

***North Dakota State University
Respiratory Protection Program***

University Police & Safety Office

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Respirator Protection Program

I. Purpose

North Dakota State University is dedicated to providing safe and healthful facilities for all employees and students, and complying with Federal and State occupational health and safety standards. Administrators, faculty, staff and students share the responsibility to ensure protection against inhalation hazards through the correct use of respiratory protective devices. This document is designed to identify and designate responsibilities for implementation of the NDSU *Respiratory Protection Program*.

II. Procedures

As per referenced in NDSU Policy 711, Standard Operating Procedures shall be developed to establish uniform safety requirements. With that focus, North Dakota State University shall establish procedures for the selection, use and care of respiratory protective devices. Respirators shall only be used to protect employees from inhalation hazards in the following circumstances: (1) when other options for hazard control (i.e., use of engineering controls or substitution of less toxic materials) are infeasible, (2) while engineering controls are being installed or repaired, or (3) during emergencies. When respirators are to be used, all requirements contained within the NDSU *Respiratory Protection Program* shall be followed.

The NDSU *Respiratory Protection Program* shall be reviewed and evaluated for its effectiveness at least annually and updated as necessary to incorporate new or modified regulations and guidelines which affect proper use of respiratory protective devices. For purposes of compliance with regulations, and the NDSU *Respiratory Protection Program*, a respirator shall be defined as any device worn to: (1) reduce or eliminate inhalation exposure to any hazardous biological, chemical or particulate material or (2) supply breathing air to the wearer. This includes respirators used to protect employees in an emergency.

III. Responsibilities

A. NDSU Police & Safety Office (UP&SO) shall:

1. Assign the Associate Director of Environmental Health and Safety as the Respiratory Protection Program Administrator to direct the NDSU *Respiratory Protection Program*
2. Develop the NDSU *Respiratory Protection Program* with annual review and revisions as necessary
3. Make the program available to all affected departments through the UP&SO website
4. Conduct analyses of respiratory hazards in the workplace with the Respirator Checklist
5. Provide guidance and training to the campus community regarding the need, selection, use, limitations, maintenance and storage of respirator equipment

6. Provide an Occupational Health Provider (Sanford Clinic Occupational Medicine) for the fit-testing program for respirator users
 7. Notify Departments annually to maintain training, fit-testing and exposure monitoring records
 8. Assist with developing and implementing controls to reduce or eliminate the need for respiratory protection
 9. Act as an information resource for problems and questions related to respiratory protection.
- B. Sanford Clinic Occupational Medicine (234-4700) on 12th Ave. N. Fargo, ND and Essentia Health West Fargo Clinic (364-5757), 1401 13th Ave., West Fargo, ND shall:
1. Provide or direct all required or recommended medical examinations appropriate for evaluation of respirator users
 2. Maintain medical records relating to consultations, examinations and medical surveillance as required by law
 3. Provide certification that persons required to wear respirators are physically able to do so without adverse medical consequences.
- C. Supervisors, Laboratory Managers or Directors shall:
1. Identify respiratory hazards in the workplace
 2. Consult toxicology information and safety data sheets (e.g., Safety Data Sheets, Standard Operating Procedures) to identify hazards to workers under their control that require respiratory protection
 3. Identify employees who may require respiratory protection equipment
 4. **Schedule initial medical examinations, follow-up medical examinations, fit-testing and training for employees required to wear respirators**
 5. Provide site-specific information in the NDSU *Respiratory Protection Program* detailing personnel, hazards and procedures
 6. Ensure respiratory protection equipment is properly used, cleaned, stored and maintained
 7. Maintain an inventory of spare parts, filters and new respirators as necessary to insure employee access to properly-functioning equipment
 8. Ensure that defective respiratory protective equipment is removed from service immediately and not used until approved repairs are completed
 9. Conduct annual worksite audits of respiratory protection activities under their control
 10. Allow employees to leave the respirator use area as necessary to prevent eye or skin irritation associated with respirator use
 11. Ensure appropriately trained and equipped employees remain in communication with respirator users inside an atmosphere considered to be Immediately Dangerous to Life and Health (IDLH)
 12. Maintain records in your department of respirator equipment inspections, exposure hazard evaluations, training and fit-testing at the unit level
 13. Notify the Respiratory Protection Program Administrator of any problems with respirator use, or any changes in work processes that would impact airborne contaminant levels

