make certain the respirator probe (if used) or fit test adapter does not leak around the outside.

- PORTACOUNT® PRO fit tester sample tube leaks where attached to probe or adapter due to wear.

Cut a short piece off the end of the tube to expose a fresh end.

- Hair interfering with face seal.

Make sure there is no hair between the respirator face seal and the individual's skin.

- Hair or foreign material in exhalation valve.

Make sure the exhalation valve is clear. A single hair can make a big difference.

- Cigarette smoker.

Do **not** allow the individual to smoke for **at least** 30 minutes prior to the fit test.

### ***Suspiciously High Fit Factors***

When fit testing full or half face respirators in most ambient environments, fit factors greater than 100,000 are considered suspicious, and should be verified using the Real-time Fit Factor function after the fit test has been completed. While still donning the respirator, have the person being fit tested purposefully break the seal of the mask to their face by sliding an object (i.e. a pen or their finger) through the sealing surface. Even with a small leak, the fit factor calculated should be very low. If the Real-time calculated fit factor drops in value as expected, the reported high fit factors are valid. If the Real-time calculated fit factor does not drop in value when the seal is broken, there may be a block or kink in the Mask Sample tubing, usually as it enters the mask.

### **Step 6—Using a Printer with the PORTACOUNT® PRO Fit Tester**

Version 2.0 and greater PORTACOUNT® firmware adds the ability to connect a compatible printer directly to the PORTACOUNT® PRO fit tester for printing Fit Test Reports in stand-alone (no PC required) testing mode.

#### ***Printer Compatibility***

The PORTACOUNT® PRO fit tester is compatible with a variety of commonly available printers, though not all printers. The connection must be USB and the printer must be compatible with, or support, a "PCL" printing language. In testing we have found that printers

specified as “PCL 3,” “PCL 3 enhanced,” “PCL 3 GUI,” “PCL 5e,” “PCL 6,” and other variations of PCL language support were also compatible. Testing has also shown that not all commercially available printers labeled as “PCL” compatible will communicate with the PORTACOUNT PRO and PRO+ fit testers. It is recommended that the **Printer Test** function be used to confirm compatibility for the printer you are testing. If a report is not printed during this printer test function, then the printer is not compatible.

At the time of firmware testing and release, we tested the PORTACOUNT® PRO fit tester and found it compatible with these specific printers:

- HP® Photosmart D5460 (HP PCL 3 GUI)
- HP® Deskjet 6940 (HP PCL 3)
- HP® Officejet H470 (HP PCL 3 enhanced)
- Lexmark™ E120 Laser (PCL 5e, PCL 6)

### ***Connecting and Testing the Printer***

There are two USB ports on the back panel of the PORTACOUNT® unit. With the PORTACOUNT® PRO fit tester powered off, connect the removable media device used to import/export and store the fit test database files to the first USB port and connect the printer to the second USB port.

To test the connection, power up the PORTACOUNT® PRO fit tester and the printer. Allow the printer to boot completely and make sure there is no error condition (refer to the printer manufacturer’s documentation).

Once the printer is in its online, idle state, select the **Setup** tab and click **Device Info**. On the screen there, you should see the message, “Printer connected”. If you see the message, “No Printer detected”, click **OK** to dismiss the Device Info screen, check the printer connection, and try again.

If you see the message “Printer detected” and this is the first time this printer has been connected to the PORTACOUNT PRO fit tester, click on the **Printer Test** icon. If everything is configured and working properly, the printer should print out a simulated Fit Test Report. If a report is not printed, the printer is not compatible.

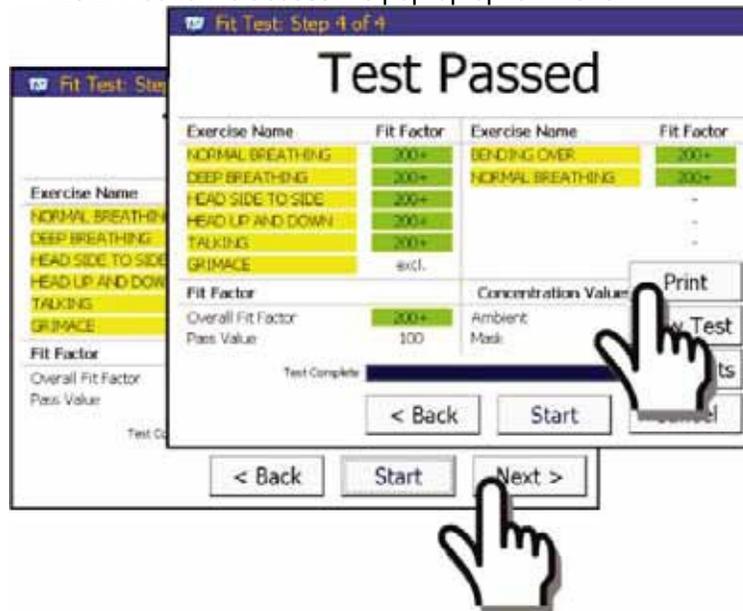
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HP is a registered trademark of the Hewlett-Packard Company. Lexmark is a trademark of Lexmark International.

### Printing Fit Test Reports

There are two places in the PORTACOUNT® PRO fit tester workflow where Fit Test Reports can be printed:

- At Fit Test Step 4, after a fit test has been completed, click the **Next >** button to access the pop-up option menu.



- At the top of that menu, select **Print** to print a report of the fit test that was just completed.

**Note:** If the test is stopped by the user before it completes, or if it fails due to a fault condition such as low ambient concentration, the fit test will not be saved to the database and will not be available for printing.

- In the “Fit Test Reports” screen, available through the “Database” page, you can print Fit Test Reports for records that you select from the currently loaded database.

### Step 7—Stand-Alone Fit Testing—Data Handling Best Practices

TSI's PORTACOUNT® PRO Respirator Fit Tester is designed to provide a robust solution for stand-alone fit testing. As with any computing application, care must be taken by users to ensure that precious data is not lost due to mishap or mishandling. This section recommends some basic and advanced guidelines for good data handling and instructions on how to use the PORTACOUNT® PRO fit tester "Advanced Database Tools" introduced in firmware version 2.0.

- In stand-alone mode, all important fit test data is stored on the removable media device (flash drive) that is connected to the PORTACOUNT® unit.



**Note:** The flash drive provided with the PORTACOUNT® PRO fit tester does **not** include the necessary PORTACOUNT® PRO database. This must be created through the FITPRO™ software, please refer to the FITPRO™ software user's manual.

- Do **not** lose or damage the flash drive! **All** fit test data is stored in files on the flash drive.
- Only connect one flash drive to the PORTACOUNT® PRO fit tester at a time. The PORTACOUNT® PRO fit tester does **not** support operation with two flash drives simultaneously.
- **Never** remove the flash drive while data is being written to it at the end of a Daily Check or Fit Test or anytime you see this message on the PORTACOUNT® screen:



- Backup the file(s) on the flash drive to a host computer as often as practical.

### Step 8—Advanced Database Tools

The “Advanced Database Tools” introduced in firmware version 2.0 are intended for use by advanced users or as instructed by TSI technical support personnel during a phone support session. The “Advanced Database Tools” can be accessed through the [Setup tab](#).

**Advanced Database Tools**

Warning: These tools are provided for advanced users, and can result in the loss of fit test data if misused. Refer to the PortaCount Operation Manual for details.

**Available Databases** refresh

FitTestData

Select a database from the list, then select one of the tools below. Use the "Save" or "Save As" tools to save the currently loaded database to a file.

