NIST National Institute of Standards and Technology • U.S. Department of Commerce

CHEMICAL MANAGEMENT

NIST S 7101.60
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[1] For revision history, see Appendix A.

1. PURPOSE

a. The purpose of the National Institute of Standards and Technology (NIST) Chemical Management Program is to define procedures that, when implemented, will:

(1) Protect employees and covered associates[2] from the health and physical hazards presented by chemicals at a NIST workplace; and

(2) Keep employee and covered associate exposures to hazardous chemicals below the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) specified in 29 Code of Federal Regulations (CFR) 1910, Subpart Z and the American Conference of Governmental Industrial Hygienist's Threshold Limit Values (ACGIH TLVs), or in the absence of both an OSHA PEL and an ACGIH TLV, below the National Institute of Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL), if available.

b. The purpose of this suborder is to serve as the written NIST Chemical Hygiene Plan (CHP), as required by OSHA 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*.

2. BACKGROUND

a. OSHA 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories* was promulgated in 1990 to protect workers from the health hazards associated with hazardous chemicals in laboratory workplaces. 29 CFR 1910.1450 requires employers engaged in the "Laboratory Use" (see definition of "Laboratory Use") of chemicals to develop and implement a written CHP that contains the following elements:

(1) SOPs relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

(2) Criteria used to determine and implement control measures to reduce employee exposure to hazardous chemicals, where particular attention shall be given to the selection of control measures for chemicals known to be extremely hazardous;

(3) A requirement that fume hoods and other protective equipment shall function properly, and definition of specific measures that shall be taken to ensure proper and adequate performance of such protective equipment;

[2] See NIST O 7101.00: Occupational Safety and Health Management System.

(4) Provisions for employee information and training in accordance with 29 CFR 1910.1450(f);

(5) The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;

(6) Provisions for medical consultation and medical examinations in accordance with 29 CFR 1910.1450(g);

(7) Designation of personnel responsible for implementation of the CHP including the assignment of a Chemical Hygiene Officer (CHO) and, if appropriate, establishment of a Chemical Hygiene Committee; and,

(8) Provisions for additional employee protection for work with a "Particularly Hazardous Substance (PHS)" [see definition of "Particularly Hazardous Substance (PHS)"].

b. In addition to the requirements of 29 CFR 1910.1450 for the "Laboratory Use" of hazardous chemicals, there are a number of U.S. regulatory agencies and associated regulations that may be applicable to the procurement, storage, use, shipment, and transportation of the hazardous chemicals used at NIST workplaces; specific hazardous chemicals that may have additional regulatory requirements include OSHA Regulated Substances, Drug Enforcement Agency (DEA) Controlled Substances and Listed Chemicals, Department of Homeland Security (DHS) Chemicals of Interest, Environmental Protection Agency (EPA) Extremely Hazardous Substances, EPA Ozone Depleting Chemicals, EPA Pesticides, EPA Solid Wastes, EPA Toxic Release Inventory, Alcohol, Tobacco Products and Firearms (ATF) Alcohol (Denatured, Tax-Exempt), ATF Explosives, and Department of Transportation (DOT) / Pipeline and Hazardous Materials Safety Administration (PHMSA) chemicals offered for transport. This suborder was written in consideration of these regulations with the intent to address the 29 CFR 1910.1450 CHP requirements for "Laboratory Use" of hazardous chemicals while also addressing hazardous chemical uses that do not meet the definition of "Laboratory Use" at NIST workplaces.

c. This suborder, upon its effective date, supersedes the following NIST Health and Safety Instructions (HSIs): NIST HSI #2, *Chemical Hoods*; NIST HSI #6, *Recognition and Safe Handling of Peroxidizable Compounds*; NIST HSI #8, *Relative Hazards of Organic Solvents*; NIST HSI #10, *Carcinogens*; NIST HSI #20, *Chemical Hygiene Plan;* and, NIST HSI #22, *Laboratory Chemical Storage*.

3. APPLICABILITY

a. The provisions of this suborder apply to all NIST workplaces.

b. The requirements of Section 6 of this suborder apply to NIST employees and covered associates whose work activities involve procuring, receiving, storing, handling, using, shipping, or transporting hazardous chemicals.

c. The responsibilities of Section 9 of this suborder apply to those who manage or support NIST employees and covered associates whose work activities involve procuring, receiving, storing, handling, using, shipping, or transporting of chemicals.

