Personal Protective Equipment

Respirators - Respirator Selection

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When should a respirator be used?

Workers should use respirators for protection from contaminants in the air if other hazard control methods are not practical or possible under the circumstances. Respirators should not be the first choice for respiratory protection in workplaces. They should only be used:

- When other categories from the "hierarchy of controls" cannot be implemented or are not fully effective (such as elimination, substitution, engineering, or administrative controls).
- While engineering controls are being installed or repaired, or if they become ineffective.
- When emergencies or other temporary situations arise (such as maintenance operations or chemical release).

How should respiratory hazards be controlled?

Respiratory hazards can include airborne contaminants such as biological contaminants, dusts, mists, fumes, and gases, or oxygen-deficient atmospheres. Note that more than one respiratory hazard can be present at the same time.

A hazard control program consists of all steps necessary to protect workers from exposure to a hazardous substance, the training and procedures required to monitor workers' health and exposure to hazards such as chemicals, materials, or substances, or other types of hazards such as noise and vibration. A written workplace hazard control program should outline which methods are being used to control the exposure and how these controls will be monitored for effectiveness.

After elimination and substitution, well-designed and maintained engineering controls are the preferred methods of controlling worker exposure to hazardous contaminants in the air. These control methods include:

- Mechanical ventilation.
- Enclosure or isolation of the process or work equipment.
- Process modifications.

Administrative controls are generally most effective when combined with other control measures. Administrative controls limit workers' exposures by scheduling reduced work times in contaminated areas or by implementing other such work rules. These control measures have many limitations because the hazard is not removed.

What are "immediately dangerous to life or health" (IDLH) considerations?

Some types of atmospheres place the worker in immediate danger because the concentrations of hazardous contaminants would impair the ability to leave the work area (self-rescue) or potentially cause irreversible health effects, serious injury, or death in a matter of minutes.

There are particular conditions that are considered "Immediately Dangerous to Life or Health (IDLH)". These include*:

- A known contaminant at a concentration known to be IDLH
- A known contaminant at an unknown concentration with the potential to be IDLH
- An unknown contaminant at an unknown concentration
- An untested confined space
- An oxygen-deficient atmosphere
- Firefighting
- Contaminants at or above 20% of their lower explosive limit (LEL—the concentration at which the gas or vapour could ignite)

To determine IDLH level of a contaminant, consult the NIOSH Pocket Guide to Chemical Hazards or NIOSH's Table of IDLH values.

*Adapted from WorkSafe BC Breathe Safer.

What are the elements to consider for a respiratory protection program??

Employers should have a written respiratory protection program that describes the proper procedures for selecting and operating respiratory protective equipment. The correct use of a respirator is just as important as selecting the proper respirator. The respiratory protection program must also address how to find out what hazards are present, how much protection the workers will need, and describe how to wear and care for the respirator.

Without a complete respiratory protection program, workers may not receive the best protection from a respirator, even if it is the correct choice for a specific job. A respiratory protection program includes several components, such as:

- Hazard identification and control.
- Exposure assessment.
- Respirator selection.
- Respirator fit-testing.
- Training.
- Inspection and record keeping.
- Cleaning and sanitizing respirators.
- Repairing, maintaining, and replacing respirators.
- Proper storage of respirators.
- Health surveillance.
- Standard operating procedures (available in written form).
- Program evaluation.

A qualified healthcare professional should examine the medical and psychological fitness of workers. This evaluation should be done before they are assigned to work in areas where respirators may be required. The workers must be physically fit to carry out the work while wearing respiratory equipment. They must also be psychologically comfortable (such as not have fears or be claustrophobic) about wearing respirators.

Workers with beards, long sideburns, or even stubble may not wear respirators because the hair breaks the seal between the skin and the respirator mask. Wearing eyeglasses could also break the respirator seal. This break means that the respirator mask will "leak" and will not provide the needed respiratory protection. Also, if a worker has facial scars or acne, the facial skin may not be able to form a good seal with a respirator mask.