Advanced Database Tools	Description
Statistics	Allows the advanced user to determine how many records of each type (people, respirators, protocols, fit test results and daily checks) are in the selected database file and reports the file size in bytes.
Clean Copy	Allows the advanced user to make a “clean” copy of an existing database file. A “clean” copy retains the people, respirator, protocol, and daily check records, of the original database, but does not copy fit test results. This tool can be used when your working database file is becoming too large to create a second, working copy.

Advanced Database Tools	Description
<b>Copy</b>	Allows the advanced user to make a copy of an existing database file. One typical use might be to create a "master database" using FITPRO™ software that contains commonly used respirator and protocol information, then using " <b>Copy</b> " to make working copies that you can customize by adding people, additional protocols or respirators using the PORTACOUNT® Fit Tester user interface as needed.
<b>Save</b>	This command writes the database that is active in memory to a file on the flash drive. This is usually not necessary because the file is saved automatically at the end of each test, but can be a useful tool in some situations. For example, in the unlikely event that your primary flash drive should fail and you receive an error message that the data was not saved, you could swap out the primary drive with a backup and use " <b>Save</b> " to write the database from memory to the backup flash drive. You could then continue working with the backup flash drive in place.

Advanced Database Tools	Description
Save As	<p>This command is like <b>Save</b>, but allows you to save the currently loaded database under a different file name. This would not usually be necessary, but you could use this tool to make a backup copy of your database under a different name as an additional precaution.</p> <p>This tool is also capable of saving the “Demo-Training” database to a flash drive, providing a method for creating a new database in stand-alone mode without using FITPRO™ software. The steps in creating a new database based on the “Demo-Training” database are:</p> <ol style="list-style-type: none"> <li>1. Insert a blank flash drive into the PORTACOUNT® Fit Tester (or remove the flash drive from the PORTACOUNT® Fit Tester).</li> <li>2. Use “<b>Select Database</b>” from the Database page to load the “Demo-Training” database into memory.</li> <li>3. Replace the flash drive, if you had previously removed it, and use the “<b>Save As</b>” tool in the Advanced Database Tools to save the database from memory to flash drive.</li> <li>4. Use “<b>Select Database</b>” from the Database page to load the new database into the PORTACOUNT® Fit Tester’s memory. The newly created database can be used just like a database exported from FITPRO™ software and you can customize it by adding protocols, respirators and people using the PORTACOUNT® Fit Tester user interface.</li> </ol>
Delete	<p>Allows advanced users to delete database files from the flash drive. Use this tool with caution because it <b><i>permanently deletes a database file from the flash drive!</i></b></p>

## Chapter 5

# Operating Modes and User Interface

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This chapter describes the operating modes of the PORTACOUNT<sup>®</sup> PRO Respirator Fit Tester and describes the options available through the user interface (touch screen).

### Modes of Operation

There are two modes of operation: External Control (using FITPROTM software) and Stand-alone.

<b>External Control Mode</b>	The PORTACOUNT <sup>®</sup> PRO Respirator Fit Tester is operating in External Control Mode when it is being controlled by FITPROTM software running on your computer. If you attempt to perform an operation from the PORTACOUNT <sup>®</sup> PRO touch screen while it is being controlled by FITPROTM software, a message appears asking if you want to unlock the PORTACOUNT <sup>®</sup> PRO fit tester. If you respond <b>YES</b> , the PORTACOUNT <sup>®</sup> PRO fit tester breaks the connection with the computer (and the FITPROTM software) and begins to operate in stand-alone mode.  <i>Note: You may lose data already collected in the active flash drive database.</i>  Refer to the online help of the FITPROTM software for operating details.
<b>Stand-alone Mode</b>	The PORTACOUNT <sup>®</sup> PRO Respirator Fit Tester is operating in Stand-alone Mode when it is <b>NOT</b> controlled by FITPROTM software running on your computer. When you turn the PORTACOUNT <sup>®</sup> PRO fit tester on, the instrument automatically begins a warm-up period. When the warm-up period is over, a beep sounds and the touch-screen display appears. The PORTACOUNT <sup>®</sup> PRO fit tester is now ready for Fit Testing and other stand-alone operations.

### User Interface

The touch screen provides the user interface to all functions when the instrument is operating in stand-alone mode. These functions are accessed through the tabs at the bottom of the display. The functions available through each tab are described below.

## Activities Tab

The Activities tab lets you perform three functions: Fit Testing, Daily Checks, and Real-time fit factors.

### Fit Test

Press **Fit Test** [  ] to start a fit test in stand-alone mode. Refer to [Chapter 4](#) for a complete description.

### Daily Check

Press **Daily Check** [  ] to start the Daily Checks of the instrument. Refer to [Chapter 2](#) for a complete description.

### Realtime

Press **Realtime** [  ] to view a graph showing real-time fit factors or perform an ambient concentration check.

The real-time fit factor display is generally used for respirator training and troubleshooting. It allows a test subject to experiment with strap tension and other adjustments while watching the effect these efforts have in real-time.

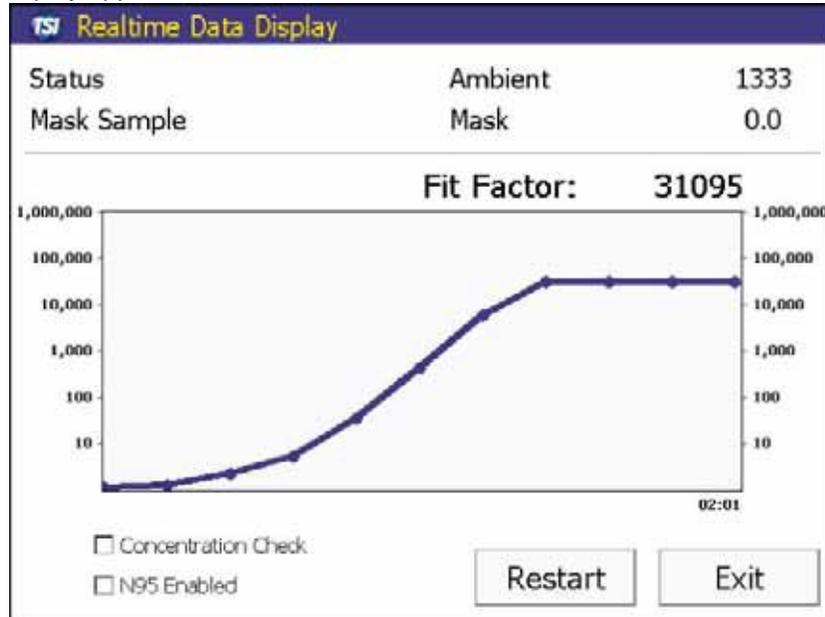
The test subject learns how each adjustment affects the fit, and learns how to achieve a fit that is comfortable and has minimum leakage.

**Note: This feature is intended for training. It should not be used immediately before a fit test.** Using the feature to help the test subject don the respirator immediately before the official fit test defeats one of the main purposes of fit testing: to prove that the test subject knows how to don the mask properly without help. Use the Real-time Fit Factor feature for training and practice only.

*You can use the real-time fit factor display prior to a fit test as long as you have the test subject remove the mask and put it on again (without the use of the real time display or other assistance) before the final test.*

Before you start the real-time fit factor display, the test subject should put on the respirator and it should be properly attached to the PORTACOUNT® PRO Respirator Fit Tester.

When you press **Realtime** [  ] the Real-Time Fit Factor Display appears.

