

# Technical Data Bulletin

# OHI&ESD

## #160 – Reusable Respirator Facepieces and Powered Air Purifying Respirator Systems (PAPRs) in the Health Care Environment: Considerations for Use

Published: August, 2003

The purpose of a respirator is to help reduce the wearer's exposure to airborne contaminants and to bring that exposure to within an "acceptable" level as determined by regulatory agencies and health organizations. However, no safe exposure levels (i.e. the amount you can inhale without adverse health effects) have been set for biological aerosols. Therefore, while respirators can reduce exposures they cannot eliminate the risk of contracting infection, illness, or disease.

The use of respirators in occupational settings, including health care, is often regulated by government agencies. Please refer to local occupational health and safety regulations regarding requirements for a respiratory protection program. This bulletin outlines considerations for use of reusable respirator facepieces and powered air purifying respirators (PAPRs) in the healthcare environment including: selection, contraindications, fit testing, re-use, cleaning, maintenance, inspection and storage.

### Infection Control Precautions

Isolation precautions for health care settings, as described by the Centers for Disease Control and Prevention (CDC) are widely adopted by facilities around the world. The

CDC describes five main routes of transmission. The same pathogen/microorganism can be transmitted by more than one route. The route of transmission defines the infection control precaution to follow. The type of precautions include:

- Contact Precautions
- Droplet Precautions
- Airborne Precautions
- Common Vehicle Precautions
- Vectorborne Precautions

This document will focus on Airborne Precautions and the occupational use of reusable respirators by health care workers to help reduce exposure to airborne pathogens/biological aerosols. Although airborne precautions are discussed, it is important to understand that a respirator is just one of several preventative measures that can be used to help reduce exposure to airborne microorganisms. For specific information on the remaining routes of transmission and preventative measures, please refer to the CDC's website at: <http://www.cdc.gov/ncidod/hip/ISOLAT/Isolat.htm><sup>1</sup>

### Airborne Transmission and Precautions

Airborne transmission occurs by dissemination of airborne particles containing the infectious agent.

Microorganisms currently known to be transmitted by airborne route include *Mycobacterium tuberculosis* and the rubeola and varicella viruses (note: persons immune to rubeola or varicella do not need to wear respiratory protection during exposure to these specific organisms.)<sup>1</sup>

Airborne precautions have also been recommended by CDC in the Updated Interim Domestic Infection Control Guidance in the Health-Care and Community Setting for Patients with Suspected SARS<sup>2</sup>.

The CDC recommends at a minimum, the use of an N95 respirator when entering the room of a patient known or suspected to be infected with an airborne organism. The most commonly used N95 respirators in health care settings are disposable filtering facepiece respirators. These respirators fit over the nose and beneath the chin and are one example of a "half facepiece" or "half-mask" respirator.

In addition to the use of N95 filtering facepiece respirators there are certain situations, such as aerosol-generating procedures conducted on patients with tuberculosis (TB) or SARS, where some health care facilities have used higher levels of respiratory protection.

## Technical Data Bulletin #160 – Reusable Respirator Facepieces and Powered Air Purifying Respirator Systems (PAPRs) in the Health Care Environment: Considerations for Use

---

### Aerosol-Generating Procedures

Aerosol-generating procedures may increase the risk of transmission to the health care worker (HCW). Each of these procedures is capable of stimulating the patient's cough/gag reflex thus potentially increasing the airborne particles in the environment. Some facilities consider these "high risk" procedures when performed on patients with known or suspected TB or SARS. Additionally, some facilities include patients with atypical pneumonia as part of high-risk group. According to the CDC, procedures capable of promoting the generation of aerosols include:

- Aerosolized medication treatments (e.g. albuterol)
- Diagnostic sputum induction
- Bronchoscopy
- Airway suctioning
- Endotracheal intubation
- Positive pressure ventilation via facemask (e.g. BiPAP, CPAP)<sup>3</sup>, and
- High frequency oscillatory ventilation (HFOV)<sup>3</sup>

The CDC recommends, at a minimum, the use of disposable N95 particulate respirators for aerosol-generating procedures performed on patients known or suspected to be infected with TB or SARS. The CDC also suggests that facilities consider using higher levels of respiratory protection for persons present during an aerosol-generating procedure on a SARS or TB patient. The higher levels of respiratory protection include:

- Powered Air Purifying Respirator (PAPR) with loose-fitting facepiece that forms a partial seal;
- PAPR with hood or helmet;
- PAPR with half or full tight-fitting facepiece; and
- Negative pressure full facepiece with N, R, or P 100 filters.

