

Respiratory Protection Manual

UCSB Environmental Health & Safety

Environmental Health & Safety
University of California, Santa Barbara

RESPIRATORY PROTECTION MANUAL

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SUMMARY OF RESPIRATORY PROTECTION PROGRAM REQUIREMENTS

The Santa Barbara Campus Respiratory Protection Program, through the requirements described in this manual, establishes policy and procedures for the use of respirators. The criteria are based on the revised regulation that took effect November 1988, California Code of Regulations, Title 8, General Industry Order 5144, and are designed for those University personnel who, during their normal duties, are or could be exposed to hazardous substances or atmospheres that may affect their well being or their health, or that may otherwise be detrimental to their safety.

Program Goal:

The prevention and control of those occupational diseases caused by breathing air contaminated with harmful dusts, fumes, sprays, mists, fogs, smokes, vapors, or gases.

Program Objectives:

1. The prevention of atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures. However, when not feasible or while such measures are being instituted or evaluated, the program provides appropriate respiratory protection to personnel who might be exposed to unhealthy or unusual conditions.
2. Provision of protective procedures and equipment when a working atmosphere is oxygen deficient or when airborne radioactive or toxic materials could exceed acceptable limits. (Sections Two and Four)
3. Provision of the proper selection and fitting of respiratory equipment and for the training of University personnel in the proper use of such equipment (Section Three)
4. Establishment of requirements and controls for those employees who must use respirators and for their supervisors and management including the specification of:
 - A. Who must wear respiratory protective equipment (RPE).
 - B. How to obtain RPE.
 - C. Departmental and supervisory responsibilities involving the obligation to prevent an employee from performing a task known or ought-to-be known to be unsafe, and to assure the correct use of appropriate RPE. (Sections 1.31 and 1.32, 2.10)
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SECTION ONE

RESPIRATORY PROTECTION PROGRAM

1.10 Campus Policy

- a) It is the policy of the University of California, Santa Barbara, to maintain, insofar as it is reasonably within the control of the University to do so, an environment that will not adversely affect the health, safety, and well-being of students, employees, visitors, and neighboring human populations.
- b) Because of the potential hazards involved from exposure to hazardous substances and atmospheres, the Santa Barbara Campus provides necessary respiratory protection equipment and develops safe procedures for its use by those persons required to utilize such equipment.
- c) All activities involving the use of respiratory protection equipment, as defined in this manual, in facilities controlled by the University of California, Santa Barbara, shall be conducted in compliance with California Code of Regulations, Title 8, General Industry Safety Order 5144, and with the provisions of this manual.
- d) This manual established the procedures and requirements necessary to meet various enforcing agencies' regulations for use of respiratory protection equipment and to provide the necessary health and safety protection to those persons falling within the jurisdiction of the program.
- e) Requirements outlined in this manual are mandatory in nature where the work "SHALL" is used and are advisory in nature where the word "SHOULD" is used.

1.20 Summary of Program Execution

1.21 Respiratory Protection Execution

- a) The Environmental Health and Safety Office will technically assist departments in their administration of the Campus Respiratory Protection Program.
- b) EH&S provides a centralized facility and databank for purchasing, and fitting all on-site respiratory equipment and for training Santa Barbara Campus personnel in its use.

1.22 Who Must Wear Respiratory Protective Equipment

Respiratory protective devices shall be used as appropriate:

- a) For activities that cannot be safely or practically controlled by engineering methods or procedural alterations, such as for pesticide applications or spray painting.
- b) When the working atmosphere is or may be oxygen deficient.
- c) When working in confined spaces.
- d) When airborne radioactive or toxic materials could exceed acceptable limits.
- e) For emergency use when loss of life or serious property loss or damage is involved.

1.23 How to Obtain Respiratory Protection Equipment

- a) Obtain written approval from supervisor for respiratory usage.

- b) Contact EH&S for an evaluation of the job(s) to be performed.
- c) Submit the UCSB Respiratory Protection Program Medical History Form (see Appendix IV) to Student Health Services. A determination of need for a physical examination for respirator usage approval will then be made by the SHS physician or other licensed health care professional (PLHCP) reviewing the employee Medical History Form.
- d) Call EH&S X3743 or X8787 for an appointment to be fitted for a respirator.
- e) After being properly fitted, the employee will be issued a new respirator; the costs will be recharged to the employee's department.

1.24 How to Obtain Replacement Respirators

The employee must bring the used respirator and cartridges to EH&S for an exchange for a new unit.

1.30 Responsibilities

1.31 The department chairperson or unit manager is responsible for:

- a) Assuring the health and safety of employees, visitors, and students in University of California, Santa Barbara, facilities under his/her control.
- b) Reviewing and approving research and all protocols for research prior to their initiation in the department.
- c) Being kept informed of all areas under his or her jurisdiction where potentially hazardous conditions exist and initiating safety programs that adhere to the respiratory protection requirements of this manual.
- d) Assuring that applicable manual requirements for project leaders, program supervisors, or superintendents, and University personnel under their supervision, are adhered to.
- e) Maintaining appropriate and current records of employees who have been issued respiratory protection.

1.32 Project Leader, Supervisor, or Principle Investigator

Each person in charge of a research project or other activity where respiratory protection equipment is or may be required is responsible for:

- a) Identifying, with the assistance of personnel from EH&S, those employees who may need respiratory protection equipment, and scheduling them for fitting and training in the proper use and maintenance of the equipment.
- b) Requesting assistance from EH&S personnel in evaluating new operations that may present health and safety hazards.
- c) Obtaining approval from the SHS PLHCP before assigning known or suspected medically restricted employees to jobs requiring the use of respirators.
- d) Enforcing the use of respiratory protective equipment and other requirements when applicable.
- e) Keeping the department chairperson or unit manager informed of any actions proposed or taken regarding the Respiratory Protection Program.

- f) Ensuring their employees are up to date on and have completed all: necessary training, fit testing and other requirements before allowing them to use a respirator.

1.33 User Responsibility

Any user of respiratory protection devices on the UCSB campus who is required under the Respiratory Protection Program to wear such equipment is responsible for:

- a) Utilizing the issued respiratory protection equipment in accordance with instruction and training provided by EH&S personnel.
- b) Informing his/her supervisor of any personal health problems that could be aggravated by the use of respiratory equipment.
- c) Guarding against damage and ensuring respirators are not disassembled, modified, or otherwise altered in any way other than by the changing of respirator cartridges/filters.
- d) Reporting any observed or suspected malfunctioning respirator to EH&S personnel.
- e) Using only those brands and types of respiratory protection equipment for which they have been trained and fitted.
- f) Replacing filters/cartridges in accordance with the "Respirator Cartridge Change Schedule" using the "Respirator/Cartridge Usage Log." (Appendix I)

1.34 Rights of Users

All users who may have to wear respirators for health protection must be trained in the proper selection, maintenance, and use of respirators; they must also be taught the limitations of each type of respirator. Cal-OSHA regulations and University of California policy require that users be trained and that training provide an opportunity for them to:

- a) Handle the respirator.
- b) Have the respirator fitted by competent personnel.
- c) Test the facepiece-to-face seal.
- d) Wear the respirator in normal air for a familiarization period.
- e) Pass a quantitative fit test while wearing the respirator under work like conditions.
- f) Learn how to wear, adjust and test the respirator for proper fit before each wearing.

1.35 Environmental Health and Safety

EH&S is responsible for performing the following functions:

- a) Providing respiratory protection equipment and supplies.
- b) Providing instruction on the need for respiratory protection, criteria for selecting respirators, and respirator fitting, use and maintenance.
- c) Providing approved respiratory protective equipment, and the following additional services:

1. Conducting initial, annual, and other required fit tests for users who utilize respiratory equipment.
2. Assuring appropriate medical clearance has been obtained prior to issuance of a respirator.
3. Conducting inspections for respiratory protective equipment usage, maintenance, and storage.
4. Acting on a consulting basis for respiratory protection.

