“In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination.”

OSHA 1910.134(a)(1)
The Basics of Respiratory Protection

The days of bringing canaries down in the mine to determine if and when the air was toxic are, fortunately for us and also for the canaries, long gone. Today, gas monitors and new technology alert us to the dangers in the air around us so that we can take appropriate measures to protect our health.

Respiratory protection is perhaps one of the least understood and often the most daunting areas of workplace safety most of us have to tackle. But it doesn’t have to be. Understanding and applying some basic principles can make respiratory protection as natural as... well breathing!

On April 8, 1998 OSHA’s revised 29 CFR 1910.134 standard became law. It reflects the first major revision since the 1971 original standard.

This paper has two objectives:

1. To enhance your understanding of the advantages and limitations of respiratory protective products.
2. To provide you with other information on current OSHA regulatory requirements.

1. OSHA REGULATORY REVIEW 1910.134

   • Engineering and or administrative controls of environmental hazards should be the employers’ primary safety goal.

   • If engineering/administrative controls are not readily attainable, the employer shall develop an effective respiratory protection program that is site specific.

   • The employer shall have a trained program administrator.

   • The employer shall establish an effective and dynamic written work site specific program.

   • The employer shall provide appropriate respirators, training and medical evaluations at no cost to the employee.

   • Employer shall evaluate present and probable work site hazards by either measured or estimated means.

   • Employer shall select proper respiratory protection based on work site specific hazards.
• Employer shall provide medical evaluations for every respiratory user, including those worn for comfort reasons in non-hazardous atmospheres.

• Conduct pre-use and annual fit testing of all tight fitting respirators, including air supplied types.

• All fit testing must be conducted in the negative pressure mode using Qualitative (QL) or Quantitative (QN) protocols.

• End users wishing to use only 1 fit test method for both must use QN

• OSHA requires annual fit testing and thereafter whenever the employer observes conditions or changes in the physical condition of the wearer or, the wearer requests another test or, there is a change in the workplace conditions.

• Employers training programs shall include procedures and schedules for cleaning and disinfecting, storing, inspecting, repairing, disposal and maintaining respirators.

• Program shall include procedures for proper respirator use in routine and foreseeable emergency operations.

• Ensure adequate quantity, flow and quality of breathing air including oxygen content, CO alarm and non-interchangeability of air house couplings for supplied air respirators.

• Program shall include
  • Pre-use and annual training in the proper use of respirators
  • Demonstrate knowledge regarding the respirators need, care and maintenance
  • Effective limits

USER TRAINING
Employers shall have an effective training program which results in the employees being able to demonstrate a working knowledge of the following:

• Why the respirator is necessary and how improper fit, usage, or maintenance can compromise its operation.

• What are the respirators working capabilities and limitations.

• How to inspect, put on, remove, use and perform user seal checks.

• How to use the respirator in emergency situations, including those involving malfunction.

• Proper procedures for respiratory maintenance and storage.

• How to recognize the medical signs and symptoms that may limit or prevent respirator use.
• A general understanding of the employer’s respiratory protection program.

**RESPIRATOR SELECTION**

1910.134 (d) requires the employer to evaluate respiratory hazards in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors.

Respirator selection requires the employer to identify workplace hazards by:

• Estimating the employee’s exposure to respiratory hazards
• Determining if the workplace environment is Immediately Dangerous to Life and Health (IDLH)
• Identifying contaminants, and answering the following questions:
  o What are the concentrations of the contaminants?
  o Are the contaminants a gas, or a particulate?
  o Are contaminants IDLH?

If the employer cannot identify, or reasonably estimate the employees’ exposure, the workplace atmosphere must be considered IDLH.

