2016

SAFETY: RESPIRATORY PROTECTION PROGRAM

PARTICIPANT GUIDE FOR DISTANCE LEARNING COURSE

BUREAU OF LAND MANAGEMENT
OFFICE OF SAFETY, OCCUPATIONAL HEALTH, AND EMERGENCY MANAGEMENT

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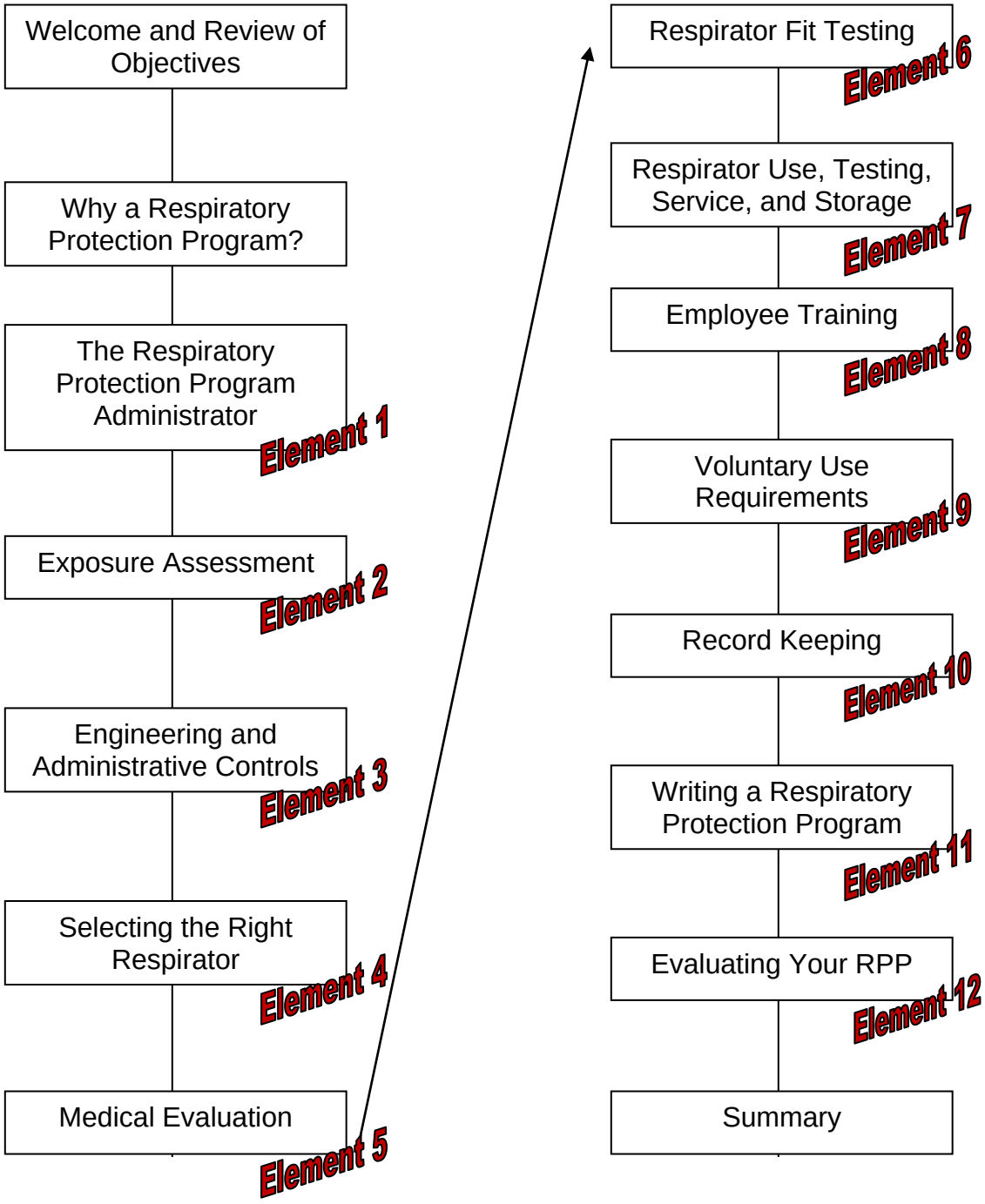
Respiratory Protection Program Implementation– Topics



Course Objectives

Notes

At the conclusion of this course, you should be able to--

1. Identify the twelve program elements in a Respiratory Protection Program (RPP).
2. List the responsibilities of an RPP Administrator (RPPA).
3. Access the textual and human resources available to an RPPA and to Supervisors involved in an RPP.
4. Describe in basic terms the human respiratory system, its normal function and protective mechanisms.
5. Explain the basic concepts, principles, and procedures involved in assessing worker exposures to respiratory hazards.
6. Explain how to reduce respiratory hazards through engineering and administrative control measures.
7. Recognize limitations of certain types of respirators in selecting proper respirators for the job site.
8. Demonstrate how to correctly test, use, service, and store respirators of different types.
9. Describe the requirements for voluntary respirator use.
10. List the requirements for medical evaluations and follow-up medical examinations.
11. Explain the RPP's employee training requirements.
12. Describe record keeping requirements within the RPP.
13. Explain when and how to conduct an RPP evaluation.

Why Implement a Respiratory Protection Program?

After completing this module, you should be able to:

Identify reasons for being concerned about respiratory hazards and for implementing a Respiratory Protection Program .You should be able to describe in basic terms the human respiratory system, its normal function and protective mechanisms.

Why should you give a second thought to the apparently good air that you and your employees breathe during the course of the workday?

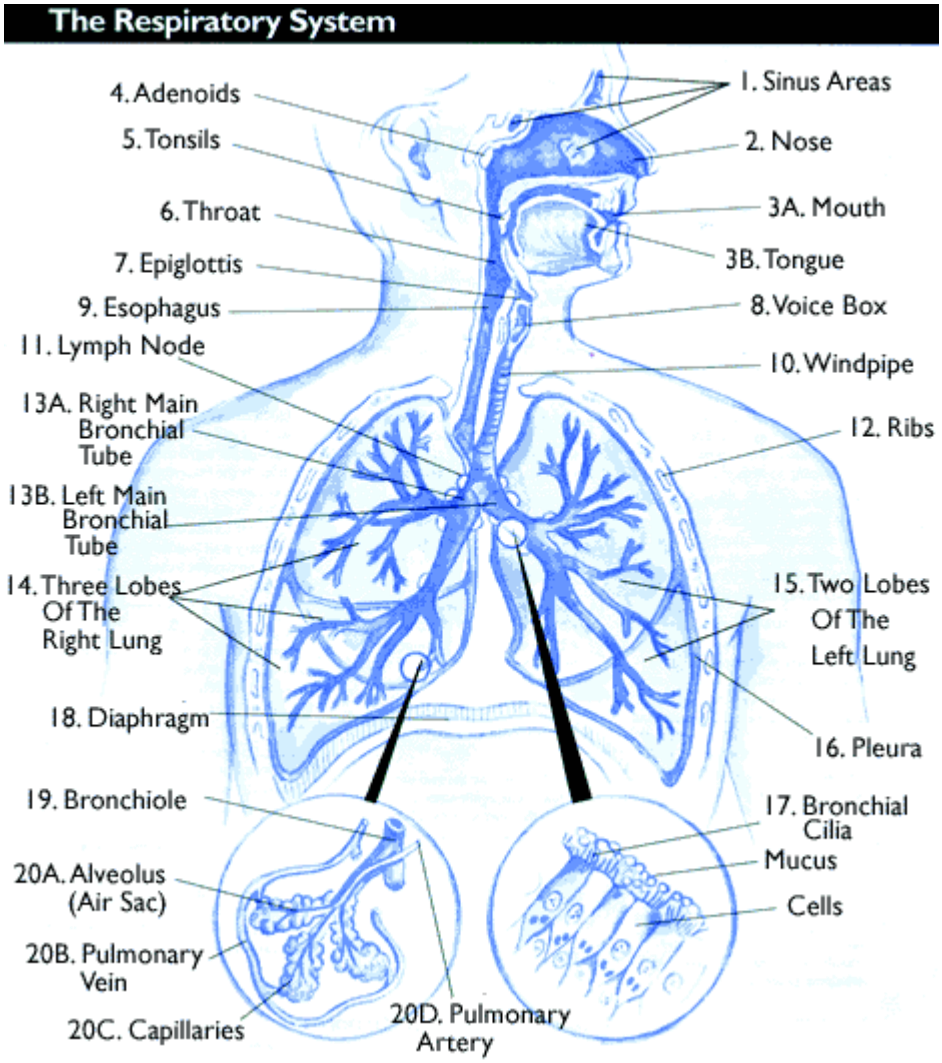


Illustration from American Lung Association [http://www.lungusa.org/learn/resp_sys.html]

Why Implement a Respiratory Protection Program?