1.36 Student Health Services

A physician or other licensed health care professional (PLHCP) at Student Health Services (SHS) will provide a medical evaluation to determine the employee's ability to use a respirator, before the employee is fit tested or required to use the respirator in the workplace.

The PLHCP at SHS is responsible for conducting medical evaluations using the Health Status Questionnaire and any follow-up medical examinations, test, consultations, or diagnostic procedures that the PLHCP deems necessary (any cost will be recharged to the appropriate department recharge number). The Health Status Questionnaire and examinations will be administered confidentially during the employee's normal working hours. SHS will evaluate respirator users for the following reasons:

- a) Prior to initial use of required respiratory protection equipment.
- b) Have been previously approved for use of respiratory equipment but have experienced respiratory problems that might prove hazardous to the health and safety of such persons should they continue to use such equipment.
- c) Have informed their supervisor of any health problems that could be aggravated by the use of respiratory equipment.
- d) A change occurs in workplace conditions that may result in a substantial increase in the physiological burden placed on an employee.
- e) Require medical clearance for any reason before assignment to activities requiring the use of respirators.
- f) Are referred by EH&S, or if observations are made during fit testing indicates the need for a reevaluation.

The PLHCP shall make the final determination of physical parameters necessary for an employee to be able to safely utilize a respirator based on the standard adopted by the American National Standard Institute, ANSI Z88.6 – 1984, "For Respiratory Protection – Respirator Use – Physical Qualifications for Personnel." As the ANSI standard is revised, the University will adopt the latest version.

SECTION TWO*AUTHORIZATION FOR USE***2.10 Authorization for Use of Respiratory Protection Equipment**

Only those persons who have been designated by the supervisor or project leader as being required to utilize respiratory protection equipment and who have been properly fitted and trained in its use shall utilize such equipment.

2.11 Evaluation of Required Respiratory Equipment

EH&S shall evaluate and approve the purchase of all respiratory equipment before it is used. This selection is subject to change as new and improved equipment appears on the market.

2.12 Instruction, Selection, Fitting, Training and Maintenance

EH&S shall provide instruction on the need for respiratory protection, shall develop criteria for the selection and fitting of respirators, and shall provide training in the proper use and maintenance of respirators.

2.13 Procurement of Respirators

- a) Half-mask and full face-mask respirators are available to the employee through EH&S (x3743 or x8787) following approval by the user's department. EH&S will stock several approved brands of respirators that provide needed protection. Each respirator shall be equipped with a filter and/or cartridges for the specific hazard to be protected against. Emergency needs may be processed through EH&S (x3743 & x8787).
- b) Other types of respiratory protection equipment, such as self-contained breathing apparatus, may be procured through processing of an approved purchase order after evaluation by EH&S as to the specific type of equipment needed and the nature of its use.
- c) The selection of proper respiratory equipment by EH&S personnel follows the "Respiratory Equipment Selection Guide" and "Respirator Protection Factors" (see Appendix II).

2.14 Training

Effective training of employees shall be comprehensive, understandable, recur annually, and more often if necessary. UCSB's training program will ensure that each employee can demonstrate knowledge of at least the following:

- a) Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator.
- b) What the limitations and capabilities of the respirator are.
- c) How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions.
- d) How to inspect, put on and remove, use, and check the seals of the respirator.
- e) What the procedures are for maintenance and storage of the respirator.
- f) How to recognize medical signs and symptoms that may limit or prevent the effective use of

respirators.

- g) The general requirements of the California Code of Regulations, Title 8, Section 5144, will be presented in a manner that is understandable to each employee.

2.15 Medical Evaluation

No employee is assigned to a task requiring the use of a respirator unless it has been determined that the person is physically able to accommodate the use of such equipment. Each employee whose duties require the use of a respirator will be required to fill out the Medical History Form B (Appendix IV) and will be evaluated by the Health Center Physician before being fitted with a respirator. Although referrals may be required following evaluation of the Medical History Form, upon completion of the evaluation and approval, the individual will be fitted with a respirator.

SECTION THREE

REQUIREMENTS FOR FITTING AND TESTING

3.10 Procedure for Fitting and Testing Respirators

3.11 Fit Testing Requirements

All campus personnel required to utilize respiratory protection equipment must be qualitatively or quantitatively fit tested prior to use of the equipment.

3.12 Fit Testing Procedures

Fit testing shall be performed using one of following methods:

1. **Quantitative Fit Testing:** A test that assesses the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.
2. **Qualitative Fit Testing:** A pass/fail test that uses a challenge agent to assess the adequacy of respirator fit and relies on the individual's response to the test agent.

3.13 Selection of Proper Respirator

Upon completion of the test results, the proper type of respirator will be selected by EH&S utilizing the chart and table found in Appendixes I and II.

3.14 Restrictions

- a) Hair interferes with the fit or operation of half or full face mask if it extends under the facepiece sealing area. If this condition exists, no attempt will be made to fit such personnel under any circumstances.
- b) If an employee exhibits difficulty in breathing during the test, he or she shall be referred to the Health Center Physician to determine whether the employee can wear a respirator while performing his or her duties.
- c) Contact lenses are prohibited while utilizing respiratory equipment.
- d) If for any reason an individual is unable to obtain a satisfactory facepiece seal when presented with a variety of sizes and models of respirators, that individual shall not be assigned to nor allowed to engage in a task requiring suitable respiratory equipment.
- e) A supervisor shall not permit an employee to perform a task where a respirator is required without assuring that an EH&S on-site job evaluation has been performed, and that the employee has been medically evaluated, fitted and trained in the proper use of a respirator.

3.15 Annual Fit Testing Requirements

- a) Fit testing will be conducted annually for all employees required to wear a respirator. In addition, because the seal of the respirator may be affected, fit testing shall be redone if the test subject has:
 1. A weight change of 20 pounds or more.

2. Significant facial scarring in the area of the facepiece seal.
3. Significant dental changes, i.e., multiple extractions without prosthesis, or dentures.
4. Reconstructive or cosmetic surgery.
5. Any other condition that may interfere with facepiece sealing.

3.16 Records

- a) After fitting has been completed, each employee shall be issued a wallet-sized "Respirator Training & Fitting Card" (see Appendix IV) indicating:
 1. Brand and type of respirator approved to be used by the employee.
 2. Date tested.

SECTION FOUR

OPERATING PROCEDURES FOR RESPIRATORY EQUIPMENT

4.10 Types of Respirators and Operating Procedures

This section contains operating instructions for each of the respiratory systems routinely used at UCSB and instruction on their limitations for use. Specific respirators will be selected by EH&S based on a job hazard evaluation.

4.11 Filtering Facepiece (Disposable Mask)

a) Availability and Types for Use

Filtering facepieces of various kinds, including disposable types, are available from EH&S and have been approved against low concentrations of certain dusts, including asbestosis, pneumoconiosis-, or fibrosis-producing dusts.

b) Limitations

Filtering facepieces do not provide protection against gases and vapors or supply oxygen, they cannot be used in oxygen-deficient areas; nor can they be worn for protection against toxic contaminants, while wearing contact lenses, or when facial hair extends under the facepiece sealing area.

c) Procedure

When a filtering facepiece is required for a job situation, the user should:

1. Put on the mask and adjust it for proper fit. Some masks have adjustable face-sealing areas.
2. Discard disposable filtering facepieces after use or when breathing becomes difficult. If the filtering facepiece has a replaceable dust filter, replace the filter with a new one when normal breathing becomes difficult.

