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Respirators: Air Purifying

Self-Study

COURSE 40723

June 2017

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Introduction

Course Overview

Respirators: Air Purifying Self-Study (COURSE 40723) is designed for Los Alamos National Laboratory (LANL) workers, support services subcontractors, and other LANL subcontractors who work under the LANL Respiratory Protection Program (RPP). This course also meets the air-purifying respirators (APRs) retraining requirement.

Course Objectives

After completing this course, you will be able to recognize

- why an air-purifying respirator is necessary;
- standards and requirements that affect the LANL RPP;
- airborne respiratory hazards;
- the roles and responsibilities of personnel associated with respiratory protection at LANL;
- the limitations and capabilities of an air-purifying respirator;
- how to inspect, don, and seal check an air-purifying respirator;
- how to use a respirator effectively in emergency situations;
- medical signs and symptoms that may limit or prevent the effective use of an air-purifying respirator; and
- how to remove, clean, maintain, and store an air-purifying respirator properly.

Program Owner

This course was developed under the direction and technical oversight of the RPP, the functional program owner for this training.

Target Audience

The purpose of this course is to familiarize and refresh LANL workers in the proper use of APRs at LANL. All LANL employees covered by the RPP are required to take this course.

This course, along with your medical evaluation and the *Request for Respiratory Protection Evaluation and Use* (LANL Form 1465, available at the Forms Center on the LANL website), are prerequisites to the fit test. You must pass this course successfully before you are fit tested with an APR.

Course Limitations

Taking and passing this course does not authorize you to wear an APR. You must also pass your medical evaluation and complete your fit test successfully.

About This Self-Study Course

Respirators: Air-Purifying Self-Study (COURSE 40723) is taken online. To receive credit in UTrain for completing this course, you must score 80% or better on the 20-question quiz. Directions for initiating the quiz are appended to the end of this training manual.

Acronyms

ANSI	American National Standards Institute
APF	assigned protection factor
APR	air-purifying respirator
CFR	Code of Federal Regulations
ESLI	end-of-service-life indicator
HEPA	high-efficiency particulate air
HP	health physicist
HPI	human performance improvement
IDLH	immediately dangerous to life and health
IH	industrial hygiene
IWD	integrated work document
LANL	Los Alamos National Laboratory
NCO	nuclear chemical operator
NIOSH	National Institute of Occupational Safety and Health
OSH-ISH	Occupational Safety and Health-Industrial Safety and Hygiene

OSH-OH	Occupational Health
OSHA	Occupational Safety and Health Administration
P	procedure
PPE	personal protective equipment
QLFT	qualitative fit test
QNFT	quantitative fit test
RCT	radiological control technician
RP-PROG	Radiation Protection
RPE	respiratory protection equipment
RPP	respiratory protection program
RWP	radiological work permit
SCBA	self-contained breathing apparatus

Module 1: LANL Respiratory Protection Program

Purpose of the Respiratory Protection Program

The purpose of the LANL RPP is to ensure that respiratory protection equipment (RPE) is selected, inspected, used, maintained, and stored in accordance with acceptable practices and in compliance with the

- United States Department of Labor Occupational Safety and Health Administration (OSHA) requirement 29 Code of Federal Regulations (CFR) 1910.134, *Respiratory Protection*;
- American National Standards Institute (ANSI) *Standard for Respiratory Protection* (ANSI Z88.2-1992); and
- National Institute for Occupational Safety and Health (NIOSH).

Facilities and equipment at LANL are designed to reduce or eliminate the potential for worker exposure to airborne hazardous materials. However, when engineering controls do not eliminate or sufficiently reduce the potential for worker exposure to airborne hazardous materials, respiratory protection may be necessary.

Medical Evaluation

Potential respirator users must have a medical evaluation to determine whether they are able to wear a respirator. Occupational Health (OSH-OH) performs the medical evaluation. A physician or other licensed health care provider will determine the components of the evaluation. The evaluation is administered according to 29 CFR 1910.134, *Respiratory Protection*. A medical evaluation is performed after the line supervisor has completed the *Request for Respiratory Protection Evaluation and Use* (LANL Form 1465) and the request has been approved by the qualified health and safety professional.

The written evaluation indicates your qualifications to use a particular type of respirator. When you complete and pass your medical evaluation, OSH-OH will notify you and the RPP that you are medically able to use the type of respirator indicated on the medical evaluation. You must complete the medical evaluation every year. You may discontinue the medical evaluation as it applies to APRs if you are no longer required to use a respirator in your work.

Fit Testing

Once you have passed the medical evaluation and this course, you must pass a respirator fit test before you may be issued an APR. When you pass the fit test successfully, you will be issued a respirator authorization card.

Before you schedule your fit test, you must have completed the following items:

- a *Request for Respiratory Protection Evaluation and Use* (LANL Form 1465), signed by the respirator user (you) within the last year;
- a medical evaluation, dated within the last year; and
- this course (COURSE 40723) and the course quiz with a passing score.

To set up your fit-test appointment,

- Go to UTrain to schedule a day and time for COURSE 3549 (the fit test). You will receive a pending message. Once Occupational Safety and Health-Industrial Safety and Hygiene (OSH-ISH) confirms that your prerequisites have been met, you will be enrolled.
- Fit testing is generally performed Monday through Friday, from 7:45 a.m. to 3:00 p.m.
- Arrive for the fit test clean-shaven, with no facial jewelry.
- If you require corrective lenses for your respirator, bring them to your fit test. Spectacle inserts are available from local eye doctors. Follow the instructions on the *Personal Protective Equipment Approval Source Document for Computer/Safety Glasses and Respirator Inserts* (LANL Form 1882b), which can be found under the LANL Forms Center.
- If you wear dentures, they should be in place during your fit test.
- Do not smoke at least 1 hour before your fit test. Smoking can interfere with your fit-test results.
- If you use safety glasses with a half-mask respirator, bring them with you to the fit test.

If you need to use a respirator soon after your fit test, learn the location of a respirator issue point at or near your work area.

Respirator fit tests are performed at OSH-ISH, TA-59, Building 1, Room 127. TA-59 is located on Pajarito Road near Diamond Drive.

When you arrive for your fit test:

1. You will be asked to sign a roster so that training records may be entered into UTrain.

2. A fit-testing respirator will be given to you.

3. You will be instructed to inspect your respirator while being observed completing this task. Your performance will be recorded on a checklist.

4. After you have successfully inspected your respirator, you will be instructed to don it. You will be observed completing this task, and your performance will be recorded on a checklist.

5. After donning the respirator, you will be asked to perform negative-pressure and positive-pressure seal checks. You will be observed completing these tasks. You may have to perform these seal checks several times before an acceptable seal is achieved.

Your successful negative- and positive-seal achievement will be recorded on a checklist.

Note: *You must wear the respirator for at least 5 minutes before the fit test to assess comfort. If it is not comfortable, request a different type or size of respirator.*

6. You will need to pass a quantitative fit test (QNFT). After entering a QNFT chamber, a tube will be connected to the probe in your fit testing respirator. Your QNFT will be processed using a software program that requires you to perform a set of eight activities while in the chamber. The QNFT takes about 8 minutes.

7. After you have passed the fit test successfully, you will be observed doffing your respirator. You will be given additional instruction on doffing, if needed.

8. After you have successfully doffed your respirator, you will receive your respirator authorization card.

Note: *If you are new to wearing a respirator, you should get a respirator and practice donning, performing seal checks, and doffing before you perform actual work in the respirator.*

Training and fit testing are required annually by OSHA.

Human Performance Improvement

Unauthorized Worker Asked to Wear Respirator

Human Performance Improvement (HPI) is an approach that is used to address human error in the workplace. HPI treats human error as a symptom or a result of deeper problems within a system. One of the five basic principles of HPI is that people achieve high levels of performance based largely on the encouragement and reinforcement from peers, leaders, and subordinates.

As you read the incident below, see if you can identify the circumstance(s) that allowed this incident to occur and how the behavior shown by the worker could be encouraged in others.

A supervisor requested that a worker don a respirator, even though the worker was not an authorized respirator worker. Neither an integrated work document (IWD) nor a documented hazard assessment existed. The worker was a former authorized respirator user and understood that to don a respirator, he/she must have a current authorization. The worker correctly refused to don the respirator.

Question 1. What circumstance(s) could have allowed this incident to occur?

Question 2. How could the behavior shown by the worker be encouraged in others?

(Answers appear on the next page.)

For more information about HPI, register for *Human Performance for Workers* (Course 43428) through UTrain.

Human Performance Improvement – Unauthorized Worker Asked to Wear Respirator

Answers

Question 1. The supervisor was not aware of the worker's lack of current authorization to wear a respirator. The supervisor did not have the required controls in place. The workplace culture appeared to value production over other concerns.

Question 2. Publicly recognize the work in a group meeting, give the worker a SPOT award, and/or discipline the supervisor.

Retraining Is Required

Retraining reinforces your proficiency and/or introduces you to new or revised control methods and procedures.