According to the CDC, factors to consider when choosing respirators includes the potential for exposure to higher levels of aerosolized respiratory secretions, availability of the product, impact on mobility, comfort, and the potential for reusable respirators to serve as fomites for transmission.

### Comparing Protection Obtained from Half Mask, Full Face, and Powered Air Respirators.

The overall level of protection offered by a certified respirator is described by the "Assigned Protection Factor" (APF). An APF is the minimum anticipated protection provided by a properly functioning respirator or class of respirators to a given percentage of properly fitted and trained users.

The APF takes into account all expected sources of facepiece penetration such as face seal penetration, filter penetration, and valve leakage. The APF is not intended to take into account factors that degrade respirator performance such as poor maintenance, failure to follow manufacturer's instructions, and failure to wear the respirator during the entire exposure period.

The APF indicates the factor by which the respirator will reduce your exposure. APFs are assigned by respirator class. The APF of a NIOSH-certified half-facepiece respirator (using any certified filtration level) is 10. This means that a properly used NIOSH-certified half facepiece respirator (one that covers your nose and mouth only) will reduce your exposure to airborne contaminants by a factor of 10. Therefore, for respirators approved by NIOSH, increasing only the filter level (i.e. from N95 to N100) does not increase the level of protection.

If you wish to increase the amount of exposure reduction you receive, then you must move to a NIOSH-certified full facepiece respirator (one that covers your nose, mouth and eyes) or a NIOSH-certified powered air purifying respirator (PAPR).

The difference between a half facepiece respirator, such as a disposable respirator, with an N95 level filter and a half facepiece respirator with a P100 level filter, is that the P100 level filter provides higher filtration efficiency under laboratory conditions than the N95 filter. However, the overall level of protection afforded by the respirator outside the laboratory will not be changed.

Full facepiece negative pressure respirators have an APF (using any certified filtration level) of 50 in the USA when quantitatively fit tested, and 10 if qualitatively fit tested. Powered air purifying respirators have an APF of 25 when used with

## Technical Data Bulletin #160 – Reusable Respirator Facepieces and Powered Air Purifying Respirator Systems (PAPRs) in the Health Care Environment: Considerations for Use

---

a loose fitting headgear. If a helmet or hood is used then the APF is 1000. The same concept applies to European CE marked respirators. The APF generally increases as you move from half facepieces to full facepieces in negative pressure modes. For areas outside the USA refer to the authority having jurisdiction in your region for APFs.

Some facilities select increased levels of respiratory protection for aerosol generating procedures involving probable or confirmed SARS or TB patients. Moving from half facepiece to full facepiece to PAPR with hood will provide increasing levels of APF. Moving to higher filtration categories within the same class of respirator is not the preferred action. Respirators may help reduce exposures to airborne biological contaminants, but they don't eliminate the risk of exposure, infection, illness or death.

### Contraindications

Contraindications for PAPR units in health care settings are the same as with any valved respirator. PAPRs and respirators with exhalation valves are not recommended for use in hospital environments requiring a sterile environment such as the operating room. Sterilization processes such as steam sterilization, ethylene oxide and gamma radiation have not been tested with 3M respirators at this time.

### Fit Testing

In many countries, such as the U.S., regulatory requirements for fit testing of tight-fitting facepieces exist in the occupational health standards. PAPRs with loose-fitting facepieces and hoods do not require fit testing and are therefore sometimes selected for persons who cannot be fit tested and those with facial hair that interferes with the respirator to skin seal with tight-fitting respirators.

### Re-Use of Respirators

Considerations for re-use of any respirator in a health care environment must not only include the regulatory requirements for use of respirators in occupational settings but also the infection control policies and procedures of the health care facility. Infection control procedures should include the proper sequencing of events such as removal of PPE to reduce the potential of cross-contamination if contact transmission is of concern.

For reusable half- and full-facepiece respirators and for PAPRs, the requirements for cleaning, disinfecting, inspection, storage and maintenance must also be addressed.

If reusable facepieces or PAPR's are chosen, specific protocols for removing, handling and decontaminating them safely between patients should be in place.

### Cleaning and Decontaminating

The cleaning procedures commonly found in respirator instructions for reusable facepieces and PAPRs were developed for industrial applications. The primary intent of these procedures is to keep the respirator/components clean so as to prevent the use of an unsanitary respirator from presenting a health hazard to the employee. This must be accomplished in a manner that will not affect the performance of the respirator. Some components of PAPRs, for example, are not designed for submersion into any liquid and doing so would render the unit useless. Normally, these components are wiped down with a cleaning solution. For this reason, it is important to follow the directions specified by the manufacturer. The respirators are also sanitized using a disinfecting agent before being worn by another user. After being cleaned and sanitized, the respirator components should be inspected per the instructions and replaced if damaged or deteriorated.

