Office of Laboratory and Field Safety

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Respiratory Protection

This training is offered in compliance with Respiratory Protection standards

• Federal OSHA - 29 CFR 1910.134
• Michigan OSHA Part 451
Objectives

• Hazards that may require the use of respiratory protection
• Types of respirators
• Fit testing
• Medical evaluation
• Potential limitations
• Selection
• Donning
• Care and maintenance
• Respiratory Program
Respiratory Hazards

Common respiratory hazards that may be encountered include:

• **Oxygen deficiency** (<19.5%)
• **Particulates** (dust, spray, fume, mist, fog, smoke)
• **Gases and vapors** (formaldehyde, benzene, etc.)
Types of Respirators

• **Air-Supplying (ASR)**
  Provides worker with a source of clean air through a tank worn on the back or near the work area. Examples include:
  - Self-Contained Breathing Apparatus (SCBA)
  - Supplied-Air/Airline (SAR)

• **Air-Purifying (APR)**
  The air the worker inhales is filtered by cartridges attached to the respirator that are appropriate for the hazards present. Cartridges are available for different applications, such as:
  - Mechanical filter for particulates
  - Chemical sorbent for vapors/gases
  - Combination for multiple hazards
Types of Respirator Face Pieces

- Single use/disposable
- Quarter mask
- Half mask
- Full face
- Helmet
This image shows a worker wearing a half-mask respirator with cartridges installed to remove contaminants in the work environment.
“The employer shall select a NIOSH-approved respirator.”

This note in the regulations is designed to protect the worker by ensuring that respiratory protection provided by the employer has been tested and is approved for use in respiratory protection programs. All respirators provided by CMU are NIOSH-approved.
This is a picture of a Self-Contained Breathing Apparatus (SCBA)
This image shows a Supplied Air/Airline Respirator.
This is a full-face respirator with P100 cartridges installed, which remove particulate hazards from the air.
Air-Purifying Cartridges

Air-purifying cartridges remove contaminants from the air the employee is breathing. There are different cartridges for different contaminants or applications, such as:

- Mechanical
- Organic Vapor
- Acid Gas
- Ammonia
- Specialized (such as mercury or formaldehyde)
- Combination Cartridges (remove gas/vapor AND particulates)
Identification of Filters, Cartridges, and Canisters

Written in the regulations (42 CFR Part 84 Respiratory Protective Devices) are rules that address certification requirements for non-powered, air-purifying, particulate respirators. This ensures the employer and the worker that, regardless of the manufacturer, the performance of the respirator has been documented and is acceptable. Likewise, color-coding of air-purifying cartridges is standardized across manufacturers.
This table shows the air-purifying cartridge color and what contaminant would be removed by the cartridge.

<table>
<thead>
<tr>
<th>Color</th>
<th>Contaminant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olive</td>
<td>Multi-contaminant</td>
</tr>
<tr>
<td>White</td>
<td>Acid gas</td>
</tr>
<tr>
<td>Black</td>
<td>Organic vapors</td>
</tr>
<tr>
<td>Green</td>
<td>Ammonia gas</td>
</tr>
<tr>
<td>Yellow</td>
<td>Acid gas and organic vapors</td>
</tr>
<tr>
<td>Purple</td>
<td>Any particulates - P100</td>
</tr>
</tbody>
</table>
Photo of typical air-purifying, color-coded cartridges
Air-Purifying **Particulate** Respirators

- Three levels of efficiency at removing particulate hazards:
  - 95% (= 95 rating when ordering)
  - 99% (= 99 rating when ordering)
  - 99.97% (= 100 rating when ordering)

- Three categories of resistance to oil:
  - N = “Not” resistant to oil
  - R = “Resistant” to oil
  - P = Oil “Proof”

These respirators and their performance are certified by NIOSH and DHHS.

“R” Series respirators should **ONLY** be used one shift when oil is present.
Purchasing Air-Purifying *Particulate* Respirators

- When ordering your particulate respirator, multiple product options are available such as N99, N95, R99, P100, etc.
- Be sure to choose the right level of *efficiency* and the proper *resistance to oil* – as determined during the hazard evaluation.
- Additionally, choose the *correct size*. You must purchase the exact same respirator that you wore during the fit testing process.
Respirator Fit Testing

Written into the regulations (Appendix A) are specific FIT TESTING procedures to be conducted on employees wearing a respirator.

The law states that the employer:

- Must fit test all respirators with tight-fitting face pieces
- Fit testing is REQUIRED
  - Prior to initial use
  - Whenever a different respirator face piece is used
  - At least annually, thereafter
  - If the employee reports changes in physical conditions, such as a weight loss/gain of 20 pounds or more
Qualitative vs. Quantitative Fit Test

• QLFT – Qualitative fit testing is done using Bitrex or Irritant Smoke – result is Pass/Fail

• QNFT – Quantitative fit testing uses specialized equipment which calculates a fit factor to determine adequate protection

Note: Qualitative fit testing may only be used to fit test negative pressure, air-purifying respirators that must achieve a fit factor of 100 or less.
OSHA Fit Testing Protocol

Standard Exercises for QLFT & QNFT are listed below. Each exercise is done for 1 minute while wearing the respirator.

- Normal breathing
- Deep breathing
- Head side-to-side
- Head up and down
- Talking
- Grimace (QNFT only)
- Bending
- Normal breathing
Medical Evaluation

• Each employee requiring respiratory protection must complete a Medical Questionnaire as prescribed in Appendix C of the regulation.
• Employees will have a follow-up medical exam for any positive response to the questionnaire.
• The questionnaire and conversations the employee has with the physician are confidential. CMU receives a written recommendation from the physician stating that the employee is approved to wear a respirator.
• When meeting with the physician, employees must describe the conditions of respirator use.
• If the employee cannot use a negative pressure air-purifying respirator, CMU will provide to the employee a powered air-purifying respirator (PAPR).
• Follow-up evaluations must be conducted if conditions of use change or the employee reports a change in health.
Limitations for Respirator Wearers

The physician will assess the employee for medical conditions which may affect the employee’s ability to wear a respirator:

- Respiratory Impairment
- Anemia
- Epilepsy
- Facial Hair
- Punctured ear drum
- Cardiovascular Impairment
- Diabetes
- Claustrophobia
- Comfort
- Vision
The following note is written into the regulation regarding facial hair:

“Employer shall not permit respiratory protection equipment to be worn by employees who have facial hair that comes between the sealing surface or interferes with the valve function, or any condition that interferes with the face piece seal (other glasses, goggles or other protective equipment may not interfere with the seal).”
Respirator Selection Criteria

When choosing the right respiratory protection for you, the following must be considered:

- Physical state of the contaminant – i.e. particulates, vapors, both?
- Contaminant concentration in the work environment
- Oxygen deficiency
- Warning properties of the contaminant
- Potential for **Immediately Dangerous to Life and Health (IDLH)** atmospheres
- Can the contaminant be adsorbed by media on a respirator?
- Can the contaminant be absorbed through the skin? Is other Personal Protective Equipment needed?
- Is the contaminant irritating to the eyes?
Requirements for use of Air-Purifying Respirators (APR)

• Oxygen levels must be in the normal range of 19.5-23.5%

• The chemical substance in the work environment must be identified and the concentration in the atmosphere is known

• A canister/cartridge for a respirator is available to effectively reduce the contaminant to a safe level

• The airborne concentration does not exceed the IDLH level
Respirator Options for Non-IDLH Atmospheres

- If gases and/or vapors are present, an Air-Supplying Respirator (ASR) would provide the employee with a source of clean air to breathe while working; however, this respirator may be cumbersome or not appropriate for the employee’s task.

If a chemical cartridge is available for the contaminant of concern, an Air-Purifying Respirator (APR) may be more appropriate. When using an APR, attention to the cartridge service life must be noted and the employee is required to change the cartridge as indicated per the change schedule to maintain respiratory protection.
Respirator Options for Non-IDLH Atmospheres

- For particulate hazards in the work environment, an **Air-Supplying Respirator (ASR)** will provide respiratory protection; but may be excessive depending on the work being done.

