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Hazardous or Toxic Agents and Environments

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## SECTION 6

### Hazardous or Toxic Agents and Environments

#### 06.A General.

##### 06.A.01 Exposure standards.

a. Exposure, through inhalation, ingestion, skin absorption, or physical contact, to any chemical or biological agent in excess of the acceptable limits specified in the current American Conference of Governmental Industrial Hygienist (ACGIH) guideline, "Threshold Limit Values and Biological Exposure Indices", published Department of the Army (DA) or Department of Defense (DoD) Exposure Limits, or by OSHA shall be prohibited. For the purpose of this document, the applicable standard is the Occupational Exposure Limit (OEL). Physical agents are addressed individually in this section.

➤ Note: For Beryllium, the Department of Energy's exposure value of 0.2 ug/m<sup>3</sup> may be allowed with written permission from the HQUSACE-SO.

b. In case of conflicts between ACGIH, OSHA, DoD or DA standards or regulations referenced in this manual, the more stringent shall be used as the OEL.

c. The employer shall comply with all applicable standards and regulations to reduce contaminant concentration levels As Low As is Reasonably Achievable (ALARA).

d. Activities where occupational exposure to a chemical or biological warfare agent is possible, shall comply with current DA safety and occupational health requirements for chemical and biological agents.

e. Activities involving ammunition and explosives or their constituents or chemical warfare agents may have additional requirements as specified in EM 385-1-97, Explosives Safety and Health Requirements Manual.

##### 06.A.02 Hazard evaluation.

a. Jobsite operations, materials, and equipment involving potential exposure to hazardous or toxic agents or environments shall be evaluated by a qualified Industrial Hygienist, or equivalent competent person in Industrial Hygiene operations, to formulate a hazard control program. A description of the methods to be used must be accepted by the GDA or local Safety and Occupational Health Office (SOHO) before the start of the specific operation. > This evaluation shall be performed at least annually for USACE operations.

b. Activity Hazard Analysis (AHA) and/or Position Hazard Analysis (PHA) shall be used to document the evaluation of the hazards and the controls present. The hazard evaluation shall identify all substances, agents, and environments that present a health, explosive or fire hazard to workers or visitors, the risk of the hazard, and recommend hazard control measures. Engineering and administrative controls shall be used to control hazards; in cases where engineering or administrative controls are not feasible, personal protective equipment (PPE) may be used.

c. The hazard evaluation shall document: the nature of the evaluation (air, biological or radiological samples, etc.); that it serves as certification of hazard evaluation; the workplace and activity evaluated; the name, position and credentials of the person certifying that the evaluation has been performed; any controls and training being utilized; and the date of the evaluation. This evaluation shall be documented in a written report and available for review by the GDA or SOHO for USACE operations.

#### 06.A.03 Testing and monitoring.

a. Approved and calibrated testing devices shall be provided to measure hazardous or toxic agents and environments. Devices shall be labeled with calibration information (name of individual performing the calibration and date of the most current calibration). Calibration results shall be maintained in a calibration log.

b. Individuals performing testing and monitoring shall be trained in hazards and testing and monitoring procedures. Testing devices shall be used, inspected, and maintained in accordance with the manufacturer's instructions, a copy of which shall be maintained with the devices.

c. NIOSH, OSHA, Environmental Protection Agency (EPA) or DA sampling and analytical methods or other independently verified sampling and analytical methods shall be used. Laboratories used for analysis shall be accredited by nationally recognized bodies, such as the American Industrial Hygiene Association (AIHA), for the type of analysis performed.

d. Determination of the concentration of, and hazards from, hazardous or toxic agents and environments shall be made by a qualified industrial hygienist or other competent person during initial startup and as frequently as necessary to ensure the safety and health of the workers or other potentially exposed individuals.

e. Records of testing/monitoring shall be maintained on site and shall be available to the GDA or SOHO for USACE operations upon request.

06.A.04 The following methods shall be utilized for the control of exposure to hazardous or toxic agents and environments and shall be followed in the order below, unless infeasible:

- a. Substitution: if the substitute process or product is determined to provide the same outcome and to be less of a hazard;
- b. Engineering controls: (i.e., local/general ventilation), to limit exposure to hazardous or toxic agents and environments within acceptable limits;
- c. Work practice controls: when engineering controls are not feasible or are not sufficient to limit exposure to hazardous or toxic agents and environments within acceptable limits;
- d. Appropriate PPE (i.e., respirators, gloves, etc.) and associated programs: shall be instituted when engineering, work practice controls, or material substitution are not feasible or are not sufficient to limit exposure to hazardous or toxic agents;
- e. Regular housecleaning (work and break area surface cleaning) and personal decontamination procedures: shall be instituted in areas where the operations generate toxic dust and fume hazards. The frequency of surface cleaning and of decontamination procedures is dependent on the nature of the hazard, and frequency and risk from the exposure and shall be documented in the Project Safety and Occupational Health (SOH) Plan or Accident Prevention Plan (APP).

#### 06.B Hazardous or Toxic Agents Handling.

06. B.01 Chemical Hazard Communication (HazCom). A written HazCom Program shall be developed when hazardous or toxic agents (any chemical which is a physical/health hazard) are present or procured, stored or used at a project site (per 29 CFR 1910.1200). The written HazCom program shall address the following in project- specific detail:

a. Hazardous or Toxic Agent Inventory. A list of the hazardous or toxic agents with the following information:

(1) Explanation of how the agents are to be used at the project.

(2) For emergency response purposes, approximate quantities (e.g., liters, kilograms, gallons, pounds) that are onsite or will be on site at any given time shall be provided for each material. If the chemical name and/or quantity and/or location are classified information, it shall be maintained in a location so that it can be provided to emergency responders during an emergency. This could be in a secure area outside of the area the chemical is used or stored, or just outside the entrance to the location in a secure box.

(3) A site map will be attached to the inventory showing where inventoried substances are stored.

(4) The inventory and site map will be updated annually at a minimum, but as frequently as necessary to ensure it is current and accurately reflects those materials on site.

b. Hazardous or Toxic Agent Labeling. Procedures for assuring that containers used to store and transport hazardous or toxic agents around the project site are appropriately labeled to communicate the physical and health hazards associated with the agents in the containers. The pictorial labels required by the OSHA HazCom standard are acceptable labels.

c. Material Safety Data Sheet (MSDS) or Safety Data Sheet (SDS) Management. Procedures to ensure MSDSs (SDSs) are maintained at project site for each chemical, combustible dust, or product. During the period of 2013 through 2016, the MSDS will be phased out and replaced with the SDS. The new SDSs content is mandated and allows for the toxicological hazard to be based on similar chemicals. For the purpose of this manual, either a MSDS or SDS meeting the criteria of the OSHA globally harmonized system standard is acceptable.

(1) Employees shall have access to the MSDSs (SDSs) and the safety and health protection procedures.

(2) Applicable information contained in the MSDS (SDS) shall be incorporated in the AHA/PHAs. If the chemical or toxic agent is used extensively in the operation, the applicable information shall be incorporated into the AHA and MSDS (SDS) shall be attached to the AHA.

(3) The information will be followed in the use, storage, and disposal of material and selection of hazard control and emergency response measures.

d. Employee Information and Training. Procedures to ensure employees are trained initially and periodically when use of hazardous or toxic agents is altered or modified to accommodate changing on-site work procedures. Training shall be provided to employees working with or in the area of use of any potentially hazardous chemical. Training shall cover the following topics:

- (1) Requirements of the HazCom program on the project;
- (2) The location of all hazardous or toxic agents at the project;
- (3) Identification and recognition of hazardous or toxic agents on the project;

(4) Physical and health hazards of the hazardous or toxic agents pertinent to project activities;

(5) Protective measures employees can implement when working with project-specific hazardous or toxic agents.

(6) The location and content of the MSDS (SDS) for the chemicals. The content and meaning of the information provided on the MSDS.

(7) All workers in locations covered by the HazCom standard shall be briefed on the recent changes to the standard. These changes include MSDS to SDS, label content, the new pictographs on the labels, and an explanation of chemical banding.

06.B.02 When engineering and work practice controls or substitution are either infeasible or insufficient, appropriate PPE and chemical hygiene facilities shall be provided and used for the transportation, use, and storage of hazardous or toxic agents.

a. When irritants or hazardous substances may contact skin or clothing, chemical hygiene facilities and PPE shall be provided. PPE may include suitable gloves, face/eye protection and chemical protective suits.

(1) The qualified IH or other competent person shall determine the scope and type of PPE required.

(2) Special attention shall be given to selecting proper chemical protection when working with materials designated with a "skin" notation by OEL. Such materials may produce systemic toxic effects through absorption through unbroken skin. > See Section 5.

(3) Before commencing use of epoxy resins, concrete, or other dermatitis-producing substances, employees shall be made aware of the manufacturer's skin protection recommendations. Barrier cream ointment or other skin protection measures recommended by the manufacturer for the specific exposure shall be available for use.

b. When eyes or body of any person may be exposed to hazardous or toxic agents, suitable facilities that comply with ANSI Z358.1, Emergency Eyewash and Shower Equipment, for quick drenching or flushing of the eyes and body shall be provided in the work area for immediate emergency use and shall be no more than 10 seconds from the hazardous material. > See ANSI Z358.1.

(1) Emergency eyewash equipment must be provided where there is the potential for an employee's eyes to be exposed to corrosives, strong irritants, or toxic chemicals.

(2) The emergency eyewash equipment must irrigate and flush both eyes simultaneously while the operator holds the eyes open.