**RESPIRATOR SELECTION FOR IDLH ENVIRONMENTS**

If the work site atmosphere is found to be IDLH, the employer must provide the following respirators to the employee:

• A Full Facepiece NIOSH Certified SCBA with minimum service life of 30 minutes
  or
• A Full Facepiece NIOSH Certified pressure demand airline respirator with auxiliary self contained air supply.
Oxygen deficient atmospheres shall be considered IDLH, except when the employer can demonstrate that under all foreseeable conditions the oxygen concentration can be maintained within the following specified ranges:

<table>
<thead>
<tr>
<th>Altitude (feet)</th>
<th>Oxygen deficient atmospheres for which the employer may rely on any atmosphere supplying respirators.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 3,001</td>
<td>16.0 - 19.5</td>
</tr>
<tr>
<td>3,001 - 4000</td>
<td>16.4 - 19.5</td>
</tr>
<tr>
<td>4,001 - 5000</td>
<td>17.1 - 19.5</td>
</tr>
<tr>
<td>5,001 - 6000</td>
<td>17.8 - 19.5</td>
</tr>
<tr>
<td>6,001 - 7000</td>
<td>18.5 - 19.5</td>
</tr>
<tr>
<td>7,001 - 8000</td>
<td>19.3 - 19.5</td>
</tr>
<tr>
<td>Above 8000</td>
<td>Exception does not apply.</td>
</tr>
</tbody>
</table>

**RESPIRATOR SELECTION FOR NON-IDLH ENVIRONMENTS**

If the work site atmosphere is found to be Non IDLH, the employer must provide employees with respirators appropriate for the contaminants concentration level, and physical characteristics (Particulates, or Gaseous).

Respirators for protection against Particulates must be selected from

- Appropriate NIOSH certified air supplied respirator, or
- Air purifying respirator equipped with NIOSH certified 30 CFR 11HEPA (P-100) grade filter, or
- Air purifying respirator equipped with NIOSH Certified filters under 42 CFR 84.

**VOLUNTARY RESPIRATOR USE**

In non-hazardous work site atmospheres, the employer may provide respirators at the request of employee’s or permit employee’s to use their own respirators, as long as such use in itself does not create a hazard.

If voluntary respiratory use is permissible, the employer shall implement those elements of a written program concerning:

- The employee’s medical status
- Correct respirator selection
- Instruction on respirator cleaning, maintenance and storage
- Respirator protection capabilities and limitations

**NOTE:** Filtering face pieces (dust masks) are exempt from the OSHA regulation when voluntarily used in documented non-hazardous work site atmospheres.
Do I need to have a written respiratory protection program if only voluntary users wear respirators at my facility?

- **NO**, if the only respirators being worn voluntarily are filtering face pieces (dust masks)
- **YES**, if APR’s or PAPR’s are being used voluntarily. But when this is the case, your written program needs to include only the elements that pertain to voluntary users:
  - Medical Evaluations
  - Inspection
  - Care
  - Maintenance
  - Limitations

**CHECKLIST FOR RESPIRATORY PROTECTION PROGRAMS**

In order to comply with OSHA you will need a written respiratory protection program that is specific to your workplace and covers the following:

- Procedures for selecting respirators
- A Medical evaluation of each employee required to wear a respirator
- Fit testing procedures
- Procedures for use in routine and emergency situations
- Procedures for cleaning, disinfecting, storing, inspecting, repairing, discarding and maintaining respirators
- Procedures for ensuring adequate air quality for supplied air respirators
- Training in respiratory hazards
- Program evaluation procedures
- Voluntary use requirements
- Designated qualified program administrator
- Procedures to update written program as and when necessary

**The Purpose of Respirators**

A respirator is a device to protect the wearer from the inhalation of harmful atmospheres.

Before implementing a respiratory program, all efforts should first be made to engineer out the hazards.

**Use of Respirators**

Respirators must be approved for the type and severity of conditions in which they are used.

**Types of Respirators**

- Air Purifying (APR)
RESPIRATORY HAZARDS
When we think of respiratory protection, what part of our body are we trying to protect?

While most people will automatically answer “the lungs!” you are actually trying to protect not only the lungs but also the liver and through the liver all kinds of other internal organs. The hazard may, in fact, have no effect on the lungs at all but, if it gets into the bloodstream, it may have short-term or long-term adverse effects on any number of internal organs.

TYPES OF HAZARDS
There are two types of hazards that you are protecting against:

1. Dust and particulates which is measured in mg per M³. These enter the body and ultimately the blood stream through the lungs.
2. Vapors which are measured in parts per million (PPM). These enter directly into the blood stream by one of three methods, inhalation, ingestion or absorption.

Vapors are more of an immediate hazard.
Particulates are and can be dangerous but are usually chronic and not acute (see below).

