
Respiratory Protection Program

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I. INTRODUCTION

The Respiratory Protection Program Manual has been developed by the University's Loss Control Committee to establish basic procedures and provide guidelines for the implementation of the Respiratory Protection Program at the University of North Dakota.

Each department is encouraged to develop additional procedures applicable to their specific operations and to correlate them with the requirements of this manual. Additions should be approved by the Respiratory Protection Program Administrator (RPPA).

The Occupational Safety and Environmental Health Office (OSEH) has overall responsibility for the administration of the University's Respiratory Protection Program. OSEH is available to provide assistance to all departments that may use the Respiratory Protection Program.

II. PURPOSE

The University's Respiratory Protection Program is designed to:

- A. Provide acceptable employee protection against inhalation of respirable dusts, toxins, vapors, fumes, mists, and radioactive air contaminants and oxygen deficiency when engineering controls are not adequate, feasible, or applicable.
- B. Prevent employee overexposure to hazardous substances or atmospheres that may adversely affect an employee's health or safety.
- C. Establish procedures for respirator selection, maintenance, and inspection.

III. POLICY

It is the University's policy to provide its employees with a safe and healthful working environment. This is accomplished as much as practical with acceptable engineering and administrative controls. However, when these methods are not feasible or adequate, respiratory protection will be provided to authorize employees to reduce exposure to a level below the permissible exposure limit established by regulatory and/or professional organizations. Additionally, as required or requested, the University determines what applications, processes, and/or operations require the use of respiratory protection equipment.

IV. REFERENCES

- A. American National Standards Institute, New York. Standards:
 - Practices for Respiratory Protection, Z88.2-1992, 1992
 - Physical Qualifications for Personnel, Z88.6-1984, 1984
- B. National Institute for Occupational Safety and Health (NIOSH). A Guide to Respiratory Protection of the Asbestos Abatement Industry, EPA-560-OPTS-86-001. Cincinnati: NIOSH
- C. National Safety Council. Fundamentals of Industrial Hygiene, 3rd ed. 1988. Chicago: National Safety Council
- D. Occupational Safety and Health Administration. Washington D.C.: U.S. Government Printing Office

- 29 CFR 1910.134, Respiratory Protection
- 29 CFR 1910.139, Respiratory Protection for M. Tuberculosis
- 29 CFR 1910.1025, Medical Surveillance Guidelines
- 29 CFR 1910.1001, Asbestos
- 29 CFR 1926.62, Lead
- 29 CFR 1926.1101, Asbestos
- Instruction CPL 2-2.54, Respiratory Protection Program Manual

V. DEFINITIONS

- A. **Air-Purifying Respirator:** A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.
- B. **Atmosphere-Supplying Respirator:** A respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.
- C. **Canister or Cartridge:** A container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.
- D. **Demand Respirator:** An atmosphere-supplying respirator that admits breathing air to the face piece only when a negative pressure is created inside the face piece by inhalation.
- E. **Emergency Situation:** Any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.
- F. **Employee Exposure:** Exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.
- G. **End-of-Service-Life Indicator:** A system that warns the respirator user of the approach of the end of adequate respirator protection, for example, that the sorbent is approaching saturation or is no longer effective.
- H. **Filter or Air-Purifying Element:** A component used in a respirator to remove solid or liquid aerosols from the inspired air.
- I. **Filtering Face Piece (dust mask):** A negative-pressure particulate respirator with a filter as an integral part of the face piece or with the entire face piece composed of the filtering medium.
- J. **High-Efficiency Particulate Air (HEPA) Filter:** A filter that is at least 99.7% 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.
- K. **Immediately Dangerous to Life or Health (IDLH):** Any atmosphere that poses an immediate hazard to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from dangerous atmospheres.
- L. **Loose-Fitting Face Piece:** A respirator face piece that is designed to form a partial seal with the face.
- M. **Negative Pressure Respirator (tight-fitting):** A respirator in which the air pressure inside the face piece is negative during inhalation with respect to the ambient air pressure outside the respirator.
- N. **Oxygen-Deficient Atmosphere:** An atmosphere with oxygen content below 19.5% by volume.

- O. **Permissible Exposure Limit (PEL):** The legally (by the Occupational Safety and Health Administration) established time-weighted average (TWA) concentration or ceiling concentration of a contaminant that shall not be exceeded.
- P. **Poor Warning Properties:** A substance whose odor, taste, or irritation effects are not detectable or not persistent at concentrations at or below the exposure limit.
- Q. **Positive-Pressure Respirator:** A respirator in which the pressure inside the face piece exceeds the ambient air pressure outside the respirator.
- R. **Powered Air-Purifying Respirator (PAPR):** An air-purifying respirator that uses a blower to move air through air-purifying elements to the respirator face piece.
- S. **Pressure Demand Respirator:** A positive-pressure atmosphere-supplying respirator that admits breathing air to the face piece when the positive pressure is reduced inside the face piece by inhalation.
- T. **Required Use:** Refers to situations in which supervisors, the Respiratory Protection Program Administrator, or other designated individual have made the determination that respirator use is a necessary element for job completion.
- U. **Self-Contained Breathing Apparatus:** An atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user. This respirator may be used in atmospheres immediately dangerous to life or health.
- V. **Supplied-Air Respirator or Air Line Respirator:** An atmosphere-supplying respirator for which for source of breathing air is not designed to be carried by the user.
- W. **Tight-Fitting Face Piece:** A respirator face piece that is designed to form a complete seal to the user's face.
- X. **Time-Weighted Average:** The average concentration of a contaminant in air during a specific time period.
- Y. **User Seal Check:** An action conducted by the respirator user to determine if the respirator is properly seated to the face.
- Z. **Vapor:** The gaseous phase of matter that normally exists in a liquid or solid state at room temperature.

VI. RESPONSIBILITIES

- A. **Supervisory:** Supervisors are responsible for ensuring that personnel within their purview are knowledgeable of the respiratory protection required for the area/operation where the work is taking place. They are also responsible for ensuring that their employees are informed that they must comply with all facets of this respiratory program, including equipment inspection and maintenance. Any questions regarding compliance may be directed to the Respiratory Program Administrator.
- B. **Employees:** It is the responsibility of all employees to have an awareness of the respiratory protection requirements for their work areas. Employees are also responsible for wearing the appropriate respiratory equipment according to proper instructions and for maintaining the equipment in a clean and operable condition. An employee's failure to follow the policies and procedures pertaining to respirator use could lead to disciplinary action, up to and including termination.

VII. WORK AREA MONITORING

Monitoring is conducted to provide for a continuing healthful environment for university employees and to assure the adequacy of the respiratory protection program. When sampling equipment is used, acceptable industrial hygiene standards will be followed.

VIII. RESPIRATOR SELECTION

A. General requirements:

1. The use of privately owned respirators is forbidden for tasks requiring the use of respirators. The use of privately owned respirators is permissible in voluntary use situations provided the employee supply documentation pertaining to proper medical surveillance, training and fit testing for the respirator to be used.
2. Employees who wear a filtering-face piece respirator on a voluntary basis are to be provided the information contained in Appendix G, Information for Employees Using Respirators When Not Required.
3. The basic purpose of any respirator is to protect the respiratory system from inhalation of hazardous atmospheres. Respirators provide protection either by removing contaminants from the air before they are inhaled or by supplying an independent source of respirable air. Respirators are to be selected based on the potential exposure that the worker may face. Important additional information on the selection of the proper respirator is provided in Appendix A and should be consulted.
4. Respirators used by university employees must be NIOSH-certified and used following the conditions of the certification as described by the manufacturer. All manufacturers' use criteria are to be followed by the user.
5. Respirators will be selected from a sufficient number of respirator models and sizes so that the respirator correctly fits the user.

B. Respirators for IDLH atmospheres:

1. Respirators approved for IDLH atmospheres are (except for emergency escape):
 - a. A full-face piece pressure-demand SCBA certified by NIOSH for a minimum service life of 30 minutes.
 - b. A combination full-face piece pressure-demand SAR with auxiliary self-contained air supply.
2. Respirators provided only for escape from IDLH atmospheres must be NIOSH-certified for escape from the atmosphere in which they will be used.
3. All oxygen-deficient atmospheres are considered IDLH atmospheres.

C. Respirators for atmospheres that are not IDLH:

Provide employees with a respirator that is adequate to protect the health of the employee and is certified for the intended use. Consult Appendix A for additional information on respirator selection.

Table I	
Altitude, feet	Oxygen Deficient Atmospheres (% O₂) for which the Employer May Rely on Atmosphere-Supplying Respirators
Less than 3001	16.0 - 19.5
3001 - 4000	16.4 - 19.5
4001 - 5000	17.7 - 19.5
5001 - 6000	17.8 - 19.5
6001 - 7000	18.5 - 19.5
7001 - 8000	19.3 - 19.5
8001 - 14,000	Exception does not apply
Above 14,000	Oxygen-enriched breathing air must be supplied

IX. MEDICAL SURVEILLANCE

- A. All employees who wear a respirator must participate in the University's Medical Surveillance Program. As part of the program, employees must be medically evaluated to determine their ability to wear a respirator. This medical evaluation is performed by the university's designated licensed health care professional. All medical evaluation results are kept on file in the OSEH office.
- B. The frequency of an employee's medical evaluation will be based on the criteria associated with the employee's exposure. For details consult the Medical Surveillance Program.
- C. When an employee is removed from the respiratory protection program, medical surveillance may be discontinued.

