Respiratory Protection

Everything You Wanted to Know About Respiratory Protection
– and Probably a Bit More.

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Purpose of this training

- OSHA requires that workers be provided with respirators by the employer when such equipment is necessary to protect the health of the employee.
- The employer shall provide training in the proper use of respirators including donning and removing them, maintenance, limitations and respiratory hazards to which the workers may potentially be exposed during routine and emergency situations.
Respirators are NOT the first line of defense

- Engineering controls and good work practices are the first line of defense. It is best to design the work so that hazardous contaminants don’t get to the worker in the first place, or if they do, to minimize the amount.
- Respirators are used as necessary additional protection to workers’ respiratory systems.
What You’re Protecting

- The respiratory system draws air through the nose and mouth down through airways to the lungs, where the alveoli of the lungs allow inhaled oxygen to enter the blood and carbon dioxide to leave it to be exhaled.

- CO2–oxygen exchange is vital. If you can’t breathe you won’t survive long.

- Lungs & airways are delicate tissues.

- Chemicals and particulates in the air in sufficient quantities can damage them.

- Engineering controls and respirators are used to protect the lungs by keeping damaging materials away from them.
Respiratory System

The main parts of the system are
- Nose and Mouth
- Throat (including larynx)
- Trachea (windpipe)
Bronchi
(branches from trachea)

Alveoli
(air sacs in the lungs)
Diaphragm and chest muscles
What you’re protecting against when you wear a respirator

Respiratory Hazards

There are three main categories of respiratory hazard:

- Oxygen Deficiency
- Toxic Contaminants
- Biological Agents
Oxygen Deficiency

• Oxygen Deficiency occurs where other gases have displaced the oxygen (such as in low spots in confined spaces) or consumed it (fires).
• If used in sufficient quantity, certain fire-fighting materials such as carbon dioxide or halon from fire extinguishers can displace oxygen. Exit a fire area immediately.
There are three categories of toxic contaminants:

- **Gases and Vapors** (carbon monoxide, gasoline)
- **Particulates** (asbestos, dust from pool chlorination tablets)
- **Combinations of gases/vapors and particulates**
Biological Agents

- Respirators are also used to protect against inhalation of certain contagious biological agents such as bacteria and viruses. N95 respirators have been used to protect medical personnel from biological agents such as tuberculosis (TB) and SARS.
How to protect your respiratory system

Control of Respiratory Hazards

To control respiratory hazards

- Assess the hazard (identify the contaminant & its concentration)
- Reduce or eliminate the hazard (use good work practices and engineering controls.)
- Provide respiratory protection equipment based on work activities, environmental conditions and needs of the workers.
Types of Respirators

There are four categories of respirators

- Air-purifying respirators (APR)
- Supplied-air respirators (SAR)
- Self-contained breathing apparatus (SCBA)
- Combination respirators
Air-Purifying Respirators

- Removes contaminant from air before it is inhaled.
- Made of a facepiece, or a facepiece and disposable filter cartridges.
- Depends on the lung power of the wearer to draw air through the filter (negative pressure.)
APRs remove limited amounts of contaminants from the worker’s breathing zone, but do nothing to change the oxygen content or the air or affect conditions where the contaminant concentrations exceed the limits of the respirator and filter cartridges.

Do not depend on an APR in an oxygen-deficient environment!
Air-Purifying Respirators

Two types of APR

- Particulate removing or mechanical (includes HEPA filters)
- Gas and vapor removing or chemical (includes organic vapor and acid gas absorbents)
N 95 medical respirators
Half mask respirators with P100 (HEPA) filter cartridges
Full face respirator with HEPA and acid gas filter cartridges
Powered Air-Purifying Respirators

A special category of APR

- Uses a blower and portable battery pack to force air through filter cartridge (positive pressure)
- Leakage helps push contaminants out of breathing zone.
- Is no protection in oxygen-deficient atmospheres.
Powered air purifying respirator (PAPR) with HEPA filter cartridge
Supplied Air Respirators

- Supplies uncontaminated air from source independent of surrounding atmosphere
- Air line feeds air to facepiece
- Safe to use in oxygen-deficient atmospheres
- Complex, needs monitoring, more regulations.
- Mobility limited to length of air hose.
- (Not used on campus.)
Self-Contained Breathing Apparatus (SCBA)

- User carries source of breathable, uncontaminated air
- Provides highest level of protection
- Tanks hold only 30 or 60 minutes of air.
- Safe to use in oxygen-deficient atmospheres.
Self-contained breathing apparatus (SCBA)
Combination Respirators

- “Escape Bottles”
  (5 or 10 minute SCBAs)
- Supplied air respirators with emergency HEPA filters
- (not used on campus)
How is it determined which type to use?