Notes

What is a respirator?

A respirator is a protective device that covers the nose and mouth or the entire face or head to guard the wearer against hazardous atmospheres.

Respirators may be:
■ Tight-fitting—that is, half masks, which cover the mouth and nose and full facepieces that cover the face from the hairline to below the chin; or
■ Loose-fitting, such as hoods or helmets that cover the head completely.

In addition, there are two major classes of respirators:
■ Air-purifying, which remove contaminants from the air; and
■ Atmosphere-supplying, which provide clean, breathable air from an uncontaminated source. As a general rule, atmosphere-supplying respirators are used for more hazardous exposures.

Why do employees need respirators?

When employees must work in environments with insufficient oxygen or where harmful dusts, fogs, smokes, mists, fumes, gases, vapors, or sprays are present, they need respirators. These health hazards may cause cancer, lung impairment, other diseases, or death. Where toxic substances are present in the workplace and engineering controls are inadequate to reduce or eliminate them, respirators are necessary. Some atmospheresupplying respirators can also be used to protect against oxygen-deficient atmospheres. Increased breathing rates, accelerated heartbeat, and impaired thinking or coordination occur more quickly in an oxygen-deficient or other hazardous atmosphere. Even a momentary loss of coordination can be devastating if it occurs while a worker is performing a potentially dangerous activity such as climbing a ladder.

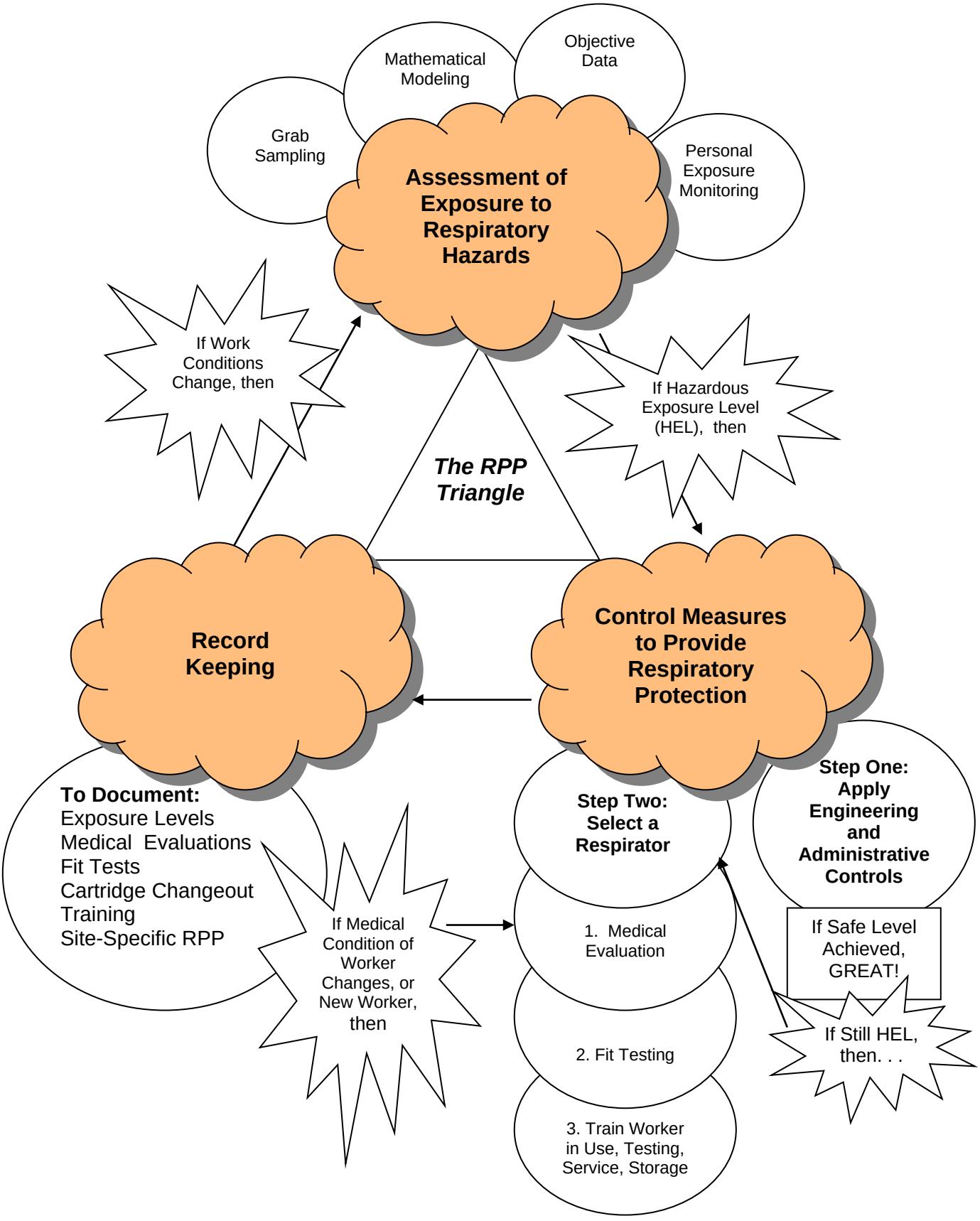
OSHA’s respirator standard requires employers to establish and maintain an effective respiratory protection program when employees must wear respirators to protect against workplace hazards. Different hazards require different respirators, and employees are responsible for wearing the appropriate respirator and complying with the respiratory protection program.

The Respiratory Protection Program Elements

Notes

Twelve Elements:

1. Program Administration
2. Exposure Assessment
3. Engineering and Administrative Controls
4. Respirator Selection
5. Medical Evaluation
6. Respirator Fit Testing
7. Safe Use of Respirators
8. Employee Training
9. Voluntary Respirator Use
10. Record Keeping
11. Written Respiratory Protection Program
12. Program Evaluation


Mathematical Modeling
Objective Data
Grab Sampling
Personal Exposure Monitoring
Assessment of Exposure to Respiratory Hazards
If Work Conditions Change, then
If Hazardous Exposure Level (HEL), then
The RPP Triangle
Record Keeping
Control Measures to Provide Respiratory Protection
To Document:
Exposure Levels
Medical Evaluations
Fit Tests
Cartridge Changeout
Training
Site-Specific RPP
If Medical Condition of Worker Changes, or New Worker, then
Step Two: Select a Respirator
1. Medical Evaluation
2. Fit Testing
3. Train Worker in Use, Testing, Service, Storage
Step One: Apply Engineering and Administrative Controls
If Safe Level Achieved, GREAT!
If Still HEL, then. . .

Element One:

Notes

Program Administration

After completing this module, you should be able to:
List the responsibilities of an RPP Administrator.

The Respiratory Protection Program Administrator (RPPA) has **two major responsibilities**:

1. Carry out the steps of the Respiratory Protection Program.
2. Write a District Office/Field Office-specific RPP that addresses the policies and procedures for the implementation of the District Office/Field Office's RPP.

Where Can You Go for RPP Help?

First, you can contact your RPPA. If this is not the District Office/Field Office safety officer or collateral duty safety officer, that person will know who the RPPA is.

Second, you can access the following textual resources for support:

- 29 CFR 1910.134 Respiratory Protection at http://osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=12716
  This document gives us the regulatory requirements for respiratory protection programs.
- 29 CFR 1910 Subpart Z Toxic and Hazardous Substances at http://osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992 http://osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9993
  This section lists chemicals for which PELs have been established. In some cases the limit will be designated as a Ceiling limit (identified with a "C" in the table). This is concentration which must never by exceeded. The z-tables will also tell us if the dermal route of exposure is particularly important. This alerts us to the need for skin protection in addition to respiratory protection. (See appendix B for these tables.)
- 29 CFR 1910 and 1926 Agent Specific Regulations. Some agents such as lead, asbestos, vinyl chloride, benzene, arsenic, and cadmium have their own section in the regulations. Not only will PEL be provided here, but the regulation may also provide additional specific guidance for respiratory protection such as required ventilation, prohibited work practices, and types of respirator allowed.
- NIOSH. 1987. Respirator Decision Logic. DHHS (NIOSH) Publication No. 87-108 at http://www.cdc.gov/niosh/87-108.html. This document provides guidance for selection of proper respirators.

