NOVA SOUTHEASTERN UNIVERSITY	ENVIRONMENTAL HEALTH AND SAFETY
POLICY/PROCEDURE TITLE: Industrial Hygiene Plan	POLICY/PROCEDURE NUMBER:

DOCUMENT HISTORY

OWNER:	Facilities Management/AHIS	Date: 1 Sept 2010
APPROVED:	NSU EH&S Committee	Date: 1 Sept 2010
IMPLEMENTED:		Date: 1 Oct 2010
RETIRED:		Date:

Date:	**Revision No.**	**Review / Changes**	**Reviewer**

Distribution: The current version is available via NSU intranet. Paper copies of this document require prior approval before printing

INDUSTRIAL HYGIENE PLAN

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Section 1: Introduction

Industrial hygiene is the science of anticipating, recognizing, evaluating, and controlling workplace conditions that may cause workers' injury or illness. Industrial hygienists use environmental monitoring and analytical methods to detect the extent of worker exposure and employ engineering, work practice controls, and other methods to control potential health hazards.

The U.S. Congress has passed three landmark pieces of legislation relating to safeguarding workers' health: (1) *the Metal and Nonmetallic Mines Safety Act of 1966*, (2) *the Federal Coal Mine Safety and Health Act of 1969*, and (3) *the Occupational Safety and Health Act of 1970 (Act)*. Today, nearly every employer is required to implement the elements of an industrial hygiene and safety, occupational health, or hazard communication program and to be responsive to the Occupational Safety and Health Administration (OSHA) and its regulations.

The aid of an industrial hygienist can provide a university's Environmental Health & Safety's office with expertise in assessing & controlling health issues created by exposure to chemical, physical (noise and temperature) and ergonomic hazards. The services include: program development and implementation guidance, environmental sampling and hazard evaluation, hazard control strategy design, ventilation system assessment, training, and emergency response.

1.1 Occupational Health Hazards

Measures are provided for the control of hazards such as:

a) Chemical (OSHA 29 CFR 1910.1000) - Liquids, dusts, fumes, mists, vapors, or gases. The three routes of entry into the body being inhalation, skin absorption, and ingestion.
b) Physical - Non-ionizing radiation, noise, pressure, vibration, illumination, and temperature extremes.
c) Biological - Viruses, bacteria, fungi, and insects.

1.2 Scope

This plan provides requirements and guidance related to select industrial hygiene concerns, hazards, and controls. Issues which will be covered in this plan include: drinking water, noise, ventilation, indoor environmental quality, asbestos, lead, confined spaces, respirators, and procurement.

Section 2: Asbestos

Asbestos is a naturally occurring mineral fiber that has been mined, processed, and has been in use for thousands of years. It is a general term applied to a highly fibrous mineral. There are two major classes: serpentines and amphiboles. Serpentines have a layered lattice structure in contrast with the amphiboles that have a chain like appearance. Both classes, however, have excellent resistance properties to deterioration caused by chemicals, heat, and exhibit superb electric insulation characteristics. Subsequently, asbestos is found in all kinds of materials such as floor tile and associated adhesives and roofing materials. See Appendix A for a list of materials which can contain asbestos.

In the late 1970's the Environmental Protection Agency implemented a ban on the use of asbestos in various building materials. The ban was a result of public health concerns based on medical evidence compiled through many years. This evidence was gleaned from records of employees in various trades which had significant exposures to asbestos containing materials as well as independent research. The data revealed a correlation between asbestos exposure and the incidence of various forms of cancer, namely: lung, stomach, esophageal, and intestinal. Also, a rare form of cancer, mesothelioma, affecting the chest and abdomen lining has been attributed to asbestos exposure. A latency period of 20-40 years from the time of exposure to the manifestation of the disease was also documented.

In addition to implementing the ban on asbestos, the EPA developed and implemented several regulations pertaining to the handling, removal, and disposal of asbestos containing and/or contaminated materials. See, 40 CFR Part 763 (EPA Worker Protection Rule).

OSHA's primary mission was to institute a governing body to develop regulations and enforce standards to create a safer and healthier work environment. Asbestos is one of many substances that are regulated by OSHA. This hazardous substance has its own specific standard found in regulations for both general industry and construction, and can be found in 29 Code of Federal Regulations (CFR) 1910.1001 and 1926.1101, respectively.

The State of Florida requirements fall under the Florida Statutes 255.551 – 255.565, 469.001 – 469.014; and the Florida Administrative Code Division No. 38I and 61E1.

Asbestos in good condition that remains undisturbed does not represent an exposure hazard unless asbestos fibers become airborne. Therefore, it is a requirement to check with the EH&S before disturbing building materials suspected of containing asbestos.

2.1 Responsibilities

1. The Environmental Health and Safety Office

The Environmental Health and Safety Office (EH&S) provides exposure monitoring services, asbestos awareness training, building inspection/surveys (bulk sampling) for the identification of asbestos containing materials, review of asbestos project designs, asbestos abatement project

inspections and air monitoring services, emergency response to fiber release episodes, and recordkeeping.

Facilities Management shall research whether the building materials that will be impacted by any construction project contains asbestos. If asbestos-containing material (or ACM) will be impacted by renovation/work activity, Facilities Management will conduct one of the following:

a) EH&S will be responsible for determining the projects and contact an asbestos consultant to perform testing before an outside asbestos abatement contractor can be hired to remove the asbestos.
b) If the work is contracted to an outside asbestos abatement contractor, Facilities Management in conjunction with the asbestos consultant will be responsible for managing the project.
c) The asbestos consultant shall provide Facilities Management at EH&S with all inspection data, a copy of the abatement project design, and the projected start/completion dates for the project.
d) Upon project completion, the asbestos consultant shall forward a copy of the post documentation to Facilities Management at EH&S.

2. Director or Department Chair

Directors and/or department chairs are responsible for ensuring the health and safety of employees, faculty, students and visitors in NSU facilities under his/her control. They make necessary provisions, in collaboration with the EH&S, to ensure employees, faculty, students and visitors are protected from any asbestos hazards that are identified.

Directors and/or department chairs are to inform faculty, staff, and students of any asbestos related hazards of which they have been apprised.

3. Building Manager, Department Manager, or Supervisors

Each person responsible for a building facility is responsible for identifying, with the assistance of EH&S, asbestos containing building materials prior to any disturbance of these materials. In collaboration with EH&S, this person implements practices and procedures to protect personnel and building occupants from asbestos hazards.

4. Maintenance and Housekeeping Personnel

All maintenance, construction or housekeeping employees, are responsible for understanding and following the requirements of the Asbestos Control Program.

5. Construction Management and Services, Facilities Design and Planning

Facilities Design and Planning, as well as Construction Management and Services are responsible for identifying and managing asbestos whenever renovation or demolition projects involve the potential disturbance of ACM. The asbestos inspection report and subsequent

project design specifications will be coordinated by the EH&S, who will maintain all documentation relating to asbestos.

2.2 Definitions

Asbestos: includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that has been chemically treated or altered.

Asbestos-Containing Material (ACM): any material containing more than one percent asbestos.

Asbestos-Containing Building Material (ACBM): any surfacing ACM, thermal system insulation ACM, or miscellaneous ACM that is found in or on interior structural members or other parts of a building.

AHERA: Asbestos Hazard Emergency Response Act

Class I Asbestos Work: the removal of thermal system insulation and/or surfacing material (ACM or PACM).

Class II Asbestos Work: removal of any ACM which is not Class I, such as wallboard, floor tile, ceiling tile, linoleum, transite board, roofing materials and mastics.

Class III Asbestos Work: repair and maintenance operations where ACM is likely to be disturbed.

Class IV Asbestos Work: maintenance and custodial activities during which individuals contact but do not disturb ACM, and activities to clean up dust and debris which may be generated by Class I, II, or III work.

Clearance Air Monitoring: Air monitoring conducted by a State Licensed Asbestos Project Monitor at the conclusion of an asbestos project. Clearance air monitoring includes the successful completion of a final visual inspection for work area debris and the collection and analysis of air samples in accordance with Florida Regulation. The abatement project is considered complete when clearance air samples are analyzed by phase contrast microscopy using the NIOSH 7400 method result in a fiber concentration less than or equal to 0.010 fibers per cubic centimeter of air.

Disturbance: activities that disrupt the matrix of ACM, crumble or pulverized ACM, or generate visible debris from ACM.

Encapsulation: treatment of ACBM with a material that surrounds or embeds asbestos fibers in an adhesive matrix to prevent the release of fibers.

Friable Asbestos Containing Material: any material containing more than one percent asbestos, which when dry, may be crumbled, pulverized or reduced to powder by hand pressure.

High Efficiency Particulate Air (HEPA) Filter: a filter capable of trapping and retaining at least 99.97 % of all mono-dispersed particles of 0.3 micrometers in diameter.

Negative Exposure Assessment (NEA): a demonstration by the employer, which complies with the criteria in OSHA 29 (CFR) 1926.1101 paragraph (f) (2) (iii), that the individual exposure during the monitored operation is expected to be consistently below the PELs.

Non-Friable Asbestos Containing Material: materials in which asbestos is bound in a matrix which cannot, when dry, be crumbled, pulverized or reduced to powder by hand pressure (such as floor tile and asphaltic building materials).

Permissible Exposure Limits (PELs): regulatory limits on the amount or concentration of a substance in the air.

1. Time Weighted Average (TWA): the employer shall ensure that no individual is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter as an eight (8) hour time weighted average.
2. Excursion Limit (EL): the employer shall ensure that no individual is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air as averaged over a sampling period of thirty (30) minutes.

Presumed Asbestos Containing Material (PACM): thermal system insulation and surfacing material in buildings constructed no later than 1980 are assumed to contain asbestos until it has been analyzed to verify or negate its asbestos content.

Regulated Area: means an area established by the employer to distinguish areas where airborne concentrations of asbestos exceed or there is a reasonable possibility that they may exceed the permissible exposure limits.

Vinyl Asbestos Floor Tile (VAT): vinyl floor tile and in some cases its mastic which contain more than one percent asbestos and must be handled as ACM.

2.3 Hazard Identification

Precautions

Do not touch asbestos containing materials on walls, ceilings, pipes or boilers. All staff and students are NOT to drill holes, hang plants or other objects from building components made from or which may contain asbestos materials. Beware of asbestos-containing materials when replacing light bulbs and do not disturb damaged ACMs or asbestos debris.

Building Surveys

EH&S will coordinate the completion of a comprehensive building survey for suspect asbestos-containing materials for each building on NSU campus. This project will occur in phases based upon building classification and the following priority schedule:

- Residence Halls
- Houses (perimeter properties)
- Academic / Administrative Buildings
- Miscellaneous
- New Acquisitions

A qualified individual holding a valid and current Florida Department of Business and Professional Regulation (DBPR) Asbestos Inspector License will conduct building surveys. The Project Manager for construction projects should consult with EH&S records during project planning stages to determine whether or not a completed survey is available prior to any building renovation and or demolition activity. Where no previous survey has been conducted or incomplete bulk sampling of existing suspect ACM's which may be impacted during renovations, it will be the responsibility of Facilities Management at EH&S to ensure a Industrial Hygiene Consultant is hired to conduct a survey (asbestos inspection) as a component of the project. This survey may be a comprehensive building survey or a survey limited in scope to the sections of the building where asbestos disturbance may occur.

All surveys will be conducted with the oversight of EH&S and will include:

a. Mechanical Room Signage and Labeling
b. Bulk sampling and analysis by polarized light microscopy in accordance with method EPA/600/R-93/116 of all homogeneous areas
c. Floor plans identifying material locations
d. Tables identifying room locations, classes of materials and estimated quantities
e. Abatement Cost estimates
f. Recommendations regarding conditions of materials
g. A statement of compliance with the NESHAPs survey requirements and the credentials of the Asbestos Inspector.

Each time a significant asbestos abatement project is conducted, Facilities Management will commission the Industrial Hygiene Consultant to update the existing survey to reflect the changes in the building conditions. Updates of the existing survey may include records such as:

a. A letter of addendum to be attached to the building survey indicating amounts and locations where asbestos was removed.
b. A modified building floor plan identifying areas where asbestos containing materials remain.

Asbestos building surveys shall be accessible to all University Faculty, Staff, and Students during normal business hours of EH&S.

2.4 Bulk Samples

Bulk samples may be collected at any time there is a question regarding the asbestos content of a building component. An inspector holding a valid Florida Department of Business and Professional Regulation Asbestos Inspector's license must collect bulk samples. EH&S will, in

conjunction with the industrial hygiene consultant, collect bulk samples upon request and arrange for laboratory analysis of the material. An area of homogeneous material may be considered to be ACM without analyzing any remaining samples if one bulk sample analysis shows more than 1% asbestos. If all of the required samples collected contain less than 1% asbestos as found by an accredited laboratory, then the area of homogeneous material may be treated as non-ACM. Results of analyses will be maintained in EH&S files.

