Thompson Rivers University

Thompson Rivers University Respiratory Protection Program

Safety and Emergency Management – July 2014

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Introduction:

This program has been designed to help reduce staff exposure to occupational airborne contaminants such as dust, fumes, mists, gases, vapours and microorganisms. Where feasible, prior to relying on personal respiratory protection exposure to contaminants will be eliminated by either:

a) The elimination of or substitution of a less hazardous process or material.
b) The implementation of *Engineering Controls* (e.g. general/local exhaust ventilation enclosure or isolation).

When the elimination or substitution of a hazard, or effective engineering controls is not feasible, Thompson Rivers University (TRU) is committed to ensuring that appropriate respiratory protective equipment; safe work procedures, education and training are provided to staff.

The purpose of the TRU Respiratory Protection Program is to outline specific information to facilitate:

a) Conducting the necessary hazard identifications and assessments.
b) Selecting appropriate respirators. Hence, information is provided pertaining to:
    - The types (models/sizes) of respirators available;
    - The fitting of respirators;
c) The required education for both respirator trainers and users;
d) The proper use, care and maintenance of the chosen respirator(s);
e) The record keeping associated with the issuance of respirators.

As designed, it is expected that this Respiratory Protection Program will meet and or/exceed the requirements of a written respiratory protection program as outlined in Work Safe BC's Occupational Health and Safety Regulations.

Scope:

This Respiratory Protection Program is intended to include all of the respirator types and associated equipment utilized throughout Thompson Rivers University. (TRU)

Examples of the respirators provided or utilized at TRU include those listed in Table 1. Reusable respiratory protection is supplied by North Safety Product Canada. There are two suppliers of disposable respirators, Kimberly-Clark (health care applications) and 3M (health care and facilities, maintenance and operations)

Table 1: TRU Respirator Types Currently Available

Respirator Type	Examples	Applications	Limitations
Disposable (N-95) Respirators Health Care Applications	3M 1860 3M 1860S 3M 1870	Protection from airborne microorganisms(e.g. active TB, SARS, measles, chicken pox)	- Not suitable for working with chemicals (e.g. changing solutions, cleaning up spills) - Not suitable for use in an oxygen deficient environment
Disposable (N-95) Respirators Facilities Maintenance & Operations only	3M 8210 3M 8710	Filtration efficiency against solid and liquid aerosols that do not contain oil	- Not suitable for working with chemicals (e.g. Changing solutions, cleaning up spills) - Not suitable for use in an oxygen deficient environment
Half-Face Cartridge Respirator Facilities Maintenance & Utility workers	3M 7502 3M 6200 3M 6300	Protection when working with organic based chemicals, mercury, asbestos etc. The type of cartridge utilized will be specific for the application	-Not suitable for working with airborne microorganisms unless fitted with a duel cartridge fitted with P100 filter - Not suitable for use in an oxygen deficient environment.
Full-Face Cartridge Respirator	North 5400 Series North 7600 Series	Protection when working with organic based chemicals, mercury, asbestos etc. The type of cartridge utilized will be specific for the application. Provides eye protection	-Not suitable for working with airborne microorganisms unless fitted with a duel cartridge fitted with P100 filter - Not suitable for use in an oxygen deficient environment.

The Respiratory Protection Program is meant to facilitate the proper selection, use and care of the above mentioned respirators. Further guidance is found in other TRU Health and Safety program manuals (e.g. confined space, asbestos management, spill protection, etc.). As well, information can be obtained in other departmental publications (e.g. Facilities, Maintenance & Utility Manuals)

Standards and Guidelines:

The Workers' Compensation Act and Occupational Health & Safety Regulation

The *Occupational Health & Safety Regulation* is adopted under the *Worker's Compensation Act* (effective April 15, 1998) as amended by the Workers' Compensation (Occupational Health and Safety) Amendment Act (effective March1, 2012). This document outlines the requirement for health and safety programs in provincially regulated workplaces in the province of British Columbia.

Canadian Standards Association

CSA Standard Z94.4-11 "*Selection, use and the care of Respirators*" specifies the requirement for the proper selection, use and care of respirators and outlines the essential components necessary for and effective respiratory protection program. The purpose is to establish a standard that, if followed, should protect respirator users from any know or potential respiratory hazards.

The standard is not intended to address the selection of respirators for the use against infectious agents, but does apply to all aspects of the respirator program for these agents.

Selection of Respirators

Selecting the appropriate respirator for a particular hazard or set of hazards is critical to mitigate staff and student health risk related to the hazard(s). The following pages outline a systematic approach to determining the type(s) of hazards, the level(s) of hazards and the type of protection required.

Although staff and supervisors are encouraged to assist in the respiratory protection selection process, a qualified person (e.g. a member of the Health and Safety Department) should be asked to make the final decision regarding the appropriateness of the selected personal protective equipment.

The following methodology must be used when choosing an appropriate respirator. The steps are as follows:

A. Hazard assessment process
B. The consideration of the following factors in the selection of the correct respirator:
   i. The types of respirators available
   ii. Protection factors
   iii. Considerations for the use of air purifying respirators
   iv. Change-out procedures and schedules

1. The Hazard Assessment

i) Basic Overview

To select the correct respiratory protection, a hazard assessment must be conducted to determine the nature of the hazard(s) that are or may be present. A representative from Health and Safety can assist in this assessment.
Please note that the hazard assessment process is not applicable to N-95 disposable respirators use.