LANL requires retraining in APR every year and/or whenever

- changes occur in the type of respirators being used;
- inspections reveal inadequacies in the knowledge or use of APRs; and/or
- changes in your health or physical condition occur, such as gaining weight, starting to wear dentures, or scarring on your face from an accident or illness.

Additional Training Requirements

On-the-job training may be required to familiarize you with the specifics in your work area for using the respirator you have been issued—especially doffing and decontamination procedures.

Doffing instructions may be posted in a particular location. A peer may provide one-on-one training.

Module 2: Hazards

Module Objectives

When you complete this module, you will be able to recognize

- why it is important to use APRs,
- the concept of assigned protection factor (APF), and
- airborne respiratory hazards and their sources.

What Is an Air-Purifying Respirator?

An APR is a respirator in which ambient air is passed through an air-purifying element that removes the contaminant(s). Air is passed through the air-purifying element by means of the breathing action.

In other words, an APR is a piece of respiratory protective equipment that has cartridges or canisters that remove contaminants from the air by passing it through air-purifying elements before it reaches the user.

Simply stated, air-purifying respirators filter the air you inhale.

Hazards in the Air

Sometimes air contains materials that are harmful, even though these materials can be neither seen nor smelled. When you inhale these airborne hazardous materials, they can

- irritate your respiratory system,
- cause you to have health problems, or
- cause an early death.

If you need to work in areas where an airborne hazardous material might exist, you may need to wear respiratory protection to reduce your risk of exposure to the hazardous material.

Which Environments Are Hazardous?

If airborne hazardous materials are present in the air at high-enough levels, they can be harmful if inhaled. These airborne contaminants can cause a variety of health effects, ranging from irritation and discomfort to serious irreversible damage because of repeated and/or prolonged exposure. Sometimes it takes years for the effects to show up.

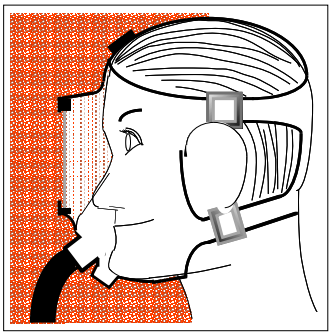
Sometimes the inhalation of airborne hazardous materials can damage your health immediately. If the air in the environment contains these materials, the environment is considered immediately dangerous to life and health (IDLH).

An IDLH atmosphere poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere. At LANL, an atmosphere is considered IDLH when

- it contains less than 19.5% oxygen or
- it contains airborne concentrations of toxic or radioactive contaminants that pose an immediate hazard to life or produce immediate, irreversible debilitating health effects; or
- employee exposure to a hazard cannot be identified or reasonably estimated.

Note: *The types of respiratory protection presented in this course are NOT designed for use in oxygen-deficient atmospheres or IDLH environments. NEVER use an APR in an oxygen-deficient atmosphere or an IDLH environment.*

Assigned Protection Factors



The APF is defined as the expected workplace level of respiratory protection that would be provided by a properly functioning respirator or class of respirators to properly fit-tested and trained users. The APFs used at LANL are shown in the following table.

APFs Used at LANL	
Respirator Class	**LANL APF**
Filtering	
Filtering Facepiece (dust mask for voluntary use)*	1
Air Purifying	
Half-Mask	10[a]
Full Facepiece	50
Powered Air Purifying	
Full Facepiece	1000
Loose-Fitting Facepiece	25
Hood/Helmet	25/1000[a]
Supplied Air	
Full-Facepiece Pressure Demand	1000
Hood/Helmet	25/1000[a]
Self-Contained Breathing Apparatus (SCBA) Pressure Demand	10,000

[a] *Certain conditions and restrictions apply. Refer to the LANL RPP Plan for more information, or contact your industrial hygiene (IH) support person.*

The definition of APF is sometimes confused with the definition of fit factor, but the two are not the same. ***Fit factor*** *is defined as a quantitative measure of the fit of a specific respirator facepiece to a particular individual and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.*

A ***pressure-demand respirator*** *is a positive-pressure, atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.*

The higher the APF, the greater the protection provided by the RPE, assuming proper training, fit testing, maintenance, and use. In selecting a specific respirator for use, the APF must be greater than the expected concentration divided by the exposure limit. For example, if the expected concentration is 30 parts per million ppm and the exposure limit is 2 ppm, a respirator with an APF of at least 15 must be used.

Hazards to the Respiratory System

Many airborne hazardous materials are invisible and odorless, yet when they are in your respiratory system they can cause irritation, health problems, or even death. These hazards generally fall into the following basic categories:

- dusts,
- fumes,
- mists and sprays,
- vapors, and
- gases.

Knowing the characteristics of each of these hazards and the types of operations that produce them will help you understand why the proper selection of respiratory protection is so important.

Note: *Some atmospheric hazards, such as oxygen deficiency, pose respiratory hazards that are not covered in this course because they require respirators that supply air rather than APRs, which purify it.*

Dust Hazards

Dust is made up of tiny particles that are created when solid materials break down into fine fragments that float in the air before finally settling down. Dust is produced by activities such as

- grinding,
- drilling,
- blasting,
- abrading,
- milling,
- sanding, and
- crushing.

Dust can become trapped in your respiratory system, where it may cause irritation, health problems, or early death. In many cases, the health effects caused by repeated exposure to airborne dusts do not appear for many years.

Fume Hazards

Fumes are very tiny airborne particles—smaller than dust particles. They are created when metal is melted, vaporized, and then condensed into particles by quickly cooling. Operations that produce fumes include

- arc-welding that produces iron oxide fumes,
- smelting (extracting metals from ores),
- pouring molten metal,
- burning magnesium metal,
- welding on surfaces coated with lead-based paint, and
- gas cutting on galvanized metal.

LANL has special equipment that can be used to protect against welding fume hazards. This equipment includes hoods and half-masks with low-profile filters.

Mist and Spray Hazards

Mists and sprays are composed of tiny airborne droplets. Some of the operations that create them are

- spraying operations that produce paint spray mists;
- electroplating, which can produce acid mists;
- pickling, which can produce acid or alkali mists;
- mixing operations; and
- cleaning operations.

Vapor Hazards

Vapors are the airborne form of substances that are normally either liquids or solids at room temperature. Vapors are formed when solids or liquids evaporate. Products that can release vapors include

- gasoline,
- paint thinners, and
- degreaser solvents.

Vapors cannot be seen, and not all vapors can be smelled. Although some vapors have distinctive odors, such as gasoline or banana oil, you should not rely on odor alone to indicate whether an atmosphere is hazardous.

Vapor Exposure

On April 6, 1994, Sandra, a unit operator with ARCO Products, was conducting rounds of the coker unit when she observed a leak coming from the mechanical seal of the heavy-gas oil pump of coker unit #1. Sandra decided to seek assistance; the head unit operator and six or seven unit operators responded. The operators put water and steam on the leak to suppress the vapor from the seal. The head unit operator decided to shut down the pump and transfer the product to the secondary pump.

As the operator shut down the primary pump, the mechanical seal blew, causing a vapor cloud to generate from the seal. The operators continued to put steam and water on the seal and isolated the pump from the pipeline. The remaining product in the pipeline leading to the primary heavy-gas oil pump vaporized, leading to the dispersion of the vapor cloud. The operators who responded were wearing bunker gear, and several wore emergency respirators. Those with respirators isolated the pump from the pipeline by closing the suction and discharge valves.

The operators who were not wearing emergency respirators stationed themselves upwind of the vapor cloud and put water on the cloud; however, the wind changed direction several times, exposing unprotected operators to vapors. Susan and James, two unprotected operators who responded to the incident, were taken to Long Beach Memorial Hospital to be treated for the inhalation of hydrocarbons. Susan was hospitalized.

Gas Hazards

Spreading quickly and usually undetected, gases are invisible contaminants that are airborne at room temperature. Gases can be hazardous or inert and may be produced by chemical processes or high-heat operations. Hazardous gases can cause short- or long-term health effects. Inert gases can displace oxygen and can be released from leaking gas cylinders or pressurized systems. Under the right conditions, either hazardous or inert gases can cause an atmosphere to become IDLH.

Many gases, such as carbon monoxide, cannot be seen or smelled. Examples of potentially hazardous gases include

- phosphine and
- exhaust from internal combustion engines.

Examples of inert gases include

- nitrogen,
- helium, and
- argon.

Module 3: Types of APRs

Module Objectives

When you complete this module, you will be able to recognize

- situations in which an APR can and cannot be used and
- the parts of a half-mask and full-facepiece respirator and their functions.

When to Use APRs

Airborne hazardous materials can be removed safely from the air that you breathe with the use of an APR. APRs are used when

- existing engineering controls do not remove a sufficient amount of airborne hazardous materials to make the atmosphere safe to breathe,
- enough oxygen exists in the air to support life,
- the identity and the amount of the airborne hazardous materials are known, and
- the existing air can be purified safely.

