

# Occupational Health and Safety Bulletin

## Respiratory Protective Equipment: An Employer's Guide

### Background

Dusts, chemicals, or reduced oxygen in the air create health hazards for workers. Employers must eliminate these hazards if possible. If this is not possible or practicable, employers must minimize the hazards through engineering controls.

Engineering controls include:

- providing local exhaust ventilation
- adding clean air to oxygen-deficient spaces
- enclosing the process that is producing the airborne contaminant.

If engineering controls are not sufficient or practicable, employers can use administrative controls to reduce exposure to airborne hazards.

Administrative controls include:

- implementing safe-work procedures
- scheduling job rotation
- training

Only where airborne hazards cannot be eliminated or sufficiently reduced with engineering or administrative controls may personal protective equipment be used. There are few situations where respiratory protective equipment alone is the best way to protect workers.

# Legislation for respiratory protective equipment

This bulletin highlights a number of important requirements in Alberta's Occupational Health and Safety (OHS) legislation for respiratory protective equipment.

Alberta's health and safety legislation includes a number of requirements for respiratory protective equipment. Specifically:

- Employers are required to take reasonable measures to use engineering, work practice or administrative controls *before* using respiratory protective equipment.
- If respiratory protective equipment is used, employers are required to provide the appropriate equipment, maintain and store it properly, and ensure that it is properly fitted to the individual worker. Where the efficiency of respiratory protective equipment depends on a facial seal, the employer must ensure that the wearer is clean shaven where the respirator seals to the skin of the wearer's face.
- When selecting the appropriate respiratory protective equipment, the employer must consider the following factors:
  - the nature of the contaminant
  - the concentration or likely concentration of any airborne contaminants or biohazardous materials
  - the duration or likely duration of the worker's exposure
  - the toxicity of the contaminants
  - the concentration of oxygen in the work area • the warning properties of the contaminant(s)
  - the need for emergency escape.
- Respiratory protective equipment must be approved by NIOSH (National Institute for Occupational Safety and Health) or another standard setting organization approved by a Director of Occupational Hygiene.
- Compressed breathing air used with respiratory protective equipment must meet the minimum standards of quality described in the OHS Code. Equipment used to supply breathing air to workers must be designed and intended for that use.
- Employers must ensure that workers using respiratory protective equipment are adequately trained.
  - Employers must select respirators based on the selection criteria in CSA Standard Z94.4-02, *Selection, Use and Care of Respirators*. This standard does not specify selection criteria for biohazardous materials, however the OHS legislation requires that respiratory protection be provided and made available when the effects of worker exposure to airborne biohazardous materials are unknown i.e. the health effects and mechanism of transmission have not yet been characterized, and no procedures are in place to effectively limit exposure. Unknown exposure effects include adverse health effects such as an acute or chronic illness, acute or chronic disease, or death.
- Respiratory protective equipment must be properly fitted to the wearer's face. Employers must comply with the CSA Standard Z94.4-02 when fit testing respiratory protective equipment, and use the assigned protection factors (APFs) specified in that standard.
- Employers must develop a written Code of Practice governing the selection, maintenance and use of respiratory protective equipment.

## Selecting respiratory protective equipment

Selecting the right respirator for the task to be performed is a two-stage process.

- (1) Choosing the appropriate type of respiratory protective equipment.
- (2) Choosing the specific model from among the appropriate types available.

The person selecting respiratory protective equipment must thoroughly understand the equipment and the types of equipment available. This person must be familiar with the equipment's capabilities, including the degree of protection it can provide, and its limitations.

The employer must determine the degree of danger the conditions that are or may be present at the work site present to the worker. These findings are used to select the respiratory protective equipment appropriate for those conditions. The employer must stay informed of any change in conditions at the work site that might affect the degree of protection provided by the respiratory protective equipment in use.

Tables 1 and 2 summarize some important information about air-purifying and atmosphere-supplying types of respiratory equipment.

Table 1. Air-Supplying Respirators

TYPE	SUB-TYPE	ASSIGNED PROTECTION FACTOR	LIMITATIONS
Airline Types <sup>(2)</sup>  Includes: Airline Respirators, Hoods, Helmets, and Suits	Demand Mode Half-Face piece	10	Hose limits the workers' mobility.  Only <i>positive-pressure</i> <sup>(1)</sup> equipped units with an escape air-supply bottle may be used in immediately dangerous to life or health (IDLH) situations.
	Demand Mode Full-Face piece	100 <sup>(3)</sup>	
	Positive Pressure <sup>(1)</sup> Half-Face piece	50	
	Positive Pressure <sup>(1)</sup> Full-Face piece	1000	
	Helmet/Hood <sup>(4)</sup>	1000	
	Loose-Fitting Face piece <sup>(4)</sup>	25	
Self-Contained Breathing Apparatus (SCBA)	Demand Mode Full-Face piece	100 <sup>(3)</sup>	Use time limited by worker training and cylinder capacity. Bulk and weight limits use for strenuous work and work in confined spaces. Only <i>positive-pressure</i> <sup>(1)</sup> units with at least a 30-minute capacity and a low-capacity warning alarm may be used in IDLH situations.
	Pressure-demand (positive pressure)	(5)	