The following are the steps for conducting a Hazard Assessment:

a) Identify what contaminants may be present in the workplace
b) Identify the physical properties of the airborne contaminants
c) Measure or estimate the concentration
d) Determine if the atmosphere is potentially oxygen deficient
e) Identify the appropriate occupational exposure limit for each airborne contaminant.
f) Determine if an Immediately Dangerous to Life or Health (IDHL) atmosphere is present.
g) Determine if there is an applicable health regulation or standard for the contaminants.
h) Determine if a known odour, taste, or irritation threshold exists.
i) Determine for particulate hazards if oil present.

j) Determine if the contaminant can be absorbed through or is irritating to the skin or eyes.

Contaminant Identification

The activity or process of concern must be assessed to determine what contaminant (s) may be present. It is important to remember that in many work situations; more than one type of breathing hazard can be present at a time.

e.g. Paint spraying may produce mists and vapours
e.g. Welding may produce gases and fumes.

Identification of the Contaminants physical State(s)

It is critical to determine the physical state(s) that is most likely to be encountered (i.e. whether the contaminant is present as a gas/vapour or particulate). The following provides a review of the various states:

Gaseous Hazards

- Many substances, like carbon monoxide and chlorine are hazardous gases at normal room temperature and air pressure.
- Vapours are the gas form of substances normally liquid at room temperature. Solvents like gasoline, acetone, or turpentine will produce vapours when they evaporate and mix with the surrounding air.
- Vapours are expected when liquids are present.
- Some gas and vapour molecules can irritate lungs, while others can be easily absorbed through the lungs into the bloodstream. Once in the blood, some of these chemicals can damage the nervous system and internal organs

Particulate Hazards

Particulates can take many different forms:

I. Dusts/Fibres (small/Solid Particulates)

Dusts and fibres can cause a variety of health concerns, depending on the size of the type and size of the material. For example, large dust particles can irritate the nose, throat, and airways; very small dust particles can lodge deep in the lungs and cause serious lung disease depending on the type of the dust or fibres that is inhaled.

- Dusts are formed when solids are broken down (e.g. through processes such as sanding, milling, cutting, crushing, grinding or drilling)
- Fibres are solid particles with a length several times longer that the width (e.g. asbestos fibres or glass fibres)

II. **Mists (Very Small Liquid Droplets)**

Mists are tiny airborne droplets of liquid that form when liquid is sprayed, shaken, mixed or stirred.

- Depending on the liquid, mists can irritate the skin, eyes, lungs or air passages
- Some mists are strongly irritating; other mist can damage internal organs if they are inhaled and absorbed into the bloodstream through the lungs, over a long period of time.

III. **Fumes (Very Small Solid Particles)**

Fumes form when solid material like metal or plastic is heated, causing some of it to "boil off." The boiled off material cools in the air and then condenses into fumes tiny, solid particles/ Processes such as welding, smelting, soldering and brazing produce fumes. Inhaling some types of fumes can cause health problems ranging from flu-like symptoms (i.e. short-term exposure to zinc fumes) to serious lung and nerve damage (i.e. Long-term exposure to lead fumes) and death (which can be caused by short-term exposure to cadmium fumes).

Measure/Estimate the Contaminant Concentration

A qualified person must determine (through measurement or estimation) the possible contaminant concentration(s). This can be done though air sampling and analysis, mathematical modeling, or information available in scientific literature that documents similar circumstances.

Determination of a Potentially Oxygen-Deficient Atmosphere

Normally air (at sea level) contains approximately 21% oxygen. However, when this level drops below 19.5% by volume, a condition known as "oxygen deficiency" results that can be deadly – a lack of oxygen affects the brain very quickly. If you enter an area with low oxygen, you could faint and die within a few minutes.

Oxygen deficiency can develop in confined or enclosed spaces like tanks, sewers, and areas where inert gases, such as nitrogen, are used. As a result, ***All*** confined spaces should be considered to contain an atmosphere that is immediately dangerous to life and health (IDLH) until proven otherwise by testing with specialized monitoring equipment.

Oxygen deficiency can occur in two ways:

a) Oxygen is used up by:
    1. Combustion of flammable substances such as in welding and other hot work.
    2. Explosions or fires (oxygen levels may stay dangerously low long after the fire is out because the oxygen is replaced by the products of combustion.
    3. Chemical reactions such as rusting of metal
    4. People working in the space and using up oxygen as they breathe.

b) Normal air can be displaced by other gases (e.g. welders using argon gas as a shielding gas to displace normal air around the weld during some welding processes). Shielding gas used in a confined or enclosed work space can build up and displace the air that workers need for breathing. Leaking gas lines also let gas into areas where it is not normally present. The oxygen level at the work location must be known if conditions exist which may affect the oxygen levels (i.e. confined spaces, use of asphyxiant gases, tec.).

If the oxygen level is below 21% and especially if the levels are approaching or below 19.5%, Health and Safety must be notified immediately. A TRU Safety Officer must review the situation and assist in the development of safe work procedures. Air purifying respirators are not approved for use for oxygen levels below 19.5%. Where the oxygen level is less than 19.5% either a self –contained breathing apparatus (SCBA) or a supplied respirator with an escape bottle **must be** used and all workers entering the area must follow special procedures.