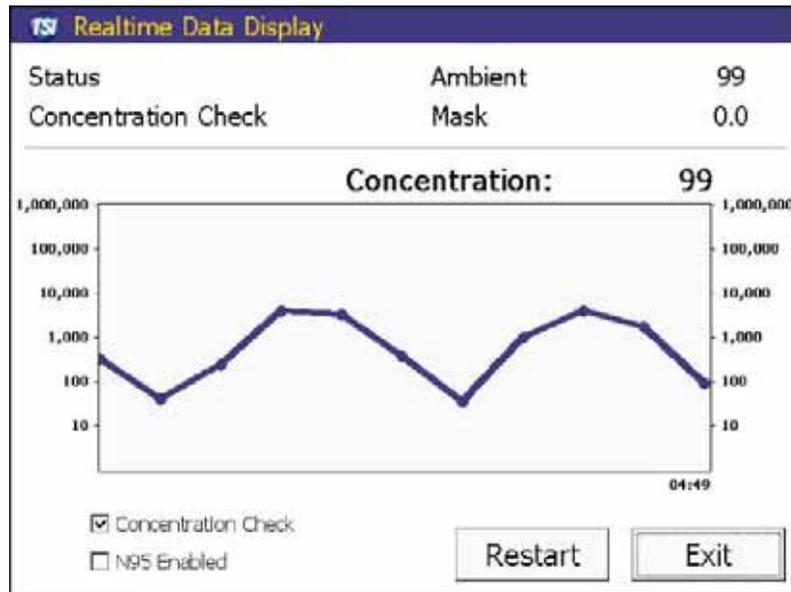


The PORTACOUNT® PRO Respirator Fit Tester takes an ambient concentration reading and stores the value. Next it purges the mask and then begins continuous monitoring of the mask concentration.

The line graph lets you (and the test subject) observe the Fit Factor reading as it fluctuates in near real time. (There is a delay of a few seconds between when a change in fit occurs and when the graph displays the change in fit factor.)

The graph pauses every 5 minutes while the PORTACOUNT® PRO fit tester takes a fresh ambient air measurement. Press **Restart** to force a new ambient reading sooner.

The Realtime Data Display page also has an “**Ambient Concentration Check**” mode.



In this mode, the PORTACOUNT® PRO fit tester continuously measures the particle concentration through the ambient inlet port allowing the user to easily check ambient concentration in preparation for testing.

Press **Exit** to close the Real Time display.

#### Database Tab

The Database tab lets you select an active database to use for fit testing or view the People, Respirator, Protocols, and Fit Test records of the active database. (See the *FITPRO™ Fit Test Software User Manual* for instructions on how to configure the USB flash drive.)

**Note:** Unless a flash drive with valid database files is inserted in one of the USB ports, you cannot use an active database. There is a database available in the PORTACOUNT® PRO fit tester for demonstrations and training purposes only. But this database cannot be permanently modified and adding new records or making other modifications to this internal database does not permanently change them. All changes and additions are lost when you turn off the PORTACOUNT® PRO fit tester.

### **Select Database**

When you press **Select Database**, a dialog opens displaying the available databases on the flash drive. If there is no flash drive attached to the PORTACOUNT® PRO fit tester, a message appears to warn you. If you do not want to use a database from a flash drive, press **Exit**, otherwise insert a flash drive with a valid database (or databases) in the root directory and press **Refresh**.

**Note:** *Unless a flash drive with valid database files is inserted in one of the USB ports, you cannot use a real database. The database stored in the PORTACOUNT® PRO fit tester is for demonstration/training purposes only. Adding new records or making other modifications to the internal database does not permanently change (save) them and information cannot be exchanged with FITPRO™ software.*

1. Use the down arrow to select the database you want to use.
2. Verify the database you want to use displayed in the “Available Databases” field.
3. Press **Load**. The database is imported and becomes the *active* database. All changes, additions, fit test results and so on are stored to this database. The database can be exported to your computer running FITPRO™ software by inserting the flash drive in one of your computer’s USB ports.
4. Press **Done** to exit this function.

### **Fit Test Reports**

Select **Fit Test Reports** [  ] to view the Fit Test records of those individuals in the active database. Use the arrow at the right of the Selected Fit Test field to show all the records and select a record by pressing on the person’s name in the dropdown box.

If you have a compatible USB printer connected, you will have the option to print a report for the record you’ve selected.

When you are done viewing records, press **Exit** to end this function.

### **People**

Select **People** [  ] to view the records of people in the active database or add a new person to the database.

1. To view records, press the arrow at the right of the People List. Select a record by pressing the name in the dropdown box.
2. To add a new record, press **New**, and fill in the required fields using the on-screen keyboard, then press **Save**. If necessary, refer to the *FITPRO™ Fit Test Software User's Manual* for a description of these fields.
3. Press **Exit** to close the People list.

### **Respirators**

Select **Respirators** [  ] to view the records of the respirators in the active database or add a new respirator to the database.

1. To view the records, press the arrow at the right of the Respirator List. Select a record by pressing the respirator name in the dropdown box.
2. To add a new record, press **New**, and fill in the required fields using the on-screen keyboard, then press **Save**. If necessary, refer to the *FITPRO™ Fit Test Software User's Manual* for a description of these fields.
3. Press **Exit** to close the Respirator list.

### **Protocols**

Select **Protocols** [  ] to view the current protocol or access other protocols in the active database or add a new protocol to the database.

1. To select a different protocol, press the arrow at the right of the Current Protocol field. Select the protocol by pressing the Protocol name in the dropdown box. This now becomes the active protocol for fit tests.
2. To add a new Protocol, press **New**, enter a name using the on-screen keyboard, edit the fields using the

up/down arrows in the **Protocol Details** dialog, and then press **OK**.

3. When the **Create New Entry** dialog appears, click on a Exercise Name field to open the **Exercise # Parameters** dialog and enter information for that exercise (you can also modify any information you entered on the Protocol Dialog in step 2 by clicking on the specific parameter). You can enter up to 12 exercises.

The following table describes the fields.

<b>Button or Field Name</b>	<b>Description</b>
<b>Ambient Purge Time</b>	Use the up/down arrows to set the time (in seconds) the ambient air is purged before an ambient sample measurement is made.
<b>Ambient Sample Time</b>	Use the up/down arrows to set the time (in seconds) the ambient air is sampled before the Mask purge time begins.
<b>Cancel</b>	Closes the dialog without saving any changes.
<b>Exercise Name</b>	A list of all the exercises in the protocol (up to 12 exercises).
<b>Exclude</b>	Check this box if you want PORTACOUNT® PRO fit tester to exclude this exercise when calculating the fit factor. This exercise then is essentially a “time-out.” It is typically used for the OSHA 29CFR1910.134 grimace exercise. Do <b>not</b> exclude exercises unless you are absolutely certain they are not required for the overall fit factor result. <b>Note:</b> When an exercise is excluded, the value stored as the mask sample time becomes the time used for the entire exercise. No actual measurement is made.
<b>OK</b>	Closes the dialog box and saves your values.
<b>Mask Purge Time</b>	Use the up/down arrows to set the time (in seconds) the mask is purged before the Mask sample time.
<b>New Exercise Name</b>	Enter a name for the exercise using the on-screen keyboard.
<b>Next Test In _ months</b>	Number of months before the next fit test is due. This is typically 12 months, although some regulations call for 6 or 24 months. Consult the applicable regulations for additional information. Valid range from 1 to 99. Use the up/down arrows to set this field.

Button or Field Name	Description
<b>N95</b> (Model 8038 only)	If this protocol will be used for testing masks with < 99% filter efficiencies such as N95, P2, and P1 respirators, check this box.
<b>Protocol Name</b>	Enter the name for the exercise protocol you are creating using the on-screen keyboard.
<b>Mask Sample Time</b>	Use the up/down arrows to set the Mask Sample Time for the exercise.
<b>Save</b>	Saves the current protocol information and adds the record to the database.
<b>Stop Fit Test immediately when any exercise fails</b>	If the protocol requires <i>all</i> exercises to pass, check this box. Most regulations allow an exercise to fail as long as the overall fit factor passes. Default is unchecked.