Chemical exposures are divided into two categories:

1. Acute - High concentrations which produce immediate affects.
2. Chronic - Low dose exposure which cause problems in later years.

The toxic affects for either may possibly be permanent or reversible. It is extremely important to know what affects hazards will have on the body.

Medical issues - The affect for each person will differ. It will be influenced by smoking habits, alcohol consumption, medication and/or age.

Both dusts and vapors are cataloged by their individual distinct dangers:

• Anesthetics: Loss of feeling
• Sensitizes: Cause physiological affects
• Systemic poisons: Can produce cancer
• **Asphyxiants:** Inert substances dilute O2
• **Chemical asphyxiants:** Low concentrations interfere with supply of oxygen in the body

### Physical Symptoms of Oxygen Deficiency

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.9%</td>
<td>Minimum oxygen in normal air</td>
</tr>
<tr>
<td>19.5%</td>
<td>Increased Pulse and respiration, impaired judgment, coordination loss</td>
</tr>
<tr>
<td>12.0%</td>
<td>Very hard to breath, fatigue, faulty judgment poor circulation, symptoms in seconds</td>
</tr>
<tr>
<td>10%</td>
<td>Nausea, vomiting, loss of consciousness</td>
</tr>
<tr>
<td>6-0%</td>
<td>Convulsions, gasping respiration, cessation of breathing, cardiac arrest, death.</td>
</tr>
</tbody>
</table>

### Understanding the Respiratory Factor

A respirator protection factor is a measure of the degree of protection a respirator design provides to the wearer...

The protection factor is the **THEORETICAL** ratio of an ambient airborne substance to the concentration of the substance inside the respirator that we would expect to see as a consequence of the respirator design no matter who is wearing the respirator.

<table>
<thead>
<tr>
<th>Respirator</th>
<th>Protection Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 Mask w/Organic Vapor or Hepa</td>
<td>10</td>
</tr>
<tr>
<td>Full Face W/Organic Cartridge or Hepa</td>
<td>50</td>
</tr>
<tr>
<td>PARP Loose Fitting</td>
<td>25</td>
</tr>
<tr>
<td>PAPR w/HEPA (full face)</td>
<td>1000</td>
</tr>
<tr>
<td>PAPR w/Vapor Cartridge Full Face</td>
<td>25</td>
</tr>
<tr>
<td>Airline 1/2 mask, continuous flow, demand type</td>
<td>10</td>
</tr>
<tr>
<td>Airline Full Face Continuous Flow, demand type</td>
<td>100</td>
</tr>
<tr>
<td>Self Contained, demand type half face</td>
<td>10</td>
</tr>
<tr>
<td>Self Contained, demand type full face</td>
<td>100</td>
</tr>
<tr>
<td>Airline Full Face Pressure Demand w/Escape</td>
<td>10,000</td>
</tr>
<tr>
<td>SCBA Pressure Demand</td>
<td>10,000</td>
</tr>
</tbody>
</table>

**Maximum concentration** in which a respirator may be used is found by multiplying the TWA or PEL by the Protection Factor of the Respirator.

Example - Exposure to toluene - PEL is 100 ppm

For a 1/2 mask APR with an organic vapor cartridge the protection factor is 10. Therefore the maximum allowable concentration is = 100 x 10. You may work in 1000 ppm excluding other limitations. Limits of Exposure are based on an 8 hours day and a 40 hour week.
The **Time Weighted Average** is the exposure limits averaged out over the number of hours worked. Example – 100 ppm total exposure divided by 8 hours is 12.5 ppm.

The **Ceiling Limit** is the maximum concentration to which an unprotected person may be exposed.

The **Short Term Exposure Limit** (STEL) - Some gases and vapors have an allowable max short term exposure limit which is higher than the eight hour TWA - STEL is calculated at 15 min. STEL exposures must not be repeated more than 4 times per day. Successive STEL exposures must be separated by least 1 hour.

### Proper Fit Testing

**Quantitative vs. qualitative testing**

- At or below 10 times the permissible exposure limit (PEL) then you must do a **QUALITATIVE** fit test.
- Above ten times the PEL then you must do a **QUANTITATIVE** fit test.