2.5 Air samples

When friable ACM is removed or non-friable ACM becomes friable during removal, and the amount of material is 3 square or linear feet or greater, final air clearance sampling must be conducted. For abatement projects 3 linear feet or square feet to 260 linear or 160 square feet, PCM clearance testing is required. Projects with areas greater than 260 linear or 160 square feet, require TEM clearance testing. All final clearance testing must follow the published AHERA protocol methods.

2.6 Warning Signs

Warning signs are required for all regulated areas which is a zone where airborne asbestos fiber levels are likely to exceed the permissible exposure limit (PEL) of 0.10 fiber per cubic centimeter of air as an 8 hour time weighted average, or the excursion limit of 1.0 fibers per cubic centimeter of air as a 30 minute period, as established by OSHA Construction Standard 1926.1101. All active asbestos abatement projects will be classified as regulated areas. A space with significantly damaged ACM might also be restricted and deemed a regulated area.

All asbestos regulated area signs must read:

RESTRICTED AREA - DANGER
ASBESTOS CONTAINING MATERIAL
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY

If the asbestos regulated area also requires respiratory protection and protective clothing, the sign must also state:

RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA

Signs are to be in comprehendible languages with graphics when warranted to ensure that the employee, faculty and student population in the immediate area fully understands the warning. This will be determined on a case by case basis by Facilities Management.

Signs are to be posted at the entrance to mechanical rooms/areas in which employees, faculty and students reasonably can be expected to enter and which contain ACM and/or PACM. Below is an example of what a sign must read for an area with asbestos insulation, similar signs must be used for other asbestos related conditions.

The sign for asbestos thermal systems insulation material must read:

WARNING
Pipe insulation and other thermal system insulation in this area/room
CONTAINS ASBESTOS
AVOID CREATING DUST
If disturbance of this material is anticipated during any work duties
then contact the Environmental Health & Safety Office at 262-8800
prior to beginning work.

2.7 Training

There are various levels of training required for employees, faculty and students depending on the type of involvement with asbestos material. Each department is responsible for ensuring employees, faculty, and students who may be in contact with ACM receive training for their level of asbestos involvement. EH&S will assist with training.

1. Awareness

Class IV worker awareness training as outlined in OSHA Construction Standard 1926.1101 requires two hours of awareness training for all employees performing custodial and maintenance work within 30 days of initial assignment to a building containing asbestos or presumed asbestos containing material and annual training thereafter.

2. Class I and Class II

Class I and II worker training are for university employees who will perform disturbances and small scale removal of ACM as part of their duties. The training shall follow the EPA Model Accreditation training guidelines. See Appendix B - OSHA 1926.1101(k)(9) regulations on employee information and training.

2.8 Exposure Assessments

NSU will hire an outside abatement contractor and a licensed consultant for any testing that is required by law to be conducted by individuals holding special licenses and certifications. These abatement projects which may result in exposure to asbestos above the OSHA permissible exposure limit (PEL) and short-term exposure limit (STEL). Where work practices are conducted near asbestos containing materials and there is a concern for a potential disturbance of asbestos fibers, EH&S will arrange for exposure monitoring to assess individual exposure levels.

For any one specific task that will be performed by employees who have been trained in compliance with the OSHA, EPA and Florida DEP regulations, the employer must demonstrate that the employee exposures will be below the OSHA allowable exposure limits. This assessment will include a review of objective data, work practices, training, and exposure monitoring, as defined in the OSHA regulations.

Specific work practices are described in the established work practices which might result in new exposures to your Supervisor for review by EH&S. Examples of tasks and associated work practices where negative exposure assessments have been achieved are listed below:

a. Buffing VAT flooring
b. Repair, remove or disturb the insulation within fire doors
c. Routine work in the Central Heating Plant
d. Painting plastered ceilings or removing ceiling tiles containing ACM
e. Knife cutting of small holes in VAT to allow for drilling beneath for cable work
f. Routine work in mechanical rooms
g. Routine plumbing work in mechanical rooms
h. Routine work above ceilings near ACM
i. Repair and/or removal of roofing materials with the exception of flashing, coatings, adhesives and mastics.

2.9 Vinyl Asbestos Floor Tile Removal

Removal of individual intact asbestos tiles may be conducted safely following prescribed work practices. Removal of large quantities of tile, and any removal project that involves breaking tiles (such as lifting carpet over VAT) must be conducted as an asbestos abatement after the appropriate notification period.

2.10 Asphalt Roofing Material Removal

All suspect roofing materials shall be sampled for asbestos content following the State of Florida sampling criteria prior to disturbance or removal of the material. The roofing condition shall be assessed by a licensed Asbestos Consultant and a recommendation made to Facilities Management regarding the appropriate response action and use of a Florida licensed asbestos abatement contractor or a Florida certified roofing contractor.

2.11 Medical Surveillance

All employees, faculty and students who perform asbestos work for a minimum of 30 days per calendar year or have been exposed at or above the permissible exposure limit are required to cooperate with necessary medical consultations and examinations. Employees who are required to wear negative pressure respirators are also required to have medical examinations and consultations. Days when asbestos work is conducted for less than sixty minutes are not counted towards the 30-day accrual time for medical surveillance. The medical examinations are repeated annually or could be more frequent as determined by the physician.

Prior to a medical examination, the University must provide the physician with:

a. The affected individual's duties as related to the exposure;
b. The individual's exposure level or anticipated exposure level;

c. Description of any personal protective equipment used by the individual; and
d. Any information from previous medical examinations that may not be available to the examining physician.

Medical examinations for purposes of asbestos work includes, but is not limited to, the following:

a. Medical and work history
b. Pulmonary function test
c. Chest X-ray
d. Any examinations or tests deemed necessary by the physician

EH&S will maintain all confidential medical surveillance records for the duration of the individual's association with the University (whether it be employment or as a student) plus 30 years, these records may retain abbreviated documents, such as a brief physician's written opinion about whether or not the effected individual may wear respiratory protection.

Records maintained by Health Services shall include:

a. Individual's name and social security number
b. The individual's medical exam results, including the medical history, questionnaires, responses, test results, and physician's recommendations
c. The physician's written opinions
d. Any employee, faculty and student medical complaints related to asbestos exposure
e. A copy of any information provided to the examining physician

Medical surveillance records will be made available to the tested individual, anyone having specific written consent of this individual, and OSHA's Assistant Secretary.

2.12 Recordkeeping

The following asbestos management documents will be stored in permanent files in EH&S:

a. Air and bulk sampling records
b. Inspection and survey reports
c. ACM disturbances reports
d. Industrial Hygiene plan
e. Asbestos waste shipment records and abatement information.

The records of all employees, faculty and students engaged in asbestos-related work shall be maintained in EH&S for at least 30 years. These records include personal air sampling, medical and training records.

Section 3: Indoor Air Quality

Nova Southeastern University is concerned about indoor air quality (IAQ) and committed to providing a work environment that is free of recognized hazards. The IAP policy was adopted to protect employees, faculty, and students and the public from unsafe indoor air quality such as Sick Building Syndrome or Building-Related Illnesses.

EH&S will coordinate appropriate and practical proactive, investigative, and corrective measures concerning IAQ matters with all University departments.

3.1 Scope

This plan is extended to the entire university campus as NSU recognizes the impact that indoor air quality has in the workplace.

The objectives of this plan include the following:

a. To prevent illness and adverse health symptoms associated with poor indoor air quality
b. To respond to indoor air quality complaints effectively and make recommendations for improvement
c. To provide information to employees, faculty and students about indoor air quality
d. To maintain indoor air quality within acceptable levels according to consensus guidelines.

3.2 Definitions

Airborne infectious agents - human-generated infectious agents include viruses and bacteria.

Air cleaners - portable units that include humidifiers, dehumidifiers, and air fresheners.

Ambient air - outside air is drawn into or mechanically introduced to the inside of a building. The quality of outside air is generally believed to be 200% to 500% better than indoor air.

Air contaminant - a gaseous, liquid, or solid substance or combination of substances in a form transported by or in air that has the potential to be detrimental to human health.

ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers, Incorporated.

Carbon Dioxide – a colorless, odorless gas that can also be liquid or solid. OSHA permissible exposure limits are 5000 ppm. ASHRAE standard 62-2003 (Ventilation for Acceptable Indoor Air quality) recommends that CO_2 levels be maintained below 1000 ppm.

Carbon Monoxide – a colorless, odorless gas that interferes with the delivery of oxygen throughout the body. OSHA exposure limits are 35 ppm time weighted average.

Humidity - high humidity levels and/or the presence of water act as hosts for biological contaminants. Low humidity causes the eyes to dry out results in dry skin etc. ASHRAE recommends comfort levels of relative humidity of 30% to 60%.

Indoor air pollution - gases, particles, and microbioal contaminants.

Multiple Chemical Sensitivity (MCS) - acquired disorder characterized by reoccurring symptoms in multiple organ systems caused in response to exposure to many chemically unrelated compounds at doses well below established standards.

Ozone - a molecule of three atoms of oxygen. Found in the stratosphere is good but when the source is from air cleaners, bleach, deodorizing agents, and outdoor air then this is bad ozone which is very corrosive and can cause lung inflammation.

Radon - colorless, odorless gas and radioactive gas when released from the soil or rock as uranium naturally breaks down. It has been found in well water.

Sick Building Syndrome - when building occupants experience acute health or discomfort effects in the form of headaches, dizziness, sinus congestion, itchy or watery eyes and an inability to concentrate that "appear" to be linked with the time spent in the building.

Ventilation or Air Exchange Rate - number of times a volume of indoor air is replaced by an equal volume of (fresh) outdoor air.

3.3 Building Design

The design, physical layout, mechanical systems, equipment and space usage are elements that can affect air quality. Building layout can create physical barriers that impede the flow and distribution of air, which can impact the quality of air in a given area.

With a new building or a renovation, pollutant "pathways" have to be considered in design and physical layout to allow airborne gases and particles to migrate to different areas of buildings. These pathways may not be obvious and are not necessarily physically defined. Pollutants can travel by air movement or pressure differential where unwanted contamination move from areas of relative positive pressure to those of relative negative pressure through a path of least resistance.

New buildings - design and construction standards that facilitate the maintenance of acceptable IAQ should be established.

Site and Facility Planning - building design should consider the following:

a) Building structure factors - shape and size, orientation, layout, proximity to pollution-generating activities, building materials, ventilation system design, location of air intakes and exhausts, and susceptibility to pest intrusion should be considered.

b) Internal contaminant sources - proper venting to the outside atmosphere of pollution source areas such as laboratories should be provided.
c) Loading docks - designed that vehicle exhaust is prevented from entering enclosed work spaces.
d) Moisture prevention - water intrusion, condensation, water vapor intrusion, and other moisture problems in the building must be avoided through the proper design and installation of the building components.

Space allocation - building space must be adequate for maintenance access and proper operation of building equipment, such as the HVAC system.

Building materials, interior finishes and furnishings - building materials must be the lowest chemical-emitting materials, interior finishes and furnishing should be practical. Materials for buildings must prevent microbial growth and porous or fleecy materials are discouraged which can absorb moisture.

HVAC system – design of system should include the following components:

- Air intakes - sufficient acceptable outside air to maintain a healthy environment in all occupied areas should be provided.
- Air distribution - proper air distribution should be provided to all occupied areas.
- Filters - medium to high efficiency filtering systems should be used.
- Access doors/ports - convenient to facilitate inspection, maintenance and cleaning of air handling units and ducts.
- Coils - adequate heating and/or cooling capacity.
- Drain pans - insulated drain pans with proper slope and drainage to prevent standing water should be installed on all new cooling coils.
- Drain lines and traps - drain lines need to be adequately sloped to provide proper drainage with drain traps installed.
- Ducts - internal surfaces can be easily cleaned.
- Return air - ducting of return air is recommended.
- Exhaust systems - adequate systems for restrooms, storage rooms, chemistry lab etc.
    1. exhausts should be vented directly to the outside
    2. located to avoid contaminants being drawn back into the building and no closer than 25 feet from an air intake.

Air diffusers - used to manage air flow volumes, mixing and patterns for occupant comfort. Normal occupied spaces should have an average air velocity between 20 and 50 feet per minute in the occupied zone.

Controls - proper controls and energy management systems should be installed to maintain recommended interior conditions. Thermostats should be installed in every room. Humidistat should be used in room where humidity control is important.

3.4 Poor Quality Air - Symptoms

Typical symptoms arising from poor indoor air quality mimic those symptoms commonly associated with a cold, flu or allergies. Symptoms may include upper respiratory irritation, congestion, headaches, nausea, fatigue, and itchy or watery eyes.