(3) The emergency eyewash equipment must deliver at least 0.4 gal (1.5 L) of water per minute for 15 minutes or more, providing a minimum of 6 gal (22.7 L) of water).



(4) Water used in emergency eyewashes and showers shall meet drinking water standards. When these items are exposed to the elements, steps will be taken to ensure the water does not freeze or become stagnate.

(5) Personal eyewash equipment may be used to supplement emergency washing facilities. They must not be used as a substitute. Personal eyewash fluids shall be visually inspected monthly to ensure they remain sanitary with no visible sediments.

(6) All plumbed emergency eyewash facilities and hand-held drench hoses shall be connected to an approved potable water supply and activated weekly and inspected annually to ensure that they function correctly and that the quality and quantity of water is satisfactory for emergency washing purposes.

c. When personal protective clothing is required:

(1) An area shall be established for the removal of the personal protective clothing which limits the spread of any chemical waste, dust, or fume;

(2) Workers shall be trained in the removal of personal protective clothing and equipment to prevent further spread or contamination.

06.B.03 Storage prior to transportation of hazardous chemicals, materials, substances and wastes shall be under the supervision of a qualified person.

a. Transportation, use, and storage of hazardous or toxic agents shall be planned and controlled to prevent contamination of people, animals, food, water, equipment, materials, and environment.

b. All storage of hazardous or toxic agents shall be in accordance with the recommendations of the manufacturer, OSHA and NFPA requirements and accessible only to authorized personnel.

c. Disposal of surplus or excess hazardous or toxic agents shall occur in a manner that will not contaminate or pollute any water supply, ground water, or streams; and will comply with Federal, State, and local regulations and guidelines.

d. Containers used to hold hazardous or toxic agents should not be used to hold other materials unless they have been managed or cleaned under hazardous waste and DOT regulatory requirements.

e. Every hazardous or toxic agent being transported for disposal shall be transported with a copy of the substance's MSDS (SDS) whenever applicable.

f. Persons who prepare shipments of hazardous chemicals, materials, substances and/or wastes that are defined as hazardous material under DOT regulations are required to be DOT trained, certified and issued an appointment letter in accordance with Defense Transportation Regulation 4500.9-R, Chapter 204.

06.B.04 A Process Safety Management (PSM) Program of highly hazardous chemicals shall be employed in accordance with 29 CFR 1910.119 or 29 CFR 1926.64 whenever a work activity involves:

a. A process that involves a chemical at or above the threshold quantities listed in Appendix A of the above-cited CFRs; or

b. A process that involves a flammable liquid or gas on site in one location in a quantity of 10,000 lb (4,535.9 kg) or more as defined in 29 CFR 1926.59(c), except:

(1) Hydrocarbon fuels used solely for workplace consumption as a fuel if such fuels are not part of a process containing another highly hazardous chemical covered by the standards cited above; or

(2) Flammable liquids stored in atmospheric tanks or transferred that are kept below their normal boiling point without benefit of chilling or refrigeration.

## 06.C Lead and Asbestos Hazard Control.

### 06.C.01 General.

a. No asbestos-containing materials (ACMs) shall be used or brought onto any USACE projects. Lead-based paints (LBP) shall only be used with written approval of the GDA or USACE SOHO and shall never be used inside a residence, child care facility, or medical treatment facility.

b. All construction or maintenance projects will be evaluated for the potential to contact ACM and LBP.

(1) Lead and asbestos sources are to be labeled as a lead or asbestos hazard that should not be disturbed without proper protection. If infeasible to label each source, a site map may be posted which points out the location of the lead and asbestos hazards.

(2) If the evaluation shows the potential for activities to generate unacceptable occupational exposure to LBP, a written lead compliance plan shall be written. The lead compliance plan shall be in accordance with 29 CFR 1910.1025 and 29 CFR 1926.62.

(3) If the evaluation shows the potential for activities to disturb ACM, an asbestos abatement plan shall be developed. The plan shall be in accordance with 29 CFR 1910.1001; 29 CFR 1926.1101; and 40 CFR 61, Subpart M.

(4) These plan(s) shall be developed as an appendix to the APP or, for USACE operations, the Project SOH Plan. The written plan(s) shall be submitted for acceptance by the GDA or local SOHO before beginning work.

06.C.02 Lead Compliance Plan. A lead compliance plan shall describe the procedures to be followed to protect employees from lead hazards while performing lead hazard control activities. The Plan shall address the following:

a. A description of each work activity in which lead is emitted, to include equipment and materials used, controls in place, crew size, job responsibilities, operating procedures, and maintenance practices, work activity locations and lead-containing components keyed to the project drawings;

b. Description of means to be used to achieve exposure compliance, including any engineering controls;

c. Employee exposure assessment procedures to monitor and document employee lead exposure. Exposure monitoring shall include two types:

(1) Initial determination (may be omitted if there is sufficient objective/historical data showing action level compliance according to the requirements); and

(2) Continued exposure monitoring required as a result of initial exposure determinations.

d. Protective clothing, housekeeping procedures to prevent spread of lead contamination both in and beyond the lead hazard control area, and hygiene facilities and practices to prevent employees from inadvertent ingestion of lead;

e. Administrative controls to limit employee exposure to lead, including employee rotation schedule to be employed, if engineering controls or PPE fail to eliminate exposures exceeding the PEL;

f. Medical surveillance procedures to monitor employee exposures and ensure fitness for wearing respiratory protection;

g. Competent person (CP) and employee training required;

h. Detailed sketches identifying lead hazard control areas, including decontamination areas and facilities, critical barriers, and physical and air distribution boundaries;

- i. Perimeter or other area air monitoring outside or adjacent to the regulated area;
- j. Security required for each lead hazard control area; and
- k. Waste generation, characterization, transportation, and disposal (including recordkeeping).

06.C.03 Asbestos Abatement Plan. An asbestos abatement plan shall describe procedures to be followed to protect employees from asbestos hazards while performing work that will disturb ACM. It shall address the following:

a. A description of each activity where asbestos will be disturbed, including OSHA class of work, equipment required, controls to be used, crew size, job responsibilities, maintenance practices, and locations keyed to the project drawings;

b. The method of notification of other employers at the worksite;

c. A description of regulated areas, types of containment, decontamination unit plan, and engineering controls;

d. Air monitoring plan - personal, environmental and clearance. Employee exposure assessment procedures shall address monitoring and documenting employee exposures.

(1) An initial determination (may be omitted if there is sufficient objective/historical data showing compliance with the requirements);

(2) Continued exposure monitoring may be required as a result of initial exposure determinations;

(3) Environmental monitoring shall demonstrate the absence of asbestos fiber migration outside the regulated area; and

(4) Clearance monitoring to document that the area has met specified clearance criteria.

e. PPE, including respirators and clothing;

f. Housekeeping procedures that address prevention of spread of contamination both in and beyond the regulated area;

g. Hygiene facilities and practices;

h. CP and employee training required;

- i. Medical surveillance, as required, to assess exposure and to monitor employee fitness to perform work tasks while wearing PPE to include respiratory protection devices;
- j. Waste generation, containerization, transportation, and disposal (including recordkeeping); and
- k. Security, fire, and medical emergency response procedures.

#### 06.D Hot Substances.

- Note: For heating devices and melting kettles, see Section 09.E.

06.D.01 Protection from Hot Substances. Hazards from hot substances include increased inhalation and skin hazards and burns from the heat. When working with hot substances the following shall be considered:

- a. PPE (respirators, gloves, etc.) shall be evaluated for efficiency in hot atmospheres and protectiveness from heat as well as the chemical hazard;
- b. Heat stress precautions and measurements shall be taken as required by Section 06.I;
- c. Location where hot substances are heated shall be located away from any ventilation intake air vents. If hot substances are being applied to a roof, the ventilation intake air vents shall be temporarily relocated so as to prevent the uptake of the fumes into the building or the work shall be completed at a time when the building is not occupied.

#### 06.D.02 Transporting and handling hot substances.

- a. Runways or passageways, clear of obstructions, shall be provided for all persons carrying hot substances.
- b. Hot substances shall not be carried up or down ladders.
- c. When hoists are used to raise or lower hot substances, attention shall be given to assuring that the hoisting mechanism is adequate for the loads imposed and is securely braced and anchored.
- d. All persons handling hot substances shall be provided protection against contact with, or exposure to radiant heat, glare, fumes, and vapors of the substances. At a minimum, roofers handling roofing materials shall be fully clothed including long sleeved shirts, shoes secured and at least 6 in (15 cm) in height, and gloves up to the wrist. > See Section 5.

e. Containers for handling and transporting hot substances shall be of substantial construction (minimum 24-gauge sheet steel), free from any soldered joints or attachments, and shall not be filled higher than 4 in (10.1 cm) from the top.

f. Piping used to transport hot substances shall have an entry and exit shut off valve and shall be made of flexible metallic hoses fitted with insulated handles. In cold climates, piping shall be insulated to prevent material from solidifying on the inside of the pipe.