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Element One: **Notes**

Program Administration

- ACGIH. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. This is for sale at http://acgih.org. TLVs, as we said earlier, are up-to-date consensus standards. BLM will use PELs or TLVs, whichever are more protective.
- OSHA Small Entity Compliance Guide at http://osha.gov/Publications/secgrev-current.pdf
- NIOSH Pocket Guide to Hazardous Chemicals at http://www.cdc.gov/niosh/npg/npg.html.
  This document includes information on hundreds of hazardous chemicals. It gives physical and chemical properties, protective clothing and respirator recommendations, exposure limits, immediately dangerous to life and health (IDLH) concentrations, symptoms of exposure and first aid.

Element Two: **Notes**

Exposure Assessment

It is the dose that makes the poison."

Know These Important Terms and Acronyms!

- Occupational Exposure Limit (OEL): an allowable concentration or intensity of a hazardous agent in the employee's immediate work environment over a given 8- hour period of time.
- Eight-Hour Time-Weighted Average (TWA8): the usual period of time over which exposure to a given concentration of a hazardous agent is calculated.
- Short-Term Exposure Limit (STEL): an allowable concentration or intensity of a hazardous agent in the employee's immediate work environment over a 15- or 30-minute duration.
- Permissible Exposure Limit (PEL): a legal exposure limit set by OSHA. Accessible at http://www.osha.gov/SLTC/pel/index.html.
- Threshold Limit Value (TLV): a consensus exposure standard determined and published by the American Conference of Governmental Industrial Hygienists (ACGIH). Accessible at www.acgih.org.

There are more Acronyms listed in the Appendix A for your reference through this training.

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GRAB SAMPLING

 Sorbent Tube for Collecting Vapors

1. Draw sample of “worst case air” using *colorimetric detector tube*.
2. Read concentration directly from the scale on the tube.
3. Calculate exposure level as an eight-hour time-weighted average.
4. Compare with OELs and TLVs and draw conclusions.

Element Two: **Notes**

Exposure Assessment

Calculate an Exposure Level! Troy works in an environment that exposes him to carbon monoxide. He could be in a warehouse, using propane-fueled lift trucks; he could be an auto mechanic in the auto shop; he could be working at a marina. Grab sampling shows **35 ppm** of Carbon Monoxide. Troy is exposed for 3 **hours** during his work shift. Using the following formula, calculate his exposure as an 8-hour TWA.

TWA_8= [(35 X 3) + (0 X 5)] / 8 = 13 ppm

Find the PEL using the portion of the OSHA Z-Table provided in Appendix B on page 40 of this participant guide. Is Troy's exposure permissible? **The PEL for Carbon Monoxide is a TWA of 50 ppm, so the exposure of 13 ppm is permissible.**

If Troy were exposed at this level for 6 hours, what would the TWA be? If we used the ACGIH TLV of 25 ppm, would it be permissible?

TWA8= [(35 X 6) + (0 X 2)] / 8 = 26 ppm

In this case, the ACGIH TLV of 25 ppm would be exceeded, but it would still be under the OSHA PEL of 50 ppm. Since BLM has a management goal of using the more protective standard of the PEL or TLV, this would not be an acceptable exposure for BLM, although still legally permissible.

Some Cautions!

- Another limit to be aware of in determining if exposure is at hazardous levels is the ***ceiling limit*** (see OSHA Table Z-2 in appendix B).

If there is no formal ceiling value established, a common rule of thumb is to use 10 times the permissible 8 hour TWA as a ceiling value.

- When you are uncertain about exposure levels or the levels are high risk, get an ***experienced industrial hygienist*** to help with exposure assessment.

Element Two: **Notes**

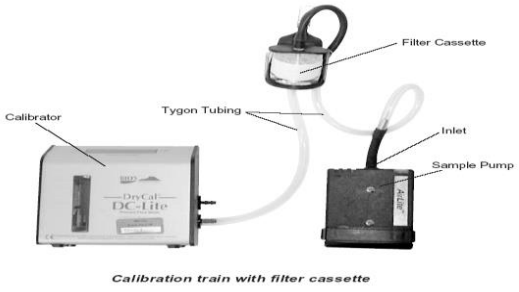
Exposure Assessment

ANALYSIS OF AVAILABLE OBJECTIVE DATA

Objective data
- can be data which shows that the use of a product cannot lead to an overexposure.
- may take the form of personal monitoring data for similar tasks conducted under essentially the same conditions.
- may be accessed from manufacturer's data, scientific studies, past sampling results.

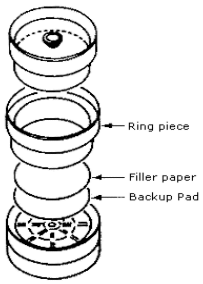
PERSONAL EXPOSURE MONITORING

1. Get basic equipment: sampling pump (calibrated to pump air at a given flow rate across a collection media) and sampling media. Media may be one of several types of filters (mechanical collection) in a cassette or sorbents such as activated charcoal (just like your fish tank filter or home air cleaner) in a glass tube (see following diagram).



Calibration train with filter cassette

FIGURE II:1-1a. EXPLODED VIEW OF THREE-PIECE CASSETTE SHOWS PLACEMENT OF BACK-UP PAD.



(illustrations from OSHA tech manual)

2. Collect sample and ship media to a laboratory for analysis.
3. Receive lab report, which gives an amount, usually in grams, per total volume of air that passed through the media. This figure is converted to ppm for vapors.
4. Compare with OELs and TLVs and draw conclusions.

Note: Exposure monitoring may be conducted by a Workplace Monitor, usually under the direction of an experienced industrial hygienist.

Element Three: **Notes**

Engineering and Administrative Controls

Following this module, you should be able to List engineering and administrative controls that can be used to reduce respiratory hazards at their work sites.
Students should also be able to explain how these engineering and administrative control measures reduce respiratory hazards.

Engineering and Administrative Control Measures include:

1. *Enclosure of the operation to create barrier between the worker and the hazardous substance.* One example of this is the glove box.

2. *Installation and proper maintenance of general dilution ventilationor local exhaust ventilation systems.*

   With filtering/re-circulating air cleaners **be aware** of these issues:
   - Required maintenance.
   - Pressure loss and adequate flow to prevent settling of particulates (a big problem in carpenter shops).
   - Placement of exhaust fans and ducts. Too frequently, exhaust from paint spray booths is directed into District Office/Field Office parkiing lots. Also too frequently, discharge is positioned so that it eddies back to building air intakes.

3. *Implementation of work practice controls.* Examples include
   - Using a HEPA vacuum instead of broom sweeping.
   - Substituting wet sanding equipment for dry sanding equipment.
   - Following personal hygiene requirements consistently.
   - Establishing clean change areas and no smoking areas.
   - Prohibiting eating in work areas.
   - Following personal and workplace hygiene requirements for lead, etc.

4. *Substitution of less toxic substances in order to eliminate the hazard completely.* One example is the substitution of Limonene-based (citrus) cleaners for mineral spirits or toluene for cleaning of greasy parts.

Look for Control Measures at Your Site! Take some time to look at your District Office/Field Office specifically. You probably recognize several engineering and administrative control measures for respiratory protection already in place at your site. Element 3 of this participant guide contains a list of engineering and administrative control measures. Take a minute to highlight the controls you see being implemented at your site.

Element Three:

Engineering and Administrative Controls

Some Engineering and Administrative Control Measures For Controlling Airborne Hazards

Strengths/Weaknesses?

