INTRODUCTION

Respiratory Protective Equipment (RPE) is used to protect the worker from exposure to airborne contaminants (e.g. dust, fumes, vapours, biohazardous material). Alberta Occupational Health & Safety (OHS) requires employers to conduct [hazard assessments](#) to identify existing or potential workplace hazards and implement means to eliminate or control the hazards. The preferred and legislated method for elimination or reduction of airborne hazards in the workplace is through substitution, engineering or administrative measures prior to considering the use of respiratory protective equipment. The OHS Code requires employers to provide the appropriate respiratory protective equipment. It also requires employers to develop and implement a worksite specific [Code of Practice](#) governing the use, selection and maintenance of respiratory protective equipment.

The University’s RPE Code of Practice includes information on the following:
- Responsibilities
- Hazard assessment
- Types of RPE
- Selection of appropriate RPE
- Worker health assessment
- Respirator fit testing
- Use, care and maintenance of RPE
- Worker training and documentation

This program establishes a system to manage the use of RPE in University work areas. RPE is used under the following circumstances:
- When engineering and other control measures to manage airborne contaminants are not practicable;
- While control measures are being instituted;
- During shut-down for maintenance, repair; or
- In an emergency situation.

SCOPE

This program applies to all University of Alberta worksites where workers may need to use RPE to carry out their work activities. It provides general information to assist Faculties and Departments implement an effective respiratory protection program. It outlines responsibilities of all University of Alberta staff associated with the implementation and administration of the Respiratory Protection Program. All worksites, including laboratories that use respirators must complete the Respiratory Protective Equipment (RPE) Code of Practice form in Appendix A to make this Program specific to their worksite.

Note: For the purposes of this program, a worker includes faculty, staff, volunteers, visitors and students.
RESPONSIBILITIES

Supervisors

- Conduct/coordinate hazard assessments to identify situations/work processes that require RPE;
- Determine the level of respiratory protection required and identify the appropriate RPE required according to the hazard(s) identified;
- Provide workers with the appropriate RPE;
- Ensure that health screening, fit testing and training are conducted prior to assigning work that requires RPE;
- Implement a cleaning and maintenance program for all respirators;
- Maintain records of the type of respirator required, fit testing performed and training delivered;
- Ensure workers wearing tight-fitting respirators are clean-shaven or free of any barriers that may affect the seal of the respirator;
- Evaluate the work processes and adjust the type or degree of respiratory protection required whenever there is a change in the type and/or level of the airborne contaminant;

Workers

- Participate in the training and education provided;
- Follow the established safe work procedures;
- Wear the appropriate respirator at all times when working in an area or work process that requires respirators;
- Be clean shaven and/or free of any barriers that may affect the seal of tight fitting respirators;
- Inspect respirator and perform positive and negative pressure seal checks prior to each use to ensure a tight seal;
- Properly clean, maintain and store the respirator as instructed and as per manufacturer’s recommendations;
- Change cartridges/canisters/filters as per change schedule; and
- Immediately report any damage or malfunction of the respirator to the supervisor.

Environment, Health and Safety

- Assist departments/faculties in the implementation of the Respiratory Protection Program;
- Provide assistance in hazard assessment, as well as the selection of appropriate respirators;
- Conduct air sampling to measure contaminant concentrations;
- Provide/assist with training;
- Conduct health screening;
- Conduct respirator fit tests;
- Periodically review and update the University’s RPE Code of Practice as necessary; and
- Periodically review Departmental Respiratory Protection Programs.
HAZARD ASSESSMENTS

Hazard assessment is a systematic process of identifying hazards, assessing the associated risk and implementing appropriate control methods to eliminate or minimize exposure to these hazards. A hazard is defined as a condition or behaviour that has the potential to cause injury or loss. The Alberta Occupational Health & Safety Code requires employers to conduct hazard assessments. A blank form available on EHS website can be used to document hazards and corresponding corrective measures and the hazard management procedure provides useful information to conduct hazard assessments.

Hazard Identification

Most hazards that may require respiratory protection can be classified into three main categories: chemical, biological or physical. Workers are exposed to airborne hazards in the workplace via inhalation. Airborne contaminants may be present as particulates, mists or aerosols, gases or vapours. In addition, workers may be in environments that may be oxygen deficient or have the potential to become oxygen deficient. The type of airborne contaminant in the workplace will vary depending on the process, activity or experiment.

