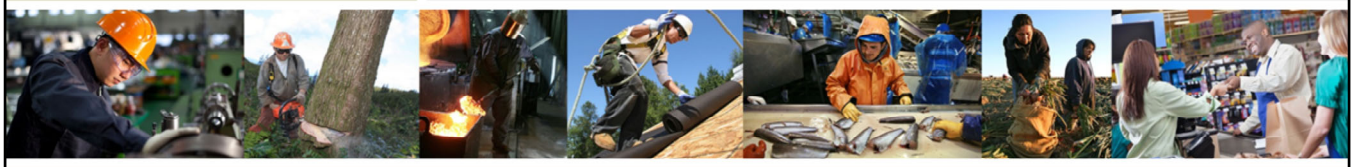
Washington State Department of
Labor & Industries

Respiratory Protection – Cartridge Respirators

Training for employees



September, 2021

All photos from Adobe Stock unless otherwise indicated

Introduction- why this training is required

We have areas where wearing respirators is required.

If you don't know how to use a cartridge respirator properly, you can get a false sense of protection.

L & I requires training for anyone required to wear cartridge respirators.

2

Here are some of the reasons why this training is required. We want to make sure you are protected from the health effects of the hazardous dust and chemicals at our facilities by providing you with respirators at no cost to you. This training will provide information you should know about cartridge respirators so that you understand their limitations.

When are respirators needed to protect you?

When there is not enough oxygen,

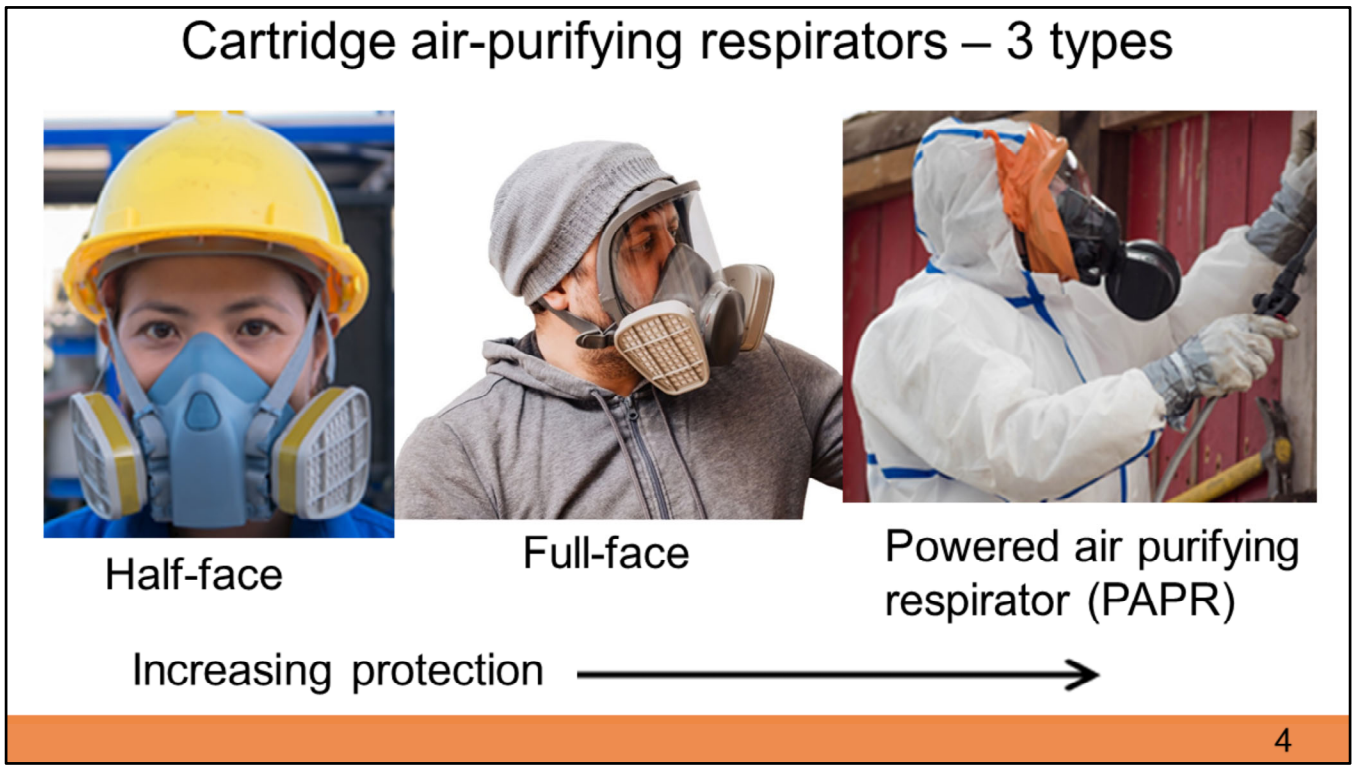
when amounts of dusts and chemicals in the air exceed safe limits,