X. FIT TESTING

- A. Employees wearing a tight-fitting face piece respirator must be fit tested when the respirator is initially selected for use and periodically afterwards. Fit testing is done by the RPPA or designated representative and must be completed as required by the type of hazard.
- B. The fit test protocol used by the University is contained in Appendix F.
- C. Considerations for proper fit:

1. Facial hair: An employee who has hair (stubble, moustache, sideburns, beard, low hairline, or bangs) which passes between the face and the sealing surface of a tight-fitting face piece will not be permitted to wear a respirator. Additionally, any person who has hair (moustache, beard) which interferes with the functions of the respirator valve(s) will not be permitted to wear a respirator.
2. Glasses and eye/face protective devices: If a spectacle, goggle, face shield, or welding helmet must be worn with a respirator, the eye protection must be worn so that the respirator seal is not adversely affected. A spectacle that has temple bars or straps which pass between the sealing surface of a respirator face piece and the wearer's face is not allowed to be worn. When a full-face respirator is used, special prescription glasses are available if needed.

XI. USER SEAL CHECKS

- A. When using a tight-fitting respirator, the wearer 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 below or the respirator manufacturer's recommended user seal check method must be used. User seal checks are not substitutes for fit testing.
1. Positive-pressure seal check: 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 build up inside the face piece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.
 2. Negative-pressure seal check: Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the face piece collapses slightly, and hold the breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the face piece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.
 3. Manufacturer's recommended seal check: The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures, provided that the manufacturer's procedures are equally effective as the checks listed above.
- B. If the respirator fails to pass these checks, the fit is not acceptable. Try adjusting the respirator or adjusting the head straps and then repeating the checks. If the respirator continues to fail the checks, the RPPA or designated representative must be contacted before proceeding further.

XII. RESPIRATOR USAGE

- A. When there is a change in the work area conditions, the level of exposure, or the degree of physical burden, the effectiveness of the selected respirator must be reevaluated.

B. Employees must leave a respirator use area:

1. To wash their faces and respirator face pieces as necessary to prevent eye or skin irritation associated with respirator use.
2. If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the face piece.
3. To replace the respirator or the filter, cartridge, or canister elements.

C. Procedure for IDLH atmospheres

1. At least one other employee must be located outside of the IDLH atmosphere.
2. Visual, voice, or signal line communication must be maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere.
3. The employee(s) located outside the IDLH atmosphere must have been trained and equipped to provide effective emergency non-entry rescue.
4. The employee(s) outside the IDLH atmosphere must have the capability to summon rescue personnel in the event of an emergency.

XIII. CLEANING, INSPECTION, MAINTENANCE, AND STORAGE

A. Cleaning and disinfecting

1. Whenever possible, a respirator should be issued to a single employee. When a respirator is worn by more than one employee, the respirator must be cleaned and disinfected between each use.
2. The following procedure can be used for cleaning and disinfecting tight-fitting face piece respirators:
 - a. Wash with a mild detergent or a detergent/disinfectant combination, in warm water (110 F maximum) using a soft brush.
 - b. Rinse in clean, warm water (or rinse once with a disinfectant and once with clean water). The clean water rinse is particularly important because traces of detergent or disinfectant left on the mask can cause skin irritation and/or damage respirator components.
 - c. Hand-dry with a clean, lint-free cloth or air dry the respirator. If air drying is used, position the respirator in a position that is natural to the face piece and will not distort the respirator. Respirators are not to be hung in lockers for drying or storage. If an electric dryer is used for drying, keep the respirator at least 2 feet from the dryer to avoid a temperature in excess of 120 F.

B. Inspection

1. The wearer of a respirator must inspect it before each use and during the cleaning process following the manufacturer's criteria. At a minimum, the portion of the checklist provided in Appendix C that applies should be followed.
2. Supervisors should periodically spot check respirators for fit, usage, and condition.

C. Maintenance

1. Continued use of respiratory equipment may require periodic repair or replacement of component parts of the equipment. Such repairs and parts' replacement must be completed following the manufacturer's instructions and by trained personnel.
2. Substitution of parts from a different brand/type of respirator is strictly forbidden.