- Notes:
- (1) Positive pressure refers to pressure-demand mode or continuous-flow mode respirators.
  - (2) Air used for atmosphere-supplying respirators must be of a quality that complies with Table 1 of CSA Standard Z180.1-00, *Compressed Breathing Air and Systems*, and does not contain a substance in a concentration greater than 10% of the applicable Occupational Exposure Limits listed in Alberta's *Occupational Health and Safety Code*. (This does not apply to substances already listed in Table 1 of the CSA Standard.)
  - (3) Assigned protection factors listed are from CSA Standard Z94.4-02 for a respirator that has been fitted using quantitative fit-test methods according to the standard. If qualitative fit testing is done, the assigned protection factor for demand-mode airline respirators and SCBA is 10.
  - (4) Need not be fit tested.
  - (5) When potential hazardous concentrations can be estimated, an APF of no greater than 10,000 should be used.

Table 2 Air-Purifying Respirators

TYPE	SUB-TYPE	ASSIGNED PROTECTION FACTOR	LIMITATIONS
Particulate Filter  Chemical Cartridge or Canister	Half-Face piece	10	Unacceptable for protection in IDLH conditions or oxygen deficient atmospheres.  Choice of filter depends on identity of contaminant and, for particulate respirators, the presence of oil. <sup>(1)</sup>  Service life depends on factors such as the type and amount of filtering medium, concentration of contaminant, temperature and humidity.
	Full-Face piece	100 <sup>(2)</sup>	
Combination Particulate/Chemical			
Powered Air-Purifying Respirator	Half-Face piece	50	
	Full-Face piece	1000	
	Helmet/Hood <sup>(3)</sup>	1000	
	Loose-Fitting Face piece <sup>(3)</sup>	25	

- Notes: (1) NIOSH has classified air-purifying particulate filters as “N” (**N**ot oil resistant), “R” (oil **R**esistant), or “P” (oil **P**roof). You can obtain these filters with filtering efficiencies of 95%, 99% or 99.97%.
- (2) Assigned protection factors listed are from CSA Standard Z94.4-02 for a respirator that has been fitted using quantitative fit-test methods according to the standard. If qualitative fit testing is done, 10 is the assigned protection factor for a full face-piece air-purifying respirator.
- (3) Need not be fit tested.

# Choosing the appropriate type of respiratory protective equipment

A number of factors need to be carefully considered when selecting the appropriate type of respiratory equipment. It is very important to assess all these factors for each situation, each time equipment is being chosen. Always take into consideration whether or not the equipment is going to be used for emergency conditions.

- *Identify the airborne contaminant(s)* — Know the contaminant to ensure the respirator selected is approved for protecting against that specific contaminant. To select the appropriate particulate filter using the NIOSH classification system, it is necessary to determine whether or not oil is present in the workplace where the respirator will be used.
  - *Determine the concentration of the airborne contaminant(s)* — Determine the average workday concentration and the highest short-term concentrations of the contaminant.
- (1) **Determine the oxygen concentration** — Workers in an oxygen-deficient atmosphere require air-supplying respiratory protective equipment. Compare the identity and concentration of the contaminant, including the concentration of oxygen in the work area, against the concentration of the contaminant considered to be immediately dangerous to life and health (IDLH). An IDLH concentration would cause immediate injury or debilitating health effects. Very high concentrations of acutely toxic substances or very low concentrations of atmospheric oxygen are examples of IDLH situations. IDLH situations require the use of positive-pressure air-supplying respiratory protective equipment. CSA Standard Z94.4 provides guidance for addressing IDLH situations involving oxygen deficiency. NIOSH provides a listing of IDLH concentrations for a wide variety of chemicals at [cdc.gov/niosh/idlh/](https://www.cdc.gov/niosh/idlh/)
  - (2) **Determine the physical form of the contaminant** — The contaminant may be present as a dust, mist, fume, fibre, gas or vapour (for example, silica dust, asbestos fibre or hydrogen sulphide gas). Sometimes it is present in more than one form. For example, spray-painting produces paint mist and solvent vapour; welding produces metal fumes and gases.
  - (3) **Find out the Occupational Exposure Limit (OEL) for the contaminant and the concentration of the contaminant in the air** — Once the airborne concentration of the contaminants that the worker may be exposed to is known, a hazard ratio can be calculated:

$$\text{Hazard Ratio} = \text{Airborne Concentration/OEL}$$

A respirator should never be used in an environment where the hazard ratio is greater than its assigned protection factor. To select the appropriate level of respiratory protective equipment, use the highest hazard ratio (HHR) of the individual components present.