Selecting Your Respirator

Your RPE is selected only after the respiratory hazards, the workplace factors, and your medical condition have been evaluated. At a minimum, the following factors are considered when selecting your RPE:

- the type and estimated concentration of the airborne contaminants of concern;
- the oxygen concentration in the work atmosphere;
- the effectiveness of the RPE against the contaminants of concern;
- the known operational limitations of the RPE;
- the APF;
- the comfort, fit, and worker acceptance of the RPE;
- the characteristics of the workplace (laboratory, confined space, machine shop, etc.);
- the characteristics of the work to be performed; and
- the requirements of OSHA standards.

Types of APRs

Two types of APRs—the half-mask respirator *(left)* and the full-facepiece respirator *(right)*—are shown in the photographs below.

Note: *North 7700 half-mask respirators at LANL are made of silicone and assorted polymers. MSA full-facepiece respirators can be made of either high-carbon rubber or silicone.*

Half-Mask Respirators

Half-mask respirators are air-purifying devices that cover the nose, mouth, and chin. The facepiece is equipped with either cartridges or filters that remove airborne hazardous materials from the air you breathe. Each cartridge or filter is designed to remove a specific gas, vapor, or particle hazard, with some types offering protection against a combination of hazards.

At LANL, half-mask respirators are used for protection

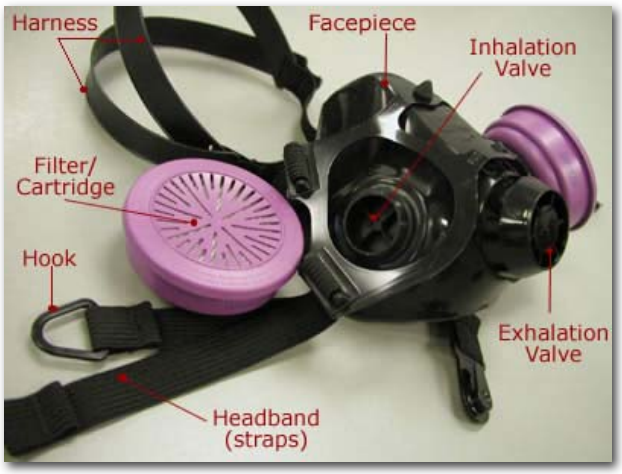
- from paint vapors,
- from dust, and
- in areas where hantavirus may be present.

Note: *Half-mask respirators are NOT approved for use with radiological materials or airborne radioactivity.*

Half-Mask Respirator Parts

The following photograph identifies the main parts of a half-mask respirator.

- **Facepiece**—covers your nose, mouth, and chin to protect you from inhaling airborne hazardous materials.



- **Headband (Straps)**—holds the respirator in place on your head.
- **Hook**—fastens the bottom straps/headbands of the respirator around your neck.
- **Filter/Cartridge**—removes airborne hazardous materials from the air you inhale.
- **Inhalation Valve**—allows you to breathe air in through the cartridge or filter as a one-way valve located under the cartridge or filter, and prevents air from being exhaled through the cartridge or filter.
- **Exhalation Valve**—allows you to exhale the air you have breathed in as a one-way valve located under the cartridge or

filter but prevents outside air from entering the respirator during inhalation.

Full-Facepiece Respirators

Full-facepiece respirators provide more protection than half-mask respirators because their shape allows a better mask-to-face seal. These respirators also protect the eyes from irritating chemicals, splashes, or particulate atmospheres.

Full-facepiece respirators are equipped with different types of air-purifying cartridges—depending on the protection required—to remove dust, mists, fumes, or gas and vapor hazards from the air you inhale.

Full-Facepiece Respirator Parts

The following photograph identifies the main parts of a full-facepiece respirator.

- **Lens**—protects your eyes from the airborne hazardous materials.
- **Tabs**—prevent the straps/headbands from going through the buckles.

- **Buckles**—secure the tightness of the straps/headbands.
- **Straps/Headbands/Harness**—hold the respirator in place on the head.
- **Cartridge/Filter**—filters airborne hazardous materials from the air you inhale.
- **Receptor**—contains the gasket that allows a tight seal between the cartridge and the receptor and prevents hazardous airborne materials from bypassing the cartridge.
- **Inhalation Valve**—allows you to breathe air in through the cartridge or filter as a one-way valve located under the cartridge, and prevents air from being exhaled through the cartridge or filter.
- **Exhalation Valve**—this one-way valve allows you to exhale the air you have breathed in but prevents air from entering the respirator during inhalation.

Inhalation valve.

APR Cartridges

Filters and cartridges filter the airborne hazardous materials from the air that you breathe. The type you will use depends on the kind of airborne hazard you want to avoid. You must have the right cartridges and/or filters for the job, or you may inhale airborne hazardous materials without knowing it.

Cartridges and filters are color-coded, based on the hazard for which they are used. Always read the information on the cartridge to make sure you have the correct cartridge. ***DO NOT*** just look at the color.

The three main categories of cartridges used in APRs are the

- P100 filters,
- chemical cartridges, and
- combination chemical and HEPA cartridges.

HEPA Filters

P100 filters are used to filter out small particles, such as

- dust,
- fumes, and
- radioactive particles.

Chemical Cartridges

Gases and vapors can pass through a P100 filter without being removed. Therefore, you must use a chemical cartridge instead of a high-efficiency particulate air (HEPA) filter to protect against gases and vapors. Special filters, sorbents, or catalysts in chemical cartridges act like a chemical flypaper or chemical sponge to remove airborne hazardous chemicals while allowing clean air to pass through. Combination cartridges that contain P100 filters and specific types of sorbents or catalysts are also available.

Note: *Chemical cartridges and combination cartridges need to be replaced after each work shift at a minimum. Never use chemical cartridges for more than one workday.*

APR Filter and Cartridge Colors

ANSI/AIHA Z88.7-2001, American National Standard for Color Coding of Air-Purifying Respirator Canisters, Cartridges and Filters, provides a system for color coding filters and cartridges. However, it is important that you read the information on the filter and/or cartridge to make sure you have the correct filter and/or cartridge. ***DO NOT*** just look at the color.

The top of the filter reads, "Type P100 – High-Efficiency Filter. Refer to instruction manual for complete limitations. NIOSH P/N 814915 MSA"

The side reads, "MSA Chemical Cartridge GMD—Ammonia & Amines." The labeling also contains limitation information.

Which Filter/Cartridge to Use?

Which filter/cartridge is best suited to your needs? The answer will be determined and stated in your work control document [IWD, radiological work permit (RWP), or other work control document] by

- an industrial hygienist or
- the radiological control technician (RCT) or health physicist (HP).

However, whenever you use your respirator, it is important for you to read the label on the cartridge to make sure it will give you the protection you need against the hazard with which you are working. If you have any questions regarding which cartridge you should use, contact your

- industrial hygienist (for an airborne chemical hazard) or
- RCT (for an airborne radiological hazard).

Potential Mercury Exposure Caused by Similar-Looking Respirator Cartridges

Lessons Learned:

- Use care when selecting respirator cartridges because cartridges and cartridge boxes may look similar. In this event, two types of respirator cartridges, with and without certified Hg (mercury) protection, were similar in size and appearance. The technician who used the wrong cartridges is color blind. Each respirator cartridge is identified in writing, but the lettering is small. From the technician's standpoint, the cartridges all looked alike (basing his selection mainly on what looked like the correct cartridge size).
- Allow sufficient time to prepare for a job, especially when it is not performed often.

Discussion: The work involved the removal of Hg from parts potentially contaminated with Hg (from the Hg shutter system). Two technicians were wearing full-facepiece respirators. During the job, the industrial hygienist (IH) noticed that one of the technicians was using respirator cartridges that were not certified to remove Hg. Work was stopped, and the technician who had the proper respirator cartridges placed the work site in a safe configuration. Mercury monitoring by the IH and subsequent blood and urine tests for the two technicians suggested no Hg exposure.

Analysis: A Human Performance Improvement (HPI) analysis was performed on this incident.

HPI Aspects and Considerations:

- The two types of respirator cartridges in question (both with and without certified Hg protection) were similar in size and had a similar appearance (some, but not all the same coloring). The technician who used the wrong cartridges (T2) is color blind. Each respirator cartridge is identified in writing, but the lettering is small. T2 selected his cartridges from a bag that contained both types of cartridges (the correct and incorrect), via two boxes of cartridges. From T2's standpoint, the cartridges all looked alike (basing his selection mainly on what looked like the correct cartridge size). Figure 1 shows a picture of the two types of respirator cartridges side by side.

Figure 1. A comparison of non-certified (on the left) and certified (on the right) respirator cartridges. Note that they are similar in size and appearance.

- Figures 2 and 3 show boxes of respirator cartridges. Two of these boxes, one with red lettering on a green background, the other with white lettering on a silver background, contained cartridges that include certified Hg protection. This was also the case for the boxes containing cartridges not certified for Hg work. Furthermore, the boxes that held the same cartridges had different part numbers.

