

Industrial Hygiene & Hazardous Material

Management Laboratory Manual

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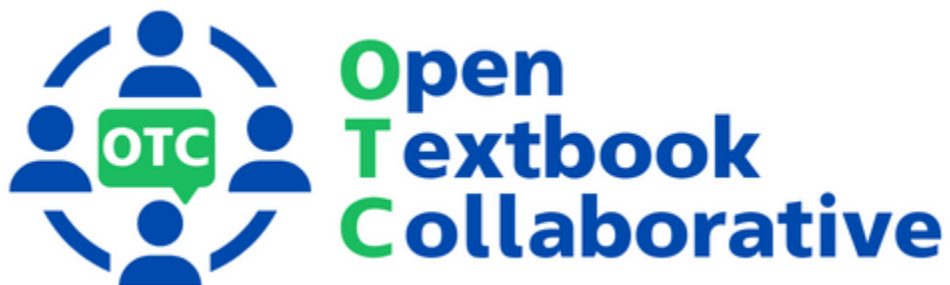
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Industrial Hygiene & Hazardous Materials Management

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Open Textbook Collaborative

The [Open Textbook Collaborative](#). (OTC) project is a statewide project managed by Middlesex College along with assistance from Brookdale Community College, Ocean County College, Passaic County Community College, and Rowan University.

The project engages a consortium of New Jersey community colleges and Rowan University to develop open educational resources (OER) in career and technical education STEM courses.

The courses align to [career pathways in New Jersey's growth industries](#) including health services, technology, energy, and global manufacturing and supply chain management as identified by the New Jersey Council of Community Colleges.

Industrial Hygiene & Hazardous Material Management Laboratory Manual



Foreword

The 10 laboratory experiments in this manual have been formatted to introduce beginning students to various aspects within the industrial hygiene/hazardous materials management program.

These experiments are meant to enhance the learnings of the teachings and the textbook of the lecture section of the course.

Together, the student will experience the base knowledge necessary to begin their journey into the expanding and constantly adapting world of industrial hygiene and hazardous materials management.

With the enhanced learning of the industrial hygiene/hazardous material management techniques and with the hands-on applications provided with these experiments, a fostering of continued learning perpetuates significant knowledge gains within this study.

As the student learns world applications, they will appreciate the important work to be accomplished.

Emphasis on terminology, diagrams, illustrations, ease of experimentation along with integration of successive labs was paramount when preparing this lab manual for the student's use.

Enjoy.....and learn.

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SECTION II THE LABS

Lab 1: NIOSH Methods

Background:

NIOSH has the mandate to assure “every man and woman in the Nation safe and healthful working conditions and to preserve our human resources.” The Occupational Safety and Health Act of 1970 established the National Institute for Occupational Safety and Health (NIOSH) as a research agency focused on the study of worker safety and health, and empowering employers and workers to create safe and healthy workplaces. When workplaces have hazards present, it is often the responsibility of the employer to quantitatively assess an employee’s exposure to these hazards. NIOSH has developed methods to standardize the assessment of hazards in the workplace.

Objectives

The objectives of the NIOSH Methods lab is to

- Understand how NIOSH methods are used in the field
- Understand the limitations of certain NIOSH methods in different situations.

Materials

- Various NIOSH methods
 - o NIOSH Method 1400 - Particulates Not Otherwise Regulated (PNOR):
 - o NIOSH Method 7300 - Elements by ICP (Inductively Coupled Plasma)
 - o NIOSH Method 2016 - Diesel Particulate Matter (DPM)
 - o NIOSH Method 5515 - Organophosphorus Compounds (AChE Inhibitors):

- Various Pumps and collection materials
- Chain of Custody

NIOSH Experiment 1: Comparing Different NIOSH Methods

Experiment 1 Setup

- Layout various NIOSH Methods and pumps, collection media, and Chain of Custody

Experiment 1

- Review the differences between NIOSH methods and compare the different types of pumps and collection media

Experiment 1 Discussion and Follow-up

- Discuss the differences in these methods and discuss any changes you think are appropriate, adding or taking away anything from these programs.

NIOSH Experiment 2: Mock NIOSH Method Test

Experiment 2 Setup

- Review mock company sampling request.

Experiment 2

- Develop and implement mock testing via NIOSH methods.

Experiment 2 Discussion and Follow-up

- Present your mock sampling procedure to the class.

