RESPIRATORY PROTECTION PROGRAM

(Updated 9/28/07)

I. PURPOSE: The purpose of this program is to ensure proper respiratory protection of individuals who may be exposed to an atmosphere that is contaminated with harmful dusts, fibers, fogs, fumes, mists, gases, smokes, sprays, or vapors.

A. Regulations: The Respiratory Protection Program for Virginia Commonwealth University is written in accordance with

1. American National Standards "Practices for Respirator Protection," ANSI Z88.2-1969

2. **Code of Federal Regulations (CFR),** Title 29, Part 1910.134, Occupational Safety and Health Standards.

B. Program: Engineering control measures are preferred where feasible. When respirators are necessary to protect employee health, equipment and training are provided by the employer at no cost to the employee. It is incumbent upon the employee to use the respirator as instructed. The Respiratory Protection Program is updated annually. Guidance as to the proper selection and purchase of respiratory protection equipment is provided by the Office of Environmental Health and Safety (OEHS). Respirators must be labeled as approved by the Mine Safety and Health Administration (MSHA) or the National Institute of Occupational Safety and Health (NIOSH).

C. Specific Programs: Other written programs from OEHS explain specific respiratory hazards in detail: the Asbestos Program, the Formaldehyde Program, and the Ethylene Oxide Program. Exposure levels and emergency situations where respiratory protection may be required are described. Respirators and other types of personal protective equipment are also discussed in the Chemical Waste Program. This Respiratory Protection Program is itself a reference document for those laboratories required to have a written Chemical Hygiene Plan per OSHA's Laboratory Safety Standard.

II. SELECTION: The following steps should be taken to assess a potential respiratory hazard and ensure adequate protection from it:

A. Process:

1. Identify the hazard, with consideration given to chemical and physical properties, toxicity data, and concentration of hazardous constituents

2. Assess the work environment - space, ventilation, mobility, work rate, etc

3. Hazard: Select the respirator certified for use with that particular hazard

4. Pressure test: Ensure that the device is functioning properly - perform positive and negative pressure checks each time the respirator is worn.

B. Types: The many different types of respirators available can be categorized into three basic types: air-purifying respirators, air-supplying respirators, and self-contained breathing apparatus (SCBA).

1. Air-Purifying Respirators: The purpose of air-purifying respirators is to remove limited concentrations of air contaminants from the breathing air; they do not affect oxygen content. Under no circumstances, therefore, are they to be used in areas that are oxygen deficient or in atmospheres that are immediately dangerous to life or health (IDLH). Air-purifying respirators range from simple dust masks to sophisticated positive pressure respirators. These respirators are generally composed of a soft, rubber face piece and a replaceable filter or cartridge. Two major subcategories of air-purifying respirators are the mechanical filter type and the chemical cartridge type: the mechanical filter is used for protection against particulates such as dust, while the chemical cartridge is used to protect against light concentrations of chemicals, such as solvent vapors.

a. Sub-categories of air-purifying respirators are:

(1) Single Use (disposable) Respirator: This type of respirator offers very limited protection and is intended for use by those working around simple dusts, dirt or paint droplets. Painters, plasterers, carpenters and movers are some of the classifications of employees who would benefit from its use. It offers no protection from asbestos fibers or chemical vapors.

(2) Half-Mask Respirator: It is called half-mask because it covers half the face from under the chin to the bridge of the nose. Various cartridges for asbestos and different chemicals can be affixed to the face piece. Because the eyes are not covered, care must be taken in determining whether this level of protection is adequate to prevent exposure to the particular respiratory hazard.

(3) Full-Face piece Respirator: The full-face piece respirator extends from under the chin to the forehead. This broader coverage provides a better face fit, some eye protection, and a higher overall protective factor. Regardless of the number of straps, which can vary with the make, the respirator is donned by placing the chin into the chin strap and tightening straps from the bottom to the top.

(4) Powered Air-Purifying Respirator (PAPR): The respirators described in the foregoing sections rely on breathing energy to draw air in through the cartridge or filter. In contrast, a PAPR uses a battery-powered blower that passes the contaminated air through the cartridge or filter where the air is cleaned and forced through a hose to the face piece. One advantage of using a PAPR is that it supplies air at a positive pressure within the face piece, so that leaks are from inside to outside. PAPR's must deliver at least four cubic feet of air per minute (4 CFM) to a tight-fitting face piece and at least 7 CFM to a loose-fitting hood or helmet. The batteries will only last a limited amount of time and so must be recharged after use or during use depending on the total work time and the particular model of the PAPR.

(5) Air-Supplied Respirator: Air-supplied respirators deliver breathing air from a clean air source through a supply hose connected to the worker's face piece. If air-supplied respirators are to be used on any job(s) within the University, OEHS will provide specific instructions and training.