Figures 2 and 3. The boxes that contain Hg-certified (top) and non-certified (bottom) cartridges are very similar in appearance. In addition, boxes with the same cartridges have different part numbers.

- No one knew why the non-Hg certified respirator cartridges were at the Lujan Center. Although this is the fifth time this job was being carried out, in general, these workers do not often use respirators in their work.
- There was pressure to get this work completed (because a lot of other work was waiting to be completed).
- Qualitative exposure assessments must be completed by the IH before each activity.

Actions:

- Segregate and apply additional labeling to respirator cartridges to prevent intermixing.
- Analyze personal protective equipment (PPE) before a job, and implement measures to minimize any potential confusion when donning PPE.
- Workers should inspect each other's PPE to verify correct use and identify any possible problems.

Human Performance Improvement – Error Precursors

HPI is an approach that is used to address human error in the workplace. HPI treats human error as a symptom or a result of deeper problems within a system. One of the five basic principles of HPI is that error-likely situations are predictable, manageable, and preventable.

Error precursors are conditions that can cause or lead to an error-likely situation, By identifying error precursors, you can develop defenses that will eliminate or reduce the risk. Categories used in HPI to describe error precursors are as follows:

- **Task Demands,** such as time pressure; repetitive actions, simultaneous, multiple tasks; unclear goals, roles, and/or responsibilities; and unclear standards.
- **Work Environment,** such as distractions; changes to routine; confusing controls; workarounds; unexpected conditions; and personality conflicts.
- **Individual Capabilities,** such as unfamiliarity with task; new technique; inexperience; "hazardous" attitude; and illness or fatigue.
- **Human Nature,** such as stress that affects attention to task; bad habits; inaccurate assumptions; overconfidence; and mental shortcuts.

By demonstrating a questioning attitude and looking for error precursors such as those listed above, you can predict many error-likely situations.

For more information about HPI, register for *Human Performance for Workers* (Course 43428) through UTrain.

Wrong Cartridge Selection

The supervisor of a night crew wanted to use more workers to help speed up a tank-cleaning job. The company had depleted the local supplier's stock of appropriate respirators. Additional respirators were ordered, but because it was the weekend and after hours, the order was made through an on-call person. After being confirmed by the onsite supervisor, the order was shipped to the work site.

Upon arrival, the respirators were issued to the employees, who entered the tank to commence the cleanup. After approximately 2 hours, around 2:30 a.m., 13 employees began to get sick. One employee suffered a seizure.

It was later determined that the respirator cartridges issued were HEPA filters instead of organic vapor cartridges. Analysis of the sludge in the tank being cleaned revealed it contained benzene, toluene, styrene, and xylene as major components.

Module 4: Limitations

Module Objectives

When you complete this module, you will be able to recognize the

- limitations of half-mask and full-facepiece respirators and
- personal limitations that might affect an individual‘s ability to wear an APR successfully.

When to Use an Air-Purifying Respirator

APRs are used when

- existing controls do not ensure a safe atmosphere,
- enough oxygen exists to support life,
- the identity and amount of the airborne hazardous materials are known, and
- the existing air can be purified safely.

However, limitations may affect the ability of an APR to remove airborne hazardous materials. You will learn about such limitations in this module.

Warning! NEVER use an APR in IDLH atmospheres.

Limitations of Half-Mask APRs

The limitations of half-mask respirators are as follows.

- A half-mask APR does not supply oxygen; therefore, it must not be used in an oxygen-deficient area (less than 19.5% oxygen).
- A half-mask APR must not be used in IDLH atmospheres.
- A half-mask APR provides no eye protection. If eye protection is needed, wear safety glasses, goggles, or a face shield.
- A half-mask APR should be used only for protection from the contaminants listed on the cartridge or on the manufacturer's cartridge selection chart.
- A half-mask APR is not approved for use with radiological materials or airborne radioactivity.
- A half-mask APR cannot be used against natural gas or vapors that have poor warning properties, such as carbon monoxide, nitrogen, and organic mercury.

WARNING! If you smell gas or vapor or if the breathing resistance increases while wearing a half-mask APR, leave the area immediately.

Limitations of Full-Facepiece APRs

Full-facepiece respirators present the same limitations for use as half-mask respirators, except that full-facepiece respirators have a lens that protects the eyes. Full-facepiece respirators

- must not be used in an oxygen-deficient area (less than 19.5% oxygen) because they do not supply air,
- cannot be used in IDLH atmospheres, and
- should not be used in extreme temperatures.

IDLH Full-Facepiece Mask Incident

Berry entered a tanker trailer that contained a residue of sulfuric and nitric acids. His task was to replace a safety valve. He was not aware that compressed nitrogen had been used in the unloading process. He was equipped with protective clothing and a full-facepiece, air-purifying respirator with an organic vapor cartridge.

When Berry collapsed upon entering, Rafael went in after him and also collapsed. Rafael was quickly pulled out, but Berry could not be reached from the outside. When he was pulled out after 30 minutes, he was dead. He needed an atmosphere-supplying respirator, not an air-purifying respirator.

The APR was not adequate for an oxygen-deficient atmosphere. Air testing and venting were not done. Probable causes of death were an oxygen deficiency or the presence of nitrogen dioxide.

Personal Limitations to Using an APR

In addition to limitations inherent in the respirators themselves, some personal limitations can affect the effective use of APRs. These personal limitations include facial hair and/or the use of eyeglasses, both of which can interfere with the function of the respirator or the respirator seal.

Hair

Facial hair that might interfere with the respirator seal and cause leaks is not allowed. This category includes wide mustaches, sideburns, beards, and goatees. The photographs below are examples of common facial hairstyles that are not allowed during respirator use.

When donning an APR, your facial hair must not interfere with the function or fit of the respirator.

If you do not plan to wear an APR immediately, you can grow back your facial hair. Just remember that before you are issued or don an APR, you must be clean shaven.

Note: *The RPP administrator has determined that it is not acceptable to have facial hair below the lower lip or to wear facial jewelry during respirator fit testing or use.*

Personal Limitations to Using an APR

Eyeglasses

Regular eyeglasses cannot be worn with full-facepiece respirators because they can break the seal, exposing you to airborne hazardous materials. If you need glasses, including bifocals and trifocals, specially designed spectacle inserts are available free of charge. If you already have spectacle inserts, bring them with you to the fit test to ensure that they do not interfere with proper respirator fit. Contact lenses can be used safely with full-facepiece respirators, but their use and purchase are the APR user's responsibility.

Worker is wearing glasses.

The respirator cannot make a seal over the temple bars.

Worker slides spectacle inserts into the respirator mask.

Other Limitations

Other personal limitations to using an APR include dentures, head coverings, and certain facial contours. You may wear dentures as long as the respirator is fitted while the dentures are in place.

You may not wear surgical caps, skullcaps, or any form of head covering under the respirator straps, headband, and harness. A head covering worn under these straps may prevent you from maintaining a seal, exposing you to airborne hazardous materials. If you need to wear a head covering, wear it over your straps, headband, and harness.

Certain facial contours caused by acne, cuts, scars, or broken bones may interfere with achieving a proper seal. If you have acne, cuts, scars, or broken bones, consider requesting to be fit tested with a silicone respirator.

Module 5: Inspection

Module Objectives

When you complete this module, you will be able to recognize

- how to inspect the parts of a half-mask and full-facepiece respirator and
- respirator problems during an inspection.

Receiving an Air-Purifying Respirator

Respirators are issued either from OSH-ISH at TA-59, Building 1, Room 126, or from various sites at LANL, by personnel who have received respirator issuer training. Some of these issue sites include

- Chemistry and Metallurgy Research (CMR), TA-3,SM29
- Waste Management at TA-50, Building 196
- Waste Disposal Site at TA-54, Building 51
- Plutonium Facility at TA-55, PF4, Room 135

LANL Responsibility

Effectiveness lies with YOU!

It is LANL's job to

- determine the type of equipment you need,
- maintain the equipment, and
- train you on using the equipment.

However, the responsibility for effectively using the respirator lies with **YOU**. Always inspect your respirator before donning it.

APR Inspection Checklist

You must inspect your entire respirator before using it and while cleaning it. Some people also inspect their respirators after using them. You should inspect the following parts of your respirator:

- **Harness/Straps/Headbands**—As you stretch out the harness/straps/headbands, check for rips, stress tears, or cracks within or along the serrations.
- **Tabs**—Check the tabs to make sure no tears or cracks exist.
- **Buckles**—Check the buckles to make sure they are not broken, rusted, or bent and that there are no places where they have come loose.
- **Lens/Facepiece**—Check the lens/facepiece to make sure there are no deep scratches, pits, cracks, or holes. Make sure you can see clearly through the lens.
- **Exhalation Valve**—Check to make sure the valve is present and in good condition and that there is nothing that would hold it open (such as sand, a piece of hair, lint, dirt, or dust).
- **Cartridge**—Make sure the cartridge is not cracked or otherwise damaged and that it is tightly screwed into the receptor/filter cup but not cross-threaded in the cartridge receptacle.
- **Cartridge Receptacle**—Make sure the receptor housing is not cracked or distorted.
- **Gasket**— If the gasket fits in the receptor properly and securely, do not remove it. The respirator has been leak checked with the gasket in place. If it has been disturbed, alert the issuer.
- **Inhalation Valves**—Make sure that the valves are present and in good condition and that nothing would hold them open (such as sand, a piece of hair, lint, dirt, or dust).