What are the different classes of respirators?

The two main types are air-purifying respirators (APRs) and supplied-air respirators (SARs).

Air-purifying respirators can remove contaminants in the air that you breathe by filtering out particulates (such as dusts, metal fumes, mists, etc.). Other APRs purify air by adsorbing gases or vapours on a sorbent (adsorbing material) in a cartridge or canister. They are tight-fitting and are available in several forms:

- Mouth bit respirator (fits in the mouth and comes with a nose clip to hold nostrils closed - for escape purposes only)
- Quarter-mask (covering the nose and mouth)
- Half-facepiece mask (covering the face from the nose to below the chin)
- Full facepiece (covering the face from above the eyes to below the chin)

Respirators with a full facepiece also protect the eyes from exposure to irritating chemicals.

Supplied-air respirators (SARs) supply clean air from a compressed air tank or through an air line. This air is not from the workroom area. The air supplied in tanks or from compressors must meet certain standards for purity and moisture content (such as CSA Standard Z180.1 Compressed Breathing Air and Systems).

Supplied-air respirators may have either tight-fitting or loose-fitting respiratory inlets. Respirators with tight-fitting inlets have half- or full-facepieces. Types with loose-fitting respiratory inlets can be hoods or helmets that cover the head and neck or loose-fitting facepieces with rubber or fabric side shields. These respirators are supplied with air through airlines.

Examples of these classes of respirators include:

Air-purifying respirators (APRs):

- Particulate filtering facepiece respirators (FFRs, also called dust, fume, and mist respirators or masks. These respirators include N95 respirators.
- Chemical cartridge respirators that can have a combination of chemical cartridges, along with a dust pre-filter. This combination provides protection against different kinds of contaminants in the air.

- Gas masks (contain more adsorbent than cartridge-type respirators and can provide a higher level of protection than chemical cartridge respirators).
- Powered air-purifying respirators (PAPRs).

Supplied-air respirators (SARs):

- Self-contained breathing apparatus (SCBA)
- Airline supplied-air respirators
- Protective suits that totally encapsulate the wearer's body and incorporate a life-support system

Supplied air respirators can be divided into demand-type (where air only flows into the facepiece as needed by the user), pressure-demand (which maintains a positive pressure in the facepiece), and continuous flow (for escape only). Additionally, SCBAs can be open circuit (where air is not recycled) or closed circuit (where air is recycled). Demand-type open-circuit SCBAs are not suitable for IDLH environments.

Some combinations of airline respirators and SCBAs allow workers to work for extended periods in oxygen-deficient areas or where airborne toxic contaminants are present. The auxiliary or backup SCBA source allows the worker to escape with an emergency source of air if the airline source fails.

There are also combination air-purifying and atmosphere-supplying respirators. These devices will offer worker protection if the supplied-air system fails when the appropriate air-purifier units are selected. These respirators cannot be used in oxygen-deficient areas or where the air concentration of a contaminant exceeds the IDLH level.

Since filters capture particles, caution must be exercised to always check that these filters are not clogged, as this makes it harder for air to pass through. Cartridges can also become "full" or saturated. They will stop working, and a "breakthrough" will occur – this term means that the gases or vapours will leak through the cartridge. Both cartridges and filters must be replaced on a regular basis by using the manufacturer's recommendations (usually determined by using warning properties or end-of-service indicators).

There are different classes of particulate filters, depending on the particulate material. They are also classified based on levels of oil resistance and filter efficiency. Oil can break down certain types of filters, which means it is important to know the materials you are working with at all times and always select the right cartridge for your respirator.

The main categories are:

- N series (Not resistant to oil) - May be used in any atmosphere where there is no oil particulate.

- R series (Resistant to oil) - May be used in any atmosphere where there is no oil particulate, or up to one shift where there is oil particulate present. "One shift" means eight hours of continuous or intermittent use.
- P series (Strongly resistant to oil) - May be used in any atmosphere, including those with oil particulates, for more than one shift. If the filter is used in atmospheres with oil particulates, contact the manufacturer to find out the service life of the filter.