#### 06.E Harmful Plants, Animals and Insects.

06.E.01 Protection against hazards from insects and/or animals harboring fleas or disease-carrying insects shall include, as applicable, the following:

a. PPE such as netted hoods, leather work gloves, and high-top work boots worn in conjunction with trousers and long-sleeved shirts;

b. Clothing treated at the factory with DEET or Permethrin are recommended in areas of high insect population;

c. Drainage or spraying of breeding areas;

d. Destroying or flagging (marking as hazard) of nests;

e. Smudge pots and aerosols for protecting workers and small areas;

f. Elimination of actions or conditions that propagate insects or vermin;

g. Extermination measures by a certified pesticide applicator or, for over the counter items, following the instructions on the label;

h. Approved first aid procedures for employees; employees allergic to bee stings shall be encouraged to self identify to the supervisor and to carry an EpiPen;

i. Inoculation against diseases known to be a local hazard; and

j. Instruction in recognition of the animals and insects and their common nesting habits, aggressiveness, etc.

06.E.02 In areas where there is exposure to poisonous snakes or lizards, employees shall be required to:

a. Wear snake chaps or knee-high snake boots worn in conjunction with trousers and long-sleeved shirts;

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b. Be trained in recognition of the snakes and their common nesting habits, aggressiveness, etc.; and

c. Be trained in the proper first aid procedures for bites.

06.E.03 In areas where employees are exposed to poisonous plants, the following protective measures, as applicable, shall be provided:

a. Removal or destruction of plants, where practical;

b. Appropriate protective clothing such as gloves;

c. Protective ointments;

d. Soap and water for washing exposed parts; and

e. Instruction in recognition and identification of the plants.

06.E.04 When burning poisonous plants, controls shall be instituted to prevent contact with or inhalation of toxic elements contained in the smoke.

06.F Ionizing Radiation.

06.F.01 Anyone who procures, uses, possesses, transports, transfers, or disposes of radioactive materials or radiation generating devices shall:

a. Notify, in writing, the GDA or USACE Command Radiation Safety Officer (RSO) of the nature of the material or device, a description of intended use, the location of use and storage, and all transportation and disposal requirements;

b. Secure appropriate authorization or permit if any radioactive material or a radiation generating device is to be used on a DoD installation (a lead time of at least 45 days should be allowed for obtaining a DoD authorization or permit);

c. Provide to the GDA or USACE Command RSO a copy of all US Nuclear Regulatory Commission (NRC) or Agreement State licenses, the Army Radiation Authorization (ARA), Army Radiation Permit, and reciprocity forms (to include NRC Form 241), as applicable.

d. When a USACE Radiation Safety Program exists at a location/facility that has potential Radon-222 emissions from radioactive material use, the more restrictive of the specific limits, the specific license condition or the NRC requirements in 10 CFR 20 for Radon-222 shall apply. If USACE employees work in a building, structure, or tunnel that has naturally occurring Radon-222, then OSHA requirements in 29 CFR 1910.1096 are applicable as specified in Section 06.F.14, Radon.

➤ Note: See OSHA Directive CPL 02-00-086, Memorandum of Understanding between OSHA and the U.S. Nuclear Regulatory Commission, 22 December 1989, for a delineation of radiation sources regulated by each agency.

#### 06.F.02 Qualified Personnel.

a. Operations involving radiation hazards or use of radioactive material or radiation generating devices shall be performed under the direct supervision of a RSO, who is qualified and responsible for radiological safety.

b. The RSO will be technically qualified and will meet the experience, training, and education requirements listed below:

(1) Formally trained in radiation protection topics including the following: physics of radiation; radiation's interaction with matter; mathematics necessary for the subject matter; biological effects of radiation; type and use of instruments for detection, monitoring and surveying radiation; radiation safety techniques and procedures; and use of time, distance, shielding, engineering controls, and PPE to reduce radiation exposure;

(2) Hands-on training in the uses of equipment, instrumentation, procedures, and theory used in their unit;

(3) Knowledge of applicable regulations including those of the NRC, EPA, DOE, OSHA, DOT and DoD, to include all applicable DoD Components, pertaining to radioactive materials, radiation generating devices, and radioactive and mixed waste; and

(4) Knowledge of the USACE Radiation Safety Program, and recordkeeping requirements for work with radioactive materials and radiation generating devices.

#### 06.F.03 Radiation Safety Program.

a. Operations involving radiation hazards, and users of radioactive material or radiation generating devices, shall develop and implement a Radiation Safety Program.

(1) The program shall be managed by the RSO and based on sound radiation safety principles that shall keep occupational doses and doses to the public ALARA.

(2) The RSO is responsible for performing or ensuring the performance of an annual review of the program. Documentation of the review shall be retained for two (2) years.

(3) A Radiation Safety Committee (RSC) shall be established in accordance with 10 CFR 20 and DA PAM 385-24 as part of the Radiation Safety Program.



b. All personnel entering an area where radioactive material or radiation generating devices are used, and where there is a potential for an individual to receive a Total Effective Dose Equivalent (TEDE) of 100 mrem or more in one (1) year, shall receive instruction in:

- (1) The presence of the material or device;
- (2) Health and safety problems associated with exposure to radiation, including the potential effects of radiation on a pregnant female, the fetus, or embryo;
- (3) Precautions and controls used to control exposure;
- (4) Proper use of instrumentation and dosimetry in the area;
- (5) The Radiation Safety Program required in 06.F.03.a; and
- (6) Their rights and responsibilities.

c. Users of radioactive material or radiation generating devices without a potential to receive a TEDE of 100 mrem or more in one (1) year and visitors to a site shall coordinate with the RSO for appropriate training.

d. The Radiation Safety Program will include plans and procedures for handling credible emergencies involving radiation and radioactive materials. This will include coordination with civilian and/or military emergency response organizations as necessary.

#### 06.F.04 Dose Limits.

a. Occupational dose limits shall be based on the TEDE. > See Table 6-1.

(1) An annual (calendar year) limit that is the more limiting of: 5 rem [0.05 sieverts (Sv)] TEDE, or the sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue of 50 rem (0.5 Sv), or 15 rem (0.15 Sv) to the lens of the eye, or 50 rem (0.05 Sv) shallow dose equivalent to the skin or any extremity.

(2) Without the written approval of the USACE Radiation Safety Staff Officer (RSSO), the annual occupational dose shall not exceed the more limiting of: 0.5 rem (0.005 Sv) TEDE, or the sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue of 5 rem (0.05 Sv), or 1.5 rem (0.015 Sv) to the lens of the eye, or 5 rem (0.05 Sv) shallow dose equivalent to the skin, or any extremity.

TABLE 6-1  
Occupational Dose Limits

Body part	Annual limits with RSSO approval	Annual limits without RSSO approval	Suggested ALARA limits
Whole body	5 rem (0.05 Sv)	0.5 rem (0.005 Sv)	0.1 rem (0.001 Sv)
Individual organ	50 rem (0.5 Sv)	5 rem (0.05 Sv)	0.5 rem (0.005 Sv)
Lens of eye	15 rem (0.15 Sv)	1.5 rem (0.015 Sv)	0.15 rem (0.0015 Sv)
Skin or extremity	50 rem (0.5 Sv)	5 rem (0.05 Sv)	0.5 rem (0.005 Sv)

(3) To keep doses ALARA, the user shall set administrative action levels below the annual dose limits. These action levels shall be realistic and attainable. Suggested action levels are the more limiting of: 0.1 rem (0.001 Sv) TEDE, or the sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue of 0.5 rem (0.005 Sv), or 0.15 rem (0.0015 Sv) to the lens of the eye, or 0.5 rem (0.005 Sv) shallow dose equivalent to the skin or any extremity.

(4) Any exposure in excess of an ALARA limit requires investigation by the RSO.

b. In accordance with DA PAM 385-24, planned special exposures shall not be performed.

c. No employee under 18 years of age shall receive occupational exposure to ionizing radiation (excluding exposure to Radon-222).

d. The dose to a declared pregnant employee shall not exceed 0.5 rem (0.005 Sv) during the entire gestation period and efforts shall be made to avoid variations in a uniform monthly exposure rate. If the dose to the embryo/fetus is between 0.05 rem and 0.5 rem at the time of declaration, then dose to the embryo/fetus is limited to 0.05 rem for the remainder of gestation.

#### 06.E.05 Radiation Monitoring, Surveys, and Dosimetry.

a. Users of radioactive material or radiation generating devices shall conduct surveys and monitoring to ensure occupational dose limits are not exceeded.

b. Instruments used for radiation monitoring and surveying shall be:

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(1) Available and used whenever radioactive material or radiation generating devices are used;

(2) Properly calibrated at least annually to a National Institute of Standards and Technology (NIST) traceable source;

(3) Appropriate for the type and intensity of the radiation surveyed;

(4) Operationally checked against a dedicated check source before each use; and

(5) The RSO must maintain at least two survey instruments to accommodate maintenance and calibration downtime.

c. Users of radioactive material or radiation generating devices and visitors or personnel performing work tasks in the area shall coordinate with the RSO for appropriate dosimetry use whenever any of the following situations exist:

(1) An individual enters a Radiation Area (> 5 mrem [50 microsieverts ( $\mu\text{Sv}$ )] in any one (1) hour at 1 ft (30 cm) from the radiation source), or a High Radiation Area (> 100 mrem [1 mSv] in any one (1) hour at 1 ft (30 cm) from the radiation source), or a Very High Radiation Area (>500 rad [5 Gray (Gy)] in 1 hour at 3.3 ft (1 m) from the radiation source);

(2) An individual has the potential to receive greater than the ALARA limits established pursuant to Section 06.F.04.a.(3) in 1 year.

d. All external dosimetry shall be processed by a National Voluntary Laboratory Accreditation Program (NVLAP) certified laboratory. USACE personnel shall use dosimetry provided by the Army Dosimetry Center.

e. Users of unsealed radioactive material sources shall institute an internal dosimetry program:

(1) When there is a potential for an employee to receive an internal dose of greater than 0.5 rem (5 mSv) per year;

(2) That is reviewed and approved by a qualified health physicist, and

(3) That contains provisions for a pre-exposure bioassay, a bioassay method capable of detecting internal radioactive materials, at a level below 10% of the annual limits of intake (ALI) listed in Appendix B of 10 CFR 20 for each radionuclide used, appropriate action levels for requiring additional bioassay, actions for individuals found to have internally deposited radioactive materials, and provisions for post-exposure bioassay.

