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Choosing the Right Respiratory Protection

It is important for you and your workers to have confidence in your safety equipment.

BY TOM BURGESS

When it comes to selecting respirators for the work environment, numerous resources are available from respirator suppliers, the OSHA respirator selection e-tool, the National Institute for Occupational Safety & Health (NIOSH) and other resources. However, we can still end up with a wide and daunting range of choices and considerations.

Is an N95 filter good enough, or should we be using a P100? Should we use an organic vapor or combination cartridge, and when do we need a filter? How long will cartridges last, including if we don't use them regularly?

Filters

Filters are used for solids or liquids suspended in air. The term "aerosol" includes any suspension of tiny particles or droplets in the air, such as dusts, mists or fumes. "Fumes" is a commonly misused term, and for respirator selection, it is important to distinguish between fumes and vapors. Fumes are solid particles generated by condensation, such as during welding—when vaporized metal condenses into solid particulate fumes. Vapors, on the other hand, are the gaseous form of a liquid or solid substance. It is possible for fumes to pass through a vapor cartridge and also for vapors to pass through a filter. The correct terminology is important and for protection from fumes, we want a filter.

The ongoing COVID-19 pandemic has made everyone familiar with the term "N95." This is commonly used to refer to the N95 filtering facepiece respirator, but the N95 designation applies to any filtering apparatus meeting the NIOSH specifications, including those used with half or full-face respirators. The selection of an N, P or R filter rating depends on the need for oil resistance, as oils can degrade the filter media. N is not resistant to oil, R is resistant to oil and P is oil-proof.

The three levels of filter efficiency are 95 (95 percent), 99 (99 percent) and 100 (99.97 percent). The term "high-efficiency" or "HEPA" is used with filters for powered air purifying respirators with a 99.97 percent efficiency.

The NIOSH filter efficiency rating is based on how well it can filter a 0.3 micrometer (µm) diameter aerosol. The 0.3 µm diameter is approximately the most penetrating particle size for particulate filters. Although it's contrary to expectation, smaller particles do not penetrate as readily as 0.3 µm particles. Therefore, these respirators will filter all other particle sizes at least as well as the certified efficiency level.

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a 95-rated filter? A quick assessment may be that the 100-rated is 5 percent better, and I should use it because it will be more protective. I've encountered this type of request numerous times when N95s were being introduced for protection from COVID-19. In actual use, a filter is only as effective as the face seal.

So, if I'm wearing a half-face respirator or filtering facepiece respirator with a protection or fit factor of 10, it has a seal efficiency of 90 percent. Factoring in the fit, the effective difference between the 95 and 100 filter is less than 1 percent. This includes a full-face respirator with a protection factor of 50 or 98 percent seal efficiency. For most needs, the 95 filter will be adequate.

Cartridges

When you look up the type of chemical for cartridge selection, there may are many chemicals listed but limited types of cartridges to select from. Respirator cartridges must pass specific NIOSH tests to demonstrate effectiveness for specific test chemicals and criteria, such as flow, temperature and duration.

For example, an organic vapor cartridge is tested with carbon tetrachloride. So, when you are looking for a cartridge for a solvent like methyl ethyl ketone and find that an organic vapor cartridge is recommended, NIOSH does not require that it is specifically tested for methyl ethyl ketone. This doesn't mean it is not effective; it means that cartridges are designed to be effective for a range of chemicals with similar properties. You may have a solvent that is not specifically listed in a selection guide, but you may still be able use an organic vapor cartridge, since it is effective for a similar chemical.

A pre-filter should be used when dust or other aerosols are present. A chemical cartridge will not provide the efficiency of a filter in removing aerosols. Like dust, aerosols can clog the cartridge, impacting effectiveness. And aerosols, like mists, can overload the cartridge, reducing life expectancy.

Life expectancy calculators are also based on data for the category of chemicals and mathematical models. The life expectancy of cartridges will be affected by the breathing rate of the user. More exertion and faster breathing means that more air that has to be filtered, reducing the time that the cartridge will be effective.

Heat can also reduce the effectiveness of carbon media, like organic vapor cartridges, by thermally loosening the attractive forces that make the chemical absorb to the surface of the carbon. High humidity can also decrease cartridge life. The life expectancy calculators will include these factors, and it important to recognize that hot, humid environments will have an impact on cartridge life.

Life expectancy calculators are based on usage time, not time from when the package is opened or when the cartridge is first used. Sometimes respirators are used infrequently. If you use a cartridge for a few hours and store it for days or weeks, does that storage reduce the life expectancy? The simple answer is yes. The impact will depend on the storage conditions, including temperature, humidity and vapors or gases in the ambient air that continue to react with the cartridge media.

My preference for storing cartridges that are only used periodically is to take them off the respirator and store them in a sealed plastic bag that's been placed in a controlled environment. If I haven't used the respirator in a while, my decision would then be to get a new pair of cartridges.

Extending the life expectancy and managing the cost is more important when respirators are used regularly. For those used occasionally, since cost isn't as much of a factor, it can be easier to just get new cartridges. Whichever way you manage it, it is important for you and your workers to have confidence in your safety equipment. OHS

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