Respirator type is decided by exposure level to contaminants in the work area. Chemicals have a known Permissible Exposure Limit (PEL). The goal is to choose a respirator that will prevent more than that level from reaching your lungs. This is done using protection factors.
Protection Factors

- The type of respirator determines the level of protection it gives the wearer.
- The protection factor (PF) is the concentration of contaminant outside the mask divided by the concentration of contaminant inside the mask.
- Using the PF it is possible to determine what type of respirator is right to maintain the level of contaminant inside the respirator below the permissible exposure limit (PEL) of the known contaminant.
# Protection Factors of Respirators with Filter Cartridges

<table>
<thead>
<tr>
<th>Respirator Type</th>
<th>Protection Factor</th>
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</thead>
<tbody>
<tr>
<td>Half face APR</td>
<td>10</td>
</tr>
<tr>
<td>Full face APR</td>
<td>50</td>
</tr>
<tr>
<td>Powered APR (PAPR)</td>
<td>100</td>
</tr>
<tr>
<td>Supplied Air</td>
<td>1,000</td>
</tr>
<tr>
<td>SCBA</td>
<td>10,000</td>
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Particulate Filter Types

- Respirator filters are given a rating by NIOSH indicating the oil resistance of the filter media and its efficiency at filtering out contaminants.
  - N indicates the material is not resistant to oils, such as oil mists.
  - R indicates the material is resistant to oils.
  - P is oil resistant to the point of being oil proof.
  - 100 indicates 99.7% efficiency at filtering materials down to 0.3 micron in size.
  - 99 is 99% efficient.
  - 95 is 95% efficient.
Particulate Filter Types

So, P100 filter cartridges are oil proof and 99.7% efficient down to 0.3 micron. This is considered a HEPA filter, for High Efficiency Particulate Air filter.

By contrast an N95 respirator is not oil resistant and is 95% efficient to 0.3 micron. Though the whole mask serves as the filter it is not considered HEPA.
How to wear a respirator

Respirator Fitting

Respirator must fit tight to the face. This seals the contaminant out of the breathing zone.

- Try on different sized respirators to get the right fit.
- The facepiece cannot seal over facial hair.
- Excess facial movement can break the seal. Do not chew gum or tobacco, and especially do not smoke while wearing a respirator!
How to wear a respirator

Inspecting the Respirator

Check facepiece and valves for
• Excessive dirt
• Distortion from poor storage
• Anything cracked, torn or missing

Check straps for
• Loss of elasticity
• Anything cracked, torn, broken or missing
Fit Checks for Respirators with Filter Cartridges

The wearer needs to perform a fit check every time he or she dons the respirator. It consists of two tests:

- Negative Pressure Check
- Positive Pressure Check
Negative Pressure Check

The wearer

- blocks the filter cartridge inlets with the palm of the hand so air cannot pass through
- inhales so facepiece collapses slightly
- holds his or her breath for 10 seconds. If there is no inward leakage of air, the test is passed.
Negative Pressure Check
Positive Pressure Check

The wearer

- covers the respirator’s exhalation valve with the palm of the hand
- gently exhales in the facepiece for 10 seconds.

If pressure can be built in the facepiece without outward leakage, the test is passed.
Positive Pressure Check
Fit Checks

If the respirator fails either fit checks, adjust the straps and try again. If that fails, try a respirator of a different size and fit check it.

It is important the respirator fits comfortably. If it becomes irritating the wearer may not be able to tolerate it over any length of time.
Fit Testing

Respirator users must be fit tested to ensure proper fit.

Once fit checks are passed, the respirator is tested. An appropriate test material is puffed around the intakes and seals. If the respirator wearer can detect the test substance, another respirator must be chosen and the checks and test repeated.
Fit Testing

Different materials are used to test the fit.

- N95 respirators are tested using a nebulized mist of saccharin or a bitter substance known as Bitrex.
- HEPA filtered respirators are tested using an irritating smoke (stannic chloride or titanium tetrachloride).
- Filters for organic compounds are tested using banana oil.
Fit Testing

The wearer may be asked to do

- Normal breathing
- Deep breathing
- Turn head side to side
- Nod head
- Talk
- Jog in place,
  all while the test substance is blown in and around the mask.
Fit Testing

If the user detects the substance inside the respirator, the respirator fails this test.

(It is very difficult to pretend to pass when irritant smoke is used because it causes involuntary coughing and sneezing.)
Fit Testing with irritant smoke
Maintaining your respirator

Cleaning

It is best that respirators are not shared. Used N95s are disposable. Other respirators should be cleaned and disinfected by

- Wiping with an alcohol or respirator cleaning wipe, first inside, then the outside. Let air dry.

Or

- Rinse with clean water, then detergent, then clean water again and let air dry.
Respirator Storage

Store respirator clean and dry in a closed, resealable bag. Respirators must be protected from extremes of heat and cold, sunlight, dust, excessive moisture and damaging chemicals. Store in a clean, sanitary place.
Questions

Contact Mary Schlagel at
NIU Environmental Health & Safety Dept.
Phone 815-753-1577

One More Thing...
Quiz!

Please print out the quiz now and complete it. Remember to sign and date it. Send the completed, signed and dated quiz to NIU Environmental Health and Safety Dept., attention Mary.

Thank you! Be safe out there.