06.F.06 Access, Storage, and Control.

- a. All radiological devices and radioactive materials shall be designed, constructed, installed, used, stored, transported, and disposed of in such a manner to ensure personnel exposures are kept ALARA.
- b. Users of radioactive materials or radiation generating devices shall post signs and control access to radiation areas in accordance with Section 06.E.08.
- c. Where radiation levels exceed 2 mrem (20  $\mu$ Sv) in any 1 hour period, users shall use engineering controls, shielding, access time limitation, and/or physical separation to keep doses to the public ALARA.
- d. Users shall secure radioactive material and radiation generating devices against theft or unauthorized use.
- e. Storage shall be in accordance with any license or permit requirements.
- f. Radioactive material and radiation generating devices, not in storage, shall be under constant control and surveillance.
- g. Operations involving regulated radiation hazards or users of regulated radioactive material or radiation generating devices shall conduct surveys to ensure that the public dose limit of 0.01 rem (0.0001 Sv) is not exceeded.

#### 06.E.07 Respiratory Protection and other Controls.

- a. Users of radioactive material shall, to the extent practicable, institute process or engineering controls to limit concentrations of radioactive materials in air.
- b. Where process or engineering controls are unable to control airborne radioactive material concentrations, users shall increase monitoring and limit intakes of radioactive materials through control of access, limitation of exposure times, use of respiratory protection equipment, or other controls.
- c. The use of respiratory protection equipment shall be in compliance with Section 05.G of this manual, and shall be limited by the protection factors listed in Appendix A of 10 CFR 20.

#### 06.E.08 Signs, Labels, and Posting Requirements.

- a. The RSO shall post in a conspicuous location a sign or signs bearing the standard radiation symbol shown in Figure 8-7 and the following words:

(1) "Caution, Radiation Area" - areas where radiation field is equal to or greater than 5 mrem (0.05 mSv) in any 1 hour and less than 100 mrem (1 mSv) in any 1 hour at 30 cm from the radiation source;

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(2) "Caution, High Radiation Area" - areas where radiation field is equal to or greater than 100 mrem (1 mSv) in any 1 hour at 12 in (30 cm) from the radiation source and less than 500 rads (5 Gy) in any 1 hour at 3.3 ft (1 m) from the radiation source;

(3) "Grave Danger, Very High Radiation Area" - areas where the radiation field is equal to or greater than 500 rads (5 Gy) in any 1 hour;

(4) "Caution, Airborne Radioactivity Area" – rooms, enclosures, or areas where airborne radioactive material concentrations are greater than the derived air concentration (DAC) limits listed in 10 CFR 20, Appendix B or where concentrations (excluding Radon-222) exist to such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6% of the annual limit on intake (ALI) or 12 DAC-hours; or

(5) "Caution, Radioactive Material" – areas or rooms where quantities of radioactive materials in excess of ten times the 10 CFR 20, Appendix C quantities are used or stored.

b. Users who receive or expect to receive a package containing radioactive material shall follow the package receipt procedures listed in 10 CFR 20.1906.

c. When a site has an NRC license, the RSO shall post an NRC Form 3 in a location visible to all employees who work with or around radioactive materials

#### 06.F.09 Radioactive Waste Disposal

a. Radioactive sealed sources (and gauges) when no longer needed may be returned (transferred) to the manufacturer. The local USACE RSO must be notified and any applicable licenses or permits amended or terminated.

b. Radioactive waste disposal shall be coordinated with the GDA. For disposal actions specific to USACE operations and activities the GDA or Project Manager shall coordinate with the USACE Command RSO and the USACE Environmental and Munitions Center of Expertise.

c. Tritium (H-3) and Carbon-14 used in liquid scintillation counting, at concentrations below 0.05 microcuries per gram ( $\mu\text{Ci/g}$ ), may be disposed without regard to its radioactivity. (Note: Many liquid scintillation fluids are hazardous wastes and must be disposed of as such.)

#### 06.F.10 Records.

a. All users of radioactive material or radiation generating devices shall prepare and maintain records of the Radiation Safety Program for three (3) years after termination of the license or permit.

b. For any individual for whom monitoring was required by Section 06.F.05, the RSO shall prepare and maintain documentation of that person's occupational dose during the current year. The RSO shall also attempt to obtain records of cumulative occupational radiation dose.

c. All users of radioactive material or radiation generating devices shall prepare and maintain records of all calculated or monitored radiation dose to individual members of the public so as to document compliance with Section 06.F.05.

#### 06.F.11 Reports.

a. Any loss, theft, damage, or overexposure shall immediately upon discovery be reported to the RSO who will then file a report (if required) with NRC in accordance with the requirements of 10 CFR 20.

b. Mishaps involving radioactive material or radiation generating devices shall be reported immediately to the RSO and the USACE RSSO.

c. Annual reports shall be issued by the RSO for each individual USACE radiation employee with the recorded or calculated dose assigned to the USACE individual for the year or specific work project. These shall be maintained in such a manner that accumulated exposure can be determined at a future date.

#### 06.F.12 Transportation.

a. Users of radioactive material shall comply with the requirements of the DOT for inter- and intra-state transport contained in 49 CFR.

b. Persons who prepare shipments of radioactive materials that are defined as hazardous material under DOT regulations are required to be trained (49 CFR 173.1(b)), certified, and issued an appointment letter in accordance with DoD 4500.9-R, Chapter 204.

06.F.13 Medical surveillance. > See Section 33 for requirements specific to work conducted under the provisions of 29 CFR 1910.120 and 29 CFR 1926.65.

a. Medical examinations are not routinely required before occupational exposure to ionizing radiation. For USACE personnel, a medical examination shall be conducted in accordance with DA PAM 40-501, when deemed necessary, by a physician, the RSO, or other regulations. The RSO will coordinate with supporting medical personnel to help ensure that personnel receive appropriate occupational health surveillance.

b. All cases of overexposure and suspected ingestion or inhalation of radioactive materials shall be referred to a physician for examination.

#### 06.F.14 Radon-222.

a. If a work area is occupied for 40-hours per week or more by an individual 18 years of age or older, and average natural occurring radon-222 concentration is greater than 100 pCi/L, then number of hours worked in the area by the individual shall be reduced or engineering controls introduced to reduce the radon-222 concentration. If the exposure is due to a regulated radiation source, the requirements of the NRC license shall apply. > See 29 CFR 1910.1096(c)(1) which references 10 CFR 20 Appendix B Table 1 and Table 2.

b. Any work area in a structure, building, or tunnel, wherein workers may be reasonably expected to be exposed to naturally occurring radon-222 exceeding 25 pCi/L averaged over a 40-hour work week, is an Airborne Radioactivity Area and shall be posted in accordance with 29 CFR 1910.1096(e)(4)(ii).

c. All individuals working in or frequenting any portion of an area posted per Section 06.F.14.b shall receive instruction regarding exposure to radiation as per 29 CFR 1910.1096(i).

06.G Non-ionizing Radiation, Magnetic and Electric Fields.

06.G.01 Lasers.

a. Only qualified and trained employees may be assigned to install, adjust, and operate laser equipment. Proof of qualification of the laser equipment operator shall be in the operator's possession during operation. A qualified employee shall design or review for adequacy all radiation safety Standard Operating Procedure (SOP).

b. Laser equipment shall bear a label to indicate make, maximum output, and beam spread.

c. Areas in which lasers are used shall be posted with standard laser warning signs.  
> See Figures 8-5 and 8-6

d. Employees whose work requires exposure to laser beams shall be provided with appropriate laser safety goggles that will protect for the specific wavelength of the laser and be of optical density adequate for the energy involved, as specified in Table 6-2. Protective goggles shall bear a label identifying the following data: the laser wavelengths for which use is intended, the optical density of those wavelengths, and the visible light transmission.

TABLE 6-2

Laser Safety Goggle Optical Density Requirements

Intensity, continuous wave maximum power density (watts/cm <sup>2</sup> )	Attenuation	
	Optical density	Attenuation factor
0.01	5	10,000
0.1	6	100,000
1.0	7	1,000,000
10.0	8	10,000,000

e. Beam shutters or caps shall be used, or the laser turned off, when laser transmission is not required. When the laser is left unattended for a period of time (e.g., during lunch hour, overnight, or at change of shifts) the laser shall be turned off.

f. Only mechanical or electronic means shall be used as a detector for guiding the internal alignment of the laser.

g. The laser beam shall not be directed at employees: whenever possible, laser units in operation shall be set above the heads of employees.

h. When it is raining or snowing or when there is dust or fog in the air, the operation of laser systems shall be prohibited (as practical); during such weather conditions employees shall be kept out of range of the areas of source and target.

i. Employee exposure to laser power densities shall be within the TLVs as specified by the ACGIH in "Threshold Limit Values and Biological Exposure Indices."

j. Only Class 1, 2, or 3a lasers may be used as hand-held pointing devices. Lasers used as pointing devices (e.g., during briefings) shall not be directed toward employees and shall be handled and stored in accordance with the manufacturer's recommendations.

k. Suspected LASER eye injuries: Immediately evacuate personnel suspected of experiencing potentially damaging eye exposure from LASER radiation to the nearest medical facility for an eye examination. LASER eye injuries require immediate specialized ophthalmologic care to minimize long-term visual acuity loss. Medical personnel should obtain medical guidance for LASER injuries from the Tri-Service LASER Incident Hotline, (800) 473-3549 (24-hour phone line).