Type of Control	Examples
Administrative Controls	
Employee Training and Education	
Hazard Recognition	-Risk Assessments and Industrial Hygiene surveys identify hazardous tasks -MSDS
Worker Rotation	-Limit duration of individual worker exposure
Maintenance.	-maintain local exhaust systems to ensure proper capture velocities
Housekeeping	-maintain clean work surfaces and clothing to prevent chronic exposures. -return hazardous chemicals proper storage after use to prevent accidental spills
Process Elimination	-contract asbestos removal to eliminate exposure during routine maintenance
Engineering Controls	
Source modification--changing a hazard source to make it less hazardous	-using wet methods to reduce airborne dust particles -lowering the temperature of liquids to reduce evaporation.
Substitution--substituting a less hazardous material, piece of equipment, or process	-use soap and water in place of solvents -use limonene cleaners in dip tanks in place of hydrocarbon solvents
Process Automation	-use automated rather than manual equipment
Isolation, Enclosure, Separation—separate employees from the hazard	-use of control rooms -isolation booths -glove box -remote access to valves, meters
Process Change	-brush or roller application of paints rather than spraying -use chemical strippers in place of machine sanding to remove lead-based paint
Dilution (general exhaust) Ventilation	-supplied air islands -use of ventilated storage rooms for chemicals
Local Exhaust Ventilation	-dust collection systems for stationary and portable tools -laboratory fume hood
Personal Protection	
Respirators	-when other methods to control airborne exposure are not adequate to protect employee.

Element Three: Engineering and Administrative Controls

Notes

Do Our Controls Really Work?

After implementing engineering and administrative controls, it is essential that we

1. Reassess exposure levels to make sure that Troy is now protected.
2. Maintain and monitor equipment to ensure that it is performing according to design.
3. Be prepared to select a respirator--the next line of defense—if
   - Exposure levels are still hazardous
   - Engineering/administrative controls are still being prepared
   - Non-routine work might expose Troy to hazardous substances or oxygen-deficient atmospheres.
     In this case, the supervisor should contact the RPPA to select the appropriate respirator to reduce the exposure.

Element Four: **Notes**

Selecting the Proper Respirator

After completing this module, you should be able to:
Recognize the limitations of certain types of respirators and to select the proper respirator for the hazardous condition.

Three Basic Respirator Selection Principles

1. The respirator is selected only after the type and concentration of the contaminant have been identified.

2. The RPPA selects the respirator, in consultation with a qualified Industrial Hygienist if necessary.

3. All respirators must be NIOSH-certified and consistent with NIOSH Respiratory Decision Logic.

Six Factors in Selecting a Respirator

1. Effectiveness of the device against the substance of concern;
2. Maximum concentration of the substance in the work area;
3. General environment (open shop or confined space, etc.);
4. Known limitations of the respiratory protective device;
5. Comfort, fit, and worker acceptance; and
6. Other contaminants in the environment or potential for oxygen deficiency.

Notes

Element Four: Selecting the Proper Respirator

Notes

Select the Right Respirator! Now let's practice.

To find the minimum Required Protection Factor for an 8 hour Occupation Exposure Limit, perform the following calculation:

Required Protection Factor = Concentration / OEL
RPF = 60 / 50 = 1.2

To find the minimum Required Protection Factor for a Short Term Exposure Limit, perform the following calculation:

Required Protection Factor = Concentration / STEL
RPF = 60 / 50 = 1.2

Using the chart below, choose the respirator with an APF value equal to or greater than the RPF. For this scenario, the minimally acceptable respirator type is the ½ face APR.

Type of respirator[1], [2]	Quarter mask	Half mask	Full facepiece	Helmet/ hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	[3]10	50	.....	.....
2. Powered Air-Purifying Respirator (PAPR)	.....	50	1,000	[4]25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	.....	10	50	.....	.....
• Continuous flow mode	.....	50	1,000	[4]25/1,000	25
• Pressure-demand or other positive-pressure mode	.....	50	1,000	.....	.....
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	.....	10	50	50	.....
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	.....	.....	10,000	10,000	.....

Element Four: Selecting the Proper Respirator

Example respirator selection for each scenario in the table below.

Example Respirator Selection Scenarios

Agent	***Breathing Zone Concentration***	***OEL***	***Required Protection Factor?***	***Minimally Acceptable Respirator Type***
Lead	60 ug/m3	50 ug/m3	1.2	½ face APR
Toluene	400 ppm	50 ppm	8	½ Face Piece APR
Nickel welding fume	1.0 mg/m3	1.5 mg/m3	.66	None Required at this level for nickel, ½ face N95 recommended because of other potential metal contaminants from welding
Chlorine	0.4 ppm TWA_8, 2.0 Short term or Ceiling	0,5 ppm (1 ppm STEL)	2	Full face APR * full face to reduce eye irritation

Element Four: Selecting the Proper Respirator

Below are three examples in which employees are exposed to a respiratory hazard requiring the use of some type of respirator. Using the “Respirator Selection Matrix” , the scenarios show how to determine which type of respirator would best protect the employee.

Scenario 1:
In a chemical storage warehouse, a drum of carbon tetrachloride developed a leak on Friday evening. When the leak was discovered on Monday morning, the storage room had an airborne concentration of 1000 ppm carbon tetrachloride. Choose respiratory protection for the following:

1. Initial entry for hazard evaluation.
2. Clean up of the area given the following information:
   - Oxygen content: 21%
   - Carbon tetrachloride concentration: 1000 ppm.
   - No other contaminants present.

Respirator Selection Matrix

Step 1: Respiratory Hazard Identification

Oxygen Concentration: 21%
Contaminant(s): Carbon Tetrachloride
Physical State(s): Liquid, vapor
Concentration: 1000 ppm
Oil Present: No Oil Concentration:N/A

Step 2: Hazard Analysis

Permissible Exposure Limit: 10 ppm
APF Needed (Hazard Ratio): 100
Skin Absorption/Irritation yes
Eye Irritation: yes
Warning Properties
Odor Threshold:
Nose/Throat Irritation:
IDLH Concentration: 500 ppm
Lower Flammable Limit: N/A
Sorbent Efficiency:
Special Considerations:

Step 3: Respirator Type Required Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

Minimum Acceptable:
Alternative: Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Step 4: Specific Solutions

1. An SCBA would be required for initial entry and evaluation.
2. For clean-up activities, it would be recommended to ventilate the space until concentrations came down to below the IDLH level and below 100 ppm. At that point. Work could be conducted with full face PAPR or respirators with OV cartridges.
3. Must protect skin and eyes because of absorption and irritant properties/

Scenario 2:

Employees in a regulated area where Class III asbestos work (repair and maintenance that might disturb asbestos containing material) is being performed have been monitored for exposure to asbestos. The air monitoring results were 8-hr TWA exposure of .87 f/cc for the job classification with the highest exposures. No oil is present during the job. Choose respiratory protection to be used by employees until adequate engineering controls are in place.

Respirator Selection Matrix

Step 1: Respiratory Hazard Identification

Oxygen Concentration: 21%
Contaminant(s): Asbestos
Physical State(s): fibers in air
Concentration: .87f/cc
Oil Present: No Oil Concentration:

Step 2: Hazard Analysis

Permissible Exposure Limit: 0.1 f/cc
APF Needed (Hazard Ratio): 9
Skin Absorption/Irritation N/A
Eye Irritation: N/A
Warning Properties
Odor Threshold:N/A
Nose/Throat Irritation: N/A
IDLH Concentration: N/A
Lower Flammable Limit: N/A
Sorbent Efficiency: N/A
Special Considerations:

Step 3: Respirator Type Required half face APR with high efficiency (99.97%) particulate filter

Minimum Acceptable:
Alternative:

Step 4: Specific Solutions

1.Must address all requirements under OSHA asbestos standard.

Scenario 3:

A spill of acetone has resulted in vapor concentrations of 10,000 ppm in a small paint mixing room. Oxygen content in the room is 21%. No other contaminants are present in measurable concentrations.

Respirator Selection Matrix

Step 1: Respiratory Hazard Identification

Oxygen Concentration: 21%
Contaminant(s): Acetone
Physical State(s): Vapor
Concentration: 10,000 ppm
Oil Present: No Oil Concentration:

Step 2: Hazard Analysis

Permissible Exposure Limit: 1,000 ppm
APF Needed (Hazard Ratio): 10
Skin Absorption/Irritation
Eye Irritation:
Warning Properties
Odor Threshold:
Nose/Throat Irritation:
IDLH Concentration: 2,500 ppm
Lower Flammable Limit: 2.5% (25,000 ppm)
Sorbent Efficiency:
Special Considerations:

Step 3: Respirator Type Required
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

Minimum Acceptable: Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus
Alternative:

Step 4: Specific Solutions

1. AT THIS AIR CONCENTRATION, THE PRIMARY HAZARD IS FIRE/EXPLOSION.
2.IDLH is based upon 10% of LEL (2,500 ppm), when LEL meter should be alarming.
3. Except in extreme life saving situation, area should not be entered until concentration has dropped below fire/explosion IDLH level.