Lab 2: Hazard Controls

Background:

Controlling exposures to hazards in the workplace is vital to protecting workers. The hierarchy of controls is a way of determining which actions will best control exposures. The hierarchy of controls has five levels of actions to reduce or remove hazards. The preferred order of action based on general effectiveness is: Elimination, Substitution, Engineering controls, Administrative controls, and Personal protective equipment (PPE)

Objectives

The objective of the Hazard Control Lab is to

- Identify common techniques for each of the hazard controls.
- Know how to properly implement these controls into your health and safety program in an effective manner.

Materials

- Local ventilation systems
- Air flow measuring devices.
- Various PPE
- General Industry Respiratory Protection Standard
- General Industry PPE standard
- Common Elimination, Substitution, and Administrative Control

Techniques

Hazard Controls Experiment 1: Assessment of controls

Experiment 1 Setup

- Layout various Personal protective equipment and ventilation systems

Experiment 1

- Review the differences between the PPE, ventilation systems, and different elimination, substitution, and administrative control.

Experiment 1 Discussion and Follow-up

- Discuss the differences in the control methods evaluated and discuss when it is appropriate to implement these controls

Engineering Controls Experiment 2: Mock implementation of controls

Experiment 2 Setup

- Review mock company hazard assessment.

Experiment 2

- Develop and implement mock hierarchy of control methods.

Experiment 2 Discussion and Follow-up

- Present your mock sampling procedure to the class.

Lab 3: Health and Safety Programs

Background:

Having detailed and implemented written Health and Safety Programs can provide necessary structure to an organization to uphold standards of health and safety during highly stressful periods of competing production and profitability. Some OSHA standards require written compliance programs while others may not. Having a detailed written safety and health program will enhance an organization's safety culture.

Objectives

The objective of the Health and Safety Programs Lab is to

- Identify key parts of a Health and Safety Program
- Know how to properly implement an effective Health and Safety Program

Program

Materials

- Copies of the following standards
 - o Hazard Communication (29 CFR 1910.1200)
 - o Lockout/Tagout (29 CFR 1910.147)
 - o Confined Spaces (29 CFR 1910.146)

- o Bloodborne Pathogens (29 CFR 1910.1030)
- o Process Safety Management (29 CFR 1910.119):
 - MS office

H&S Program Experiment 1: Safety Program Evaluation

Experiment 1 Setup

- Layout OSHA Safety Programs that require written compliance programs

Experiment 1

- Compare written compliance program requirements, noting the similarities and differences between them.

Experiment 1 Discussion and Follow-up

- Discuss the differences in these program requirements and discuss any changes you think are appropriate, adding or taking away anything from these programs.

H&S Program Experiment 2: Mock Safety Program Implementation

Experiment 2 Setup

- Review mock companies work practices and organizational structure

Experiment 2

- Develop and implement mock Safety Programs for these work practices.

Experiment 2 Discussion and Follow-up

- Present your mock program to the class.

Lab 4: Phase I and II Environmental Site Assessments

Background:

Properly conducting Phase I and Phase II environmental site assessments (ESA) is of paramount importance for a variety of reasons. A Phase I ESA serve as a critical initial step in identifying potential environmental risks associated with a property, helping to mitigate financial and legal liabilities for prospective buyers, sellers, or property developers. A Phase II ESA involve more in-depth, intrusive investigations, including soil and groundwater sampling, to confirm or rule out the presence of contaminants. This step ensures that any discovered environmental issues are thoroughly understood and properly evaluated. Together, these assessments help to safeguard not only the financial interests of stakeholders but also the

overall well-being of communities and the preservation of natural resources, making them integral components of responsible environmental management and sustainable development.

Objectives

The Objective of the Phase I and II ESA lab is to

- Understand the basis for PH I/II ESAs and the applicable ASTM standards including ASTM E1527-21 and ASTM E1903-19;
- Differentiate between an area of concern (AOC) and a recognized environmental condition (REC);
- Understand use of information requests (FOIA) and regulatory database products for assessments;

Learn about safety considerations when conducting PH I/II ESAs. Materials

- CERCLA Section 107(b);
- Applicable ASTM standards; Set of historical Sanborn Fire Insurance maps for Ocean County College;
- Set of historical USGS topographical maps for Ocean County College;
- Current OCC site plan;
- U.S. Geological Survey Report providing depth to groundwater information for Ocean County.