06.G.02 Radio frequency and electromagnetic radiation.



a. Ensure that no employee is exposed to electric or magnetic fields, radio frequency (RF) including infrared, ultraviolet, and microwave radiation levels exceeding the values listed in the ACGIH Threshold Limit Values and Biological Exposure Indices.

b. Routine use of RF protective clothing to protect personnel is prohibited.

(1) Protective equipment, such as electrically insulated gloves and shoes for protection against RF shock and burn, or for insulation from the ground plane, is permissible when engineering controls or procedures cannot eliminate exposure hazards.

(2) Users will identify, attenuate, or control potentially hazardous RF electromagnetic fields and other radiation hazards associated with electronic equipment by engineering design, administrative actions, or protective equipment, (in that order), or a combination thereof. Use process and engineering controls before PPE to protect employees.

c. All personnel routinely working with RF emitting equipment where exposures may exceed TLVs will receive training in RF hazards, procedures for minimizing these hazards, and their responsibility to limit potential overexposures. Operator's manuals, Training Orders, Equipment SOPs, etc. will be available for all RF generating equipment and safety guidance will be followed.

d. Whenever personnel are potentially exposed to RF fields exceeding PELs, the fields will be measured and evaluated using Institute of Electrical and Electronics Engineers (IEEE) guidance. District and/or project safety personnel will use this information and document RF environments. Where multiple RF electromagnetic radiation emitters are located in fixed arrangements, RF evaluation data will include a determination of weighted contributions from expected simultaneously operated emitters.

#### 0.6.H Ventilation and Exhaust Systems.

##### 06.H.01 Portable and Temporary Ventilation Systems.

a. All portable or temporary ventilation systems shall remove dusts, fumes, mists, vapors and gases away from the worker and the work environment or provide air to prevent an oxygen deficient atmosphere.

b. Portable or temporary ventilation systems shall be used as designed by the manufacturer. All hoses shall be only as long as the maximum allowed by the manufacturer to provide the required air flow at the supply or exhaust point. If adding or changing hoses, only hoses and/or connectors shall be used that are comparable and compatible with the hoses and connectors provided by the manufacturer.

c. Make-up air for air supply ventilation systems shall draw air free of contaminants and away from any potential contaminant source.

d. Any portable or temporary ventilation system and the locations where the systems are to be used shall be approved by the GDA or SOHO before use. Manufacturer information or design criteria shall be provided with the request for approval.

e. Airborne contaminants created by portable or temporary ventilation systems (such as drills, saws, and grinding machines) in concentrations exceeding acceptable safe limits shall be effectively controlled at the source. > See Section 06.A.03.

f. The use of high efficiency, filtered, recirculated ventilation units shall be allowed when:

(1) The filtration system lowers the levels of any of the toxic fumes or dust from the operation to less than half of the OEL. This shall be documented by an IH or CP through sampling for the contaminants.

➤ Note: Welding, carbon monoxide, ozone, and carbon dioxide are common contaminants that are not filtered out by most filtration devices.

(2) The unit and filtration are regularly maintained and the maintenance procedure and schedule is written and documented when maintenance is completed.

(3) The air is not recirculated into a confined space.

(4) The contaminant is not beryllium or chromium. Fumes or particulate from beryllium or chromium are not to be filtered and recirculated.

06.H.02 Ventilation systems shall be operated and maintained in such a manner to ensure the maintenance of a volume and velocity of exhaust air sufficient to gather contaminants and safely transport them to suitable points for removal.

06.H.03 Duration of operation.

a. Ventilation systems shall be operated continuously during operations when persons are exposed to airborne contaminants or explosive gases at or above acceptable safe limits as defined in Section 06.A.01 or as otherwise specified by this manual, referenced standards, or regulations.

b. Ventilation systems shall remain in operation for a period of time after the work process or equipment has ceased to ensure the removal of any contaminants in suspension or vaporizing into the air.

06.H.04 Local exhaust ventilation systems shall be periodically evaluated to ensure that proper contaminant capture, movement through the system and filtration or exhaust to the outside.

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06.H.05 Dusts and refuse materials removed by exhaust systems or other methods shall be disposed of in a manner that will not create a hazard to employees or the public and in accordance with Federal, State, and local requirements.

06.H.06 Ventilation systems used to remove hazardous dusts, fumes, gases, or substances shall be evaluated annually to determine if the system requires cleaning. The cleaning of the ventilation system shall be part of the written housekeeping program section of the Project SOH Plan or APP.

06.I Abrasive Blasting.

06.I.01 General. Silica sand shall NOT be used as an abrasive blasting media. Alternative abrasive blasting materials are available and listed in Table 6-3. Depending on the application, one of these alternative materials is suggested for use as an abrasive blasting media.

a. Abrasive blasting operations shall be evaluated to determine composition and toxicity of the abrasive and the dust or fume generated by the blasted material, including surface coatings. This determination shall be documented on the AHA (Activity Hazard Analysis) developed for the abrasive blasting activity.

b. Written operating procedures shall be developed and implemented for abrasive blasting operations, including pressurized pot procedures (filling, pressurizing, depressurizing, and maintenance and inspection). The procedures should be added as an appendix to the APP.

c. The concentration of respirable dust and fume in the breathing zone of individuals exposed to the blasting operation shall be maintained below any OEL for the material being blasted and the blasting agents or its byproducts.

d. No employee will be allowed to work in abrasive blasting operations unless he has met the medical surveillance and training and experience requirements, and has been provided the appropriate PPE.

e. All production and control systems used in a stationary abrasive-blasting process shall be designed or maintained to prevent escape of airborne dust or aerosols in the work environment and to ensure control of the abrasive agents.

f. Pressurized systems and components shall be inspected, tested, certified and maintained in accordance with the requirements of Section 20.

g. Engineering controls for noise and dust shall be used even if they cannot reduce the exposures to below OEL (significantly reduces noise and dust exposure to the employees).

TABLE 6-3

Abrasive Blasting Media: Silica Substitutes

Applications	Media	Advantages
Cleaning Hard Metals (Titanium); Removing Metal Etch Glass; Carve Granite	Aluminum Oxide	Recyclable
General Paint Removal Stripping Aircraft Skins Cleaning Surfaces in Food Processing Plants Removing Paint from Glass	Baking Soda (Sodium Bicarbonate)	Less Material Used/Less Cleanup Low Nozzle Pressures (35-90 PSI) Non-Sparking Water Soluble
General Paint, Rust, & Scale Removal from Steel Paint Removal from Wood Exposure of Aggregates	Coal Slag	Less than 1% Free Silica Inert, Fast Cutting Creates Anchor Profile
General Paint, Rust & Scale Removal from Steel Paint Removal from Wood	Copper Slag	Rapid Cutting
Deburring Paint & Rust Removal from Wood & Metal	Corn Cob Granules	Low Consumption Low Dust Levels Biodegradable
Cleaning Aircraft Parts Cleaning Exotic Metals	Dry Ice (Carbon Dioxide)	No Residue Remains Minimal Cleanup
General Paint, Rust & Scale Removal from Steel	Garnet	Lower Nozzle Pressure (60-70 PSI) Low Dust Levels Fast Cleaning Rates Can be Recycled 6-7 Times Low Free Silica
Cleaning & Polishing Deburring	Glass Beads	Uniform Size and Shape Recyclable Provide High Luster Polished Surface
General Paint, Rust & Scale Removal from Steel	Nickel Slag	Rapid Cutting
Cleaning Soft Materials (e.g. Aluminum, Plastic, Wood) Cleaning Surfaces in the Petroleum Industry	Nut Shells	High Removal Speed Non-Sparking Low Consumption
Clean Light Mill Scale/Rust from Steel 2.5 MIL Profile & Finer	Olivine	Low Chloride Ion Level Low Conductivity

#### 06.I.02 Blast Cleaning Enclosures and Rooms.

a. The ventilation in all blast enclosures shall be measured annually to confirm the flow is adequate and the system does not require cleaning or maintenance. Exhaust systems shall be part of a regular cleaning and maintenance program.

b. All air inlets and access openings shall be baffled to prevent the escape of abrasive agent and contaminant and the recommended continuous airflow into the air inlets is a minimum of 250 fpm (4.6 kph).

c. Negative pressure shall be maintained inside during blasting.

d. The rate of exhaust shall be sufficient to provide prompt clearance of the dust-laden air within the enclosure after cessation of the blasting.

e. If abrasive blasting is automated, the blast shall be turned off before the enclosure is opened. The exhaust system shall be run for a sufficient period of time to remove the dusty air within the enclosure to minimize the escape of dust into the workroom and prevent any health hazard.

f. In the room, a cleanup method other than broom sweeping or compressed air blowing shall be used to collect the abrasive agent after blasting (e.g., vacuum cleaning). If the blasting agent is removed manually, appropriate personal protective equipment, including respiratory protection shall be worn and not removed until outside the blasting room.