4.12 Air-purifying Half-Mask Respirators

a) Availability and Types for Use

Half-mask respirators are the most widely used types of respirators. Several brands of this type are provided by EH&S to assure employees a satisfactory fit. Each half-mask facepiece is normally equipped with High Efficiency Particulate Air (HEPA) filter elements, or vapor and gas removing cartridges. HEPA filters protect against low concentrations of radioactive and toxic particulates. Vapor or gas removing cartridges protect against low concentrations of organic vapors and/or acid gas vapors.

b) Limitations

Since this type respirator does not supply air, it cannot be used in oxygen-deficient atmospheres, in Immediately Dangerous to Life or Health (IDLH) atmospheres, or in confined spaces. It can only be used for protection against the contaminants listed on the cartridge. The wearer should leave an area immediately if he or she detects an odor inside the mask or if the breathing resistance increases. The half-mask respirator shall not be worn with contact lenses or when facial hair extends under the face-mask sealing area.

c) **Procedure**

How to put on and adjust a half-mask:

1. Use the mask approved for use, as indicated on the Respirator Training and Fitting card.
2. Hold the mask so the narrow nose-cup points upward.
3. Grasp both lower mask straps and hook them behind the neck.
4. Grasp both top straps and hook them behind the head and above the ears for proper fit.
5. Adjust the straps so the fit is snug but comfortable.
6. Check the leaks when possible by covering the filter elements with the palms of the hands and inhaling gently. If the mask pulls in toward the face, the fit is good.
7. Return used respirators to EH&S for cleaning and maintenance or for replacement as instructed by EH&S.

4.13 Full Face-Mask Respirators

a) **Availability and Types for Use**

Full face-mask respirators provide more protection than half-masks because their shape allows a better mask-to-face seal. They also protect the eyes from irritating chemicals or particulate atmospheres. Full face-masks come equipped with selective types of air-purifying canisters, dependent upon the protection required. Additionally, full face-masks are available with air-supplied systems such as air lines or SCBA units.

b) **Limitations**

Air-purifying full face-masks have the same limitations for use as half-mask respirators. Additionally, standard eyeglasses interfere with the mask-to-face seal; therefore, respirator wearers should obtain an additional pair of glasses through EH&S for installation into a mask. Limitations for use of full face-mask with air-supplied systems are covered under subsection 4.14 on SCBA.

c) **Procedure**

How to put on a full face-mask:

1. Loosen all straps, pull the harness over the head, and place the chin in the chin cup.
2. Pull the head harness well down on the back of the head.
3. Tighten the harness gently, starting with the bottom straps and then the middle and top straps.
4. Check the fit by closing off the air hose or canister opening with the palm of the hand and inhaling gently. The user should then hold his/her breath for a few seconds. A good fit is indicated if the mask remains collapsed toward the face during this time.

5. Return the respirator to EH&S for cleaning and maintenance or for replacement as instructed by EH&S.

4.14 Self-Contained Breathing Apparatus (SCBA)

a) Availability and Types for Use

SCBA units provide the user with a pure supply of breathing air regardless of ambient air contamination. They may be used in atmospheres unsuitable for air-purifying respirators. This includes use in IDLH atmospheres, in confined spaces, and for emergencies where breathing hazards may exist. Departments required to utilize SCBA units must purchase their own equipment as approved by EH&S. However, the use of such equipment by University personnel comes under the control of the EH&S Respiratory Protection Program. SCBA units may be used in IDLH atmospheres, only in conjunction with a positive-pressure full face-mask.

b) Limitations

1. The air supply in standard SCBA cylinders is normally rated for a specified limited time; however, heavy exertion and stress will increase breathing rates and therefore deplete the air in less than the rated time. An alarm alerts the user when the air supply is low.
2. No one shall work alone in hazardous atmospheres; a standby with SCBA and proper communications equipment shall always be nearby. (For additional information see Campus Confined Space Entry Policy.)
3. The positive-pressure full face-mask used with the SCBA unit cannot be worn with contact lenses or when facial hair extends under the facepiece sealing area of the mask.

c) SCBA Inspections

Each SCBA unit stored for emergency use shall be inspected monthly to ensure proper operation. EH&S personnel will coordinate this inspection, as well as quarterly inspections and annual training classes on SCBA inspection and maintenance requirement.

Any department assigned a SCBA shall designate a specific individual(s) responsible for the routine monthly inspection and minor maintenance required.

Full inspection procedures will be provided by EH&S.

d) EH&S Responsibility

- 1) EH&S personnel will make a quarterly survey of each SCBA unit to determine that proper inspection and records are being maintained.
- 2) EH&S personnel shall conduct training classes on SCBA inspection and maintenance requirements for departmental personnel who may utilize SCBA units. All individuals shall be certified in the utilization of a SCBA unit prior to their being allowed to use such equipment. Refresher courses will be required six months following the initial certification and on an annual basis thereafter. All users should meet at least quarterly to maintain a high degree of familiarity with the equipment. Special instructions will be provided by EH&S for routine SCBA checkout procedures.

4.15 Specialized Respiratory Protection Equipment

- a) Use of a pressure-demand, air-line system may be permitted in an IDLH atmosphere under certain conditions. For example, if protection were required over an extended period of time, it would be impractical to use SCBA because of frequent bottle-changing requirements.
- b) Should the above type protective equipment or other specialized equipment be required, contact EH&S personnel for consultation and evaluation of the needs.

4.20 Emergency Use of Respirators

4.21 Limitations

This procedure limits the type of respirators to use during those emergencies where breathing hazards may exist.

4.22 Emergency Situations

An emergency is defined as “an unforeseen combination of circumstances that calls for immediate action.” Respiratory hazards often occur during emergencies when emergency service personnel need immediate entry into a fire or accident scene. Other types of breathing hazards may occur when personnel are exposed to hazardous substances while trapped by an accident or escaping from the scene of a fire or accident, or when they are exposed to hazardous spills; an unforeseen chemical reaction may result in an overexposure to hazardous substances.

4.23 Acceptable Type of Equipment During Emergencies

Each respiratory device has a limited ability to protect health. During emergency entry, when there is usually neither time nor opportunity to evaluate the degree of exposure, only SCBA operating in the pressure-demand mode should be used. SCBA are approved for use in IDLH atmospheres. After the type and degree of breathing hazards are evaluated, other respiratory equipment may be recommended.

4.24 Reports

Following any incident where emergency respiratory protection equipment has been used, EH&S personnel shall be notified.

SECTION FIVE

MAINTENANCE AND CARE OF RESPIRATORS

5.10 Basic Requirements

5.11 Respirator Maintenance and Care

Maintenance and care of respirators shall include the following:

- a) Inspection for defects (including a leak check)
- b) Cleaning and disinfecting
- c) Replace filters/cartridges as needed
- d) Repair
- e) Storage

5.12 Employee (User) Responsibility

Primary responsibility for maintaining the respirator in proper and clean condition rests with the employee wearing the respirator.

- a) Inspect valves, head straps and other parts before each use.
- b) Clean and disinfect respirators after each use or as needed.
- c) Store respirator in proper location away from heat, light and moisture.
- d) Replace filters/cartridges in accordance with the "Respirator Cartridge Change Schedule" using the "Respirator/Cartridge Usage Log" (Appendix I)
- e) Contact EH&S if respirator becomes damaged or defective.
- f) Inspect and examine SCBA units on a monthly basis to assure proper operation (refer to subsection 4.14).

5.13 EH&S Responsibility

- a) Perform an industrial hygiene survey of employee's job and work site.
- b) Coordinate employee's medical evaluation with the student Health services.
- c) Provide training on proper inspection, use and care of respirators.
- d) Select a proper respirator and provide fit testing.
- e) Provide respiratory equipment to approved respirator users.
- f) Repair or replace defective respirators for users.
- g) Coordinate annual service/inspection of SCBA units.