Note: At the time of issue, if the respirator either is not in a plastic bag or the plastic seal is broken, DO NOT USE the respirator. Return the respirator to your respirator issue point.

APR Inspection

The Respirator Bag

When you receive a new respirator, it should be in a heat-sealed plastic bag. *Before removing the mask*, check the sealed bag for holes, tears, and any materials that should not be in the bag, such as insects, dirt, or debris.

Return the respirator to your respirator issue point if the heat-sealed bag is damaged or the bag contains debris or insects.

Inspect seal and front, side, and back of bag.

Do not use the respirator if the bag is damaged.

APR Inspection

Respirator Size

When you are issued a respirator, make sure it is of the correct size and material. Respirators are available in three sizes—small, medium, and large. Full-facepiece respirators are made of either high-carbon rubber or silicone.

Gray lens ring (small).

Black lens ring (medium).

Yellow lens ring (large).

You may wear only the type, size, and style of respirator with which you were fit tested and are currently authorized to use.

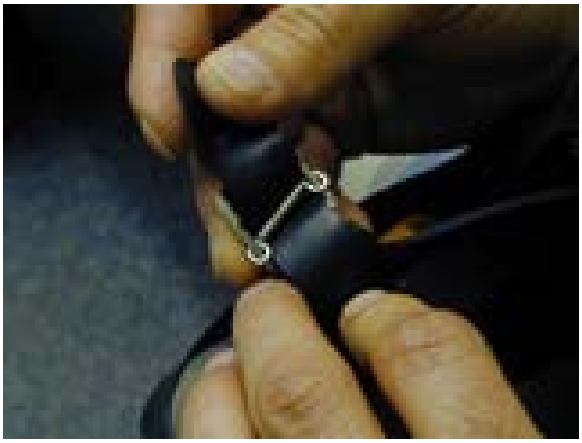
The size of the respirator is stamped inside the respirator at the top of the nose cup. Make sure it matches the size on your respirator authorization card.

Silicone masks are stamped with the word “silicone” above the lens on the facepiece of the respirator.

Harness, Straps, Tabs, and Buckles

In addition to inspecting the type, size, and style of the respirator, make the following inspections:

Stretch and check each strap and headband for cracks, rips, and stress tears. Be careful not to overstretch them.



Make sure that the strap has tabs and that the tabs are in good condition. Check for tears and cracks.

Make sure each stainless steel buckle works. Make sure the buckles are not bent, broken, or rusted.

Make sure that the harness does not have any tears or holes and is in good condition.

APR Inspection

Facepiece and Lens

Check the facepiece and lens for scratches, pitting, and distortions that could block your vision. Also, check for cracks and holes, which could allow leakage.

Good facepiece.

Damaged facepiece.

Cartridge Receptors and Inhalation Valves

All LANL respirators have two cartridges. Check the cartridge receptors and inhalation valves, as follows:

1. Hold onto the back or side of the receptor, and gently turn the cartridge to remove it. Check both cartridges for dents and cracks.

2. Check inside the filter cups of the receptor for cracks and dirt. Check for the presence of a gray gasket, but do not remove it.

3. Check the inhalation valve for distortion, wear, cracks, dirt, sand, dust, lint, hair, and other debris. If the inhalation valve is missing, do not use the respirator. Notify the RPP administrator.

APR Inspection

Inspect PPE before Use

PPE should be carefully inspected before use.

Discussion: On 6 July 2000, at the former Mound facility in Ohio, a P100 filter fell off a full-facepiece respirator worn by a mechanic while he was working in a radiological area. The work in question required the mechanic to lie on his side and remove equipment by hand from a tight location. To see what he was doing, he was obliged to push his head into tight areas. His mask brushed against various objects during this process. Upon his exiting from beneath the equipment and standing up, the filter and housing fell from the mask. The mechanic immediately exited the room and doffed his PPE with the assistance of an RCT. He was surveyed for contamination with a portable monitor, a nasal smear was taken, and he exited through the portal contamination monitor. No contamination was discovered.

Analysis: The respirator was inspected, and no apparent reasons for the filter falling from the respirator were found. There were no obvious signs that the equipment had structurally failed or that the filter was pulled from the mask by snagging it on something. When disassembled, the respirator was found to have one filter gasket missing. A review of the respirators in inventory revealed three additional respirators with similar problems.

The demolition technician responsible for respirator maintenance had been on vacation and upon his return had found 100–150 respirators waiting to be processed. Because of the work schedule and concern about possible work shutdowns, the respirators were processed as quickly as possible. The assembly errors were the result of a rushed job.

Recommended Actions: Safety equipment maintenance should not be compromised by a perceived urgency for production. In this instance, management should have anticipated the maintenance worker's vacation and arranged alternate coverage instead of allowing respirators to accumulate. An opportunity to detect the faulty assembly was evidently missed when the user did not detect it in a pre-use inspection. Mound work practice makes it the wearer's obligation to inspect the assigned respirator before use. This inspection has always required that the P100 filters be removed, the gaskets inspected, and the filters reinserted. A checklist has been prepared to guide the wearer on what aspects of respirators to check before they are worn. Mound requested their managers to brief employees on this event and recommended that their industrial hygiene group conduct spot inspections of assembled respirators.

APR Inspection

Exhalation Valve

Now examine the exhalation valve.

1. Remove the exhalation valve cover.

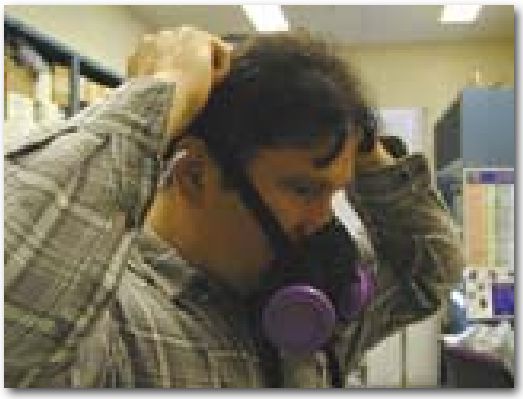
   Note: *The cap is not part of the exhalation valve.*

2. Check the flapper valve to make sure it is flexible and not deformed. Also, check it for holes and debris (hair, dust, lint, dirt, and sand). Even a single hair can cause a leak. Check the exhalation valve for rips and tears.

3. Replace the cap, and make sure it is secure.

APR Inspection

APR Inspection Completed



Once you have inspected the respirator and noted that everything is in good working order, you are ready to don it. Putting on your respirator is covered in the next module titled “Donning an APR.”

Remember, never don a respirator without inspecting it first. Every part must pass inspection.

Module 6: Donning an APR

Module Objectives

When you complete this module, you will be able to recognize

- how to properly don half-mask and full-facepiece APRs,
- how to properly perform positive- and negative-pressure checks on half-mask and full-facepiece APRs, and
- difficulties that may be encountered when wearing an APR.

WARNING! You may not wear an APR until you have completed a 1465 Form, passed your medical evaluation, passed this course, and passed your fit test at OSH-ISH.

Donning the APR

Always don your respirator in a nonhazardous atmosphere before entering an area that contains airborne hazardous material. If you enter the hazardous area first, you may be exposed to airborne hazardous material.

Donning: Half-Mask APR

To don a half-mask APR, follow these steps:

1. Remove any eyewear. Pull the harness over your head. Make sure the harness is centered on the crown of your head.

2. Fasten the bottom strap/headband hook behind your neck.

3. Position your chin in the facepiece. Adjust the facepiece so that the nose section rests low on the bridge of your nose. The mask should fit comfortably.

4. Tighten the harness straps/headbands and the lower straps/headbands. Tighten both straps as necessary for a snug, comfortable fit. Make sure the harness is centered on your head and the facepiece is centered on your face.

   Note: *Do not overtighten; this can cause buckling of the thin silicone material, which may in turn cause a leak.*

If you will wear safety glasses in the workplace, you should wear them during the half-mask APR fit test. Always wear the temple bars of the glasses outside of the straps/headbands.

Don your eyewear now. You are ready to perform your seal checks.

Donning: Half-Mask APR

Negative-Pressure Seal Check

Once the half-mask APR is firmly secured on your face, check the effectiveness of the seal. Perform the negative- and positive-pressure seal checks in either order. Make sure you have your eyewear on, over the straps, before performing a seal check.

The negative-pressure seal check allows you to check the seal of the respirator facepiece. To perform the negative-pressure seal check:

1. Lightly place the palms of your hands over the filters.
2. Inhale and hold your breath for 10 seconds.
3. If the facepiece collapses slightly and you do not feel or hear air leaking between the facepiece and your face, you have a seal.