Identifying Appropriate Occupational Exposure Limit for Airborne Contaminants

Applicable exposure limits need to be determined primarily through referencing the American Conference of Governmental Industrial Hygienists' (ACGIH) publication, "Threshold Limit Values and Biological Exposures Indices" TRU Health and Safety have these limits on file and up to date.

Determination of an Immediately Dangerous to Life and Health (IDLH) Atmosphere

An "IDLH Atmosphere" is one that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape.

IDLH Atmospheres are always assumed when one or more of the following circumstances exist:

- A known contaminant at or greater than an ACGIH IDLH concentration;
- A known contaminant at an unknown, but potentially toxic, concentration;
- An oxygen deficiency;
- An untested confined space
- Contaminants at or above the lower explosive limit; and
- Structural Fire Fighting.
- An area where in the opinion of a qualified person presents a potential IDLH atmosphere.

If any of the above conditions exist or if there is a significant risk of accidental release into the workers' breathing zone, Health and Safety should be contacted and asked to assist in the review and/or development of safe work procedures prior to the work commencing.

When a worker is required to enter or work in an IDLH or oxygen deficient atmosphere, the worker must:

a. Wear a full face piece positive pressure respirator which is either an SCBA or an airline respirator with an auxiliary self –contained air cylinder of sufficient capacity to permit the worker to escape unassisted from the contaminated area if the air supply fails and
b. Be attended to by at least one other worker stationed at or near the entrance to the contaminated area who is equipped and capable of affective rescue.

2. Role of the Supervisor

i. Collecting the Hazard Data

If it is deemed that staff member or a group of staff must wear respiratory protection, it is the immediate **supervisor's responsibility** to begin collecting the

necessary assessment data. This should be done using parts A and B of TRU's "Respirator Selection Information Sheet."

A copy of this document has been provided in Appendix "A".

There are a number of sources of information that can be utilized when collecting the necessary background information. These include:

a. **Material Safety Data Sheets (MSDS's)**
A Material Safety Data Sheet (MSDS) is very useful when selecting which respiratory protective equipment is appropriate for the product being used. Appendix "B" provides a sample material safety data sheet as an example of the general appearance of this type of documentation. Readers are referred to and encouraged to complete TRU's Workplace Hazardous Materials Information System (WHMIS) Training for more information.

A typical MSDS contains sixteen sections that provide a variety of detailed technical information on controlled products such as the measures needed to protect workers at risk of over exposure (e.g. personal protective equipment selection, spill control measures, etc.).

The following information can be obtained from the MSDS to assist in selecting the proper PPE (i.e. respiratory protection) and for the development of safe work procedures:

- Threshold Limit Values of airborne contaminants;
- Physical state(s) of the substance
(e.g. gas or vapour, particulate; or a combination of both);
- Warning properties if the substance is a gas or vapour;
- Exposure routes (e.g. eyes, skin, lungs, etc);
- Personal protective equipment required (e.g. eye protection, hand protection, respiratory protection, etc);
Note: This may be especially important if the individual must wear eye protection in combination with respiratory protection.
- Lower Explosive Limit LEL of substance);
- IDLH concentration and the possibility of cartridge/canister having poor sorbent efficiency at IDLH concentration and below.
- Chemical reactivity and vapour pressure of substance; and
- Expected workplace airborne concentrations of contaminants.

Certain airborne hazards such as: particulate hazards (e.g. biological hazards, smoke, etc.), oxygen deficiency, gaseous or vapour hazards may not have an MSDS. In these cases, the Respirator Selection Information Sheet should be completed using information from sources such as:

b. **WSBC OH&S Regulations**
Work Safe BC enforces the Workers' Compensation Act and the Occupational Health and Safety Regulation. The regulation contains a considerable amount of information regarding the requirements for respiratory protection against a number of different airborne hazards. As a result, individuals attempting to select a level/type of respiratory protection must be familiar with the regulatory requirements.

In addition, it should be noted that there have been a number of changes to the WCB regulatory requirements. Hence, an individual conducting a hazard assessment should access the Workers' Compensation Board's web page (www.worksafebc). ON that page, there are also a number of online publications that may be of assistance as reference material.

c. **Existing Safe Work Procedures**.
It is important that safe work procedures be consulted prior to work commencing. Additionally, it is essential to review the information to ensure it is still appropriate and that is will enable staff to work safely. If there are concerns, TRU's Health and Safety should be consulted to assist in reviewing and possibly, revising the procedures.

d. **Health and Safety Department**
Where the individual charged with collecting the hazard assessment data has questions or concerns, she/he should contact TRU Health and Safety. The Safety Officer will assist that person in completing the documentation appropriately or assist in the data collection process.

ii. **Forwarding the Information**

Upon completion of the necessary information, the supervisor is responsible for forwarding the form to TRU Health and Safety for reviewing and the completion of the final selection on the form ("Additional Exposure Information")

Based on the data provided, Health and Safety will recommend a respirator suitable for the hazard being assessed and the contact the supervisor to provide a recommendation for respiratory protection.