UCSB Respiratory Protection Program (RPP) Respirator Cartridge Change Schedule

Introduction

UCSB Environmental Health & Safety has developed a cartridge change schedule for the university respirator users, based on four principals listed below. Exposure assessment by personal air-sampling is not feasible for all groups of users in the university setting, due to broad application of respirators, job nature of the respirator users, wide variety of chemicals/products, and variable tasks on daily/weekly basis. However, exposure assessments have been conducted for two groups of users (see Appendices V & VI) who work with certain chemicals regularly and the concentrations of the chemicals do not vary significantly. For the groups that exposure assessment is not feasible, we have developed a cartridge change-out schedule based on, expert opinion, manufacturer's recommendations and rules of thumb as listed below. Overall, this "conservative" approach ensures that cartridge change-out takes place before cartridge break-through occurs.

Principals Used to Develop Cartridge Change Schedule

1. Exposure Assessments

Exposure assessments has been performed for two groups of UCSB respirator Users: Community Hazardous waste Collection (CHWC) and MBE (Molecular-Beam Epitaxy) Lab. See attached reports (Appendices V-VI) on exposure assessment for CHWC (former CEC) and MBE Lab.

2. Expert Opinion

The UCSB Industrial Hygiene (IH) Program has based this Cartridge Change Schedule on the following parameters: Type/amount/concentration of hazardous substances used, breathing rate, working conditions (indoor/outdoor), presence/absence of mechanical ventilation (ACH), temperature and relative humidity. It is also based on the boiling point of the chemicals, vapor pressure, toxicity, and other relevant information from the MSDS.

3. Manufacturer's Recommendation

Manufacturer's Recommendation can result in a more accurate estimate for a particular brand of respirator. We rely on the manufacturer's broad knowledge and expertise by obtaining their recommendation for a cartridge change schedule. Some cartridges with end of Service Life Indicator (ESLI) are used, such as Mercury cartridges.

3. Rule of Thumb

Available rules of thumb: driven or resulted from experimental work by scientific organizations (AIHA, NIOSH). One such "Rule of Thumb" for estimating *organic vapor cartridge* service life is found in Chapter 36 of the AIHA publication "The Occupational Environment – Its Evaluation and Control." It suggests that:

- The chemical's boiling point is $> 70^{\circ}\text{C}$ and the concentration is less than 200 ppm you can expect a service life of 8 hours at a normal work rate.
- Service life is inversely proportional to work-rate (breathing rate). Most cartridge studies have used the high end of moderate work-rate of 50-60 liters per minutes.
- Reducing concentration by a factor of 10 will increase service life by a factor of 5.
- Humidity above 85% will reduce service life by 50%.
- The higher the temperature the lower the service life. Temperature effects alone have been reported to reduce the service life 1-10% for every 10 degrees Celsius rise depending on the specific solvent (Nelson, et. Al., 1976).

APR Cartridge Change Schedule for UCSB individual groups of users

Based on the above four principals the following cartridge change Schedule is recommended:

Department RP Users	Cartridge Type(s)	Respiratory Hazards	Cartridge Change Schedule
Animal Resource Center	P100	Animal dander	After 40 hours of use
Biology Life Science	OV/AG/P100	Captan Fungicide Orthene Horticulture Oils Pesticides	After 16 hours of use
EH&S - CHWC	OV/AG/P100 ammonia, methylamine, formaldehyde and hydrogen fluoride	Organic Solvents Acids Oil & water-based Paints Pesticides Asbestos Waste Engine Oil Engine coolants Consumer products	<i>Bulking paints/solvents:</i> After 8 hours of use <i>Collection/Segregation/Over-packing:</i> After 40 hours of use (See Exposure Assessment at Community Hazardous Waste Site-Appendix V)
EH&S - Haz Waste	OV/AG/P100 ammonia, methylamine, formaldehyde and hydrogen fluoride Mercury (Hg)	Organic Solvents Acids Mercury	<i>Bulking:</i> After 8 hours of use <i>Collection/Segregation/Over-packing:</i> After 40 hours of use The cartridges will be changed Once the ESLI turns brown ESLI: End of Service Life Indicator
EH&S - ERT	OV/AG/P100 ammonia, methylamine, formaldehyde and hydrogen fluoride	Organic Chemicals, Acids, Heavy metals, Asbestos Potential short-term response (1-2 hours) to an emergency	After each use when responding to an emergency
Facilities & Housing Trades	OV/P100	Consumer Products Lubricants Solvents Glues	After 16 hours of use
Facilities & Housing Painters	OV - P100	Oil/latex/water-based paints Old Lead paints Acetone Paint thinner	<i>Oil-based paints & Solvents:</i> After 8 hours of use <i>Lead Paint sanding:</i> After 8 hours of use <i>Latex/Water-based Paints:</i> After 40 hours of use

Facilities & Housing Grounds	OV - P100	Roundup Pro	After 40 hours of use Under California Code of Regulations, Title 8, Section 5144, respiratory protection is not required for the application of Roundup Pro, however UCSB requires the use of APR or PAPR respirators.
Facilities & Housing Asbestos	P100	Asbestos	After one shift of work or 8 hours of use, Whichever is shorter
Facilities- Water Engineers	OV/AG/P100	Hydrochloric Acid Sodium - Hypochlorite Chlorine Tablets	After 40 hours of use
Materials - MBE	OV/AG/P100	Isopropanol Acetone Arsenic Phosphorous Gallium Aluminum Iron Silicon Manganese Indium Antimony Beryllium	Cartridges will be changed after each shutdown or service to equipment. No more than 40 hours of use for each cartridge. RP is not required under California Code of Regulations, Title 8, Section 5144, however, UCSB requires the use of a respirator during shut down and maintenance operations. (See MBE Lab Exposure Assessment-Appendix VI)
Materials ECE	Multi-Gas Vapor/P100	Sandblasting involving heavy metals, acids, chlorine, ammonia, boron trichloride, silicon tetrachloride	After 40 hours of use
Molecular Cellular and Developmental Biology	P100	Bio-Safety Level 3 Bacteria & Viruses	After each use
Parking Services Grounds	OV/P100	Roundup Pro	After 40 hours of use Under California Code of Regulations, Title 8, Section 5144, respiratory protection is not required for the application of Roundup Pro, however UCSB requires the use of APR or PAPR respirators.
Student Health Services	N95	Influenza virus	After each use
Users exposed to welding/soldering fumes	P100	Welding Fumes	After 40 hours of use

UCSB Respiratory Equipment Selection Guide
TYPES AND WEIGHT OF RESPIRATORS ----- OUNCES*

TYPE	SIZE	WEIGHT (oz)
------	------	-------------

MSA RESPIRATORS

Comfo Elite	Small	6.5
	Medium	6.5
	Large	7.5

Comfo Classic	Small	6.0
	Medium	6.4
	Large	6.5

Ultra -Twin	Small	20.5
	Medium	21.1
	Large	21.0

3M RESPIRATORS

6100	Small	2.8
6200	Medium	2.9
6300	Large	3.0

SCOTT

1/2 Face	Small	6.0
	Medium	6.0
	Large	6.0

Full Face	Small	19.0
	Large	19.0
	X-Large	19.0

WEIGHT OF ONE PAIR OF CARTRIDGES (2)