Airborne Hazards

Inhalation is considered the most significant route of exposure to airborne contaminants in the workplace. Some gases and vapours may be absorbed through intact skin or mucous membranes.

Airborne hazards can be classified as:
- Particulates (includes dusts, mists, fumes, fibres, fog, smoke etc.)
- Gases and/or vapours
- Oxygen deficient atmospheres
- Combination of particulates, gases and/or particulates and oxygen deficient atmosphere

Particulates are defined as any liquid or solid airborne contaminant, other than a gas or vapour, but including dusts, fumes, mists, fibres, fog, pollen, smoke, spores and bioaerosols\(^1\). Airborne particles vary considerably in size; the smaller the particle size the longer it will take to settle onto a surface. Inhalable particles are particles with an aerodynamic size of 10 micrometers (\(\mu\)m) or less. Inhalable particles pass through the nose and throat and settle in different parts of the lungs depending on their size. Generally, the smaller the particle the farther it will travel into the lung.

Mists are suspended liquid droplets formed as a result of condensation of a gas to a liquid state. Mist is formed when a finely divided liquid is suspended in air.

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\(^1\) Canadian Standards Association Z94.4-11 – Selection, use, and care of respirators
Gases are airborne substances that are in a gaseous state at ambient temperature and pressure. Hydrogen sulfide, ammonia, hydrogen chloride and chlorine are examples of some of the hazardous gases used in research laboratories on campus.

Vapour – is a gaseous phase of a substance that is a solid or a liquid at ambient temperature and pressure. Evaporation of solvents such as toluene, acetone, xylene and ethanol produce vapour. Unlike vapour, a fume is an airborne particulate formed from an evaporation of a solid e.g. metal fume formed during metal welding.

Fume – is comprised of very small airborne particles, commonly formed by condensing vapors from burning or melting metals. For example iron oxide from welding or copper oxide from smelting. (DiNardi 1998)

Bioaerosol – a liquid droplet or a solid particle suspended in the air and that is living or originates from living organisms. Bioaerosols include living or dead micro-organisms, fragments, toxins, and particulate waste products from all varieties of living things. They are capable of causing infection or adverse or allergic response.²

Oxygen-deficient atmosphere – According to the Alberta OHS Code, an oxygen-deficient atmosphere is one that contains less than 19.5% oxygen by volume. Some gases, e.g., nitrogen, helium, carbon dioxide, may displace oxygen in an enclosed area or an area with inadequate ventilation resulting in an atmosphere that does not have enough oxygen to support life.

The specific type of airborne hazard will vary depending on the type of processes and work being undertaken. Thus a thorough hazard assessment is critical to identify airborne hazards and determine appropriate control measures.

Hazard Control Methods

- **Engineering Controls** – This is the preferred method of control because the hazard is eliminated or minimized at the source by substitution, isolation, automation or local exhaust ventilation. Whenever possible, hazards should be eliminated or controlled at the source i.e. as close as possible to the point of generation. For example, fume hoods, when installed and used properly, are an effective form of exhaust ventilation necessary to remove airborne chemicals away from the laboratory worker’s breathing zone as they are generated.

- **Administrative Procedures** – When engineering controls are not possible then administrative procedures such as additional training, safe operating procedures, job rotation and effective repair and maintenance and housekeeping programs can be implemented to control workers’ exposure to harmful substances. Administrative procedures focus on process, procedure and best practices.

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² Canadian Standards Association Z94.4-11 – Selection, use, and care of respirators
The document outlines the process for conducting a hazard assessment for determining RPE requirements. For questions about this Code of Practice, please contact the EHS Department.

- **Personal Protective Equipment (PPE)** – personal protective equipment is used as a method of controlling airborne hazards only when neither engineering controls nor administrative procedures can effectively minimize the impact of the hazard. PPE is considered a last line of defense because the potential for exposure has not been removed and any breach (e.g. improper fit or use) will result in worker exposure. PPE is not considered a very reliable method because the degree of protection is highly dependent on the proper selection, fit and use of the equipment. Thus respirators should be used only in cases where engineering controls or administrative controls cannot sufficiently reduce the concentration of airborne contaminants.