4. REFERENCES

a. American National Standards Institute/American Industrial Hygiene Association (ANSI/AIHA) Z9.2, *Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems*

b. ANSI/AIHA Z9.5, *Laboratory Ventilation*

c. ANSI/American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) 110, *Method of Testing Performance of Laboratory Fume Hoods*

d. ANSI/International Safety Equipment Association (ISEA) Z358.1, *American National Standard for Emergency Eyewash and Shower Equipment*

e. ATF 27 CFR Part 22, *Distribution and Use of Tax-Free Alcohol*

f. ATF 27 CFR Parts 70-399, *Alcohol, Tobacco, and Firearms*

g. ATF 27 CFR Part 555, *Commerce in Explosives*

h. DEA 21 CFR Parts 1300-1321, *Controlled Substances*

i. DHS 6 CFR Part 27, *Chemical Facility Anti-Terrorism Standards*

j. EPA 40 CFR Parts 260-272, *Hazardous Waste Management*

k. EPA 40 CFR Part 761, *Toxic Substances Control Act*

l. EPA 40 CFR Chapter I, Subpart C, *Air Programs*

m. EPA 40 CFR Chapter I, Subchapter E, *Pesticide Programs*

n. EPA 40 CFR Chapter I, Subchapter I, *Solid Wastes*

o. EPA 40 CFR Chapter I, Subchapter J, *Superfund, Emergency Planning, and Community Right-to-Know Programs*

p. EPA CFR Chapter I, Subchapter R, *Toxic Substances Control Act*

q. National Fire Protection Association (NFPA) 30, *Flammable and Combustible Liquids Code* (2015 Edition)

r. NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals* (2015 Edition)

s. NFPA 400, *Hazardous Materials Code* (2016 Edition)

t. OSHA 29 CFR Part 1960, *Basic Program Elements for Federal Employees*

u. OSHA 29 CFR 1910 Subpart H, *Hazardous Materials*

v. OSHA 29 CFR 1910 Subpart I, *Personal Protective Equipment*

w. OSHA 29 CFR 1910 Subpart J, *General Environmental Controls*

x. OSHA 29 CFR 1910 Subpart K, *Medical and First Aid*

y. OSHA 29 CFR 1910 Subpart L, *Fire Protection*

z. OSHA 29 CFR 1910 Subpart Z, *Toxic and Hazardous Substances*:

(1) 29 CFR 1910.1001 - *Asbestos*.
(2) 29 CFR 1910.1002 - *Coal tar pitch volatiles; interpretation of term*.
(3) 29 CFR 1910.1003 - *13 Carcinogens (4-Nitrobiphenyl, etc.)*.
(4) 29 CFR 1910.1017 - *Vinyl chloride*.
(5) 29 CFR 1910.1018 - *Inorganic arsenic*.
(6) 29 CFR 1910.1025 - *Lead*.
(7) 29 CFR 1910.1026 - *Chromium (VI)*
(8) 29 CFR 1910.1027 - *Cadmium*
(9) 29 CFR 1910.1028 - *Benzene*.
(10) 29 CFR 1910.1029 - *Coke oven emissions*.
(11) 29 CFR 1910.1043 - *Cotton dust*.

(12) 29 CFR 1910.1044 - *1,2-dibromo-3-chloropropane*.
(13) 29 CFR 1910.1045 - *Acrylonitrile*.
(14) 29 CFR 1910.1047 - *Ethylene oxide*.
(15) 29 CFR 1910.1048 - *Formaldehyde*.
(16) 29 CFR 1910.1050 - *Methylenedianiline*
(17) 29 CFR 1910.1051 - *1,3-Butadiene*.
(18) 29 CFR 1910.1052 - *Methylene Chloride*.
(19) 29 CFR 1910.1053 - *Respirable crystalline silica*.
(20) 29 CFR 1910.1200 - *Hazard Communication*.
(21) 29 CFR 1910.1450 - *Occupational Exposure to Hazardous Chemicals in Laboratories*

aa. PHMSA 49 CFR Parts 171-180, *Hazardous Materials Regulations (HMR)*

5. APPLICABLE NIST OCCUPATIONAL SAFETY AND HEALTH SUBORDERS

a. NIST S 7103.02: *Air Emissions Management (Gaithersburg), Air Emissions Management (Boulder)*

b. NIST S 7101.50: *Biosafety*

c. NIST 7 7101.59: *Chemical Hazard Communication*

d. NIST S 7101.22: *Hazard Signage*

e. NIST S 7301.04: *Chemical Waste Accumulation/Disposal at NIST Boulder, Chemical Waste Accumulation/Disposal at NIST Gaithersburg*