Respirators Should Be Selected According to:

- The characteristics of the hazard
- The capabilities and limitations of the respirator
- The ability of each respirator wearer to obtain a satisfactory fit with the respirator
PART #1 Air Purifying Respirator (APR)

Air purifying means simply that during inhalation, air is passed through a filter, cartridge, or canister which removes particles, vapors, gases, or combination of these contaminants. It is considered a negative pressure respirator.

Particulate Respirators (Filtering Face Pieces, “Dust Masks”)

The most inexpensive, easy to use type of respiratory protection, the filtering face piece (more commonly referred to as the “dust masks”) can be used for most of the general cleanup work. They protect against most airborne particles. They are available with or without an exhalation valve. If they are going to be worn for an extended period of time or if they are going to be worn in a hot and/or humid environment, it is best to select one with an exhalation valve. Filtering Facepieces are also available with nuisance level odor filters from blocking most nuisance-level odors such as those encounter in moldy and musty areas.
When more substantial protection is required, a half mask or full-face respirator is needed. Where chemical leaks or “Black Mold” are present an air-purifying respirator with the appropriate cartridge provides a higher degree of protection to keep contaminants out of the lungs. If the hazard is respiratory in nature only, a half-mask can be used. Some contaminants, however, can enter the blood stream through the eyes as well as the lungs. For optimal protection, workers should either wear goggles with a half-mask or switch to a full-face.

**APR Limitations**

- APRs do not supply oxygen.
- APRs may not be used in an IDLH environment.
- APRs must be fit tested.
- APRs are not approved for use in atmospheres with less than 19.5% oxygen.

**Using the right cartridge**
Respirators and cartridges must be approved for the type and severity of conditions in which they are used.

Cartridges protect only for the specific contaminants for which they are approved. Make sure it’s the right one for the job!

Applications and approvals will be listed on the cartridges, charts and owners’ manual.

Employers must now develop a cartridge change schedule for exposure to vapors.

Employees must discard the cartridge prior to the end of the cartridge life for vaporous compounds.

Under 1910.134(d) if there is no ESLI (Estimated Service Life Indicator) appropriate for conditions in the employers’ workplace, the employer must implement a change out schedule for canisters and cartridges that is based on objective information or data that will ensure cartridges are changed BEFORE the end of their service life.

The type of date you should record for a cartridge service life schedule is:

1) Hazard area identification
2) Employees Name
3) Nature of work performed
4) Contaminant(s)
5) Estimated or actual concentration level
6) Temperature
7) Humidity
8) Breakthrough (smell, taste and or irritation)

The employer can take the Lowest recorded breakthrough time, multiply it by a safety factory (OSHA 80% - EPA 60% and use this number as the change time).

Points to remember in using the ESLI and protection factor

- Use the ESLI with caution for atmospheres containing mixtures.
- Actual cartridge life may be less than the ESLI would estimate for a gas or vapor present alone.
- The program does not calculate service times for mixtures directly.
- Follow the OSHA recommended procedures for mixtures.
- Do not use an ESLI with inaccurate or unreliable site specific data.
- Organic Vapor contaminants having a boiling point of 65°C (149°F), cartridges must be changed at the end of each shift even if the ESLI would permit longer use.
- Recalculate service time estimates if there are changes in concentration, humidity, temperature, work rate or work pattern.
- If user experiences odor, taste or irritation from the contaminant before end of estimated time, immediately leave the area and change cartridges.
- Follow an accelerated change schedule. If cartridge changes must be made too frequently, airline (supplied air) should be used.
• OSHA no longer allows taste, smell or irritation to determine cartridge breakthrough (If you can taste or smell it or if it creates irritation, than you are already being exposed to the harmful vapors).
• For protection against contaminants with poor warning properties a supplied air respirator should be used.