Element Five: Medical Evaluations

Notes

Two major reasons for medical evaluations before fitting are

- The respirator might not fit the employee well enough to provide adequate protection—it might leak.
- The respirator might be a health risk to the employee due to an unforeseen health condition.
- You can further check into these requirements, in detail, in Appendix C of 29 CFR 1910.134 and in the Medical Evaluation Checklist provided in Appendix E.
- Along with the medical questionnaire, it is vital to provide a copy of the written respiratory protection program and 29 CFR 1910.134 must be presented to the physician.

Element Six: Fit Testing

Notes

Two Fit Testing Methods

The “Bitrex” and “Irritant Smoke” methods of determining if a face piece seal fits well or leaks is a qualitative method.

The quantitative method of fit testing counts relative concentrations inside and outside of the face piece.

Retesting. Retesting is required when any of the following condition occur:

- Annually.
- Whenever a different respirator face piece (size, style, model or make) is used.
- When the employer, PLHCP, supervisor, or program administrator makes visual observations of changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.
- Whenever the employee reports that the fit of the respirator is unacceptable.

An employee cannot be fit tested for a tight fitting respirator if facial hair comes between the sealing surface of the respirator and the skin.

Records. Records of all fit tests will be retained for all respirator users until the next fit test is administered. Records must include

- the name of the employee;
- name of tester;
- type of fit test;
- specific make, model, style and size of respirator tested;
- date of the test; and
- test results.

Element Seven: Safe Respirator Use, Testing, Service, and Storage

Notes

When and How to Change Out Cartridges and Canisters

1. Look for an End of Service Life Indicator (ESLI) on the cartridge or canister to know when to replace it.
2. If there is no ESLI, implement a change schedule determined by one of these methods:
   - **Rule of Thumb**: If a chemical's boiling point is >94 ^{o}F and the concentration is less than 200 ppm you can expect a service life of 8 hours at a normal work rate. **Note: This basic rule must be modified for work rate, chemical concentration, and humidity.**
     1. Service life is inversely proportional to work rate.
     2. Reducing concentration by a factor of ten will increase service life by a factor of five.
     3. Humidity above 85% will reduce service life by 50%.

Determine Change-Out Schedule Using Rule of Thumb!
Troy is using toluene. We can find the boiling point for toluene in the NIOSH Pocket Guide to Hazardous Chemicals, available at http://www.cdc.gov/niosh/npg/npg.html The boiling point is 232 F. If our exposure evaluation showed that Troy could expect concentrations of 100 to 200 ppm (2 to 4 times the TLV) at his work site (and breathing zone), his organic vapor cartridges would be expected to provide adequate protection for an entire 8-hour work shift. What if it were a common mid-Atlantic or southeast US august day (rH > 85%)? Look at Rule of Thumb modification number 3. Troy would then be required to change his OV cartridges after 4 hours.
Note: This rule provides only an estimate of service life and should be supported by other methods.

- **Mathematical Predictive Modeling**:
  Wood Model—
  http://www.osha.gov/SLTC/etools/respiratory/mathmodel_woodtable.html
  Yoon-Nelson Model--
  http://www.osha.gov/SLTC/etools/respiratory/mathmodel_yoon-nelsonmodel.html

Determine Change-Out Schedule Using Wood Model!
Troy is exposed to toluene at a concentration of 200 ppm for 307 minutes and at a concentration of 100 ppm for 562 minutes. Using the Wood table in the OSHA Pre-Calculated Breakthrough Times for Contaminants table calculate the service life of his respirator cartridge.

Element Seven: Safe Respirator Use, Testing, Service, and Storage

Notes

- **Manufacturer's Objective Data**: Manufacturers can provide breakthrough information via telephone or fax, but most have web-based tools that can be used to calculate service life using specific information about the working conditions that you input; for example, the expected concentration of the contaminants, the relative humidity in the work area, and the work rate. Two manufacturers and the website addresses for their service life calculators are shown below:

  MSA:
  http://www.msanet.com/msanorthamerica/msaunitedstates/resptest/index.html

  3M: See Appendix K for step by step directions
  http://csrv.3m.com/csrv/

3. Documentation: The District Office/Field Office must describe in the respiratory protection program the information and data relied upon, the basis for reliance on the data, and the basis for the canister and cartridge change schedule. A sample Cartridge Change Schedule Documentation form is provided in Appendix H of this participant guide.

How to Wear Respirator and Perform a User Seal Check

Every time you put on a respirator, perform the following checks:

1. Positive Pressure User Seal Check (make certain the face piece seal holds air when you exhale with the exhalation valve covered).
2. Negative Pressure User Seal Check (make sure the seal is tight enough to keep the face piece collapsed after inhaling and with all inlets covered).
3. A manufacturer's recommended procedure may be substituted for the above if shown to be adequate (for example, when there is no exhalation valve or it is impossible to cover inlets).

Element Seven: Safe Respirator Use, Testing, Service, and Storage

Notes

Inspect a Respirator! Use the following checklist:

- Check respirator function.
- Check tightness of connections and the condition of the various parts including, but not limited to the
  - face piece,
  - head straps,
  - valves [Remove valves in ½ face respirator and check condition---roll up between thumb and forefinger then release. Should spring back to original position. If it doesn't, replace.]
  - cartridges, canisters or filters.
- Check of elastomeric parts for pliability.
- Check for signs of deterioration.
- Check regulator and warning devices for proper function.

After inspecting respirators maintained for emergency use:

- Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and

- Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports stored as paper or electronic files. This information shall be maintained until replaced following a subsequent certification.

Breathing Air Quality

Check the Air

As per ANSI/Compressed Gas Association Commodity Specifications for Air, compressed air is safe if

- Oxygen content (v/v) is 19.5-23.5%;

- Hydrocarbon (condensed) content is 5 milligrams per cubic meter of air or less;

- Carbon monoxide (CO) content is 10 ppm or less;

- Carbon dioxide content is 1,000 ppm or less; and

- There is a lack of noticeable odor.

Element Seven: Safe Respirator Use, Testing, Service, and Storage

Notes

Check the Compressor

All compressors used to supply breathing air to respirators must

- Be constructed and situated so that the air supply cannot become contaminated.
- Be equipped with in-line air-purifying sorbent beds and filters to further ensure breathing air quality. (Sorbent beds and filters must be maintained and replaced or refurbished periodically following the manufacturer's instructions).
- Have breathing air couplings that are incompatible with outlets for non-respirable air or other gas systems.

Oil-Lubricated compressors must

- Be monitored for carbon monoxide levels to ensure that they do not exceed 10 ppm.
- Have a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. (If only high-temperature alarms are used, the air supply must be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm).

How to Repair and Clean Respirator

Some guidelines that should be followed:

- **Maintenance.**
  1. Always refer to manufacturer’s recommendations for maintenance.
- **Repair.**
  1. Respirators that are damaged or fail inspection must be repaired or discarded and replaced.
  2. Repairs will be made only by appropriately trained persons.
  3. Only the manufacturer’s NIOSH-approved replacement parts designed for the respirator will be used.
  4. All repairs will be made according to the manufacturer’s recommendations and specifications for the type and extent of repairs to be performed.

Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer.

Element Seven: Safe Respirator Use, Testing, Service, and Storage

Notes

Disassemble, Clean, and Reassemble a Respirator!

Disassembly and Repair.

- ❑ 1. Remove filters, cartridges, or canisters.
- ❑ 2. Disassemble face pieces by removing speaking diaphragms, demand and pressure- demand valve assemblies, hoses, or any components recommended by the manufacturer.
- ❑ 3. Discard or repair any defective parts.

Cleaning. (Caution! Never use alcohol, which can cause deterioration of rubber and silicon face pieces.)

