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Respiratory Protection for Exposures to Particulate Air Pollution

Air pollution is a current concern in China and many other places around the world. This term is broad and typically refers to atmospheric air being polluted with any of several different contaminants, including particulate matter, ozone (O₃), sulfur dioxide (SO₂), nitrogen dioxide (NO₂) and carbon monoxide (CO). Air pollution can cause a variety of health effects, as described below. The International Agency for Research on Cancer (IARC), part of the World Health Organization (WHO), has classified outdoor air pollution as a Group 1 carcinogen: *carcinogenic to humans* (Group 1).

According to the WHO, particulate matter affects more people than any other component of air pollution. Inhalation of these types of particles can cause a variety of possible effects ranging from irritation, infection and discomfort to exacerbation of asthma. Smokers or individuals with pre-existing conditions, such as heart or lung disease, may experience additional or more severe symptoms. Long-term exposure has been associated with an increased risk of developing cardiovascular and respiratory disease and even lung cancer. The risks of health effects depend on the level of exposure. **At this time, there are no recommendations from health authorities for the general public to wear respiratory protection to help reduce their exposures to particles from air pollution.** However, certain individuals are making the choice to wear a respirator. This document will help provide information regarding respirator use for air pollution.

In addition to the airborne particulates, some of the additional causes for concern in air pollution arise from elevated exposures to certain gases, such as ozone, nitrogen dioxide, and carbon monoxide. According to the WHO and the United States Centers for Disease and Prevention (CDC), among other effects:

- Exposure to ozone can trigger asthma and cause breathing problems, lung disease and reduced lung function.
- Exposure to nitrogen dioxide at high levels can cause inflammation of the airways and reduced lung function and can increase certain symptoms in asthmatics.
- Exposure to sulfur dioxide can trigger inflammation of the respiratory tract, resulting in coughing, increased mucus, and aggravation of pre-existing conditions.
- Exposure to carbon monoxide can result in several symptoms, including headaches, nausea, exhaustion, dizziness, and confusion.

When air quality is reported, levels are often reported for particulates as well as gases (for instance, O₃, SO₂, NO₃, and CO), along with other environmental factors, such as temperature and relative humidity. The relative levels for each contaminant do not always correlate -- when the levels for one contaminant are high, it does not always mean the others are high as well.

There are several ways to help reduce exposures to air pollution, and it is essential to follow the advice of your local health authority or a national health agency, such as the WHO or US CDC.

In general, the best way to help reduce exposures to air pollution is to try to avoid exposure, such as by staying indoors in clean air during periods of poor outside air quality. If one does face poor air quality, respiratory protection may be used to help reduce exposure to the particulate matter in air pollution, although no respirator eliminates exposure completely. To help reduce exposure to airborne particulate matter, it is very important to select a government-approved respirator and to follow the fitting instructions and user instructions carefully, including performing a user seal check. Disposable particulate respirators, such as filtering facepiece style respirators, typically come with a government-designated rating:

- In the U.S., respirators are approved by the United States National Institute for Occupational Safety and Health (NIOSH). NIOSH classifies particulate respirators into one of three main classes -- N (not resistant to oil), R (somewhat resistant to oil), and P (oil proof). NIOSH ratings are applied with particulate filtration efficiencies of 95%, 99%, and 99.97%; N95 respirators are commonly used to help reduce exposure from non-oily particulates, such as air pollution particulates.
- In the Chinese standard, particulate respirators are divided into two classes: KN and KP classes. KN class respirators only filter non-oily particles, such as dust, mist and microorganisms. Particulate air pollution is typically considered a non-oily particulate. KP class filter respirators can be used for both oily and non-oily particulates. China-approved respirators are also available with several filtration efficiencies: 90%, 95% and 99.97% efficiency. KN90 and KN95 respirators are commonly used to help reduce exposures to non-oily particulates such as air pollution particulates.

According to US Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.134 and Chinese standard GB / T 18664, half facepiece respirators are suitable to help reduce exposures to airborne particulate matter when the concentration does not exceed 10 times the occupational exposure limit. For higher levels of protection, a full facepiece respirator or a powered or supplied air respirator can be selected. As currently there are no occupational exposure limits set for air pollution, respirator selection will need to be based on professional judgment or recommendations by local or national health authorities. The level of protection that a specific respirator can provide when used properly can be obtained from the respirator's packaging and user instructions.

Note that loose-fitting masks (e.g. gauze or surgical masks) are not considered respirators and do not provide much benefit in reducing exposure to airborne particles, because they typically have gaps between the face and the edge of the mask that allow much leakage of air and particles into the mask (and thus the user's respiratory system).

Particulate respirators usually will not help reduce exposures to gases and vapors such as ozone, sulfur dioxide and nitrogen dioxide. If a respirator is desired to help reduce exposures to gases and vapors, then a respirator with a particulate filter in combination with a carbon cartridge for acid gases and organic vapors can help reduce exposures to ozone, sulfur dioxide and particulate matter. Cartridges for nitrogen dioxide are available but typically not in combination with other gas and vapor cartridges. Carbon monoxide cannot be filtered by conventional respirators with filters and carbon cartridges.

Employers distributing respirators to their employees for the purpose of helping to reduce respiratory exposure to air pollution should train their employees in the proper use and limitations of the respirator they have selected. For example, employers in the US must provide medical clearance, fit testing and training, per OSHA 29 CFR 1910.134, when they distribute respirators to their employees. Employers should always follow the local regulations with regards to respirator use.