in emergency or unknown situations of air contamination like a large chemical spill,

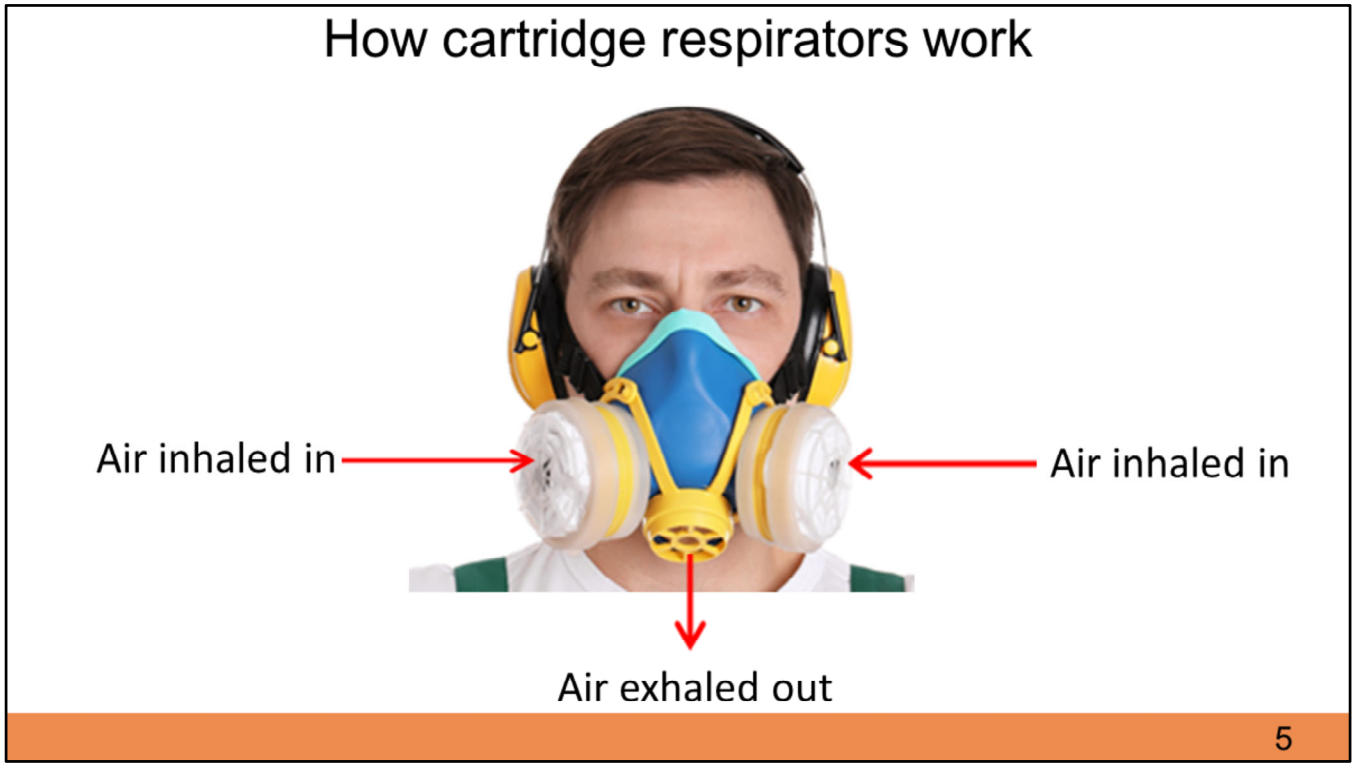
when required by a pesticide label.