14. Notify Sanford Clinic Occupational Medicine or Essentia Health West Fargo Clinic of any change in an employee's medical condition, work environment or workload that might impact the safe use of respiratory protective equipment.
- D. Respirator Wearers shall:
1. Comply with all required components of the *Respiratory Protection Program* (medical surveillance, training and fit-testing) BEFORE using any respirator
 2. Use respiratory protection equipment as instructed and in accordance with all provisions of the *NDSU Respiratory Protection Program*
 3. Properly store, clean, inspect and maintain all assigned respirator equipment
 4. Report any respirator deficiencies or malfunctions to the supervisor
 5. Use the correct type of respiratory protection for the hazard(s) involved
 6. Inform supervisors of new situations that may require a change in the use of respiratory protection equipment, or if contaminant levels are suspected to increase
 7. Inform supervisors of any change in medical condition that might affect the safe use of respiratory protective equipment
 8. Immediately follow emergency procedures and leave the respirator use area if a respirator fails to provide proper protection.

IV. Information

Assistance will be provided by the University Police and Safety Office (UP&SO) to any Department requesting guidance, exposure monitoring, fit-testing or training to satisfy implementation of this procedure. Additional information may be obtained from the [Chemical Safety](#) section of the UP&SO Web Page.

V. Respirator Use Requirements

The use of required respiratory protection equipment at NDSU is strictly limited to employees who have a documented need to utilize such equipment, pass and maintain an appropriate medical evaluations, attend annual training, and complete annual fit-testing (if required). These basic requirements are described below and elsewhere in this program.

VI. Documentation of Respirator Needs

Respirators are only to be used in situations where engineering controls are infeasible or during installation of such controls. Respirators shall be provided by the employer (supervisor) when such equipment is necessary to protect the health of the employee. The supervisor is required to identify the respiratory hazard(s) in the workplace and have these hazards evaluated to determine appropriate respiratory protective equipment. In emergency situations such as:

- A. Access to areas where the uncontrolled release of a hazardous airborne substance is suspected
- B. Rescue or access in confined spaces where oxygen or contaminant levels are unknown
- C. Hazardous material releases causing injuries or illnesses, if the supervisor cannot identify the contaminant or if exposure levels are unknown, the exposure shall be considered Immediately Dangerous to Life and Health (IDLH). The supervisor shall

provide information as necessary to permit evaluation of hazards in the workplace that may affect respirator use.

VII. Medical Evaluation

Prior to respirator fit-testing, workers must be medically certified capable of wearing the specified respirator without adverse health consequences. The **supervisor must initiate the Respirator Questionnaire** for each employee required to utilize respiratory protection. This form is available with instructions on line and shall be forwarded to Sanford Clinic Occupational Medicine or Essentia Health West Fargo Clinic for documentation of hazard evaluations and determination of appropriate level(s) of respiratory protective equipment. Sanford Clinic Occupational Medicine or Essentia Health West Fargo Clinic will maintain the completed evaluation form that determines appropriate levels of medical surveillance for the identified jobs. Certification of medical capability shall be provided by a physician or other licensed health care professional (PLHCP) at Sanford Clinic Occupational Medicine or Essentia Health West Fargo Clinic. Two copies of the completed release form will be provided to the employee. The employee is then responsible for providing a copy to the supervisor. Medical evaluations may be discontinued when the employee is no longer required to use a respirator.

VIII. Medical screening shall be conducted as follows:

All employees participating in the Respiratory Protection Medical Surveillance Program must have a current and accurate Respirator Questionnaire on file with the medical provider. Follow the instructions for completing and submitting the questionnaire. Employees will be asked to verify the information contained in this form at each examination. Supervisors are responsible for assuring attendance of any required medical evaluation, including fit testing.