Understanding the Cartridge Color Code
Cartridges are color coded for easy identification. The color code is shown here:

<table>
<thead>
<tr>
<th>Color Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Organic Vapors</td>
</tr>
<tr>
<td>Yellow</td>
<td>Acid Gases</td>
</tr>
<tr>
<td>Purple</td>
<td>Organic Vapors and Acid Gases</td>
</tr>
<tr>
<td>Green</td>
<td>Ammonia</td>
</tr>
<tr>
<td>Pink</td>
<td>Dust/Mist/Fumes/Radon/Asbestos</td>
</tr>
<tr>
<td>Red</td>
<td>Combination of Dust/Mist/Fumes/Radon/Asbestos &amp; Organic Vapor</td>
</tr>
<tr>
<td>Green/Red</td>
<td>Combination of Dust/Mist/Fumes/Radon/Asbestos &amp; Acid Gases</td>
</tr>
<tr>
<td>Green/Purple</td>
<td>Combination of Dust/Mist/Fumes/Radon/Asbestos &amp; Organic Vapor and Acid Gases</td>
</tr>
<tr>
<td>Pink/Green</td>
<td>Combination of Dust/Mist/Fumes/Radon/Asbestos &amp; Ammonia</td>
</tr>
</tbody>
</table>

PARTICULATE FILTERS
A particulate is a fine solid or liquid that is in the air (dusts, fogs, fumes, smoke and spray). A contaminant may be a particulate, a vapor or a combination of both.

Health affects
• Particles larger than 15 microns are trapped in the nose
• If they are between 5 and 10 they end up in the upper respiratory tract
• If they are 0.5 and smaller they end up in the lungs
• If they are smaller than 1/10 of a micron they will enter the blood stream through the lungs.
New Efficiency Ratings

- Minimum efficiency is 95%
- The new N R & P99 minimum efficiency is 99%
- The new N R & P100 minimum efficiency is 99.97%

Filter Ratings

**N Series** = Approved for non-oil particulate contaminants. Examples: dusts, fumes, mists not containing oil.

**R Series** = Approved for all particulate contaminants. Examples: dusts, fumes, mists (including those containing oil). Time restriction of 8 hours when oils are present.

**P Series** = Approved for all particulate contaminants. Examples: dusts, fumes, mists (including those containing oil). Manufacturers time use restrictions apply.

Oil vs. Non-Oil

<table>
<thead>
<tr>
<th>Likely Oil Compounds</th>
<th>Non-Oil Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral Oil</td>
<td>Water Based Pesticides</td>
</tr>
<tr>
<td>Vegetable Oils</td>
<td>Cadmium</td>
</tr>
<tr>
<td>Glycerin</td>
<td>Chromic Acid</td>
</tr>
<tr>
<td>PCB’s</td>
<td>Cotton Dust</td>
</tr>
<tr>
<td>Asphalt Fumes</td>
<td>Silica</td>
</tr>
<tr>
<td>Oil/Solvent based pesticides</td>
<td>Asbestos, Wood Dust, Paint Spray</td>
</tr>
</tbody>
</table>

**Note:** Lead, Arsenic, Asbestos, Metheylene, Dianiline, Cotton Dust and Cadmium require a 100 class filter.

Particulate Filter Limitations

- They do not supply oxygen.
- They may not be used in an IDLH environment.
- They are do not protect against vapors and gases.

Wearing an APR

- Check the respirator for worn, cracked, corroded or brittle parts.
- Do a positive and negative pressure check.
Positive and Negative Pressure Check

Cover and Breathe Out (Positive Test)

Cover and Breathe In (Negative Test)
Part #2 Air Supplying Respirators

Air supplying respirators deliver to the wearer, air independent of ambient atmospheric conditions. They are available in 3 formats:

1. Continuous Flow
2. Pressure Demand Positive pressure
3. Combination

All three are Positive Pressure

Because breathing atmosphere is independent of ambient atmospheric conditions, air supplying respirators provide protection against oxygen deficiency and toxic atmospheres.

Air supplying respirators supply air independently of ambient atmospheric conditions. The air that the user breathes comes from an ambient air pump, a compressor or cylinders.

All Continuous flow and pressure demand airline respirators must be supplied from an air source which provides grade “D” or better breathable air at all times.

**WARNING: Never use Compressed Oxygen in place of breathable air.**

Use of air supplying respirators in IDLH atmospheres is limited to specific devices under specific conditions. It is possible to “out breathe” the air supply.

**Air Supplied, Non-IDLH**

- Continuous Flow Airline Respirators (CFAR) and Pressure Demand Airline Respirators (PDAR) must not be used in IDLH atmospheres, or poorly ventilated areas for firefighting or non approved abrasive blasting.
- CFAR & PDAR must not be used in contaminant levels higher than applicable OHSA, EPA or NIOSH regulations
• CFAR & PDAR must not be used in atmospheres containing less than 19.5% oxygen.