Table 3 Use of HHR to select a respirator

HHR	Minimum Level of Respirator Needed	
	Air Purifying	Air Supplying
≤ 10	Half facepiece	Demand half facepiece
≤ 25	Loose-fitting facepiece PAPR	Loose-fitting facepiece/visor
≤ 50	Half facepiece PAPR	Positive pressure half facepiece
≤ 100	Full facepiece	Positive pressure full facepiece or demand SCBA
≤ 1,000	Full facepiece PAPR	Positive pressure full facepiece
≤ 10,000	May not be used	Positive pressure SCBA or positive pressure air supply respirator with auxiliary air supply. *

PAPR = Powered Air Purifying Respirator

SCBA = Self-Contained Breathing Apparatus

\*Supplied air respirator with an additional air supply (usually a cylinder) used should the primary air supply fail

- (4) **Determine whether workers will be exposed to biohazardous substances** — The OHS Code defines a “biohazardous” material as a pathogenic organism, including a bloodborne pathogen, that because of its known or reasonably believed ability to cause disease in humans, would be classified as Risk Group 2, 3 or 4 as defined by the Public Health Agency of Canada, or any material contaminated with such an organism.

Examples of situations in which workers may be exposed to airborne biohazardous materials include:

- (a) sewage plant workers exposed to aerosols created during effluent processing or during equipment maintenance,
- (b) laboratory workers exposed to aerosols while handling biohazardous materials,
- (c) health care workers exposed to airborne biohazardous materials,
- (d) rendering plant workers exposed to aerosols created during materials processing,
- (e) workers involved in renovations removing mouldy building materials, and
- (f) workers stirring up dusts containing waste products from animals such as birds, bats and mice. These contaminated dusts may contain materials that could cause disease in humans.

Many factors affect the nature and exposure circumstances of a worker’s exposure to an airborne biohazardous material, such as:

- (a) the type of biological agent,
- (b) the route of transmission,

- (c) the pathogenicity of the agent,
- (d) concentration of the agent,
- (e) size of airborne particles,
- (f) duration of exposure,
- (g) work activity, and
- (h) work practices and procedures for which exposure to biohazardous material is possible.

The size of the particles will affect whether they become airborne. Droplets are relatively large particles which, because of their size and mass, travel a short distance through air, usually no further than 2 metres. Most droplets land on inanimate objects and do not pose a respiratory hazard. Inhalable infectious airborne particles that remain aloft because of their small size and low mass do present a potential respiratory hazard to workers. These particles may be generated during coughing and sneezing, during some medical procedures, and by aerosolization of liquids and stirring up of dusts containing biohazardous materials.

NIOSH provides additional guidance on respirator selection for protection against biological agents at:

[cdc.gov/niosh/docs/2009-132](https://www.cdc.gov/niosh/docs/2009-132)

- (5) **Consider the length of time the respirator will be needed** — Certain types or respirator are effective for use over longer periods of time. When a respirator must be worn for extended periods of time, it can become uncomfortable.
- (6) **Know the toxic properties of the contaminant(s)** — Recognize the potential health effects of overexposure to the contaminant. Certain properties of the contaminant will influence the choice of a respirator. For example, choosing a fullface piece, rather than a half-mask respirator, is necessary for protection against contaminants that irritate the eyes.
- (7) **Warn workers how to detect contaminant(s)** — Workers need to know the concentration at which most people can detect the substance by smell, or by nose or throat irritation. When a worker detects the contaminant this way, it indicates the respirator fits poorly, has developed a leak, or has exhausted its cartridges or canister. For this reason, use air-supplying respirators for protection against gases or vapours that have poor warning properties at or above their OELs.

For contaminants with poor warning properties, air-purifying respirators may *only* be used if:

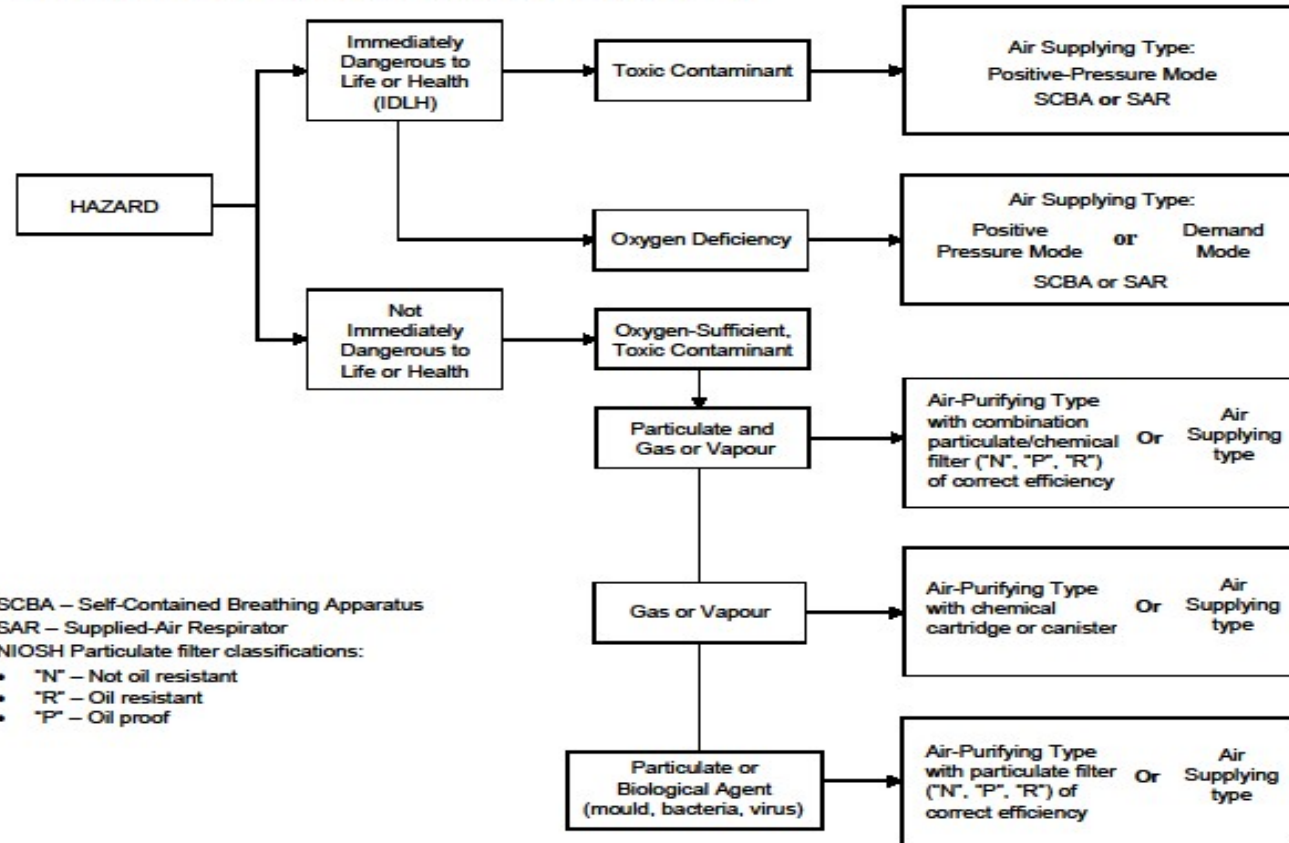
- the respirator cartridge is equipped with an end-of-life indicator
- or
- a qualified person calculates the change-out schedule using product information from the manufacturer or estimates based on knowledge of the effectiveness of the cartridge to remove the contaminant. The calculation method used must be the U.S. Occupational Safety and Health Administration (OSHA) model or an equivalent method. The OSHA model can be found at



- (8) **Address the need for emergency escape** — A mouth-bit and nose clamp respirator may be used for emergency escape situations if it can provide protection against the contaminants present and the respirator is not being used in an oxygen-deficient atmosphere. Other types of respiratory protective equipment that can be proven to provide equal or greater protection may also be used.

Figure 1 summarizes the process for choosing appropriate respiratory protective equipment.

Figure 1 Choosing an Appropriate Type of Respiratory Protective Equipment



# Choosing the specific model of respiratory protective equipment

The employer is responsible for ensuring that workers use the right types and models of respiratory protective equipment to effectively protect them. Choosing the appropriate model of respiratory protective equipment follows choosing the appropriate type. Each type of respirator is available in a number of models. The right model will fit the worker correctly and be comfortable to wear. Fit and comfort vary among individuals, so it is best to test various models before making a selection. There are several factors to be considered in the selection process.

- (1) **Regulatory approval** — Respirators chosen to protect workers against health hazards must be approved:
  - by the National Institute for Occupational Safety and Health (NIOSH)  
or
  - by another standard-setting and equipment-testing organization, or combination of organizations acceptable to Employment and Immigration.
- (2) **Manufacture specifications** — The breathing air used in an atmosphere supplying respirator can be supplied from a high pressure compressor, a low pressure ambient air pump, or by compressed air cylinders. The OHS Code requires employers to ensure that equipment is used in accordance with the manufacturer's specifications or the specifications certified by a professional engineer. An employer must ensure that equipment used to supply breathing air to workers has been designed and intended for that use and is being operated in accordance with the manufacturers specifications.
- (3) **Facial fit** — Many models offer face pieces in different sizes. If none of the face pieces on the selected model fits the worker properly, the worker will have to use a different type of respiratory protective equipment. The alternate selected must have a protection factor equal to or greater than the protection factor of the type originally chosen.
- (4) **Worker comfort** — Hot, cold or confined working conditions are uncomfortable at the best of times. Wearing respiratory protective equipment may increase this discomfort. Every effort should be made to choose respirators that are as comfortable as possible.
- (5) **Other factors** — Choosing the appropriate model of respiratory protective equipment may be influenced by other factors, such as the cost of the basic unit and replacement parts, and availability of service through a local repair centre.