D. Storage

1. Store respirators in a convenient, clean, and sanitary location.
2. Care must be taken to ensure respirators are properly stored and protected from dust, harmful chemicals, sunlight, excessive heat or cold, moisture, and mechanical damage.
3. Store respirators in plastic bags which can be sealed, or in containers with tight-fitting lids. Respirators must be thoroughly dried before being sealed in any container.
4. Pack or store a respirator so that the face piece and valves rest in the normal position. Do not hang respirators by their straps.

XIV. EMERGENCY EQUIPMENT

- A. Various respiratory protection equipment may be prepositioned in specific areas and designated for emergency use. Such positioned equipment shall be used only by specifically trained employees.
- B. Test the equipment in an uncontaminated atmosphere before entering the hazardous area.
- C. Do not work with this equipment in a hazardous atmosphere alone. At least one additional person suitably equipped with a similar breathing apparatus must be in contact with the first person and must be available to render assistance if necessary.
- D. This equipment must be inspected at least monthly by trained personnel.

XV. TRAINING

- A. Employees will be provided training on the use, care, and maintenance of respiratory protection equipment prior to requiring an employee to use a respirator. Employees who voluntarily use a filtering face piece must be provided with the information contained in Appendix G.
- B. Training provided will include but is not limited to:
 1. Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator.
 2. What the limitations and capabilities of the respirator are.
 3. How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions.
 4. How to inspect, don and remove, use, and check the seals of the respirator.
 5. What the procedures are for maintenance and storage of the respirator.
 6. How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators.
 7. The general requirements of the University's Respiratory Protection Manual.

C. Refresher training is provided at the annual fit testing or when one of the following situations occurs:

1. Changes in the workplace or the type of respirator may render previous training obsolete.
2. Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the level of understanding or skill required.
3. Any other situation arises in which retaining appears necessary to ensure safe respirator use is maintained.

XVI. PROGRAM EVALUATION

- A. Regular evaluations (at least annually) of the Respiratory Protection Program will be completed by the Respiratory Program Administrator or designated representative. Individuals will be observed in the work environment to determine whether respirators are being properly selected, used, and maintained.
- B. Problems will be solved by the selection of alternate equipment, additional training, or other appropriate means.
- C. Training will be evaluated (at least annually) to determine if employees are receiving knowledge and/or skills adequate for the program. This evaluation will be conducted randomly, choosing employees to demonstrate proper procedures regarding the program. Recommend approval.

Summary of Changes:

Changes in 29 CFR 1910.134 necessitated major changes in the University's Respiratory Protection Program. Therefore, this manual has been totally rewritten to comply with current regulatory requirements.

Appendix A: Respirator Selection

I. Respirator Selection Criteria Based on Type of Respirator

A. Air-purifying respirators: Ambient air, before being inhaled, is passed through a filter, cartridge, or canister which removes contaminants. Different filters are required to remove different contaminants.

1. Non-powered air-purifying respirator: The breathing action of the wearer operates the non-powered type of respirator. Equipped with a tight-fitting face piece and filter(s), the respirator is secured to the face by means of a strap or harness. The wearer draws air through the filters during inhalation. The half-mask and full-face piece respirators provide greater protection than the dust mask because their design allows for a better fit. These respirators provide protection against dusts, mists, fumes, vapors, gases, or any combination of these contaminants, depending on the type of filter used. The full-face piece respirator provides the greatest degree of protection and protects the eyes as well. Many different filter elements are available. Vapor cartridges should be changed when odors "break through" and are noticeable inside the mask. Some chemicals, such as mercury, have no odor and require a special filter that has an end-of-service-life indicator that must be visible to the wearer or to another worker at all times. Choosing the right filter or combination of filters for a given job is important.
2. Powered air-purifying respirator (PAPR): The powered type contains a portable blower that moves ambient air through a filter and then supplies purified air to the wearer. The powered type is equipped with a tight-fitting face piece or a loose-fitting helmet, hood, or suit.

B. Atmosphere-supplying respirators: A respirable atmosphere, independent of the surrounding air, is supplied to the wearer. Atmosphere-supplying respirators provide a greater level of protection than air-purifying respirators because they do not rely on a filtering mechanism to provide clean air.

1. Self-contained breathing apparatus (SCBA): A supply of air, oxygen, or oxygen-generating material is carried by the wearer. Normally equipped with a full face piece, but may be equipped with a half-mask face piece, helmet, hood, or mouthpiece and nose clamp.
2. Supplied-air or air-line respirator: Respirable air is supplied through a small-diameter hose from a compressor or compressed air cylinder. The hose is attached to the wearer by a belt and can be detached rapidly in an emergency. A flow-control valve or orifice is provided to govern the rate of air flow to the wearer. Exhaled air passes to the ambient atmosphere through a valve or opening in the enclosure (face piece, helmet, hood, or suit). Air-line system couplings must be incompatible with non-respirable work site air or other gas systems.
3. Breathing air quality: Compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration shall be of high purity. Oxygen must meet the requirements of the United States Pharmacopoeia for medical or breathing oxygen. Breathing air must meet at least the requirements of the specification for Grade D breathing air as described in

Compressed Gas Association Commodity Specification G-7.1-1966. Compressors shall be constructed and situated to avoid entry of contaminated air into the system and suitable in-line air-purifying sorbent beds and filters installed to further assure breathing air quality.