In some cases, a combination of all or two of the control methods described here may be required to adequately protect the worker.
RESPIRATOR TYPES

Respirators are classified into two major categories: air purifying respirators and atmosphere supplying respirators.

**Air Purifying Respirators**

Air purifying respirators clean the air by trapping the contaminant(s) onto a filter or other media. Filters, cartridges or canisters are used to remove the contaminant in ambient air before it reaches the user. Air purifying respirators equipped with particulate filters provide protection against dusts, bioaerosols, mists and fumes whereas those equipped with chemical filters (cartridges) protect against gases and vapours. The filters are generally available as particulate filters, gas and vapour filters or combination particulate and gas and/or vapour filters. Air purifying respirators are available in a number of configurations and styles from a variety of manufacturers: Examples of air purifying respirators are shown in Figure 1

| **Half-face cartridge/filter respirators.** These respirators cover half of the face from under the chin to the bridge of the nose. Depending on the airborne contaminant, a gas or vapour cartridge or a filter may be attached. The respirator and the cartridge or the filter must be made by the same manufacturer. |
| **Half-face filtering face piece respirators** (often referred to as N95 respirators). N95 according to the National Institute of Occupational Safety and Health (NIOSH), refers to a filtering facepiece that filters out at least 95% of airborne particles that are of “most penetrating” size. The filtering facepiece respirator is also referred to as a disposable respirator because the entire respirator is discarded when it becomes non-usable. These respirators have no replacement parts. Since oil degrades filter efficiency, NIOSH assigns N,R & P designations to filtering facepiece respirators depending on the filter’s oil resistance as described in Table 1. |
| **Full-face respirator** – These respirators are often used in situations where the contaminant may irritate the eyes and the skin or when a higher level of protection is required. Like the half-face respirator, an appropriate cartridge or filter is attached. Since wearing prescription eye glasses may impact the seal of the respirator, a special adapter for prescription eye glasses would be required. |
| **Powered Air-Purifying Respirators (PAPRs)** use a blower to force the ambient air through air-purifying elements to the inlet covering. This creates a positive pressure within the respirator thereby limiting the chance for leakage of contaminants into the face piece. These are available in various styles – half face, full face, maybe tight fitting as indicated in the picture or with a loose fitting hood. |

Figure 1 : Air Purifying Respirators
(Pictures courtesy of University of Calgary)
Table 1: NIOSH Filtering Facepiece Respirator Designations

<table>
<thead>
<tr>
<th>Filter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N95, N99, N100</td>
<td>Filters at least 95%, 99%, &amp; 99.97% of airborne particles. Not resistant to oil</td>
</tr>
<tr>
<td>R95, R99, R100</td>
<td>Filters at least 95%, 99%, &amp; 99.97% of airborne particles. Somewhat resistant to oil</td>
</tr>
<tr>
<td>P95, P99, P100</td>
<td>Filters at least 95%, 99%, &amp; 99.97% of airborne particles. Strongly resistant to oil</td>
</tr>
</tbody>
</table>

Filter Cartridges

Some cartridges contain special filters for removing particulates and fibers from the air. After a while the filters will become fully loaded and it may become difficult for the wearer to breathe. Thus the filter cartridges should be replaced on a regularly scheduled basis.

The cartridges must be made by the same manufacturer as the respirator. Do not interchange respirators and cartridges from different manufacturers.

Gas and Vapour Cartridges

Gas and vapour cartridges used in air purifying respirators contain activated charcoal and/or specific chemical compounds to adsorb or react with the airborne contaminant to remove it from the air before it is inhaled by the wearer. After some use, the cartridges will become saturated and will become ineffective in protecting the wearer. Thus it is imperative that a regular cartridge change schedule be established. This will be further discussed in Part 4 – Selection of Respirators.

Warning Properties

Air-purifying respirators can only be used for chemicals that have adequate warning properties such as irritation of nose, odour or taste. A chemical is considered to have adequate warning properties if the respirator wearer is able to detect its presence before it reaches a concentration that could be harmful to the wearer. That concentration is usually considered to be above the chemical’s occupational exposure limit.