Phase I and II ESA Experiment 1: Identification of “Recognized Environmental Condition” (REC)

Experiment 1 Setup

- Review CERCLA 107 (b) and ASTM E1527-21;
- Identify, review and understand innocent landowner defense;
- Identify, review and understand differences between Areas of Concern (AOCs) and Recognized Environmental Conditions (RECs);

Experiment 1

- Using historical information assess development of the OCC campus over time;
- Identify information regarding historical use that may be considered an AOC or REC including land use patterns, hazardous materials or fuel storage, and waste conveyance or collection systems. Document findings with rationale on item selection;
- Inspect the laboratory building including lab rooms and basement. Identify AOCs or RECs, document findings with rationale on item selection.

Experiment 1 Discussion and Follow-up

- Conduct a group discussion and provide written summary regarding the regulatory basis of Phase I ESAs;
- Discuss and document the primary differences between an AOC and

REC. Provide an explanation as to why this is important to a financial entity investing in a property and funding the Phase I ESA.

- Discuss and document as a group; safety considerations associated with completion of a Phase I ESA site visit.

Phase I and II ESA Experiment 2: Phase II ESA Plan Development

Experiment 2 Setup

- Layout and orient the OCC Site Plan;
- Review the USGS hydrogeological report, identify depth to groundwater and flow gradient information;

Experiment 2

- Using information developed from Experiment 1 plot all identified AOCs and RECs that could impact soil or groundwater quality on the OCC Site Plan;
- Using USGS hydrogeological and topography information plot estimated groundwater flow direction;
- Select two primary AOCs/RECs. Using the site plan plot soil boring and groundwater well locations. Include information regarding depth of soil samples and depth of groundwater well installation;
- Document all information presented in the marked-up OCC site plan in an Xcel spreadsheet that includes soil boring and groundwater well locations, descriptions, # of samples, and rationale for placement;

Experiment 2 Discussion and Follow-up

- Review sampling plan including site plan and spreadsheet. Discuss any differences within the group regarding selection of soil and groundwater sample points;
- Discuss and document as a group; safety considerations associated with the implementation of the sampling plan such as installing soil borings and groundwater wells, as well as protection against potential contamination that may be present.

Lab 5: Environmental Stressors

Background:

Environmental stressors, such as heat stress and ergonomic stress, can have a profound negative impact on worker safety and overall well-being. Heat stress, often a consequence of working in hot or humid environments, can lead to heat-related illnesses like heat exhaustion and heatstroke. Workers experiencing such conditions may exhibit symptoms like dizziness,

weakness, nausea, and confusion, which can impair their decision-making abilities and physical coordination, ultimately jeopardizing their safety. Additionally, ergonomic stress, stemming from poor workplace design, repetitive tasks, or improper body positioning, can result in musculoskeletal disorders and chronic pain. These conditions not only reduce worker productivity but also increase the risk of workplace accidents and injuries.

Objectives

The Objective of the Environmental Stressors Lab is to

- Identify how heat stress and ergonomic stress can impact worker safety and health
- Know how to control these hazards on various job sites.

Materials

- Hand tools
- Computer station
- Thick gloves
- Heavy clothing
- Various sized boxes with materials in them

Environmental Stressors Experiment 1: Assessment of Environmental Stressors

Experiment 1 Setup

- Layout various clothing materials and work station set ups

Experiment 1

- Compare the various work station set ups and environments that could contribute to Ergonomic and heat stress.

Experiment 1 Discussion and Follow-up

- Discuss the differences in the control methods evaluated and discuss when it is appropriate to implement these controls

Environmental Stressors Experiment 2: Mock implementation of controls

Experiment 2 Setup

- Review mock company work station.

Experiment 2

- Develop and implement Ergonomic and Heat stress assessment.

Experiment 2 Discussion and Follow-up

- Present the results of your mock assessment to the class.

Lab 6: Noise

Background:

Noise is a by-product of many industrial processes. Sound consists of pressure changes in a medium (usually air), caused by vibration or turbulence. Exposure to high levels of noise causes hearing loss and may cause other harmful health effects as well. The extent of damage depends primarily on the intensity of the noise and the duration of the exposure. Noise is measured in Decibels on a logarithmic scale that translates the increasing pressure changes to numbers that can be taken action on. Noise is often experienced by a worker from Continuous, Intermittent, and or Impulsive sources.

- Continuous noise is noise that is experienced without interruption
- Intermittent noise is experienced in cycles thought a time period, sometimes high sometimes low
- Impulsive noise is sudden bursts of noise

Employers who have employees that are exposed to noise at or above 85 decibels (dB) averaged over 8 working hours, or an 8-hour time-weighted average (TWA) must implement a hearing conservation program.

Objectives

The objective of the noise lab is to

- Understand how noise is measured at the workplace.
- Understand and implement parts of a mock hearing conservation program.
- Understand the limitations of hearing protection PPE.
- Understand the limitations of reporting on noise data in the workplace.