Note: Health and Safety may contact the department for clarification and confirmation of the assessed hazards as some complex situations may require additional detailed information; this may involve a meeting with the supervisor.

iii. **Preparing Safe Work Procedures.**

Based on the response by Health and Safety, the supervisor will be responsible for the ensuring that safe work procedures are developed, reviewed and /or revised for the hazard or activity requiring the respiratory protection.

a) **Fit Testing**

Supervisors are responsible for ensuring that staff requiring fit testing, are fit tested in accordance with the WSBC's requirements and as per the instructions in the TRU Respiratory Protection Program. (RPP)

Supervisors will be able to book fit testing for staff requiring respirator fit tests through TRU's Health and Safety Department. Health and Safety have persons qualified to perform fir testing in accordance to WSBC and TRU RPP.

3. Selecting the Correct Respirator

I. Over-view

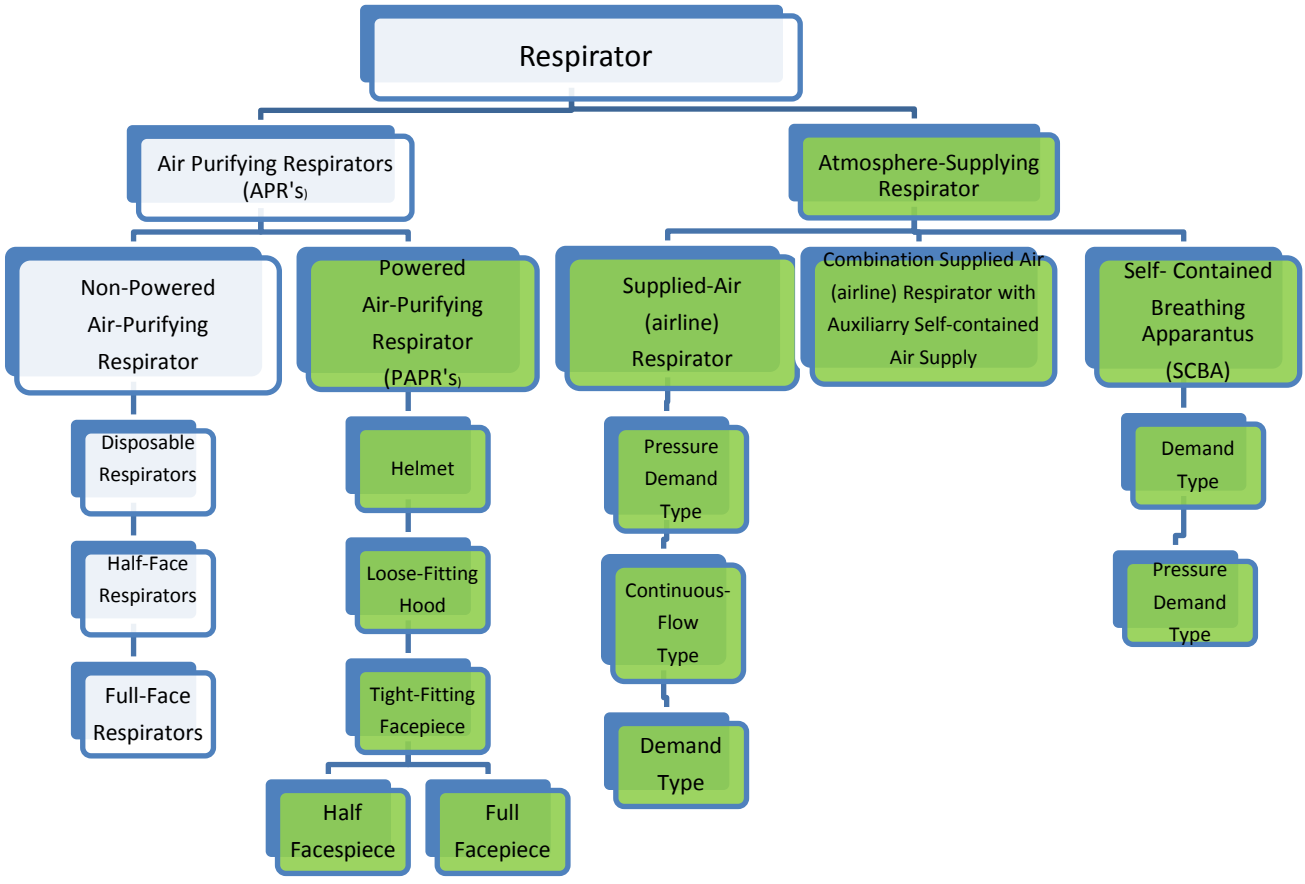
Selecting the correct respirator can be a difficult task. The individual responsible must be able to correctly assess the risks associated with the identified hazards and then determine a respirator that will achieve an adequate level of protection given the chosen respirator's various advantages and drawbacks. It is strongly recommended that the selection of respirators be conducted with a qualified person in the TRU Health and Safety Department. Additionally, the qualified personnel are strongly advised to consult with the Occupational Hygiene Officer at WSBC during and/or after the decision-making process if he/she has any lingering concerns regarding his/her decision.

3.1 Selecting the Correct Respirator: Respirator Types

As mentioned previously, in choosing an appropriate respirator for a particular hazard, one must be aware of the types of respirators available within the scope of Thompson Rivers University.
The following is a summary of the most common types of respirators that are available on the market today.

*Note not all of the respirators types discussed in the following pages re available or utilized at Thompson Rivers University due to supply and training of individuals.

Table 2 Schematic Overview of the Common Respirator Types



Included in the TRU Respiratory Protection Program

Not included in the TRU Respiratory Protection Program at this time

In general, there are two types of respirators.