3.5 Factors affecting Indoor Air Quality

1. Inadequate ventilation

Inadequate ventilation occurs when an insufficient amount of fresh outside air is supplied to the interior environment, or the ventilation system have not been designed to account for building remodeling and or additions.

2. Contamination from inside buildings

Contaminants can be released from copiers and fax machines, pesticides, cleaning agents, sewer gas from dry traps and cosmetics. Many building maintenance activities are potential sources of volatile organic compounds (VOC's). Particulate matter is also considered an air contaminant and includes dust, pollen, mold spores and bacteria.

3. Contamination from outside the building

Exterior contaminants include, but are not limited to, exhaust from motor vehicles and fumes from construction or renovation.

4. Microbial contamination

Microbial contamination includes fungus (mold) in buildings that are susceptible to water leaks and other sources of moisture.

5. Building material contamination

Building components treated with a variety of chemicals and preservatives are common sources of indoor air quality problems. Glues and adhesives from new carpeting, upholstery are sources of contamination.

6. Temperature and relative humidity

The optimal temperature and relative humidity need to be maintained at all times to prevent moisture build up and IAQ problems.

Factors effecting IAQ with Standards and Guidelines

Parameters	Health effects	Sources	Limit / Range	References
Temperature			70 to 74 ^{o}F Winter 74 to 78 ^{o}F Summer	ASHRAE Standard 55-1992, OSHA
Relative Humidity	Low humidity - dry eyes and skin		20% to 60%	ASHRAE Standard 55-1992, OSHA
Air Movement			25 to 45 ft/minute	ASHRAE
Ventilation (fresh air)			15 to 60 cfm/ person minimum	ASHRAE Standard 62-2003
Ventilation (CO_2)			No more than about 400 ppm over outdoor ambient	ASHRAE Standard 62-2003
Particle Concentration in Cleaned HVAC systems			1.0 µg/100cm^2	NADCA 1992-01
Carbon Monoxide	Nausea, headaches, visual disturbances, brain damage, angina	Auto exhaust, hot water heaters, furnaces	50ppm- 8hr TWA 35ppm - 8hr TWA 9 ppm - 8hr TWA 9 ppm (peak) 9 ppm & no greater than 2 ppm above outdoor levels	OSHA NIOSH EPA ASHRAE LEED EQ Credit 3.2
Formaldehyde	Mucous membrane irritation, fatigue	Particle board, plywood, adhesives	PEL: 0.75 ppm, AL: 0.5 ppm - 8hr TWA 0.05 ppm	OSHA 1910.1048 LEED EQ Credit 3.2
Ozone	Upper respiratory irritation, dry eyes	Copiers, laser printers, air ionizers	0.1 ppm - 8hr TWA	OSHA 1910.1000 Table Z-1
Organic Vapors	Upper respiratory irritation, fatigue and nausea	Paints, solvents, disinfectants and plastics	Varies per chemical, IAQ Guideline: 50 ug/m^3 (TVOC)	 LEED EQ Credit 3.2
Dusts	Upper respiratory irritation, dry throat, rhinitis	Various	10 mg/m^3 total dust, 5 mg/m^3 respirable fraction - 8 hr TWA 0.05 mg/m^3 (PM10)	OSHA 1910.1000, table Z-1 LEED EQ Credit 3.2
Biological Agents - fungi, bacteria, viruses, protozoa	Hypersensitivity, pneumonitis, chronic rhinitis	Various	None available	

3.6 Maintaining Acceptable IAQ

To accomplish acceptable indoor air quality, the following measures should be taken:

a. Monitor the operations of the HVAC equipment. Repair and adjust the system as required to maintain proper air flow within occupied spaces.

b. Facilities department should perform regular scheduled maintenance of the HVAC system, with scheduled filter changes to keep the HVAC system running and providing clean air.
c. Identify any external intake of air contamination and relocate the equipment/source so it will not impact the IAQ. For example, pigeon nest near or in the building air intake.
d. Identify any internal sources of air contamination and eliminate the sources. Substitute with materials that do not generate problems.
e. If necessary, the internal source can be isolated with a physical barrier or by using air pressure differential.
f. Good housekeeping will help maintain indoor air quality by controlling odors and dust within the occupied space.
g. Review all cleaning and maintenance materials to ensure they do not emit objectionable odors or vapor into the indoor environment.
h. Minimize volatile organic compounds (VOC's) by purchasing and using low-emission building materials, paints, carpeting and furniture.
i. Porous building supplies which have become water-damaged should be discarded to avoid the potential for mold contamination.
j. During renovation activities, areas need to be isolated and enhanced ventilation provided to prevent dust and odors from impacting occupants within the building.
k. Minimize the length of time staff and students are exposed.
l. Dilute air pollutants and remove them from the building with increased ventilation.
m. Increase filtration to clean the air and remove pollutants.

3.7 Investigating Indoor Air Quality

It is advisable to consult with an experienced an IAQ professional or industrial hygienist when devising an IAQ investigation. Complaints received by Facilities Management, involving specific symptoms, should be forwarded directly to EH&S for review. Facility staff and campus maintenance workers who identify IAQ problems or risks (odors, faulty building humidification systems) should contact EH&S directly.

1. Initial on-site investigation

When notified, EH&S will conduct an initial on-site investigation and will evaluate the following typical conditions:

a. Percentage (%)of outside air being supplied to building
b. Location of outside air intake(s)
c. Immediate outside environment
d. Ventilation rate
e. Operation and maintenance of HVAC system
f. Relative humidity
g. Temperature
h. Carbon dioxide level
i. Signs of water intrusion including plumbing, roof and foundation leaks.

EH&S will evaluate the work area and building for probable sources of contamination, such as chemical leaks, general housekeeping, recent renovations, and/or new furnishings.

2. Phase II IAQ investigation

A Phase II investigation is usually conducted to provide more detailed information regarding the nature of the problem. The following should be, at a minimum, included in the investigation:

a. Monitoring for chemical contamination
b. Bio-aerosol monitoring
c. Detailed HVAC evaluations
d. Medical examination and/or testing of employees, faculty and students.

3.8 Report and Remedial Measures

Once an investigation has been conducted both by EH&S and a consultant, a written report with the possible causes of the IAQ problem will be submitted to the department and administration office.

EH&S will determine if IAQ risks are actionable by evaluating four variables:

1. Probable source of contamination, its extent or magnitude
2. Number of occupants with symptoms appropriate for the suspected contaminant, and the severity of their symptoms
3. The availability of reasonable and effective measures to mitigate the suspected contaminant
4. Time of exposure of the symptomatic employees, faculty and students to the suspected contaminant.

Remedial measures, when indicated, will be conducted in conjunction with EH&S. When the source of an indoor air quality problem and appropriate remedial measures are difficult to discern, recommendations will rely on the judgment of the industrial hygiene consultant, facility engineer and EH&S.

Section 4: Mold

Molds, a type of fungi, are found both indoors and outdoors. They are necessary for the recycling of organic building blocks that allow plants and animals to live. Molds need external organic food sources and water to be able to grow. Molds can grow on a variety of things including; wood, leather, cloth, carpets, sheet rock, and insulation. It is possible for people to become exposed to molds and their products, either by direct contact on surfaces, or through the air. Many molds reproduce by making spores. When these spores land on a moist food source, they can germinate and begin reproducing. Molds have varying requirements for moisture, food, temperature and other environmental conditions for growth. When excessive moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or unaddressed. Concern about indoor exposure to mold has been increasing as the public becomes aware that exposure to mold can cause a variety of health effects and symptoms.

4.1 Health Effects of Mold Exposure

Mold spores primarily cause health problems when they enter the air and are inhaled in large number. A relatively small number of mold spores can cause health problems in some people and for others it may take many more. Some species of mold, such as Stachybotrys, are capable of producing harmful mycotoxins. The basic rule is, if you can see or smell it, take steps to eliminate the excess moisture, and to cleanup and remove the mold. Allergic reactions may be the most common health problem of mold exposure. Typical symptoms reported (alone or in combination) include:

a. respiratory problems - wheezing and difficulty in breathing
b. nasal and sinus congestion
c. watery, red, burning eyes, light sensitive or blurry vision
d. dry, hacking cough
e. sore or irritated throat
f. nose or skin irritation
g. aches and pains
h. possible fever

4.2 Indoor Air Regulations on Mold

There are no state or federal statutes or regulations at this time regarding molds and indoor air quality. Some public agencies, however, do make publications regarding mold on indoor air quality available to the public. Useful references include the following:

- "Mold Remediation in Schools and Commercial Building," United States EPA - http://www.epa.gov/iaq/molds/mold_remediation.html
- "Mold Facts," Centers for Disease Control - http://www.cdc.gov/NCEH/airpollution/mold/moldfacts.htm
- "Mold and Fungi," and "A Brief Guide to Mold in the Workplace," OSHA Health & Safety Topics - http://www.osha.gov/dts/shib/shib101003.html

4.3 Responsibilities

1. The Environmental Health and Safety Office

EH&S will:

a. Provide oversight and guidance as needed to assure compliance with this policy;
b. Coordinate investigations of employee, faculty or student concerns about mold;
c. Coordinate and assist in arranging for any air, bulk, or other sampling, and evaluating any data generated from the sampling;
d. Develop specifications for mold remediation projects;
e. Maintain contact information of approved consultants and mold remediation contractors;
f. Coordinate mold remediation projects with consultants and remediation contractors;
g. Maintain indoor air quality reports on file;
h. Periodically evaluate the Plan and update as needed.

2. Facilities Management

Facilities Management has the overall responsibility for minimizing and eliminating mold in NSU Campus facilities. The facilities manager is responsible for:

a. Maintaining the building infrastructure in a manner that minimizes the possibility of water damage and moisture build-up;
b. Fixing the underlying cause(s) of water incursion and/or leaks prior to removal and replacement of mold-damaged materials when mold is identified;
c. Coordinating with the necessary department(s) to prepare an area prior to the start of any mold remediation project;
d. Scheduling the removal of mold damaged materials with EH&S, schedule the restoration with facilities employees and/or contractors;
e. Coordinating the cleaning of the ventilation system as needed;
f. Ensuring the facilities staff and contractors comply with the program;
g. Contact EH&S after a leak or flooding is discovered.

3. Faculty, Staff, Employees and Students

All faculty, staff, employees and students are responsible for:

a. Notifying their department heads or supervisors of suspected or visible mold problems;
b. Employees performing clean-up and restoration work must report signs or symptoms that may indicate a reaction to mold exposure, or other agents associated with the work;
c. All other employees and students must report to the University Health Center if they are experiencing health symptoms they attribute to mold exposure at work.

4.4 Preventing and Eliminating Mold

There is no practical way to eliminate all molds and mold spores in the indoor environment; the control moisture is the key to mold control. The following are recommendations in the prevention and elimination of mold at NSU facilities:

a. Fix the source of the water problem or leak to prevent mold growth is the first step, example is leaky plumbing and leaks in the building.
b. Keep heating, ventilation and air conditioning (HVAC) drip pans clean, flowing properly, and unobstructed. Perform regular building/HVAC inspections and maintenance.
c. Reduce indoor humidity (maintain to 30-60%) to decrease mold growth by: venting bathrooms, dryers, and other moisture-generating sources to the outside; using air conditioners and de-humidifiers; increasing ventilation; and using exhaust fans whenever cooking, dishwashing, and cleaning.
d. Clean and dry any damp or wet building materials and furnishings within 24-48 hours to prevent mold growth.
e. Clean mold off hard surfaces with water and detergent (bleach), and dry completely.
f. Replace absorbent materials such as ceiling tiles that are wet and moldy.
g. Reduce the potential for condensation on cold surfaces (i.e., windows, piping, exterior walls, roof, or floors) by adding insulation.
h. Do not install carpeting in areas where there is a perpetual moisture problem, i.e., by drinking fountains, by classroom sinks, or on concrete floors with leaks or frequent condensation.

Mold growth indoors may not always be obvious. Mold can grow on hidden surfaces, such as the backside of dry wall, wallpaper, or paneling, the top of ceiling tiles or the underside of carpets, etc. Other locations of hidden mold can include pipe chases and utility tunnels, walls behind furniture, condensate drain pans inside air handling units, porous thermal or acoustic liners inside ductwork, or roof materials above ceiling tiles.

If a building smells moldy with no visible source, the mold may be hidden and will require investigation by EH&S to identify the source.

4.5 Mold Reporting Procedures

Procedures for reporting mold varies. Each procedure must be evaluated on a case-by-case basis.

1. Flooding or Large Water Leak

In the event of flooding or large water leak, immediately contact Facilities Management and EH&S. Locate and secure the source of the water if possible.

2. Odor

If a musty/moldy odor exists in the building or occupants have reason to suspect the presence of mold, contact EH&S to investigate and resolve the problem(s). EH&S will conduct a thorough

visual inspection and conduct an assessment of the IAQ including all air sampling when deemed necessary.