#### 06.I.03 Blasting without Enclosures.

a. If abrasive blasting must be performed inside a building without enclosures, respiratory protection shall be provided for all employees in the area. Portable engineering control devices shall be used at the location to collect the entire used abrasive agent as it is applied.

b. When airborne abrasive-blasting dust becomes sufficiently heavy in an area to cause a temporary safety hazard by reduced visibility, or discomfort to the unprotected employees not engaged in abrasive blasting, such operations in the affected area shall be discontinued until the airborne dust is removed by exhaust ventilation and the settled dust has been removed from the horizontal surfaces in the area. If such operations have to continue, appropriate respiratory protection shall be provided to those employees remaining in the area.

c. Abrasive materials shall not be allowed to accumulate on aisles and walkways to create a slipping hazard.

d. If wet abrasive blasting is employed to reduce dust exposures, the aerosols produced and the dried residues that become airborne might be potential hazards and shall be considered.

06.I.04 Confined spaces. Abrasive blasting work conducted in a confined space shall be performed in accordance with Section 34. If the space is mechanically ventilated, means shall be provided to collect dust before release to the open atmosphere.

06.I.05 Blasting Outdoors.

a. Work completed outside has been shown to create exposures to health hazards for the worker and other trades in the area. Air and noise samples shall be taken to document the level of exposure to the worker and the workers in the area, unless similar operations documented no exposure. Blasters shall be protected in a manner equivalent to Section 05 and/or 29 CFR 1910.94(a)(5), whichever is more stringent.

b. Engineering controls and work practices, such as wet blasting methods, shall be used to prevent the dust cloud from spreading to other work areas. Check with Local and State requirements which may add restrictions to outdoor abrasive blasting. If the surface to be blasted is painted or contains high levels of silica and/or heavy metals, such as lead, chromium, or cadmium, an enclosure may be required to prevent disbursement of the hazard.

c. Hearing protection and respiratory protection shall be available to all employees in the area unless noise and air sampling documents the workers are not exposed to the blasting agent or contaminants from the blasted surface.

06.I.06 Personal Protective Equipment (PPE).

a. Selection and use of PPE shall be in accordance with Section 05. If reusable coveralls are used, they shall be vacuumed before all breaks and removed at the end of the shift. Clothes shall not be taken home to be cleaned by the worker or family, but shall be laundered by the employer.

b. Air-supplied helmets, blast helmets/hoods, dust respirators, ear muffs, safety boots or toe guards, durable coveralls, closeable at wrists, ankles, and other openings, and safety glasses should be an individual issue item, identified with and used by only one employee. Such equipment may be reissued to another employee only after complete cleaning, repair, and decontamination.

c. Means shall be provided to clean and store air-supplied respiratory equipment after each shift of use. Storage shall be in a clean enclosure such as locker, footlocker, plastic container or zip-lock type bag. Employees shall be trained to maintain issued equipment in clean and good working condition.

d. Replacement of prescription or plano safety glasses shall be made if multiple pitting or etching is visible in the center of the lenses.

e. Replacement of faceplates in air-supplied helmets and blast helmets/hoods shall take place when a side-on light source produces obscuring visible reflections and glare from the etched spots and pit holes in the faceplate. Mylar coating, or similar transparent plastic material, is recommended to protect the glass or plastic faceplate.

f. Length of air hose may not be altered from the manufacturer's specifications.

g. Daily checks shall be performed by the wearer of PPE to maintain it in good working condition. Rips, tears, and openings of PPE that expose skin to abrasive agents shall be mended or replaced. Functional tests for leaks, proper respiration, and good connections shall be performed on the complete air-supply system.

h. Air supply - portable.

(1) The breathable air supplied to the blast helmet or hood shall be drawn from an oil and carbon monoxide free air compressor. The compressor used for blasting cannot be used for breathing air. Breathable air-supply system should be equipped, if possible, with audible alarm at the helmet or hood to warn the user of low air pressure.

(2) Hearing protection. Suitable hearing protection, capable of attenuating employee noise exposure as discussed in Section 05.C, shall be worn inside the blast helmet or hood unless hearing protection is an integral part of such helmet or hood.

(3) Heat stress. Cooling of breathable air, supplied to the blast helmets/hoods, should be considered depending on season and employee exposure to heat sources.

#### 6.J Heat/Cold Stress Management.

06.J. General. Employer's APP or Project SOH plans shall include control of heat and/or cold stress hazards, as appropriate for the season and work location. Heat/Cold Stress sections in the APP or Project SOH plans, shall take into consideration the influence of environmental conditions, workload, and personal factors.

06.J.01 Heat Stress: The APP or Project SOH Plan and individual AHAs shall address heat stress under the following working conditions:

a. CONUS and OCONUS locations when hot/dry or hot/humid environments are forecasted;

b. Work in conducted in semi-permeable or impermeable clothing and/or heavy clothing such as arc-rated suits;

c. Work in confined work environment with minimal air movement;

d. Work when heat index is greater than 75° F (24° C) or dry temperature is 75° F with 55% humidity or Wet-Bulb-Glove Temperature (WBGT) exceeds the action level for various exertion levels in Table 2 of the TLV and Action Limit for Heat Stress Exposure in the current ACGIH TLV/ BEI booklet;

e. Work around heat-producing equipment, furnaces, boilers, asphalt pots, engines, compressors, etc.

06.J.02 Heat Stress Monitoring Plan (HSMP). The written HSMP shall be incorporated into the APP or Project SOH Plan and shall cover the following topics relative to the on-site conditions expected:

a. Training on heat-related illnesses and how it can be prevented and the control measures to be taken;

b. Method used to monitor for heat stress, including standards being utilized and the responsible party for monitoring heat stress;

c. Signs and symptoms of heat-related illnesses and first aid procedures for each condition;

d. Exacerbation of heat related injury and illness based on various types of clothing, including general work clothing, semi-permeable and non-permeable clothing, arc flash clothing, and other protective clothing which reduces the evaporation rate;

e. The dangers of using drugs and alcohol in hot work environments.

06.J.03 In hot environments as defined above, the following shall be required:

a. Potable drinking water shall be available to employees and employees are encouraged to frequently drink small amounts, (e.g., 1/2 cup every 15-20 minutes). The water shall be kept reasonably cool 50-60° F (10-15° C) to encourage consumption.  
> See Section 02.C.

b. Tool box training which addresses the requirements in the HSMP, anticipated weather conditions for the day, any heat-related incidents, etc.

c. When possible, work should be scheduled for cooler periods during the day.

d. Implement a buddy system. Workers should not only monitor themselves, but also be alert to changes and the symptoms of their co-workers.



e. Workers who have not previously worked in a hot environment or have had a previous heat-related injury, or are known to be on medication, shall acclimatize with a regimen of increasing exposure each day of work.

f. Provide recovery areas where possible, such as air-conditioned enclosures, or shaded areas, with intermittent breaks and water breaks.

g. If a worker is required to wear semi-impermeable or impermeable clothing, then physiological monitoring shall include:

(1) Heart rate monitoring with a standard of a sustained heart rate in excess of 180 beats per minute (bpm) minus the age of the worker in years, recovery heart rate at one minute after a peak work effort is greater than 120 bpm, or

(2) Monitoring of the core body temperature with a standard of greater than 100.4°F (38.0°C) for unacclimatized workers, and 101.3°F (38.5°C) for acclimated workers.

(3) Workers exceeding the above standards are required to have work/rest regimens and fluid replacement schedules.

h. If a worker is wearing permeable clothing:

(1) Environmental monitoring or physiological monitoring shall be conducted and work/rest regimens established.

(2) Monitoring shall be conducted when temperature exceeds 75°F (24° C) and 55% humidity.

(3) Use of a WBGT instrument is preferred, however, if a WBGT instrument is not available, and the WBGT cannot be obtained from local weather stations, then Figure 6-1, the Approximate WBGT Temperature Chart, should be used to approximate the WBGT.

(4) If Figure 6-1 is used, direct radiant sun exposure, air velocity, temperature, and humidity and adjustment factors for various work clothing should be taken into consideration.

i. Employees exposed to solar radiation with the potential for sunburn, should be encouraged to use sun screen with a sun protection factor (SPF) of 30 or greater, and should wear hats, long sleeve shirts, sunglasses, and other protective attire.

j. Workers who experience heat stress shall seek medical attention. Workers who have more than one heat-related episode within a month shall have a doctor's written release prior to returning to exposures in a potential heat stress environment.

06.J.04 Cold Stress Management Plan (CSMP). A CSMP shall be incorporated into the APP or Project SOH Plan for the following work activities:

- a. Extended work duration in refrigerated rooms;
- b. Work in cold environments taking into consideration heat loss from wind speeds (e.g., when air temperature or wind chill could drop below 40°F (4.4°C);
- c. Extended bare-hand work in cold weather;
- d. Working with hands or parts of the body in cold water for periods greater than 10-12 minutes or potential cold water emersion;
- e. Working in snow or ice.

06.J.05 The CSMP shall address:

- a. Training on the signs, symptoms, and first aid for hypothermia, frostbite, and trench foot;
- b. Control and prevention measures to include PPE, engineering and administrative controls, eating, drinking, and safe work practices;
- c. Conditions and limitations in which bare hand work can be performed;
- d. Frequency. Air temperature and wind speed shall be taken should be taken at least every 4 hours when the temperature drops below 20°F (-6°C) and wind speed exceeds 5 mph (8 kmph) or broadcasted wind chill factors may be used if the reading is within 10 miles of the location.