- ❑ 4. Wash components in warm (110 deg. F maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle brush may be used to facilitate the removal of dirt.
- ❑ 5. Rinse components thoroughly in clean, warm (110 deg. F maximum), preferably running water. Drain.
- ❑ 6. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in hypochlorite solution (50 ppm of chlorine), made by adding approximately one milliliter of laundry bleach to one liter of water at 110 deg. F; or, other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.
- ❑ 7. Rinse components thoroughly in clean, warm 110 deg. F maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on face pieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.
- ❑ 8. Components should be hand-dried with a clean lint-free cloth or air-dried.

Element Seven: Safe Respirator Use, Testing, Service, and Storage

Notes

How to Store Respirator

Follow this checklist in storing respirators:

- Always refer to manufacturer's storage guidelines.
- Store respirators so that the face piece sealing surfaces and valves are protected from damage, deformation and contamination.
- Emergency respirators must be kept accessible to the work area and stored covered and clearly marked as a respirator for emergency use.

Element Eight: **Notes**

Employee Training

After completing this module, you should be able to:
Implement the RPP's employee training requirements.

These ***guidelines*** need to be followed as you implement your training program:

1. At the conclusion of the training, workers must be able to demonstrate knowledge and skills.

2. Training will be repeated annually to provide reinforcement and updated information. Train more often if
   - Changes occur in workplace conditions or equipments, or
   - It becomes apparent that an employee has not retained required understanding or skill to ensure safe respirator use.
3. The District Office/Field Office shall maintain a record of educational and training programs for each worker for the duration of employment plus 1 year. On termination of employment, the employer should provide a copy of the training record to the worker.

Employee training must be provided prior to allowing the employee to use a respirator and shall include at a minimum, the topics on the following checklist:

- ❑ Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
- ❑ What the limitations and capabilities of the respirator are;
- ❑ How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- ❑ How to inspect, put on and remove, use, and check the seals of the respirator (hands-on training in these skills must be provided);
- ❑ What the procedures are for maintenance and storage of the respirator;
- ❑ How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators;
- ❑ The general requirements of the District Office/Field Office and the BLM Respiratory Protection Program.

Element Nine:

Notes

Requirements for Voluntary Respirator Use

The objective of this module is to describe the requirements for voluntary respirator use.

When is voluntary respirator use allowed?

For Filtering Face Piece Respirators (Dust Masks):

1. The workplace shall be free of atmospheric hazards that would *require* the use of a respirator.
2. An evaluation of the workplace and circumstances under which the respirator would be used has been conducted, and it has been determined that use of the respirator will not in itself create a hazard.
3. Voluntary use has been approved by the RPPA.
4. Voluntary users of respirators shall be provided a copy of Information for Employees contained in the back of this guide.

For Respirators Other Than Filtering Face Pieces:

In addition to the conditions above, medical evaluation as discussed above and outlined in of this guide should be provided when respirators other than filtering face pieces are used voluntarily.

Element Ten: **Notes**

Record Keeping

After completing this module, you should be able to
Describe and follow record keeping requirements for the Respiratory Protection Program.

The following ***guidelines*** will help you remember what records to keep and how long to keep them:

Exposure Monitoring. All workplace exposure evaluations and personal exposure monitoring records will be maintained for the duration of employment plus on year. Remember that MSDSs are a part of the exposure assessment record.

Medical Evaluations. Medical evaluations are normally kept by the PLHCP. However, the District Office/Field Office must maintain the PLHCP's written recommendation. This record must be maintained for the duration of employment plus one year.

Fit Test Records. Fit test records will be maintained until the next fit test is administered. Each fit test record must contain the employee identification, type of fit test, date last tested, the results of the test, and the make, model and size of the respirator tested.

Cartridge Change-Out Determinations. A record will be kept of cartridge change-out schedule determinations for as long as the respirator cartridge is in service.

Training Records. Training records will be maintained for the duration of employment plus one year.

Reasons for keeping Records:

1. To document training, fit testing and medical certification for enforcement or BLM policy actions.
2. To notify supervisors of specific respirator the employee can wear.
3. To identify any medical restrictions.
4. For auditing the effectiveness of the program.

Element Eleven:

Notes

Writing a Respiratory Protection Program

After completing this module, you should be able to meet the objective of writing a Respiratory Protection Program specific to your site.

As you write your site-specific RPP, make sure you address the following elements:

- Program administration and designation of program administrator;
- Procedures for selecting respirators for use in the workplace;
- Medical evaluations of employees required to use respirators;
- Fit testing procedures for tight-fitting respirators;
- Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;
- Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;
- Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;
- Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations; (see also hazard communication);
- Conditions for voluntary use where no hazard exists;
- Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and maintenance;
- Procedures for regularly evaluating the effectiveness of the program.

Element Twelve: **Notes**

Evaluating Your RPP

After completing this module, you should be able to:
Explain when and how to conduct an RPP evaluation.

To make sure your program continues to protect workers, *you should* ***review*** *it* *at least annually* *and* ***update*** *it* *as necessary* to reflect those changes in workplace conditions that affect respiratory control measures, including respirator use.

A Sample plan is located on the KRC for you to use

Appendix A: Acronyms

Notes

ACGIH - American Conference of Governmental Industrial Hygienists
AL - action level
APF - Assigned Protection Factors
APR – Air Purifying Respirators
CDSP - collateral duty safety officer
CFR – Code of Federal Regulations
ESLI - End of Service Life Indicator
HEPA - High Efficiency Particulate Air
IDLH - Immediate Danger to Life and Health
KRC – Knowledge Resource Center
LE officers - Commissioned Law enforcement Officers
MSDS - Material Safety Data Sheet
MUC - Maximum use concentration
NIOSH – National Institute for Occupational Safety and Health
NIOSH REL - National Institute for Occupational Safety and Health Recommended Exposure Limit
OEL - Occupational Exposure Limit
OSHA – Occupational Safety and Health Administration
PAPR - powered air purifying respirator
PEL - Permissible Exposure Limit
QLFT - qualitative fit tests
QNFT - quantitative fit tests
RPPA - Respiratory Protection Program Administrator
SAR-IDLH - supplied air respirator with back-up bottle of air
SCBA - Self Contained Breathing Apparatus
STEL - short- term exposure limits
TIC - Toxic Industrial Chemicals
TLV - Threshold Limit Values™
TWA - Time Weighted Average
TWA8 - 8-hour time weighted averages
WMD/Domestic Terrorism Preparation – Weapon of Mass Destruction

Appendix B: Lists of Additional Resources

Table of Common DOI Tasks, Airborne Toxicants, and Health Hazards

Common Tasks and Their Respiratory Hazards

Task	Hazardous Agent	Physical Nature	Critical Effects/Target
Welding low toxicity metals & galvanized	Iron Fume, Zinc Oxide Fume, Oxides of nitrogen, Smoke, Gases. Variable depending on metal, rod, flux.	Fume, smoke, gas	Metal fume fever; lung; irritation, pulmonary edema,
Welding stainless steel	Nickel	fume	Pneumoconiosis, cancer, lung, irritation
Painting, oil based, stains	Organic solvents such as xylene, toluene, MEK,	vapor	CNS, solvent neurotoxicity, liver, kidney, blood
Painting, polyurethane	TDI, MDI, Isophrone DI,MEK	vapor	Sensitization, asthma, irritation, CNS
Paint spray equipment cleaning	MEK, Organic solvents	vapor	CNS
Chemical paint stripping	Organic Solvents, Caustics	vapor	CNS, anoxia, cancer
Wood working, cutting, sanding	Wood dusts. Allergenic species—Western red cedar Carcinogens—Oak, Mahogany, Teak, Walnut,	Dust	Cancer; irritation; dermatitis, lung, mucostasis
Removing rodent nests, cleaning rodent infested cabins, handling trapped rodents	Hantavirus	Particulate aerosol	Hantavirus Pulmonary Syndrome
Removing accumulations bat or bird feces	Fungus (*Histoplasma capsulatum)*	Particulate aerosol	histoplasmosis
Fossil preparation and storage	Radon	Gas, radionuclide	Cancer, lung
Rock drilling	Crystalline silica	Dust	Silicosis, lung fibrosis
LE. Domestic Terrorism Response	unknown agents that may include nerve and mustard agents, biological organisms, radioactive dusts,	Vapor, particulate aerosol	Linked to agent
Confined space	Oxygen deficiency,	O2 deficiency, gas,	Anoxia, linked to

entry	toxins	vapor	agent
Activity near internal combustion engines	Carbon monoxide, diesel exhaust	Gas, particulate aerosol	Anoxia, CNS, reproductive, cardiovascular
Structural Fire fighters	Combustion products, Smoke, unknown toxics, oxygen deficiency	Gas, vapor, smoke, mist, dust, particulate aerosol	Linked to agent
Hazardous Materials Spill Responders	Unknown toxic compounds	Gas, vapor, aerosols	Linked to agent
Gasoline fuel transfer	Benzene, organic vapors	Vapor	CNS, cancer, irritation
Herbicide application		Vapor, mist, dust	Blood,
Insecticide application	Organophosphates, carbamates, organochlorines	Vapor, mist, dust	Cholinergic, neurotransmission, liver
Laboratory	Formaldehyde, mercury, silica	Vapor, particulate	Irritation, lung cancer, CNS, kidney, reproductive
Petroleum Engineering Technician	Methane, Benzene, Hydrogen Sulfide	Gas, Vapors	Asphyxiation
Mine inspector	Methane. Coal Dust	Gas, oxygen displacement	Asphyxiation, Black Lung