# Using respiratory protective equipment

## Code of Practice

Employers must develop a Code of Practice regarding respiratory protective equipment. The code must:

- be in writing
- provide a detailed explanation of the selection, maintenance and use of respiratory protective equipment at the particular job site
- be readily accessible to all workers at the workplace
- be re-evaluated as appropriate.

Where healthcare workers may be exposed to airborne biohazardous material, an employer must ensure that the code of practice includes annual training. The training should include

- (a) information about the airborne biohazardous materials that workers may be exposed to including their potential health effects,
- (b) an explanation of why the particular respiratory protective equipment being used was chosen, including information about its capabilities and limitations and how to test for a satisfactory fit, and
- (c) an explanation of how to properly put on and take off the respiratory protective equipment without contaminating oneself or other workers.

## For more information:

[ohs-pubstore.labour.alberta.ca/pppe004](https://ohs-pubstore.labour.alberta.ca/pppe004)

Guideline for the Development of a Code of Practice for Respiratory Protective Equipment – PPE004

## Training

Workers wearing respiratory protective equipment must be thoroughly trained in its use and limitations. Training must include:

- information about the airborne contaminants, including their potential health effects and ways to detect the contaminants' presence
- why the particular respiratory protective equipment was chosen, and information about its capabilities and limitations
- how to properly put on and take off the respirator
- how to test for a satisfactory fit
- familiarization with the Code of Practice.

This training needs to be updated regularly, whenever different respiratory protective equipment is used or work conditions change. The CSA Standard recommends that

refresher training be provided at least every 2 years. Some types of equipment and the circumstances under which they are used may require more frequent training updates.

## Quality of Breathing Air

The OHS Code requires an employer to ensure that air used in a self-contained breathing apparatus or an air line respirator,

- is of a quality that meets the requirements of Table 1 of CSA Standard Z180.1-00, *Compressed Breathing Air and Systems*, and
- does not contain a substance in a concentration that exceeds 10 percent of its occupational exposure limit. (This does not apply to substances listed in Table 1 of the CSA Standard.)

The CSA Standard specifies that breathing air samples should be collected and analyzed at least once every six months. Employers are encouraged to follow the sampling and testing requirements outlined in the Standard to ensure continued compliance with Table 1. Additional air monitoring may be required depending on the source of the breathing air. Documentation on the breathing air quality tests must be maintained. The CSA Standard 294.4 recommends that records be kept for at least 10 years.

Equipment used to supply breathing air to workers should be located away from running equipment or idling vehicles which can introduce carbon monoxide, sulphur dioxide and oxides of nitrogen into the breathing air.

## Respirator fit testing

### General

Respiratory protective equipment that has a tight fitting face piece must be fit tested according to the CSA Standard Z94.4. There are two types of fit tests, qualitative or quantitative. In some cases, the assigned protection factor for the respirator will depend on the type of test that is done (see Tables 1 and 2 of this publication).

When fit testing is done:

- The respirator must be operating in a demand (negative pressure) air supply or non-powered air purifying mode.
- The tester must be qualified and trained to do the type of tests required. They are also required to maintain fit test records. The fit tester must also be able to wear a respirator and have worn one before.
- The wearer of the respirator must be clean-shaven where the respirator will contact the skin of the face prior to fit testing or fit testing may not be done.
- The wearer must be able to wear the respirator safely.

Fit testing must be done when:

- the respirator is first issued
- at least every two years if there is no change in the respirator or wearer
- if there is a change in the type, style, brand or size of respirator
- if there is a change to the wearer's physical condition that could affect respirator fit.

## Competency of the fit tester

Respirator fit testing services may be readily available from manufacturers, suppliers or health and safety consultants. The employer may also designate an individual at the work site to conduct fit testing.

There is no requirement in Alberta for a respirator fit tester to be “certified”, however the employer must ensure that they are competent. “Competent” is defined in the OHS Code as “adequately qualified, suitably trained and with sufficient experience to safely perform work without supervision or with only a minimal degree of supervision”.

CSA Standard Z94.4-02 requires that the persons who conduct fit testing have a minimum level of training in the following areas:

### General knowledge

General knowledge covers an understanding of the respiratory protection program including

- (a) local policies and procedures;
- (b) respiratory hazards encountered in the workplace, their potential health effects on the worker and the means to control them;
- (c) the rationale for the respirator selected;
- (d) where to find information; and
- (e) procedure to follow in case of an emergency.