Air-Purifying Respirators – These devices clean the air in the surrounding environment as it is introduced into the face piece by either the respirator wearer's inhalation or through mechanical means such as a fan unit.

Atmosphere-Supplying Respirators – These respirators supply a clean air source to the respirator wearer via an airline attached to a compressor outside the immediate work vicinity or from an air tank carried by the individual.

Air-Purifying Respirators (APR's)

APR's use an air-purifying element such as a cartridge or filter system to clean environmental air as it is inhaled by the wearer. As the air is pulled through the filter or cartridge media the contaminant is removed. There are a variety of filtration types and hence it is important that the:

a) Chosen media is appropriate for the surrounding contamination.
b) Mask is properly fitted (e.g. air only enters the mask through the filtration media)
c) Mask and the filtration media are in proper working condition.
d) Filtration media is only worn for the length of time specified by the change-out schedule.
    - The change out schedule will be determined by: the type of filter, the concentration of the airborne contaminants, the user's respiratory rate and environmental conditions such as the temperature and humidity levels in the ambient air.

Limitations of the APR's:

- APR's do not supply air, they only filter the surrounding air, and it is important that they are not utilized in areas that are or could become oxygen deficient (e.g. < 19.5%)
- Air-Purifying respirators cannot be used in IDHL environments
- No protection is provided against:
    - Skin irritation
    - Absorption of materials through the skin.
- Non-powered air-purifying respirators cause discomfort due to the resistance associated with inhalation.

- Several types of APR's create problems for users who require corrective eyewear.

Types of APR's:

Presently at TRU there are only non-powered air-purifying respirators. These are divided into two basic categories: Disposable respirators and Half-face air-purifying respirators. In the future the need for other types of respirators can be reviewed and possibly included into the TRU Respiratory Protection Program.

i. Disposable Respirators

The manufacturers of disposable masks provided by TRU are all equipped with two straps and are single use, disposable masks. Each model of N-95 disposable masks can be fit tested and fit-checked; according to the WSBC OH&S Regulation. If an employee is required to wear a disposable respirator for protection against a hazardous substances, she/he must be fit tested and educated on the appropriate use of the respirator.

The following are a list of concerns regarding the use of N-95 Disposable Respirators:

a) A disposable mask should not be used to protect against levels of contaminants that exceed the respirator's approved maximum use concentrations or in oxygen deficient environments.
   - Hence, it is critical that users unfamiliar with the requirements of the mask consult with the manufacturer's instructions or a member of Health and Safety to discuss the respirator's appropriate use.

b) Disposable masks must be worn with both straps positioned correctly.
   - It is inappropriate to use only one strap or to modify the mask such that one strap is removed.

c) Respirator straps should not be unnecessarily stretched to facilitate the donning of the mask. Straps should not be stretched over hard-hats as this warps the filter and reduces the elasticity of the straps thereby reducing the protective capabilities of the mask.

d) Disposable masks should not be folded as folding creases the filter, thus possibly reducing the efficiency of the mask.

e) Damaged masks should not be worn and be discarded.

f) As the respirator filter traps dusts, mists or fumes, it becomes clogged, making it harder for air to pass through. This may increase the chance that

contaminated air will enter the mask around the seal. When breathing becomes more difficult replace the respirator.

g) N-95 respirators are not to be used against particulates contaminated with oil.

h) Users should change his or her respirator if the mask becomes soiled by blood or body fluids. In addition, the mask should be changed if the user coughs or sneezes while wearing the respirator as this can disrupt the seal.

ii. **Half-Face Air-Purifying Respirator**

A half-face respirator is similar in size to a disposable respirator as, both cover from the bridge of the nose to below the chin. However, these respirators protect against higher levels of contaminants than disposable respirators. These respirators are made using silicone or rubber face piece that is held against the face by head straps. This sturdier design allows for a better seal against the faces, making it harder for contaminated air to leak into the respirator.

N.B. The standard half-face respirator used at TRU is the 3M 7500 series and the 3M 6200 series. This mask is silicone-based with a head strap for the top and the back of the head and a strap for the back of the neck.

Generally, these types of respirators are designed such that one or more filters or cartridges snap or screw onto the face piece. As mentioned previously, TRU uses the 3M 7500 and 6200 mask series that relies on two screw-on cartridges being adapted to the mask prior to use.

- When inhaling, one-way valves (located behind the cartridge(s) open and allow air to be drawn through the filters/cartridges where contaminants are removed. When exhaling, another one-way valve (located close to the chin) opens, letting the air out. After exhaling, this valve closes to prevent contaminated air from entering the respirator when the next breath is taken.

iii. **Full-Face Air-Purifying Respirators.**

A full face respirator is similar in construction to a half-face respirator (e.g. both are generally made with rubber or silicone) and both have sturdy straps to secure them on the user's head. A half-face mask covers only the nose, mouth and chin. Conversely, a full-face mask covers the entire face, protecting the eyes and facial skin against irritating contaminants, thus offering a higher degree of protection.

N.B. TRU presently does not use or stock full-face respirators, however if a condition were to arise where the additional protection of the eyes and face are deem necessary, Health and Safety will resource the appropriate respirator for the task.

Full-face respirators are also designed such that one or more filters or cartridges snap or screw into the face piece.