If you hear or feel air leaking, reposition the facepiece on your face and/or adjust the tension of the straps/headbands and repeat the negative-pressure seal check. Keep repeating until you get a seal. If you do not get a seal after a few attempts, remove the respirator, don it again, and repeat the seal check. If you still do not get a seal, return it to your respirator issue point in the resealable plastic bag and get another respirator.

You must perform a negative-pressure seal check with your respirator each time you use it.

Positive-Pressure Seal Check

The positive-pressure seal check allows you to check the seal of the respirator facepiece. To perform the positive-pressure seal check:

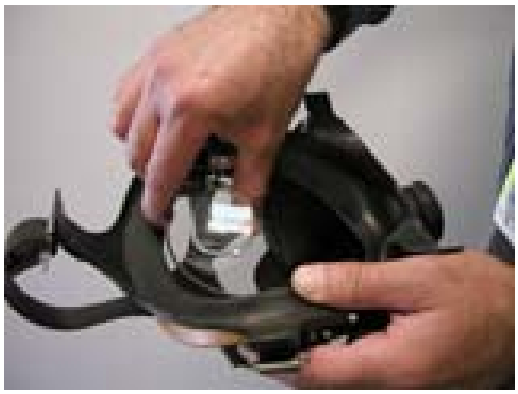
1. Place the palm of your hand over the exhalation valve cover.
2. Exhale gently until a slight positive pressure builds up inside the facepiece without evidence of leaking.
3. If the facepiece bulges slightly and you do not feel or hear any air leaks between the facepiece and your face, you have a seal.

If you hear or feel air leaking, reposition the facepiece on your face and/or adjust the tension of the straps/headbands and repeat the positive-pressure seal check. Keep repeating this process until you get a seal. If you do not get a seal after several attempts, remove the respirator, don it again, and repeat the seal check. If you still do not get a seal, return it to your respirator issue point in the resealable plastic bag and get another respirator.

You must perform a positive-pressure seal check each time you use your respirator.

Donning: Full-Facepiece APR

To don a full-facepiece APR, follow these steps:



1. If you normally wear prescription glasses, you will need prescription spectacle inserts when you use a respirator. Place the prescription spectacle inserts into the respirator.

2. Position your chin in the respirator's chin cup.

3. Place the mask against your face, and pull the harness over your head. Holding the speaking diaphragm, push upward to ensure a good seal between the chin cup and the chin. Make sure the mask is centered on your face.

4. Tighten the straps/headbands to keep the mask against your face. Make sure the straps/headbands are not twisted; do not overtighten them. First, tighten the bottom straps/headbands, applying equal pressure on both sides.

   Note: *When tightening the straps/ headbands, always pull the straps/headbands straight back, not out to the side.*

5. Then tighten both side straps/headbands as necessary for a snug, comfortable fit. Make sure the mask is centered on your face.

6. Finally, tighten the top strap/headband.

Negative-Pressure Seal Check

Once the full-facepiece APR is secured firmly to your face, it is important for you to check the effectiveness of the seal. You must perform both the negative-pressure and the positive-pressure seal checks in either order.

The negative-pressure seal check allows you to check the seal of the respirator facepiece. To perform a negative-pressure seal check:

1. Place the palms of your hands over the openings in the cartridges or filters.
2. Inhale and hold your breath for about 10 seconds.
3. If the facepiece collapses slightly and you do not feel or hear air leaking between the facepiece and your face, you have a seal.

If you hear or feel air leaking, reposition the facepiece on your face and/or adjust the tension of the straps/headbands and repeat the negative-pressure seal check. Keep repeating until you get a seal. If you do not get a seal after a few attempts, remove the respirator, don it again, and repeat the seal check. If you still do not get a seal, return it to your respirator issue point in the resealable plastic bag and get another respirator.

You should perform a negative-pressure seal check each time you use your respirator.

Positive-Pressure Seal Check

The positive-pressure seal check allows you to check the seal of the respirator facepiece. To perform a positive-pressure seal check,

1. Place the palm of your hand over the exhalation valve cover.
2. Exhale gently until a slight positive pressure builds up inside the facepiece without evidence of leaking.
3. If the facepiece bulges slightly and you do not feel or hear any air leaks between the facepiece and your face, you have a seal.

If you hear or feel air leaking, reposition the facepiece on your face and/or adjust the tension of the straps/headbands and repeat the positive-pressure seal check. Keep repeating this process until you get a seal. If you do not get a seal after several attempts, remove the respirator, don it again, and repeat the seal check. If you still do not get a seal, return it to your respirator issue point in the resealable plastic bag and get another respirator.

You must perform a positive-pressure seal check each time you use your respirator.

Wearing the APR

When you first put on the APR, you may experience mild resistance to breathing because you are breathing through filters. However, your body will easily adapt.

While you are wearing the APR, you should NOT

- chew gum or tobacco (the movement of your jaw can cause the seal to break) or
- adjust the mask while you are in the contaminated area. If you need to adjust the respirator, leave the contaminated area first.

Note: *Coughing, sneezing, and heavy sweating can break the seal on your respirator. Always perform negative- and positive-pressure seal checks after coughing or sneezing. Leave the contaminated area to perform these seal checks.*

APR Leak Indications

While wearing your respirator, you may experience the following indications that you have a leak in your respirator:

- an unusual smell or taste (such as an airborne contaminant);
- shortness of breath;
- irritation of your eyes, nose, and/or throat; or
- nausea or dizziness.

If you suspect a leak in your respirator, you should stop work, immediately exit the area, and seek fresh air. *If you suspect you have a leak in your APR, notify the RCT and/or IH immediately!*

Perspiration Causes Silicone Respirator Mask Slippage

Silicone respirators may feel slippery when perspiration builds up under the seal. The wearer should exit the airborne contamination area if he or she is suspicious of the seal's integrity.

Discussion: A nuclear chemical operator (NCO) at the Waste Encapsulation and Storage Facility at Hanford was using an MSA silicone mask for work in the Hot Manipulator Shop when he felt the mask slide down his face. The NCO immediately exited the area and was surveyed by an RCT with no contamination detected on his mask, cartridges, or himself. Other employees experienced similar sensations of their masks slipping.

Analysis: Silicone masks tend to feel slippery on the face during warm weather. As long as the seal is intact, however, there is no problem. All respirators will form a "sweat seal" after extended use and may feel slippery. A final inspection by a responsible worker adds assurance that the mask fits and is properly sealed before entering a radiological area with airborne contamination. Remember to perform the negative user seal check and the positive user seal check for 10 seconds each.

The first steps in a respiratory protection program are to establish written standard operating procedures governing the selection and use of respirators, assess the respiratory hazards to be encountered in the workplace, and develop guidelines for the proper selection of appropriate respiratory protective equipment.

Proper inspection, maintenance, and repair of respiratory protective equipment are mandatory to ensure success of any respiratory protection program. A respirator deficiency can adversely impact the ability to complete work in the field safely.

Recommended Actions: Respirators are for use by trained, qualified personnel only. If any of the following situations occurs while in an airborne contamination area, leave the area immediately:

- breathing becomes difficult,
- you feel dizzy or otherwise distressed, or
- you taste or smell a contaminant.

APR User Problems

It is possible to experience the following additional physical problems while wearing your respirator:

- **Headaches**—caused by overtightening the APR straps or getting your hair caught in the buckles.
- **Claustrophobia**—a fear of being in closed spaces.
- **Heat stress or heat stroke**—failure of the body's temperature regulation system, which causes body temperature to rise to critical levels. Heat stroke is a medical emergency! If you observe someone experiencing heat stroke symptoms, call 911 immediately!
- **Neck/back pain**—caused by improper posture because of the weight of the respirator. If you start experiencing pain, advise your supervisor and go to OSH-OH immediately.

Information about heat stress, heat stroke, and claustrophobia follows. To learn more about hazards, symptoms, and controls for heat stress, see *Thermal Stress Awareness Self-Study* (COURSE 18649) by accessing UTrain.

APR User Problems

Heat Exhaustion	Heat Stroke
Heat exhaustion is a form of heat stress that can occur when prolonged physical work in a hot environment causes excess thermal stress and dehydration (loss of body water). Signs and symptoms of heat exhaustion include • excessive sweating; • pale, clammy skin; • weakness; • thirst; • elevated temperature; • accelerated pulse; • headache; • nausea; • dizziness; • vertigo (a feeling of moving in space); • confusion; and/or • fainting.	Heat stroke occurs when the body's temperature regulation system fails and body temperature rises to critical levels. Heat stroke is a medical emergency. If body temperature gets too high, death can occur. The primary signs and symptoms of heat stroke are • confusion, • irrational behavior, • slurred speech, • dizziness, and/or • fainting. **Note:** For more information about heat exhaustion, heat stroke, and other forms of heat stress, see *Thermal Stress Awareness Self-Study* (COURSE 18649) at https://int.lanl.gov/org/padops/adbs/central_training/institutional-training-services/ct-its-course-materials.shtml.