### Health surveillance

The fit tester must have an understanding of the health surveillance process. The health surveillance must be conducted by a health care professional. Health surveillance involves a review and a written opinion by a health care professional of the suitability of the worker to safely use a respirator. This activity also requires the maintenance of accurate records. Refer to “Health Surveillance for Workers Wearing Respiratory Protective Equipment” on page 20 of this document for more details.

### Fit testing

The fit tester must have practical experience in the qualitative and quantitative fit testing method used to ensure that the user can achieve an acceptable seal with a specific tight-fitting respirator. The fit tester is also responsible for the maintenance of accurate records on fit testing done at the work site.

The fit tester must be able to demonstrate that they are adequately qualified to conduct fit-testing. This can be verified by a (dated) training card or certificate from a (competent) third party such as a training agency or respirator manufacturer. The fit tester should be able to demonstrate positive and negative pressure user seal checks and qualitative and/or quantitative fit testing to a competent person such as a trainer from a supplier or manufacturer or an Occupational Health and Safety Officer from Human Services.

If the fit tester will be doing qualitative fit testing, they must be able to properly demonstrate the method(s) that they use.

Fit testers administering quantitative fit tests should be able to

- calibrate the equipment
- perform the tests
- recognize invalid tests
- calculate fit factors
- ensure equipment is working properly

### **Care and practical use of respirators**

Care and practical use of respirators refers to

- (a) hands-on training relating to the choice of appropriate respirator for a given hazard
- (b) the operation of each respirator that will be tested, including
  - user seal checks
  - care
  - cleaning
  - inspection
  - end-of-service recognition
  - change-out of filter elements
  - replacement of air cylinders
  - identification of problems
  - use under failure or emergency modes
  - storage
  - removal from service
  - basic maintenance
  - familiarity with and adherence to the manufacturer's instructions and specifications

### **Limitations of the respirator**

These are the restrictions, cautions, warnings and prohibitions imposed by the manufacturer, testing and certification agencies, regulatory authorities and the employer on the use, care and maintenance of the respirator.

## User seal checks

A user seal check must be done each time a respirator is donned. Before fit testing is done, the wearer must also do the user seal checks. **User seal checks are not substitutes for fit testing.**

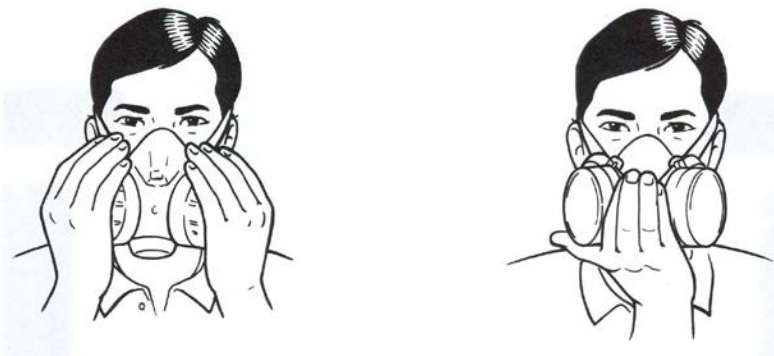
### Negative pressure seal check

The negative pressure seal check is done by closing off or blocking the inlet opening(s) of the air purifying elements of the respirator so that when the user inhales, no air will flow into the facepiece. The user then gently inhales and holds their breath for at least 5 seconds. The face piece should collapse slightly on the face and remain collapsed while the breath is being held. If this occurs, the test is successful. Otherwise, the user must verify the seal of the respirator to the face and adjust the facepiece and harness and repeat the test. If the test cannot be successfully completed, the user should check the respirator facepiece components for leakage or use a different brand/size of respirator.

### Positive pressure seal check

The positive pressure seal check is done by closing off or blocking the exhalation valve or breathing tube, or both, of the respirator so that no air will flow out of the facepiece. The wearer exhales gently and checks for a slight positive pressure in the facepiece. If no air leaks from the facepiece while positive pressure is maintained, the test is successful. Otherwise the seal of the facepiece must be checked and the harness adjusted and the test must be repeated. Again, if the user is not able to successfully complete this test, the respirator must be checked or another type tried.

Figure 1 Negative pressure fit check    Figure 2 Positive pressure fit check





## Seal checks for disposable respirators

For disposable respirators, the user seal checks are done somewhat differently. For non-valved disposable respirators, both hands must be placed completely over the respirator while the wearer exhales. The respirator should bulge slightly. For disposable respirators that have a valve, both hands should be placed over the respirator and the user inhales sharply. The respirator should collapse slightly. If air leaks at the edges of the respirator, it should be re-positioned and adjusted for a more secure fit and the test repeated. If the seal check cannot be successfully completed, another type/style/size of respirator should be tried.