Appendix C: Segment of OSHA Tables Z-1 and Z-2

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Acetic acid.....	64-19-7	10	25	
Acetone.....	67-64-1	1000	2400	
Ammonia.....	7664-41-7	50	35	
Asbestos; see 1910.1001.....	(4)			
Benzene; See 1910.1028. See Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028(d)	71-43-2			
Beryllium and beryllium compounds (as Be).....	7440-41-7		(2)	
Carbon monoxide.....	630-08-0	50	55	
Chlorine.....	7782-50-5	(C)1	(C)3	

TABLE Z-2

Substance	8-hour time weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift	
			Concentration	Maximum duration
Benzene(a) (Z37.40-1969).....	10 ppm.....	25 ppm.....	50 ppm...	10 minutes.
Beryllium and beryllium compounds (Z37.29-1970).....	2 ug/m(3)..	5 ug/m(3)..	25 ug/m(3)	30 minutes.
Toluene (Z37.12-1967).....	200 ppm....	300 ppm....	500 ppm..	10 minutes

Appendix D: Calculation for Mathematical Modeling

Mathematical Modeling

Concentration = [(A in – A out)]/room volume.

Where A = amount.

5. **Find amount, convert ounces to milliliters:**

   .5 oz X 29.57 milliliters/1 oz = 15 ml

6. **The Specific Gravity of Toluene is .865 grams /ml convert** milliliters to grams

   15 ml X .865 g / ml = 13 grams of toluene

7. **Find room volume:** Area of a rectangle = width X length X height

   12'x16'x10'=1920 ft^3

8. **Convert volume to cubic meters**:

   1920 ft^3 x .028316847 $m^3/1ft^3$ = 54m^3

9. **Find concentration:** (**grams/volume**)

   [(13 g – 0)]/54 m^3 = 0.24 g/ m^3 = 240 mg/ m^3

10. **Convert to parts per million ppm =** $\frac{\textbf{(24.45) x mg/m}^3}{\textbf{(gram molecular weight of substance)}}$

    Molecular Weight of Toluene is = 92.14 gram/mol (which you can calculate)

    ppm = $\frac{24.45 \times 240}{92.14}$ = 63.5 ppm

Find concentration: [(13 g – 0)]/54 m3 = 0.24 g/ m3 = 240 mg/ m3

Mathematical Modeling

Convert to ppm = $\frac{24.45 \times \text{mg/m3}}{\text{(gram molecular weight of substance)}}$

MW of Toluene = 58.14 gram/mol which you can calculate

ppm = 24.45 x 240 = 63.5 ppm
92.14

Mathematical Modeling

But, how long is the potential exposure? 1 hour?
If so, Troy's full work shift TWA exposure is
63.5 ppm x 1hr /8hr = 8 ppm

If we refer to Table Z we find that the value is below the Permissible Exposure Limit (PEL) which is 200 ppm. If we look at the American Conference of Governmental Industrial Hygienists (ACGIH)
Threshold Limit Value (TLV) booklet we find the TLV for Toluene is 20 ppm. The concentration in the room is below that value.

Appendix E: Survey Sheet for Written Respiratory Protection Program

Collect the following information:

1. District Office/Field Office Name:
   _____
2. Respiratory Protection Program Administrator (RPPA) for your District Office/Field Office (name and
   position of person who is or will be designated): _____

   _____
3. Will the RPPA require assistance at one or more divisions or departments? _____
   Person who has been or will be designated to assist the RPPA in those divisions or departments (name and division or department): _____

   _____
4. How will exposure assessment be conducted at your District Office/Field Office? In-house or contracted or regional support?
5. Person(s) who will be responsible for conducting or coordinating exposure assessment [name(s) and organization(s)]: _____

   _____
6. Collect the following information for tasks that might require the use of respirators. Try to produce a comprehensive list of potentially hazardous tasks. Your list can be used later as a starting point for exposure assessments. (An expanded chart for you to list your information is provided on the next page.)

Operation	Location	Engineering Controls in Place	Hazardous Agent	Type of Respirator	Criterion	Cartridge Change-out	
						Schedule	Method
List the hazardous task, process, procedure, operation.	Provide the location(s) or divisions within the District Office/Field Office where they occur (such as carpenter shop, backcountry -trails, buildings mainten-ance).	List controls such as ventilation and isolation that will limit employee exposure.	List the hazardous agent (asbestos, lead, MEK, Stoddard solvent, gasoline).	Half-face w/ N100 filter; or N100 Filtering face piece.	Provide the exposure threshold (from z-tables, agent specific regulations, or TLV).	Input air purifying element replace-ment frequency.	Name the method used to calculate change-out schedule.

7. Physician or Licensed Health Care Professional who will be providing medical evaluations for your District Office/Field Office (name and address):

   _____

8. Personnel trained to conduct qualitative fit tests for your District Office/Field Office's employees [name(s) and division(s)]:

   _____

   _____

9. Will you have need for quantitative fit testing? Person who will provide this service (name and address of provider): _____

   _____

10. Person who will coordinate quantitative and qualitative fit testing for employees (name and division): _____

11. Qualitative fit test methods you will use at your District Office/Field Office:

    _____

    _____

12. Will supplied air respirators be used? Person responsible for testing air quality (name and division): _____

    Laboratory that will be used to conduct air quality analysis (name and address):

    _____

13. Person who will be responsible for coordinating or conducting training of employees required to wear a respirator: _____

    _____

14. Person who will be responsible for maintaining training records and where records will be maintained:

    _____

15. Person who will be responsible for medical evaluation records and where records will be maintained:

    _____

16. Person who will be responsible for exposure assessment records and where records will be maintained:

    _____

Operations Requiring Respiratory Protection Measures Form

Operation	Location	Engineering Controls in Place	Hazardous Agent	Type of Respirator	Criterion	Cartridge Change-out	
						Schedule	Method
List the hazardous task, process, procedure, operation.	Provide the location(s) or divisions within the District Office/Field Office where they occur (such as carpenter shop, backcountry-trails, buildings mainten-ance).	List controls such as ventilation and isolation that will limit employee exposure.	List the hazardous agent (asbestos, lead, MEK, Stoddard solvent, gasoline).	Half-face w/ N100 filter; or N100 Filtering face piece.	Provide the exposure threshold (from z-tables, agent specific regulations, or TLV).	Input air purifying element replace-ment frequency.	Name the method used to calculate change-out schedule.

Appendix F: Medical Evaluation Checklist

- ❑ 1. Complete a medical questionnaire, which is then reviewed by a physician or other licensed healthcare professional (PLHCP). [See OSHA Respiratory Medical Evaluation Form in Appendix ___.]
- ❑ 2. The PLHCP must be provided the following information:

  a) The type and weight of the respirator to be used by the employee;

  b) The duration and frequency of respirator use (including use for rescue and escape);

  c) The expected physical work effort;

  d) Additional protective clothing and equipment to be worn;

  e) Temperature and humidity extremes that may be encountered;

  f) A copy of the written respiratory protection program and 29 CFR 1910.134;

  g) Medical Evaluation Questionnaire.

- ❑ 3. Following the review of the medical questionnaire, further medical examination must be provided under the following circumstances:

  a) When an employee gives a positive response to any question among questions 1 through 8 in Section 2 of the medical questionnaire;

  b) When the initial medical examination demonstrates the need for a follow-up medical examination;

  c) When the follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the PLHCP deems necessary to make a final determination.