TYPE	WEIGHT (oz)
------	-------------

MSA CARTRIDGES

P100	2.7
GMC-P100	7.5, 7.8
GME-P100	9.0, 9.5

3M CARTRIDGES

6000 Org Vap	6.0
60923 OV. AG, P100	8.0

P100 filters	0.6
N95 +retainer	1.0

SCOTT

P-100	3.5
OA	8.0
OV	7.0
OV-H	10.5
OA-P100	10.5

WEIGHT OF ASSEMBLED RESPIRATOR AND PAIR OF CARTRIDGES

RESPIRATOR PLUS CARTRIDGE TYPE

MSA		P100 HEPA	GMC-P100 COMBO	GME-P100 COMBO-PLUS		
Comfo Elite	S	9.0	14.3	16.0		
	M	9.0	14.5	16.0		
	L	10.0	15.3	16.8		
Comfo-Classic	S	8.5	13.7	15.5		
	M	9.0	14.5	16.0		
	L	8.8	14.7	16.0		
Ultra-Twin	S	23.0	28.5	30.0		
	M	22.5	28.0	30.0		
	L	23.0	28.5	30.0		
3M		6000 OV	60923 OV, AG, P100 HEPA	P100	5N11=501 N95+retainer	
6100	S	8.9	11.0	3.5	4.0	
6200	M	8.9	11.0	3.5	4.0	
6300	L	9.0	11.0	3.5	4.0	
SCOTT		P100	OA	OV	OV-H	OA-P100
1/2 Face	S	9.5	14.0	13.0	16.5	16.5
	M	9.5	14.0	13.0	16.5	16.5
	L	9.5	14.0	13.0	16.5	16.5
Full-Face	S	22.5	27.0	26.0	29.5	29.5
	L	22.5	27.0	26.0	29.5	29.5
	XL	22.5	27.0	26.0	29.5	29.5

*weighed on a Pelouze Postal Scale (accuracy is +/- 0.5 oz)

UCSB Respiratory Protection Policy P-5440

UC Santa Barbara Policies

Policy 5440

Issuing Unit: Administrative Services

Date: May 1, 1987

RESPIRATORY PROTECTION

I. REFERENCES:

A. Title 8, California Administrative Code, General Industry Safety Order 5144.

B. UCSB Respiratory Protection Manual.

II. POLICY:

It is the policy of the University of California, Santa Barbara, to maintain an environment, insofar as it is reasonably within the control of the University to do so, that will not adversely affect the health, safety and well-being of students, employees, visitors and neighboring human populations.

A. Because of the potential hazards associated with exposure to hazardous substances and atmospheres, a Respiratory Protection Program has been designed which defines necessary respiratory protection equipment and safe procedures for its use.

B. All activities involving the use of respiratory protection equipment, in facilities controlled by the University of California, Santa Barbara, shall be conducted in compliance with Title 8 of the California Administrative Code, General Industry Safety Order 5144, and with the provisions of the UCSB Respiratory Protection Manual.

C. The Respiratory Protection Manual establishes the procedures and requirements necessary to meet various enforcing agencies' regulations for use of respiratory protection equipment and to provide the necessary health and safety protection to those persons falling within the jurisdiction of the program.

D. Department chairpersons, unit managers, and/or principal investigators and line supervisors are responsible and accountable for assuring employee compliance with the respiratory protection program stipulations. The Environmental Health and Safety Office will provide technical assistance to departments in their administration of this program.

E. The Office of Environmental Health and Safety will act as the sole source for purchasing, cleaning, maintaining, fitting and approving the use of all respiratory equipment and for training Santa Barbara Campus personnel in its use.

APPENDIX IV
Directions for Using Forms**Directions For Obtaining Respirators**

The next Respiratory Protection Training Class will be held on _____ at _____ if you are unable to attend this class or need a respirator prior to the above date please follow the steps 1-5 below. **If you can attend the above listed class you do not need to go to Student Health prior to coming to the training class**, the medical evaluation will be conducted during the training session. Please make sure to bring your Form A to class with the supervisor's selection completed. If you have any questions regarding these directions please call EH&S at 893-3743.

1. An industrial hygiene survey will be conducted for your job/process and the Industrial Hygiene Evaluation section of Form A will be completed by the EH&S industrial hygienist.
2. Have your supervisor fill in the first section of Form A.
3. Make an appointment with Student Health Services (SHS) at x3371 for your medical evaluation.
4. Submit Form A and completed Form B to SHS when you go to your appointment. SHS will help you with the questions you are not able to answer on Form B. After the medical evaluation, Form A is completed and returned to you and Form B is kept in your medical file by SHS.
5. Make an appointment with EH&S at x3743 for respirator training, fit testing and obtaining your respirator. ***Submit completed Form A at the time of fit testing.*** Allow approximately 1 hour for training, fit testing, and obtaining your respirator. ***Men must be well shaved at the time of fit testing and whenever they use their respirator.*** As required by OSHA regulations, fit testing will not be conducted for employees with interfering facial hair.

UCSB Environmental Health and Safety
Respiratory Protection Program
Respirator Usage Approval Form

Supervisors: Fill out this section and forward to SHS.

The use of proper respiratory protection equipment is being requested for _____ (employee's name), based upon my understanding of the Campus Respiratory Protection Manual and Cal-OSHA regulations.

Employee / Perm Number: _____

If respiratory equipment is required, the department recharge number is: _____

Supervisor/Dept. Head:

Name: (please print) _____

Signature: _____ Date: _____

Extension: _____

Department: _____

Industrial Hygiene Evaluation

An industrial hygiene survey of the above listed employee's job and work site has been conducted and it is determined that the employee will/will not (check one) require respiratory protection.

Type of Respirator/Cartridges Required: _____

Respirator/Cartridges Weight: _____

Additional Protective Clothing Required: _____

Work Activity: _____

Work Activity Level: _____

Frequency of Use: _____

Duration: _____

Temperature & Humidity Extremes Encountered: _____

Date

Industrial Hygienist

Medical Evaluation

The above listed employee's health status has been evaluated and is approved/denied (check one) for respirator usage recommended by the Industrial Hygienist.

Date

Evaluating Physician/Practitioner

Comments: _____

I authorize the release of Billing Information for this service to the above named department.

Employee Signature: _____ **Date:** _____

Please return completed form to EH&S

UCSB Environmental Health and Safety
RESPIRATORY PROTECTION PROGRAM
HEALTH QUESTIONNAIRE
CONFIDENTIAL

Date: _____

The following information is required in order to maintain accurate records of your participation in this program. All health related information will be kept at Student Health and is confidential. Information may only be released with your signed consent. Please print all information requested.

Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

Can you read? (circle one): Yes / No

Name: _____ Birth date: _____ Sex: _____

Address: _____

Phone: _____ Employee/Perm Number: _____

Height: _____ Weight: _____

List all medications taken routinely: _____

Job Title: _____

Have you ever worn a respirator? (circle one) Yes / No

If yes, what type(s)? _____

RESPIRATORY PROTECTION PROGRAM
HEALTH QUESTIONNAIRE

Date: _____

These questions must be answered by every employee who has been selected to use any type of respirator.