- When inhaling, one-way valves (located behind the cartridge(s) open and allow air to be drawn through the filters/cartridges where contaminants are removed. When exhaling, another one-way valve (located close to the chin) opens, letting the air out. After exhaling, this valve closes to prevent contaminated air from entering the respirator when the next breath is taken

3.2 Choosing the Respirator: Considerations Surrounding the Use of Air-Purifying Respiratory Protection.

Although, there are two main classes of respiratory protection, this program will only discuss Air-Purifying Respirators. These respirators clean the contaminated, ambient air using a filtration media.

When attempting to assign an air-purifying respirator to counter a hazard (or group of hazards), it is important to remember that these types of respirators **can definitely not be used** for oxygen deficient or IDHL environments. Once this has been established, it is important to realize that there are two basic types of cartridges or filters:

a. **Cartridges that are not used for gases or vapours;**
b. **Filters that are used for particulates;**

N.B. There are systems that combine particulate filters with gas or vapour cartridges, but a particulate filter should never be used on its own to address a gas/vapour hazard and vice versa.

The following outlines a number of features inherent to both the particulate filters and the gas/vapour cartridges.

A. Cartridges and filters for Air-Purifying Respirators

When choosing between specific types of cartridges and filters, it is important to remember that each is designed for specific contaminants. If an improper cartridge is selected, the wearer will have a false sense of security and protection.

In addition to choosing the correct filter and /or cartridge, it is also important to note that the brand of filter/cartridge must match the specific respirator brand being used. For example, a North cartridge cannot be used with a 3M half-face respirator and vice versa.

i. **Cartridges:**

Cartridges are designed to remove gases and vapours when air is breathed through them. Cartridges contain activated charcoal or another compound that is used to trap/react with the specific contaminants thus removing them from the air prior to the air being inhaled. Specific cartridges are utilized for removing specific contaminants and only cartridges designed to remove the contaminants of interest can be used. For NIOSH approved cartridges there is a specific colour code system. The colour code is attached directly to the filter/cartridge and provides information regarding which types of contaminant is designed to remove.

Table 3: NIOSH-Colour Coding for Air-Purifying Respirator Cartridges/Filters

Contaminant	**Assigned Colour code**
Acid Gas	White
Organic Vapour	Black
Ammonia Gas & Methyl Amine	Green
Carbon Monoxide	Blue
Acid Gas & Organic Vapours	Yellow
Particulate (Dust, Fume, Mist)	Grey
Mercury	Orange
Defender	Brown(Olive)
HEPA (Dust, mists, fumes, asbestos,)	Purple

Prior to assigning a particular cartridge for use, the type of cartridge chosen should be reviewed by a qualified person (e.g. Health and Safety). Additionally, if there are continued concerns it is useful to ensure that an Occupational Hygienist at Work Safe BC also reviews the selection.

a) **Breakthrough:**

When a cartridge is “full” it will no longer remove contaminants from the air and those contaminants will begin to leak into the respirator. This process is referred to as “breakthrough” and it explains why this type of respiratory protection cannot be used in IDHL environments.
In addition to the IDHL “restriction” it is also important to ensure that this type of respiratory protection is only used against gas/vapour contaminants with adequate warning properties. (e.g. smell, taste or breathing irritation alerts the user of possible problems well before the user experiences deleterious effects).

Examples of Where Odour Threshold Can Be Used as a Warning Property.

To rely on the odour threshold as an indicator for breakthrough, the odour threshold must be considerably lower that the permissible concentration. (e.g. the highest concentrations allowed by Work Safe BC for a contaminant ion a workplace before workers are required to wear respiratory protection). TRU Health and Safety does not advocate the use of odour threshold. This is due to the range in people’s ability to smell certain chemicals and the possibility of olfactory fatigue (the decrease in olfactory perception of a chemical due to exposure to that particular or even a similar substance).

b) **End-of-Service-Life Indicators:**

For some contaminants with poor warning properties, there are cartridges with end-of service-life indicators (ESLI’s). ESLI’s, generally change colour to indicate when the cartridge has reached the end of its usefulness, and needs to be replaced. (e.g. Mercury Vapour Cartridges have ESLI’s due to Mercury’s poor warning properties.

c) **Air-Purifying Canisters:**

Canisters are just like cartridges except that they are considerably larger and consequently, tend to last longer.

d) **Change-out Procedures/Schedules:**

Respirator filters, cartridges and canisters are only capable of functioning effectively for a certain period of time. If the cartridge has a built in end of service life indicator (ESLI), this feature may be used to determine when the cartridge must be changed. For all other circumstances, a change-out schedule must be developed. If a proper change-out schedule is not adopted, use of the respirator may provide the wearer with false sense of security and protection.

e) **Air-Purifying Cartridges and Canisters – Usage Guidelines**

Gas/Vapour cartridges/canisters are available for a wide range of contaminants. It is important to know which hazards are present so that the appropriate system can be chosen. These units have a limited life span and thereby must be replaced on a regular basis. All cartridges should be dated when put into service so that she/he has an idea regarding when they should be replaced.
Gas/Vapour cartridges/canisters should be stored in accordance with manufactures recommendations. It is recommended that they be stored in re-sealable plastic bags to keep the active material in the filters from reacting with the contaminants in the air.

