A Guide to Air-Purifying Respirators

Air-purifying respirators (APRs) work by removing gases, vapors, aerosols (airborne droplets and solid particles), or a combination of contaminants from the air through the use of filters, cartridges, or canisters. These respirators do not supply oxygen from other than the working atmosphere, and therefore cannot be used in an atmosphere that is oxygen-deficient[1] or immediately dangerous to life or health[2] (IDLH). The appropriate respirator for a particular situation will depend on the environment and the contaminant(s).

Filtering Facepiece Respirators

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Filtering facepiece respirators (FFRs) remove particles from the inhaled airstream of the wearer. They may be referred to as "N95 respirators". They are also sometimes called disposable respirators because the entire respirator is discarded when it becomes unsuitable for further use because of hygiene, excessive resistance, or physical damage.

FFRs are divided into classes based on their filtration capabilities. "N95" is a term referring to the N95 filter class, which removes at least 95% of airborne particles using a "most-penetrating" sized particle during "worst case" NIOSH testing. The FFR classes include N (not resistant to oil), R (somewhat resistant to oil), and P (strongly resistant to oil) series, which are available at 95, 99, and 100 filtration efficiency levels.

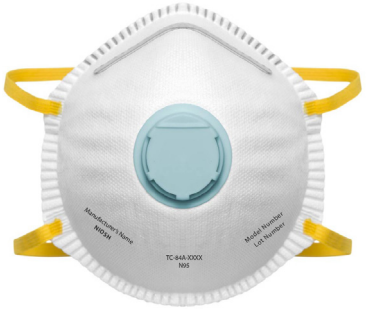
FFRs provide protection against particles, but not gases or vapors, and should not be used for respiratory protection to protect against hazardous gases or vapors. These classes and oil-resistant designations are applicable to all types of air-purifying respirators.

N95, N99, N100 – Filters at least 95%, 99%, 99.97% of airborne particles. Not resistant to oil.

R95, R99, R100 – Filters at least 95%, 99%, 99.97% of airborne particles. Somewhat resistant to oil.

P95, P99, P100 – Filters at least 95%, 99%, 99.97% of airborne particles. Strongly resistant to oil.

FFRs form a tight seal against the user's face, covering the nose and mouth. As the user inhales air through the facepiece, particulate material collects on the fibrous material of the filter, which removes the particulate contaminant from the airstream. An FFR may have an exhalation valve located on the filter, which reduces breathing resistance during exhalation.



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[1] OSHA CFR 1910.134(b) defines oxygen-deficient as an atmosphere with an oxygen content below 19.5% by volume.

[2] IDLH values can be found at: https://www.cdc.gov/niosh/idlh/intridl4.html

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Filtering Facepiece Respirators (continued)

Because the effectiveness of this type of respirator relies upon the breathing air travelling through the filter, a tight seal to the user's face is very important. Therefore, the Occupational Safety and Health Administration (OSHA) (29 CFR 1910.134) requires an annual respirator fit test to ensure that users receive the expected level of protection by minimizing any leakage of unfiltered contaminant through gaps between the face and facepiece. When used with a respiratory protection program, including annual fit-testing, an FFR will reduce exposures by 1/10th. Another way to express this is that the OSHA Assigned Protection Factor (APF) is 10. For proper donning (putting on) and doffing (taking off) techniques of this type of respiratory protection, refer to the manufacturer's instructions.

Elastomeric Half Facepiece Respirators

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Elastomeric half facepiece and quarter facepiece respirators are reusable devices with exchangeable cartridges or filters. The facepiece is made of rubber or silicone that forms a seal against the user's face. The facepiece of the elastomeric respirator must form a tight seal against the user's face, covering the nose and mouth just like the disposable FFRs; therefore, fit testing is required. The attached filters and cartridges are replaceable and can be easily changed. Elastomeric respirators can be used to protect against gases, vapors, and/or particles if equipped with the appropriate filters and/or cartridges.

When cleaning and sanitizing a respirator, the manufacturer's guidelines should always be followed. Check the manufacturer's website if guidance is not included with the packaging of the respirator. If guidance isn't available, OSHA provides general cleaning and sanitizing guidelines. Elastomeric half facepiece respirators have an APF of 10.

OSHA Definitions of Filter and Cartridge/Canister, CFR 1910.134(b)

Filter or air-purifying element means a component used in respirators to remove solid or liquid aerosols from the inspired air.

Canister[3] or cartridge means a container with a filter, sorbent, catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

Elastomeric Full Facepiece Respirators

Photo courtesy of Honeywell International Inc

Like the elastomeric half facepiece respirator, the elastomeric full facepiece respirator is a reusable device. This type of respiratory protective device uses exchangeable cartridges, canisters, or filters. It is also made of rubber or silicone, but the elastomeric full facepiece has a clear plastic lens that covers the face and provides eye protection. The full facepiece covers roughly from the hairline to below the chin. These types of respirators tend to provide a more reliable face seal than FFRs or elastomeric half facepiece respirators. Since these respirators cover the user's face and eyes, they can also be used to protect against liquid splashes and irritating vapors. Annual fit testing is still required. Elastomeric full facepiece respirators have an APF of 50.

[3] A canister on a tight fitting full facepiece or PAPR can be used for escape from unknown concentrations of gas or vapor hazards whereas a cartridge based system cannot be used in this capacity.

Powered Air-Purifying Respirator

Photo courtesy of Honeywell International Inc.

Powered Air-Purifying Respirators (PAPRs) are battery-powered devices that use a blower to pull air through attached filters (for particles) or cartridges (for gases or vapors) to clean it before delivering it to the breathing zone of the wearer. High-efficiency (HE) filters are the only class of particulate filters available for powered air-purifying respirators. The benefits of PAPRs include a low breathing resistance with a high level of protection. PAPRs can be used to protect against gases, vapors, or particles, if equipped with the appropriate cartridge, canister, or filter. PAPRs are generally more protective than non-powered half mask respirators because the blower creates positive pressure inside the facepiece under most work conditions, which reduces inward leakage of potentially contaminated air. A half facepiece PAPR has an APF of 50, and a full facepiece PAPR has an APF of 1,000.

A PAPR may have a tight-fitting half or full facepiece or a loose-fitting facepiece, hood, or helmet. The loose-fitting PAPR does not require fit testing. Loose-fitting PAPRs may be an alternative for users who have facial hair or are otherwise not able to pass a fit test with a tight-fitting respirator. However, OSHA does require fit testing for a tight-fitting PAPR[3]. Loose-fitting PAPRs have an APF of 25. Loose-fitting PAPRs with a helmet or hood can have an APF up to 1,000 if supported by manufacturer-supplied test evidence.

Photo courtesy of MSA

References

Occupational Safety and Health Administration (OSHA) CFR 1910.134 https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=12716

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[4] OSHA CFR 1910.134(f)(8) states that fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.

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