Refer to the regulation or standard that applies to your industry or hazard for guidance on which exercises should be performed and how many there should be.

4. Press **Save** to save the new protocol.
5. Press **Exit** to close the Protocol

#### database. **Setup Tab**

The Setup tab lets you set the PORTACOUNT® PRO fit tester's date and time, get information about the model number and firmware version of your instrument, calibrate the touch screen, and verify/test the printer connection.

#### **Date and Time**

Select **Date and Time** [  ] to set the date, time, and date format on the instrument. The date and time need to be set to accurately bookmark when a fit test is done.

1. When you press **Date and Time**, a dialog opens with the default date and time. Use the arrows to the right of the **Date** field to pick the date from the pop-up calendar.
2. To change the time, select the segment of time you want to change (hour, minute, second), then use the arrows to increase or decrease the value.
3. Select the Date Format from the Date Format box.

**Note:** When you set the date format here it does not change the date format that FITPROTM software uses. When

*data is exchanged with FITPRO™ software, it is exchanged in a universal date format.*

4. Press **OK** to close this dialog and save your settings or **Cancel** to close the dialog without changing it.

### **Device Info**

Press **Device Info** [  ] to view the model number, serial number and version level of your PORTACOUNT® PRO fit tester and verify USB printer connection. The box that appears also contains other information that may be helpful with troubleshooting the instrument with a TSI representative.

### **Touch Screen Calibration**

Press **Touch Screen Calibration** [  ] to recalibrate the touch screen. The touch screen needs recalibration when you touch one area of the screen and the wrong action is performed. This is most noticeable when using the on-screen keyboard. For example, you touch the “u” and “j” appears. Use the stylus for calibration, **not** your finger.

As instructed on the touch screen, “Carefully press and briefly hold stylus on the center of the target. Repeat as the target moves around the screen.”

When the calibration is complete, you are notified that the settings have been measured. Press anywhere on the screen to end the calibration.

### **Printer Test**

To verify that the connected printer is working correctly or to easily test the compatibility of a new printer, select the “**Printer Test**” icon. If a compatible printer is connected to the PORTACOUNT® PRO fit tester, a simulated Fit Test Report will be printed. If no printer is attached, you will see the message, “No Printer Detected”.

### **Advanced Database Tools**

These tools provide a means for advanced users to manage the fit test result database files stored on removable media devices. Refer to Chapter 4, [“Step 7—Stand-Alone Fit Testing—Data Handling Best Practices”](#) for details.

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## Chapter 6

### Service and Maintenance

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#### Recalibration Interval

TSI recommends that the PORTACOUNT® PRO Respirator Fit Tester be cleaned and recalibrated annually. Try to arrange your fit testing schedule to allow for annual factory recalibration. If your fit testing schedule is seasonal or you expect heavy usage during an upcoming period (such as an outage), TSI recommends that you have the PORTACOUNT® PRO fit tester serviced prior to that time. TSI's Customer Service Department provides fast service in order to minimize your down time. Contact TSI on the Internet at [www.tsi.com](http://www.tsi.com) or send e-mail [to PortaCount@tsi.com](mailto:toPortaCount@tsi.com).

#### Status Messages

Two status messages can be displayed by the PORTACOUNT® PRO Respirator Fit Tester.

<b>Low Particle Message</b>	The PORTACOUNT® PRO fit tester is factory programmed not to allow fit testing when the ambient particle concentration is below 1000 particles/cm <sup>3</sup> for the Model 8030 or 8038 when testing masks with % efficiencies or greater and 30 particles/cm <sup>3</sup> for the Model 8038 when testing masks with <99% efficiencies. If the ambient sample in Fit Test Mode is below these levels, the "Low Particle" message appears on the touch screen display and the fit test is automatically terminated.  This message appears in Fit Test Mode only, for one of the reasons described below. Consult the <a href="#">Troubleshooting</a> chapter if necessary.
<b>Low Alcohol Level Message</b>	When the "Low Alcohol Level" message is displayed, it means that the PORTACOUNT® PRO fit tester may be low on alcohol. This message does not necessarily mean that the PORTACOUNT® PRO fit tester will stop working soon. Fit test results are accurate even when this message is on. Refer to the <a href="#">Troubleshooting</a> chapter for other possible causes and solutions for this message.

## Reordering Supplies

TSI part numbers for consumable supplies and miscellaneous replacement parts are:

Model/Part No.	Description
8016	Box of 16, 30 ml bottles of isopropyl alcohol (480 ml total)
8033	Box of 10 Alcohol Wicks
803X-ZFLTR	Zero Check Filter
8017	Sampling Hose Kit with 3 Twin Tube Assemblies and 10 each 3/16 in. and 1/4 in. Tube Adapters.
800197	Twin Tube Assembly (Quantity 1)
8034	AC Adapter for Model 8030/8038 (voltage sensing)
6001868	PORTACOUNT® PRO Respirator Fit Tester Operation & Service Manual
6002211	FITPRO™ Fit Test Software Installation Guide
8032	Alcohol Cartridge and Fill Capsule Kit for Model 8030/8039
8032-FC	Alcohol Fill Capsule with Storage Cap
8032-SC	Storage Cap
8032-CT	Alcohol Cartridge with wick

## Shipping & Storage Precautions

When transporting or storing the PORTACOUNT® PRO Respirator Fit Tester, it is important to remove all alcohol. Transporting or storing the PORTACOUNT® PRO fit tester with the alcohol cartridge inside may cause flooding of the optics.

When you put the PORTACOUNT® PRO fit tester back into the carrying case you should do the following:

1. Remove the Alcohol Cartridge from the PORTACOUNT® PRO fit tester and store it in the Alcohol Fill Capsule. The Alcohol Fill Capsule is designed to be a safe transportation and storage container for alcohol. The Alcohol Cartridge can be left soaking in alcohol indefinitely.
2. Cover the Cartridge Cavity with the Storage Cap. Installing the Storage Cap into the Cartridge Cavity prevents dirt or lint from getting inside the PORTACOUNT® PRO fit tester.

**NEVER** ship the PORTACOUNT® PRO fit tester back to TSI with any alcohol bottles.

### Changing the Alcohol Wick

The wick inside the Alcohol Cartridge may be changed in the field. Two spare wicks are included with the PORTACOUNT® PRO Respirator Fit Tester. Normally, the wick does not need to be changed unless one of the following problems develops:

- Moisture accumulates in the wick and causes the Low Alcohol Level message to come on even when there is an adequate alcohol supply. This may happen when the PORTACOUNT® PRO fit tester is used extensively for weeks on end. Especially if you are fit testing in an area with high humidity.

If moisture accumulation occurs, the Alcohol Wick can be removed, allowed to dry, and then re-installed into the Alcohol Cartridge.

- The wick becomes contaminated with dirt, oil, or other foreign substances. This should not happen unless the instrument is used to sample aerosols other than those normally found in ambient air.

If the Alcohol Wick is contaminated, it should be discarded and replaced with a new one. Note that some discoloration of the wick is normal and will not influence performance.

To remove the Alcohol Wick from the Alcohol Cartridge:

1. Grasp the cartridge with both hands. With the knob in one hand and the Wick Retainer Cap in the other, twist and pull apart the assembly. The cartridge should snap apart exposing the end of the white Alcohol Wick.



2. After separating the two halves, push the Alcohol Wick out of the Wick Retainer Cap from the opposite end with the Wick Removal Tool (wood dowel) provided with each new alcohol wick. Do **not** use a pencil point because bits of lead could break off.