II. Respirator Selection Criteria Based on Potential Hazard

A. Respirators should be selected on the basis of the hazard(s) the employees will or could be exposed to and the guidance provided in American National Standards Institute (ANSI) Standard Z88.2-1992. Therefore, when selecting a respirator for a given circumstance, the following must be considered:

1. Oxygen deficiency:

- a. NIOSH approval for supplied-air and air-purifying respirators is valid only for atmospheres containing greater than 19.5% oxygen. If it is determined that an oxygen-deficient atmosphere may exist, then selection is limited to pressure demand SCBAs or pressure demand air-line respirators with escape provision. See exception in Section VII.B.3. of this manual.
- b. If oxygen deficiency is not an issue, then the contaminant and its concentration should be determined.

2. Physical properties of the hazard: Physical properties to be considered include:

- Physical state
- Particle size
- Molecular weight
- Vapor pressure

3. Chemical properties of the hazard: Chemical properties include:

- Solubility in water and other liquids
- Reactivity with other chemicals
- Hazardous decomposition products

4. Physiologic effects on the body: Determine the toxicological effects on the body in terms of:

- Eye irritation
- Skin absorption
- Adverse effects (if any) on olfactory sense

5. Actual Concentration of a Toxic Compound: If a measurement has been made, then this is extremely useful information because bounds are established for the degree of protection necessary. This should be used in conjunction with permissible exposure limits to select the correct respirator.

6. Permissible exposure limit (PEL): The permissible exposure limit (time-weighted average or ceiling limit) may be used to establish proper selection. The concentrations and PELs are compared to protection factors assigned to certain types of respirators.
7. Warning properties: If an air-purifying respirator is to be used for protection against gas or vapor contaminants, then there must (with limited exceptions) be suitable warning properties of contaminant breakthrough or respirator malfunction.
 - a. Adequate warning properties can be assumed when the odor, taste, or irritation effects of the substance are detectable and persistent at concentrations at or below the PEL.
 - b. If the odor or irritation threshold of a substance occurs at concentrations greater than three times the PEL, this substance should be considered to have poor warning properties.
 - c. If the odor or irritation threshold is somewhat above the PEL (but not in excess of three times the limit) and there is no ceiling limit, determine whether an undetected exposure in this concentration range could cause serious or irreversible health effects. If not, the substance is considered to have adequate warning properties. In such a situation, it is expected that environmental concentrations will vary considerably, and warning of respirator failure would, therefore, soon be perceived at contaminant concentrations somewhat above the PEL.
 - d. It is important to realize that NIOSH approvals for respirators generally do not apply to gases and vapors with poor warning properties except where the device is equipped with an end-of-service life indicator (e.g., carbon monoxide). However, Occupational Safety and Health Administration (OSHA) may permit such a use for specific gas or vapor where approved respirators are not available (e.g., vinyl chloride, acrylonitrile).

B. The nature of the hazardous operation is also a consideration in respirator selection. It is necessary to know the details of operations where respirators are required. These include:

1. Operation or process characteristics.
2. Work area characteristics.
3. Materials used or produced during the process.
4. Worker's duties and actions.
5. Abnormal situations which may necessitate different respirator selection; i.e., upset conditions or emergencies.

C. The length of time a respirator will have to be worn is a factor which must be evaluated. This is most pronounced in the use of a SCBA where the air supply is finite. However, time is also important during routine use when workers' acceptance and comfort are essential.

D. The respirator protection factor is one of the most important factors and indicates how much protection a respirator provides. To apply an assigned protection factor for a particular type of respirator, one must know both the actual contaminant concentration in the work area and the established time-weighted average concentration. Multiplying the time-weighted average concentration by the respirator protection factor gives the maximum concentration of the contaminant against which the respirator can be used. If the actual concentration is less than the calculated maximum use concentration, then the respirator may be used. Anything such as

facial hair or glasses that prevents proper face-to-face piece sealing nullifies application of a respirator protection factor. Appendix B lists respirator protection factors.

- E. It is the supervisor's responsibility to inform the Respiratory Protection Program Administrator or designated representative of monitoring needs and process changes that may require additional monitoring. Once it is determined that a respirator is needed, the Respiratory Protection Program Administrator or designated representative in conjunction with the principal investigator and the supervisor will select a type of respirator for that process.