f. NIST S 7101.24: *Incident Reporting and Investigation*

g. NIST S 7101.21: *Personal Protective Equipment*

h. NIST S 7201.01: *Radioactive Material at NIST-Gaithersburg*

i. NIST S 7201.02: *Radioactive Material at NIST-Boulder*

j. NIST S 7101.58: *Respiratory Protection*

k. NIST S 7101.23: *Safety Education and Training*

l. NIST S 7301.06: *Storm Water Management (Boulder), Storm Water Management (Gaithersburg)*

m. NIST S 7101.20: *Work and Worker Authorization Based on Hazard Reviews*

6. REQUIREMENTS

a. Chemical Procurement

(1) Hazardous chemicals should not be procured until their hazards have been addressed in a hazard review conducted, reviewed, and approved in accordance with NIST S 7101.20: *Work and Worker Authorization Based on Hazard Reviews* (see Section 6f).

(2) Controlled Substances and Listed Chemicals shall be procured in accordance with DEA 21 CFR Parts 1300-1321, *Controlled Substances and Listed Chemicals* (see Appendix C).

(3) Tax-free alcohol shall be procured in accordance with the applicable requirements of 27 CFR Chapter I, Part 22, Subpart N, *Distribution and Use of Tax-Free Alcohol*.[3]

(4) Hazardous chemicals that are radioactive materials shall be procured in accordance with NIST S 7201.01: *Radioactive Materials at NIST-Gaithersburg* or NIST S 7201.02: *Radioactive Material at NIST-Boulder*, as applicable.

(5) Hazardous chemicals that are Biohazardous Materials shall be procured in accordance with NIST S 7101.50: *Biosafety*.

b. Chemical Receiving and Transporting

(1) Receiving Hazardous Chemicals at a NIST Workplace

(a) NIST Gaithersburg Package Services Group

i. Hazardous chemical packages transported to NIST Gaithersburg by Department of Transportation (DOT) licensed hazardous materials transporters (e.g., FedEx, UPS, U.S. Postal Service) shall be received and inspected by the NIST Package Services Group employees or covered associates who have completed training in accordance with the requirements of the HMR and who are in a position to store the packages promptly and properly.

[3] Tax-free alcohol is un-denatured alcohol used for non-beverage purposes in scientific research and medicine by educational organizations, hospitals, laboratories, etc. acquired tax-free. The distribution and use of tax-free alcohol is regulated to prevent illegal diversion to taxable beverage use.

ii. Hazardous chemical packages should be inspected for any signs of damage or leakage at the chemical receiving location prior to accepting receipt of the packages.

(i) If any evidence of damage or leakage exists, receiving employees should not accept receipt of the chemical packages.

(ii) In the event that damaged or leaking chemical packages are received, chemical incident response procedures shall be implemented [see Section 6i(2)].

(iii) Damaged or leaking chemical packages should not be delivered to their final NIST Gaithersburg destinations.

iii. Hazardous chemical package receiving locations shall maintain materials (e.g., sorbent pads, spill kits) needed to contain chemical spills and address any emergency concerns related to storing the received hazardous chemical packages.

iv. Hazardous chemical package receiving locations shall have the equipment needed to provide the specific storage requirements (e.g. chemical segregation, temperature control, ventilation) for the chemical packages that will be stored in the receiving location.

v. Hazardous chemical packages should be stored at receiving locations in accordance with any specific storage requirements indicated on the chemical packages, indicated by the shipper, or provided by the OU that ordered the packages.

(b) All Other NIST Organizations

i. Hazardous chemical packages should be received by "Chemical Owners" (see definition of "Chemical Owners").

(i) When this is not possible, hazardous chemical packages shall be received by employees or covered associates, such as Office Managers, who have completed the training provided by OSHE on the receipt of hazardous chemical packages and are in a position to transfer the packages promptly to "Chemical Owners".

ii. Prior to their being accepted from delivery personnel, hazardous chemical packages should be inspected for any signs of damage or leakage by "Chemical Owners" or by individuals who have completed the training provided by OSHE on the receipt of hazardous chemical packages.

(i) Chemical incident response procedures shall be implemented for damaged or leaking packages [see Section 6i(2)].

iii. "Chemical Owners" shall store the hazardous chemical containers in accordance with Section 6c below.

(2) Transporting Hazardous Chemicals at a NIST Workplace

(a) General Requirements

i. Hazardous chemical packages shall be transported only by employees and covered associates who have completed the training provided by OSHE on transportation of hazardous chemical packages.

ii. Hazardous chemical packages shall be transported by employees or covered associates prepared to respond to foreseeable emergencies (e.g., spills, leaks, releases) associated with the specific hazardous chemical packages they will be transporting.

iii. Hazardous chemicals shall be transported in a manner that segregates incompatible chemicals from each other.

iv. Hazardous chemicals shall be transported in inner packaging that should be contained inside outer packaging.