Treatment

If a person shows signs of heat exhaustion or heat stroke,

- place the person in a shady area;
- remove all clothing and personal protective equipment that may add to his/her heat load;
- have the person drink water or an electrolyte drink (if the person is conscious), or pour water on him/her (if not conscious); and
- call for medical assistance immediately.

Note: *Heat stroke is a medical emergency that must be treated immediately!*

Heat exhaustion is easily treated with prompt treatment, but it must be taken seriously. Fainting associated with heat exhaustion can be dangerous if the victim is operating machinery, working at elevated levels, or controlling an operation that should not be left unattended. More importantly, the victim may be injured when he or she faints. The signs and symptoms of heat exhaustion are similar to those of heat stroke—a medical emergency. Fortunately, heat exhaustion responds readily to prompt treatment.

Regardless of a worker's protests, NEVER send an employee suspected of being ill from heat stroke home or leave him/her unattended unless a physician has specifically approved such an action.

Module 7: Doffing an APR

Module Objectives

When you complete this module, you will be able to recognize

- how to properly doff (remove) a half-mask and full-facepiece APR;
- the time requirements for exchanging a respirator; and
- the proper way to clean, maintain, and store a respirator.

Removing (Doffing) Your APR

Once you have completed your work, you should continue to wear your respirator until you return to fresh air. You can remove your respirator once you are in an area where no airborne hazardous material exists.

If you have come in contact with a radioactive contaminant,

- do not loosen your head straps before removing your respirator,
- contact your RCT immediately,
- do not leave the area without specific instructions or unless it is an emergency, and

- wait for an RCT to assist you in removing your respirator in a designated area. The RCT will need to monitor the facepiece for contamination.

Doffing: Half-Mask Respirator

There is no standard way of removing a half-mask respirator, except that eyewear must be removed first. To remove your half-mask respirator, perform the following steps in any order:

1. Unhook the neck strap at the clip connector, behind the neck.

2. Pull the harness over and off your head.

Doffing: Full-Facepiece APR Used in a Radiological Area

Follow the RCT's instructions.

Radiological Hazards

If you used your respirator to protect yourself from a radiological hazard, you must return your respirator to your RCT or leave it in a predetermined place for the RCT.

Doffing: Full-Facepiece APR Used in a Chemical Area

Follow these steps to remove a full-facepiece APR that you have just used, or follow the RCT's instructions:

1. Loosen the top strap/headband.

2. Loosen the bottom straps/headbands.

3. Loosen the side straps/headbands.

4. Lightly grip the cartridges, and lift the facepiece off and over your head.

APRs Used for Chemical Hazards

If you used your respirator to protect yourself from a chemical hazard, complete the following steps, then follow your facility- or project-specific requirements to turn in the respirator to the facility's respirator collection point.

1. Label the plastic bag with the contaminant or hazard.

2. Place the respirator in the bag.

3. Seal the bag using the resealable opening.

Refreshing Your Respirator

Refresh your respirator after each use. You can use wipes provided by the respirator program. To refresh your respirator, follow these steps:

1. Remove cartridges and spectacle inserts. Do not remove the valves and straps. Wipe the outside of the respirator first to keep contaminants from getting inside the mask and/or facepiece.

2. Using a new cleaning pad, wipe the inside of the respirator.

3. Dry off the respirator with a lint-free towel or allow it to air dry.

4. Return the respirator to its plastic bag and seal the bag.

Note: *Do not leave the respirator in the sun or in a hot place to dry. The heat will damage the rubber and distort the respirator. Store the respirator properly, according to the manufacturer's directions. Respirators should be stored in a clean, dry location. Do not distort the rubber facepiece during storage.*

Exchanging Your Respirator

To maintain the quality of your respirator, you must follow the 12-month and 30-day rules.

- The 12-month rule requires that you return your respirator after 12 months for quality assurance and maintenance inspections, regardless of whether the bag has been opened.
- The 30-day rule requires that you return the respirator for cleaning 30 days after opening the heat-sealed bag.

Additionally, you must return the respirator when

- it is contaminated or soiled,
- it is damaged, or
- the job has ended.

Your respirator issuer will inform you of any special procedures that affect respirator use in the facility where you work.

Respirator Return Responsibilities Neglected

What Happened: A group of qualified respirators users did not return respirators that were issued to them. The group had approximately 100 expired respirators in their lockers. The facility experienced a shortage of clean respirators, and work had to be rescheduled.

Lessons Learned: Qualified respirator users at LANL are responsible for returning respirators according to site and/or specific job requirements. Supervisors are responsible for ensuring that used and/or expired respirators are returned promptly. Respirator users/supervisors should contact their site health and safety professionals for guidance in returning respirators.

Storing Your Respirator

After wiping your respirator, place it in the bag and store it as follows:

1. Place the respirator in its plastic bag.

2. Seal the bag using the resealable opening, if available.

3. Store the respirator so that no part of it will be bent, stretched, or compressed.

Note: *Ensure that the respirator will not be exposed to extreme hot or cold temperatures. Respirators should be stored in a clean, dry location. Do not distort the rubber facepiece during storage. If you do not store your respirator correctly, it could be damaged and may leak the next time you use it.*

Changing Filters and Cartridges

Filters, cartridges, and canisters should be changed according to either the schedule established by a qualified health and safety professional or the manufacturer's end-of-service-life indicator (ESLI). If the cartridge has an ESLI, it must be changed when the color of the indicator matches the color standard indicated on the cartridge.

When you are changing cartridges and filters, carefully hand-tighten them to prevent damage to threads. To ensure a good seal against the gaskets, tighten each cartridge/filter by gripping as much of the circumference of the receptacle as possible, and then slowly turn the cartridge/filter until tight.

Chemical and combination cartridges must not be used for more than one work shift and must not be used for more than one job or application. Each cartridge must be disposed of at the end of a job. ***Never*** use a cartridge for more than one job, even when the period of use is less than one work shift.

Note: *Consult your industrial hygienist about a cartridge change-out schedule.*

The filters and cartridges on your APR need to be changed if

- breathing becomes difficult,
- you taste or smell the air coming through the cartridge, or
- the filters and cartridges become moist or wet. Do not store your respirator and filters/cartridges in a place where they can be exposed to moisture.

Cross-Threaded Respirator Cartridge

What Happened: A qualified respirator user replaced P100 filters with combination cartridges required for an upcoming job assignment. When screwing the cartridge into the cartridge receptacle, the user was unaware he/she was cross-threading the cartridge into the cartridge receptacle. When the worker was working in the contaminated area, one of the cartridges fell off the respirator. The worker immediately left the area.

Lessons Learned: Users are responsible for checking their respirators. Part of the respirator user inspection is to ensure that the cartridges are properly screwed in/attached to the cartridge receptacle.

Changing Filters and Cartridges

Factors That Shorten the Service Life of Cartridges

The following factors can shorten the service life of respirator cartridges/canisters:

- Cartridges are used for more than one chemical.
- Cartridges are used in a very dry or very humid environment. If the environment is humid, the service life of organic vapor cartridges will decrease.
- Cartridges are not stored in sealed, protective packaging. All new cartridges must be in a protective, sealed package. Do not use them otherwise.
- Cartridges are improperly stored. If they are stored in a humid environment, the sorbent characteristics may be altered.
- Cartridges are stored for too long. Cartridges/canisters may lose their effectiveness when stored too long after opening the sealed plastic.
- Cartridges are used where the concentration of the airborne contaminants is high. The higher the concentration of the contaminant (chemical), the faster it will saturate the cartridge.
- The faster and heavier the breathing of the user, the faster the cartridge will become saturated. Saturated cartridges occur often in heavy work.
- The effective life of the particular absorbent once the cartridge has been opened.
- Check the box and the cartridge for possible manufacture or expiration dates. Follow manufacturer guidance.

Incorrect Cartridge/Filter Use

What Happened: A qualified respirator user was tasked with pouring hydrochloric acid into a tank. The worker wore a full-face respirator when pouring the acid but started coughing during the process. The worker immediately left the area and notified his/her supervisor.

Lessons Learned: The work procedure indicated the proper cartridge to wear with the respirator; however, the worker was not trained adequately to the procedure. When the worker asked for a respirator at the issue station, he/she did not request the proper cartridge specified in the work procedure. To request the proper cartridge, workers should know the contents of the work control document (IWD, RWP, or Work Package), including the following:

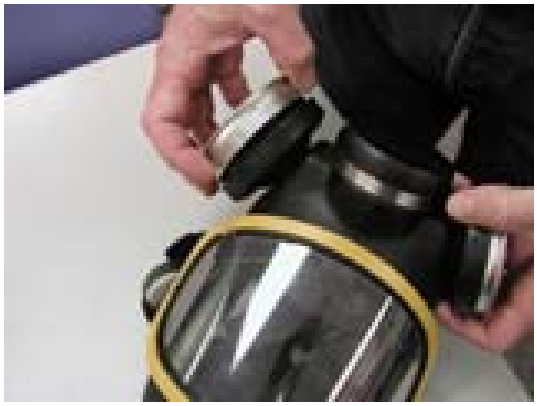
- what chemicals they might be exposed to;
- what the hazardous characteristics and the properties of the chemicals are and how to protect themselves (29 CFR 1910.1200);

- which cartridge to use for the chemical hazards they expect to be exposed to the cartridge changeout schedule, and if there is an end of service life indicator on the cartridge.
- how to recognize the cartridge based both on the color (as required in ANSI Z88.7, *Color Coding of Air-Purifying Respirator Canisters*) and the label on the side of the cartridge to ensure that it is the correct cartridge.