Respirator Selection Chart	
Hazard	Respirator
Oxygen Deficiency	Any SCBA Air-line respirator with auxiliary SCBA or an auto-storage receiver with alarm. See exception in Section VII.B.3. of this manual.
Gas and/or Vapor	Immediately dangerous to life or health (IDLH): Positive-pressure SCBA Air-line respirator with auxiliary SCBA or an auto-storage receiver with alarm Air-purifying full-face piece respirator—escape only Not IDLH: Air-line respirator Hose mask with blower Air-purifying full-face, half-face, or mouth piece respirator with chemical cartridge
Particulate	IDLH: Any SCBA Air-line respirator with auxiliary SCBA or an auto-storage receiver with alarm Air-purifying full-face piece respirator with appropriate filter Not IDLH: Air-purifying, full-face, half-face, or mouth piece respirator with filter pad or cartridge Air-line respirator Air-line abrasive-blasting respirator SCBA
Combination Gas, Vapor, and Particulate	IDLH: Positive-pressure SCBA Air-line respirator with auxiliary SCBA or an auto-storage receiver with alarm Not IDLH: Air-purifying, full-face, half-face, or mouth piece respirator with chemical cartridge and appropriate filter Air-line respirator SCBA

Appendix B: Assigned Respirator Protection Factors

Type of Respirator	Respirator Style			
	Half - Mask ¹	Full- Face Piece		
Air purifying	10	100		
Atmosphere Supplying SCBA (demand) ² Air Line (demand)	10 10	100 100		
Powered Air Purifying	Respirator Style			
	Half - Mask	Full - Face	Helmet/Hood	Loose-fitting face piece
	50	1000 ³	1000 ³	25
Atmosphere Supplying Air Line Pressure Demand	50	1000	--	--
Continuous Flow	50	1000	1000	25
SCBA Pressure Demand Open/Closed Circuit	--	4	--	--

Notes:

¹ Includes quarter-mask, disposable half-mask, and half-masks with elastomeric face pieces.

² Demand SCBA shall not be used for emergency situations such as fire-fighting.

³ Protection factors listed are for high-efficiency filters and sorbents (cartridges and canisters). With dust filters, an assigned protection factor of 100 is to be used because of the limitations of the filter.

⁴ Although positive-pressure respirators are currently regarded as providing the highest level of respiratory protection, a limited number of recent simulated workplace studies concluded that all users may not achieve protection factors of 10,000. Based on this limited data, a definitive assigned protection factor could not be listed for positive-pressure SCBAs. For emergency planning purposes where hazardous concentrations can be estimated, an assigned protection factor of no higher than 10,000 should be used.

NOTE:

Assigned protection factors are not applicable for escape respirators. For combination respirators, e.g., air line respirators equipped with an air-purifying filter, the mode of operation in use will dictate the assigned protection factor applied.

Appendix C: Respirator Inspection Checklist

1. Inspection items for disposable respirators

- Holes in filter material
- Elasticity of straps
- Deterioration of straps and metal nose clip

2. Inspection items for air-purifying respirators

- Face piece for:
 - Excessive dirt
 - Cracks, tears, holes, or distortion from improper storage
 - Inflexibility (stretch and massage to restore flexibility)
 - Cracked or badly scratched lenses in full face pieces
 - Incorrectly mounted full-face piece lens or broken or missing mounting clips
 - Cracked or broken air-purifying element or holder(s), badly worn threads, or missing gasket(s) (if required)
- Head straps of the head harness for:
 - Breaks or tears
 - Loss of elasticity
 - Broken or malfunctioning buckles and attachments
 - Excessively worn serrations on the head harness which may permit slippage
- Inhalation and exhalation valves for:
 - Foreign material, such as detergent residue, dust particles, or human hair on valve or valve seat
 - Cracks, tears, or distortion in the valve material
 - Improper insertion of the valve body in the face piece
 - Cracks, breaks, or chips in the valve body, particularly the sealing surface
 - Missing or defective valve cover
 - Improper installation of the valve in the valve body
- Filter elements for:
 - Incorrect cartridge or filter for the hazard
 - Incorrect installation, loose connections, missing or worn gaskets, or cross threading in the holder
 - Expired shelf-life date on cartridge
 - Cracks or dents in outside case of filter or cartridge
 - Evidence of prior use of sorbent cartridge, indicated by absence of sealing material over inlet

- Breathing tube for:
 - Broken or missing end connectors
 - Missing or loose hose clamps
 - Deterioration, determined by stretching the tube and looking for cracks