Odour may sometimes be used as a warning to replace the chemical cartridge only if the odour threshold is below the occupational exposure limit. Odour threshold is the lowest concentration at which the human nose may be detect the presence of that chemical. Odour thresholds are published for a number of chemicals in various sources of literature. Since odour thresholds may be subjective and often presented as a concentration range, extreme care should be exercised when using it as a warning to change cartridges.
Some special cartridges with end-of-service-life indicators may be available for contaminants with poor warning properties may be available. Air-purifying respirators should not be used for protection against chemicals with poor warning properties unless cartridges with end-of-service-life indicators are available. Otherwise, only atmosphere-supplying respirators should be used.

**Limitations of Air Purifying Respirators**

- Air purifying respirators **cannot** be used in atmospheres that are Immediately Dangerous to Life & Health (IDLH) or that are oxygen deficient.
- They have limited use in situations where the contaminants have poor warning properties. In such cases, atmosphere supplying respirators are required.
- The choice of filter depends on the identity of the contaminant and in the case of particulate filters; the choice depends on the presence of oil. NIOSH considers the presence of oil in the work environment in its classification of particulate respirators.
- Cartridge/filter must be replaced regularly. Service life of the filter/cartridge depends on the concentration of the contaminant, physical activity of the worker, temperature and humidity of the work area.

**Surgical Masks versus N95 Respirators**

Surgical masks are loose fitting masks that are designed to prevent release of large droplets from the wearer through coughing, sneezing or talking. They are not designed to protect the wearer from inhaling small airborne particles of hazardous materials. Surgical masks may be used as a barrier to reduce the risk of body fluids’ sprays or splashes reaching the wearer’s mouth and nose. They are **NOT** designed to provide respiratory protection.

N95 respirators are tight fitting filtering face piece respirators that are designed to protect the wearer against exposure to airborne particulates. Only properly fitting and NIOSH approved respirators are to be used. Certain N95 respirators have been designed to provide both respiratory and barrier protection against blood and body fluids.

**Atmosphere supplying respirators**

An atmosphere-supplying respirator supplies the user with breathing air or gas from a clean source of breathing air separate from the potentially contaminated are in the work area.

- **Self-contained breathing apparatus (SCBA)** – consists of a full face piece connected to a supply of breathing air that is carried by the user. Thus the period of time that this respirator can provide protection is limited by the amount of air in the apparatus, the ambient atmospheric pressure and the degree of physical activity of the user. SCBAs are bulky to carry and require more physical exertion.
There are three types of SCBAs:
- Open circuit SCBA – air is exhaled in the surrounding environment
- Closed-circuit – exhaled air is scrubbed and re-used for breathing
- Escape – as the name suggests it is used for escape purposes only. It cannot be used to re-enter contaminated areas. It contains a very limited amount of air.

Only positive pressure (pressure-demand or continuous-flow mode) units with at least a 30-minute capacity and a low-capacity warning alarm can be used in IDLH situations. An open-circuit pressure-demand SCBA consists of a full-facepiece or tight fitting hood with a pressure demand valve. The pressure demand valve maintains a slight positive pressure inside the facepiece. This facilitates air flow into the face piece only during inhalation.

The user must be trained in the proper use, apparatus limitations and maintenance. The user may require additional medical screening as determined by a medical professional.

Limitations:
- SCBA is generally heavy and bulky;
- Open-circuit SCBA use time is limited to the amount of air in the cylinder;
- A rigorous preventive maintenance as described by the manufacturer must be implemented.

**Supplied Air (Airline) Respirators**
Breathing air is supplied via a small hose from an air compressor or a compressed air cylinder. The hose is attached to the user by a belt. The supplied air respirator consists of a half-mask, a full facepiece, hood or a helmet through which air is supplied to the user. Air is exhaled into the ambient atmosphere. Two types of supplied air respirators are generally used:
- Continuous flow – flow of air maintains the face mask under positive pressure
- Pressure-demand – maintain a negative pressure in the face piece. The air is only supplied when the wearer inhales.