	Yes	No
Do you currently smoke tobacco, or have you smoked tobacco in the last month?		
Have you ever had any of the following conditions?		
Seizures (fits)		
Diabetes (sugar disease)		
Allergic reactions that interfere with your breathing		
Claustrophobia (fear of closed-in places)		
Trouble smelling odors		
Have you ever had any of the following pulmonary or lung problems?		
Asbestosis, silicosis, or tuberculosis		
Asthma, chronic bronchitis, or emphysema		
Pneumothorax, broken ribs, or any chest injuries or surgeries		
Lung cancer or any other lung problems that you've been told about		
Pneumonia		
Do you currently have any of the following symptoms of pulmonary or lung illness?		
Shortness of breath at rest or walking fast on level ground or walking up a slight hill		
Shortness of breath when walking at an ordinary pace on level ground		
Shortness of breath when washing or dressing yourself		
Shortness of breath that interferes with your job		
Have to stop for breath when walking at your own pace on level ground		
Coughing that produces phlegm (thick sputum) or that wakes you early in the morning		
Coughing that occurs mostly when you are lying down		
Coughing up blood in the last month		
Wheezing at rest or that interferes with your job		
Chest pain when you breathe deeply		
Any other symptoms that you think may be related to lung problems		
Have you ever had any of the following cardiovascular or heart problems?		
Heart attack, angina, heart failure, or heart arrhythmia (heart beating irregularly)		
Stroke or high blood pressure		
Swelling in your legs or feet (not caused by walking)		
Any other heart problem that you've been told about		
Have you ever had any of the following cardiovascular or heart symptoms?		
Frequent pain or tightness in your chest at rest or during physical activity		
Pain or tightness in your chest that interferes with your job		
In the past two years, have you noticed your heart skipping or missing a beat)		
Heartburn or indigestion that is not related to eating		
Any other symptoms that you think may be related to heart or circulation problems		
Do you currently take medication for any of the following problems?		
Breathing or lung problems, heart trouble		
Blood pressure		
Seizures (fits)		
If you've used a respirator, have you ever had any of the following problems?		
Eye irritation, skin allergies or rashes		
General weakness, fatigue, or anxiety		
Any other problem that interferes with your use of a respirator		

SCBA USERS PLEASE TURN OVER

Name: _____ E/P# _____

**RESPIRATORY PROTECTION PROGRAM
HEALTH QUESTIONNAIRE**

Date: _____

Every employee who has been selected to use either a **full-facepiece** respirator **or** a self-contained breathing apparatus (**SCBA**) must answer these questions.

	Yes	No
Have you ever lost vision in either eye (temporarily or permanently)?		
Do you currently have any of the following vision problems?		
Wear contact lenses or glasses		
Color blind		
Any other eye or vision problem		
Have you ever had an injury to your ears, including a broken ear drum?		
Do you currently have any of the following hearing problems?		
Difficulty hearing or wear a hearing aid		
Any other hearing or ear problem		
Have you ever had a back injury?		
Do you currently have any of the following musculoskeletal problems?		
Back pain		
Weakness in any of your arms, hands, legs, or feet		
Difficulty fully moving your arms and legs		
Pain or stiffness when you lean forward or backward at the waist		
Difficulty fully moving your head up or down or side to side		
Difficulty bending at your knees or squatting to the ground		
Climbing a flight of stairs or a ladder carrying more than 25 lbs.		
Any other muscle or skeletal problem that interferes with using a respirator		

Name: _____ E/P # _____

**RESPIRATORY PROTECTION PROGRAM
SUPPLEMENTAL QUESTIONNAIRE**

Date: _____

Every employee who has been selected to use any type of respirator must answer these questions.

	Yes	No
At work or at home or when working on hobbies, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (e.g., gases, fumes, or dust), or has your skin come into contact with hazardous chemicals?		
Have you ever worked with any of the materials, under any condition, listed below? ¹		
Asbestos		
Silica (e.g., in sandblasting)		
Tungsten/Cobalt (e.g., grinding or welding this material)		
Beryllium		
Aluminum		
Coal (e.g., mining)		
Iron		
Tin		
Dusty environments		
Any other hazardous exposures		
Do you have any second jobs or side businesses? ²		
Have you had any previous occupations? ²		
Have you ever been in the military service?		
If "yes," were you exposed to biological or chemical agents (either in training or combat)?		
Have you ever worked on a HAZMAT team?		
Will you be wearing protective clothing and/or equipment when you are using your respirator? ³		
Will you be working under hot conditions (temperatures exceeding 77° F)		

¹If yes, describe exposure: _____

²List: _____

³If yes, describe this protective clothing and/or equipment: _____

Name: _____ E/P # _____

Print and complete this form for each respirator user that is required to attend the annual "Respiratory Protection Training & Medical Evaluation" session.

Respiratory Protection - Annual Respirator Usage Approval Form

UCSB Environmental Health and Safety

Annual medical reevaluation, training, and fit testing for respirator users is required by law (CCR Title 8 Section 5144). To comply with this law, **supervisors** are required to provide the information below and have their employees bring it to the following annual "Respiratory Protection Training & Medical Evaluation" session:

Date: *Tuesday July 21st, 2009*
Time: *10:30am - 12:00pm*
Location: *EHS Training Room 1045*

Thank you,
 Jesse R. Bickley, 893-3743
 Industrial Hygiene Specialist

Supervisors must complete ALL parts of this section and sign:
Employee must bring completed form to the scheduled training session.

Any changes in work activity, activity level and work practices of the employee?

Any changes in health hazards for which the respirator was issued for the above employee?

Employee Name: _____

Employee/Perm #: _____

Recharge Number: _____

Supervisor Signature: _____

Supervisor Name: _____

Department: _____ Ext.: _____ Date: _____

Medical Re-evaluation - Completed by SHS at the training session.

The above listed employee's health status has been evaluated and is approved/ denied (*check one*) for respirator usage recommended by the Industrial Hygienist.

_____ Date _____ Evaluating Physician/Practitioner

I authorize the release of Billing Information for this service to the above named department.

Employees Signature: _____ **Date:** _____

APPENDIX IV
Form D

UCSB ENVIRONMENTAL HEALTH AND SAFETY
RESPIRATORY PROTECTION PROGRAM
ANNUAL HEALTH STATUS FORM

Date: _____

The following information is required in order to maintain accurate records of your participation in this program. All health related information will be kept at Student Health and is confidential. Information may only be released with your signed consent. Please print all information requested.

Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

Name: _____ Birth date: _____ Sex: _____

Address: _____

Phone: _____ Employee/Perm Number: _____

List all medications taken routinely: _____

	Yes	No
FOR ALL RESPIRATOR USERS		
Do you currently smoke tobacco, or have you smoked tobacco in the last month?		
During the past year, have you developed/been diagnosed with any of the following conditions?		
Seizures, diabetes, difficulty breathing due to allergic reaction, difficulty smelling odors		
Any chronic lung disease, lung cancer, injury to the chest, or pneumonia		
New shortness of breath, chest pain with deep breathing, or cough		
Heart attack or other heart problem, stroke, high blood pressure, swelling in the legs or feet		
Pain or tightness in your chest, heart skipping, heartburn not related to eating		
Eye irritation, skin rashes, weakness, fatigue, new problems using your respirator		
FOR SCBA USERS ONLY		
During the past year, have you developed/been diagnosed with any of the following conditions?		
Vision loss, or any other eye or vision problem (including contact lenses or glasses use)		
Injury to the ear or ear drum, hearing problem (including using a hearing aid)		
Back injury or pain, weakness in arms, hands, legs, or feet		
Pain or stiffness in the back when you bend or move		
Trouble climbing a flight of stairs wearing a respirator		
Any problem that interferes with using a respirator		
NEW EXPOSURES		
During the past year, have you been exposed to any of the following substances?		
Asbestos, Lead, silica, tungsten, cobalt, beryllium, aluminum, coal, iron, tin, dusty environments		
Did you take a second job or start a side business?		
Did you work on a HAZMAT team?		

Signature: _____

Respiratory Protection User Survey
UCSB - Environmental Health & Safety

Date: _____

Name: _____

Dept.: _____

Job Title: _____

Supervisor: _____

The following QUESTIONS ARE RELATED TO THE PAST YEAR of respirator use.

How many times did you use your respirator over the past year? _____

How long did you wear your respirator each time (average time)? _____

Did your respirator interfere with your work performance? Yes No

If yes, please explain. _____

Do you believe that your respirator is providing protection from hazards? Yes No

If no, please explain. _____

What types of jobs did you perform? _____

While using your respirator properly, have you experienced filter breakthrough? Yes No

If yes, please explain. _____

What chemicals/products/materials were used? _____

Did you replace or change your respirator cartridges? Yes No

If yes, how many times? _____

How did you store your respirator (i.e. sealed plastic bag)? _____

Comments or suggestions _____

Exposure Assessment at Community Hazardous Waste Site

Performed by Kevin Kaboli, CIH
June 1994 - November 1995

INTRODUCTION

This report covers the industrial hygiene (IH) survey and exposure assessment conducted by UCSB Environmental Health and Safety (EH&S) on the hazardous waste employees of the Community Environmental Council (CEC), from June 1994 thru November 1995. The exposure assessment survey served the following purposes:

- a) Response to CEC management's concern over workers' exposure to hazardous waste during collection, segregation, overpacking, & bulking (CSOB) of community hazardous waste.
- b) To assess compliance with Cal/OSHA regulations on workers' exposure.
- c) To evaluate the local exhaust ventilation systems used during the operations.
- d) To reevaluate the requirements for personal protective equipment (PPE) during the operations.
- e) To evaluate work practices during collection, segregation, overpack, labpack & bulking of community hazardous waste.

STUDY PROCEDURE

The survey was based on standard IH practices and in accordance with the current regulatory standards and guidelines of the California Occupational Safety & Health Administration (Cal/OSHA), Environmental Protection Agency (EPA) and the American Society of Heating Refrigerating & Air conditioning Engineers (ASHRAE). Air sampling and analysis were in accordance with the National Institute for Occupational Safety & Health (NIOSH) methods.

The survey included:

- a) Interviewing the CEC manager and staff.
- b) Reviewing the waste profile sheets and waste manifests.
- c) Reviewing MSDSs for most products collected as waste.
- d) Generation of a matrix for wastes and their ingredients.
- e) Reviewing relevant NIOSH analytical methods for sampling and analysis of many chemicals.
- f) Observations of CSOB operations for two weekends.
- g) Research on similar studies of household hazardous waste sites.
- h) Coordination with DataChem laboratory regarding sampling media and sample analyses.
- i) Coordination with CEC staff for the air monitoring.
- j) Evaluation of local exhaust ventilation systems during CSOB operations.
- k) Evaluation of work practices and PPE during CSOB operations.
- l) Development of a protocol for personal air monitoring.
- m) Multiple personal air samplings on several employees and area air monitoring during CSOB operations on two weekends.

- n) Data interpretation and generation of this report.

Personal air sampling was carried out using personal sampling pumps, sorbent tubes and PVC filters (for particulates) required by the pertinent NIOSH analytical method (addressed in the summary of results). All sampling trains were pre- and post- calibrated with a precision rotameter. Blanks were collected for each set of samples. All samples were analyzed by Datachem laboratory, which is accredited by the American Industrial Hygiene Association.

Passive sampling (personal & area) was also conducted using samplers which are based on diffusion principal (as opposed to passing air thru the sampler with a pump). Personal passive samples were collected side by side with personal air samples.

SUMMARY OF RESULTS

1. Air Monitoring

Personal exposure monitoring was performed for several waste categories and many chemicals, within each category, during CSOB operations. The chemicals were selected based on: 1) The CSOB operations described by the CEC management. 2) Reviewing MSDSs & waste profiles. 3) The results of GC/MS analyses for three area samples from bulking operations of oil-based paint, water-based paint and used oil. 4) Hazard rating of chemicals. 5) Observations of CSOB operations.

A total of 62 personal and 5 area air samples were collected for various operations and chemicals; the summary of the test results will follow:

Nine personal air samples were collected, during waste CSO operations, for forty seven organophosphorus/organochlorine pesticides & seven PCBs (using NIOSH methods 5600 & 5006 and DataChem method 8080MOD). None of the analytes were detected in the samples; the detection limits ranged from .01 to 2 microgram/sample.

Nineteen personal air and passive samples were collected, during CSO & bulking operations, for aromatic and total hydrocarbons (using NIOSH methods 1501 & 1550). In fifteen of the personal samples none were detected; the detection limits ranged from 0.001 to 0.1 mg/sample. Sample AHC-3 showed 0.2 ppm of benzene, which is well below the Cal/OSHA Permissible Exposure Limit (PEL) of 1.0 ppm. Sample AHC-4 indicated 0.5 ppm of ethyl benzene, 0.2 ppm of vinyl toluene, 1.0 ppm of toluene & 2.0 ppm of xylene; all of which are well below the Cal/OSHA PEL of 100, 50, 50 & 100 ppm, for these compounds, respectively. Samples THC-3A & B showed 30 ppm of total hydrocarbon.

Three area passive samples were collected (during paint drying operations & bulking of used oil) for total hydrocarbons; all three samples showed no detectable presence of hydrocarbons. The detection limit was 0.1 mg/sample.

Six personal air samples were collected, during CSO operations, for five ketones and five esters (using NIOSH methods 2500, 1300 & 1450). All ten ketones and esters were not detectable; the detection limit was .01 mg/sample.

Two personal air samples were collected, during bulking of oil-based paint & solvents, for five ketones and five esters (using NIOSH methods 2500, 1300 & 1450). The TWA concentrations of 0.45 ppm of Isobutyl Acetate and 0.45 ppm of isoamyl acetate found are well below the PEL of 150 & 100 ppm respectively.

Nine personal air samples were collected, during CSO operations, for seven alcohols (using NIOSH methods 1400 & 1401). Test results showed no detectable presence of the seven alcohols; the detection limit was 0.01 mg/sample.

Three personal air samples were collected, during bulking of oil-based paint & solvents, for seven alcohols (using NIOSH methods 1400 & 1401). One sample indicated 0.7 ppm of sec-butyl alcohol and two samples resulted a TWA concentration of 1.5 ppm isopropyl alcohol. These levels are well below the Cal/OSHA PEL of 100 ppm and 400 ppm respectively.

Three personal air samples were collected, during bulking of water-based paint, for seven alcohols (using NIOSH methods 1400 & 1401). Test results indicated no detectable presence of these alcohols; the detection limit was 0.01 mg/sample.

Five personal air samples were collected during three operations (CSO, bulking of oil-based paint/solvents & bulking of water-based paint) for three ethylene glycol ethers (using NIOSH method 1403). None was detected in the three samples; the detection limit was 0.01 mg/sample.

One personal and one area air samples were collected, during bulking of water-based paint, for ethylene glycol (using NIOSH method 5500). None was detected in either sample; the detection limit was 0.6 mg/m³.

Three personal and one area air samples were collected, during bulking of oil-based paint/solvents & water-based paint, for mercury (using NIOSH method 6009). Both samples during bulking of oil-based paint indicated 0.00016 mg/m³ of Hg (calculated as total elemental mercury). The two samples during bulking of water-based paint revealed 0.0005 & 0.0011 mg/m³ calculated as total elemental mercury Hg. These levels are well below the Cal/OSHA PEL of 0.01 mg/m³ for alkyl mercury compounds (the most toxic mercury compound).

Two personal air samples were taken, during overpacking using vermiculite & during sweeping, for total particulates (using NIOSH method 0500). Test results showed levels at 0.8 and 2.2 mg/m³ which are well below the PEL of 10 mg/m³.

UCSB - Environmental Health & Safety
MBE Lab Exposure Assessment
Industrial Hygiene Report

Performed by Dave Keller, Industrial Hygienist
 April 2001

The Environmental Health & Safety office conducted personal exposure monitoring on February 20, 2001 to determine employee baseline exposure to arsenic, phosphorus, arsine and phosphine. The monitoring was performed in the Materials Department MBE Lab, during the removal of the gallium (Ga) source in system B.

Gallium Removal Procedure

Prior to the sampling period, a 4-glove bag was installed over the port that would be opened and the bag was placed under slight positive pressure to prevent potential contamination to system B. The following procedures were conducted within the glove bag during the sampling period, which took approximately 65 minutes:

- 6201 Remove vacuum bolts and extract source
- 6202 Pour remaining Ga into container
- 6203 Insert cell into stainless steel container
- 6204 Inspect Ga cell pocket for accumulation of Ga and broken shutter arm
- 6205 Remove shutter assembly
- 6206 Check PBN shield
- 6207 Vacuum phosphorus and arsenic contamination (using Nilfisk vacuum)
- 6208 Seal the port with blank flange
- 6209 Remove tools, cell, etc. from the bag
- 6210 Clean the bag, vacuum loose debris and wipe with damp cloth
- 6211 Remove and store bag

The involved employees wore coveralls, boot covers, hood, gloves, eye protection and a 1/2 face respirator equipped with a P100 filter and organic vapor cartridge.

Survey Results

As indicated in the following tables, the sampling results were significantly below the Occupational Safety and Health Administrations (OSHA) Permissible Exposure Limits (PEL) for arsenic, phosphorus, arsine and phosphine. Refer to the following tables for detailed sampling data:

Table 1 - Arsenic

Employee Name	Sample No.	Sample Time minutes	Measured Exposure mg/m ³	OSHA 8-hour PEL mg/m ³
David Buell	22001K4	67	<0.008	0.01
Aron (Max) Andrews	22001Blue	67	<0.009	0.01
Field Blank	22001BPA	0	ND	NA

mg/m³ - milligrams per cubic meter

ND - None Detected

Table 2 - Phosphorous

Employee Name	Sample No.	Sample Time minutes	Measured Exposure mg/m ³	OSHA 8-hour PEL mg/m ³
David Buell	22001K4	67	<0.008	0.1
Aron (Max) Andrews	22001Blue	67	<0.009	0.1
Field Blank	22001BPA	0	ND	NA

Table 3 - Arsine

Employee Name	Sample No.	Sample Time minutes	Measured Exposure mg/m ³	OSHA 8-hour PEL mg/m ³
David Buell	22001K3A	71	0.0009	0.2
Field Blank	22001BA	0	ND	NA

Table 4 - Phosphine

Employee Name	Sample No.	Sample Time minutes	Measured Exposure mg/m ³	OSHA 8-hour PEL mg/m ³
Aron (Max) Andrews	22001K2P	67	0.031	0.4
Field Blank	22001BP	0	ND	NA

Conclusion

Based on exposure results listed above, the glove bag system has proven to be an excellent engineering control to prevent employee exposure.

APPENDIX VII

Definitions

Aerosol - A system consisting of particles, solid or liquid, suspended in air.

Air-Purifying Respirator - A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

Approved Respiratory Equipment - Tested and listed as satisfactory jointly by the Mine Safety and Health Administration (MSHA) and the National Institute for Occupational Safety and Health (NIOSH).

Cal/OSHA - A division of the State Department of Industrial Relations, charged with workplace enforcement of health and safety regulation. Known properly as the Division of Occupational Safety and Health (DOSH).

Canister (Air-Purifying) - A container filled with sorbents and catalysts that remove gases and vapors from air drawn through the unit. The canister may also contain an aerosol (particulate) filter to remove solid and liquid particles.

Cartridge - A small container filled with air-purifying media.

Confined Space - An enclosure such as a storage tank, process vessel, boiler, silo, tank car, pipeline, tube, duct, sewer, underground utility vault, tunnel, or pit that has limited means of egress and poor natural ventilation and that may contain hazardous contaminants or be oxygen deficient.

Contaminant - A harmful, irritating or nuisance material that is foreign to the normal atmosphere.

Emergency - An unforeseen combination of circumstances that calls for immediate action

Exhalation Valve - A device that allows exhaled air to leave a respiratory device and prevents outside air from entering through the valve.

Exposure - When a person comes into contact with a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

Facepiece - That portion of a respirator that covers the wearer's nose, mouth, and eyes in a full facepiece. It is designed to make a gas-tight or dust-tight fit with the face and includes the headbands, exhalation valve(s), and connections for an air-purifying device.

Fit Test - A test procedure to determine the effectiveness of the seal between the face mask and the wearer's face. (See Qualitative and Quantitative Fit Test below)

Filter - A fibrous medium used in respirators to remove solid or liquid particles from the airstream entering the respiratory enclosure.

High-Efficiency Particulate Air (HEPA) Filter - A filter designed to remove 99.9% of specific type particle material from air.

IDLH Atmosphere - An atmosphere that is immediately dangerous to life or health (IDLH). An IDLH atmosphere poses an immediate hazard to life, such as being oxygen deficient (containing less than 19.5% oxygen), or produced an irreversible debilitating effect on health. An IDLH concentration represents a maximum level from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects.

Inhalation Valve - A device that allows respirable air to enter the facepiece and prevents exhaled air from leaving the facepiece through the intake opening.

Mine Safety and Health Administration (MSHA) - A federal agency that tests, approves, and certifies respiratory protection equipment.

National Institute for Occupational Safety and Health (NIOSH) - A federal agency that tests, approves and certifies respiratory protection equipment.

Occupational Safety and Health Administration (OSHA) - Division of the Department of Labor that enforces and promulgates workplace health and safety regulations.

Oxygen Deficient Atmosphere - An atmosphere with the oxygen content below 19.5% by volume.

Particulate Matter - A suspension of fine solid or liquid particles in air, such as dust, fog, fume, mist, smoke, or sprays. Particulate matter suspended in air is commonly known as an aerosol.

Pesticide - For the purpose of this manual, the terms pesticide and pesticide chemical are synonymous with economic poison, as defined under the United States Department of Agriculture's Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Pneumoconiosis-Producing Dust - Dust that, when inhaled, deposited and retained in the lungs, may produce signs, symptoms, and findings of pulmonary disease.

Protection Factor (PF) - The overall protection afforded by a certain type of respirator as defined by the ratio of the concentration of contaminant outside a face mask or hood to that inside the equipment under conditions of use. For example, if a half-mask respirator has a protection factor of 10, it may be used for protection in atmospheres with a contaminant concentration up to 10 times the permissible exposure limit.

Qualitative Fit Test - A test procedure to determine the effectiveness of the seal between the face mask and the wearer's face, usually performed during the fitting process.

Quantitative Fit Test - The measurement of the effectiveness of a respirator seal in excluding the ambient atmosphere. The test is performed by dividing the measured concentration of the challenge agent in a test chamber by the measured concentration of the challenge agent inside the respiratory facepiece when the normal air-purifying element has been replaced by an essentially perfect purifying element.

Resistance - Opposition of the flow of air, as through a canister, a cartridge, or particulate filter.

Respirator - A device designed to protect the wearer from inhalation of harmful atmospheres.

Self-Contained Breathing Apparatus (SCBA) - A unit designed to provide to the wearer a respirable atmosphere independent of the ambient air. A supply of approved compressed air contained in a gas cylinder is carried by the wearer. SCBA units at UC Santa Barbara are generally restricted to types equipped with pressure-demand regulators that maintain positive pressure in a full face-mask.

Supplied-Air Respirator - For the purpose of this manual, a hose-mask respirator equipped with a facepiece,

breathing tube, safety harness, and safety line. The respirable air is supplied through an air hose connected to a compressed-air cylinder or air compressor.

Test Subject - A person wearing a respirator for quantitative fit testing.

Threshold Limit Value (TLV) - A list published yearly by the American Conference of Governmental Industrial Hygienists as a guide for exposure concentrations that a healthy individual normally can tolerate for 8 hours a day, five days a week over a working lifetime, without harmful effects. Airborne particulate concentrations are generally listed as milligrams per cubic meter of air (mg/m^3), and gaseous concentrations are listed as parts per million (ppm) by volume.

Vapor - The gaseous state of a substance that is solid or liquid at ordinary temperature and pressure.