3. Inspection items for atmosphere-supplying respirators

- Hood, helmet, blouse, or full suit for:
 - Ripped or torn seams
 - Headgear suspension
 - Cracks or breaks in face shield
 - Protective screens that are intact and fit correctly over face shields, hoods, or blouses
- Air supply systems for:
 - Breathing air quality
 - Breaks or kinks in air supply hoses and fittings
 - Tightness of connections
 - Settings of regulators and valves
 - Correct operations of air-purifying elements and alarm for carbon monoxide or high temperatures

Appendix D: Fit Test Information

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Fit Test Information May 1, 1998

NAME (FULL): _____ DATE: _____

RESPIRATOR, MAKE: _____ MODEL: _____

JOB DESCRIPTION: _____ RESPIRATOR #: _____

1. RESULTS

Isoamyl Acetate Irritant Smoke Other

Fit _____

No Fit _____

Comfort: Very comfortable _____ Comfortable _____ Tolerable _____

Uncomfortable _____ Very uncomfortable _____

Satisfactory positive-pressure test: yes _____ no _____

Satisfactory negative-pressure test: yes _____ no _____

2. LIMITATIONS: Beard _____ Denture _____ Glasses _____ None _____

Explain _____

3. TRAINING RECEIVED

Respirator selection and proper use _____ Fit test training _____

Proper cleaning training _____ Respirator inspection and care _____

4. COMMENTS:

Conducted By: _____ Date: _____

Employee Signature: _____ Date: _____

Appendix E: Classification of Respiratory Hazards According To Their Properties Which Influence Respirator Selection (taken from ANSI Z88.2-1992)

A. Gas and Vapor Contaminants

- 1) **Inert:** Substances that do not react with other substances under most conditions but create a respiratory hazard by displacing air and producing oxygen deficiency (for example: helium, neon, argon).
- 2) **Acidic:** Substances that are acids or that react with water to produce an acid. In water, they produce positively charged hydrogen ions(H⁺) and a pH of less than 7. They taste sour, and many are corrosive to tissues(for example: hydrogen chloride, sulfur dioxide, fluorine, nitrogen dioxide, acetic acid, carbon dioxide, hydrogen sulfide, and hydrogen cyanide).
- 3) **Alkaline:** Substances that are alkalies or that react with water to produce an alkali. In water, they result in the production of negatively charged hydroxyl ions (OH⁻) and a pH greater than 7. They taste bitter, and many are corrosive to tissues (for example: ammonia, amines, phosphine, arsine, and stibine).
- 4) **Organic:** The compounds of carbon. Examples are saturated hydrocarbons(methane, ethane, butane), unsaturated hydrocarbons(ethylene, acetylene), alcohols(methyl ether, ethyl ether), aldehydes(formaldehyde), ketones(methyl ketone), organic acids(formic acid, acetic acid), halides(chloroform, carbon tetrachloride), amides(formamide, acetamide), nitriles(acetonitrile), isocyanates(toluenediisocyanate), amines(methylamine), epoxies(epoxyethane, propylene oxide), and aromatics(benzene, toluene, xylene).
- 5) **Organometallic:** Compounds in which metals are chemically bonded to organic groups (for example: ethyl silicate, tetraethyl lead, and organic phosphate).
- 6) **Hydrides:** Compounds in which hydrogen is chemically bonded to metals and certain other elements (for example: diborane and tetraborane).

B. Particulate Contaminants: Particles are produced by mechanical means by disintegration processes such as grinding, crushing, drilling, blasting, and spraying or by physiochemical reactions such as combustion, vaporization, distillation, sublimation, calcination, and condensation. Particles are classified as follows:

- 1) **Dust:** A solid, mechanically produced particle with sizes varying from submicroscopic to visible or macroscopic.
- 2) **Spray:** A liquid, mechanically produced particle with sizes generally in the visible or macroscopic range.
- 3) **Fume:** A solid condensation particle of extremely small particle size, generally less than 1 micrometer in diameter.
- 4) **Mist:** A liquid condensation particle with size ranging from submicroscopic to visible or macroscopic.
- 5) **Fog:** A mist of sufficient concentration to perceptibly obscure vision.
- 6) **Smoke:** A system which includes the products of combustion, pyrolysis, or chemical reaction of substances in the form of visible and invisible solid and liquid particles and gaseous products in air. Smoke is usually of sufficient concentration to perceptibly obscure vision.