Materials

The following materials will be used during this lab.

- A copy of 1910.95 Occupational noise exposure.
- Noise source
- Noise level meter
- Noise dosimeter
- Graph paper
- Audiometric test
- Ear Plugs
- Earmuffs

Noise Experiment 1: Instrument / PPE Specification Test

Experiment 1 Setup

- Layout the Noise Level Meter, Noise Dosimeter, Ear Plugs, and Earmuffs.
- Set up noise source.

Experiment 1

- Inspect the equipment and PPE, noting specifications and limitations.
- Practice donning and doffing PPE and engaging with collection materials.

Experiment 1 Discussion and Follow-up

- Discuss the differences in design, materials, and comfort among the provided ear protection options and come up with a plan for measuring and recording noise levels at various locations and distances from the noise source.

Noise Experiment 2: Mock Employee Noise Exposure Assessment

Experiment 2 Setup

- Review mock company's noise generating inventory list

Experiment 2

- Develop and implement a mock employee noise exposure assessment.

Experiment 2 Discussion and Follow-up

- Present the results of your mock assessment to the class.

Lab 7: Lead

Background:

Lead has the highest atomic number of any stable (non-radioactive) element. It is a dense, heavy metal – yet it is soft and can be shaped and stretched without breaking. For these reasons, it was mixed with products to enhance durability of paints, cosmetics, ammunition, fuel, plumbing systems, roofing systems, welding, and much more. Unfortunately, ingestion or inhalation of lead is toxic to humans and children who ingest lead at home or school are at greatest risk of lead poisoning.

The following Federal regulations are present to manage lead exposure with the goal of employee health.

- General Industry Standard by OSHA is 1910.1025
- Construction Standards by OSHA is 1926.62
- EPA title X

Objectives

The objective of the lead lab is to

- Understand how lead exposure is measured at the workplace.
- Understand and implement mock methods of compliance according to OSHA standards.
- Understand the lead building inspector responsibility under Title X
- Understand the limitations of reporting on lead data.

Materials

The following materials will be used during this lab.

- Flow Pump
- Ghost wipe
- Inspection paper
- Paint chip collector
- PPE

Lead Experiment 1: Instrument / PPE Specification Test

Experiment 1 Setup

- Layout the Flow Pump, Ghost Wipe, Chain of Custody, Gloves, Coverall, Respirator.

Experiment 1

- Inspect the equipment and PPE, noting specifications and limitations.
- Practice donning and doffing PPE and engaging with collection materials.

Experiment 1 Discussion and Follow-up

- Discuss the differences in design, materials, and comfort among the provided ear protection options and come up with a plan for measuring and recording noise levels at various locations and distances from the noise source.

Lead Experiment 2: Mock Employee lead exposure assessment / EPA building inspection

Experiment 2 Setup

- Review mock company's blueprints and plan to handle lead materials.

Experiment 2

- Develop and implement a mock lead exposure assessment / EPA building inspection.

Experiment 2 Discussion and Follow-up

- Present the results of your mock assessment / inspection to the class.

Lab 8: Mold, Dust, and Allergen Assessment Experiment

Background:

Building occupants are impacted by mold and allergens differently due to varying sensitivities. Mold and allergens in the air and on surfaces can be attributed by some of the following things

- Mold growth in building materials due to prolonged moisture
- Mold growth on surfaces due to elevated humidity
- Mold growth in HVAC systems
- Presence of Pollen, of pests, fiberglass

Objectives

The objective of the Mold and Allergen lab is to

- Understand how mold and allergen exposure is measured.
- Understand the limitations of reporting on lead data.

Materials

- Bio Pump
- Aircell cassettes
- Anderson Pumps
- Auger Plates
- Tape samples

Mold, Dust, and Allergen Experiment 1: Instrument / PPE Specification Test

Experiment 1 Setup

- Layout various pumps and collection materials

Experiment 1

- Review the differences between the pumps and collection materials

Experiment 1 Discussion and Follow-up

- Discuss the differences in what each pump and collection materials.

Mold, Dust, and Water Experiment 2: Mock Mold, Dust, ad Allergen

Assessment

Experiment 2 Setup

- Review mock complaint regarding mold, dusts, and allergens

Experiment 2

- Develop and implement a sampling strategy to address this complaint.

Experiment 2 Discussion and Follow-up

- Present the sampling strategy to the class

Lab 9: Asbestos

Background:

Asbestos is a naturally occurring fiber that has material strengthening properties, insulating properties, fireproofing properties, and sound proofing properties. Asbestos is present in a lot of current building materials, Asbestos containing building materials (ACBM). Unfortunately, asbestos fibers that are inhaled pose a risk of disease that can lead to death and disturbing asbestos containing building materials can lead asbestos fibers becoming airborne to be inhaled.

The following Federal regulations are present to manage the disturbance of ACBM with the goal of employee health.

- General Industry Standard by OSHA is 1910.1001
- Construction Standards by OSHA is 1926.1101
- Asbestos Hazard Emergency Response Act by the EPA

Objectives

The objective of the asbestos lab is to

- Understand how asbestos exposure is measured at the workplace.
- Understand and implement mock methods of compliance according to OSHA standards.
- Understand the asbestos building inspector responsibility under AHERA
- Understand the limitations of reporting on asbestos data in the workplace.

Materials

The following materials will be used during this lab.

- A copy of 1910.1001 Asbestos standard
- A copy of 1926.1101 Asbestos Standard
- A copy of AHERA Inspection guidelines
- Asbestos pump + media
- Bulk media collection kit
- Calibration kits
- Nosh methods

Asbestos Experiment 1: Instrument / PPE Specification Test

Experiment 1 Setup

- Layout asbestos pump and media, gloves, Respirator, and coveralls.

Experiment 1

- Inspect the equipment and PPE, noting specifications and limitations.
- Practice donning and doffing PPE and engaging with collection materials.

Experiment 1 Discussion and Follow-up

- Discuss the differences in design, materials, and comfort among the provided ppe and come up with a plan for measuring and recording asbestos levels at various locations and individuals based on the work task.

Asbestos Experiment 2: Mock exposure assessment / AHERA building inspection.

Experiment 2 Setup

- Review mock company's blueprints and plan to handle Asbestos containing materials.

Experiment 2

- Develop and implement a mock asbestos exposure assessment / AHEAR building inspection.

Experiment 2 Discussion and Follow-up

- Present the results of your mock assessment / inspection to the class.

Lab 10: VOC

Background:

Volatile Organic Compounds, VOCs, are any of a large class of chemical compounds in which one or more atoms of carbon are covalently linked to atoms of other elements, most commonly hydrogen, oxygen, or nitrogen that readily vaporizes into the air at typical room temperatures. Common sources of VOCs are

- paints, paint strippers and other solvents
- wood preservatives
- aerosol sprays
- cleansers and disinfectants
- moth repellents and air fresheners
- stored fuels and automotive products
- hobby supplies
- dry-cleaned clothing
- pesticide
- building materials and furnishings
- office equipment such as copiers and printers, correction fluids and carbonless copy paper
- graphics and craft materials including glues and adhesives, permanent markers and photographic solutions.

Exposure to VOCs may cause health effects that include

- Eye, nose and throat irritation
- Headaches, loss of coordination and nausea
- Damage to liver, kidney and central nervous system

Key signs or symptoms associated with exposure to VOCs include:

- conjunctival irritation
- nose and throat discomfort
- headache
- allergic skin reaction
- dyspnea
- declines in serum cholinesterase levels
- nausea
- emesis
- epistaxis
- fatigue
- dizziness

Some types of VOCs are regulated by OSHA's general industry and constructions Subpart Z - Toxic and Hazardous Substances but there are no enforceable standards for non industrial settings.

Objectives

The objective of the VOC lab is to

- Understand how VOC exposure is measured at the workplace.
- Understand and implement mock methods of compliance according to OSHA standards.
- Understand the limitations of reporting on VOC data.

Materials

- Various sources of VOC
- VOC monitoring equipment
- VOC NIOSH method materials
- Chain of custody

VOC Experiment 1: Instrument / PPE Specification Test

Experiment 1 Setup

- Layout the tubes, VOC sources, Chain of Custody, PPE, etc.

Experiment 1

- Inspect the equipment and PPE, noting specifications and limitations.
- Practice donning and doffing PPE and engaging with collection materials.

Experiment 1 Discussion and Follow-up

- Discuss the differences in design, materials, and comfort among the

provided ear protection options and come up with a plan for measuring and recording noise levels at various locations and distances from the noise source.

VOC Experiment 2: Mock VOC exposure assessment / inspection

Experiment 2 Setup

- Review mock company's VOC inventory list and complaint of VOC presence.

Experiment 2

- Develop and implement a mock VOC exposure assessment / inspection.

Experiment 2 Discussion and Follow-up

- Present the results of your mock assessment / inspection to the class.