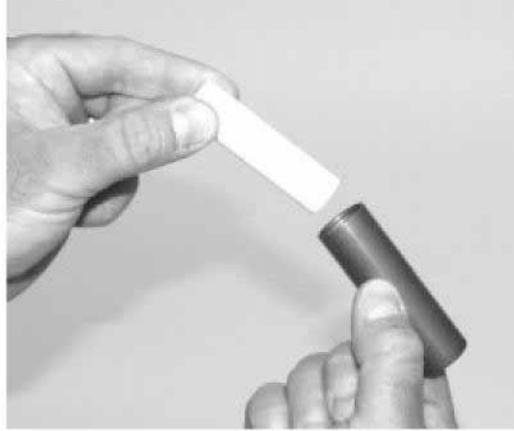


3. Examine the white Alcohol Wick. Discard wicks that are severely discolored or physically damaged. Some light brownish-yellow discoloration of the wick is normal.

If the wick is in good condition, dry it by placing it on a clean surface in a well-ventilated area and allow it to dry for at least two days.

4. Before re-installing the alcohol wick, make certain that all parts are clean. Small bits of the wick or lint can cause serious problems if they get into the PORTACOUNT® PRO fit tester.
5. Inspect the inside surfaces of the Alcohol Cartridge and the Wick Retainer Cap. Blow air into them, if necessary, to make certain that there are no dust particles present.
6. Blow air onto all surfaces of the Alcohol Wick that will be used to make certain that any loose particles that may have shed from the wick are removed.
7. Check both ends of the wick. If one end is smoother than the other, slide the smooth end of the wick into the Wick Retainer Cap first. Otherwise, simply insert the wick and push firmly until the wick hits bottom.
8. Blow everything off again.

9. Align the two halves of the Alcohol Cartridge and press firmly until they snap together.



### **Operation in High Humidity**

When using a Model 8030/8038 in a high humidity environment, the wick assembly will retain water moisture more rapidly than normal and will require more frequent wick replacements. Water moisture collecting in the wick is a normal occurrence, but is greatly increased with a rise in humidity. Under normal conditions with a dry wick freshly charged with isopropyl alcohol, the PORTACOUNT® fit tester will operate approximately 6.5 hours before the “Low Alcohol Warning” appears. This average run time will start to decrease when operating the PORTACOUNT® fit tester in higher humidity. To keep this average run time as long as possible, replace the wick each day with a dry one. To dry out the wick you removed from the PORTACOUNT® fit tester, place it in a well-ventilated area that has a humidity level of 50% or lower and let it set overnight (approximately 16 hours). The wick should then be dry and ready to be used again. The 16- hour dry time is based on an 8-hour operation in a humid environment. The total dry time will vary depending on the number of operation hours on the wick in high humidity environment.

### **Nozzle Cleaning**

If the small (pin-hole size) internal nozzle becomes clogged with lint or other debris, the following procedure should clear it. The symptom of a clogged nozzle is a low (perhaps zero) ambient particle count.

This usually, but not always, causes the Particle Check and/or Max FitFactor Check to fail. There are two procedures. Procedure A should be done first, then Procedure B if necessary.

#### Procedure A

Obtain a source of clean compressed gas, such as Chemtronics<sup>®</sup> or equivalent. It must have a long nozzle (straw) in order to reach deep into the PORTACOUNT<sup>®</sup> PRO Respirator Fit Tester.

- Turn the PORTACOUNT<sup>®</sup> PRO fit tester off and remove the alcohol cartridge.
- Insert the long nozzle inside the PORTACOUNT<sup>®</sup> PRO fit tester as shown. Keep the end of the nozzle centered in the cavity and gently push it in as far as possible. The internal nozzle is located just at the far end of the cavity and cannot be seen.
- Apply two or three bursts of gas. You will not damage the PORTACOUNT<sup>®</sup> PRO Respirator Fit Tester.



Reinsert the alcohol cartridge. Turn the PORTACOUNT<sup>®</sup> PRO Respirator Fit Tester on. Perform the Daily Checks. If the problem persists, try Procedure B.

### Procedure B

Use this procedure only if Procedure A fails to clear the internal nozzle.

- Turn the PORTACOUNT® PRO fit tester off and remove the alcohol cartridge.
- Turn and hold the PORTACOUNT® PRO fit tester up on end so that you can look down into the cartridge cavity.
- Take a bottle of the alcohol used to operate the PORTACOUNT® PRO fit tester and drip 3 to 4 drops down into the cartridge cavity. Try to keep the drops centered so they hit the bottom without touching the sides. Do not use too much. One drop is enough if it all reaches the nozzle.
- Keep the PORTACOUNT® PRO fit tester in this vertical position for about 5 minutes so the alcohol can soften or dissolve the blockage.

Put the PORTACOUNT® PRO Respirator Fit Tester down in normal operating position and perform Procedure A.



### Applying O-ring Grease to the Alcohol Cartridge

Over time, the O-ring grease on the Alcohol Cartridge and Storage Cap is worn off or lost due to repeated contact with alcohol. This can make insertion of the Alcohol Cartridge and Storage Cap difficult. To remedy this problem, place a small amount of supplied grease to the O-ring on each component as depicted in the illustrations below.

Care must be taken so grease does not get into the particle passages (holes) near the O-ring.



## Chapter 7

# Troubleshooting

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This chapter lists a series of symptoms, their possible causes and recommended solutions for problems with the PORTACOUNT® PRO/PRO+ Respirator Fit Tester. If your symptom is not listed, or if none of the solutions solves your problem, please contact TSI. Additional help is available from the TSI Web site [www.tsi.com](http://www.tsi.com) or by sending e-mail [to PortaCount@tsi.com](mailto:PortaCount@tsi.com).

Always replenish the alcohol supply as the first step in solving a problem. You can add alcohol to the fill line at any time.

Eventually, the Alcohol Wick inside the Alcohol Cartridge will absorb enough moisture to prevent proper operation. Symptoms of excess moisture are low particle counts even though there is plenty of alcohol and plenty of particles in the room, and also having to frequently replenish the alcohol supply (such as every hour or less). Changing the Alcohol Wick is the best way to solve the problem. You could also dry the wick by leaving the Alcohol Cartridge in the PORTACOUNT® PRO and then running it overnight, or by removing the wick from the cartridge and letting it dry for 48 hours.

**Always** perform the Daily Checks as described in [Chapter 4](#) as the first troubleshooting step. Passing the Daily Checks usually indicates that the PORTACOUNT® PRO is working properly and that the problem is elsewhere, such as the connection to the respirator and/or the respirator itself.

### On-line Troubleshooting Guides

Additional application notes on troubleshooting are located on the FITPRO™ software CD or visit TSI's website at <http://fittest.tsi.com>.