- ❑ 4. The PLHCP will provide a written opinion of the employee's ability to use a respirator. The employee's written approval may be required under the requirements of the Health Insurance Portability and Accountability Act of 1996 (HIPAA) for the physician to be able to release a written opinion to the District Office/Field Office. The written opinion will include the following:

  a) A determination of the employee's ability to use the respirator;

  b) Limitations on the use of the respirator;

  c) Need for follow-up evaluations:

  d) A statement that the PLHCP has provided the employee with a copy of the determination.

- 5. Additional medical evaluations will be provided when:
    a) An employee reports medical signs or symptoms that are related to his/her ability to use a respirator

    b) A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated;

    c) Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation;

    d) A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

- 6. If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used, the employer shall provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator. If a subsequent medical evaluation finds that the employee is medically able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.

Appendix G: OSHA Pre-Calculated Breakthrough Times for Contaminants

Breakthrough Times (min)

Work Shift Indicates that the service life for this contaminant is limited to a single workshift by the OSHA Standard.

Name	CAS #	Contaminant Concentration (ppm)				
		50	100	200	500	1000
Aromatics						
Benzene	71-43-2	Work Shift	Limited to a maximum concentration of 50 ppm for negative pressure APR			
		See the Benzene Standard 1910.1028(g)				
Toluene	108-88-3	1018	562	307	135	72
Ethylbenzene	100-41-4	1133	604	319	135	70
m-Xylene	108-38-3	1143	608	321	136	70
Cumene	98-82-8	1122	586	304	126	64
Mesitylene	108-67-8	1159	603	311	128	65
p-Cymene	99-87-6	1104	566	289	117	59

This table is an excerpt from the OSHA web page and provides pre-calculated breakthrough times using the Wood model.
http://osha.gov/SLTC/etools/respiratory/wood_table/wood_table.html

Appendix H: Wildland Fire Smoke - Employee Exposure and Health

The health effects of smoke have been a topic of interest for firefighters and fire managers for decades. The largest concerns came after the Northern California Fires of 1987, and 2008 along with the Yellowstone fires of 1988. In 1989, the National Wildfire Coordinating Group (NWCG) tasked the Missoula Technology and Development Center to lead the health hazards of smoke studies that were completed in 1997. Since then, new exposure studies have been conducted, new questions have arisen, and new technology has been developed for studying the health hazards of smoke, exposure monitoring, and exposure protection. The NWCG Risk Management Committee has formed the Smoke Exposure Task Group (SETG) to investigate the subject further and provide recommendations. A web site is being created as a central location for information regarding employee wildland smoke exposure and other related information. The website is: (http://www.nwcg.gov/branches/pre/rmc/setg/index.htm)

The following information is provided by the SETG and will also be available on their website:

- What we know and don't know about health effects
- Data are still lacking in critical areas. Leading scientists across the country identified a lack of any long-term employee data regarding the health effects of wildland smoke. Short-term studies have been conducted. Many of the short-term effects are transient in nature, but the lack of long term monitoring and follow up has prevented further analysis. Further complicating the issue is that wildland firefighting is seasonal and employees typically fight fire only for a portion of their career.

- What NWCG is doing to gain new knowledge
- The Smoke Exposure Task Group plans to continue monitoring wildland firefighter smoke exposure during the 2010 fire season. The San Dimas Technology & Development Center will be collecting smoke exposure (carbon monoxide and particulate matter) data on the fire lines and at fire camps to help better understand the levels of smoke exposure to firefighters and the wildfire suppression tasks that are most prone to high levels of smoke exposure.
- Respiratory protection
- Personal protective equipment, including respiratory protection, should only be implemented once engineering and administrative controls are exhausted. The need for respiratory protection during wildland firefighting operations must be determined by each agency. The requirements for respirator use are found in 29 CFR Part 1910.134.

- If a respiratory protection program is implemented, only NIOSH-approved respirators should be used. Several respiratory-type products are marketed to wildland firefighters but are not NIOSH approved (e.g. shrouds with filtration devices). CO monitoring should also be implemented simultaneously to assure that employees are not over-exposed to CO. Note: employees must be clean shaven to wear a respirator.

- NFPA wildland respirator standard
- The National Fire Protection Association (NFPA) will be publishing a new standard titled *NFPA 1984, Respirators for Wildland Fire Fighting Operations, 2011 Edition.* This new standard is a performance-based product standard for air purifying respirators (APRs) and powered APRs, and does not require the use of respirators for wildland firefighting. Again, the need for respiratory protection must be determined by each agency.

- Recommended mitigations for employee smoke exposure:
- Include smoke mitigation in operational planning. This includes exposure awareness (signs and symptoms) and techniques for mitigation. Smoke exposure needs to be part of the risk management continuum, along with other hazards.

- Risk management assessment considerations at the planning, strategic and tactical level.

  Site-specific hazards and mitigations identified prior to operational shifts to reduce firefighter exposure to smoke.

- Different individuals will have different responses to the same levels of exposure. Here are some general signs and symptoms and associated levels of CO exposure:

CO in atmosphere (ppm)	COHb in blood (%)	Signs and symptoms
10	2	Asymptomatic
70	10	No appreciable effect, except shortness of on vigorious exertion; possible tightness across the forehead, dilations of cutaneous blood vessels.
120	20	Shortness of breath on moderate exertion; occasional headache with throbbing in temples.
220	30	Headache; irritable; easily fatigued; judgment disturbed; possible dizziness; dimness of vision.
350 - 520	40 – 50	Headache, confusion; collapse; fainting on exertion.
800 - 1220	60 – 70	Unconsciousness; intermittent convulsion; respiratory failure, death if exposure is long continued
1950	80	Rapidly fatal

Source: Winter and Miller (1976), Ellenhorn and Barceloux, 1998

If you have questions regarding smoke exposure or respiratory protection, contact your agency's NWCG Risk Management Committee representative: (http://www.nwcg.gov/branches/pre/rmc/contactus.htm)

Appendix I: Cartridge Change Schedule Documentation

Job/Task: _____ Location: _____

Respirator Manufacturer: _____
Respirator Model: _____
Cartridge Model and Description: _____

Contaminants

Chemical Name	Exposure Limit	Anticipated Concentration	Boiling Point	

Patterns of Use:
Number of shifts per week: _____ Hours cartridge used during shift: _____
Estimated work rate ☐ Light ☐ Moderate ☐ Heavy

Environmental Data:
Maximum expected Temp: _____ ºC Maximum expected rH: _____ %

Basis for Service Life Estimate

☐ Rule of Thumb:

☐ Laboratory Data (Attach Data)

☐ Mathematical Model (Identify Model Used and Attach Result)

☐ Mole Fraction Calculation for Mixtures

Calculate the predicted service time of each material in the mixture by multiplying its mole fraction by its single substance service time. Breakthrough time for the mixture is based on the chemical with the shortest predicted service time in mixture.

Chemical	Concentration	Single Substance Service Time	Mole Fraction*	Predicted Service Time in Mixture

*Mole fraction + ppm of chemical / total ppm of mixture

Cartridge Change Schedule:

☐ Every _____ Hours

☐ After Each Shift

☐ After One Week

☐ Other (Specify): _____

Appendix J: Information for Employees Using Respirators When Not Required—Voluntary Respirator Use[1]

This information shall be provided to every employee that uses a respirator on a voluntary basis when respirator use is not required.

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, of if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.

2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.

3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

[1] Appendix D to Sec. 1910.134 (Mandatory) Information for Employees Using Respirators When Not Required Under the Standard

Appendix K: Respirator Selection Matrix

Step 1: Respiratory Hazard Identification

Oxygen Concentration:
Contaminant(s):
Physical State(s):
Concentration:
Oil Present: Oil Concentration:

Step 2: Hazard Analysis

Permissible Exposure Limit:
APF Needed (Hazard Ratio):
Skin Absorption/Irritation
Eye Irritation:
Warning Properties
Odor Threshold:
Nose/Throat Irritation:
IDLH Concentration:
Lower Flammable Limit:
Sorbent Efficiency:
Special Considerations:

Step 3: Respirator Type Required

Minimum Acceptable:
Alternative:

Step 4: Specific Solutions

1.
2.
3.