3. Visible Mold

If visible mold is present, action to be taken will be based on the amount of mold present and the type of material contaminated. Porous materials from which mold cannot be cleaned must be removed from the building. Non-porous building materials must be cleaned using diluted bleach, or specifically formulated cleaners for mold.

4.6 Remediation

Remediation is the restoration satisfactory building conditions by removing or cleaning the contaminated materials. Remediation should be conducted in a manner that prevents the spread of fungi and dust from the work area to adjacent clean areas.

Depending on the extent of the mold growth, the material and the location, the removal of the mold may require isolation or containment of the area. If large areas are affected, it will require evacuation of occupants, and the contracting of trained abatement professionals to perform the remediation.

Once all molds have been removed and the water or moisture problem corrected, air sampling will be conducted to verify all air contaminates have been removed and no further remediation required.

A written report will be filed with EH&S which shall include all air sampling results and any medical investigations of employees, faculty and students.

Section 5: Lead

This Plan is designed to ensure that all University employees, faculty and students are safe from any exposure to hazardous levels of lead through inhalation or ingestion. Lead is a potent neurotoxin and carcinogen that causes reproductive toxicity and is regulated by federal and state agencies. To effectively reduce exposures, the Plan considers the nature of the task involved, confirmed and presumed exposures, and the lead content of the material being used.

OSHA regulation for lead is found in "Lead Exposure in General Industry" (29 CFR 1910.1025) and "Lead Exposure in Construction" (29 CFR 1926.62). The EPA standard is 40 CFR 261.24. Another good resources is the U.S Department of Housing & Urban Development (HUD) Title 10 requirements for the notification, evaluation, and reduction of lead-based paint hazards. Although these HUD requirements only apply to federally owned residential property and housing receiving federal assistance, it is a good guideline for the University.

5.1 Responsibilities

1. The Environmental Health and Safety Office

EH&S is responsible for assuring the effective distribution of this Plan and its annual review. EH&S' responsibilities also include, but are not limited to, the following:

a. Provide technical assistance to Facilities Management regarding specification development; exposure potential of abatement and lead-related construction projects; and monitoring activities.
b. Perform personal and environmental sampling during abatement and other lead-related construction projects.
c. Maintain an inventory of all known lead and lead-based material locations
d. Inspect all phases of abatement projects.
e. Provide hazard communication and PPE training to staff that may be occupationally exposed to lead.
f. Coordinate medical surveillance of workers exposed to lead.
g. Monitor lead-related construction projects to prevent contamination of adjoining areas.

2. Facilities Management

Facilities Management's responsibilities include, but are not limited to, the following:

a. Develop work procedures where there is a potential of disturbing lead containing materials.
b. Assist EH&S with identifying, locating and maintaining of lead-based paint and lead containing construction materials campus-wide.
c. Assist EH&S with the collection of paint chip samples for laboratory analysis.
d. Ensure that all lead-related construction and abatement work is managed by Facilities staff and performed in accordance with current guidelines.

e. Ensure all Facilities Management staff are notified of the presence of lead or lead-based material.
f. Maintain all certifications of abatement and lead-related construction contractors.

5.2 Hazard Assessment

EH&S shall perform lead hazard assessments on all tasks having the potential to expose employees, faculty and students to levels of lead above the OSHA action level of 30 ug/m3 as an eight-hour time-weighted average. The assessments shall include air monitoring and observation of work practices and engineering controls typically used for each task. Unless a task conducted with lead containing material is not anticipated to create dust or debris initial employee, faculty or student monitoring may be required.

5.3 Paint Assessment and Sampling

A State of Florida accredited Lead Inspector shall perform all sampling associated with lead paint activities. EH&S will perform testing of painted surfaces, by request, for non-regulated demolition and renovation projects. EH&S will conduct testing of any painted surfaces to be disturbed within dormitory apartments or target housing. Testing of painted surfaces will be performed by a licensed Lead Inspector with a portable X-Ray Fluorescence (XRF) and/or by lab analysis of bulk paint chip samples by an AIHA accredited laboratory.

Following paint testing, EH&S will provide a written response and recommend case-specific procedures to be followed. Generally, this will include notifying all outside contractors/vendors other than NSU employees of sample results and requesting that written work practices be submitted to EH&S for review.

5.4 Project Oversight

EH&S requires that a State of Florida accredited lead contractor be used for lead paint activities within campus buildings and housing. EH&S also recommends the use of accredited contractors in unregulated renovation projects involving the disturbance of lead-based paint.

EH&S will provide occupants of dormitory apartments and housing with the EPA pamphlet entitled "Protect Your Family from Lead in Your Home" prior to renovations or maintenance activities that disturb more than two square feet of lead-based paint. EH&S will perform air and clearance wipe sampling as required to ensure the safety of building occupants.

5.5 Waste Disposal

EH&S shall perform waste stream characterization of suspected lead containing waste materials by laboratory analysis following EPA Toxicity Characteristic Leaching Procedure (TCLP) for lead (40 CFR 261.24). EH&S will coordinate waste disposal of lead-containing materials.

5.6 Medical Surveillance

In accordance with OSHA 29 CFR 1910.25 and 1926.62, employees who are performing construction work and are occupationally exposed on any day to lead at or above the AL, shall have initial medical surveillance consisting of biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels.

5.7 Training

The EH&S, shall discuss lead exposure as part of its annual Hazard Communication and job tasks that are likely to result in exposure to lead above the OSHA action level of 30 ug/m3 as an eight hour time-weighted average and discuss the importance of worker input in identifying other tasks that may not have been identified by OSHA. Employees will be informed of lead-related services offered through EH&S and trained on the importance of proper hygiene during and after performing tasks that may involve exposure to lead.

5.8 Recordkeeping

EH&S will maintain all documents relating to lead exposure including sampling data, waste disposal manifests, regulatory agency and other correspondence for a period of 30 years.

Section 6: Respiratory Protection Program

Nova Southeastern University has a commitment and responsibility to protect the health and safety of its employees, faculty, students, and visitors when participating in official activities. This program is designed to protect employees, faculty, students and visitors in accordance with OSHA Respiratory Protection Standard, 29 CFR 1910.134 and 29 CFR 1926.103. Many occupational diseases can be effectively prevented by minimizing or eliminating the potential of breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors.

All employees, faculty and students who are required to wear respirators are to follow this program during normal work operations and during certain non-routine or emergency operations. Employees, faculty and students participating in the respiratory protection program do so at no cost to them. The expense associated with medical evaluations, training, and respiratory protection equipment will be borne by NSU.

6.1 Responsibilities

1. The Environmental Health and Safety Office

EH&S administers and oversees the respiratory program and conducts evaluations of the program's effectiveness. Other responsibilities include, but are not limited to:

a. Identifying work areas, processes or tasks that require employees, faculty and students to wear respirators, and evaluate hazards.
b. Selecting the respiratory protection options.
c. Monitoring respirator use to ensure that respirators are used in accordance with their certifications.
d. Coordinating and/or conduct training.
e. Conducting qualitative/quantitative fit testing.
f. Administering the medical surveillance program.
g. Maintaining records.

2. Supervisors

Supervisors are responsible for ensuring that the respiratory protection program is implemented in their particular areas. In addition to being knowledgeable about the program requirements for their own protection, supervisors must also ensure that the program is understood and followed by the employees, faculty and students under their charge. Duties of the supervisor include, but are not limited to:

a. Ensuring employees under their supervision (including new hires) have received appropriate training, fit testing, and medical evaluation.
b. Ensuring the availability of appropriate respirators and accessories.
c. Being aware of tasks requiring the use of respiratory protection.
d. Enforcing the proper use of respiratory protection when necessary.

e. Ensuring respirators are properly cleaned, maintained, and stored according to the respiratory protection plan.
f. Ensuring respirators fit well and do not cause discomfort.
g. Continuing to monitor work areas and operations to identify changes in respiratory hazards.
h. Coordinating with EH&S on how to address respiratory hazards or other concerns regarding the program.

3. Employees, Faculty and Students

Each employee, faculty member and student has the responsibility to wear his or her respirator when and where required and in the manner in which they were trained. Employees, faculty and students must also:

a. Care for and maintain their respirators as instructed and store them in a clean and sanitary location.
b. Inform their supervisor if the respirator no longer fits well and request a new one that fits properly.
c. Inform their supervisor or EH&S of any respiratory hazards that they feel are not adequately addressed in the workplace and of any other concerns that they have regarding the program.
d. Notify their supervisor or EH&S of any other problems associated with using their respirator.

6.2 Respirator Selection

Respirators will be selected with the assistance from EH&S on the basis of many factors including the nature of the hazard, the concentration of the contaminant to which an individual is exposed, extent of the hazard, regulatory and work requirements, work conditions, and the characteristics and limitations of available respirators.

Respirators are available from EH&S. All respirators are NIOSH-certified and are to be used in compliance with the conditions of certification.

1. Specific requirements for the selection of respirators

Respirators are to be selected based on the respiratory hazard(s) to which workers are exposed along with workplace and user factors that affect respirator performance and reliability.

Each supervisor is to evaluate the respiratory hazards in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. EH&S will help supervisors evaluate potential air contaminants and inhalation hazards. The evaluation of respiratory hazards is to include a reasonable estimate of individual exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. If the hazard cannot be identified or the individual’s exposure reasonably estimated, the atmosphere is considered to be IDLH (immediately dangerous to life and health). If an unsafe exposure

situation exists, the feasibility of engineering or administrative controls will be considered. If these preferred methods of controlling exposures are not feasible, appropriate respirators shall be provided and used.

Tight-fitting air purifying respirators shall not be worn when conditions prevent a good face seal. Such conditions include, but are not limited to, growth of a beard, sideburns, any piece of clothing that projects under the face-piece, or temple pieces on glasses. When employees, faculty members or students are required to use tight-fitting air purifying respirators and have facial hair that interferes with seal of the respirator, such as a beard or goatee, the individual shall use a Powered Air Purifying Respirator equipped with a loose-fitting hood. This is the only acceptable respirator to be used under these circumstances.

2. Respirators for Immediately Dangerous to Life and Health (IDLH) Atmospheres

All oxygen-deficient atmospheres, less than 19.5% oxygen, are considered IDLH. The following respirators are to be used in IDLH atmospheres:

1. A Self Contained Breathing Apparatus (SCBA) used in the pressure-demand mode, certified by NIOSH for a minimum service life of thirty minutes, or
2. A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.
3. Respirators provided only for escape from IDLH atmospheres are to be NIOSH-certified for escape from the atmosphere in which they will be used.

All individuals who will be required to use an SCBA must be trained, tested, and certified prior to use.

3. Assigned Protection Factors (APFs)

Employers must use the assigned protection factors listed in Table 1 to select a respirator that meets or exceeds the required level of employee protection. When using a combination respirator (e.g., airline respirators with an air-purifying filter), employers must ensure that the assigned protection factor is appropriate to the mode of operation in which the respirator is being used.

Assigned Protection Factors[5]

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

Notes:

[1] Employers may select respirators assigned for use in higher workplace concentrations of a hazardous substance for use at lower concentrations of that substance, or when required respirator use is independent of concentration.

[2] The assigned protection factors in Table 1 are only effective when the employer implements a continuing, effective respirator program as required by this section (29 CFR 1910.134), including training, fit testing, maintenance, and use requirements.

[3] This APF category includes filtering facepieces, and half masks with elastomeric facepieces.

[4] The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a WPF or SWPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25.

[5] These APFs do not apply to respirators used solely for escape. For escape respirators used in association with specific substances covered by 29 CFR 1910 subpart Z, employers must refer to the appropriate substance-specific standards in that subpart. Escape respirators for other IDLH atmospheres are specified by 29 CFR 1910.134 (d)(2)(ii).

6.3 Respiratory Hazard Evaluation

EH&S will select respirators to be used on-site based on the hazards to which workers are exposed and conduct a hazard evaluation for each operation, process, or work area where airborne contaminants may be present in routine operations or during an emergency.

The hazard evaluation shall include the following:

a. Identification of respiratory hazard sources and development of a hazardous substance list used in the workplace by location or work process.
b. Review of work processes to determine where hazardous exposures occur and the magnitude of the exposures. This review will be conducted by surveying the workplace, reviewing process records, obtaining objective data (if available), and talking with employees, faculty, students and supervisors.
c. When necessary, exposure monitoring will be conducted to measure potential hazardous exposures.