Limitations:
- Since the air is supplied through a hose the user’s movement may be restricted.
- The air compressor must be located in an area free of air contaminants.
- Only positive pressure (pressure-demand or continuous-flow mode) equipped units with an escape air-supply bottle can be used in IDLH situations.
- The quality and quantity of air provided must meet the requirements of CSA Z180.1 Compressed Breathing Air and Systems.

*Contact the Department of Environment, Health and Safety for assistance in the determination of appropriate respiratory protective equipment.*
SELECTION OF RESPIRATORS

Selecting the correct type of respirator is a key step in ensuring that the worker is protected against the airborne hazard. A hazard assessment (as described in Section 4) must be conducted to determine the best method to control worker exposure to airborne hazard. The following factors must be considered in the hazard assessment:

- The nature of the contaminant: What is the identity of the chemical? Is it present as dust, mist, fume, gas or vapour? Is it a bacteria or a virus?
- When selecting an appropriate particulate filter, it is necessary to determine if oil is present in the workplace/area where respirator will be used.
- The concentration or best estimate of likely concentration of airborne contaminant(s): The best way to determine the concentration of the contaminant is to conduct air sampling and analysis according to accepted methods of measurement and analysis. Contact the Department of Environment, Health and Safety to request air sampling. The best estimate or anticipated concentrations should account for variables such as air movement, temperature and process variations.
- Determine the Occupational Exposure Limit of the contaminant. Once the anticipated airborne concentration is known, a hazard ratio can be calculated:
  \[ \text{Hazard Ratio (HR)} = \frac{\text{airborne concentration}}{\text{OEL}} \]
- Use the hazard ratio to select a respirator with an assigned protection factor greater than the HR.
- The duration or likely duration of worker exposure;
- The toxicity of the contaminant(s);
- Is there a possibility of an atmosphere that might be immediately dangerous to life and health? An IDLH atmosphere may result from a high concentration of an acutely toxic chemical, or one that may become oxygen deficient or the concentration of the contaminant is above the lower explosive limit. IDLH situations require the use of an air-supplying respirator. IDLH concentrations for specific chemicals can be found in the NIOSH Pocket Guide to Chemical Hazards.
- Warning properties of the contaminant(s); and
- The need for emergency escape.

Physical characteristics, functional capabilities and limitations of the respirators: The selected respirator must not impair the worker’s vision, communication or movement necessary to conduct work activities.

A Respirator Selection Chart is included in Appendix B to assist in the selection of an appropriate respirator. In addition, assigned protection factors (APFs) for different types of respirators are listed in Table 2.

Only respirators approved by the National Institute of Occupational Safety and Health (NIOSH) shall be used in University work areas.
Assigned Protection Factors

Assigned protection factor (APF) is a number assigned to a specific type of respirator corresponding to the expected level of protection that can be provided by that respirator. The APFs are assigned by regulatory and/or standard setting organizations. APFs listed in CSA Standard Z94.4-11 Selection, use and care of respirators are included in Table 2.

Table 2: Assigned Protection Factors (APFs) CSA Standard Z94.4-11

<table>
<thead>
<tr>
<th>Respirator Type</th>
<th>Respirator Sub-type</th>
<th>Assigned Protection Factor (APF)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air-purifying Respirators</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air-purifying</td>
<td>Half-facepiece (negative pressure) including filtering facepiece (eg N95)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Full-facepiece (negative pressure)</td>
<td>10 / 50¹</td>
</tr>
<tr>
<td>Powered air purifying respirator (PAPR)²</td>
<td>Loose-fitting facepiece/visor</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Half-face respirator</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Air-purifying (negative pressure) full-facepiece</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Full facepiece</td>
<td>1000</td>
</tr>
<tr>
<td><strong>Atmosphere Supplying Respirators</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplied-Air²</td>
<td>Airline (continuous flow) loose-fitting facepiece/visor</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Airline (pressure-demand) half-facepiece</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Airline (pressure-demand) half-facepiece</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Airline (pressure-demand) full facepiece</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>Airline (continuous flow) full-facepiece</td>
<td>1000</td>
</tr>
<tr>
<td>Self-contained²</td>
<td>SCBA</td>
<td>10,000</td>
</tr>
</tbody>
</table>

Notes
1 – Full-facepiece respirators have an APF of 10 if qualitatively fit tested and 50 if quantitatively fit tested.
2 – PAPR, Supplied Air and Self-contained respirators must be quantitatively fit tested.