Figure 3 Positive pressure user seal check – Disposable filtering facepiece respirator



## Quantitative fit testing

Quantitative fit tests involve the measurement of respirator leakage by monitoring leakage inside the respirator face piece with an instrument. These instruments can be purchased or rented from health and safety equipment suppliers. There are three types available:

- *Generated Aerosol Photometer*: concentrations of a non-hazardous test aerosol inside and outside the facepiece (such as corn oil or sodium chloride) are measured using a photometer,
- *Particle-Counting Instrument*: concentrations of particles in an aerosol are measured inside and outside the facepiece (ambient air is usually used as the challenge aerosol), and
- *Controlled Negative Pressure*: pressure differences inside and outside the facepiece are measured once a controlled negative pressure is applied.

These tests do not depend on the wearer's sense of smell or taste and tend to be more accurate than qualitative methods. Because the equipment used is more sophisticated, the fit tester will require a higher level of training to conduct the tests.

## Qualitative fit testing

There are several types of qualitative fit tests:

- odourous chemical types (banana oil) that depend on the wearer's ability to smell the test agent,
- tests that depend on the wearer's ability to taste the test agent (Bitrex™ and saccharin),
- the irritant smoke test which depends on the wearer's ability to sense irritation of the nose and throat.

For qualitative fit tests that involve the use of test agents such as banana oil, Bitrex™ or saccharin, the chemical is released into a test chamber that fits over the respirator wearer's head. For the irritant smoke test, the irritant smoke is released around the edges of the respirator. While the test is done, the wearer performs actions that simulate movements typically made during work activities such as talking, bending, reaching, nodding, etc. If the wearer detects the test agent, the respirator must be re-adjusted or exchanged and the test repeated until no odours, tastes or irritation are detected. A properly administered qualitative fit test will take about 15 to 20 minutes to perform, assuming a perfect fit during the first attempt. The specific procedures for conducting these fit tests are described in Appendix B of the CSA Standard.

### Irritant smoke test

One qualitative fit test is the irritant smoke test. It does not require a special enclosure since the test agent is released around the edges of the respirator. It involves the use of a chemical (stannic chloride or titanium tetrachloride) that reacts with the water in the air to form an acid smoke. The respirator must be fitted with a high efficiency (N100, P100 or R100) particulate cartridge and the wearer's eyes must be protected with appropriate goggles while this test is done. Alternatively, the wearer should keep their eyes closed throughout the complete test. If the employer will be using lower efficiency respirators, e.g. N95, the irritant smoke test must be performed with the same make, model and size of respirator equipped with high efficiency filters. Otherwise, another type of qualitative fit test must be done.

**The tester must ensure that they are protected from the irritant smoke while doing the fit test.** The test must be done in a well-ventilated area or outdoors and the tester should stand upwind of the respirator wearer. The tester may need to also wear a respirator and eye protection while conducting the test, if they notice irritation effects from the test agent.

The irritant smoke test procedure is as follows:

- (1) *The wearer dons the respirator along with other protective equipment such as hearing protection, head protection, eye protection, that they will be wearing at the worksite.*

- (2) *The wearer performs a negative and positive pressure seal check.*
- (3) *The fit tester prepares the irritant smoke tube for the test. This is done by breaking both ends of the glass tube using a tube-breaking tool provided by the manufacturer. A short length of rubber tubing is attached to the outlet end of the tube and the tubing and aspirator bulb provided by the manufacturer is attached to the inlet side. To produce smoke for the test, the aspirator bulb is gently squeezed to force air through the tube.*
- (4) *The tester ensures that the respirator wearer is sensitive to the irritant smoke effects and familiar with the distinctive odour of the test agent. Before the fit test is done, the tester generates smoke within one metre of the wearer's face and the wearer then brings a handful of smoke within about 20 cm of their nose and inhales gently. The results should be an involuntary cough or verbal acknowledgement of the odour of the smoke.*
- (5) *The tester releases the irritant smoke around the edges of the mask (from about 50 to 300 mm away), moving around the perimeter of the mask, with particular attention to the areas under the chin and at the bridge of the nose. If the wearer is using a quarter or half face mask, they must keep their eyes closed for this part of the test.*
- (6) *The fit tester continues to release smoke around the perimeter of the mask while the wearer does a variety of exercises. These should take about 30 seconds each, be done in the following order and will consist of:*
- *normal breathing*
  - *deep breathing*
  - *turning head from side to side while the wearer inhales*
  - *nodding the head up and down while the wearer inhales*
  - *talking*
  - *normal breathing*
- (7) *The fit test is successful if the wearer does not detect the test agent by odour or coughs.*

## **Health surveillance for workers wearing respiratory protective equipment**

Respiratory protective equipment should only be used by workers capable of working while wearing it and able to achieve an adequate facial seal. Some types of respiratory protective equipment are heavy. Other types may restrict breathing to the extent that wearing them could result in adverse health effects to workers with respiratory, lung or heart diseases.