• CFAR & PDAR must use repairable air piping, hose, fitting and couplings that are incompatible with non-breathing air equipment

• CFAR & PDAR must only use hose couplings at the air source and respirator connection points.

• Full face piece lenses must be treated with anti-fog agent if the mask is used in temperatures of 32°F or below.

• CFAR & PDAR with supplemental air-purifying elements must remove elements before cleaning/sanitizing. Always replace elements after water spray decontamination.

Breathing air compressors must be constructed and situated so that contaminated air cannot be drawn in through the intake. Breathing air compressors must be equipped with a suitable in line air purifying absorbent bed and filter.

All airline respirators must use the manufacturers NIOSH approved breathing hose. Airline respirators may be used with up to 300 feet of the manufacturers breathing hose from the point of attachment. Dedicated “Quick Connect couplers must be used on all breathing air hose, and only at the respirator and air source connection points. All other hose connection points between these two points must be threaded.

If the compressor is oil lubricated, it must be equipped with a high temperature alarm or carbon monoxide alarm or both. Breathing air couplings must be incompatible with those for plant air.

**Air supplied respirators IDLH grade**

IDLH atmosphere is one in which a worker may be subject to acute health hazards or death without uninterrupted supply of safe breathing air.

For a respirator to be considered IDLH grade, it must be:

• Positive Pressure (Pressure Demand)
• Supply the user Control of their Breathing air for Safe Egress

**Three Types**

1. Pressure Demand Airline with PDAR/EEBA
2. Self-Contained Breathing Apparatus (EEBA)
3. Emergency Escape Breathing Apparatus
Demand Only
- Delivers air through a demand valve to a tight fitting mask.
- Demand valve only permits flow when pressure inside the mask is less than ambient outside pressure.
- The demand valve shuts off when pressure inside the mask is greater than that outside.

Positive pressure/pressure demand respirators are equipped with a regulator that maintains a constant positive pressure of 6CFM inside the mask. Because pressure is greater, leakage is outward, never inward.

Emergency Escape Breathing Apparatus (EEBA)

An EEBA is comprised of 4 major components:
1. Tight fitting (neck) Hood
2. Air Regulator/Delivery System
3. Carry Bag & Strap
4. Air Cylinder (5-10 min. duration)

Unlike the pressure demand function of an SCBA, the EEBA’s regulator supplies a positive metered flow of air (42-72 lpm) which guarantees their designed 5-10 minute flow duration. EEBA’s are only for use in personal escape. Never use for entry into an IDLH atmosphere or rescue in place of a 30-60 minute SCBA. The EEBA must be inspected weekly and after each use.
Combination Self Contained Breathing Apparatus with Escape Bottle

PDAR/EEBA is comprised of 7 major components:

1. Full Facepiece
2. Air Regulator/Delivery System
3. Belt or Harness
4. 5-10 Min. EEBA System
5. Supply Hose
6. Hose Couplers
7. Breathing Air Source

Based on its' lower profile design, lighter system weight and ability to source a larger volume of external breathing air, PDAR/EEBA’s offer the advantage of easier confined space entry/egress and extended work time.

**WARNING!** - EEBA MUST NEVER BE USED FOR ENTRY INTO IDLH ATMOSPHERES

NFPA and NIOSH regulations on SCBA’s require:

1. Must have a minimum service life of 30 minutes
2. Must have NIOSH/MSHA approval
3. Must be pressure demand/positive pressure

**WARNING!** - OLDER DEMAND TYPE MUST BE MODIFIED IMMEDIATELY TO CONFORM WITH CURRENT REGULATIONS
Respirator Use in Confined Spaces

A confined space is an enclosure having limited means of entry/egress, lacking naturally occurring ventilation and not intended for continuous occupancy.

All confined spaces are to be considered IDLH until pre-entry procedures prove otherwise.

Air Quality in Confined Spaces

- Before entering a confined space, determine the concentration of known or expected oxygen, flammable and toxic concentrations.
- The safest procedure is to continually ventilate and monitor atmosphere.