- A. If any of the inhalation hazard or work condition information contained in the form changes, the supervisor shall submit an updated Respirator Questionnaire to the medical provider for review, action and transmittal. If substantial changes occur that may require additional medical evaluation, the supervisor will be contacted by the medical provider to schedule the affected employee(s) for additional evaluation.
- B. When an employee's medical certification is due for renewal, and inhalation hazards or work conditions have not changed, the supervisor shall check the appropriate block in the Respirator Questionnaire and forward it directly to the medical provider at least 30 days prior to the expiration date. **The supervisor is responsible for scheduling examinations for re-evaluation.**
- C. The medical provider will assist employees who are unable to read the questionnaire.
- D. Medical evaluation parameters are determined by the medical provider. Initial evaluations shall, at a minimum, include completion of a medical history questionnaire. Subsequent medical evaluations and follow-up testing is determined by the PLHCP, the Respiratory Protection Standard or other substance-specific regulations detailing frequency of medical evaluations.
- E. All employees will be granted the opportunity to speak with a physician about their medical evaluation, if they so request.
- F. Employees and the University Police and Safety Office will be provided a written pass/fail certification from the medical provider stating parameters under which the

- individual is medically able to wear a respirator. Respirator approval certifications from the medical provider will indicate an expiration date for the medical clearance.
- G. After an employee has received clearance and begun to wear his or her respirator, additional medical evaluations will be required under the following circumstances:
1. Employee reports signs and/or symptoms related to their ability to use a respirator, such as shortness of breath, dizziness, chest pains or wheezing. The employee or supervisor should contact the medical provider immediately if this occurs.
 2. The medical provider determines the employee needs to be re-evaluated; the supervisor will contact the employee to arrange scheduling.
 3. Information from this program, including observations made during fit-testing and program evaluation, indicates a need for re-evaluation. The supervisor will be contacted by the medical provider if this occurs.
 4. A change occurs in workplace conditions that may result in an increased notification as described in item #1.
- H. The medical provider shall assure confidentiality of all examinations and questionnaires and shall maintain records of all medical testing, medical history questionnaires and certifications of respirator use eligibility.
- I. If any employee is required for medical reasons to wear a positive pressure air-purifying respirator they will be provided with such a device by the supervisor or removed from the *NDSU Respiratory Protection Program*.

The [Respirator Authorization/Questionnaire](#) form is available on the Downloadable Forms Page in the University Police and Safety Office section. Please note that the Respirator Evaluation/Questionnaire evaluation and fit testing need to be approved by your department by use of the [Essentia or Sanford Authorization forms](#) also located on the Downloadable Forms Page.

IX. Training

Employees required to wear respiratory protection equipment shall be trained in the care, use, limitations and selection of the equipment. Training will vary depending on the type of respirator issued and the nature of the inhalation hazard. *At a minimum, employees shall receive training prior to first use of a respirator and annually thereafter.* Training shall be developed by the University Police and Safety Office, and presented by the Supervisor, and will include all required components as stipulated in OSHA regulation 29 CFR 1910.134.

- A. Contents of the OSHA Respiratory Protection Standard
- B. Respiratory hazards and health effects
- C. How respirators work
- D. Engineering controls vs. respirator use
- E. Medical evaluation
- F. Respirator selection rationale
- G. Proper use and limitations of respirators
- H. Fit testing

- I. Respirator donning/doffing
- J. Fit Checks
- K. Maintenance, cleaning and storage.

Specialized training will be required for personnel assigned to use self-contained breathing apparatus (SCBA) systems. Supervisors shall maintain records of training. Supervisors are responsible for insuring employees are currently trained and shall insure that respirators are not issued to nor used by any employee who has not received training within the previous 12 months.

X. Fit-Testing

The safe and effective use of respiratory protection equipment, especially negative pressure respirators, requires that the respirator be properly fitted to the employee. Poorly fitting respirators fail to provide the expected degree of protection. Additionally, no single model or size of respirator is capable of fitting all people. Several models may be needed to determine which provides an acceptable fit. Prior to being issued a re-useable, tight-fitting respirator, the employee must successfully pass a fit-test for that specific brand, model and size of respirator.

A fit test shall be used to determine the ability of each individual respirator wearer to obtain a satisfactory fit with any NIOSH-certified air-purifying or supplied-air respirator. Quantitative fit tests will be performed, if possible. Qualitative fit tests will be performed if testing equipment deficiencies preclude use of quantitative testing methods. Fit-testing methods shall conform to the minimum requirements as detailed in the OSHA Respiratory Protection Standard (29 CFR 1910.134). Personnel must successfully pass the fit test before being issued a respirator, and at least annually thereafter.

Qualitative Fit Tests:

The worker is exposed to an atmosphere containing an irritating aerosol and then asked to perform several exercises to challenge the respirator fit. The wearer reports any noticeable irritation caused by mask leaks.

