Chapter 5

Industrial Hygiene

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1 Overview

The discipline of industrial hygiene is concerned with identifying and controlling potential chemical, physical, and biological workplace hazards by evaluating processes and facility designs using the following steps:

1. Anticipation
2. Recognition
3. Evaluation
4. Control

Using pre-established and approved methods determined by the nature of the hazard, industrial hygienists take qualitative and quantitative measurements of potential hazards in the workplace. The results are compared to recommended exposure guidelines or consensus standards. If the results reveal a possible health hazard, industrial hygienists will recommend methods for controlling the hazard. These methods may include engineering controls and appropriate safety practices for personnel, such as the substitution of safer materials, or the use of ventilation and personal protective equipment.

This chapter describes the requirements of the industrial hygiene program and specifies how and when
- Industrial hygiene surveys are conducted
- Results are communicated to personnel
- Current and accurate calibration of industrial hygiene equipment is maintained
- Hazard control ventilation systems are checked
- Records are maintained

The industrial hygiene program was developed in compliance with federal Occupational Health and Safety Administration (OSHA) regulations to keep exposure to contaminants below the OSHA permissible exposure limit (PEL) or the threshold limit value (TLV) set by the American Conference of Governmental Industrial Hygienists (ACGIH) (see Section 4, “Definitions”).

1.1 Hazards/Impacts

The diverse work environment at SLAC may involve various potential hazards, including exposure to hazardous materials and other elements such as noise or radiation. If over-exposed to such agents, personnel may suffer acute or chronic health problems. Exposures are kept to a minimum through the use of material substitution; proper use, handling, and storage; adequate ventilation and personal protective equipment; training; and periodic monitoring as described by this chapter.
2 Scope

This chapter covers all industrial operations and workplaces at SLAC. Industrial hygiene staff survey the workplace for exposures to hazardous materials, carcinogens, noise, inadequate lighting, heat and cold stress, and non-ionizing radiation (such as ultraviolet, visible, infrared, radiofrequency, microwave, laser, and static magnetic fields).

Employees, university collaborators, users, scientists, fellows, students, and faculty are included in industrial hygiene surveys as needed to ensure a safe work environment. This chapter does not apply to SLAC casual visitors and subcontractors. Subcontractors must have and follow their own hazard analysis program.

Since the risks associated with different substances and activities vary, requirements for recognizing and dealing with them are described in the hazard-specific chapters of this manual (see Section 7, “References”).

2.1 Exemptions

There are no exemptions to the requirements of this chapter.

3 Standards

The industrial hygiene program has adopted the following standards:

- **Title 10, Code of Federal Regulations, “Energy”**:¹
  - Part 850, “Chronic Beryllium Disease Prevention Program” (10 CFR 850)
  - Part 851, “Worker Safety and Health Program” (10 CFR 851)²


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² Additional information on 10 CFR 851 and its implementation is available from the following site: “Worker Safety and Health Program Final Rule - 10 CFR 851”, [http://www.hss.energy.gov/healthsafety/WSHIP/rule851/851final.html](http://www.hss.energy.gov/healthsafety/WSHIP/rule851/851final.html)
The following third-party standard:

- American Conference of Governmental Industrial Hygienists (ACGIH), “Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs)”, (ACGIH TLVs and BEIs)⁶

4 Definitions

_Air sampling_. The collection of samples of air followed by laboratory analysis to measure the presence and concentration of chemical, physical, or biological pollutants in the air

_Analytical method_. A standardized laboratory procedure used to determine the amount or concentration of a certain contaminant in an air or wipe sample

_Area air sampling_. The collection of air samples from a fixed location in a work area

_Biological hazard_. Hazard from biological agents such as viruses, bacteria, spores, fungi, bloodborne pathogens.

_Casual visitor_. Individual coming to the SLAC campus for a period of no more than 30 days per visit, whose visit does not involve unescorted entry to industrial/accelerator or other areas where unique SLAC hazards warrant limited access, and whose visit is for the following types of purposes: attending public lectures, public tours, or other activities open to the public; attending workshops, conferences, and collaboration meetings; use of the Linear Cafe (SLAC cafeteria); use of the SLAC Guesthouse; and meetings with SLAC personnel.

_Carcinogen_. A material that causes the development of cancerous growth in living tissue

_Chemical hazard_. Hazard from chemical hazardous materials such as acids, bases, solvents, cryogens, etc.

_High-efficiency particulate air (HEPA) filter_. A filter capable of removing from the air at least 99.97 percent of dust, pollen, mold, bacteria and any airborne particles with a size of 0.3 micrometers or larger

_Industrial hygiene (IH)_. The science devoted to the anticipation, recognition, evaluation, prevention, and control of those occupational factors or stresses arising in or from the workplace which may cause sickness, impaired health and well being, or significant discomfort among workers or citizens of the community

_Industrial hygiene survey_. Workplace survey for hazardous materials and contaminants, often including air sampling

_Industrial hygienist_. A professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards and environmental issues

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Hazard control ventilation. An industrial exhaust system that captures and removes contaminants emitted from local sources before dilution into ambient workplace air can occur; includes chemical fume hoods, soldering bench hoods, extractor arms, glove boxes, and biological safety hoods or cabinets

Medical surveillance. Periodic medical evaluation for personnel potentially exposed to designated chemical, biological, and physical hazards

Occupational exposure limit (OEL). An exposure limit that is the lower of the permissible exposure limit or threshold limit value (see permissible exposure limit or threshold limit value)

Permissible exposure limit (PEL). An exposure limit published and enforced by the federal Occupational Health and Safety Administration (OSHA) as a legal standard. PEL may be either a time-weighted-average (TWA) exposure limit (eight hour), a 15-minute short term exposure limit (STEL), a ceiling (C), and may have a skin designation.

Personal air sampling. The collection of air samples at the worker’s breathing zone to reflect the level of a worker’s exposure to a contaminant throughout a work day

Physical hazard. Hazard from physical agents such as noise, non-ionizing radiation, and magnetic fields

Threshold limit value (TLV). Recommended guidelines for occupational exposure to airborne contaminants published by the American Conference of Governmental Industrial Hygienists (ACGIH). TLVs represent the average concentration for an eight-hour workday and a 40-hour workweek to which nearly all workers may be repeatedly exposed without adverse effect.

Wipe sampling. A procedure to check for contaminants by wiping a representative surface of known area with an acceptable wipe material, which is analyzed by chemical extraction

5 Requirements

5.1 General

Successful implementation of the industrial hygiene (IH) program supports a safe and healthy work environment by

- Anticipating, recognizing, and evaluating potential workplace hazards before they exist (for example during the development and review of job and area hazard analyses)
- Implementing recommended engineering controls where feasible
- Implementing administrative controls when engineering controls are not feasible
- Surveying work areas to identify hazards (such as toxic agents, ventilation problems, and noise) and taking appropriate measures to reduce them
- Training personnel to recognize hazards and to take appropriate safety measures when working under potentially hazardous conditions
- Choosing the appropriate personal protective equipment (PPE)
- Determining which personnel should undergo medical surveillance based upon their job classification and on occupational exposure surveys

The industrial hygiene program is coordinated by the industrial hygiene group within the Chemical and General Safety (CGS) Department in the Environment, Safety, and Health (ES&H) Division.\(^7\) Industrial hygiene surveys and monitoring may be performed by a designated technician, but the process is always overseen by a Chemical and General Safety Department industrial hygienist. The industrial hygiene group is also available to evaluate and assist in the design of ventilation systems, work practices, hazard analysis (JHAM and AHA), and PPE selection and usage.

5.1.1 Hazard Recognition

The industrial hygiene program addresses chemical, physical, and biological hazards. The program consists of identifying and properly evaluating hazards, then providing recommendations to reduce the potential for exposure and improve health in the workplace. (See Industrial Hygiene: Hazard Recognition Guidelines.\(^8\))

5.1.2 Surveying and Monitoring

Industrial hygiene staff use approved exposure assessment strategies to characterize and monitor workers’ potential exposures to chemical and physical hazards.

Industrial hygiene staff must perform baseline industrial hygiene surveys and periodic resurveys of work areas and operations as needed to identify and evaluate potential worker health risks. Surveys often include some type of industrial hygiene monitoring, such as air or wipe sampling, to measure the amount or concentration of the hazards.

Industrial hygiene staff will conduct risk-based qualitative reassessments of existing operations at SLAC on a biannual basis, so that each work area will be re-evaluated at least once every two years.

Industrial hygiene monitoring takes place as a result of

1. Individuals or managers submitting a request
2. Chemical acquisition or design review processes
3. Regulatory requirements, SLAC policy, or agreements with the DOE

To obtain an industrial hygiene survey, see Industrial Hygiene: Exposure Assessment Strategy, Surveying, and Monitoring Guidelines.\(^9\)

5.1.2.1 Exposure Limits

SLAC’s goal is to minimize exposures to harmful chemical and physical agents. Accordingly, the lower (that is, more protective) occupational exposure limit (OEL) between the ACGIH TLVs or the OSHA PELs...
in 29 CFR 1910 will be used (see Section 4, “Definitions”). When the ACGIH TLVs are used as exposure limits, SLAC nonetheless will comply with the other provisions of any applicable expanded health standard found in 29 CFR 1910.

The goal of SLAC’s exposure assessment strategy is to protect workers by controlling potential exposures to less than 10 percent of the OEL.

5.1.2.2 Methods

Industrial hygiene staff conduct sampling using the Assay Technologies Industrial Hygiene Sampling Guide\(^\text{10}\) as a primary resource. Assay, the primary industrial hygiene analytical laboratory for SLAC, analyzes samples in accordance with protocols established by the Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health and is accredited by the American Industrial Hygiene Association.

When a sampling method is not available from Assay, industrial hygiene staff may refer to the OSHA Technical Manual\(^\text{11}\) or NIOSH Manual of Analytical Methods\(^\text{12}\).

5.1.2.3 Results

Reports

After conducting an industrial hygiene sampling event, the industrial hygiene staff writes a detailed report that

- Describes the tasks and locations where monitoring occurred
- Identifies workers monitored or represented by the monitoring
- Identifies sampling methods and durations
- Describes control measures in place during monitoring (including the use of personal protective equipment)
- Notes any factors that may have affected sampling results
- Provides an interpretation of the results

Photographs depicting the job setup and procedural steps at the time of the sampling may be included in the report, along with any recommendations to reduce potential or actual exposures in the future.

The industrial hygiene staff e-mails the report to the supervisor of the area. The supervisor is responsible for distributing the report to affected personnel.

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\(^{11}\) Occupational Safety and Health Administration (OSHA), OSHA Technical Manual (TED 01-00-015 [TED 1-0.15A]), [http://www.osha.gov/dts/osta/otm/otm_toc.html](http://www.osha.gov/dts/osta/otm/otm_toc.html)

Notification of Personal Monitoring

If an individual was the subject of personal monitoring, the industrial hygiene staff also develops a notification of personal monitoring document and sends it to the affected person and supervisor along with the report within two weeks of the receipt of sample analysis (or sooner if required for the specific chemical program). The notification of personal monitoring and industrial hygiene report can be sent electronically or hard copy.

5.1.3 Equipment

5.1.3.1 Service and Calibration

Industrial hygiene monitoring equipment will be maintained, serviced, and calibrated according to manufacturer’s recommendations. Equipment will be sent out for factory service and calibration at a frequency established by the manufacturer. A subset of equipment is also calibrated on site by the industrial hygienist or technician before and after each use (such as air sampling pumps).

The unit will be marked with a sticker or label indicating the most recent calibration date, and when calibration is due again. Before- and after-use calibrations by the industrial hygiene staff need not be marked on the unit. Equipment will also be marked with SLAC property control tags.

Equipment that is broken, inaccurate, or past-due for calibration will be tagged out of service until repaired or recalibrated. The tag will provide the date, the person’s name, reason the unit was taken out of service, and the planned disposition of the unit.

5.1.3.2 Storage

Industrial hygiene equipment is properly stored away from light, dust, and other contaminants. At the discretion of the industrial hygiene program manager, certain units (such as gas detectors or in four-in-one meters) may be loaned to non-industrial hygiene personnel upon request for short-term jobs (such as confined space entry). Should a particular group or individual need a piece of equipment frequently or for long duration (as is needed for confined space entries, for example), the industrial hygiene program manager may ask them to purchase their own equipment.

5.1.3.3 Hazard Control Ventilation

Hazard control ventilation systems are commonly relied on as a primary engineering control in industrial operations, maintenance activities, and laboratory operations. Local exhaust ventilation hoods and points for operations must be used to ensure sufficient reduction of airborne concentrations of contaminants that could pose a risk to personnel. Local exhaust points include chemical fume hoods, extractor arms, glove boxes, biological safety cabinets, and other exhausted equipment enclosures that perform a safety or health function.

When hazard control ventilation systems are planned for installation, the industrial hygiene program manager must be consulted to ensure proper selection and installation. Ventilation performance criteria will be defined by the industrial hygiene program manager based on nationally recognized standards of performance. (See Industrial Hygiene: Hazard Control Ventilation Requirements.13)

Each hazard control ventilation system must have a designated custodian, the names of which are maintained in an industrial hygiene program database by the program manager.\(^{14}\)

Industrial hygiene staff conducts annual evaluations of chemical processes where hazard control ventilation systems are present.

### 5.1.4 Specific Hazards

#### 5.1.4.1 Beryllium

Beryllium, an element classified as a suspected human lung carcinogen, is used and machined in selected areas at SLAC. During some working processes, small particles and chips of insoluble beryllium-containing material will break off and spread through the air in the work area unless ventilation and other controls are used. The *SLAC Chronic Beryllium Disease Prevention Program*\(^ {15} \), which is incorporated into this chapter as an exhibit, specifies allowable uses and controls to prevent exposure to beryllium.

#### 5.1.4.2 Other

Hazards associated with lead, asbestos, and noise are addressed separately in related ES&H chapters (See Section 7, “References”).

### 5.1.5 Personnel

#### 5.1.5.1 Qualifications for Surveying and Monitoring

Industrial hygiene surveys and monitoring may be performed by a designated technician, but the process is always overseen by a Chemical and General Safety Department industrial hygienist.

#### 5.1.5.2 Medical Surveillance

The SLAC Medical Department performs all required medical surveillance in accordance with Chapter 3, “Medical”\(^ {16} \).

Industrial hygiene staff may recommend medical surveillance for certain personnel when an industrial hygiene evaluation indicates a potential exposure to contaminants. This recommendation is provided in writing to personnel and their supervisors, usually within the contents of an industrial hygiene report or notification of personal monitoring memo.

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5.1.6 Recordkeeping

5.1.6.1 Monitoring Reports and Notifications

Paper copies of industrial hygiene reports and notifications of personal monitoring are kept on file in the CGS Department and are indexed for easy retrieval.

5.1.6.2 Equipment Calibration Logs and Records

Industrial hygiene staff maintain an equipment calibration inventory. This identifies all industrial hygiene program-owned industrial hygiene equipment, the date of most recent calibration, and the next calibration due date.

5.1.6.3 Hazard Control Ventilation

The results of hazard control ventilation system calibrations, tests, and certifications are recorded in a database maintained by the industrial hygiene program manager. Additionally, ventilated laboratory hoods must have stickers on them that indicate when the last check was performed. (See Industrial Hygiene: Hazard Control Ventilation Requirements.)

5.1.7 Roles and Responsibilities

5.1.7.1 Industrial Hygiene Program Manager

The industrial hygiene staff will

- Perform or oversee industrial hygiene surveys
- Review associated JHAMs and AHAs during industrial hygiene surveys and provide corrective feedback as needed
- Notify supervisors and personnel of monitoring results
- Test and mark hazard control ventilation systems, and maintain associated database of such systems
- Recommend engineering or administrative controls to prevent personnel exposure to chemical, physical, or biological hazards
- Recommend warning signs where appropriate
- Maintain industrial hygiene survey and calibration equipment
- Maintain industrial hygiene survey records, notifications of personal monitoring memos, and equipment calibration logs
- Provide or coordinate hazard-specific training for personnel who work with hazardous materials or carcinogens

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• Review plans for new operations and significant changes to ongoing operations that involve hazardous materials or carcinogens
• Provide industrial hygiene oversight for subcontractor activities

5.1.7.2 Medical Department

The SLAC Medical Department conducts all required medical surveillance (see Chapter 3, “Medical”\(^{20}\)).

5.1.7.3 Managers and Supervisors

Managers and supervisors will
• Review proposed processes involving chemical, physical, or biological hazards with the industrial hygiene program manager before installing new or moving existing equipment
• Obtain industrial hygiene surveys
• Ensure engineering controls (such as hazard control ventilation) are meeting minimum performance standards and effectively preventing personnel over-exposure to chemical, physical, or biological hazards
• Red-tag hazard control ventilation equipment that does not meet minimum performance standards and prevent the use of hazardous materials or agents needing ventilation until such equipment is repaired or replaced
• Follow up on recommendations provided by industrial hygiene staff
• Ensure all chemicals and carcinogen containers display manufacturer’s warning labels or appropriate substitute labels (see Chapter 40, “Hazardous Materials”\(^{21}\))
• Ensure areas where chemicals and carcinogens are used have the proper warning signs displayed, in consultation with the industrial hygiene program manager
• Choose less-hazardous or non-carcinogenic materials whenever possible, in consultation with the industrial hygiene program manager
• Include qualitative exposure assessment of chemical, physical, and biological hazards during the development and annual review of JHAMs and AHAs

5.1.7.4 ES&H Coordinators

ES&H coordinators will
• Be familiar with the requirements of this chapter

5.1.7.5 Hazard Control Ventilation System Custodians

Hazard control ventilation system custodians will

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- Check systems and report any malfunction or system degradation through the Facilities Department service desk system\textsuperscript{22}
- Ensure deficient ventilation systems are not used until repaired
- Mark the system with a warning sign and effectively restricting activities as needed to prevent personnel over-exposure to contaminants until the system is repaired

5.1.7.6 Personnel

Personnel will
- Complete required training in hazardous materials usage before working with them
- Receive medical monitoring as required by this chapter and related chapters
- Refrain from consuming food or beverages (including chewing gum) in any industrial area where chemicals are used
- Use hazard control ventilation and personal protective equipment provided
- Report unusual odors or suspected exposures to supervisors and the industrial hygiene program manager

5.2 Procedures and Specific Requirements

The following document is required. For a full list of implementing documents, see Section 6, “Exhibits”.

5.2.1 Hazard Control Ventilation

Requirements for ventilation equipment, use, and inspection (see Industrial Hygiene: Hazard Control Ventilation Requirements\textsuperscript{23})

5.3 Training

No specific courses are required by this chapter. ES&H Training provides occupational hazard safety training for managers, supervisors, and personnel (including the use of appropriate PPE and the proper response to exposure).

Managers and supervisors must ensure that personnel are fully trained regarding occupational hazards and must occasionally provide on-the-job training. Consult the SLAC Training Assessment to determine personnel training requirements.\textsuperscript{24}

\textsuperscript{22} “CEF Service Request System”, \url{https://www-internal.slac.stanford.edu/cef/NonSafety/Default.htm}

\textsuperscript{23} Industrial Hygiene: Hazard Control Ventilation Requirements (SLAC-I-730-0A09S-021), \url{http://www-group.slac.stanford.edu/esh/eshmanual/references/IHReqVent.pdf}

\textsuperscript{24} “Training - SLAC Training Assessment”, \url{http://www-group.slac.stanford.edu/esh/training/sta/default.htm}
6 Exhibits

- Industrial Hygiene: Implementation Plan (SLAC-I-730-0A09M-004)\(^{25}\)
- Industrial Hygiene: Hazard Recognition Guidelines (SLAC-I-730-0A09T-019)\(^{26}\)
- Industrial Hygiene: Exposure Assessment Strategy, Surveying, and Monitoring Guidelines (SLAC-I-730-0A09T-020)\(^{27}\)
- Industrial Hygiene: Hazard Control Ventilation Requirements (SLAC-I-730-0A09S-021)\(^{28}\)
- Hazardous Materials: Fume Hood Velocity Survey Form (SLAC-I-730-0A09J-002)\(^{29}\)
- Hazardous Materials: Fume Hood Survey Sticker (SLAC-I-730-0A09J-004)\(^{30}\)
- *SLAC Chronic Beryllium Disease Prevention Program* (SLAC-I-730-0A09M-001)\(^{31}\)
- Industrial Hygiene Document Database\(^{32}\)
- “Ventilated Lab Hoods”\(^{33}\)

7 References

*SLAC Environment, Safety, and Health Manual* (SLAC-I-720-0A29Z-001)\(^{34}\)

- Chapter 1, “General Policy and Responsibilities”\(^{35}\)
- Chapter 2, “Work Authorization”\(^{36}\)
- Chapter 3, “Medical”\(^{37}\)
- Chapter 9, “Radiological Safety”\(^{38}\)


\(^{32}\) [http://134.79.80.221:2004/](http://134.79.80.221:2004/)

\(^{33}\) [http://www-group.slac.stanford.edu/esh/groups/cgs/ih/vent_hoods.htm](http://www-group.slac.stanford.edu/esh/groups/cgs/ih/vent_hoods.htm)

\(^{34}\) [http://www-group.slac.stanford.edu/esh/eshmanual/](http://www-group.slac.stanford.edu/esh/eshmanual/)

\(^{35}\) [http://www-group.slac.stanford.edu/esh/general/general_policy/policies.htm](http://www-group.slac.stanford.edu/esh/general/general_policy/policies.htm)

\(^{36}\) [http://www-group.slac.stanford.edu/esh/general/work_authorization/policies.htm](http://www-group.slac.stanford.edu/esh/general/work_authorization/policies.htm)

\(^{37}\) [http://www-group.slac.stanford.edu/esh/medical/chapter/policies.htm](http://www-group.slac.stanford.edu/esh/medical/chapter/policies.htm)

\(^{38}\) [http://www-group.slac.stanford.edu/esh/general/radiological_safety/policies.htm](http://www-group.slac.stanford.edu/esh/general/radiological_safety/policies.htm)
Chapter 10, “Laser Safety”
Chapter 18, “Hearing Conservation”
Chapter 19, “Personal Protective Equipment”
Chapter 20, “Lead Safety”
Chapter 27, “Asbestos”
Chapter 29, “Respiratory Protection”
Chapter 32, “Polychlorinated Biphenyls”
Chapter 34, “Biohazards”
Chapter 36, “Cryogenic and Oxygen Deficiency Hazard Safety”
Chapter 40, “Hazardous Materials”
Chapter 46, “Blood-borne Pathogens”

Other SLAC documents

- *SLAC Chemical Hygiene Plan* (SLAC-I-730-0A09M-001)
- “The ES&H Industrial Hygiene Group”

Other

- Assay Technologies, *Industrial Hygiene Sampling Guide*
- Occupational Safety and Health Administration (OSHA), *OSHA Technical Manual* (TED 01-00-015 [TED 1-0.15A])

41  [http://www-group.slac.stanford.edu/esh/general/ppe/policies.htm](http://www-group.slac.stanford.edu/esh/general/ppe/policies.htm)
51  [http://www-group.slac.stanford.edu/esh/groups/cgs/ih/](http://www-group.slac.stanford.edu/esh/groups/cgs/ih/)
52  [http://www.assaytech.us/ihsginfo.htm](http://www.assaytech.us/ihsginfo.htm)
National Institute of Occupational Safety and Health (NIOSH), *NIOSH Manual of Analytical Methods (NMAM)* (original publication 94-113, August 1994)\(^{54}\)


Other laboratories

- *Jefferson Lab Environment, Health & Safety Manual* (September 2006)\(^ {56}\)
- Lawrence Berkeley National Laboratory, *Health and Safety Manual*, Chapter 4, “Industrial Hygiene” (June 2006)\(^ {57}\)
- Stanford University, *Biosafety Manual* (2005)\(^ {58}\)
- American Conference of Governmental Industrial Hygienists, *Industrial Ventilation: A Manual of Recommended Practice* (ACGIH 2094, 2004)\(^ {59}\)

### 8 Implementation

The requirements of this chapter will be implemented according to Industrial Hygiene: Implementation Plan.\(^ {60}\)

### 9 Ownership

Department: Chemical and General Safety

Program: Industrial Hygiene

Owner: Program Manager

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\(^{54}\) [http://www.cdc.gov/niosh/nmam/](http://www.cdc.gov/niosh/nmam/)


\(^{57}\) [http://www.lbl.gov/ehs/pub3000/CH04.html](http://www.lbl.gov/ehs/pub3000/CH04.html)


# Industrial Hygiene: Implementation Plan

**Department**: Chemical and General Safety  
**Program**: Industrial Hygiene  
**Owner**: Program Manager  
**Authority**: ES&H Manual, Chapter 5, Industrial Hygiene

The requirements of Chapter 5, “Industrial Hygiene”, will take effect according to the following schedule.

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12 Jan 2007 (updated 30 Sep 2007)
Industrial Hygiene: Hazard Recognition Guidelines

Department: Chemical and General Safety
Program: Industrial Hygiene
Owner: Program Manager
Authority: ES&H Manual, Chapter 5, Industrial Hygiene

Proper implementation of the industrial hygiene program protects personnel from chemical, physical, and biological hazards. An initial step in the program is hazard recognition.

Types of Hazards

Chemical Hazards
Chemical hazards exist when there is the risk of direct skin contact, inhalation, accidental ingestion, or absorption of hazardous chemicals in the form of liquids, solids, vapors, gases, dusts, fumes, or mists. In general, the degree of risk associated with handling a specific chemical depends on the toxicity of the chemical and the magnitude and duration of the exposure. (See the chemical safe use guidelines under Chapter 40, “Hazardous Materials”, for identifying, documenting, and handling specific chemical hazards.)

Physical Hazards
Physical hazards monitored by industrial hygienists include excessive levels of noise and vibration, pressure, temperature extremes, oxygen deficiency, and non-ionizing radiation (including ultraviolet, visible, infrared, radiofrequency, microwave, laser, static magnetic fields).

Biological Hazards
Biological hazards include any virus, bacteria, fungus, protozoan, insect, or other living organism that can cause a disease in healthy humans, or damage to the environment. These materials include such agents as blood-borne pathogens, recombinant DNA molecules, and human tissue and cell cultures. Biological hazards may exist as part of the total environment (for example, in air or water), or they may be associated with specific research or industrial operations. (See Chapter 34, “Biohazards”.)

Recognizing Hazards
Industrial hygienists identify hazards by

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Maintaining familiarity with SLAC processes
Reviewing area hazard analysis (AHA) documents, job hazard analysis and mitigation (JHAM) documents, job safety analysis (JSA) documents, and pre-work hazard analysis (PWHA) documents as needed to identify activities requiring industrial hygiene consideration
Observing employee activities (such as chemical handling, procedural steps)
Surveying existing conditions (ventilation, sanitation)
Collecting preliminary screening samples
Collecting information on physical, chemical, and biological hazards
Conducting personnel and work area air monitoring
Collecting wipe samples

Industrial Hygiene: Exposure Assessment Strategy, Surveying, and Monitoring Guidelines

Department: Chemical and General Safety
Program: Industrial Hygiene
Owner: Program Manager
Authority: ES&H Manual, Chapter 5, Industrial Hygiene

Exposure Assessment Strategy

SLAC is committed to controlling exposures to chemical and physical hazards within recommended exposure guidelines or consensus standards through the development and implementation of an exposure assessment strategy. The overall approach links job hazard analysis and mitigation (JHAM), area hazard analysis (AHA), exposure assessment, and medical surveillance with prevention and control to reduce the risk of exposure and prevent adverse health effects. The industrial hygiene group uses pre-established and approved methods and rationale to characterize and monitor workers’ potential exposures to chemical and physical hazards. The exposure assessment strategy applies to all activities (including design, construction, operation, maintenance, decontamination, decommissioning, and environmental restoration activities) performed by SLAC personnel.

The goal of SLAC’s exposure assessment strategy is to protect workers by controlling potential exposures to less than 10 percent of the occupational exposure limits (OELs). The OEL is defined as the more protective limit of either Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs) or American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLVs).

The industrial hygiene group performs risk-based evaluations of new or modified processes involving chemical and physical hazards and performs baseline exposure assessments. These and other assessments, along with written reports, are located in the Industrial Hygiene Document Database. The industrial hygiene group also reviews JHAMs and AHAs in conjunction with baseline assessments to ensure accuracy and thoroughness.

An industrial hygienist will consider the following parameters during a risk-based industrial hygiene assessment:

- Type of hazard (chemical, physical, and biological)
- Toxicity
- Quantity in use
- Duration of use
- Past monitoring data
- Established occupational exposure models

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- Employee input (such as complaints or the presence of odor)
- Professional judgment and experience

SLAC’s exposure assessment process is depicted by the following flow chart.

Figure 1 Exposure Assessment Flow Chart


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Qualitative Exposure Assessment

Considerations
Qualitative exposure assessment is an integral part of job hazard analysis and work planning processes. During the development and annual review of JHAMs and AHAs, line managers and supervisors will include qualitative exposure assessment of chemical, physical, and biological hazards.

The qualitative exposure assessment includes an evaluation of potential exposures via inhalation, ingestion, dermal contact, physiological interactions, and ergonomic factors. The predominant exposure determinants and events (such as frequency, magnitude, and variability of exposure and tasks; route of exposure; potentials for short-duration tasks and exposures [acute] and long-term or frequently repeated tasks and exposures [chronic]; and the adequacy and potential for failure of engineering and work practice controls) should be considered and documented as a part of the qualitative exposure assessment.

Minor or No Risk of Exposure
If the qualitative exposure assessment indicates a minor or no risk of exposure, no further action (such as quantitative monitoring or the implementation of prevention and control measures) is required. One example of a minor or no exposure risk may include the review of a baseline exposure assessment (from the Industrial Hygiene Document Database) for a similarly exposed group that shows a measured concentration of the material that is less than 10 percent of the applicable occupational exposure limit. Another example could be where a tested, ventilated laboratory hood is properly used for the effective capture of an approved, airborne hazardous material.

For unacceptable exposure risk (estimated to be above 10 percent of the OEL), or if exposure risk is uncertain, a quantitative exposure assessment is required, and implementation of prevention and control methods may be indicated.

Guidance for Line Managers
Following an industrial hygiene survey, results and recommendations are sent to supervisors in the form of a written report. Line managers and supervisors should incorporate these recommendations when revising JHAMs and AHAs. Copies of industrial hygiene reports are available in the Industrial Hygiene Document Database.

Periodic Reassessment
The SLAC industrial hygiene group will conduct risk-based qualitative reassessments of existing operations at SLAC on a biannual basis, so that each work area will be re-evaluated at least once every two years. For quality control purposes and to ensure an accurate depiction of the potential hazard, the industrial hygiene group must review associated JHAMs and AHAs during recurring industrial hygiene surveys and provide corrective feedback as needed.

**Quantitative Exposure Assessment**

The industrial hygiene group performs surveys to assess potential employee exposures to hazardous materials and contaminants in the workplace. Hazard evaluation surveys often include some type of monitoring, such as air or wipe sampling, to measure the amount or concentration of the hazards.

**Types of Monitoring**

**Personal Air Sampling**

Industrial hygienists use personal air sampling to measure personnel exposure to airborne contaminants. Workplace air is sampled over an eight-hour period (or for the full work shift) and is representative of the individual’s breathing zone. The industrial hygienist also observes and records general information about personnel work processes.

**Area Air Sampling**

Industrial hygienists use area air sampling to define the extent of contamination or to measure the effectiveness of engineering controls. The air sampler is placed in a fixed location in the work area or near the suspected source of the hazard.

**Wipe Sampling**

Industrial hygienists may use wipe sampling to measure surface contamination for selected hazardous materials. Wipe sampling may be used to confirm medical monitoring results when the main entry route of a chemical is through the skin or mouth.

**Obtaining Monitoring**

Industrial hygiene monitoring takes place as a result of the following.

**Individual Requests**

Personnel at SLAC should discuss industrial hygiene concerns with their supervisors then contact the industrial hygiene group to request monitoring.

The requestor or area manager must notify the industrial hygiene group of changes in their work area that involve ventilation, new machinery, or new chemical processes. The industrial hygiene group arranges for appropriate evaluation and monitoring of the work environment based on the proposed use and associated hazards of the chemicals or contaminants. To request a survey, contact the industrial hygiene group.

**Chemical Purchases**

The industrial hygiene group is notified when new chemicals are added to SLAC’s chemical inventory.\(^6\) During procurement of a new chemical which raises a health concern, the industrial hygiene group may request to evaluate the storage and use of the chemical before approving the purchase.

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Design Review
When new projects at SLAC are reviewed, the design review coordinator forwards packages involving chemicals and other contaminants to the industrial hygiene group for evaluation. The industrial hygiene group identifies any areas of concern, provides comments and recommendations for safe use, and may require monitoring before equipment start up.

OSHA-required Monitoring
SLAC regularly monitors the workplace for certain contaminants as required by the federal Occupational, Safety, and Health Administration (OSHA), such as lead, beryllium, asbestos, welding on paint, hydrogen cyanide and chromium mists during electroplating. Monitoring is required when industrial hygienists believe that occupational exposures may exceed the administrative control level of 10 percent of the occupational exposure limit (OEL) (see Section 3, “Definitions”, in Chapter 5). Once the exposure is quantified by an industrial hygienist, additional monitoring is required as outlined in the following table.

<table>
<thead>
<tr>
<th>Percentage of OEL</th>
<th>Industrial Hygiene Monitoring Frequency</th>
<th>Duration of Industrial Hygiene Monitoring at Specified Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 100%</td>
<td>Continuously</td>
<td>Until controls reduce exposures to less than 100%</td>
</tr>
<tr>
<td>Between 50%-100%</td>
<td>Every six months</td>
<td>Until controls reduce exposures to less than 50%</td>
</tr>
<tr>
<td>Between 10%-50%</td>
<td>Biannually</td>
<td>Until controls reduce exposures to less than 10%</td>
</tr>
<tr>
<td>Less than 10%</td>
<td>No monitoring required</td>
<td>Until a change in the work environment or worker concern suggests that monitoring is required</td>
</tr>
</tbody>
</table>

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Industrial Hygiene: Hazard Control Ventilation Requirements

Department: Chemical and General Safety
Program: Industrial Hygiene
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Authority: ES&H Manual, Chapter 5, Industrial Hygiene

Ventilated Laboratory Hoods

A ventilated laboratory hood is a local hazard control ventilation device designed to protect workers from the hazards of airborne contaminants. Hoods also help protect people and property against small fires and explosions. (For an inventory of ventilated lab hoods at SLAC, see “Ventilated Lab Hoods”.

Other Hazard Control Ventilation Systems

Other hazard control ventilation systems, such as those in use in the electroplating, welding, and paint shops, are evaluated by the industrial hygiene program manager for adequate contaminant control as part of a periodic survey. Other ventilation systems may include soldering bench hoods, extractor arms, glove boxes, and biological safety hoods or cabinets.

Surveys

The industrial hygiene program manager conducts annual surveys of the use and performance of hazard control ventilation. Additionally, ventilation system owners can request a performance test upon the unit’s installation, when there is a change in operation, or when there is a suspected air flow issue.

Labeling

The industrial hygiene program manager records the results of the ventilation tests by updating the sticker attached to the system, usually at the point of use. The information on the sticker includes the name of the tester, the test date, and the measured flow rate. The sticker also indicates the proper alignment of the sash or slide gate damper (as applicable) to ensure adequate airflow. The results of calibrations, tests, and certifications are recorded in a database maintained by the industrial hygiene program manager.

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Industrial Hygiene: Hazard Control Ventilation Requirements

Monitoring
Some ventilated laboratory hoods have electronic flow monitors that continuously indicate the velocity of air flowing into the hood.

Use
The following precautions should be taken to reduce exposures to airborne contaminants:

- Keep the hood sash or slide gate damper (as applicable) set at the approved level or set point to provide proper air flow.
- Take care in placing equipment in chemical hoods; avoid restricting air flow or creating a fire hazard.
- Confirm the system is operational before using.
- Do not allow large equipment to be placed in front of ventilation hoods or system intakes as this could restrict air flow and reduce ventilation efficiency.
- Ensure the ventilation system is rated for the maximum hazard level of the intended operation.

Performance Standards
Laboratory fume hoods and local exhaust ventilation systems are addressed generally in standards, which incorporate references that provide specific design criteria and techniques to verify the system is in working order. The industrial hygiene program manager evaluates hazard control ventilation systems for the control of occupational hazards using the current edition of the American Conference of Governmental Industrial Hygienists, *Industrial Ventilation: A Manual of Recommended Practice.* See examples of hood face velocity sheet and fume hood survey stickers.

Upon testing, if a ventilation system fails to meet the minimum performance standard, the industrial hygiene program manager will send a report to the system’s custodian. It is the responsibility of the custodian to ensure that the deficient ventilation system is repaired and is not used until that time. Until the deficiency is corrected, the custodian will mark the system with a warning sign and effectively restrict activities as needed to prevent personnel over-exposure to contaminants.

New local exhaust ventilation systems and hoods must meet the requirements of building and fire codes and industry standards, and each hood must have a monitor that quantitatively displays the hood’s performance to the user.

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HEPA Filters
High efficiency particulate air (HEPA) filters may be used to filter hazardous chemical or biological contaminants from air streams with an efficiency of 99.97 percent. HEPA filters used for hazard control can be found in vacuum cleaners used to clean up dust and debris that contain asbestos, lead, or other particulates, biological safety cabinets in which biohazardous materials are handled, and in-place ventilation exhaust systems connected to lab hoods and glove boxes.

HEPA filters used to protect employees must be maintained according manufacturers’ specifications. Using air sampling or direct ventilation measurement techniques, the industrial hygiene program manager evaluates processes where HEPA filters are used as part of hazard control ventilation. For information regarding the evaluation of HEPA filtering systems or changing HEPA filters used for hazard control, contact the industrial hygiene program manager.

Other Ventilation Equipment
The following ventilation systems are not covered by the industrial hygiene program:

1. Ventilation systems that provide fresh and recirculated air to office and other working spaces
2. Other ventilation systems that handle non-hazardous exhaust from general laboratories or shops, vacuum pump equipment, and mechanical rooms

These and similar systems are maintained and monitored by the Facilities Department.