Appendix F: Irritant Fume Protocol

A. Respirator Selection

1. The test subject shall be allowed to select the most comfortable respirator from a large array of various sizes and manufacturers that includes at least three sizes of elastomeric half-face pieces and units of at least two manufacturers. All respirators will be equipped with high-efficiency particulate air (HEPA) filters.
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 assess a "comfortable" respirator. A mirror should be available to assist the subject in evaluating the fit and positioning of the respirator. This may not constitute the formal training on respirator use, only a review.
3. The test subject should understand that he/she is being asked to select the respirator which provides the most comfortable fit. Each respirator represents a different size and shape and, if fit properly, will provide adequate protection.
4. Test subjects hold each face piece up to their faces and eliminate those which are obviously not giving a comfortable fit. Normally, selection will begin with a half-mask, and if a fit cannot be found here, the subject will be asked to go to the full-face piece respirators. A small percentage of users will not be able to wear any half-mask.
5. The more comfortable face pieces are recorded; the most comfortable mask is donned and worn at least five minutes to assess the comfort. Assistance in assessing comfort can be given by discussing the points in No. 6 below. If the test subject is not familiar with using a particular respirator, he/she shall be directed to don the mask several times and to adjust the straps each time, so that he/she becomes adept at setting proper tension on the straps.
6. Assessment of comfort shall include reviewing the following points with the test subject:
 - Chin properly placed
 - Room to talk
 - Positioning of mask on nose
 - Tendency to slip
 - Strap tension
 - Cheeks filled out
 - Fit across nose bridge
 - Self-observation in mirror
 - Room for safety glasses
 - Adequate time for assessment
 - Distance from nose to chin
7. The test subject will conduct the conventional negative and positive pressure fit checks as outlined previously in this manual. Before conducting the negative or positive pressure checks, the subject shall be told to "seat" the mask by rapidly moving the head side-to-side and up and down, taking a few deep breaths.
8. The test subject is now ready for fit testing.
9. After passing the fit test, the test subject shall be questioned again regarding the comfort of the respirator. If it has become uncomfortable, another model of respirator shall be tried.

10. The employee will be given the opportunity to select a different face piece and be retested if, during the first two weeks of on-the-job wear, the chosen face piece becomes unacceptably uncomfortable.

B. Fit Test

1. The test subject shall be allowed to smell a weak concentration of the irritant smoke to familiarize him/herself with its characteristic odor.
2. The test subject will properly don the respirator selected as above and wear it for at least 5 minutes before starting the fit test.
3. The test conductor will review this protocol with the test subject before testing.
4. The test subject shall perform the conventional positive pressure and negative pressure fit checks. Failure of either check shall be cause to select an alternate respirator.
5. Break both ends of a ventilation smoke tube containing stannic oxychloride. Attach a short length of tubing to one end of the smoke tube. Attach the other end of the smoke tube to a low-pressure air pump set to deliver 200 milliliters per minute.
6. Advise the test subject that the smoke can be irritating to the eyes, and instruct them to keep their eyes closed while the test is performed.
7. The test conductor shall direct the stream of irritant smoke from the tube towards the face seal area of the test subject. The conductor shall begin at least 12 inches from the face piece and gradually move to within 1 inch, moving around the whole perimeter of the mask.
8. The following exercises shall be performed while the respirator seal is being challenged by the smoke. Each shall be performed for 1 minute.
 - a. Normal breathing.
 - b. Deep breathing. Be certain breaths are deep and regular, taking cautions so as not to hyperventilate.
 - c. Turning head from side to side. Be certain movement is complete. Alert the test subjects not to bump the respirator on the shoulders. Have the test subjects inhale when his/her head is at either side.
 - d. Moving the head up and down. Be certain motions are complete. Alert the test subject not to bump the respirator on the chest. Have the test subject inhale when his/her head is in the fully up position.
 - e. Talking, slowly and distinctly, so that the test conductor can hear the phrase. Have the subject recite the rainbow passage.

Rainbow Passage: When 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 end 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.

- f. Grimace. Have the test subject grimace by smiling or frowning.
- g. Normal breathing.

9. If the irritant smoke produces an involuntary reaction (cough) by the test subject, the test conductor shall stop the test. In this case the test respirator is rejected and another respirator shall be selected.
10. Each test subject passing the smoke test without evidence of a response shall be given a sensitivity check of the smoke from the same tube to determine whether they react to the smoke. Failure to evoke a response shall void the fit test. Another testing agent will be used, such as isoamyl acetate.
11. Steps using the irritant smoke must be performed in a location with exhaust ventilation sufficient to prevent general contamination of the testing area by the test agents.
12. Respirators successfully tested by the protocol may be used in contaminated atmospheres up to ten times the permissible exposure limit. In other words, this protocol may be used to assign protection factors not exceeding ten.

Appendix G: Information for Employees Using Respirators When Not Required

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 regulatory or other agencies. Before voluntarily using a 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 respirator's 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, vapor, 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.