Quantitative Fit Test:

A particle counting instrument is used to accurately measure respirator fit by comparing the dust concentration in the surrounding air with the dust concentration inside the respirator. The ratio of these concentrations is called the fit factor. A modified filter cartridge (or a modified respirator face piece) equipped with a sampling port is used to collect air from inside the respirator. With the sampler attached, the wearer is asked to perform several exercises to challenge the respirator fit. During these movements, any leakage is measured by the particle counting device. The fit test data is stored by a computer and a final fit test report is generated. For half-face or filtering face piece respirators, an acceptable fit test is a measured fit factor of at least 100. Full-face respirators must demonstrate an acceptable fit factor of at least 500.

- A. **Fit-testing is conducted by Sanford Clinic Occupational Medicine or Essential Health West Fargo Clinic.** An employee cannot be fit-tested nor wear a face-sealing respirator if there is any facial hair present between the skin, and face mask sealing surface. More than slight beard stubble at the sealing surface is considered excessive facial hair. Any other condition that interferes with the sealing

surface of the face piece or interferes with the valve function shall be identified during fit-testing and corrected. Any employee who experiences difficulty breathing or exhibits severe psychological reaction during any phase of fit-testing shall be referred to the medical provider to re-evaluate whether the employee is capable of wearing a respirator. Fit-testing shall be repeated at least annually or more frequently if any change occurs which may alter respirator fit. Such changes may include:

1. Weight change of 20 pounds or more,
2. Significant facial scarring in areas of the face seal
3. Significant dental changes (e.g., multiple extractions or new dentures),
4. Reconstructive or cosmetic surgery in the head/face
5. Any condition suspected to affect the face-respirator seal.

Supervisors shall maintain records of current fit-tests to assure testing is current and that appropriate respiratory protection equipment is available. Supervisors are responsible for insuring employees have been fit-tested within the past 12 months, and shall ensure that respirators are not issued to, nor used, by any employee who has not met this requirement. If any conditions or circumstances are observed by the supervisors that are suspected to impact the fit of an employee's respirator, the supervisor shall insure respirators are not worn unless fit testing is repeated.

XI. Selection of Respirators

Copies of fit-test reports will be forwarded to supervisors. Supervisors are to ensure that employees are provided the specific brand, model and size of respirator indicated in the fit-test report. Respirators shall not be used unless successful fit-testing has been demonstrated. The basic purpose of any respirator is to protect the user from specific inhalation hazards.

Respirators provide protection by removing contaminants from the air before inhalation or by supplying an independent source of respirable air. The National Institute of Occupational Safety and Health (NIOSH) establishes protection factors for different levels of respiratory protection. The protection factor indicates the maximum inhalation hazard's concentration for which the respirator is certified when properly used.

[Respirator Selection/Assessment Worksheet](#)

For example: If a worker is exposed to benzene at a concentration of 10 parts per million (ppm) averaged over the 8-hour work day, and the maximum acceptable exposure limit is 0.5 ppm, a respirator with a protection factor of at least 20 ($10\text{ppm}/0.5\text{ ppm}$) would be necessary to satisfy requirements. An air-purifying half-mask respirator (protection factor = 10) would not be adequate. If a worker has an 8-hour lead dust exposure of 0.20 milligrams per cubic meter (mg/m^3), and the maximum acceptable exposure limit is 0.05 mg/m^3 , a respirator with a protection factor of at least 4 ($0.20\text{ mg}/0.05\text{ mg}$) would be necessary to satisfy requirements. An air-purifying half-mask respirator (protection factor = 10) would be acceptable. The following table indicates the various types of respirators available, and the maximum NIOSH protection factor assigned to each:

Respirator Type Protection Factor	
Filtering Face-piece Respirators	10
Air-Purifying Half-Mask Respirators	10
Loose-Fitting Powered Air-Purifying Respirator	25
Air-Purifying Full-Face Respirator	50
Tight-Fitting Powered Air-Purifying Respirators	100
Air Line Respirators	1000
Self-Contained Breathing Apparatus (SCBA)	>1000

NDSU will follow the NIOSH Guide to Industrial Respiratory Protection for selection of respirator equipment. Additional information concerning types and descriptions of these respirators (including their limitations) is available from the University Police and Safety Office.

Air-purifying respirators shall not be used if:

- A. Atmospheres are oxygen-deficient (i.e., < 19.5% oxygen)
 - B. Contaminant concentrations are considered Immediately Dangerous to Life and Health (IDLH)
 - C. Contaminant concentrations are unknown
 - D. For emergencies where the concentration and/or type of contaminant is unknown.
- Selection criteria will be documented with the Respirator Questionnaire. It is often necessary to perform exposure monitoring to evaluate the need for and type of respiratory protection appropriate for the task(s). The supervisor with the guidance of the University Police and Safety Office is responsible for final determination of employee's respiratory protection needs. The medical provider will not provide a respiratory protection medical certification for any employee unless a Respirator Questionnaire has been submitted by the supervisor. Supervisors are required to have respirator selection criteria reassessed whenever circumstances change that may compel use of different levels of respiratory protection (e.g., introduction of new inhalation hazards, work practice modifications resulting in increased chemical exposures, etc.), or if the work environment places increased physical demands upon the employee. Documentation of these changes will be made by the supervisor on the Respirator Questionnaire. All respirators used by NDSU personnel shall be approved by NIOSH for the inhalation hazard presented to the employee. The following factors shall be taken into account by the supervisor when selecting the proper respirator:
- 1. Characteristics of the hazardous operation or process
 - 2. Nature of contaminant
 - 3. Concentration of contaminant
 - 4. Respirator enclosure design
 - 5. Location of hazardous area

6. Physical conditions in work environment
7. Vision
8. Communications

XII. Voluntary Use of Respirators and Disposable Dust Masks

The NDSU *Respiratory Protection Program* also covers employees who voluntarily use respiratory protective equipment. Voluntary Use means that the employee wishes to use a respirator on the job even though it is not required by the employer or regulation. Filtering face piece respirators (e.g., disposable dust masks) are often used to provide relief from nuisance levels of dusts and mists. They cannot be used for protection against fumes, vapors, gases, asbestos, sandblasting or paint sprays. If employees elect to voluntarily use disposable respirators, and if there are no identified inhalation hazards, disposable masks may be provided without medical certification or fit-testing. Employees using these disposable masks must be provided the information contained in Appendix II. Supervisors and employees issuing disposable masks are responsible for providing a copy of this appendix to affected employees. Supervisors are encouraged to document provision of this fact sheet. If the supervisor permits voluntary use of any other type of respiratory protective device, the following apply:

- A. The supervisor must read and complete the written NDSU *Respiratory Protection Program*
- B. The employee must receive medical clearance to use the respirator
- C. The employee must receive training to understand that failure to properly clean, store and maintain the respirator may present a health hazard to the user. This training is required initially and may be satisfied by the supervisor providing the employee a copy of the Voluntary Use of Respirator Fact Sheet contained in this Program as Appendix II
- D. Respirator fit-tests are not required.

If employees are **required** to wear any respirator, including filtering face piece models, they must comply with all portions of the *Respiratory Protection Program* including medical evaluations and annual training. Workers required to wear disposable respirators as protection against bloodborne pathogens or etiologic agents (protection against inhalation or mucous membrane contact) must be medically certified and trained. Workers required to wear disposable respirators with listed protection factors (e.g., 95% efficiency masks) must also be fit-tested at least annually.

XIII. Respirator Cleaning, Storage, Inspection and Maintenance

The following information is intended as a guide for appropriate cleaning, storage, inspections and maintenance practices:

A. Cleaning and Disinfecting:

Respirators shall be regularly cleaned and disinfected. Respirators issued for the exclusive use of one worker may be cleaned as often as necessary. Cleaning frequencies, facilities and materials used for cleaning/disinfecting must be determined by the supervisor as specified in Appendix I of this program. Shared respirators or emergency use respirators must be cleaned and disinfected after each use. The

person(s) responsible for cleaning and disinfecting of shared or emergency use respirators must be identified in Appendix I. Manufacturer recommendations shall be followed when cleaning respirators.

1. Wash the respirator in warm water containing a mild detergent at the temperature recommended by the manufacturer. A combination cleaner/sanitizer solution can also be used. NEVER use an organic solvent to clean a respirator
2. Clean the elastic straps by using a bristle brush and mild detergent
3. Drain water from the respirator and allow it to air-dry in a clean and sanitary location
4. Clean and sanitize all the parts previously removed from the respirator
5. Wipe the respirator and all its components with a cloth to remove any remaining water.

B. Storage

When not in use, the respirator and cartridges should be kept in a sealed container and stored in a clean, dry, moderate temperature and non-contaminated environment. It is especially important to keep gas and vapor cartridges in a sealed container so they do not passively adsorb gases and vapors from the storage area and thereby reduce the filter service life. Particulate filters should also be protected from dust and dirt. Emergency use respirators should be stored in a sturdy compartment that is quickly accessible in the work area and clearly marked.

C. Inspection Procedures and Schedules

Each respirator shall be inspected routinely before and after use. A respirator shall be inspected by the user immediately prior to each use to ensure that it is in proper working condition. After cleaning, each respirator shall be inspected to determine if it is properly functioning or if it needs repairs or replacement of parts. Respirators stored for emergency or rescue use shall be inspected at least monthly and before and after each use. Monthly inspections must be documented and include the date of inspection, name or signature of inspector, inspection findings, required remedial action and a serial number identifying the respirator if applicable. SCBA cylinders for emergency use shall be maintained in a fully charged state and recharged when pressure falls to 90% of the manufacturer's recommended pressure level, unless the SCBA is demonstrated as a training exercise. Inspections must include determinations that the regulator and warning devices function properly.

Manufacturer's recommendations shall be followed for equipment inspection, but should include at a minimum an inspection checklist for:

1. Filtering Face piece Respirators:

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

2. Inspection Checklist for Air-Purifying Respirators:

Face piece:

- Dirt
- Cracks, tears, or holes
- Distortion of face piece
- Cracked, scratched, or loose fitting lenses

Headstraps:

- Breaks or tears
- Loss of elasticity
- Broken buckles or attachments

Inhalation and Exhalation Valves:

- Dust particles, dirt, or detergent residue on valve and valve seat
- Cracks, tears, or distortion in valve material
- Missing or defective valve covers

Filter Elements:

- Proper filter for the hazard
- Approval designation
- Missing or worn gaskets
- Worn threads on filter and face piece
- Cracks or dents in filter housing
- Deterioration of canister harness
- Service life indicator or end of service date

Breathing tube:

- Cracks or holes
- Missing or loose hose clamps
- Broken or missing end connectors

3. Inspection Checklist for Atmosphere-Supplying Respirators:

Face piece:

- Dirt
- Cracks, tears, or holes
- Distortion of face piece
- Cracked, scratched, or loose fitting lenses

Headstraps:

- Breaks or tears
- Loss of elasticity
- Broken buckles or attachments

Hood, Helmet, Blouse, or Full Suit:

- Rips 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:

- Breathing air quality

Breaks or kinks in air supply hoses and fittings
Tightness of connections
Settings of regulators and valves
Adequate pressure and/or airflow
Correct operations of air-purifying elements and alarm for carbon monoxide or high temperatures

NDSU Respirator Inspection Record

D. Maintenance of Respirators

Respirators are to be properly maintained at all times to ensure that they function properly and adequately protect the employee. Maintenance involves a thorough visual inspection for cleanliness and defects. Worn or deteriorated parts will be replaced prior to use. No components are to be replaced or repairs made beyond those recommended by the manufacturer. Repairs or adjustments to regulators, reducing and admission valves, or alarms of atmosphere-supplying respirators will be conducted only by the manufacturer or other person specifically trained by the manufacturer to perform these activities.

1. Replacement Parts:

Consult the manufacturer or distributor for replacement parts and filters. Cylinders must be tested and maintained as prescribed in Department of Transportation regulations 49CFR173 and 49CFR178. These regulations detail requirements for scheduled hydrostatic testing, maintenance, etc. Supervisors with compressed air respirator equipment must be thoroughly familiar with the requirements pertaining to their equipment, and shall ensure appropriate maintenance and service.

E. Respirator Cartridge Change-Out Schedule

Air-purifying respirators function by removing contaminants from air before inhalation. Contaminants are removed by filtration (e.g., for asbestos, glass fiber), adsorption (e.g., for benzene, carbon tetrachloride), or by chemical reaction (e.g., for ammonia). Filters or cartridges designed for contaminant removal have limited effective service lives. The supervisor of each worksite utilizing air-purifying respirators must develop a change schedule and provide details in Appendix I of this NDSU *Respiratory Protection Program* which specify when cartridges are to be replaced and what information was relied upon to make this judgment. The service life of a cartridge depends upon many factors, including: environmental conditions, breathing rate, cartridge filtering capacity, and the amount of contaminants in the air. A safety factor should be applied to the service life estimate to assure that the change schedule is a conservative estimate.

Determination of service life can be accomplished through one of several methods:

1. **Experimental Tests:**

Utilizing knowledge of the inhalation hazards (material identification and exposure concentrations) and work conditions (breathing or airflow rate) presented to the employee, physically test the cartridge's ability to resist chemical penetration. The actual breakthrough time with a safety factor adjustment would be used to indicate the change out schedule.

2. **Manufacturer's Recommendation:**

Contact the respirator/cartridge manufacturer and provide details of the inhalation hazards (material identification and exposure concentrations) and work conditions (humidity and work rate). The manufacturer calculates or provides testing data indicating the expected breakthrough time. A safety factor adjustment would be made to this time to indicate the change out schedule.

3. **Mathematical Model Table:**

Utilizing knowledge of the inhalation hazard (material identification and exposure concentrations) and work conditions (humidity and breathing rate), determine estimated breakthrough time, correct for humidity and apply a safety factor to indicate appropriate change-out schedule.

4. **Mathematical Model Equation:**

A mathematical equation can determine breakthrough time if the following are known:

- A. Number of cartridges used in respirator
- B. Weight of sorbent in each cartridge
- C. Carbon micropore volume (cubic centimeters per gram)
- D. Density of packed bed (grams per cubic centimeter)
- E. Maximum temperature expected in workplace
- F. Maximum humidity expected in workplace
- G. Maximum concentration of contaminant (parts per million)
- H. Work rate or volumetric flow rate in liters per minute
- I. A safety factor adjustment would be made to this time to indicate the change-out schedule.

5. **Experimental Rule of Thumb:**

Experimental work can allow for a generalization or "rule of thumb" that broadly defines the service life of cartridges exposed to chemicals. One such rule of thumb for estimating organic vapor cartridge service life is found in chapter 36 of the AIHA publication "The Occupational Environment Its Evaluation and Control. The rule says:

- A. If the chemical's boiling point is $> 70\text{ }^{\circ}\text{C}$ and the exposure concentration is less than 200 ppm you can expect a service life of 8 hours at a normal work rate.
- B. Service life is inversely proportional to work rate.
- C. Reducing concentration by a factor of 10 will increase service life by a factor of 5.

D. Humidity above 85% will reduce service life by 50%
The Rule of Thumb is not generally recognized as a commonly-accepted method to determine cartridge change-out schedules.

6. **End-of-Service-Life-Indicator (ESLI):**

Some respirator systems are equipped with an ESLI. Cartridges must be changed immediately when indicated.

7. **Breathing Resistance:**

Employees wearing air-purifying respirators for protection against particulates (e.g., asbestos, wood dust, lead) must change filters if any breathing difficulties (i.e., resistance) are experienced while wearing their masks. Employees, wearing powered air-purifying respirators for protection against particulates, must change filters when airflow rates drop below 4 cubic feet per minute (6 CFM for loose-fitting models).

XIV. Supplied Air Respirator Requirements

Supply air respirators pose additional hazards due to the need to assure provision of adequate air. The use, inspection and maintenance of supply air respirators require implementation of additional procedures.

A. Air Quality

Air-line respirators and self-contained breathing apparatus (SCBA) must deliver acceptable air quality to the user.

B SCBA and other cylinder-supplied respirators:

Only Grade D breathing air shall be permitted for use in cylinders. If a new supplier is used, documentation must be obtained prior to use of the breathing air. The supervisor is responsible for ensuring inspections are conducted and records are available for review.

C. Air compressors:

Air compressors used to supply breathing air to respirators must be specifically approved for such use. They must be constructed and used so that:

1. Contaminated air is not allowed into the air-supply system.
2. Moisture content is minimized so that the dew point at one atmosphere pressure is 10°F below the ambient temperature.
3. Suitable in-line air-purifying sorbent beds and filters are installed to ensure breathing air quality.
4. Sorbent beds and filters are maintained and replaced per the manufacturer's instructions. A tag indicating the most recent change date and the supervisor's signature shall be maintained at the compressor.
5. Carbon monoxide concentrations must not exceed 10 parts per million.
6. Oil-lubricated compressors have a high-temperature alarm.
7. Breathing air couplings are incompatible with outlets for non-respirable gases in the workplace. Breathing air with oxygen concentrations over 23.5% or liquid oxygen shall not be used without specific approval from the Respiratory Protection Program Administrator.

XV. Evaluation of Respirator Program Effectiveness

Periodic review of the effectiveness of the respirator program is essential. The University Police and Safety Office and Supervisors will conduct periodic surveys to determine the effectiveness of the respirator program. This will include worksite inspections, interviews with respirator wearers, air-monitoring, and review of records. Acceptance of respirators by users is especially important. Users will be consulted periodically about their acceptance of wearing respirators. This includes comfort, resistance to breathing, fatigue, interference with vision, interference with communications, restriction of movement, interference with job performance, and confidence in the effectiveness of the respirator to provide adequate protection.

The above information can serve as an indication of the degree of protection provided by respirators and the effectiveness of the respirator program. Action shall be taken to correct any deficiencies noted with the program. The findings of the respirator program evaluation will be reported to the Associate Director of Environmental Health and Safety, and the report shall list plans to correct faults in the program and target dates for the implementation of the plans.

XVI. Worksite Evaluation

Supervisors are required to annually evaluate the use of respiratory protection for areas/employees under their control. The purpose of the evaluation is to identify deficiencies and issues that require correction or action. At a minimum, the following should be evaluated:

- A. Are new materials being used that require hazard assessment?
- B. Are all workers using respirators currently trained, fit-tested and medically monitored?
- C. Are respirators being properly used, stored, maintained and cleaned?
- D. Have all workers who are voluntarily using respirators (including disposable models) received a copy of the Voluntary Use of Respirator Fact Sheet?
- E. Are cartridges/filters changed according to the change-out schedule contained in the *NDSU Respiratory Protection Program*?
- F. Are workers routinely inspecting respirators?
- G. Are inspections conducted and documented for emergency use respirators?

Any problems or deficiencies identified during the audit must be expeditiously corrected. The University Police and Safety Office will assist supervisors with appropriate guidance when requested.

Occupational Health and Safety Administration – [Personal Protective Equipment](#) (29 CFR 1910.134 (c))

Occupational Health and Safety Administration - [Personal Protective and Life Saving Equipment](#) (29 CFR 1926.103)

Appendix I

Site-Specific Respiratory Protection Information

This NDSU *Respiratory Protection Program* must be customized to provide information specific to this worksite. Much of the information requires specific knowledge of the NDSU *Respiratory Protection Program* requirements and worker exposure assessments. The Respiratory Protection Program Administrator can assist, but the supervisor is responsible for the collection of data necessary to complete these documents. Individual components of this site-specific information that are to be maintained by supervisors include:

- A. Workers using respiratory protection (maintain data base with the fit-test certification)
- B. Tasks requiring use of respirators and hazard evaluation data
- C. Results of air monitoring and breathing air quality test data
- D. Respirator cartridge change-out schedules
- E. Cleaning, storage and maintenance of respirators (Inspection Logs)

The supervisor is responsible for insuring that the information required in Appendix I is completed and maintained. Modification of these sections may be required when any of the following situations occur:

- A. Addition or removal of workers assigned tasks involving use of respirators (data base)
- B. Equipment additions/modifications (respirator manufacturer's literature)
- C. Work practice alterations
- D. Introduction of new inhalation hazards (Assessment Worksheet)
- E. Any condition that may affect the proper use of respirator equipment

Personnel Using Respirators

The supervisor is responsible for maintaining information for each employee using respiratory protection. This information must be current and accurate. Additional pages may be used if necessary. Outdated pages may be removed.

Task Requiring Use of Respirator Protection: _____

Name & Job Title: _____

Types of respirator authorized (check applicable type):

- filtering face piece half-face APR full-face APR full-face PAPR
- supply-line self-contained breathing apparatus

Date of last training: _____ Date of last fit-test: _____

Medical clearance expiration date: _____

Brand/model/size of respirators issued: _____

Type of filters/pre-filters issued (if so equipped): _____

Cartridge Change-Out Schedule: _____

Appendix II

Voluntary Use of Respirator

Fact Sheet

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.