**Symptom Possible Causes Solution**

<p>Low Particle message</p>	<p>Low on alcohol.</p> <p>Hoses are reversed on Twin Tube Assembly.</p> <p>Wrong tube is connected to respirator.</p> <p>Twin Tube Assembly is kinked, pinched, or blocked.</p> <p>Particle count in area really is low.</p> <p>Moisture build-up inside PORTACOUNT® PRO fit tester.</p> <p>Inferior or contaminated alcohol.</p> <p>Plugged internal nozzle.</p> <p>Unit needs recalibration and cleaning.</p>	<p>Connect AC Adapter.</p>
<p>Does not switch on</p>	<p>AC Adapter not plugged in to unit or</p>	

Symptom	Possible Causes	Solution
Fails Zero Check	<p>Alcohol Cartridge is loose.</p> <p>Twin Tube Assembly leaks.</p> <p>Filter leaks.</p> <p>Ends of Twin Tube Assembly are poorly sealed.</p> <p>Twin Tube Assembly is disconnected.</p> <p>Slightly flooded with alcohol.</p> <p>Switching valve is not functioning.</p> <p>O-ring on alcohol cartridge is not sealing.</p> <p>Tube fittings on PORTACOUNT® PRO fit tester are loose.</p>	<p>Tightly close the Alcohol Cartridge.</p> <p>Repair or replace the Twin Tube Assembly.</p> <p>Repeat the test with a different filter.</p> <p>Cut off the worn ends on the Twin Tube Assembly.</p> <p>Connect the Twin Tube Assembly to the PORTACOUNT® PRO fit tester.</p> <p>Remove Alcohol Cartridge and run for 15 minutes, then try again.</p> <p>Return to TSI for service.</p> <p>Replace O-ring. Smear a very small amount of grease (such as Vaseline™) on the O-ring.</p> <p>Tighten fittings with pliers.</p>

Symptom	Possible Causes	Solution
Fit factor of 1 or very low	Respirator is not equipped with HEPA, class-99, class-100, or P3 filters.	Install proper filter for fit testing.
(If the PORTACOUNT passes the Daily Checks, the problem is with the respirator, not the PORTACOUNT.)	Respirator leaks, has loose filters, or a malfunctioning exhalation valve.	Repair the respirator.
	Twin Tube Assembly is disconnected.	Connect the Twin Tube Assembly to the PORTACOUNT® PRO fit tester.
	Twin Tube Assembly is not connected to respirator sampling port.	Connect the Twin Tube Assembly to the respirator sampling port (clear tube).
	Twin Tube Assembly Leaks.	Repair or replace the Twin Tube Assembly.
	Sample Tube too Long.	Use standard 5-foot Twin Tube Assembly.
	PORTACOUNT® PRO fit tester is flooded with alcohol.	Run 2 hours to dry optics (remove the Alcohol Cartridge and install Storage Cap).
	Alcohol level is low.	Add alcohol to the PORTACOUNT® PRO.
	Switching valve is not functioning.	Return to TSI for service.

Symptom	Possible Causes	Solution
<p>Suspicious readings</p> <p>(If the PORTACOUNT passes the Daily Checks, the problem is the respirator, not the PORTACOUNT.)</p>	<p>PORTACOUNT® PRO fit tester is flooded with alcohol.</p> <p>Tube fittings on PORTACOUNT® PRO are loose.</p> <p>PORTACOUNT® PRO leaks.</p> <p>Sample lines too long.</p> <p>Alcohol Cartridge is loose.</p> <p>Respirator is not equipped with HEPA filters.</p> <p>Twin Tube Assembly is kinked, pinched, or blocked.</p> <p>Leaking respirator probe.</p> <p>Tubing in fit test adapter is kinked or pinched.</p> <p>Respirator is faulty.</p>	<p>Run 2 hours to dry the optics (remove cartridge and install storage cap).</p> <p>Tighten with pliers.</p> <p>Zero-Check the PORTACOUNT® PRO fit tester and fix any leaks.</p> <p>Use standard 5-foot Twin Tube Assembly.</p> <p>Tightly close the Alcohol Cartridge.</p> <p>Install HEPA filters for fit tests.</p> <p>Straighten out the Twin Tube Assembly or remove the obstruction.</p> <p>Tighten or seal probe.</p> <p>Straighten out tubing.</p> <p>Fix or replace the respirator.</p>
Suspiciously High Fit Factors	Twin Tube Assembly is kinked, pinched, or blocked.	Use the Real-time Fit Factor function to verify the fit factor.
Refer to <a href="#">Suspiciously High Fit Factors</a> section.		Straighten out the Twin Tube Assembly or remove the obstruction.

Symptom	Possible Causes	Solution
Particle count is zero or near zero	Alcohol level is low.	Replenish alcohol.
	Sampling through HEPA Filter. Twin Tube Assembly is blocked. Moisture build-up in Alcohol Wick.  Inferior or contaminated alcohol.  PORTACOUNT® PRO fit tester is flooded with alcohol. Filter cover leaking. Plugged nozzle.	Remove filter. Remove the blockage. Change Alcohol Wick inside Alcohol Cartridge. Run 2 hours to dry optics (remove the alcohol cartridge and install storage cap). Change Alcohol Wick inside the Alcohol Cartridge. Use only approved alcohol. Run 2 hours to dry optics (remove Alcohol Cartridge and install Storage Cap). Replace cover and O-ring. See <a href="#">Nozzle Cleaning</a> in
		Service and Maintenance chapter.
Requires frequent refill of alcohol (every hour or less)	Moisture build-up inside Alcohol Wick.	Change Alcohol Wick inside cartridge. Run 2 hours to dry optics (remove the alcohol cartridge and install storage cap) Use only approved alcohol.
Alcohol visible in Twin Tube Assembly or coming out of Exhaust Port	PORTACOUNT® PRO fit tester is flooded with alcohol.	Run overnight to dry optics (remove Alcohol Cartridge and install storage cap).

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(Specifications are subject to change.)

**Model 8030 PORTACOUNT® PRO Respirator Fit Tester**

**Size** ..... 9.5 x 8.5 x 6.75 in.  
(24 x 22 x 17 cm)

**Weight**

Unit only.....5.0 lb. (2.7 kg)  
With standard accessories and case 16 lb. (7.3 kg)

**Fit Factor Range** ..... 1 to greater than 10,000

**Concentration Range** ..... 0.01 to  $2.5 \times 10^5$   
particles/cm<sup>3</sup>

**Particle Size Range** ..... 0.02 to greater than  
1 micrometer

**Typical Fit Factor Accuracy** ..... 10% of reading up to fit  
factors of 10,000

**Temperature Range**

Operation..... 32 to 100°F (0 to 35°C)  
Storage..... -40 to 160°F (-40 to 70°C)

**Flow Rate**

Sample ..... 350 cm<sup>3</sup>/min  
Total..... 1000 cm<sup>3</sup>/min (nominal)

**Power Requirements** ..... 100 to 250 VAC, 50 to 60 Hz

**Alcohol**

Hours per charge..... 6 hours at 70°F (21°C)  
Alcohol type ..... Reagent grade isopropyl  
(99.5% or better)

**Carrying Case**

Size..... 19.5 x 13.7 x 9 in.  
(49.5 x 34.8 x 23 cm)

**Pass/Fail Settings** ..... User-selectable: 0 to 10000

**Factory Recalibration Interval** ..... 1 year

**Warranty** ..... Two years on workmanship  
and materials

**Respirator Facepieces that can be Fit Tested**

- Full-face elastomeric
- Half-face elastomeric
- NIOSH series-100 filtering-facepiece
- NIOSH series-99 filtering-facepiece
- NIOSH series-95 filtering-facepiece (8038 upgrade required for series-95 only)

**Fit Factor Measurement**

Direct measurement of fit factor ( $C_{out}/C_{in}$ )  
(Mask leakage is measured simultaneously while test subject moves and breathes.)

**Model 8038 PORTACOUNT® PRO+ Respirator Fit Tester**

**Size**..... 9.5 x 8.5 x 6.75 in.  
(24 x 22 x 17 cm)

**Weight**

Unit only..... 6.8 lb. (3.1 kg)  
With standard accessories and case 18 lb. (8.2 kg)

**Fit Factor Range**..... 1 to greater than 10,000;  
1 to 200 for < 99% efficiency masks

**Concentration Range** .....0.01 to  $2.5 \times 10^5$   
particles/cm<sup>3</sup>

**Particle Size Range**.....0.02 to greater than  
1 micrometer

**Typical Fit Factor Accuracy** ..... ±10% of reading up to fit  
factors of 10,000

**Temperature Range**

Operation..... 32 to 100°F (0 to 35°C)  
Storage..... -40 to 160°F (-40 to 70°C)

**Flow Rate**

Sample ..... 350 cm<sup>3</sup>/min  
Total..... 1000 cm<sup>3</sup>/min (nominal)

**Power Requirements** .....Autosensing 100 to 250  
VAC, 50 to 60 Hz

**Alcohol**

Hours per charge .....6 hours at 70°F (21°C)  
Alcohol type ..... Reagent grade isopropyl  
(99.5% or better)

**Carrying Case**

Size .....19.5 x 13.7 x 9 in.  
(49.5 x 34.8 x 23 cm)

**Pass/Fail Settings** ..... User-selectable: 0 to 10000

**Factory Recalibration Interval** .....1 year

**Warranty** .....Two years on workmanship  
and materials

**Respirator Facepieces that can be Fit Tested**

Full-face elastomeric  
Half-face elastomeric  
NIOSH series-100 filtering-facepiece  
NIOSH series-99 filtering-facepiece  
NIOSH series-95 filtering-facepiece

**Fit Factor Measurement**

Direct measurement of fit factor ( $C_{out}/C_{in}$ )  
(Mask leakage is measured simultaneously while test subject moves and  
breathes.)

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### How the PORTACOUNT® PRO Respirator Fit Tester Works

The PORTACOUNT® PRO fit tester measures respirator fit by comparing the concentration of microscopic particles outside the respirator to the concentration of particles that have leaked into the respirator. The ratio of these two concentrations is called a fit factor. A fit factor of 100 means that the air inside the respirator is 100 times as clean as the air outside.

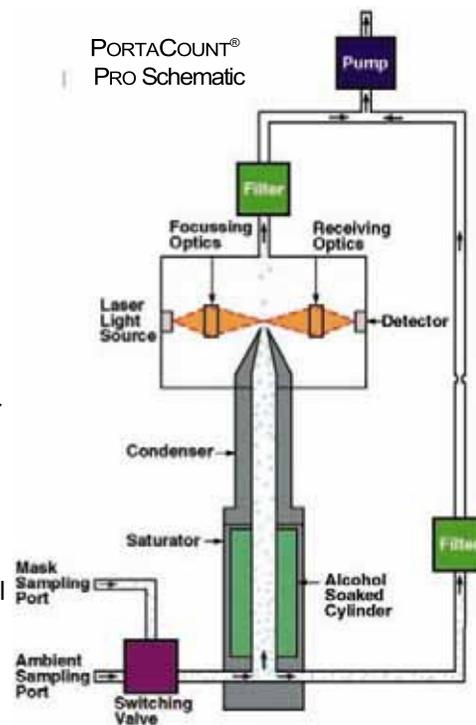
$$\text{Fit Factor} = \frac{\text{Outside Concentration}}{\text{Inside Concentration}}$$

Since the microscopic particles in the air cannot pass through the class-100 or class-99 filters used on the respirator, any particles that get into the respirator must have come in through a leak.

The PORTACOUNT® PRO fit tester has two sample tubes, one samples ambient air and the other attaches to the respirator and samples from inside it. A valve inside the PORTACOUNT® PRO fit tester switches from one tube to the other according to a programmed sequence.

#### How the PORTACOUNT® PRO Fit Tester Counts Particles

The PORTACOUNT® PRO fit tester is based on a miniature, continuous-flow Condensation Nucleus Counter (CNC), also known as a Condensation Particle Counter (CPC). A CNC takes particles that are too small to be easily detected, grows them to a larger, easily detectable size, and then counts them.



The idea of CNCs/CPCs is not new. As early as 1888, Aitken described a dust counter that grew particles to detect them. In 1943 the Nolan-Pollack photoelectric CNC was described. In the 1950s and 1960s, commercial, automatic CNCs were available. However, none were of the continuous-flow type, and the PORTACOUNT Respirator Fit Tester is the first highly portable continuous-flow CNC.

The concept of using a condensation nucleus counter (CNC) for the purpose of quantitative respirator fit testing was first demonstrated in 1981 by Dr. Klaus Willeke of the University of Cincinnati.

Reference: Willeke, K., H.E. Ayer, J.D. Blanchard. "New Methods For Quantitative Respirator Fit Testing With Aerosols," *American Industrial Hygiene Association Journal*, Feb. (1981).

The PORTACOUNT® PRO Respirator Fit Tester grows submicron particles to supermicron alcohol droplets and then measures the concentration of the alcohol droplets. This makes the PORTACOUNT® PRO fit tester sensitive to particles with diameters as small as 0.015 microns, but insensitive to variations in particle size, shape, composition, and refractive index. Thus, quantitative fit testing can be performed with virtually any aerosol, including ambient air.

Aerosol is drawn through the instrument by a diaphragm vacuum pump operating at a flow rate of 1.0 liter per minute. The flow enters the instrument through either the ambient port or the sample port. The switching valve determines which port is used. The outlet of the switching valve leads to the saturator end cap, where the flow splits. A flow rate of 0.35 liters per minute enters the saturator and passes through the condenser, nozzle, and sensing volume. The remaining flow passes through the excess airline and is recombined with the sampled flow down-stream of the sensing volume.

The PORTACOUNT® PRO sensor consists of a saturator, condenser, and optical elements. The saturator is lined with an alcohol-soaked wick. A thermoelectric device is mounted between the saturator and condenser which cools the condenser and heats the saturator. After passing through the saturator, the aerosol (now saturated with alcohol vapor) enters the condenser tube. The alcohol vapor condenses on the particles, causing them to grow into droplets. The droplets then pass through the nozzle and into the sensing volume as depicted in the schematic diagram below.

The focusing optics in the sensor consists of a laser diode and a series of lenses that focus the laser light into a sensing volume just above the nozzle. Each particle passing through the sensing volume scatters light. The light is collected by the receiving optics and focused onto a photodetector. The photodetector generates an electrical pulse from the scattered light as each droplet passes through the sensing volume. The particle count is determined by counting the number of pulses generated during a given time period. Knowing the particle count, time period and flow rate allows particle concentration to be computed.

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Fit factor is defined as the particle concentration outside the respirator divided by the particle concentration inside the respirator.

Because ambient concentration can vary over time, the PORTACOUNT® PRO Respirator Fit Tester calculates the fit factor by taking the average of the ambient concentrations measured before and after the respirator sample and then dividing by the concentration measured in the respirator. This is why the first test cycle (exercise) is longer than additional test cycles in Fit Test Mode. It is necessary to measure the required additional ambient concentration sample before the first fit factor can be calculated.

Both the ambient and respirator concentrations are determined by integration. The integrated concentrations are determined by the total number of particles counted during the sample periods.

Fit factor is actually calculated by:

$$FF = \frac{CB + CA}{2CR}$$

where:  $FF$  = fit factor

$CB$  = particle concentration in the ambient sample before the respirator sample

$CA$  = particle concentration in the ambient sample after the respirator sample

$CR$  = particle concentration in the respirator sample.

If no particles are counted in the respirator sample, the PORTACOUNT® PRO fit tester automatically adds one particle. This prevents dividing the ambient concentration by zero. At the end of a fit test, the overall fit factor is calculated and displayed, based on the individual fit factors for each test cycle.