Figure 6-1

Approximate Wet-Bulb Globe Temperature (WBGT) Chart

Relative Humidity (%)	Degrees F																						
	68	70	72	73	75	77	79	81	82	84	86	88	90	91	93	95	97	99	100	102	104	106	108
0	59	61	61	63	64	64	66	66	68	68	70	72	72	73	73	75	75	77	77	79	81	81	82
5	61	61	63	64	63	66	66	68	70	70	72	72	73	75	75	77	79	79	81	81	82	84	84
10	61	63	63	64	66	66	68	70	70	72	73	73	75	77	77	79	81	81	82	84	86	86	88
15	63	63	64	66	66	68	70	70	72	73	73	75	77	79	79	81	82	84	84	86	88	90	91
20	63	64	64	66	68	70	70	72	73	75	75	77	79	81	81	82	84	86	88	90	90	91	95
25	64	64	66	68	68	70	72	73	75	75	77	79	81	82	82	84	86	88	90	91	93	95	97
30	64	66	68	68	70	72	73	73	75	77	79	81	82	84	84	86	88	90	91	93	95	97	99
35	64	66	68	70	72	72	73	75	77	79	81	82	84	86	88	90	91	93	95	97	99	100	102
40	66	68	70	70	72	73	75	77	79	81	82	84	86	88	90	91	93	95	97	99	100	102	
45	66	68	70	72	73	75	77	79	81	81	82	84	86	90	91	93	95	97	99	100			
50	68	70	72	73	73	75	77	79	81	82	84	86	88	91	93	95	97	99	102				
55	68	70	72	73	75	77	79	81	82	84	86	88	90	93	95	97	99	100					
60	70	72	73	75	77	79	81	82	84	86	88	90	91	95	97	99	100						
65	70	72	73	75	77	79	81	82	84	86	90	91	93	97	99	100							
70	72	73	75	77	79	81	82	84	86	88	91	93	95	97	100	102							
75	72	73	75	77	79	81	84	86	88	90	91	95	97	99	102								
80	73	75	77	79	81	82	84	86	90	91	93	97	99	100									
85	73	75	77	79	82	84	86	88	90	93	95	99	100	102									
90	75	77	79	81	82	84	88	90	91	95	97	99	102										
95	75	77	79	81	84	86	88	91	93	95	99	100											
100	75	79	81	82	84	88	90	91	95	100	100	102											

Chart assumes full sunshine and light wind. Using this chart on a cloudy or windy day will result in an overestimation of heat stress

06.J.06 In cold environments the following guidelines shall be followed to prevent cold-related injury.

a. Warming shelters should be made available nearby when the wind chill drops below 10°F (-12°C).

b. A change of clothing shall be available if there is an opportunity for a worker to become wet.

c. When the wind chill drops below 0°F (-17°C), the following work practices shall apply.

(1) Workers shall use the buddy system to watch for signs and symptoms of cold related injuries or illnesses.

(2) The work rate shall be moderated to prevent sweating.

(3) Heat shelters shall be provided.

(4) New workers shall be given time to acclimate.

d. Workers exposed to -15°F (-26°C) shall use the work/warm-up schedule specified in the ACGIH TLVs/BEIs booklet.

e. If any extremity or body part is immersed in water where the air temperature is below 40°F (4°C), the employee shall be required to change any clothing that became wet and to dry off in a warm area.

f. Environmental monitoring. As the wind chill drops below 20°F (-7°C), the air temperature and wind speed (wind chill index) shall be monitored a minimum of every 4 hours or as warranted.

g. When the wind chill falls below 0°F (-17°C), the air temperature and wind speed shall be monitored every 2 hours or more frequently if it drops below this level.

#### 06.K Cumulative Trauma Disorder Prevention.

06.K.01 Work activities that require employees to conduct lifting, handling, or carrying; rapid and frequent application of high grasping forces; repetitive hand/arm manipulations; tasks that include continuous, intermittent, impulsive, or impact hand-arm vibration or whole body vibration; and other physical activities that stress the body's capabilities shall be evaluated by a competent person to ensure the activities are designed to match the capabilities of the employees.

06.K.02 When work activities that stress the body's capabilities are identified, the employer shall identify it as a hazard in the APP or Project SOH Plan. The plan shall incorporate processes that recognize cumulative trauma hazards, isolate causative factors, inform and train employees, provide and implement PPE and engineering controls, if appropriate.

06.K.03 Control measures to minimize hand-arm vibration (HAV) shall include: use of anti-vibration tools and/or gloves; implementation of work practices that keep the employee's hands and body warm/minimize vibration coupling between employee and the vibration tool; application of specialized medical surveillance to identify personnel susceptible to vibration, and adherence to TLV guidelines as specified by ACGIH in "Threshold Limit Values and Biological Exposure Indices". For USACE only, the evaluation shall include:

a. Acceleration measurements made according to ANSI S2.70 or acceleration data from the manufacturer (ISO 8662) or an online HAV database that has collected tool specific data via ISO 5349. If using manufacturer's data, a safety factor of 2.0 should be incorporated and if using an online database, a safety factor of 1.25 is warranted.

b. Using an estimate or measurement for each individual piece of equipment used by an operator, a time weighted average of the vibration exposure shall be determined. Detailed description of the proper method of completing the vibration evaluations is found in ANSI S2.70.

c. If the estimate or monitored HAV exposure is greater than 2.5 m/s<sup>2</sup>, then controls shall be implemented in the following order: changing the process to use lower vibrating equipment; using anti-vibration handles, mounts, tension chains; limited tool usage; providing training or techniques such as tool speed and proper shut off times; and the use of anti-vibration gloves that meet ANSI S2.73.

#### 06.L Indoor Air Quality (IAQ) Management.

06.L.01 Investigations. Supervisors shall report employee concerns or complaints of IAQ problems to the facility manager/owner or other designated representative. That individual will be responsible for investigating and resolving the IAQ complaint in a timely manner and reporting back to the supervisor. For leased facilities, procedures for resolving IAQ issues should ultimately be investigated and resolved by the lessor. An IH or other qualified and competent person shall initiate an IAQ investigation using appropriate guidelines published by ACGIH; AIHA; ANSI; American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE); EPA; OSHA; NIOSH; or other Federal, DOD, State, local, and host nation requirements. At a minimum the following shall be investigated:

a. Ensure building activities, such as painting, roof repairs, carpet installation and repair and other activities likely to involve usage of chemicals or solvents, are conducted after normal working hours where possible or in a manner that will prevent exposure to occupants.

b. Evaluate condition of the air-handling system for proper operation, make-up air supply, blocked dampers or diffusers, cleanliness of ducts and filters, and standing water or wet areas.

c. Educate employees and supervisors concerning measures they can take to help maintain acceptable IAQ in their work areas. Employees shall be instructed not to make unauthorized modifications to the heating, ventilation, and air conditioning (HVAC) systems (i.e., blocking off vents, removing ceiling tiles).

06.L.02 Environmental tobacco smoke (ETS). Employees shall be protected from involuntary exposure to ETS in working and public living environments.

a. Smoking, to include the use of smokeless cigarettes or cigars, shall be prohibited inside all DoD vehicles, aircraft, vessels, and work buildings.

b. Designated smoking areas only in outdoor locations that are not commonly used or accessed by nonsmokers shall be provided. In accordance with Executive Order 13058, all outside smoking areas shall be a minimum of 25 ft (7.6 m) from building entrances. Before establishing outside smoking area, local ordinances shall be reviewed and most stringent shall apply. Receptacles shall be provided in designated smoking areas for the containment of cigarette butts and other smoking by-products.

c. Designated smoking areas shall be located away from supplied-air intakes and building entryways/egresses to prevent ETS from entering occupied buildings and structures.

06.L.03 Mold Evaluation. Because mold can contribute to health problems ranging from minor irritation to serious debilitation if found in high quantities or improper locations, a mold assessment shall be performed when need is indicated.

a. Assessments/remediation shall be overseen by a competent mold inspector with a minimum of 5 years experience in evaluation of indoor air problems and an understanding both the properties of mold behaviors and building design or construction. This person shall be an IH, microbiologist, or a qualified indoor air specialist or mold inspector who has been certified by an independent IAQ certifying agency and/or who can demonstrate training and experience in the IAQ investigative field. Some states, local authorities and host nations also require this person to be licensed.

b. A visual assessment of potential mold hazards shall be performed, based on criteria in the, U.S. Army Public Health Command TG 278, Industrial Hygiene Preventive Medicine Mold Assessment Guide, the EPA Indoor Air Quality Checklists, and guidance from AIHA. Bulk and/or air samples are generally not necessary to evaluate mold hazardous environments.

c. A mold assessment shall be written and shall contain the following:

(1) Description of the area assessed including size (footprint), ventilation, and occupancy;

(2) Name and qualifications of the individual completing the assessment;

(3) Any sample results taken, including location of the sample result, date and time of the sample, temperature and humidity at the time of the sample; and laboratory procedure used to analyze the sample;

(4) Drawing of the area showing location of samples, location of visible mold or mildew and the type of substrate it is growing on, ventilation sources in the room, and other information thought to be important;

(5) Potential sources of the moisture which has caused the mold growth;

(6) Recommendations for controlling the problem and remediating the mold.

d. Causes of mold (i.e., water leakages, seepages, drainage, HVAC/ insulation repaired, etc.) shall be addressed before completing mold remediation.

06.L.04 Mold Remediation. If the assessment reveals mold remediation is required, then USAPHC TG 277, Army Facilities Management Information Document on Mold Remediation Issues, and any local, state, or host nation guidelines or regulations shall be used.

a. A Mold Remediation Plan shall be written by a competent mold expert and shall include: location and extent of the mold, description of conditions found (i.e. wet or dry), type of materials or 'substrate' that the mold is growing on, whether the substrate will be cleaned or removed, source or problem which created the mold, repair of building structure or component that is the source, and whether the mold contaminated area will be isolated from the remainder of the building and or its occupants. The plan shall also include the steps involved in remediation, identified hazards, recommended controls, equipment and materials (i.e., fungicide used for removal), inspection requirements and worker and occupant training requirements.

b. Mold remediation should not be performed by the same entity that performed the mold assessment.

c. Employees in the immediate area of the mold contamination shall be informed of the remediation, results of any testing, and symptoms of the hazard. The employees shall not be in the area during the remediation.

d. Post-remediation air sampling shall be done in the immediate area and in any areas in the mold spore or vegetative air-pathway and compared to outside air samples. Mold in areas above drop ceilings with combined air plenums shall have air samples taken within the plenum as well as in air-serviced areas. Air samples should be taken in the immediate area of remediation and analyzed by a laboratory in the AIHA Environmental Microbiology Laboratory Accreditation Program

#### 06.M Control of Chromium (VI) Exposure.

06.M.01 General. All activities which could generate chromium (VI) fumes, mists, or dusts shall be evaluated by an IH to determine potential personnel exposure over the OSHA Chromium (VI) standards. Typical operations where chromium exposures are high include: cutting or breaking up of cement surfaces made from Portland cement with a high chromium content, painting or paint removal operations, welding using rods or wire with a chromium coating, heating or welding on stainless steel, and handling or applying anti-corrosive substances or coatings.

a. The evaluation shall include a risk assessment of the type and frequency of exposure and breathing zone air samples and swipe sampling on surfaces in the work and surrounding area as described in 29 CFR 1910.1026.

b. The evaluation shall be added as an appendix to the APP or the Project SOH Plan. Individual sample results shall be provided to the employee and add to their official occupational health record and a summary of the sample results should be posted in the work area.

06.M.02 To prevent exposure to chromium (VI), the use of paints with chromium pigments, Portland cement with greater than 20 ppm chromium, or chromium/arsenic treated lumber shall be avoided when possible. Should chromium (VI) containing products be required, a justification and similar non-chromium (VI) product evaluation shall be conducted and submitted for review by the GDA or the USACE SOHO.

06.M.03 If chromium containing compounds are used and the objective determination is inconclusive, before air sampling confirms the level of exposure, the employer shall comply with the requirements of 1910.1026, 1915.1026, or 1926.1126, whichever is applicable. At a minimum, employers shall provide appropriate PPE, respirators, decontamination facilities, and a lunch room/area clean from chromium dust and/or fume.

06.M.04 If air sampling confirms chromium (VI) exposure over the OEL, and there is no adequate substitute or work practice change (i.e., use of argon instead of carbon dioxide when arc welding), then the employer shall provide appropriate engineering controls, i.e., local HEPA filtered ventilation systems, medical surveillance, housekeeping, and air sampling as required by the applicable chromium (VI) standard. If adequate engineering controls are not feasible or appropriate due to the length of the task, then PPE shall be provided.

06.M.05 In areas where chromium (VI) is generated or used, there shall be a housekeeping and decontamination program instituted.

a. Employees shall clean all surfaces a minimum of once a day or at the end of the shift that the chromium (VI) dust or fume was generated.

b. At a minimum all exhaust and ventilation systems shall be cleaned and filters changed annually.

c. At a minimum, workers shall remove outer work clothing before eating, drinking, or smoking.

06.N Crystalline Silica.

06.N.01 Occupational Standards.

a. Employee airborne exposure to crystalline silica shall not exceed the 8-hour time weighted average (TWA) OEL.

b. Mandatory requirements.



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(1) Employee exposure shall be eliminated through the implementation of feasible engineering controls.

(2) After all such controls are implemented and they do not control to the OEL, each employer must rotate its employees to the extent possible in order to reduce exposure.

(3) When all engineering or administrative controls have been implemented, and the level of respirable silica still exceeds OEL, respirators may be used in accordance with mandatory requirements of Section 5 E. and 29 CFR 1910.134.

(4) Employees shall be trained on the hazards of silica, the controls required to control the potential exposure, any sampling results and work practices to lower their exposure.

#### 06.N.02 Monitoring.

a. Each employer who has workplaces where silica is occupationally produced, reacted, released, transported, stored, handled, or used shall inspect each workplace and work operation to determine if any employee may be exposed to silica at or above the OEL. This evaluation shall be documented in the AHA for the job/task to be completed or PHA for government worker.

b. Air monitoring and analysis. Sampling and analytical methods shall be in accordance with those specified in Section 06.A.

06.N.03 Medical Surveillance. Each employer shall institute a medical surveillance program for all employees who are exposed to airborne concentrations of silica above the OEL for more than 30 days a year. The employer shall provide each employee a medical examination performed by or under the supervision of a licensed physician and shall provide the examination during the employee's normal working hours without cost to the employee. The content of the medical exam shall be determined by the physician based on the exposure records of the employee and guidance provided by NIOSH Standard DHS pub. No 92-102 Aug 1992 or OSHA Instruction CPL 2-2.7 Oct 30, 1972.

a. Medical examinations shall also be made available:

(1) At least annually for each employee exposed to airborne concentrations of silica above the OEL for more than 30 days during the last year; and

(2) Upon notification by the employee that he/she has developed signs or symptoms commonly associated with chronic exposure to silica.

b. Where medical examinations are performed, the employer shall provide the examining physician with the following information:

(1) The reason for the medical examination requested;

(2) A description of the affected employee's duties as they relate to the employee's exposure;

(3) A description of any PPE used or to be used;

(4) The results of the employee's exposure measurements, if available; and

(5) Upon request of the physician, information concerning previous medical examination of the affected employee.

c. Physician's written opinion. The employer shall obtain and furnish the employee with a written opinion from the examining physician containing the following:

(1) The signs or symptoms of silica exposure manifested by the employee, if any;

(2) A report on the findings of any medical tests completed.

(3) The physician's opinion as to whether the employee has any detected medical condition that would place the employee at increased risk of material impairment to the employee's health from exposure to silica or would directly or indirectly aggravate any detected medical condition;

(4) Any recommended limitation upon the employee's exposure to silica or the use of PPE; and

(5) A statement that the employee has been informed by the physician of any medical condition that requires further examination or treatment.

06.N.04 Training. Each employee who may be potentially exposed to silica shall be instructed at the beginning of his/her employment or assignment of potential silica exposure in the following:

a. Relevant symptoms; appropriate emergency procedures; and proper conditions and precautions for safe use or exposure;

b. To advise the employer of the development of the signs and symptoms of prolonged exposure to silica;

c. Specific nature of operations that could result in exposure to silica above the OEL, as well as safe work practices for the release of the silica and the types and function of engineering controls;

d. Proper housekeeping practices;

e. The purpose, proper use, and limitations of respirators;

- f. A description of, and explain the purposes for, the medical surveillance program; and
- g. The increased risk of impaired health due to the combination of smoking and silica dust exposure.

06.N.05 Respiratory Protection.

a. When the exposure to silica cannot be lowered below the OEL by engineering and administrative controls, an employer shall use respiratory protection.

b. Properly fitted particulate-filter respirators may be used for short, intermittent, or occasional dust exposures such as cleanup, dumping of dust collectors, or unloading shipments of sand at a receiving point when it is not feasible to control the dust by enclosure, exhaust ventilation, wetting, or other means.

06.N.06 Protective Clothing. Where exposure to airborne silica or other substances is above the OEL, work clothing shall be HEPA vacuumed before removal unless it is wet. Clothes shall not be cleaned by blowing or shaking.

06.N.07 Housekeeping.

a. To prevent the dispersal of silica dust, all exposed surfaces shall be maintained free of accumulation of silica dust.

b. Dry sweeping and the use of compressed air for the cleaning of floors and other surfaces shall be prohibited. If vacuuming is used the exhaust air shall be HEPA filtered to prevent generation of airborne respirable silica concentrations. Gentle wash down of surfaces is preferred.

c. Emphasis shall be placed upon preventive maintenance and repair of equipment, proper storage of dust producing materials, and collection of dusts containing silica. Sanitation shall meet the requirements of 29 CFR 1910.141.

06.N.08 Personal Hygiene Facilities and Practices. All food, beverages, tobacco products, nonfood chewing products, and unapplied cosmetics shall be discouraged in work areas.

06.N.09 Engineering Controls.

a. Dust suppression. Moisture, mists, fogs, etc., shall be added where such addition can substantially reduce the exposure to airborne respirable silica dust.

b. Ventilation. Where a local exhaust ventilation and collection system is used in a building, it shall be designed and maintained to prevent the accumulation or recirculation of airborne silica dust into the workplace. The system shall be inspected periodically. Adequate measures shall be taken to ensure that any discharge will not produce health hazards to the outside environment.

c. Additional control measures. When mobile equipment is operated in areas of potential silica exposure, engineering controls shall be provided to protect the operator from such exposure.

06.N.10 Itinerant Work. When employees are exposed to airborne silica at temporary work sites away from the primary worksite, emphasis shall be placed on respiratory protection, protective clothing, portable engineering controls, and provisions for personal hygiene and sanitation. Training of employees shall be provided to protect them as well as others from airborne silica dust exposure.

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