Individuals choosing to use respiratory protection should carefully read and follow the user instructions for the model of respirator they are using. It is very important that the user be clean-shaven and follow the donning instructions exactly to get a good seal between the respirator and the face. Users with underlying heart or lung conditions should consult a physician prior to use. The respirator manufacturer and / or their local health authority should be contacted with any further questions.

There are multiple options with regards to particulate respirators. Disposable filtering facepiece particulate respirators are a popular choice. In general, filtering facepiece respirators are available in two basic styles: cup-shaped and flatfold. Certain models also are available with an exhalation valve; valved respirators are typically more comfortable to wear, because the exhaled breath exits the valve more easily and the air near the face feels cooler. Some disposable filtering facepiece particulate respirators feature nuisance organic vapor odor and / or acid gas odor carbon, which can help reduce exposures to very low levels of nuisance gases and vapors.

The table below outlines several widely-available 3M disposable filtering facepiece particulate respirators that may be suitable to help reduce exposures to particulate air pollution.

Select 3M disposable filtering facepiece particulate respirators

3M Model	Style	Sizes	Valve	Respirator Description
9001	Flatfold, Earloop	Family*	No	China GB2626-2006 KN90 approved particulate respirator to help reduce exposures to airborne particulate, including PM 2.5 and PM 10.
9001V	Flatfold, Earloop	Family*	Yes	
9002	Flatfold, Headband	Family*	No	
9002V	Flatfold, Headband	Family*	Yes	
9003	Flatfold, Earloop	Family*	No	
9003V	Flatfold, Earloop	Family*	Yes	
9004	Flatfold, Headband	Family*	No	
8210	Cup, Headband	Family*	No	

8110S	Cup, Headband	Family*	No	respirator to help reduce exposures to airborne particulate, including PM 2.5 and PM 10.
9210	Flatfold, Headband	One	No	
9211	Flatfold, Headband	One	Yes	
9105	Flatfold, Headband	Two	No	
8210CN	Cup, Headband	One	No	8210CN, 8210VCN and 8511CN have dual approval as a U.S. NIOSH N95 particulate respirator and as a China GB2626-2006 KN95 particulate respirator to help reduce exposures to airborne particulate, including PM 2.5 and PM 10.
8210VCN	Cup, Headband	One	Yes	
8511CN	Cup, Headband	One	Yes	
8247CN	Cup, Headband	One	No	Particulate filtering facepiece respirator with nuisance level organic vapor odor relief to help reduce exposures to airborne particulate (includes PM 2.5 and PM 10) and nuisance levels of ozone or other organic odor. Dual approval as a U.S. NIOSH R95 particulate respirator and as a China GB2626-2006 KN95 particulate respirator.
8577CN	Cup, Headband	One	Yes	Particulate filtering facepiece respirator with nuisance level organic vapor odor relief to help reduce exposures to airborne particulate (including PM 2.5 and PM 10) and nuisance levels of ozone or other organic odor. Dual approval as a U.S. NIOSH P95 particulate respirator and as a China GB2626-2006 KP95 particulate respirator.
8246CN	Cup, Headband	One	No	Particulate filtering facepiece respirator with nuisance level acid gas odor relief to help reduce exposures to airborne particulate (including PM 2.5 and PM 10) and nuisance levels of sulfur dioxide or other acid gas odor. Dual approval as a U.S. NIOSH R95 particulate respirator and as a China GB2626-2006 KN95 particulate respirator.
8576	Cup, headband	One	Yes	Particulate filtering facepiece

				respirator with nuisance level acid gas odor relief to help reduce exposures to airborne particulate (including PM 2.5 and PM 10) and nuisance levels of sulfur dioxide or other acid gas odor. U.S. NIOSH P95 particulate respirator and China GB2626-2006 KP95 particulate respirator.
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*Family means that the respirators are part of a family of respirators with the same design but different sizes.

The 8110S and 8210 have the same design. The 8110S fits smaller faces.

The 9001 and 9003 have the same design. The 9003 fits smaller faces.

The 9001V and 9003V have the same design. The 9003V fits smaller faces.

The 9002 and 9004 have the same design. The 9004 fits smaller faces.

If additional organic vapor or acid gas exposure reduction (beyond nuisance level) is desired, then a half facepiece reusable respirator with organic vapor / acid gas cartridges, coupled with particulate filters, such as the 3M 60923 cartridges or a 6003 cartridge with a 5N11 prefilter, should be selected. If a higher level of protection to particulate and organic vapor or acid gas is desired (beyond 10 times the occupational exposure limit), then a full facepiece reusable respirator with organic vapor / acid gas cartridges, coupled with particulate filters, such as the 3M 60923 cartridges or 6003 cartridge with a 5N11 prefilter, should be selected.

For further questions regarding 3M respiratory protection in the US please contact the US Technical Services Helpline at 1-800-243-4630. Thank you.

References:

<http://www.who.int/mediacentre/factsheets/fs313/en/>

<http://www.cdc.gov/niosh/topics/co-comp/>

OSHA 29 CFR 1910.134: Personal Protective Equipment: Respiratory

Protection https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=12716&p_table=standards

GB 18664-2002: [Selection, use and maintenance of respiratory protective equipment.](#)

GB 2626-2006: [Respiratory protective equipment – non-powered air-purifying particle respirator.](#)

International Agency for Research on Cancer, WHO, Press release No 221. 17 October 2013. http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf