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*June 2014*  
During an animal health emergency, exposure to airborne hazards, such as zoonotic disease agents or chemicals, may occur. A number of different respirators are available and when used correctly can provide various levels of protection. This Just-In-Time training will overview the proper use of respirators as part of personal protective equipment during animal health emergencies. Safety concerns and considerations while wearing respirators are also addressed.

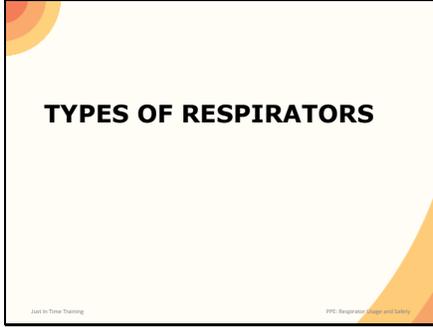
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### What is a respirator?

- Worn on face
- Covers nose and mouth
- Forms a tight seal against skin
- Filters out certain airborne particles

A respirator is a personal protective device that is worn on the face. It covers the nose and mouth and is specifically designed to provide respiratory protection by forming a tight seal against the wearer's skin. Respirators vary in their level of protection and efficiency to filter out airborne particles. The use of respirators may be needed for hazardous airborne particles, such as dust, pathogens, gases, or vapors, or chemical splash.

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Lets look at the various types of respirators available. Each type protects against different hazards at different levels. The appropriate respirator chosen for use will depend on the anticipated airborne risk for the responder. It is important to select the right respirator for a specific job.

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### Classifications of Respirators

- Air-Purifying Respirators
  - Removes contaminants from the air
    - Particulate respirators
    - "Gas mask" respirators
- Air-Supplying Respirators
  - Provides clean source of air
    - Supplied air respirators (SAR)
    - Self-contained breathing apparatus (SCBA)

Respirators can be classified as one of two types based on how they protect the user; there are air-purifying respirators and air-supplying respirators.

The first class – air purifying respirators or APRs – filter and remove contaminants from the air. This group includes various particulate respirators, which filter out airborne particles, and "gas masks," which remove gasses and vapors. Therefore, the proper cartridge, canister, or filter must be selected based on the hazardous threat. Since filter respirators only modify the ambient air, they cannot be used in oxygen deficient situations. Air-purifying particulate respirators can be further subdivided into three categories: particulate filtering facepiece respirators, elastomeric respirators, and powered air-purifying respirators, also known as PAPRs. The two types of respirators most commonly used for animal health emergencies are disposable or particulate filtering facepiece respirators and reusable or elastomeric respirators.

The other class of respirators – called air-supplying respirators (ASRs) – protect the user by supplying air from another source. Air-supplying respirators can use an airline hose attached to a remote source of air –

which are called supplied air respirators or SARs, or they may come equipped with their own compressed air or oxygen supply, which are called self-contained breathing apparatuses (SCBAs). Both are used for high-risk environments. The SCBA offers the greatest respiratory protection from the outside environment compared to other respirators.

It is important to note that basic surgical masks are not considered respiratory protection. While a surgical mask can help block large particle droplets, splashes, sprays or splatter they may contain viruses and bacteria from reaching the nose and mouth, they do not form a tight seal against the skin or filter very small airborne pathogens. Unlike surgical masks, respirators provide a tight seal to the face when worn properly (fit-tested and seal checked). [Photo: Diagram showing various types of respirators. Source: Texas State University. Respiratory Protection Program at <http://www.fss.txstate.edu/ehsm/safetymanual/ppe/resppro.html>]

**Particulate Filtering Facepiece**

- Air-Purifying Particulate Respirator (APR)
- Disposable or single-use respirators
- Some have exhalation valve
- Goggle or eye protection needed
- N95s



Particulate filtering facepiece respirators are sometimes referred to as disposable or single-use respirators since the entire respirator is discarded when it becomes unsuitable for further use. This class of respirators offers protection against particulates only. They are made of cloth or paper and are primarily used for nuisance dusts or odors. The entire respirator facepiece is comprised of filter material. Some filtering facepiece respirators also have an exhalation valve which can reduce breathing resistance, reduce moisture buildup inside the respirator, and increase work tolerance and comfort for respirator users. Goggles or other eye protection would also need to be worn and should not interfere with the seal of the respirator. These respirators are also commonly referred to as “N95s” and are one of the most commonly used respirators. N95 refers to the filtration capability of the respirator. The NIOSH respirator approval regulation defines N95 as a filter class that removes at least 95% of airborne particles during “worse case” testing using a “most-penetrating” sized particle. In most instances a NIOSH-approved N95 filtering facepiece respirator is used to protect wearers from airborne particles, including pathogens. [Photo: (Top) 3M N95 particulate disposable respirator; (Bottom) A responder fit-testing a particulate filtering facepiece respirator. Source: Dani Ausen, Iowa State University]

**NIOSH Particulate Filter Approval Categories**

Minimum Filter Efficiency	N series Not resistant to oil	R Series Somewhat resistant to oil	P Series Strongly resistant to oil
95%	N95	R95	P95
99%	N99	R99	P99
100% (99.97%)	N100	R100	P100 (~HEPA)

Filtering facepiece respirators are available in three primary filtering efficiencies – 95%, 99% or 100% - and three levels of oil resistance, designated by N, R, or P. The N Series are not resistant to oil. N95, N99, N100 filter at least 95%, 99%, 99.97% of airborne particles, respectively. The R Series are somewhat resistant to oil. R95, R99, R100 filter at least 95%, 99%, 99.97% of airborne particles. The P Series are strongly resistant to oil. P95, P99, P100 filter at least 95%, 99%, 99.97% of airborne particles. 95% is the minimal level of filtration that will be approved by NIOSH.

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### Elastomeric Respirators

- Air-Purifying Particulate Respirators (APR)
- Reusable facepiece with disposable filter cartridges
- Half-face APRs
  - Only covers nose and mouth
  - Goggles or faceshield needed
- Full-face APRs
  - Covers entire face
- Variety of filters

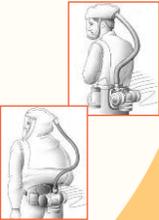


Elastomeric respirators are often referred to as reusable respirators since the facepiece can be cleaned, decontaminated, and reused, however the filter cartridges are discarded and replaced when they become unsuitable for further use. The face piece can be half-face masks, which cover the face from above the nose to below the chin or full-face masks, covering the face from the hairline to below the chin. When half-face masks are used, goggles or other eye protection may also be need to be worn to protect the eyes from exposure, but should not interfere with the seal of the respirator. Full-face respirators offers higher level of protection as it can provide a more effective seal to the face as well as provide a level of ocular protection. Elastomeric respirators allow for adjustable protection based on the filter used. [Photo: (Top) A responder wearing a half mask elastomeric respiratory. (Bottom) A responder wearing a full-face elastomeric respirator. Source: U.S. Department of Labor, OSHA at <https://www.osha.gov/Publications/3352-APF-respirators.html>]

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### Powered Air-Purifying Respirators (PAPRs)

- Air-Purifying Particulate Respirators (APR)
- Battery-powered blower pulls air through filters then moves filtered air towards facepiece
- Can be cooling device
- Not all require fit-testing and seal checks
- Check batteries



Powered air purifying respirators or (PAPRs) utilize a battery-powered blower to pull air through filters that trap particulates that may be present, and then moves the filtered air to the wearer’s facepiece. PAPRs decrease resistance to breathing and can act as a cooling device, but the battery and pump add extra weight to the equipment. Some hooded PAPRs do not require employees to be fit tested or perform a user seal check, but do require medical clearance and training in order to be used. The batteries used with PAPRs need to be used properly to be sure they last long enough to protect the wearer of the respirator. Several different types of batteries and chargers are available depending on the manufacturer of the PAPR and how long they will be used. PAPRs are generally the appropriate type of respiratory protection for high zoonotic risk levels of infectious agents. [Photo: (Top) A responder wearing a loose-fitting powered air-purifying respirator (PAPR) with a battery pack and faceshield. (Bottom) A responder wearing a hood powered air-purifying respirator (PAPR) with a battery pack and faceshield. Source: U.S. Department of Labor, OSHA at <https://www.osha.gov/Publications/3352-APF-respirators.html>]

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### Self-Contained Breathing Apparatuses (SCBAs)

- Air-Supplying Respirator
- Supply uncontaminated air to full facepiece
- Used in high risk environments
- Minimum usage time of 30 minutes
- Follow-up medical examination required
- Not commonly used in veterinary medicine



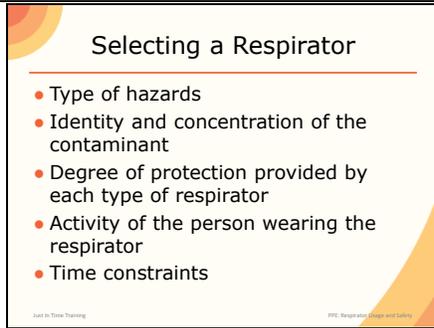
Self-contained breathing apparatus respirators are used for high-risk environments or when respiratory hazards are unknown. SCBAs come equipped with their own air supply to a full facepiece to allow for use in very high-risk environments. The SCBA offers the greatest protection from the outside environment compared to other respirators. SCBA respirators can’t be used in high risk environments for as long as PAPRs can since the air supply is limited to the size of the tank, but are required to have a minimum use of 30 minutes. Persons using SCBA respirators are required to have a follow-up medical examination in addition to the original medical examination for general respirator use. These are typically not needed for animal health emergencies. [Photo: (Top) Responder wearing a full facepiece supplied-air respirator (SAR) with an axillary escape bottle. (Bottom) Responder wearing a full facepiece self-contained breathing apparatus (SCBA). Source: U.S. Department of Labor, OSHA]

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Next we'll look at specific respirator usage requirements and safety considerations.

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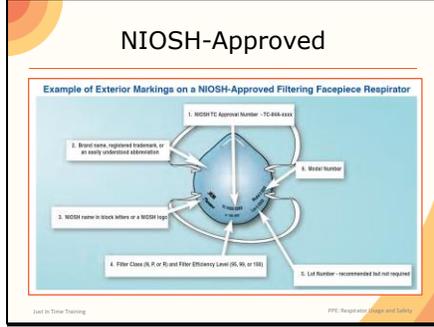
When selecting a respirator, you must know the type of hazard involved, as well as the identity and concentration of the contaminant. Additionally, consideration must be given to the degree of protection provided by each type of respirators, as well as the anticipated activity of the person wearing the respirator. Time constraints may also be a factor. Respirators are available in different types and sizes. Ensure you have selected the correct type and size of respirator for which you have been fit tested. Never replace with a different size or type of respirator.

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Safety and health standards for respirator use are established by the Occupational Safety and Health Administration (OSHA), the Food and Drug Administration (FDA), and the National Institute for Occupational Safety and Health (NIOSH). Personnel must use respirators in conjunction with the OSHA 1910.134 comprehensive respiratory protection program standards which can be found on the OSHA website at <http://www.osha.gov>. A written respiratory protection program with procedures specific to the respond should be completed. Additionally, all respirators must be approved by NIOSH and are thoroughly evaluated and tested by NIOSH to meet strict federal safety requirements. The website, <http://KnowItIs.NIOSH.gov> contains additional information regarding respirators, their use and other issues.

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This illustration shows an example of the exterior markings found on a NIOSH-approved filtering facepiece respirator. All NIOSH-approved filtering facepiece respirators are marked with the manufacturer's name, the part number (P/N), the protection provided by the filter (e.g., N95, P100), and "NIOSH." Some filtering facepiece respirators approved by NIOSH may have the NIOSH approval number (TC-84A-xxxx) as an additional identification marking. This information is printed either on the face, exhalation valve (if one exists), or head straps. The lot number or date of manufacture may appear on the respirator or may be located on the packaging. Counterfeit or modified respirators (e.g. those covered with fabric or design) do exist. These non-approved respirators, if worn, can compromise safety. It is important to verify the approval of the NIOSH "TC" number before wearing any respirator. This can be done at the NIOSH website at [http://www.cdc.gov/niosh/npptl/topics/respirators/disp\\_part](http://www.cdc.gov/niosh/npptl/topics/respirators/disp_part). [Image: Example of exterior markings on a NIOSH-approved filtering facepiece

respirator. Source: CDC NIOSH (National Institute for Occupational Safety and Health) Respirator Awareness: Your Health May Depend On It. Personal Protective Equipment for Healthcare Workers at <http://www.cdc.gov/niosh/docs/2013-138/pdfs/2013-138.pdf>.

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**Proper Use of Respirators**

- Fit-tested
- Seal checked
- Training
- Medical evaluation
  - Personal health questions
  - Medications
  - Work conditions



Just In Time Training PPE: Respirator Usage and Safety

For a respirator to work properly, it needs to be fitted to the wearer using a fit-test and then it needs to be seal-checked against the face. Respirators come in various sizes and must be individually selected to fit the users face and provide a tight seal. A proper seal between the user’s face and the respirator forces inhaled air to be pulled through the respirator’s filter material and not through gaps between the face and respirator. Fit-testing and seal checks are done to ensure there are minimal harmful particles, if any, getting through the respirator to harm the wearer. This will need to be done before the wearer is allowed into the contaminated area. All respirators that rely on a mask-to-face seal need to be annually checked with either qualitative or quantitative methods to determine whether the mask provides an acceptable fit to a wearer. A seal check is completed by the user to determine if the respirator is properly seated to the face ensuring inhalation occurs through the filter rather than around the edges of the respirator. This process may be performed differently depending on the type and model of respirator. The respirator wearer should be observed during a trial period to evaluate potential physiological problems. Tight-fitting air purifying respirators can impose a physiological burden on the user. For this reason a medical evaluation is also required prior to wearing a respirator. This involves answering a series of questions to assess your health, use of medications, and work conditions while wearing the respirator. Depending on the responses, a further work-up with a physician may be necessary to assess your pulmonary function or other concerns. A chest X-ray and or spirometry may be indicated. Responders who will need to wear respirators will need to receive training on the proper procedures for donning and doffing the particular respirator before being released into a contaminated area. [Photo: Medical evaluation of an employee for the use of a respirator. Source: Dani Ausen, Iowa State University]

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**Health Effects When Wearing Respirators**

- Increased resistance to breathing
- Reduced endurance
- Reduced visual field
- Increased risk for heat stress
- Decreased voice clarity/loudness
- Decreased hearing ability
- Discomfort or irritation
- Psychological stress

Just In Time Training PPE: Respirator Usage and Safety

There are a variety of health effects can be associated with wearing respirators. Pulmonary effects include added inspiratory and expiratory resistance and can lead to reduced endurance and exercise performance during the response. It also tends to increase ventilation. Respirators may reduce visual fields, decrease voice clarity and loudness, and decrease hearing ability. This may subsequently result in reduced productivity, and safety. Inspired air can increase the risk for heat stress since warm expired gases are rebreathed. Respirators can also cause discomfort to the user due pressure from the fit of the mask or allergic skin reaction. Eye irritation may occur from respirator air flow. For individuals that are claustrophobic, psychological stress may occur while wearing respirators.

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### Before Usage

- Inspect all parts of the respirator before use
- Batteries charged
- Proper air flow
- Do NOT use the respirator if it is not working properly



Just In Time Training PPE: Respirator Usage and Safety

All respirators must be inspected for basic function before each use. A respirator inspection must include a check of the respirator’s ability to work properly, the tightness of any connections, and the condition of the various parts, such as the facepiece, head straps, valves, tubes, hoses, and any cartridges, canisters or filters. In addition, elastomeric parts must be checked for pliability and sign of deterioration. If any parts are found to be damaged or compromised, do not use the respirator. For respirators with battery packs, be sure the battery has been charged and is ready for use. It is also important to test the air flow to make sure the respirator is working properly. If any part of the respirator is not working properly, do not use it. [Photo: An employee checking the respirator before using it. Source: Dani Ausen, Iowa State University]

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### Safe Respirator Usage

- Do not use a respirator unless
  - Formally trained and
  - Fit tested
- Select the correct respirator for the job
  - Particulate filter will not protect against gases or vapors
- Inspect the respirator before each use
- Ensure the face seal
  - Remove facial hair
  - Prevent hair or eyeglasses from interfering
- Do not wear contact lenses with a respirator

Just In Time Training PPE: Respirator Usage and Safety

Follow these guidelines to ensure safe respirator usage:

- Do not use a respirator unless you have been formally trained **and** have been fit tested for the respirator you are using
- Be sure the correct respirator for the job is selected. Do not mistakenly use a particulate or HEPA filtered respirator for protection against gases or vapors.
- Inspect the respirator before each use
- To ensure a tight fit,
  - Shave facial hair to ensure a good seal with the facemask
  - Do not allow your hair or eyeglass frames to interfere with the face mask seal
- Contact lenses should not be worn while wearing a respirator

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### During Usage

- Immediately leave contaminated area if respirator stops working
- PAPR – make sure battery charge is available
- SCBA – make sure air is available in tank



Just In Time Training PPE: Respirator Usage and Safety

While using a respirator in the field, be sure that it is working properly to filter harmful particulates and leave the contaminated area immediately if the respirator stops working or you think there may be a defect with it. If you feel nauseous, dizzy or ill, or have difficulty breathing, return to fresh air and remove the respirator. Never remove a respirator in a contaminated environment. Once in a safe area, check to see if the canister, cartridge, or filter needs to be replaced. Cartridges and canisters must be replaced if the user notices an odor, taste, or throat irritation. Wet, damaged, and grossly contaminated cartridges/canisters must also be replaced. If using battery operated respirators (PAPRs), be sure you do not work in the contaminated conditions longer than the battery will last. Check the battery periodically to make sure enough power is left to finish the job. If not, stop and get a fully charged battery from a safe area. When using SCBA respirators, be sure you only work as long as the air supply will last and don’t try to test the limit. When you know the air supply is getting low, return to a safe area for a full tank.

[Photo: A PAPR battery charging with the unit attached before usage. Source: Dani Ausen, Iowa State University]

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### Cleaning

- Follow manufacturer’s cleaning guidelines
- Warm water/mild detergent
- Disinfectant solution
- Dry thoroughly
- Never soak entire unit in detergent



Just In Time Training PPE: Respirator Usage and Safety

Cleaning reusable respirators is an important task to make sure the contaminants the respirator came in contact with do not spread. Follow manufacturer’s cleaning guidelines. Clean surfaces of the respirator with warm water and a mild detergent. Do not use organic solvents. Never soak the entire unit in cleaning solution as it can damage the respirator. If the response involved microorganisms, apply a disinfectant solution for the proper contact time. Rinse well and dry thoroughly with a lint free cloth. [Photo: An employee cleaning the outside of a PAPR respirator with a detergent and warm water mixture. Source: Andrew Kingsbury, Iowa State University]

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### Respirator Storage

- Store in accordance with manufacturer’s instructions
- Check expiration dates
- Never use and discard if:
  - Color changes
  - Shrinking
  - Wearing/thinning of material
  - Stretching
  - Cuts/tears/holes

Just In Time Training PPE: Respirator Usage and Safety

Respirators need to be maintained and properly stored in accordance with the manufacturer’s instructions. Expiration dates need to be checked as quality and integrity of some materials degrades over time. Never use defective or damaged PPE and inspect and discard if color changes, shrinking, wearing/thinning of material, stretching, cuts, tears, or holes are found in respirators.

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### Resources

- Occupational Safety and Health Administration (OSHA) – Respiratory Protection  
– <https://www.osha.gov/SLTC/respiratoryprotection/>
- National Institute for Occupational Safety and Health (NIOSH) – Respirators  
– <http://www.cdc.gov/niosh/topics/respirators/>
- U.S. Food and Drug Administration (FDA)  
– Masks and N95 Respirators  
– <http://www.fda.gov/medicaldevices/productsandmedicalprocedures/generalhospitaldevicesandsupplies/personalprotectiveequipment/ucm055977.htm>
- U.S. Department of Agriculture – Foreign Animal Disease Preparedness and Response Plan (FAD PrEP) NAHEMS Guidelines: Personal Protective Equipment  
– [http://www.aphis.usda.gov/animal\\_health/emergency\\_management/downloads/naheems\\_guidelines/fadprep\\_nahems\\_guidelines\\_ppe\\_final\\_april2011.pdf](http://www.aphis.usda.gov/animal_health/emergency_management/downloads/naheems_guidelines/fadprep_nahems_guidelines_ppe_final_april2011.pdf)

Just In Time Training PPE: Respirator Usage and Safety

For more information on the usage and safety issues associated with respirators during animal health emergency response, consult the following resources.

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### Acknowledgments

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