Hazard Evaluation Summary

Department	Contaminants	Exposure Monitoring	Permissible Exposures	Controls
Construction	Lead	20 µg/m3 TWA	50 µg/m3 TWA 30 µg/m3 AL	Hand scraping only
Paint Shop	Methylene bisphenyl isocyanate (MDI)	0.5 ppm Ceiling	0.02 ppm Ceiling	Continuous flow supplied-air respirator required
Hull Fab Shop	Styrene Fiberglass dust	75 ppm TWA 35 mg/m3TWA	50 ppm TWA 100 ppm STEL 10 mg/m3TWA	Box fans Open bay doors
Glue deck	Formaldehyde	0.35 ppm TWA 1.0 ppm STEL	0.5 ppm AL 0.75 ppm TWA 2 ppm STEL	Full-face-piece with formaldehyde canisters required on glue deck
Confined Space Rescue Team	IDLH atmospheres	Assume IDLH	N/A	SCBA required for rescue

6.4 Medical Evaluation

Employees, faculty and students assigned to tasks where respirators are utilized must be physically able to perform the work while using the respirator. Accordingly, the University has the responsibility of ensuring that these individuals are medically fit and able to tolerate the physical and psychological stress imposed by respirator use, as well as the physical stress originating from job and workplace conditions. Individuals will not be allowed to wear respirators until a physician or other licensed health care professional has determined that they are medically able to do so.

Any employee, faculty member or student refusing the medical evaluation cannot work in an area requiring respirator use.

1. Medical determination

EH&S will provide the physician or healthcare professional the following general information before evaluation begins:

a. The type and weight of the respirator to be used by the individual.
b. The duration and frequency of respirator use (e.g., for routine, rescue and escape tasks).
c. The expected physical work effort (e.g., "low", "medium" or "high")
d. Additional protective clothing and equipment to be worn.
e. Estimates of temperature and humidity extremes that may be encountered.
f. Any special or hazardous conditions the individual could encounter.

NSU will obtain a written recommendation from the healthcare professional on whether/or not the employee is medically able to wear a respirator. The recommendation must identify any limitations on the individual's use of the respirator, as well as the need for periodic or future medical evaluations that are required by the healthcare professional.

A powered air-purifying respirator (PAPR) will be provided to any individual if information from the healthcare professional's written recommendation indicates that the employee can use a PAPR but not a negative pressure respirator. If, subsequent to this evaluation, the healthcare professional determines that the employee, faculty member or student is able to wear a negative pressure respirator, NSU will no longer be required to provide a PAPR to that individual.

Individuals who have undergone a medical determination per this section will receive a copy of the healthcare professional's written recommendations directly from the healthcare professional.

2. Additional medical evaluations

Additional medical evaluations will be required when:

a. An employee, faculty member or student reports medical signs or symptoms that are related to the individual's ability to use a respirator;
b. A supervisor, or the EH&S observes that the employee, faculty member or student is having a medical problem during fit testing or workplace respirator use;
c. Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee, faculty member or student re-evaluation; OR
d. A change occurs in workplace conditions (e.g., physical work effort, type of respirator used, protective clothing, and temperature) that may result in a substantial increase in the physiological burden placed on an employee, faculty member or student.

6.5 Fit Testing

Fit testing will be required for all respirators with a tight-fitting face-piece. Fit testing will be performed:

a. After a employee, faculty member or student has completed their medical evaluation and prior to being allowed to wear any respirator with a tight fitting face-piece in the work environment.
b. Whenever a different respirator face-piece is used.
c. At least annually thereafter.
d. When there are changes in the individual's physical condition that could affect respiratory fit (e.g., obvious change in body weight, facial scarring, etc.)

Individuals will be fit tested with the make, model, and size of respirator that they will actually wear. Employees, faculty and students will be provided with several models and sizes of respirators so that they may find the optimal fit. Fit testing of tight-fitting PAPRs is to be conducted in negative pressure mode (i.e., with the fan motor turned off). Fit testing of tight-fitting airline respirators will be conducted using an identical negative pressure air purifying respirator face-piece as a substitute test mask.

If for any reason an employee, faculty member or student finds that the respirator fit is unacceptable, a reasonable opportunity to select a different face-piece and to be retested will be provided. Individuals who voluntarily chose to use air-purifying respirators are not required to be fit tested.

6.6 Proper use of Respirators

1. Face-Piece Seal Protection

Respirators will be used in accordance with specific procedures described in the manual provided by the respirator manufacturer. NSU will not permit respirators with tight-fitting face-pieces to be worn by employees, faculty or students who have conditions that would compromise the face-piece-to-face seal. Individuals with facial hair (e.g., stubble, bangs) that interferes with the face-piece seal or valve function are not permitted to wear tight fitting face-pieces.

Corrective glasses or goggles, or other personal protective equipment, must be worn in such a way that they do not interfere with the seal of the face-piece to the face. Full-face-piece respirators will be provided where either corrective glasses or eye protection is required, since corrective lenses can be mounted inside a full-face-piece respirator.

A user seal check (also known as a fit check) will be performed every time a tight-fitting respirator is put on or adjusted to ensure proper seating of the respirator to the face. The user seal check conducted must be either the positive and/or negative pressure checks.

2. Positive Pressure Check

This user seal check requires the user to close off the exhalation valve and exhale gently into the face-piece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the face-piece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

3. Negative Pressure Check

This user seal check requires the user to close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the face-piece collapses slightly, and hold the breath for ten seconds. Although the respirators currently used by the University can be checked using the palm method, the design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the face-piece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

4. Respirator Effectiveness

EH&S and/or supervisor(s) will be responsible to maintain appropriate surveillance of changes in work area conditions that may increase employee, faculty or student exposure or stress.

Employees, faculty and students will be permitted to leave the respirator use area for the following reasons:

a. To wash their faces and respirator face-pieces as needed to prevent skin or eye irritation associated with respirator use;
b. To replace the respirator or the filter, cartridge, or canister elements if the respirator user can detect vapor or gas breakthrough (by odor, taste, and/or irritation effects), a change in breathing resistance or leakage of the face-piece;
c. To replace the cartridge or canister elements according to the established replacement schedule or when the end-of-service-life indicator shows that the canister or cartridge(s) must be changed;
d. If the respirator is not properly functioning and must be replaced, repaired, or discarded; or
e. If the individual experiences severe discomfort in wearing the respirator or if the employee experiences sensations of dizziness, nausea, weakness, breathing difficulty, coughing, sneezing, vomiting, fever, and chills

In those instances where an individual left the respirator use area because of mechanical issues related to the respirator, the employee, faculty member or student will be allowed back into the respirator use area only after the respirator has been replaced or repaired.

6.7 Maintenance and Care of Respirators

Respirators must be cleaned and disinfected by each individual user and checked to see if in good working order.

Respirators will be cleaned and disinfected as follows:

a. Remove filters, cartridges, or canisters. Remove speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.
b. Wash components in warm (43°C/110°F maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A hard bristle (not wire) brush may be used to facilitate the removal of dirt.
c. Rinse components thoroughly in clean, warm (43°C/110°F maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on face-pieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.
d. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:
    i. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water (one in ten dilution) at 43°C/110°F; or,
    ii. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43°C/110°F; or,
    iii. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.
e. Components should be hand-dried with a clean lint-free cloth or air-dried.
f. Reassemble face-piece, replacing filters, cartridges, and canisters where necessary.
g. Test the respirator to make sure that all components work properly.
    i. Respirators that are issued for the exclusive use of an employee will be cleaned and disinfected as often as necessary to be maintained in a sanitary condition. Employees will be responsible to clean and disinfect respirators issued for their exclusive use.
    ii. Respirators used by more than one employee will be cleaned and disinfected prior to being used by a different individual.
    iii. Respirators maintained for emergency use as well as respirators used in fit testing and training will be cleaned and disinfected after each use.
    iv. During fit-tests, disinfectant wipes can be used in between respirator wears to minimize the risk for spreading cold, influenza or other respiratory illness.

6.8 Training

Employees, faculty and students are to be trained in the respiratory hazards and in the proper use of respirators, including putting on and removing them, any limitations on their use, and the maintenance of respirators. The training must be comprehensive, understandable and cover the following information:

a. The consequences of improper fit, usage, or maintenance on respirator effectiveness will be provided to employees.
    i. Inadequate attention to any of these program elements would obviously defeat the effectiveness of the respirator.
    ii. Proper fit, usage, and maintenance of respirators are critical to ensure employee protection.
b. An explanation of the limitations and capabilities of the respirator selected for employee use.
    i. A discussion of the limitations and capabilities of the respirator will address how the respirator operates.
    ii. Training will include an explanation of how the respirator provides protection by either filtering the air, absorbing the vapor or gas, or providing clean air from an uncontaminated source, as applicable.
c. The procedures for inspecting the respirator, donning and removing it, checking the fit and respirator seal, and actually wearing the respirator.
    i. Employees will be capable of recognizing any problems that may threaten the continued protective capability of the respirator.
    ii. The training will include the steps employees are to follow if they discover any problems during inspection, that is, who the problems are to be reported to and where they can obtain replacement equipment if necessary.
d. The proper procedures for maintenance and storage of respirators.
e. Medical information that is sufficient for them to recognize the signs and symptoms of medical conditions (e.g., shortness of breath, dizziness) that may limit or prevent the effective use of respirators.

Employees, faculty and students will demonstrate their understanding of the information covered in the training through hands-on exercises. EH&S will document respirator training and the documentation will include the type, model, and size of respirator for which each employee has been trained and fit tested.

New employees, faculty and students will be provided respirator training prior to using a respirator in the workplace. Employees, faculty and students will be retrained annually and more often as needed (e.g., if they change area/ location/ position and need to use a different respirator).

6.9 Recordkeeping

EH&S will retain a copy of the healthcare professional's written recommendation for each individual subject to medical evaluation. Each completed medical results of relevant medical

tests, examinations, and diagnosis, etc., will be maintained in EH&S records in accordance with 29 CFR 1910.1020.

EH&S will retain employee, faculty and student training records that include the names of individuals trained and the dates when training was conducted. All written materials required to be maintained under the recordkeeping requirements will be made available, upon request, to the individual who is subject of the records and to regulatory agencies.

Section 7: Occupational Noise

Noise levels that can cause interference with verbal communication when people are only a few feet away from each other may be high enough to produce a risk to hearing. NSU's plan requires occupational exposure to noise be maintained below the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) through the use of engineering and administrative controls, personal protective equipment, and other elements comply with OSHA 29 CFR 1910.95.

All NSU employees, faculty and students whose noise exposures equal or exceeds an 8-hour time weighted average (TWA) of 85 decibels will be enrolled in the noise program.

Under the OSHA regulation, the occupational noise program must include:

a. Annual monitoring of noise exposures
b. Annual training on noise exposures
c. Use of hearing protectors
d. Engineering and/or administrative controls
e. Annual audiometric testing of exposed employees

7.1 Exposure Limits

NSU uses the ACGIH threshold limit values for determining noise exposures and for complying with OSHA's regulation. The eight-hour TWA is 85 decibels (dBA). This is the maximum weighted-average noise level that employees may be exposed to without hearing protection during an eight-hour work shift. OSHA requires implementation of noise exposure controls at exposures at or above 85dBA and that hearing protection be offered.

ACGIH Noise TLV Limits

Duration Per Day (hours)	Sound Level (dBA)
16	82
8	85
6	86
4	88
3	89
2	91
1.5	92
1	94
0.5	97
0.25	100

Noise exposures above 140 dBA are not permitted for any duration

7.2 Responsibilities

1. Environmental Health and Safety Office

EH&S is responsible for administering the Occupational Noise Program. Consistent with this administrative oversight, EH&S is also responsible for the following:

a. Administer workplace and employee/staff noise evaluations:
    i. Conduct noise assessment to determine if administrative and engineering controls are needed, and how they will be implemented.
    ii. Identify areas or processes that require noise abatement and/or posting.
    iii. Evaluate and periodically reevaluate employees' exposure, by job classification, to determine which job titles need to be included in the Hearing Conservation Program.
b. Assisting employees in selection of proper protective devices and provide instruction on their use.
c. Providing hearing protection device training.
d. Maintaining records of employee, faculty and student exposure measurements.

2. Department Heads, Managers, Supervisors, and Principal Investigators

Department heads, managers, supervisors and PIs are responsible for the following in order to ensure proper implementation and compliance with NSU's Occupational Noise Program:

a. Notify EH&S of noise complaints or potential noise hazards.
b. Ensure that employees, faculty and students are provided with hearing protectors when required.
c. Ensure that employees, faculty and studetns properly use and care for hearing protectors.
d. Ensure that noise-hazardous equipment/areas are properly labeled or posted (greater than or equal to 85 dBA operating noise level).
e. Notify EH&S of process, materials or equipment changes that may alter noise exposures.
f. Ensure that potentially overexposed employees, faculty and studetns are provided with a baseline audiometric hearing test prior to the initial work assignment and then annually thereafter.
g. Ensure potentially overexposed personnel attend EH&S noise training and annual refresher training.