Contact the Department of Environment, Health and Safety before purchasing a SCBA or an airline respirator. These respirators have special care and maintenance requirements. Also, the wearer may require a more detailed health assessment.
HEALTH SURVEILLANCE

All employees required to wear respiratory protection must complete the Health Screening Questionnaire for Respirator Users. This is done to confirm the worker’s ability to use a respirator. Based on this screen questionnaire, the employee may need to set up an appointment with the University of Alberta Occupational Health Provider. Instructions are provided from the form.

Fit testing will only be conducted after approval is granted by the Occupational Health Provider.

In addition, workers assigned to wear self-contained breathing apparatus (SCBA) may require a pre-placement (baseline) medical examination as determined by the Occupational Health Provider.

Workers who do not meet the health requirements will not be able to work in an area where respiratory protective equipment is required. It is the supervisors responsibility to ensure these requirements are met.

TRAINING

Training is mandatory for all workers required to wear respirators. Training must be provided prior to initial use of respirators. Respirator training is also required for all supervisors of workplaces where respiratory protection is used. Training on the use, care and maintenance of SCBA and airline respirator must be provided by a qualified trainer.

The training shall cover the following points:

Respirator user

- A discussion on the nature, extent, and effects of respiratory hazards to which the employee may be exposed;
- An explanation on the operation, limitations, and capabilities of the selected respirator(s);
- Instruction on the inspection, checking the fit and seals, and in wearing the respirator;
- Schedule for changing the respirator cartridges;
- Instruction on proper cleaning, maintenance and storage of the respirator(s); and
- Instructions on how to deal with emergency situations.

Supervisors

In addition to the above supervisors shall also be provided training in:

- Selection, fitting, issuance and inspection of respirators; and
- Monitoring respirator use, including a schedule to change respirator cartridges/filters.
FIT TESTING

A *Fit Test* is performed to ensure that the selected tight fitting respirator provides an effective seal and is comfortable for the user. The fit test must be performed prior to assigning/using a respirator and at least once every two years on all regular respirator users. Environment, Health & Safety personnel conduct fit tests for employees who are considered medically fit to wear respirators. To initiate the fit test process, complete a [Health Screening Questionnaire for Respirator Users](#) available on EHS’ website. The questionnaire is reviewed by the Occupational Health Provider prior to fit testing to ensure that there are no medical contraindications to respirator use. If there is a concern noted in the health questionnaire the employee may be referred to a physician for further assessment. The department/faculty will be responsible for the associated costs.

Respirators that depend on a tight facial seal to perform effectively should not be worn when an effective seal to the wearer’s face cannot be maintained. The face-piece to face seal can be affected by a number of factors:

- **Facial size, shape and condition:** several makes, models and sizes of respirators are usually available during fit testing to try and fit a variety of facial sizes and shapes;
- **Dentures:** Absence of one or both dentures can seriously affect the fit of a respirator;
- **Protective eye wear:** Other protective devices such as safety glasses, goggles and face shields should not interfere with the face piece seal. Regular corrective eyeglasses should not be worn when using a full-face piece respirator because the temple bars, which pass between the sealing surface of the respirator and the wearer’s face, may prevent a good face-piece seal. For employees who require corrective eyewear, specially mounted glasses for wearing inside the face piece are available through safety equipment suppliers; and
- **Facial hair:** Facial hair results in highly variable and normally poor respirator fit. A respirator fit test shall not be attempted on any employee wearing a beard. Moustaches however can be assessed on an individual basis prior to fit testing. Employees who are required to wear respirators during work activities or in emergency situations must be clean-shaven where the face piece seals to the skin. Examples of acceptable and unacceptable facial hair are presented in Appendix C.

**Quantitative Fit testing**

Quantitative fit testing (QNFT) confirms a respirator’s fit by comparing concentration levels of a particulate outside the respirator to the concentration levels of the particulate inside the respirator.
RESPIRATOR INSPECTION, MAINTENANCE AND STORAGE

Inspection, maintenance and proper storage of respirators is an integral part of a Respiratory Protection Program. A poorly maintained or malfunctioning respirator may seriously compromise the health and safety of the wearer. All respirator users must inspect, clean, maintain and properly store their respirators in accordance with the manufacturer’s instruction. The supervisor shall establish a schedule for cleaning, inspection, and maintenance and for changing filters and cartridges.