Some issues to be considered when issuing air-purifying respirators:

- Do not use APR's in an oxygen deficient (below 19.5%) atmosphere
- Does not use gas/vapour cartridges to protect against dusts, mists, and fumes unless the cartridge is fitted with an appropriate pre-filter.
- Do not use them to protect against very toxic materials (e.g. in IDLH environments)
- Do not use them when contaminants concentrations are above the maximum-use concentrations of the cartridge.
- Do not use this type of system when the gases/vapours of concern have poor warning properties instead, an atmosphere-supplying respirator must be used.

ii. Particulate Filters:

Filters are made from fibrous materials that trap particles when air passes through it. Filters are designed to provide protection against particulate contamination (dust, mists, and fumes). Due to design, filters cannot protect the user from vapours or gases. Filters are effective because they capture the dusts/mists/fumes in the air before they are breathed in. When "captured" particles begin to accumulate on the filter, they occupy the spaces between the fibers and it becomes difficult to breathe. When this occurs, a point will be reached when it will become easier for contaminated air to leak in the sides of the mask. Hence, when it becomes difficult to breathe, it is important for the user to replace the filter.

a. Non-Powered Air-Purifying Respirator Filters

There are nine classes of particulate filters with NIOSH approval that can be used in conjunction with non-powered air purifying respirators. The classes are created by combining the respirator's ability to protect the wearer from airborne oil and its efficiency at removing respirable particles from inhaled air. N-95 disposable are respirators that are utilized by Facilities, Maintenance or used in patient care for protection against infectious airborne diseases. Above these, the next step is to refer to filters that are 99.7% efficient.

All particulate respirators are categorized as either an "N" an "R" or a "P".

"N"- Not oil resistant, May only be used in environments free of oil mists.

"R"- Resistant to oil, May be used in environments with or without oil mist.

- If used in an environment containing oil mist, they may only be used for one 8-hour shift whether used continuously or intermittently.

"**P"- O**il **P**roof, May be used in environments with or without oil mist.

- If used in an environment containing oil mist, they may be used for more than one 8-hour shift. In order to determine when the filter must be changed, a change-out schedule must be completed.

Each of these classes is further categorized into one of three classes according to their levels of filter efficiency. These classes are determined by testing the

filter's ability to remove particles that are 0.3 microns in diameter. Based on this test, the following three classes have been established:

"95" – 95% efficient in removing particles that are 0.3 microns in diameter

"99" – 99% efficient in removing particles that are 0.3 microns in diameter

"100" – 99.97% efficient in removing particles that are 0.3 microns in diameter

3.3 Choosing a Respirator: Determining Change-Out Procedures And Schedule

The respirator filters, cartridges, and canisters used with air-purifying respirators are only capable of functioning effectively for a certain period of time. If a proper change-out schedule is not adopted, use of the respirator may provide the wearer with false sense of security and protection.

The useful life of a cartridge and /or filter is affected by a number of parameters:

a. The contaminant's properties (e.g. physical state and concentration);
b. Level of exertion of wearer (e.g. breathing rate/volume);
c. Environment (e.g. temperature, humidity, pressure);
d. Physical characteristics of the air-purifying element (e.g. volume, surface area etc)
e. Respirator use pattern (continuous vs. intermittent)
f. Presence of other contaminants.

If the cartridge has a built in end of service life indicator (ESLI) this feature may be used as a means to determine when the cartridge must be changed. For all other circumstances, a change-out schedule must be developed. Odour threshold can be utilized in the overall design of the change-out schedule, but should not be used as the principal method.

3.4 Health Surveillance

Prior to fit-testing and respirator use, the "*Respirator User Screening Form"* must be completed. This documentation confirms that the individual is free from any physical or psychological conditions that may preclude him/her from being assigned the use of a selected respirator.

If any concerns regarding the use of the respirator are identified, the staff member will be referred to his/her family physician for additional assessment regarding the staff member's ability to use a respirator.

If a change in health status of the staff member occurs following the screening process, the staff member must inform his/her supervisor and contact Health and Safety to schedule a follow-up assessment.

3.5 Selecting Appropriate, User-Specific Respirator

Once the appropriate class of respirator and cartridge/filter (where applicable) has been selected by the appropriate personnel, she/he must ensure that the protection will be suitable for the user(s). To do this, she/he must ensure that the user is fit-tested and has received adequate training. The following sections outline those sessions. One of the requirements will be training the user how to conduct respirator fit checks—fit checks will be covered in its own section.

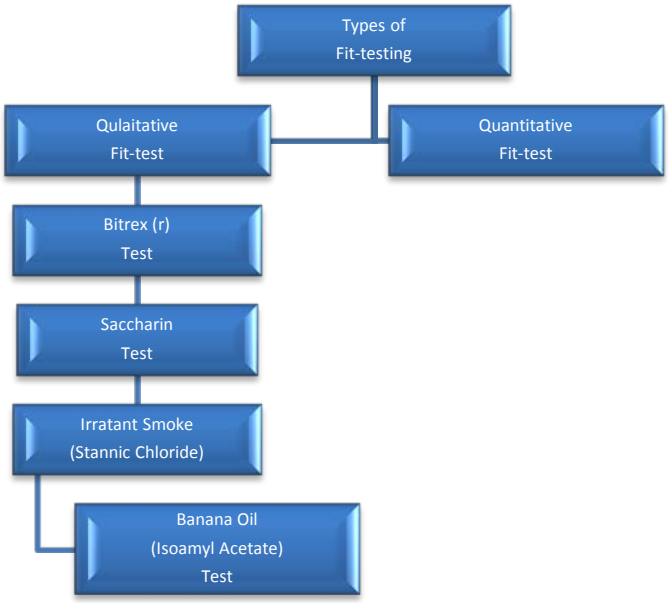
A. Fit-Testing

WSBC OH&S Regulation clearly states that under no circumstances should a staff member be issued, or be required to wear a respirator model which she/he has not been fit-tested for, or on which she/he has "failed" the fit-test. A qualified person from TRU Health and Safety will conduct the fit-test annually.

There are a number of different tests that are available for fit-testing. The following schematic diagram outlines the qualitative and/or quantitative fit-tests available to determine the ability of the user to obtain a satisfactory fit and an effective seal. The results of the fit-test, among other criteria, should be used to select specific types, makes, sizes and models of respirator for use by the individual users.

Regardless of the type of test utilized, each respirator user that is actively required to wear a respirator must be fit-tested **at least annually** or whenever work conditions necessitate a change in the type of respirator worn. In addition, the following conditions must be met:

Types of fit-testing



a) A fit test **shall never** be conducted on an individual where facial hair can be expected to interrupt the seal between the mask and that person's face.
    - This issue is further discussed in the Section discussing the topic of "Failed Fit Tests." "Male respirator User with Beards" and "Employee Failure to Comply."

b) When other personal protective equipment such as eye, face, head and hearing protection are required to be worn, these shall be worn during the respirator fit-test(s) to ensure that they are compatible with the respirator(s) and do not comprise the facial seal.

The following section outlines the test protocol used in the TRU fit testing process

B. Qualitative Fit-Tests (QLFT's)

QLFT's rely on a person's ability to detect a particular test agent by odour, taste or irritation. Qualitative fit testing shall be done on any respirator that has been given an assigned protection factor of 10 or less (this includes N-95 disposable respirators).

To date, there are no studies that indicate that the use of qualitative fit test protocols present a danger to the health and safety of the person conducting the test or to the test subject when conducted in the prescribed manner. However, it is important that the testers review the manufacture's Material Safety Data Sheet(s) for appropriate handling and disposal procedures of the challenging agents.

At TRU, the choice of which test method to be used will follow the following selection criteria:

i. **N-95 Disposable Respirators:**
This type of respirator can only be fit tested using Bitrex (chemical bitter) or Saccharin. Typically, Bitrex will be used as the primary test agent; in situations where Bitrex cannot be utilized. (e.g. the worker cannot taste the solution) the saccharin solution will be used.

The Bitrex/Saccharin Tests will be administered according to the test protocols outlined in CSA Standard Z-94.4-02 (Selection, Use, and Care of Respirators)

Both the Bitrex solution and saccharin solutions will be administered using a 3M FT-30 Qualitative Fit-Test Apparatus kit.

In both cases, the relevant Material Safety Data Sheets (MSDS's) will be available during fit-testing for reference by both the tester and the user. Information from both the Bitrex and Saccharin fit-test processes will be recorded using TRU Fit- Testing Records.

ii. **Elastomeric (Half-Face Respirator)**
Re-usable half-face respirators can be fitted using all four of the suggested QLFT protocols (e.g. Bitrex, Saccharin, Irritant smoke). The sequence for considering the test protocols will be:

1. Bitrex – generally administered using 3M FT-30 Qualitative Fit-Test Apparatus
2. Saccharin – generally administered using a 3M Ft-30 Fit-Test Apparatus
3. Irritant Smoke

Banana oil is not presented on this list because CSA Standard's requirement to provide a specialized enclosure for conducting the tests. Hence, for a majority of cases, if the first three options are no viable, the user will be tested using a quantitative method. This method is presently not available at Thompson Rivers University.

In all three cases, the relevant Material Safety Data Sheets (MSDS) will be available during fit-test sessions for reference by tester or user.

Information obtained during the fit-test sessions will be recorded using TRU Fit-Test Records.

iii. **Personnel Responsible for Qualitative Fit-Testing.**

Qualitative Fit-Testing will only be conducted by:

a) Individuals trained by Health and Safety.
b) Representatives from Health and Safety.
    - Health and Safety personnel will provide fit-testing clinics under limited circumstances.

Unless specifically approved by Health and Safety, only these two groups may provide qualitative fit-testing at Thompson Rivers University.

C. Education & Training

All Respiratory Protection Program participants shall be given adequate training by a qualified person to ensure the proper use of the respiratory protection within TRU.

I. **Trainers:**

Trainers will be trained to provide fit-testing on:

a) Half-face piece – filtering face piece (N-95) respirators only
b) Half face piece – elastomeric face piece respirators only.
c) Both “a” and “b” above.

II. **Training for Staff Members Required to Wear Respirator:**

Staff will receive education/training at the same time as their fit-test, on an annual basis. The initial training will occur prior to the staff member being issued a respirator or being assigned a task requiring the use of respiratory protection. Additional training will be performed if inadequacies in the employee’s knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill.

Education/training and fit-testing will be provided by members of the Health and Safety Department, or those performing testing for Health and Safety under their approval.

Topics covered during the education/training component of a fit-test session will include:

- Overview of the Respirator

- Inspection
- Maintenance
- Storage
- Limitations
- Donning and Doffing
- Fit-test Overview
- Fit-test

Records of the training will be maintained with the Health and Safety Department.

Follow-up refresher training will be conducted each year at the time of annual fit-testing.