Air Purifying, Air line, and Demand respirators may only be worn in confined spaces if:

1. Testing shows an oxygen deficiency does not exist
2. Testing shows no IDLH atmosphere
3. While wearing an APR, the air must be continuously monitored.

If testing determines the atmosphere to be IDLH:

1. Positive pressure SCBA must be worn
2. Positive pressure airline respirator with auxiliary self contained air supply for egress must be worn.
Fit Testing

Here is an example of a fit test form. Every employee must pass a medical evaluation first, before he or she can be fit-tested. The fit test must be performed by a qualified person who has been properly trained.

Medical Evaluations can be obtained from a licensed health care professional and must state that the worker has passed the evaluation. If the worker does not have the medical evaluation he should not be fit tested.

Qualitative Fit Test Form for Stannic Chloride

Name: ____________________________________________  Date: __________

Company/Organization: __________________________________________________

Medical Questionaire Completed?  Yes __ No__  Date: __________

Respiratory Training Completed? Yes __ No__  Date: __________

Approved for Respirator use and wear? Yes __ No__

Tested with necessary PPE? Yes __ No__

Respirator Make: ______________ Model: __________ Size: __________

Canister or Cartridge used: ______________________________________________

Respirator Type (Circle One):

- Dust Mask
- Air Purifying
- PAPR
- Supplied Air
- Escape Only
- Pressure Demand
- SCBA

If respirator is a Dust Mask, please specify the rating:
N95  N99  N100  R95  R99  R100  P95  P99  P100

Tight fitting, positive pressure respirators are to be fit tested in the negative pressure mode.

Do not use a hood for this test
Mirror available
Respirator must be equipped with P100 filters.
Position respirator
Person must wear respirator for at least 5 minutes
Check comfort
Check fit
Provide second choice of respirator if necessary
Adjust properly
Perform positive and negative pressure check
Describe Test procedure and method
Procedure: Normal Breathing 1 minute
Deep breathing 1 minute turning head side to side
Moving head up and down for 1 minute
Talk loudly or read loudly for 1 minute
Bend at the waist as if to touch toes for 1 minute
Normal breathing for 1 minute
Any adjustments during the test voids test and you must start over
Cover the end of the tube with a short piece of plastic tube to protect wearer from jagged edges.
Take precautions to minimize wearers’ exposure to smoke.
Perform test in area with adequate ventilation
Smoke is administered for each of the test positions described earlier.
No evidence of response, have wearer remove the respirator. Give wearer small dose without respirator, if they respond, test is passed.
If there is no response by the wearer to the smoke, the test is void.

PROCEDURE
• Put on the respirator
• Position the respirator on the face
• Set strap tension
• Determine an acceptable fit
• Provide a mirror for employees to use.
• Inform wearer that they are asked to select the respirator that provides the most acceptable fit.
• Each respirator represents a different size and fit.
• If fitted and used properly, each respirator will provide adequate protection
• Hold respirator up to face and eliminate those that do not give an acceptable fit.
• The most comfortable mask must be worn at least five minutes
• If unfamiliar with mask, have them put it on several times.
• Check for comfort by insuring room for eye protection, room to talk, position on face and cheeks.
Anytime during the testing procedure, if the respirator must be refitted to face, the test is void and must be started over.
• Complete positive and negative seal check.
• Insure no beards or stubble, hair or mustache and sideburns to affect sealing surface.
• Normal breathing 1 minute.
• Deep breathing 1 minute
• Turning head side to side at extreme positions for 1 minute
• Moving head up and down at extreme positions for 1 minute.
• Talking out loud slowly and loud enough for tester to hear clearly for 1 minute, recite the rainbow passage or count down from 100.
• Bending over at the waist as if to touch the toes for 1 minute
• Normal breathing again for 1 minute.
• At each test step introduce smoke to the sealing surface.
• Give wearer passing the smoke test, without evidence of response a second sensitivity screening check with the smoke from the same tube. If they react to the smoke, they pass the test. The fit test is void if an employee does not respond to the smoke not wearing the respirator.