(a) Self-Contained Breathing Apparatus (SCBA): SCBA's provide protection for varying periods of time depending upon the amount of breathing air (air pressure and tank size) and the breathing demands of the wearer. When using these devices the worker is independent of his/her surrounding atmosphere; therefore, they can be used in IDLH atmospheres. The self-contained respirators are heavy and awkward to wear. They also have a limited air supply (usually 30 to 60 minutes), thus requiring numerous air tanks on hand depending on the size of the job.

(b) Alarms: SCBA's and some gas masks contain warning devices such as signal alarms or gauges which allow the individual wearing the equipment to be aware of how much air is still available. Most other gas masks and air-purifying respirators do not have warning devices; therefore, their filters should be changed according to the manufacture's and OEHS's recommendations.

III. TRAINING: All individuals using respiratory protective equipment must be trained as to proper selection, fit, use, and maintenance. Perhaps the most important element of their training is to have a good understanding of the limitations of the equipment. Trainers also explain that improper use of respirators can result in irritation, discomfort, and overexposure, and that the consequences of overexposure can include acute injury, the development of chronic diseases, and even death.

A. Training Elements: Training is conducted by OEHS and consists of the following elements:

1. **Seal:** Fitting and checking the face piece to face seal.

2. **Hazards:** Nature of respiratory hazards involved and what may happen if proper respiratory equipment is not worn.

3. **Controls:** Controls being used (environmental, engineering, and administrative) and the need to provide extra protection through respirator use.

4. **Selection:** Criteria for selecting a respirator.

5. **Limitations:** Limitations of the respirator.

6. **Method:** Proper method for donning the respirator and checking its operation.

7. **Maintenance:** Respirator maintenance.

8. Emergency: Recognizing/handling emergency situations.

IV. FIT TESTING: Individuals who use respirators must be instructed how to wear the respirator properly, to make adjustments, and to determine a proper fit.

A. Seals: Proper seals between the wearer and the face piece are essential for respirators to work at the maximum design efficiency. Having facial hair, lacking teeth, or wearing corrective lenses interfere with a proper fit. Even contact lenses should not be worn while wearing a respirator in a contaminated area; if the integrity of the seal is breached and the contaminant is an eye irritant, injury to the eyes can be worsened by the contacts.

B. Participation: Fit testing is conducted by OEHS, according to the VOSH Respiratory Protection Standard, on a project-by-project basis and at departmental request; supervisors who will oversee the project must participate. Periodic updates may be necessary, especially in the case of weight gain or loss, or other changes in the shape of the face that may affect the seal.

C. Fit Test: There are two types of fit tests: qualitative and quantitative. Qualitative tests are fast but not as accurate as the quantitative test. The quantitative test entails the use of bulky and expensive equipment. The qualitative tests, the positive pressure fit test and the negative pressure fit test, can be used as a quick check of the fit of the respirator face piece before beginning or during work in the hazardous atmosphere. These tests apply only to the air-purifying respirators. The user tests the face piece to face seal of the respirator by wearing it in a test atmosphere where a known contaminant is present.

D. Qualitative Fit Test Methods: Qualitative tests are fast and easily performed. However, they rely on the wearer's sensitivity, and are therefore not entirely reliable. The two major qualitative tests are described below.

1. Isoamyl Acetate Test: Isoamyl acetate is a low toxicity substance with a banana-like odor. It is widely used in testing the face piece fit for organic vapor cartridge/canister respirators. The prospective user should don the respirator away from the isoamyl acetate, and then perform the following after isoamyl acetate is placed on a cotton wad nearby:

a. Normal breathing

b. Deep breathing, as during heavy exertion

c. Side-to-side and up-and-down head movements

d. Talking

e. Other exercises, according to the VOSH standard

2. Irritant Smoke Test: Irritant smoke is used to test the face piece fit of particulate filter respirators. This test can be used for both air-purifying and air-supplying respirators, but an air-purifying respirator must have a high-efficiency filter(s). The test substance is an irritant

(stannic chloride or titanium tetrachloride). These are available in sealed glass tubes. The tube ends are broken and air is passed through them so that a dense irritating smoke is emitted. If the wearer detects it then the fit is defective. The likelihood of a false indication of proper fit is reduced using this test because individuals who detect the irritating smoke usually cough or sneeze.

3. Negative Pressure Test: This should be used only as a gross determination of fit. The wearer should use this test just before entering the hazardous atmosphere. In this test, the user closes off the inlets by covering them with the palms of his hands or squeezing the breathing tube so that it does not pass air, inhales gently so that the face piece collapses slightly, and holds breath for about 10 seconds. The face piece should remain slightly collapsed and no inward leakage should be detectable.

4. Positive Pressure Test: This test, similar to the negative pressure test, is conducted by closing off the exhalation valve and exhaling gently into the face piece. The fit is considered satisfactory if slight positive pressure can be built up inside the face piece without any evidence of outward leakage.

E. Quantitative Tests: Quantitative respirator performance tests involve placing the wearer in an atmosphere containing an easily detectable, relatively nontoxic gas, vapor or aerosol. The atmosphere within the respirator is continuously sampled through a probe in the respirator inlet covering. The leakage is expressed as a percentage of the test atmosphere outside the respirator, called "penetration". The greatest advantage to quantitative fit testing is that it indicates respirator fit numerically and does not rely on a subjective response. Two materials used in the quantitative tests are sodium chloride and dioctyl phthalate.