The following equation is used to calculate the overall fit factor in the PORTACOUNT® PRO fit tester:

$$\text{Overall } FF = \frac{1}{\frac{1}{FF_1} + \frac{1}{FF_2} + \frac{1}{FF_3} + \dots + \frac{1}{FF_{n-1}} + \frac{1}{FF_n}}$$

where:  $FF_x$  = fit factor for test cycle  
 $n$  = number of test cycles (exercises).

**Disclaimer:** The measurement provided by the PORTACOUNT® PRO Respirator Fit Tester is an assessment of respirator fit during a fit test only. Respirator fit at other times will vary. The fit factor value is not intended for use in calculating an individual's actual exposure to hazardous substances.

## Calculating Particle Concentration

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Particle concentration is calculated by counting the number of particles passing through the sensor in a given period of time. Since the flow rate is known (5.83 cm<sup>3</sup>/sec), the particle concentration can be determined.

In 1-Second Count Mode the equation is:

$$N_1 \text{ Particle Concentration} = \frac{\text{Number of Particles}}{(1 \text{ sec}) \times 5.83 \text{ cm}^3/\text{sec}}$$

where  $N_1$  is the number of particles counted in a 1-second period. Note that the total flow rate of air through the PORTACOUNT<sup>®</sup> PRO is a nominal 16.7 cm<sup>3</sup>/sec. The reason that we use 5.83 cm<sup>3</sup>/sec. in the

calculations above is because the flow path inside the PORTACOUNT<sup>®</sup> PRO is divided into two branches, the sensor flow and the bypass flow. The sensor flow is set at **precisely** 5.83 cm<sup>3</sup>/sec and the bypass flow is **approximately** 10.8 cm<sup>3</sup>/sec.

Using the equation above, you can see that the minimum measurable concentration is 0.17 particles per cm<sup>3</sup> in 1-Second Count Mode.

The equations above can also be used to determine the minimum measurable mask concentration that can be measured in Fit Test Mode given the mask sample time that is used. For example, with a 40 second mask sample (factory setting), the minimum measurable concentration is 0.004 particles per cm<sup>3</sup>.

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## Timing in Fit Test Mode

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### Test Sequence

When performing a fit test, PORTACOUNT® PRO Respirator Fit Tester automatically samples both the ambient air and the particles inside the respirator. An internal switching valve automatically switches between the two sampling ports. In each test cycle, (exercise) both an ambient sample and a respirator sample are taken. Also, time is allowed for purging of the sensor between each of the samples.

The PORTACOUNT® PRO fit tester uses the ambient sample taken before and after each exercise to compute the fit factor. The two ambient particle concentrations are averaged together and then divided by the mask particle concentration to yield the fit factor for that exercise. Averaging the before and after ambient particle concentrations is done to offset any ambient particle concentration drift that may have occurred during the mask sample.



### Caution

Do **not** lengthen the Twin Tube Assembly more than a few inches unless the mask sample purge time has also been extended accordingly. Insufficient purging between mask and ambient samples will result in unrealistically low fit factors. Shortening the Twin Tube Assembly is n e v e r a p r o b l e m .

## Appendix G

### **Using the PORTACOUNT® PRO Respirator Fit Tester to Fit Test Positive Pressure Respirators**

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On January 8, 1998, OSHA released the long-awaited revision to the Respiratory Protection Standard 29CFR1910.134. It replaces the standard with the same name and number that was released in 1971. This new revision has far reaching impact on a large number of existing OSHA standards in that it replaces certain provisions related to respirator use.

One of the new requirements is that OSHA now requires all tightfitting respirator facepieces to be fit tested annually. This includes air-supplied and positive-pressure respirators such as Powered Air Purifying Respirators (PAPR), airline respirators, and Self Contained Breathing Apparatus (SCBA). With few exceptions, these respirator styles were previously exempted from OSHA's fit testing requirements. For detailed information regarding the new standard and to download your own copy, see TSI Application Note ITI-056 Respirator Fit Testing Highlights for OSHA Respiratory Protection Standard 29CFR1910.134 on our website <http://fittest.tsi.com>.

Self Contained Breathing Apparatus (SCBA) are respirators that supply breathing air from a backpack mounted tank. The most common application for SCBA is fire fighting. There are other types of positive-pressure respirators also, including air-line and recirculating respirators.

Powered Air Purifying Respirators (PAPRs) are a special class of respirator that utilizes a battery operated blower motor to pump air into the mask through an air-purifying cartridge. The blower/filter assembly is usually either belt mounted or fastened to the front of the facepiece.

The OSHA fit testing requirement is only for tight-fitting masks. Tight fitting respirators utilize a facepiece similar to the facepiece on a conventional negative-pressure air-purifying respirator with filter cartridges. In fact, many respirator manufacturers use the identical facepiece for negative and positive-pressure respirators. Tight-fitting masks form a tight seal around the wearer's face.

Loose fitting respirators usually employ a hood that fits over a person's head and loosely seals around the neck. The quality of the seal is not dependent on a close physical match with the wearer's body. Since there is no "seal" to test, there is no requirement to do a fit test. Note that some hood-type respirators are classified as tightfitting and, therefore, require fit testing.

Respirator fit testing (testing facepiece leakage) cannot be done while the pressure inside the facepiece is maintained positive by some outside air supply. The positive-pressure will alter the seal and the measurement will not reflect how well the shape of the facepiece matches the person's face. For this reason, all fit testing of positive-pressure respirators must be done in negative-pressure mode, or in other words, without a forced air supply. Any tests done in positive pressure mode are overall performance tests, not fit tests. Hood-style respirators can be performance tested but not fit tested because there is no face seal to test.

There are two ways to accomplish fit testing positive-pressure masks in negative-pressure mode. The method preferred by many is to temporarily convert the employee's assigned mask into a negative-pressure mask. This is accomplished through the use of special fit test adapters that temporarily attach to the mask and allow the use of filter cartridges. Added benefits of this method are that an integrity test of the mask is performed simultaneously with the fit test and also, the hygienic concerns associated with sharing a test mask are greatly reduced. Fit Test Adapters are available from the respective respirator manufacturer and from TSI for many popular respirators.

When an adapter is not available, the only alternative is to use a surrogate mask or test mask. This involves purchasing a negative-pressure air-purifying mask that has the same sealing surfaces as the positive-pressure mask that will actually be used for respiratory protection. For quantitative fit testing, the mask will need a sampling port so that a sample can be drawn from the breathing zone. Most respirator manufacturers have these available. If the mask comes in multiple sizes, you will need at least one test mask in each size. Using this technique, fit testing for positive-pressure respirators becomes identical to fit testing for negative-pressure respirators.

For those people who wish to conduct performance tests on positive-pressure respirators using a PORTACOUNT® fit tester, there are a few special precautions. The primary concern is aerosol particulates in the air supply. The PORTACOUNT® fit tester will measure these

particles as leakage and report performance factors (fit factors) that are significantly lower than actual. Most PAPRs have a blower motor on the clean side of the filter. Most of these motors generate small particles that the PORTACOUNT® fit tester can easily measure. Likewise, air from SCBA tanks, and from compressors, contains significant numbers of particles. Grade D breathing air is by no means particle free. The only way to overcome this problem is to pass the air through a HEPA filter just before it reaches the facepiece. There is no OSHA requirement to do this type of performance testing.

Related information located on the TSI Web site: <http://fittest.tsi.com>:

- TSI Application Note ITI-070, Introduction to Respirator Fit Testing
- TSI Application Note ITI-029, What You Need to Quantitatively Fit Test Various Brands of Self-Contained Breathing Apparatus Available in the USA
- Fit test adapter list
- TSI Application Note ITI-056, Respirator Fit Testing Highlights for OSHA Respiratory Protection Standard 29CFR1910.134.

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## The Rainbow Passage

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**W**hen 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 his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

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