What are the different types of cartridges and filters?

Equally important is the selection of the correct type of cartridge or filter.

Filters are made of a material that is designed to trap particles as you breathe. Cartridges contain a material that absorbs gases and vapours. It is very important to make sure you are using the right filter or cartridge for the chemicals or substances present in the workplace.

How do you select the right respirator?

Choosing a respirator is a complicated matter. Experienced safety professionals or occupational hygienists who are familiar with the actual workplace environment are the staff who should select the proper respirator. They can choose a suitable respirator only after they have evaluated all relevant factors. This decision includes considering the limitations of each class of respirator.

Before the proper respirator can be selected for a job, be sure you have already:

- Identified the respiratory hazard
- Evaluated the hazard
- Considered whether engineering controls are feasible

There are too many types of situations to cover them all fully here. However, the following questions represent part of "decision logic" that a safety professional or occupational hygienist can use when selecting a respirator:

- Is it to be used in firefighting or emergencies?
- Is it to be used in oxygen-deficient atmospheres (less than 18% oxygen in air; some jurisdictions say below 19.5%)?
- What is the nature of the hazard (chemical properties, concentration in the air, warning properties)?
- Is there more than one contaminant (that is, a mixture or more than one chemical is present)?

- Is the airborne contaminant a gas, vapour, or particulate (mist, dust, or fume)?
- Are the airborne levels below or above the exposure limit, or are they above levels that could be immediately dangerous to life or health?
- What are the health effects of the airborne contaminant (carcinogenic, potentially lethal, irritating to the eyes, absorbed through the skin)?
- What are the characteristics of the operation or the process (such as hot temperature, confined space)?
- What activities will the worker be doing while wearing the respirator (such as strenuous work)?
- How long will the worker need to wear the respirator?
- Does the selected respirator fit the worker properly?
- Where is the nearest safe area that has respirable air?

Use the safety data sheet (SDS) for guidance on the requirements of the particular respiratory hazard.

Other considerations include:

The assigned protection factor (APF) can be used to select the appropriate respirator. The APF is the anticipated level of respiratory protection that would be provided by a properly functioning, well-fitted respirator. The type of respirator determines the APF. For example, an air-purifying half-facepiece respirator has a lower APF than a powered air-purifying full-facepiece respirator. Refer to your jurisdiction's occupational health and safety legislation or the applicable version of the CSA Standard Z94.4, Selection, Use, and Care of Respirators, to find out the assigned protection factor for the types of respirators.

Select a respirator based on its APF and the occupational exposure limit for the airborne contaminant the worker is exposed to. The APF indicates how many times more than the occupational exposure limit a worker can be exposed when wearing a respirator. For example, a respirator with an APF of 10 offers protection if the worker is exposed to up to 10 times the occupational exposure limit. If the worker is exposed to more than 10 times the occupational exposure limit, a respirator with an APF of 10 does not provide the necessary protection.

The maximum use concentration is the highest concentration of an airborne contaminant that a worker would be protected from when wearing a respirator.

Maximum use concentration = APF of a respirator x occupational exposure limit

A worker wearing a respirator is overexposed if working in an atmosphere where the concentration of an airborne contaminant is more than the maximum use concentration. In that case, use a higher APF respirator or implement other control measures to reduce the exposure.

Biological hazards (such as viruses and bacteria) do not have concentration limits. When selecting a respirator for a biological hazard, consider the working environment, bioaerosol risk group, generation rate, and control level.

The CSA Standard Z94.4 Selection, Use and Care of Respirators outlines a respirator selection decision logic model in more detail. It provides more guidance about respirator selection for chemical and biological hazards.

Contact the government department responsible for health and safety in your jurisdiction for additional information on regulatory requirements for respiratory protection.

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