Did the wearer complete all the above requirements?  Yes  No

This respirator fit test is:  Satisfactory  Unsatisfactory

Reason for failure (if applicable):

Steps to be taken prior to the next fit test (if applicable):

Wearer’s signature: ___________________________ Date: ______

Program Administrator’s Signature: ___________________________ Date: ______

Fit Testing Official’s Signature: ___________________________ Date: ______

Fit Testing Official’s Company: ___________________________

My signature on this document indicates my agreement to use the assigned respirator in an approved manner in accordance with State and Federal requirements governing their use and limitations. I will abide by the policies of my employer regarding the use of the respirator for which I have been trained.
QUALITATIVE PROCEDURE
It is the employer’s responsibility to ensure that the persons administering qualitative fit tests are able to prepare test solutions, calibrate equipment, conduct tests properly, recognize invalid tests and assure that test equipment is in proper working order. All necessary equipment for conducting the irritant smoke test is included in the kit.

Stannic Chloride (Irritant Smoke Test)
• Use N7500-82 or -83 cartridges.
• Describe test procedure and exercises the subject will be performing
• Tester: Wear Eye Protection, Break the tips off both ends of fresh tube, or remove protective caps from tube ends.
• Cut the tip off one of the protective caps provided and slip over one end of the type to prevent injury from sharp glass
• Insert other end of tube into aspirator bulb.
• Advise subject to keep eyes closed due to possible irritation.
• Have subject put on respirator, wear for 5 minutes prior to test
• Must have a mirror present to allow worker to properly position mask on their face.
• No eating, drinking, or smoking 30 minutes prior to the test.
• Prior to test, have test subject conduct user seal checks.

Bitrex aerosol fit tests for filtering face pieces (dust masks)
Connect the snaps at the top of the hood so that the connections help support the hood. Unscrew the solution well and squeeze bulb of the nebulizer marked #1 sensitivity test solution from the top portion and pour one teaspoon of the sensitivity test solution into the solution well. Unscrew the solution well and squeeze bulb of the nebulizer marked #2 fit test solution from the top portion and pour one teaspoonful of the fit test solution into the solution well.

This test is done to assure that the person being fit tested can detect the taste of the test solution at very low levels. The Sensitivity is a very dilute version of the Fit Test Solution. The subject should not consume anything orally for at least 15 minutes before the test.

SENSITIVITY TEST: With Nebulizer #1 Put hood on subject without wearing the respirator. Position hood with about 6 inches between subjects face and hood window. Instruct subject to breathe through his or her mouth and notify you when he or she detects the bitter taste of the solution. Remove vent plug and nozzle plug. Insert nebulizer through hole in window. Inject 10 squeezes, fully collapsing bulb on each squeeze. Note the number of squeezes subjects tastes the compound.
Have subject put on respirator and perform user seal check. Wear respirator in uncontaminated area for 5 minutes. Put on and position hood. Put Nebulizer #2 through hole in hood window. Inject aerosol using same number of squeezes noted as threshold testing. After aerosol is injected, ask subject to perform following exercises:

- Normal Breathing (Standing upright)
- Deep Breathing
- Turning Head
- Move Head up and Down
- Speak out Loud
- Bend at Waist
- Normal Breathing (while standing upright)

If entire test is completed without the subject detecting the taste, the test is successful and fit is deemed adequate.

**REFERENCE TERMS AND ABBREVIATIONS**

- **ANSI** = American National Standards Institute
- **APF** = Assigned Protection Factors
- **APR** = Air Purifying Respirator
- **CEL** = Ceiling Exposure Limit
- **CFAR** = Continuous Flow Airline Respirator
- **CFR** = Code of Federal Regulations
- **EEBA** = Emergency Escape Breathing Apparatus
- **ESLI** = End of Service Life Indicator
- **IDLH** = Immediately Dangerous to Life and Health
- **MSDS** = Material Safety Data Sheet
- **MSHA** = Mine Safety and Health Administration
- **NIOSH** = National Institute for Occupational Safety and Health
- **OSHA** = Occupational Safety and Health Administration
- **PAPR** = Powered Air Purifying Respirator
- **PDAR** = Pressure Demand Airline Respirator
- **PEL** = Permissible Exposure Limit
- **SCBA** = Self Contained Breathing Apparatus
- **STEL** = Short Term Exposure Limit
- **TLV** = Threshold Limit Value
- **TWA** = Time Weighted Average