V. MAINTENANCE: Respirators must be properly maintained if they are to continue to afford the same degree of protection. Equipment should be checked for signs of wear and deterioration before and after each use. Special attention should be given to rubber components, which may become brittle, and to connections, which are under the most stress. The following checklists outline potential problem areas that should be monitored frequently.

A. Air-Purifying Respirators (quarter-mask, half-mask, and full face piece):

1. Rubber face piece maintenance

a. Excessive dirt (clean all dirt from face piece)

b. Cracks, tears, or holes (obtain new face piece)

c. Distortion (allow face piece to "sit" free from any constraints and see if distortion disappears; if not, obtain new face piece)

d. Cracked, scratched, or loose-fitting lenses (contact respirator manufacturer to see if replacement is possible; otherwise obtain new face piece)

2. Head straps maintenance

a. Breaks or tears (replace head straps)

b. Loss of elasticity (replace head straps)

c. Broken or malfunctioning buckles or attachments (obtain new buckles)

d. Face piece slips (replace head straps)

3. Inhalation/Exhalation valves maintenance

a. Detergent residue, dust particles, or dirt on valve or valve seat (clean residue with soap and water)

b. Cracks, tears, or distortion in the valve material or valve seat (contact manufacturer for instructions)

c. Missing or defective valve cover (obtain valve cover from manufacturer)

4. Filter element(s) maintenance

a. Filter appropriate to the hazard

b. Approval designation

c. Missing or worn gaskets (contact manufacturer for replacement)

d. Worn filter or face piece threads (replace filter or face piece)

e. Cracks or dents in filter housing (replace filter)

f. Missing or loose hose clamps (obtain new clamps)

B. Air-Supplying Respirators: Check face piece, head straps, valves, and breathing tube, as for air-purifying respirators.

1. Hood, helmet, blouse, or full suit maintenance (check if applicable)

a. Headgear suspension (adjust properly for user)

b. Cracks or breaks in face shield (replace face shield)

c. Protective screen intact and fits correctly over the face shield, abrasive blasting hoods, and blouses (otherwise obtain new screen)

2. Air supply system maintenance

a. Breathing air quality

b. Breaks or kinks in air supply hoses and end fitting attachments (replace hose and/or fitting)

c. Tightness of connections

d. Proper setting of regulators and valves (consult manufacturer's recommendations)

e. Correct operation of air-purifying elements and carbon monoxide or high-temperature alarms

3. Monthly Check: All self-contained breathing apparatus must be regularly inspected (monthly) and oxygen cylinders must be fully charged per manufacturer's specifications.

C. Maintenance All Respirators:

1. Cleaning: After each use, respirators are to be cleaned thoroughly with soap and water or alcohol wipes in order to provide the wearer with a sanitary respirator for the next use. This is particularly important when respirators are interchanged between different workers.

2. Marking: Chemical cartridges and gas mask canisters must be marked appropriately so that they can be replaced as suggested by the manufacturer.

3. Alert/Warning: All alert or warning devices have to be checked prior to use in order to ensure proper performance.

4. Storage: Respiratory equipment is stored in an area which protects the equipment from dust, moisture, chemicals, and other environmental elements. The respirators are stored with face pieces and exhalation valves resting in a position that will not cause malformation of the equipment. A specific area should be designated for placement of all respiratory equipment, not only for proper protection, but also for easy accessibility during emergencies.

5. Repair: Repairs of respiratory equipment must be conducted by qualified individuals. Timely inspections and recording of these inspections must follow any repair.

VI. MEDICAL EXAMINATIONS: Employees assigned to tasks which require the use of a respirator must be physician-certified as physically able to work with the additional strain on heart and lungs that wearing a respirator entails.

A. Employee Health Services: An initial examination is conducted to determine fitness; periodic check-ups are also required. Individual departments can arrange for medical examinations with the University's Employee Health Service.

B. Exposure Occurrence: If there is a concern that an individual was exposed to an air contaminant while wearing a respirator then appropriate laboratory tests are provided for this individual. These may include urine, blood, and fecal analyses to determine the level of exposure. Laboratory tests are also conducted by the Employee Health Service.

C. Exposure Follow-up: Evidence of exposure to a worker will be followed up with work area surveillance to determine if additional engineering controls are necessary.

VII. WORK AREA SURVEILLANCE: Surveillance of work area conditions is conducted periodically to assess worker exposure.

A. Procedural Changes: Changes in operating procedures can influence the concentration of an air contaminant; monitoring must therefore continue to ensure that the degree of contamination has not exceeded the protective factor of the particular respirator.

B. Records: Monitoring records are maintained by the Office of Environmental Health and Safety.

VIII. Appendix

Occupational Safety and Health Standard: Respiratory Protection
OSHA Training and Reference Materials Library - Respiratory Protection