Returning Your Respirator

If you are not wearing the respirator again, prepare it to be returned to the RPP team as follows:

1. Remove any personal spectacle inserts from the facepiece.



2. Remove the cartridges from the respirator, and dispose of them according to the type of contamination encountered while you were wearing them. Respirators should never be sent to Unitech with the filters or cartridges affixed.

3. Place the respirator back into its plastic bag, identify on the bag the airborne hazardous material (such as beryllium or asbestos) where the respirator was used, and return the used respirator to the respirator issue station or other respirator collection point.

Module 8: Roles and Responsibilities

Module Objectives

When you complete this module, you will be able to recognize

- the roles and responsibilities of key personnel and organizations involved in the LANL Respiratory Protection Program (RPP).

Roles and Responsibilities

The RPP is administered by OSH-ISH.

In addition to OSH-ISH and Environment, Safety, and Health Deployed (DESH), personnel from the following organizations support the team:

- Radiation Protection (RP-PROG) and
- OSH-OH.

Each organization and individual participating in the RPP is responsible for complying with quality assurance and quality control measures as specified in LANL Institutional Procedure (P) 101-6, *Personal Protective Equipment*.

Respirator Users

When issued an APR, respirator users must

- always use APRs according to instructions and training;
- carry a current respirator authorization card at all times during APR use, or leave the card in a location designated by facility-specific requirements;
- inspect the APR before each use;
- leave the contaminated area immediately if the APR malfunctions, and report the malfunction to the supervisor;
- perform user seal checks every time an APR is donned;
- store the APR in a sealed plastic bag (APRs should be stored in areas where they are protected from extreme heat, cold, contamination, and sunlight and in a manner that prevents physical distortion of the respirator);
- use only the type of APR cartridge selected by a qualified health and safety professional;
- notify OSH-OH of any changes that might affect the fit of an APR (for example, weight loss or wearing dentures);
- participate in the medical surveillance program, and notify OSH-OH personnel of any changes in medical status that might affect the ability to wear an APR; and
- visit an optometrist for a prescription if you require spectacle inserts.

Line Supervisor

Line supervisors who oversee APR users must

- ensure that APR users receive an annual medical evaluation;
- ensure that APR users receive appropriate training and a fit test;
- ensure that a job requiring RPE has been evaluated by an RCT or HP and an industrial hygienist;

- ensure that only individuals who are authorized (medically qualified, trained, and fit tested) respirator users are scheduled to perform a job requiring RPE;
- ensure that the individuals receive the appropriate APR and are wearing APRs properly;
- ensure that adequate respirator storage facilities are provided; and
- report any problems in the use of APRs to the RPP administrator.

Industrial Hygiene and Safety Group

The OSH-ISH group is responsible and accountable for overall RPP management, including

- providing RPE users with training and fit testing;
- maintaining and distributing RPE;
- coordinating the purchase of approved respirators;
- ensuring that respirators are cleaned, sanitized, inspected, and repaired;
- coordinating the efforts of supporting organizations; and
- designating a single person as the RPP administrator who has the following responsibilities:
  - supplying APRs to authorized users;
  - maintaining and repairing LANL-supplied APRs; and
  - providing respirator users with a respirator authorization card that states the card's expiration date and the size and type of respirator the user is authorized to use.

UniTech Services

UniTech Services provides the following respirator cleaning and sanitizing services:

- receives used and potentially contaminated RPE, and surveys them for radiological contamination before cleaning and reuse or disposal;
- cleans, decontaminates, and sanitizes facepieces;
- surveys all RPE for radiological contamination after cleaning and testing; and
- transports clean respirators to the RPP at TA-59 for distribution. TA-55 respirators are directly transported to TA-55 for issue.

OSH-OH

OSH-OH determines the medical qualifications of employees and must

- perform and document annual evaluations to ensure that employees are medically qualified to wear RPE; and
- identify medical restrictions and notify the employee, employee's supervisor, and OSH-ISH of such restrictions.

DESH-F and DESH-S

DESH has the following responsibilities:

- provides information to respirator users and supervisors regarding the proper type of respirator for the hazards in radiological controlled areas,
- assesses airborne radioactivity in work areas before respirators are selected,
- performs periodic monitoring of airborne radioactivity levels in work areas to ensure that the protection factor for the type of respirator selected is appropriate, and
- supports LANL organizations in determining feasible engineering controls for radiological hazards.

Roles and Responsibilities

Subcontractors

Task order subcontractors are required to develop and implement an RPP for their employees who must enter and/or work in areas at LANL where exposure to airborne hazardous materials cannot be adequately controlled or avoided. Their programs must meet OSHA and ANSI requirements and be approved by their LANL subcontract technical representative.

Subcontractors must follow the Exhibit F terms.

Specifically, subcontractors must

- use APRs in accordance with criteria identified by ANSI Z88.2 1992 and OSHA 29 CFR 1910.134;
- ensure that only NIOSH-approved respiratory protection equipment is used by subcontractor employees;
- ensure periodic surveillance of RPE during field use;
- ensure the review and approval of procedures for jobs requiring respiratory protection and selection of RPE;
- ensure that all of their respirator wearers are qualified, trained, and quantitatively fit tested; and
- maintain a current list of their approved respirator wearers with dates of training/fit testing, medical approval, and other appropriate information.

Resources

Contacts

The following LANL organizations are associated with APRs and can be contacted for information.

Respiratory Protection Program (RPP)	TA-59, 7-3560 or 7-6270;
RPP provides RPE users with fit testing and training. RPP also maintains and distributes RPE, coordinates efforts by supporting organizations, and provides qualified staff to complete respiratory protection tasks.	
DESH	TA-59, 5-9472
DESH provides information to respirator users and supervisors on the proper type of respirator needed for the hazards possible in radiological controlled areas. The group assesses airborne radioactivity in work areas before respirators are selected and performs periodic monitoring of airborne radioactivity levels in work areas to ensure that the protection factor for the type of respirator selected is appropriate. DESH supports other LANL organizations to determine feasible engineering controls for radiological hazards.	
OSH-OH	TA-3, 5-7264
OSH-OH determines the medical qualifications of RPE users and performs and documents annual evaluations to ensure that employees are medically able to wear RPE. The group also identifies medical restrictions, as required, and notifies the employee and the employee's supervisor of such restrictions.	

OSHA Requirements

29 CFR 1910.134, *Respiratory Protection*

29 CFR 1910.134, *Respiratory Protection - Appendix A, Fit Testing Procedures*

29 CFR 1910.134, *Respiratory Protection - Appendix B-1, User Seal Check Procedures* (Mandatory)

29 CFR 1910.134, *Respiratory Protection - Appendix B-2, Respirator Cleaning Procedures* (Mandatory)

29 CFR 1910.134, *Respiratory Protection - Appendix C, OSHA Respirator Medical Evaluation Questionnaire* (Mandatory)

29 CFR 1910.134, *Respiratory Protection - Appendix D, Information for Employees Using Respirators When Not Required under Standard*

Respiratory Protection Program

http://int.lanl.gov/safety/industrial_hygiene_and_safety/ihs_programs/respiratory-protection.shtml

LANL OSH Division Operating Procedure, *Respiratory Protection Program Plan*, OSH-ISH-PLAN-003.

Request for Respiratory Protection Evaluation for the Use of Personal Protective Equipment (LANL Form 1465 via the Forms Center on the LANL home page)

Personal Protective Equipment Approval Source Document for Computer/Safety Glasses and Respirators (LANL Form 1882b via the Forms Center on the LANL home page)

Taking the Quiz

To receive credit for this self-study, you must complete the associated quiz in UTrain. You can access the quiz in either of two ways.

CRYPTOCard

If you have a CRYPTOCard that is assigned to you with administrative authorities to LANL's Integrated Computing Network (ICN):

1. Click on the link below to return to UTrain.
2. Click on the "Return to Content Structure" button.
3. Click on the "Quiz" link to begin the quiz.

To return to UTrain, click on the following link:

http://int.lanl.gov/training/tools/wrapper/submit.html

No CRYPTOCard

If you *do not* have a CRYPTOCard or if you have a CRYPTOCard *without* administrative authorities to LANL's ICN, you will need to locate a worker with UTrain proxy authority to grant you access to the quiz.

Call or email your training administrator for assistance. The following link should help you find your training administrator.

http://int.lanl.gov/services/training/admin-proctor-proxy.shtml