3. Employees, Faculty and Students

Employees, Faculty, and Students are responsible for:

a. Wearing hearing protection devices as required in posted high noise areas (also applies to students, visitors and guests).
b. Attending required training sessions on noise hazards.
c. Reporting noise hazards and hearing protector problems to the appropriate supervisor
d. Maintaining hearing protectors in sanitary condition and proper working order

7.3 Engineering and Administrative Controls

When NSU employees, faculty and students are subject to noise levels exceeding 85 dBA, administrative or engineering controls will be implemented.

The preferred method for reducing noise to safe levels is to implement engineering controls. Engineering controls modify the equipment producing the noise, the characteristics of the receiver's (exposed individual's) environment, or the path through which the noise travels. Some examples of engineering controls are the use of absorption materials, muffling devices and vibrational dampening equipment.

Hearing protection for employee/faculty and staff use may include one of the following:

a. Ear Plugs seals the ear canal to prevent excessive noise levels from reaching delicate parts of the ear. Earplugs are inexpensive and portable, but can be hard to fit and can introduce dirt into the ear if not kept clean. There are disposable and reusable earplugs.
b. Canal Caps are soft pads on a headband that seal the entrance to the ear without entering the ear. If used incorrectly, they may not seal the ear properly.
c. Ear Muffs have a headband, ear cups and ear cushions. This type of ear protection generally provides the greatest amount of protection.

If controls fail to reduce sound levels to acceptable limits, personal hearing protection shall be provided at no extra cost to the staff and/or student.

7.4 Hearing Loss and Audiometric Testing

Exposure to high noise levels may cause hearing loss that can be either temporary or permanent. Temporary hearing loss, or auditory fatigue may occur after a few minutes of exposure to excessive noise levels, but normal hearing is recovered after a short period of time away from the noise. Permanent hearing loss may occur when exposure to high noise levels is repeated, and the time away from the noise is limited. Audiometric testing is conducted on potentially exposed employees to determine if any hearing loss has occurred.

Employees, faculty and students who are exposed to noise at or above the OSHA TWA level of 85 dBA must have an initial baseline audiogram within six months of the start of the noise exposure, and must have annual audiograms for the duration of the exposure. EH&S will track all employees, faculty and students who may be exposed above the limit.

7.5 Noise Sources

Decibel levels of some common noise sources:

Noise Source	Decibels
Average quiet office	40
Light traffic	50
Freeway traffic, vacuum cleaner	70

Alarm clock	80
Lawn mower, food blender	90
Vehicle horn - within 3 feet	110
Thunderclap - nearby	120
Jet airplane - taking off	150
Rocket engine - lift off	180

7.6 Training

Employees, Faculty and staff who are required to wear hearing protection must be trained. Training will be provided initially and annually thereafter. The training will include:

a. The effects of noise on hearing
b. Factors effecting hearing loss
c. Noise hazard assessments
d. Noise exposures and monitoring results
e. Audiometric testing
f. Noise control measures
g. Hearing protection devices (HPD's)

7.7 Recordkeeping

Employee, faculty and student exposure measurements and assessments are maintained by EH&S. Audiometric test records shall be retained for the duration of the affected employee's employment plus 30 years.

Section 8: Heat Stress

Operations involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, or strenuous physical activities have a high potential for inducing heat stress in employees engaged in such operations. Such places include: iron and steel foundries, nonferrous foundries, brick-firing and ceramic plants, glass products facilities, rubber products factories, electrical utilities (particularly boiler rooms), bakeries, confectioneries, commercial kitchens, laundries, food canneries, chemical plants, mining sites, smelters, and steam tunnels.

Outdoor operations conducted in hot weather, such as construction, refining, asbestos removal, and hazardous waste site activities, especially those that require workers to wear semi-permeable or impermeable protective clothing, are also likely to cause heat stress among exposed workers.

8.1 Causal Factors

It is difficult to predict just who will be affected and when, because individual susceptibility varies. Age, weight, degree of physical fitness, degree of acclimatization, metabolism, use of alcohol or drugs, and a variety of medical conditions such as hypertension all affect a person's sensitivity to heat. Even the type of clothing worn must be considered. Prior heat injury predisposes an individual to additional injury.

Environmental factors also affect an individual's response to heat. These factors include, but are not limited to, the ambient air temperature, air movement, conduction, and relative humidity.

8.2 Definitions

The American Conference of Governmental Industrial Hygienists (1992) states that workers should not be permitted to work when their deep body temperature exceeds 38°C (100.4°F).

Heat - a measure of energy in terms of quantity.

Calorie - the amount of heat required to raise 1 gram of water 1°C (based on a standard temperature of 16.5 to 17.5°C).

Conduction - the transfer of heat between materials that contact each other. Heat passes from the warmer material to the cooler material. For example, a worker's skin can transfer heat to a contacting surface if that surface is cooler, and vice versa.

Convection - the transfer of heat in a moving fluid. Air flowing past the body can cool the body if the air temperature is cool. On the other hand, air that exceeds 35°C (95°F) can increase the heat load on the body.

Evaporative cooling - when sweat evaporates from the skin. High humidity reduces the rate of evaporation and thus reduces the effectiveness of the body's primary cooling mechanism.

Radiation - the transfer of heat energy through space. A worker whose body temperature is greater than the temperature of the surrounding surfaces radiates heat to these surfaces. Hot surfaces and infrared light sources radiate heat that can increase the body's heat load.

Globe temperature - the temperature inside a blackened, hollow, thin copper globe.

Metabolic heat - a by-product of the body's activity.

Natural wet bulb (NWB) temperature - measured by exposing a wet sensor, such as a wet cotton wick fitted over the bulb of a thermometer, to the effects of evaporation and convection. The term natural refers to the movement of air around the sensor.

Dry bulb (DB) temperature - measured by a thermal sensor, such as an ordinary mercury-in-glass thermometer, that is shielded from direct radiant energy sources.

8.3 Heat Disorders and Health Effects

1. Heat Strokes

Heat stroke occurs when the body's system of temperature regulation fails and body temperature rises to critical levels. If body temperature is too high, it causes death. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict, including but not limited to a combination of work load and environmental heat load. Its occurrence is difficult to predict. Heat stroke is a medical emergency.

The primary signs and symptoms of heat stroke include the following:

a. Confusion
b. Irrational behavior
c. Loss of consciousness
d. Convulsions
e. A lack of sweating (usually)
f. Hot, dry skin, an
g. An abnormally high body temperature, e.g., a rectal temperature of 41°C (105.8°F).

If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady area and the outer clothing should be removed. The worker's skin should be wetted and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness of first aid treatment.

Regardless of the worker's protests, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.

2. Heat Exhaustion

The signs and symptoms of heat exhaustion are headache, nausea, vertigo, weakness, thirst, and giddiness. Fortunately, this condition responds readily to prompt treatment. Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, a medical emergency.

Workers suffering from heat exhaustion should be removed from the hot environment and given fluid replacement. They should also be encouraged to get adequate rest.

3. Heat Cramps

Heat cramps are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused by both too much and too little salt. Cramps appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (±0.3% NaCl), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments.

Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Recent studies have shown that drinking commercially available carbohydrate-electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

4. Heat Collapse (“Fainting”)

In heat collapse, the brain does not receive enough oxygen because blood pools in the extremities. As a result, the exposed individual may lose consciousness. This reaction is similar to that of heat exhaustion and does not affect the body's heat balance. However, the onset of heat collapse is rapid and unpredictable. To prevent heat collapse, the worker should gradually become acclimatized to the hot environment.

5. Heat Rashes

Heat rashes are the most common problem in hot work environments. Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by un-evaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

6. Heat Fatigue

A factor that predisposes an individual to heat fatigue is lack of acclimatization. The use of a program of acclimatization and training for work in hot environments is advisable. The signs and symptoms of heat fatigue include impaired performance of skilled sensorimotor, mental, or vigilance jobs. There is no treatment for heat fatigue except to remove the heat stress before a more serious heat-related condition develops.

8.4 Investigation Guidelines

Guidelines for evaluating heat stress can be found in the 1992-1993 ACGIH publication, *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.* In conducting heat stress investigations, the inspector will review the OSHA 200 Log and, if possible the OSHA 101 forms for indication of prior heat stress problems.

1. Employer and Employee Interviews

The following are some questions for employer interviews: What type of action, if any, has the employer taken to prevent heat stress problems? What are the potential sources of heat? What employee complaints have been made?

The following are some questions for employee interviews: What heat stress problems have been experienced? What type of action has the employee taken to minimize heat stress? What is the employer's involvement, i.e., does employee training include information on heat stress?

2. Walkaround Inspection

During the walkaround inspection, the investigator will: determine building and operation characteristics; determine whether engineering controls are functioning properly; verify information obtained from the employer and employee interviews; and perform temperature measurements and make other determinations to identify potential sources of heat stress. Investigators may wish to discuss any operations that have the potential to cause heat stress with engineers and other knowledgeable personnel. The walkaround inspection should cover all affected areas. Heat sources, such as furnaces, ovens, and boilers, and relative heat load per employee should be noted.

3. Work-Load Assessment

a. High Temperature/Heavy Workload Conditions

Under conditions of high temperature and heavy workload, the CSHO should determine the work-load category of each job (Table III:4-1 and Figure III:4-1). Work-load category is determined by averaging metabolic rates for the tasks and then ranking them:

- Light work: up to 200 kcal/hour
- Medium work: 200-350 kcal/hour

- Heavy work: 350-500 kcal/hour

b. Cool Rest Area:

Where heat conditions in the rest area are different from those in the work area, the metabolic rate (M) should be calculated using a time-weighted average, as follows:

EQUATION III: 4-1. Average Metabolic Rate

$$Average\,M = \frac{(M_1)(t_1)+(M_2)(t_2)+\ldots+(M_n)(t_n)}{t_1+t_2+\ldots+t_n}$$

where: M = metabolic rate
t = time in minutes

In some cases, a videotape is helpful in evaluating work practices and metabolic load.

FIGURE III:4-1. ACTIVITY EXAMPLES Light hand work: writing, hand knitting
Heavy hand work: typewriting
Heavy work with one arm: hammering in nails (shoemaker, upholsterer)
Light work with two arms: filing metal, planing wood, raking the garden
Moderate work with the body: cleaning a floor, beating a carpet
Heavy work with the body: railroad track laying, digging, barking trees

Sample Calculation: Assembly line work using a heavy hand tool

Walking along	2.0 kcal/min
Intermediate value between heavy work with two arms and light work with the body	3.0 kcal/min
Add for basal metabolism	1.0 kcal/min
	Total: 6.0 kcal/min

TABLE III:4-1. ASSESSMENT OF WORK ***Body position and movement*** ***kcal/min****

Sitting	0.3
Standing	0.6
Walking	2.0-3.0
Walking uphill	add 0.8 for every meter (yard) rise

Type of work		***Average kcal/min***	***Range kcal/min***
Hand work			
	Light	0.4	0.2-1.2
	Heavy	0.9	
Work: One arm			
	Light	1.0	0.7-2.5
	Heavy	1.7	
Work: Both arms			
	Light	1.5	1.0-3.5
Heavy	2.5		
Work: Whole body			
	Light	3.5	2.5-15.0
	Moderate	5.0	
	Heavy	7.0	
	Very heavy	9.0	

* For a "standard" worker of 70 kg body weight (154 lbs) and 1.8m^2 body surface (19.4 ft^2).

SAMPLING METHODS.

BODY TEMPERATURE MEASUREMENTS. Although instruments are available to estimate deep body temperature by measuring the temperature in the ear canal or on the skin, these instruments are not sufficiently reliable to use in compliance evaluations.

ENVIRONMENTAL MEASUREMENTS. Environmental heat measurements should be made at, or as close as possible to, the specific work area where the worker is exposed. When a worker is not continuously exposed in a single hot area but moves between two or more areas having different levels of environmental heat, or when the environmental heat varies substantially at a single hot area, environmental heat exposures should be measured for each area and for each level of environmental heat to which employees are exposed.

WET BULB GLOBE TEMPERATURE INDEX. Wet Bulb Globe Temperature (WBGT) should be calculated using the appropriate formula (Equation III:4.2). The WBGT for continuous all-day or several hour exposures should be averaged over a 60-minute period. Intermittent exposures should be averaged over a 120-minute period. These averages should be calculated using the following formula:

Equation III:4-2. Average Web Bulb Globe Temperature (WBGT)

$$Average\ WBGT = \frac{(WBGT_1)(t_1) + (WBGT_2)(t_2) + \ldots + (WBGT_n)(t_n)}{t_1 + t_2 + \ldots + t_n}$$

For indoor and outdoor conditions with no solar load, WBGT is calculated as:

$$WBGT = 0.7NWB + 0.3GT$$

For outdoors with a solar load, WBGT is calculated as

$$WBGT = 0.7NWB + 0.2GT + 0.1DB$$

where: WBGT = Wet Bulb Globe Temperature Index
NWB = Nature Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Temperature

The exposure limits in Table III:4-2 are valid for employees wearing light clothing. They must be adjusted for the insulation from clothing that impedes sweat evaporation and other body cooling mechanisms. Use Table III:4-3 to correct Table III:4-2 for various kinds of clothing.