In health care settings, infection control procedures for the specific microorganism may dictate how personal protective equipment and environmental surfaces are decontaminated. Manufacturers of personal protective equipment may be able to provide guidance on compatibility of their products with the cleaning and disinfecting agents to be used. If cleaning and decontaminating of a reusable

## Technical Data Bulletin #160 – Reusable Respirator Facepieces and Powered Air Purifying Respirator Systems (PAPRs) in the Health Care Environment: Considerations for Use

---

facepiece or PAPR is considered to be similar to a non-critical patient item, establish similar decontamination procedures. It is important to check with the manufacturer of the respirator/respiratory system as many components have not been tested for compatibility with commonly used hospital cleaning/decontaminating agents at this time. Thorough inspection after completing your decontamination process is essential as well as conducting a user seal check for negative pressure respirators and an air flow check for PAPRs. Facility procedures should also include infection control considerations such as the use of PPE during the cleaning/decontamination process to reduce the potential of cross-contamination if contact transmission is of concern.

The filter elements themselves cannot be cleaned or disinfected. In some cases the outside casing or holder of a filter element can be wiped with a solution, but not the filter media itself. Particulate filters are normally disposed of when breathing resistance increases or if the filter becomes damaged or exposed to blood or body fluids. When used with biological agents, the transmission mode of the microorganism again plays a role in the determination of appropriate filter replacement. If contact transmission is not of concern, a facility may elect to reuse the filters from reusable facepieces

and PAPRs in accordance with the manufacturer's instructions. When particles are collected on a filter they are strongly held to the filter. Breathing through a filter has not been shown to dislodge the particles collected in that filter<sup>4</sup>. If contact transmission is of concern, it may be more appropriate to immediately dispose of any used replaceable filters.

Do not sterilize filters or cartridges as it may affect their performance.

### Inspection

Inspection of the respirator system must be conducted prior to each use per the procedures in the respirator instructions. A respirator with any damaged or deteriorated components should be repaired or discarded. Again, procedures should include any infection control considerations.

### Storage

Respirators must be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture and damaging chemicals. Respirators dedicated to specific individuals should be identifiable to the person (e.g. write name on headband of respirator, store in a specified location, etc.).

### Maintenance of Batteries

Powered air purifying respirators operate on batteries. If PAPRs are selected to be used, battery charging and maintenance must be taken into consideration. Typically, batteries

are designed to operate for an 8 hour shift. They do, however, require several hours to re-charge. If use of the PAPRs is routine, a battery maintenance schedule should be established. If used in an emergency, management practices must be established to help ensure the PAPR systems are ready to perform as expected when needed. Additional resources related to battery management and maintenance are listed in the Resource section.

### Glossary of Terms

- **Air Flow Check:** A method, as determined by a manufacturer for each model of powered air purifying respirator, for the user to assess adequate air flow of the PAPR before each use.
- **Assigned Protection Factor (APF):** The expected workplace level of respiratory protection that would be provided by a properly functioning respirator or a class of respirators to properly fitted and trained users.<sup>5</sup>
- **CE Marked:** Respirators that are tested and certified to a European respiratory protection standard.
- **Filtering Facepiece:** A negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.
- **Fit Test:** The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

## Technical Data Bulletin #160 – Reusable Respirator Facepieces and Powered Air Purifying Respirator Systems (PAPRs) in the Health Care Environment: Considerations for Use

---

- **Full-Facepiece Respirator:**  
A respirator that covers your nose, mouth and eyes.
- **Half-Facepiece or Half-Mask Respirator:** A respirator that fits over the nose and beneath the chin, covering your nose and mouth.
- **Hood:** A respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.
- **Loose-Fitting Facepiece:** A respiratory inlet covering that is designed to form a partial seal with the face.
- **National Institute for Occupational Safety and Health (NIOSH):** The governmental body that tests and certifies respirators in the United States.
- **Negative Pressure Respirator (tight-fitting):** A respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator. A person's lungs are the mechanism for air to flow through the filter.
- **Powered Air Purifying Respirator (PAPR):** An air-purifying respirator that uses a blower to force the ambient atmosphere through air-purifying elements to the inlet covering.
- **Respirator:** A personal device designed to help protect the wearer from the inhalation of hazardous atmospheres.<sup>5</sup>
- **SARS:** Severe Acute Respiratory Syndrome
- **Tight-Fitting Facepiece:** A respiratory inlet covering that forms a complete seal with the face.
- **User Seal Check:** An action conducted by the respirator user to determine if the respirator is properly seated to the face.