3

We are responsible for determining when you need a respirator, and what type is the best. Sometimes, air testing is required to measure oxygen levels or what harmful air contaminants exist at what amounts to determine what kind of respirator provides the best protection for you.



There are three types of cartridge respirators as shown, with increasing levels of protection. The attached cartridges all provide protection by filtering out chemicals and dusts in the air when the respirators are worn.



When you inhale, air is pulled through the two cartridges on the sides, where air contaminants are trapped. When you exhale, a small flap in the exhalation valve opens up, and your exhaled breath goes out.

Cartridge respirator parts

Air movement in and out is controlled by the rubber inhalation and exhalation valves.

If the valves are cracked, ripped or warped they must be replaced.

Straps must be snug, but not too tight for a good seal on the face.

Respirator parts from different brands are not interchangeable.

6

The single exhalation valve prevents outside contaminated air from bypassing the cartridges when you inhale. The two inhalation valves prevent moist exhaled air from going out through the cartridges. Too much moisture will reduce the effectiveness of the cartridges. The facepiece should be the right size to fit you properly. Respirators usually come in 3 sizes – small, medium and large.

Types of cartridges and how they work

Particulate cartridges filter out dusts, mists and fumes only.

Chemical cartridges trap different types of chemicals, but not dust, mists or fumes.

Combination cartridges filter out both chemicals and dust, mists and fumes.

Cartridges are labeled and color-coded for the type of chemical or dust.

Particulate

Chemical

Combination

7

Particulate cartridges have a filtering material in them which trap or block the dust, mist or fumes, much like a furnace filter. “Fumes” in this case means welding fumes or smoke, rather than what people sometimes say to describe chemical vapors. Chemical cartridges have other materials such as activated charcoal which absorb and trap the chemicals. Combination cartridges have both filters and chemical absorbing material.

Types of particulate cartridges

N-95 cartridges filter out 95% of dust particles

photo by Gerson Co.

N-99 cartridges filter out 99% of dust particles

N-100 cartridges filter out 99.7% of dust particles

Photo by 3M

N-99 or N-100 masks are recommended for very fine dust or dangerous dusts such as asbestos or silica.

8

Particulate cartridges come in a variety of shapes and sizes, depending on the manufacturer. But there are three basic types as shown here - N-95, N-99 and N-100.

Respirator Cartridge Color Coding

- Dust/fumes/mists – teal
- Dust/fumes – pink (HEPA filter)
- Ammonia – green
- Organic vapors (solvents) – black
- Yellow – acid gases and organic vapors

These are some commonly used cartridges. They will filter out only the contaminants shown by the color.

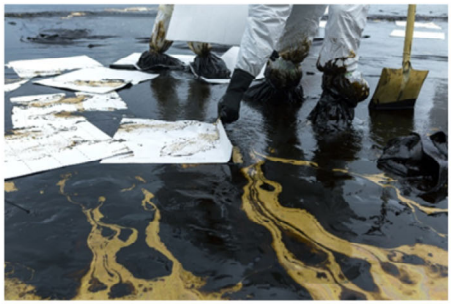
9

Cartridges are colored-coded to show what substance they should be used for. The pink HEPA cartridges are for highly toxic dusts like silica, asbestos or certain welding fumes. Cartridges are also labeled for the chemicals for which they provide protection. There are no effective cartridges for carbon monoxide.

Cartridge respirators have many limitation

Cartridge respirators won't protect you in the following situations:

- carbon monoxide in the air,
- lack of oxygen,
- high levels of toxic chemicals,
- confined spaces,
- major chemical spills, leaks or fires.



10

Cartridge respirators do not supply fresh or clean air, they only purify existing air. If you are in an area where there is a lack of oxygen, you would need a respirator that supplies clean air from a tank or hose. Confined spaces can have very high air contaminant levels and cartridge respirators will not provide sufficient protection. The cartridges would be overwhelmed in situations of large leaks or spills. Cartridge respirator are not appropriate for fire fighting since most fires produce huge amounts of toxic combustion products including carbon monoxide.

More limits of cartridges - breakthrough

Chemical cartridges can absorb only so much chemical.

When their capacity is reached, breakthrough will occur.

You can't always tell if a respirator leaks by a chemical odor.

Some chemicals have no odor, or can only be smelled at high levels that could harm you.

Particulate cartridges will become more difficult to breathe through when they fill up with dust.

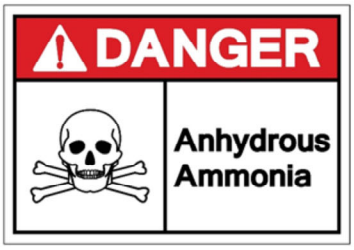
11

Breakthrough means the chemical goes through the cartridge into the facepiece. If you smell the chemical with your respirator on, you know it is not working. But if the chemical has no odor, or the odor can only be detected at high levels, you may not know if your respirator is working properly. That's why chemical cartridges have to be changed regularly. Cartridge-type respirators are not suitable for prolonged exposure to high levels of toxic chemicals.

Cartridge respirator levels of protection vary

Half-face cartridge respirators provide protection to levels 10 times above the chemical or dust permissible exposure limit.

Full-face respirators provide protection to levels 50 times above the permissible exposure limit.



Half-face respirator protection up to 250 ppm of ammonia.

Full-face respirator protection up to 1250 ppm of ammonia.

12

Another way of saying this is that a half-face respirator can reduce the amount of chemical inside the respirator to one tenth of the concentration outside the respirator. If the level of chemical in the air is more than 10 times the permissible limit, you would need a more protective respirator. Chemical permissible exposure limits are often listed in “parts per million” or “ppm” in the air. 25 ppm is twenty five parts per million of the chemical in one million parts of air. 25 ppm of ammonia in the air is may not seem like much, but it is enough to be quite irritating to your eyes and nose. The limits for some very toxic chemicals are much lower.

Powered air purifying respirator protection factor

A powered air purifying respirator has a battery-powered blower that sucks air through a cartridge and blows it into the facepiece.

A powered air purifying respirator can provide protection from 25 to 1000 times above the permissible exposure limit.

The protection factor is unique to the manufacturer of the PAPR and how it is designed.

Optional slide if PAPRs are used

13

Because powered air purifying respirators blow air into the facepiece, they tend to be cooler and more comfortable than other respirators and they are less prone to leakage. Some are tight fitting, and some are loose fitting where air constantly blows out around the mask edge which prevents leakage into the facepiece. The cartridges have the same limitations as those on other cartridge respirators.

More limits of cartridge respirators

Most chemicals have listed high level limits where cartridge respirators are not adequate.

These limits are called “immediately dangerous to life or health” or “IDLH”.

A cartridge respirator is too prone to leaking to use at chemical levels in the air above IDLH.

The only alternative is a respirator that supplies clean breathing air from a tank or hose.

No IDLH protection

14

If you were to inhale a chemical in the air that was more than its listed IDLH, you could die or be seriously injured. Fortunately, in most workplaces, IDLH conditions rarely occur. Confined spaces are the exception - IDLH conditions are much more common in sewers or tanks where welding is done or which contained chemicals or fuel.

We use the following types of respirators in the following work areas or job duties

15

When it smells bad or you feel sick

Sometimes respirators don't work even when levels of airborne chemicals are low.

If you notice an odor or feel ill, or you think your respirator leaks, leave the area and notify your supervisor.

16

Your respirator can leak for several reasons. The cause may be a poor fit, a missing valve, a tear or hole in the facepiece, a cartridge not tightened properly, or the cartridge may need changing. You may feel ill without noticing an odor if the respirator is leaking and the chemical has no odor. Be especially aware of such symptoms as dizziness, nausea, coughing, nose or throat irritation, feeling "high", or having trouble breathing.

Respirator fit-testing

Before any tight-fitting cartridge respirator can be worn, a fit-test must be done.

A fit-test is required to make sure the respirator does not leak around the edges.

Facial hair can prevent a proper fit of a tight-fitting respirator.

This man's respirator will leak

17

A variety of respirator fit-testing procedures are available. We are required to conduct fit-testing of any tight-fitting respirator that you wear at your worksite. When you are first required to wear a respirator, fit-testing must be done and then annually after that To get a proper fit, several sizes and brands are usually made available for you to try on for comfort and good fit. The straps must be snug, but not too tight to assure a good seal on the face. The man with a full beard will not get a tight fit, and his respirator will leak. Some loose-fitting powered air-purifying respirators do not require fit-testing and can be used by people with beards.

Our fit-testing procedures

Cartridge masks and facial hair

Cartridge masks must fit tightly on the face to prevent leaks around the edges. Facial hair that interferes with the edge of the mask is not allowed.

19

Facial hair, including stubble, will prevent a tight seal on the edges of the mask. Some facial hair styles don't interfere with the sealing edge of a cartridge mask and would be allowed. Filtering facepieces is a term used for dust masks, but this chart applies to cartridge respirators as well. [Click on the illustration shown to see the CDC chart of facial hairstyles and which styles are acceptable.]

Respirator seal check

Inhalation check

Photos courtesy of U.S Army

Exhalation check

20

A respirator seal check at the beginning of work is a quick way to make sure the respirator is fitting correctly on your face. Put your hands over the cartridges and inhale and the mask should tighten on your face and you should not feel any leakage along the edges. Then put your hand over the exhalation valve and blow out gently. Again, the respirator should not leak along the edges. If you feel leakage when performing these quick checks, readjust the mask on your face and try again. If you still feel leakage, your respirator may be the wrong size or brand for you or there is a defect in the respirator.

Cartridge respirators and physical fitness – medical evaluation

Medical evaluations are required for anyone who has to wear a respirator.

Breathing through a respirator is work for the body.

Respirators can be hazardous to people with heart or lung problems.

21

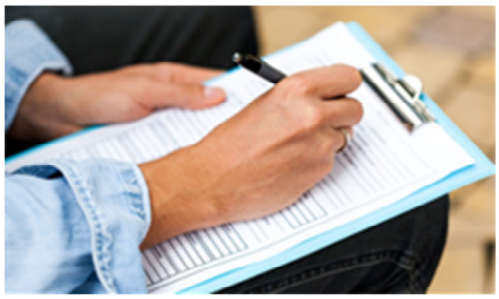
Although breathing through a cartridge respirator can be more difficult, especially during heavy exertion, most reasonably fit people will not have a problem wearing a cartridge respirator. Nevertheless, since we require you to wear a respirator, you must also have a medical evaluation.

Medical questionnaire for respirator users

The first step of a medical evaluation is a confidential medical questionnaire.

A healthcare provider reviews the questionnaire and decides if you need a medical exam.

The results are only used to determine if you are fit to wear a dust mask.



22

The detailed results of a medical exam cannot be given to us, only a note that you are or are not fit enough to wear a respirator.

Outline or describe your medical evaluation procedures here

Respirator cleaning and maintenance

Since cartridge respirators are used over and over, they can get dirty, and need to be cleaned regularly.

The thin respirator valves can split, dry out or warp, and need regular checking.

Take them apart and wash in warm soapy water (except the filters).

24

Respirator cleaning is especially needed in dusty workplaces. A daily or more frequent quick cleaning inside the facepiece can be done with wet wipes. [If you clean respirators for your employees, describe the process here.]

Respirator maintenance and storage

Cartridges must be replaced on a regular schedule.

Inspect your respirator daily for cleanliness, damage or deterioration.

Store your respirator in a clean dry place, not unprotected in the work area.

Don't store them like this!

25

A cartridge replacement schedule depends on the amount of chemical in the air and how long you are exposed. Constant exposure to high levels of air contaminants would need more frequent changes, in some cases even daily. We have a changeout schedule which we will discuss next. When changing cartridges, make sure they are seated properly in the respirator. Check straps regularly, since broken straps will prevent a tight fit and must be replaced. Don't leave your respirator laying around in your work area.

Cartridge change-out schedules

[Describe your cartridge change-out schedules here]

Cartridge change-out guide from OSHA

26

Change-out schedules are important when respirators must be worn for long periods of time or frequently, or chemical levels are high because the absorbing material in the cartridges can only absorb so much chemical. Dust cartridges are replaced when breathing becomes noticeably more difficult because the filtering material is plugged up. For irregular exposure to chemicals or dust, change out schedules can be stretched out to once or week or once a month or longer. [The link to the OSHA change-out guide describes ways to determine change-out schedules.]

Blank slide for adding additional information as needed.