Use of Table III:4-2 requires knowledge of the WBGT and approximate workload. Workload can be estimated using the data in Table III:4-1, and sample calculations are presented in Figure III:4-1.

MEASUREMENT. Portable heat stress meters or monitors are used to measure heat conditions. These instruments can calculate both the indoor and outdoor WBGT index according to established ACGIH Threshold Limit Value equations. With this information and information on the type of work being performed, heat stress meters can determine how long a person can safely work or remain in a particular hot environment.

TABLE III:4-2. PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES

	---------- Work Load* ----------		
Work/rest regimen	**Light**	**Moderate**	**Heavy**
Continuous work	30.0°C (86°F)	26.7°C (80°F)	25.0°C (77°F)
75% Work, 25% rest, each hour	30.6°C (87°F)	28.0°C (82°F)	25.9°C (78°F)
50% Work, 50% rest, each hour	31.4°C (89°F)	29.4°C (85°F)	27.9°C (82°F)
25% Work, 75% rest, each hour	32.2°C (90°F)	31.1°C (88°F)	30.0°C (86°F)

*Values are in °C and °F, WBGT.

These TLV's are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38°C (100.4° F). They are also based on the assumption that the WBGT of the resting place is the same or very close to that of the workplace. Where the WBGT of the work area is different from that of the rest area, a time-weighted average should be used (consult the ACGIH *1992-1993 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* (1992).

These TLV's apply to physically fit and acclimatized individuals wearing light summer clothing. If heavier clothing that impedes sweat or has a higher insulation value is required, the permissible heat exposure TLV's in Table III:4-2 must be reduced by the corrections shown in Table III:4-3.

OTHER THERMAL STRESS INDICES.

The Effective Temperature index (ET) combines the temperature, the humidity of the air, and air velocity. This index has been used extensively in the field of comfort ventilation and air-conditioning. ET remains a useful measurement technique in mines and other places where humidity is high and radiant heat is low.

The Heat-Stress Index (HSI) was developed by Belding and Hatch in 1965. Although the HSI considers all environmental factors and work rate, it is not completely satisfactory for determining an individual worker's heat stress and is also difficult to use.

TABLE III:4-3. WBGT CORRECTION FACTORS IN °C	Clothing type	Clo* value	WBGT correction
	Summer lightweight working clothing	0.6	0
	Cotton coveralls	1.0	-2
	Winter work clothing	1.4	-4
	Water barrier, permeable	1.2	-6

*Clo: Insulation value of clothing. One clo = 5.55 kcal/m^2/hr of heat exchange by radiation and convection for each degree °C difference in temperature between the skin and the adjusted dry bulb temperature.

Note: Deleted from the previous version are trade names and "fully encapsulating suit, gloves, boots and hood" including its clo value of 1.2 and WBGT correction of -10.

Source: ACGIH 1992.

8.5 Control

Ventilation, air cooling, fans, shielding, and insulation are the five major types of engineering controls used to reduce heat stress in hot work environments. Heat reduction can also be achieved by using power assists and tools that reduce the physical demands placed on a worker.

However, for this approach to be successful, the metabolic effort required for the worker to use or operate these devices must be less than the effort required without them. Another method is to reduce the effort necessary to operate power assists. The worker should be allowed to take frequent rest breaks in a cooler environment.

8.6 Acclimatization

The human body can adapt to heat exposure to some extent. This physiological adaptation is called acclimatization. After a period of acclimatization, the same activity will produce fewer cardiovascular demands. The worker will sweat more efficiently (causing better evaporative cooling), and thus will more easily be able to maintain normal body temperatures.

A properly designed and applied acclimatization program decreases the risk of heat-related illnesses. Such a program basically involves exposing employees to work in a hot environment for progressively longer periods. NIOSH (1986) says that, for workers who have had previous experience in jobs where heat levels are high enough to produce heat stress, the regimen should be 50% exposure on day one, 60% on day two, 80% on day three, and 100% on day four. For new workers who will be similarly exposed, the regimen should be 20% on day one, with a 20% increase in exposure each additional day.

8.7 Fluid Replacement

Cool (50°-60°F) water or any cool liquid (except alcoholic beverages) should be made available to workers to encourage them to drink small amounts frequently, e.g., one cup every 20 minutes. Ample supplies of liquids should be placed close to the work area. Although some commercial replacement drinks contain salt, this is not necessary for acclimatized individuals because most people add enough salt to their summer diets.

8.8 Engineering Controls

General ventilation is used to dilute hot air with cooler air (generally cooler air that is brought in from the outside). This technique clearly works better in cooler climates than in hot ones. A permanently installed ventilation system usually handles large areas or entire buildings. Portable or local exhaust systems may be more effective or practical in smaller areas.

Air treatment/air cooling differs from ventilation because it reduces the temperature of the air by removing heat (and sometimes humidity) from the air.

Air conditioning is a method of air cooling, but it is expensive to install and operate. An alternative to air conditioning is the use of chillers to circulate cool water through heat exchangers over which air from the ventilation system is then passed; chillers are more efficient in cooler climates or in dry climates where evaporative cooling can be used.

Local air cooling can be effective in reducing air temperature in specific areas. Two methods have been used successfully in industrial settings. One type, cool rooms, can be used to enclose a specific workplace or to offer a recovery area near hot jobs. The second type is a portable blower with built-in air chiller. The main advantage of a blower, aside from portability, is minimal set-up time.

Another way to reduce heat stress is to increase the air flow or **convection** using fans, etc. in the work area (as long as the air temperature is less than the worker's skin temperature). Changes in air speed can help workers stay cooler by increasing both the convective heat exchange (the exchange between the skin surface and the surrounding air) and the rate of evaporation. Because this method does not actually cool the air, any increases in air speed must impact the worker directly to be effective.

If the dry bulb temperature is higher than 35°C (95°F), the hot air passing over the skin can actually make the worker hotter. When the temperature is more than 35°C and the air is dry, evaporative cooling may be improved by air movement, although this improvement will be offset by the convective heat. When the temperature exceeds 35°C and the relative humidity is 100%, air movement will make the worker hotter. Increases in air speed have no effect on the body temperature of workers wearing vapor-barrier clothing.

Heat conduction methods include insulating the hot surface that generates the heat and changing the surface itself.

Simple engineering controls, such as shields, can be used to reduce radiant **heat,** i.e. heat coming from hot surfaces within the worker's line of sight. Surfaces that exceed 35°C (95°F) are sources

of infrared radiation that can add to the worker's heat load. Flat black surfaces absorb heat more than smooth, polished ones. Having cooler surfaces surrounding the worker assists in cooling because the worker's body radiates heat toward them.

With some sources of radiation, such as heating pipes, it is possible to use both insulation and surface modifications to achieve a substantial reduction in radiant heat. Instead of reducing radiation from the source, shielding can be used to interrupt the path between the source and the worker. Polished surfaces make the best barriers, although special glass or metal mesh surfaces can be used if visibility is a problem.

Shields should be located so that they do not interfere with air flow, unless they are also being used to reduce convective heating. The reflective surface of the shield should be kept clean to maintain its effectiveness.

8.9 Administrative Controls and Work Practices

1. Training

Training is the key to good work practices. Unless all employees, faculty and students understand the reasons for using new or changing old work practices, the chances of program success are greatly reduced.

NIOSH (1986) states that a good heat stress training program should include at least the following components:

a. Knowledge of the hazards of heat stress;
b. Recognition of predisposing factors, danger signs, and symptoms;
c. Awareness of first-aid procedures for, and the potential health effects of, heat stroke;
d. Employee responsibilities in avoiding heat stress;
e. Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments;
f. Use of protective clothing and equipment; and
g. Purpose and coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs.

Hot jobs should be scheduled for the cooler part of the day, and routine maintenance and repair work in hot areas should be scheduled for the cooler seasons of the year.

2. Worker Monitoring Programs

Every worker who works in extraordinary conditions that increase the risk of heat stress should be personally monitored. “Extraordinary” conditions include, but is not limited to, wearing semi-permeable or impermeable clothing when the temperature exceeds 21°C (69.8°F) or working at extreme metabolic loads (greater than 500 kcal/hour).

Personal monitoring can be done by checking the heart rate, recovery heart rate, oral temperature, or extent of body water loss.

a. To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.

b. The recovery heart rate can be checked by comparing the pulse rate taken at 30 seconds (P_1) with the pulse rate taken at 2.5 minutes (P_3) after the rest break starts. The two pulse rates can be interpreted using Table III: 4-4.

TABLE III:4-4. HEART RATE RECOVERY CRITERIA Heart rate recovery pattern	**P_3**	**Difference between P_1 and P_3**
Satisfactory recovery	<90	--
High recovery (Conditions may require further study)	90	10
No recovery (May indicate too much stress)	90	<10

c. Oral temperature can be checked with a clinical thermometer after work but before the employee drinks water. If the oral temperature taken under the tongue exceeds 37.6°C, shorten the next work cycle by one third.

d. Body water loss can be measured by weighing the worker on a scale at the beginning and end of each work day. The worker's weight loss should not exceed 1.5% of total body weight in a work day. If a weight loss exceeding this amount is observed, fluid intake should increase.

3. Other Administrative Controls

The following administrative controls can be used to reduce heat stress:

a. Reduce the physical demands of work, e.g., excessive lifting or digging with heavy objects;
b. Provide recovery areas, e.g., air-conditioned enclosures and rooms;
c. Use shifts, e.g., early morning, cool part of the day, or night work;
d. Use intermittent rest periods with water breaks;
e. Use relief workers;
f. Use worker pacing; and
g. Assign extra workers and limit worker occupancy, or the number of workers present, especially in confined or enclosed spaces.

8.10 Personal Protective Equipment

1. Reflective Clothing

Reflective clothing can vary from aprons and jackets to suits that completely enclose the worker from neck to feet, can stop the skin from absorbing radiant heat. However, since most reflective clothing does not allow air exchange through the garment, the reduction of radiant heat must more than offset the corresponding loss in evaporative cooling. For this reason, reflective clothing should be worn as loosely as possible. In situations where radiant heat is high, auxiliary cooling systems can be used under the reflective clothing.

2. Auxiliary Body Cooling

a. Ice Vests

Commercially available ice vests**,** though heavy, may accommodate as many as 72 ice packets, which are usually filled with water. Carbon dioxide (dry ice) can also be used as a coolant. The cooling offered by ice packets lasts only 2 to 4 hours at moderate to heavy heat loads, and frequent replacement is necessary. However, ice vests do not encumber the worker and thus permit maximum mobility. Cooling with ice is also relatively inexpensive.

b. Wetted clothing

Wetted closthing is another simple and inexpensive personal cooling technique. It is effective when reflective or other impermeable protective clothing is worn. The clothing may be wetted terry cloth coveralls or wetted two-piece, whole-body cotton suits. This approach to auxiliary cooling can be quite effective under conditions of high temperature and low humidity, where evaporation from the wetted garment is not restricted.

c. Water-cooled garments

Water-cooled garments range from a hood, which cools only the head, to vests and "long johns," which offer partial or complete body cooling. Use of this equipment requires a battery-driven circulating pump, liquid-ice coolant, and a container.

Although this system has the advantage of allowing wearer mobility, the weight of the components limits the amount of ice that can be carried and thus reduces the effective use time. The heat transfer rate in liquid cooling systems may limit their use to low-activity jobs; even in such jobs, their service time is only about 20 minutes per pound of cooling ice. To keep outside heat from melting the ice, an outer insulating jacket should be an integral part of these systems.

d. Circulating air

Circulating air is the most highly effective, as well as the most complicated, personal cooling system. By directing compressed air around the body from a supplied air system, both

evaporative and convective cooling are improved. The greatest advantage occurs when circulating air is used with impermeable garments or double cotton overalls.

One type, used when respiratory protection is also necessary, forces exhaust air from a supplied-air hood ("bubble hood") around the neck and down inside an impermeable suit. The air then escapes through openings in the suit. Air can also be supplied directly to the suit without using a hood in three ways: (1) by a single inlet; (2) by a distribution tree; or (3) by a perforated vest.

In addition, a vortex tube can be used to reduce the temperature of circulating air. The cooled air from this tube can be introduced either under the clothing or into a bubble hood. The use of a vortex tube separates the air stream into a hot and cold stream; these tubes also can be used to supply heat in cold climates. Circulating air, however, is noisy and requires a constant source of compressed air supplied through an attached air hose.