  An **Air-Purifying Respirator (APR)** may be a better choice for employee comfort and effectiveness.
Assigned Protection Factors (APF)

Assigned protection factors for NIOSH approved respirators are written into the regulations. This value provides an expectation of how many times the contaminant level can be reduced when wearing a properly fitted respirator. Examples are listed below:

<table>
<thead>
<tr>
<th>Respirator</th>
<th>APF</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Negative Pressure</td>
<td></td>
</tr>
<tr>
<td>Full face piece APR</td>
<td>50</td>
</tr>
<tr>
<td>Half mask APR</td>
<td>10</td>
</tr>
<tr>
<td>• Positive Pressure</td>
<td></td>
</tr>
<tr>
<td>Full face piece SCBA</td>
<td>10,000</td>
</tr>
</tbody>
</table>
Maximum Use Concentration (MUC)

Maximum use concentration is defined in the regulations as the “Maximum atmospheric concentration of hazardous substance from which an employee can be expected to be protected when wearing a respirator, and is determined by the assigned protection factor of the respirator or class of respirators and the exposure limit of the hazardous substance.”
Maximum Use Concentration (MUC)

Maximum use concentration is determined by multiplying the **Assigned Protection Factor (APF)** of the respirator and the **Permissible Exposure Limit (PEL)** of the contaminant of concern. (Note: The PEL is established by OSHA for hazardous chemicals and may be found on the Safety Data Sheet or other reference materials specific to the chemical in question)
Maximum Use Concentration (MUC)

MUC = APF x PEL

If the answer to the above calculation exceeds the IDLH level for a hazardous substance, or the performance limits of the cartridge or canister, then the MUC must be set at that lower limit.
Maximum Use Concentration (MUC)

Cumene Example

Full face piece Air-Purifying Respirator (APR)  APF = 50

PEL for Cumene = 50 ppm

IDLH level for Cumene = 900 ppm

\[ \text{MUC} = 50 \text{ (APF)} \times 50 \text{ (PEL)} = 2500 \text{ ppm} \]

Since this calculated result is >900 ppm (IDLH level for Cumene), the maximum use concentration must not exceed 900 ppm Cumene to use a full face piece Air-Purifying Respirator.
Sources of Exposure with Air-Purifying Respirators

• **Face Seal Leakage**
  Prevention: Fit testing, proper wearing

• **Exceeding Cartridge Capacity**
  Prevention: Proper cartridge selection, adequate replacement interval
  Note: If the cartridge contains an End-of-service life indicator (ESLI) – the cartridge must be changed when indicated. Cartridges that do not contain an ESLI – the employee must follow a change out schedule to ensure appropriate protection.
Donning a Respirator

• Conduct a **visual inspection** of the equipment
• Perform a **negative pressure test**  
  (Done by covering the inhalation areas of the respirator and taking a breath. The wearer should feel the respirator tighten against the face if the respirator is on correctly.)
• Perform a **positive pressure test**  
  (Done by covering the exhale area of the respirator and breathing out. The wearer should assess for any feeling of air leaking around the seal.)
Negative & Positive Pressure Test

• The purpose of these tests is to subjectively assure that there is an adequate seal of the face piece to the face of the wearer.
Negative Pressure Test
Positive Pressure Test
Care and Maintenance

• Change cartridges/canisters
• Clean and disinfect after each use
• Store in a clean, sealed bag
• Follow manufacturer’s recommendations for maintenance
• N95 Respirators are single-use and must be disposed of after each shift
Respiratory Protection Program

- Written program
  [https://www.cmich.edu/fas/fsr/rm/EHS/Written_Plans/Pages/default.aspx](https://www.cmich.edu/fas/fsr/rm/EHS/Written_Plans/Pages/default.aspx)
- Respirator selection
- Medical evaluations
- Fit testing
- Cleaning, disinfecting, maintenance, storage, inspection
- Procedures to ensure air quality and flow for ASR
- Training (annual or more often)
- Regular program evaluation
When Respirators are NOT Required

If a worker feels they need respiratory protection in an area that does not require it, the following must be considered:

• If dust masks only are used and not required, no written program is required
• A worker can use a respirator if it does not create a hazard
• **Voluntary Users** must be given Appendix D of the regulation
CMU Procedure

1. Training
2. Hazard evaluation (make an appointment), need to determine cartridge change out schedule and type of respirator needed.
3. Medical approval
4. Fit testing
5. Purchase respirator
6. Ongoing review throughout the year
7. Annual training and fit testing
8. Questions? Contact Office of Laboratory & Field Safety, 774-3215
Next Steps

• Congratulations! You have completed the required training for Respiratory Protection.
• Please contact the Office of Laboratory and Field Safety to schedule your fit testing appointment, 774-3215.
• At the appointment, you will receive a short quiz covering the content of this presentation.