Prior to fit testing and respirator use, the employer should ensure that a worker is free from physiological (physical) or psychological (mental) conditions that may preclude the worker from using the selected respirator(s). Approximately 2 to 2.5% of workers receive medical restrictions or disqualifications from using respirators.

The use of a respirator may place a physiological or psychological burden on a person. Health surveillance is important to ensure that a person is able to use a respirator without serious difficulty. The extent of the health surveillance needed is based on the type of respirator protection to be worn, work activities the worker will carry out, the length of time the respirator will be worn and the health of the worker.

A first step in health surveillance is to have the worker complete a questionnaire to identify any health conditions they have that would affect their ability to use a respirator. The Sample Respirator User Screening Form in Appendix E, CSA Standard Z94.4-02, *Selection, Use and Care of Respirators* provides an example of what could be included in a questionnaire when conducting health surveillance for workers wearing respiratory protection.

Privacy of worker's health information must be protected and must be considered by the employer. If a worker indicates that they have a health conditions on a questionnaire, they should be assessed by a health professional. Specific health information should only go to the health care professional. The CSA Standard defines a health care professional as "an individual who is licensed by a provincial licensing authority or equivalent to practice medicine or nursing and who possesses relevant experience and knowledge in the field of occupational health and safety".

The employer should outline the procedure (process) to be followed for health surveillance as part of the Respiratory Code of Practice. When the worker goes to the health professional to have the health surveillance completed, the employer should also provide information about the type of respiratory protection to be worn, work activities the worker is required to carry out, approximately how many hours per day the respiratory protection is required to be worn, and whether the worker is required to wear other personal protective equipment, in addition to the respirator.

After the health surveillance is completed, the health professional should provide the employer with documentation indicating whether the worker is fit to wear respiratory protection or has limitations. An example of the documentation required is found in Part 6 and 7, Appendix E of the CSA Standard.

The employer should determine the frequency of health surveillance. The extent of the review of fitness will vary depending on the type of respirator and the potential exposure circumstances and in some cases will only be verification of no change in medical status since the last assessment. The employer should ensure that a review of the fitness to wear a respirator is included at the time of fit testing to ensure that the respiratory protective equipment and medical status have not changed since the initial evaluation.

Additionally, there may be circumstances when a worker normally able to wear respiratory equipment may be unable to do so on a short-term basis. For example, a worker, returning to work following surgery or after recovering from a medical condition, may not be able to wear a respirator. The employer policy should include evaluation of these workers.

## Maintenance of respiratory protection equipment

- After each use, inspect the respiratory protective equipment for damage or deterioration, and clean it according to the manufacturer's instructions.
- Sanitize it between uses, when more than one person is using it.
- Replace cartridges and canisters that are near the end of their service life.
- Replace, exactly as specified by the manufacturer, worn or damaged valves, straps, and other parts.
- Store equipment not in use in ready-to-use condition in a clean, dry, easily accessible location.

For certain equipment, such as self-contained breathing apparatus, only individuals trained and certified by the manufacturer may do repairs.

## Additional Information Sources

This Safety Bulletin highlights the major factors to consider when selecting and using respiratory protective equipment. For more detailed guidance, consult the following sources:

[cdc.gov/niosh/docs/96-101/](https://www.cdc.gov/niosh/docs/96-101/)

National Institute for Occupational Safety and Health. *NIOSH Guide to the Selection and Use of Particulate Respirators*. Publication no. 96-101; NIOSH, Cincinnati, Ohio; 1996

[cdc.gov/niosh/npg/default.html](https://www.cdc.gov/niosh/npg/default.html)

NIOSH Pocket Guide to Chemical Hazards

Canadian Standards Association (CSA). Standard Z94.4-02. *Selection, Use, and Care of Respirators*. Rexdale, Ontario; 2002.

Information about contaminants may be obtained from the manufacturer's Safety Data Sheets (SDSs) or from reference books. The Canadian Centre for Occupational Health and Safety (CCOHS) also has a good web site for chemical information [ccohs.ca](https://www.ccohs.ca).

## Contact us:

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### **OHS Contact Centre**

(Complaints, questions, reporting serious incidents)

Anywhere in Alberta

- 1-866-415-8690

Edmonton & surrounding area

- 780-415-8690

Deaf or hearing impaired

- 1-800-232-7215 (Alberta)
- 780-427-9999 (Edmonton)

### **Website**

[alberta.ca/OHS](http://alberta.ca/OHS)

## Getting copies of OHS Act, Regulation & Code:

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Queen's Printer

[qp.gov.ab.ca](http://qp.gov.ab.ca)

Occupational Health and Safety

[alberta.ca/ohs-act-regulation-code.aspx](http://alberta.ca/ohs-act-regulation-code.aspx)

Edmonton 780-427-4952

Call any Government of Alberta office toll-free  
Dial 310-0000, then the area code and telephone number you want to reach

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