One problem with this system is the limited mobility of workers whose suits are attached to an air hose. Another is that of getting air to the work area itself. These systems should therefore be used in work areas where workers are not required to move around much or to climb. Another concern with these systems is that they can lead to dehydration. The cool, dry air feels comfortable and the worker may not realize that it is important to drink liquids frequently.

3. Respirator Usage

The weight of a self-contained breathing apparatus (SCBA) increases stress on a worker, and this stress contributes to overall heat stress. Chemical protective clothing such as totally encapsulating chemical protection suits will also add to the heat stress problem. The University recommends against the use of self-contained breathing apparatus unless no other viable option is available.

APPENDIX A

Asbestos Containing Materials - asbestos has been commonly used as an acoustic insulator, thermal insulation, fire proofing and in other building materials. Asbestos fibers are incredibly strong and have properties that make them resistant to heat.

Cement corrugated sheet
Cement flat sheet
Cement pipe and siding
Cement and roofing shingle
Roof coatings and felt
Elevator brake shoes
Cement wallboard
HVAC duct insulation
Brake - disc pads, drum linings and blocks
Boiler insulation
Asphalt and vinyl floor tile
Vinyl Sheet Flooring
Cooling Towers
Flooring backing and felt
Pipe insulation (corrugated air-cell, block, etc.)
Construction mastics (floor tile, carpet, ceiling tile, etc.)
Heating and electrical ducts
Acoustical plaster
Electrical panel partitions
Decorative plaster
Textured paints/coatings
Electric wiring insulation
Ceiling tiles
Chalkboards
Blown-in insulation
Fireproofing materials
Base flashing
Taping compounds (thermal)
Thermal paper products
Fire doors and blankets
High temperature gaskets
Caulking/putties
Adhesives
Asbestos - Laboratory gloves
Wallboard
Joint and spackling compounds
Fire curtains
Vinyl wall coverings
Elevator equipment panels

APPENDIX B

OSHA 1926.1101

Employee Information and Training.

1926.1101(k)(9)(i)
The employer shall, at no cost to the employee, institute a training program for all employees who are likely to be exposed in excess of a PEL and for all employees who perform Class I through IV asbestos operations, and shall ensure their participation in the program.

1926.1101(k)(9)(ii)
Training shall be provided prior to or at the time of initial assignment and at least annually thereafter.

1926.1101(k)(9)(iii)
Training for Class I operations and for Class II operations that require the use of critical barriers (or equivalent isolation methods) and/or negative pressure enclosures under this section shall be the equivalent in curriculum, training method and length to the EPA Model Accreditation Plan (MAP) asbestos abatement workers training (40 CFR Part 763, subpart E, appendix C).

1926.1101(k)(9)(iv)
Training for other Class II work.

1926.1101(k)(9)(iv)(A)
For work with asbestos containing roofing materials, flooring materials, siding materials, ceiling tiles, or transite panels, training shall include at a minimum all the elements included in paragraph (k)(9)(viii) of this section and in addition, the specific work practices and engineering controls set forth in paragraph (g) of this section which specifically relate to that category. Such course shall include "hands-on" training and shall take at least 8 hours.

1926.1101(k)(9)(iv)(B)
An employee who works with more than one of the categories of material specified in paragraph (k)(9)(iv)(A) of this section shall receive training in the work practices applicable to each category of material that the employee removes and each removal method that the employee uses.

1926.1101(k)(9)(iv)(C)
For Class II operations not involving the categories of material specified in paragraph (k)(9)(iv)(A) of this section, training shall be provided which shall include at a minimum all the elements included in paragraph (k)(9)(viii) of this section and in addition, the specific work practices and engineering controls set forth in paragraph (g) of this section which specifically relate to the category of material being removed, and shall include "hands-on" training in the work practices applicable to each category of material that the employee removes and each removal method that the employee uses.

1926.1101(k)(9)(v)
Training for Class III employees shall be consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at 40 CFR 763.92(a)(2). Such a course shall also include "hands-on" training and shall take at least 16 hours. Exception: For Class III operations for which the competent person determines that the EPA curriculum does not adequately cover the training needed to perform that activity, training shall include as a minimum all the elements included in paragraph (k)(9)(viii) of this section and in addition, the specific work practices and engineering controls set forth in paragraph (g) of this section which specifically relate to that activity, and shall include "hands-on" training in the work practices applicable to each category of material that the employee disturbs.

1926.1101(k)(9)(vi)
Training for employees performing Class IV operations shall be consistent with EPA requirements for training of local education agency maintenance and custodial staff as set forth at 40 CFR 763.92(a)(1). Such a course shall include available information concerning the locations of thermal system insulation and surfacing ACM/PACM, and asbestos-containing flooring material, or flooring material where the absence of asbestos has not yet been certified; and instruction in recognition of damage, deterioration, and delamination of asbestos containing building materials. Such course shall take at least 2 hours.

1926.1101(k)(9)(vii)
Training for employees who are likely to be exposed in excess of the PEL and who are not otherwise required to be trained under paragraph (k)(9)(iii) through (vi) of this section, shall meet the requirements of paragraph (k)(9)(viii) of this section.

1926.1101(k)(9)(viii)
The training program shall be conducted in a manner that the employee is able to understand. In addition to the content required by provisions in paragraphs (k)(9)(iii) through (vi) of this section, the employer shall ensure that each such employee is informed of the following:

1926.1101(k)(9)(viii)(A)
Methods of recognizing asbestos, including the requirement in paragraph (k)(1) of this section to presume that certain building materials contain asbestos;

1926.1101(k)(9)(viii)(B)
The health effects associated with asbestos exposure;

1926.1101(k)(9)(viii)(C)
The relationship between smoking and asbestos in producing lung cancer;

1926.1101(k)(9)(viii)(D)
The nature of operations that could result in exposure to asbestos, the importance of necessary protective controls to minimize exposure including, as applicable, engineering controls, work practices, respirators, housekeeping procedures, hygiene facilities, protective clothing, decontamination procedures, emergency procedures, and waste disposal procedures, and any necessary instruction in the use of these controls and procedures; where Class III and IV work will be or is performed, the contents of EPA 20T-2003, "Managing Asbestos In-Place" July 1990 or its equivalent in content;

1926.1101(k)(9)(viii)(E)
The purpose, proper use, fitting instructions, and limitations of respirators as required by 29 CFR 1910.134;

1926.1101(k)(9)(viii)(F)
The appropriate work practices for performing the asbestos job;

APPENDIX C

EPA- "Mold Remediation in Schools and Commercial Buildings"

Table 1: Water Damage - Cleanup and Mold Prevention	
Guidelines for Response to Clean Water Damage within 24-48 Hours to Prevent Mold Growth*	
Water-Damaged Material†	**Actions**
Books and papers	• For non-valuable items, discard books and papers. • Photocopy valuable/important items, discard originals. • Freeze (in frost-free freezer or meat locker) or freeze-dry.
Carpet and backing - dry within 24-48 hours§	• Remove water with water extraction vacuum. • Reduce ambient humidity levels with dehumidifier. • Accelerate drying process with fans.
Ceiling tiles	• Discard and replace.
Cellulose insulation	• Discard and replace.
Concrete or cinder block surfaces	• Remove water with water extraction vacuum. • Accelerate drying process with dehumidifiers, fans, and/or heaters.
Fiberglass insulation	• Discard and replace.
Hard surface, porous flooring§ (Linoleum, ceramic tile, vinyl)	• Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary. • Check to make sure underflooring is dry; dry underflooring if necessary.
Non-porous, hard surfaces (Plastics, metals)	• Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.
Upholstered furniture	• Remove water with water extraction vacuum. • Accelerate drying process with dehumidifiers, fans, and/or heaters. • May be difficult to completely dry within 48 hours. If the piece is valuable, you may wish to consult a restoration/water damage professional who specializes in furniture.
Wallboard (Drywall and gypsum board)	• May be dried in place if there is no obvious swelling and the seams are intact. If not, remove, discard, and replace. • Ventilate the wall cavity, if possible.
Window drapes	• Follow laundering or cleaning instructions recommended by the manufacturer.
Wood surfaces	• Remove moisture immediately and use dehumidifiers, gentle heat, and fans for drying. (Use

	caution when applying heat to hardwood floors.) • Treated or finished wood surfaces may be cleaned with mild detergent and clean water and allowed to dry. • Wet paneling should be pried away from wall for drying.

* If mold growth has occurred or materials have been wet for more than 48 hours, consult Table 2 guidelines. Even if materials are dried within 48 hours, mold growth may have occurred. Items may be tested by professionals if there is doubt. Note that mold growth will not always occur after 48 hours; this is only a guideline.

These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then Personal Protective Equipment and containment are required by OSHA. An experienced professional should be consulted if you and/or your remediators do not have expertise remediating in contaminated water situations. Do not use fans before determining that the water is clean or sanitary.

† If a particular item(s) has high monetary or sentimental value, you may wish to consult a restoration/water damage specialist.

§ The subfloor under the carpet or other flooring material must also be cleaned and dried. See the appropriate section of this table for recommended actions depending on the composition of the subfloor.

Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water*

Material or Furnishing Affected	Cleanup Methods†	Personal Protective Equipment	Containment
SMALL - Total Surface Area Affected Less Than 10 square feet (ft^2)			
Books and papers	3	Minimum N-95 respirator, gloves, and goggles	None required
Carpet and backing	1, 3		
Concrete or cinder block	1, 3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1, 2, 3		
Non-porous, hard surfaces (plastics, metals)	1, 2, 3		
Upholstered furniture & drapes	1, 3		
Wallboard (drywall and gypsum board)	3		
Wood surfaces	1, 2, 3		
MEDIUM - Total Surface Area Affected Between 10 and 100 (ft^2)			
Books and papers	3	Limited or Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Limited Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area
Carpet and backing	1,3,4		
Concrete or cinder block	1,3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1,2,3		
Non-porous, hard surfaces (plastics, metals)	1,2,3		
Upholstered furniture & drapes	1,3,4		

Wallboard (drywall and gypsum board)	3,4		
Wood surfaces	1,2,3		
LARGE - Total Surface Area Affected Greater Than 100 (ft^2) or Potential for Increased Occupant or Remediator Exposure During Remediation Estimated to be Significant			
Books and papers	3	Full Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area	Full Use professional judgment, consider potential for remediator exposure and size of contaminated area
Carpet and backing	1,3,4		
Concrete or cinder block	1,3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1,2,3,4		
Non-porous, hard surfaces (plastics, metals)	1,2,3		
Upholstered furniture & drapes	1,2,4		
Wallboard (drywall and gypsum board)	3,4		
Wood surfaces	1,2,3,4		

* Use professional judgment to determine prudent levels of Personal Protective Equipment and containment for each situation, particularly as the remediation site size increases and the potential for exposure and health effects rises. Assess the need for increased Personal Protective Equipment, if, during the remediation, more extensive contamination is encountered than was expected. Consult Table 1 if materials have been wet for less than 48 hours, and mold growth is not apparent. These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then the Occupational Safety and Health Administration (OSHA) requires PPE and containment. An experienced professional should be consulted if you and/or your remediators do not have expertise in remediating contaminated water situations.

† Select method most appropriate to situation. Since molds gradually destroy the things they grow on, if mold growth is not addressed promptly, some items may be damaged such that cleaning will not restore their original appearance. If mold growth is heavy and items are valuable or important, you may wish to consult a restoration/water damage/remediation expert. Please note that these are guidelines; other cleaning methods may be preferred by some professionals.

Cleanup Methods

- **Method 1:** Wet vacuum (in the case of porous materials, some mold spores/fragments will remain in the material but will not grow if the material is completely dried). Steam cleaning may be an alternative for carpets and some upholstered furniture.
- **Method 2:** Damp-wipe surfaces with plain water or with water and detergent solution (except wood —use wood floor cleaner); scrub as needed.
- **Method 3:** High-efficiency particulate air (HEPA) vacuum after the material has been thoroughly dried. Dispose of the contents of the HEPA vacuum in well-sealed plastic bags.
- **Method 4:** Discard - remove water-damaged materials and seal in plastic bags while inside of containment, if present. Dispose of as normal waste. HEPA vacuum area after it is dried.

Personal Protective Equipment (PPE)

- Minimum: Gloves, N-95 respirator, goggles/eye protection
- Limited: Gloves, N-95 respirator or half-face respirator with HEPA filter, disposable overalls, goggles/eye protection
- Full: Gloves, disposable full body clothing, head gear, foot coverings, full-face respirator with HEPA filter

Containment

- Limited: Use polyethylene sheeting ceiling to floor around affected area with a slit entry and covering flap; maintain area under negative pressure with HEPA filtered fan unit. Block supply and return air vents within containment area.
- Full: Use two layers of fire-retardant polyethylene sheeting with one airlock chamber. Maintain area under negative pressure with HEPA filtered fan exhausted outside of building. Block supply and return air vents within containment area.