### References:

1. **Garner, J.S.,** Hospital Infection Control Practices Advisory Committee: Guideline for isolation precautions in hospitals. *Infect Control Hosp Epidemiol* 1996; 17:53-80, and *Am J Infect Control* 1996;24:24-52.
2. **CDC,** Updated Interim Domestic Infection Control Guidance in the Health-Care and Community Setting for Patients with Suspected SARS, May 1, 2003.
3. **CDC,** Interim Domestic Infection Control Precautions for Aerosol-Generating Procedures on Patients with Severe Acute Respiratory Syndrome (SARS), May 20, 2003.
4. **Qian, Y., K. Willeke, S. Grinshpun, and J. Donnelly:** Performance of N95 Respirators: Reaerosolization of Bacteria and Solid Particles, *Am. Ind. Hyg. Assoc. J.* 58:876-884 (1997).
5. **American National Standards Institute (ANSI):** *ANSI Z 88.2 (1992), American National Standard for Respiratory Protection.* New York: ANSI, 1992.

### Resources:

- 3M Technical Data Bulletin #150, September 2001, Reusable Respirators
- 3M Technical Data Bulletin #144, January 2000, Maintenance And Management Of Battery Packs For 3M™ Powered Air Purifying Respirators (PAPRs)
- 3M Technical Data Bulletin #151, March 2002, PAPR Management and Planning for First Responders
- "Respiratory Protection," *Code of Federal Regulations.* Title 29 Part 1910. pp. 412-437. 1998.
- "Respiratory Protection for M. tuberculosis," *Code of Federal Regulations.* Title 29 Part 1910. pp. 442-446. 1998.
- Selection, Use and Care of Respirators. *Canadian Standards Association.* October, 2002. CSA-Z94.4-02.
- OSHA: [www.osha.gov](http://www.osha.gov)
- National Institute for Occupational Safety and Health: *Respiratory Protection Program In Health Care Facilities* (DHHS Pub. No. 99-143). September 1999.
- American Industrial Hygiene Association: *Respiratory Protection, A Manual and Guideline,* Fairfax, Virginia: American Industrial Hygiene Association, 2001.

## Technical Data Bulletin #160 – Reusable Respirator Facepieces and Powered Air Purifying Respirator Systems (PAPRs) in the Health Care Environment: Considerations for Use

### **WARNING**



Respirators help reduce exposure to certain airborne contaminants. **Misuse may result in sickness or death.** Before use, the wearer must read and understand *User Instructions* provided as a part of product packaging. Time use limitations may apply. Call 3M OH&ESD Technical Service at 1-800-243-4630. In Canada, call 1-800-267-4414.

#### **Important**

Before using respirators, you must determine the following:

1. The type of contaminant(s) for which the respirator is being selected.
2. The concentration level of contaminant(s).
3. Whether the respirator can be properly fitted on the wearer's face. All respirator instructions, warnings and use and time limitations must also be read and understood by the wearer before use.

Before use of these respirators, a written respiratory protection program must be implemented, meeting all the requirements of OSHA 29 CFR 1910.134, including training, medical evaluation and fit testing.

#### **For more information, please contact:**

#### **3M Occupational Health and Environmental Safety Division (OH&ESD)**

#### **In the U.S., contact:**

##### **Sales Assistance**

1-800-896-4223

##### **Technical Assistance**

1-800-243-4630

##### **Fax On Demand**

1-800-646-1655

##### **Internet**

<http://www.3M.com/occsafety>

##### **For other 3M products**

1-800-3M HELPS

#### **In Canada, contact:**

3M Canada Company, OH&ESD

P.O. Box 5757

London, Ontario N6A 4T1

##### **Sales Assistance**

1-800-265-1840, ext. 6137

##### **Technical Assistance (Canada only)**

1-800-267-4414

##### **Fax On Demand**

1-800-646-1655

##### **Internet**

<http://www.3M.com/CA/occsafety>

##### **Technical Assistance In Mexico**

01-800-712-0646

5270-2255, 5270-2119 (Mexico City only)

##### **Technical Assistance In Brazil**

0800-132333

##### **Fax On Demand O.U.S. Locations**

1-651-732-6530



#### **Occupational Health and Environmental Safety Division**

3M Center, Building 235-2E-91

St. Paul, MN 55144-1000