Cleaning and Sanitizing

If the respirator is to be used by more than one person it must be cleaned and disinfected after each use.

To clean a respirator:

- Disassemble respirator by removing filters, cartridges, head harness, diaphragms and other removable parts. See Figure 2 for parts of a typical half-face respirator.
- Cleanse the face piece and parts (with the exception of cartridges/filters or canisters) in warm water with a mild detergent or a cleaner recommended by the manufacturer.
- Rinse thoroughly with clean warm water and allow respirator and parts to air dry.
- Reassemble the facepiece. Replace filters, cartridges or canisters if necessary.
- Ensure all components work and that the respirator fits properly.

Inspection

Respirators should be inspected prior to each use. Respirator inspection includes but is not limited to the following:

- Tightness of connections;
- Condition of component parts i.e. facepiece, valves, filters, cartridges, canisters, hood, helmet and cylinders;
- End-of-service-life indicators;
- Shelf-life dates;
- Pliability and deterioration of rubber and other elastomeric parts; and
- Regulators, alarms and other warning systems if present.

There should be no worn or damaged parts. Figure 2 shows the basic parts of a respirator.

Inspection and storage of SCBA and airline respirators must be in accordance of manufacturer’s instructions and must meet the requirements outlined in CSA Standard Z94.4-11.
Respirator Storage

Store clean respirator in a resealable plastic bag and rested in a normal position so that the respirator and the cartridge/filter or canister is not damaged or deformed. Always store respirators in a clean area, away from chemicals, sunlight, extreme heat or cold, and excessive moisture.
Chemical Cartridge/Canister Change Schedule

A change schedule states how often chemical cartridges or canisters should be replaced and what information is relied upon to make this judgment. A cartridge's useful service life is how long it provides adequate protection from harmful chemicals in the air. The service life of a cartridge depends upon many factors, such as environmental conditions, breathing rate, cartridge filtering capacity, and the amount of contaminant(s) in the air. Thus predicting the life span of a respirator cartridge is difficult. To determine the service life of a chemical cartridge or canister, the following factors are considered:

- **Worker Exertion Level:** The total amount of captured contaminant is directly related to the work rate or breathing rate; i.e., a worker breathing twice as fast as another will draw twice the amount of contaminant through the respirator cartridge. Most cartridge studies have used a breathing rate of 50-60 liters per minute. This rate approximates a high end of moderate work. For work rates that exceed this level (e.g., heavy shoveling, running) you may need to apply or take into account a correction factor when determining a service life.

- **Respirator Cartridge Variability:** The service life of a respirator cartridge is directly related to the amount of active material in the cartridge. If the specific cartridge being evaluated can be reproducibly determined to have a certain amount of active material, then modifications to the service life may be justified. Information on cartridge specifications can be provided through the manufacturer.

- **Temperature:** High temperatures can adversely affect the adsorptive capacity of respirator cartridges and canisters. Temperature effects alone have been reported to reduce the service life by 1-10% for every 10 degrees Celsius rise depending on the specific solvent. Corrections to cartridge estimated service life for this effect alone are probably not necessary under normal working temperatures.

- **Relative Humidity:** Relative humidity is a measure of the amount of water vapor the air will hold at a specified temperature and is expressed in percentage values. High relative humidity is a significant negative factor in the capacity of organic vapor cartridges since the large quantity of water vapor will compete with the organic vapors for active sites on the adsorbent. If organic vapor cartridges are used in a significantly humid environment (> 65%), then a safety factor should be applied when determining the service life. The exact magnitude of the humidity effect is complex, dependent in part upon chemical characteristics and concentrations of both the contaminant and the water vapor. Based upon relatively few studies, a reduction by a factor of 2 in the cartridge service life may be made when the relative humidity reaches 65%. If the relative humidity exceeds 85%, you should consider experimental testing or another method to more specifically determine the service life. Mathematical modeling may be an appropriate, albeit complex, approach to predict the effect of humidity at various chemical concentrations.

- **Multiple Contaminants:** Multiple contaminants introduce a great deal of variability into the prediction of service life for respirator cartridges. Much of the laboratory testing and the mathematical models have utilized a single contaminant to determine service lives. Only a limited number of multiple contaminant situations have been studied and reported. Cartridge service life for mixtures of compounds with significantly different chemical characteristics is probably best determined by experimental methods. Predictions based upon models without experimental data should be very conservative and ascribe the service life derived from the least well adsorbed compound to the total mixture concentration in terms of parts per million. In some cases, the displacement of a less well adsorbed compound by a more highly adsorbed one may alter the actual service life from the estimated one.
CODE OF PRACTICE

Whenever the atmospheric concentration of a dust, biohazardous material, vapour, mist or gas requires the use of RPE, a Code of Practice describing the selection, use and maintenance of that equipment must be developed. This information is used to protect workers against respiratory hazards in the workplace. The extent of the information presented in the Code of Practice depends on the complexity of the work being performed at the work site.

All University work sites where respirators are used shall develop a “Code of Practice” specific to the work site and/or work procedures. The information provided in this document applies to all work areas at the University. A data sheet is provided in Appendix A to assist in the development of a Code of Practice. Once developed this Code of Practice must be at the work site in a readily accessible location to workers and other persons who may need to refer to it. All workers must be trained in the Code of Practice. As a minimum, the Code of Practice shall include:

- A policy statement specifying the use of RPE is required. This should detail the intended use of the respiratory protective device(s) at the work site including routine use, specific operations and/or emergency use;
- The name of the person responsible for the RPE including the selection, provision and maintenance of the equipment at the worksite;
- Determination of the need for RPE. This includes the type of airborne hazard identified, control measures in place i.e. local ventilation or other control measures as well as potential exposure levels and the duration of exposure;
- Selection criteria for appropriate Respiratory Protection Equipment;
- Respirator fit testing and training to include specific hazards of airborne contaminant(s), use and inspection including the cleaning, sanitizing, and maintenance and storage of respiratory protective devices, as well as the requirement for health surveillance of respirator users; and
- If cartridge type air purifying respirators are used, a cartridge change schedule indicating the cartridge’s service life based on an evaluation of the concentration of the chemical in the environment, as well as other factors including environmental conditions, breathing rate, and cartridge filtering capacity.
REFERENCES


Respiratory Protective Equipment (RPE) Code of Practice for ____________________________________________

Department/Faculty

All workers affected must be trained in this RPE Code of Practice

A. Person Responsible for Selecting and Providing Respiratory Protective Equipment

Name: __________________________ Telephone: __________________________ Position: __________________________

B. Conditions for Use of RPE:

1. Health Screening: Workers must complete a respirator wearer’s questionnaire and submit through the Department of Environment, Health and Safety.

2. Fit-Testing: RPE that depends on an effective seal for its safe use must be properly fit-tested by a competent (trained) person (this must be done every two years or when physical conditions change)

3. NIOSH Approval: RPE required at the worksite must be NIOSH approved (it will bear a NIOSH approval # e.g. TC-XXXX)

4. Clean Shaven: Workers must be clean shaven where the respirator contacts the face

<table>
<thead>
<tr>
<th>Task (e.g. spray painting)</th>
<th>Airborne Hazard (e.g. type of solvent, dust etc)</th>
<th>Type of Respirator (e.g. half mask)</th>
<th>Respirator Make/Model #</th>
<th>Type of Cartridge (e.g. P100)</th>
<th>Cartridge Make/Model #</th>
<th>RPE Use Mandatory Y/N</th>
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D. Maintenance/Cleaning/Storage of Respiratory Protective Equipment:

Maintenance: Cartridges/filters must be replaced as per the manufacturer’s instructions or earlier if smell, taste or irritation from contamination is detected or if there is resistance to breathing (see manufacturer’s instructions)

Cleaning: RPE should be cleaned after each use. Wipes may be used, but should not be the only method of cleaning RPE (see manufacturer’s instructions)

Storage: RPE must be stored in a manner that will prevent its contamination (e.g. sealed bag (Ziploc™))