(i) Inner packaging[4] shall be:

[i] A leak-tight, sealed container that is in physical contact with the hazardous chemical being transported;

[ii] Composed of material that is compatible with the hazardous chemical being transported and resistant to breakage or damage; and,

[iii] Labeled in accordance with NIST S 7101.59: *Chemical Hazard Communication* for inner packaging prepared at NIST.

[4] In general, the hazardous chemical container is the inner packaging.

(ii) Outer packaging[5] shall be:

[i] Composed of material that is compatible with the hazardous chemical being transported in the inner package and capable of protecting against breakage or damage;

[ii] Provide cushioning or some other mechanism of maintaining the inner package in an orientation that prevents leakage of the transported hazardous chemical from the inner package; and,

[iii] Capable of containing the full contents of the transported hazardous chemical contained within the inner packaging.

v. Hazardous chemical packages should be transported in transport vehicles or on transportation carts when the number, size, or weight of the packages cannot be transported safely by carrying.

vi. Hazardous chemical packages, when transported by motorized vehicles, shall be transported by employees or covered associates only in "Hazardous Chemical Transport Vehicles" (see definition of "Hazardous Chemical Transport Vehicle").

vii. Hazardous chemical packages shall not be transported in vehicle passenger compartments.

viii. Hazardous chemical transport vehicles shall be occupied only by the employees or covered associates who are performing the chemical transport, when hazardous chemical packages are present.

ix. Hazardous chemical transport vehicles should follow the most direct delivery route to deliver the hazardous chemical packages to their final destinations.

x. Hazardous chemical transport vehicles should not perform intermediate stops unrelated to package deliveries or be left unattended when hazardous chemical packages are stored inside.

[5] Under certain conditions (e.g., compressed gas cylinders, Dewars), the inner package and outer package are the same container; under these conditions, only the inner packaging requirements need be met [see Section 6b(2)(a)(iv)(i)].

xi. Transportation carts should have sides on each shelf that are of a height capable of retaining the hazardous chemical containers or packages on each shelf; cart wheels should be of sufficient size to ensure that the wheels do not catch in floor cracks or door thresholds, which may cause the cart to tip over.

xii. Elevators, when used to transport hazardous chemical packages, should be occupied only by the employees or covered associates who are transporting the packages.

(b) Additional Requirements Applicable to the NIST Gaithersburg Package Services Group and NIST Gaithersburg Storeroom (in the latter case, if applicable)

i. Hazardous chemical containers should be packaged, loaded, segregated, transported, and unloaded in accordance with the requirements of the HMR for the specific hazardous chemical packages being transported. Contact OSHE for assistance.

(3) Transporting Hazardous Chemicals <u>from</u> a NIST Workplace

(a) General Requirements

i. Hazardous chemical packages shall be transported from a NIST workplace by DOT licensed hazardous materials transporters (e.g., FedEx, UPS, U.S. Postal Service) in accordance with the HMR, except as described in Section 6b(3)(c)(ii).

(b) Additional Requirements Specific to the NIST Gaithersburg Package Services Group

i. Pre-transportation functions (e.g., packaging, labeling) shall be performed by employees or covered associates who have completed training in accordance with this suborder.

ii. Pre-transportation functions shall be performed in accordance with the HMR for the specific hazardous chemical packages being offered for transport.

iii. Transportations functions shall be performed in accordance with the HMR for the specific hazardous chemical packages being transported.

(c) Additional Requirements Applicable to All Other NIST Organizations

i. Hazardous chemical containers that will be offered for transport [i.e., shipped from a NIST workplace and transported via a DOT licensed hazardous materials transporters (e.g., FedEx, UPS, U.S. Postal Service)] shall be provided to shipping personnel for the respective NIST workplace in containers that are:

(i) Leak-tight, sealed, and composed of materials that are compatible with the hazardous chemicals that will be transported;

(ii) Resistant to breakage or damage;

(iii) Labeled in accordance with NIST S 7101.59: *Chemical Hazard Communication*; and

(iv) Accompanied by Safety Data Sheets (SDSs) in accordance with NIST S 7101.59: *Chemical Hazard Communication*, when required by the shipping office.

ii. Hazardous chemical containers that will be transported from a NIST workplace by employees or covered associates shall be transported in accordance with the requirements of Section 6b(2)(a) and the following.

(i) Hazardous chemical inner packages shall be labeled in accordance with NIST S 7101.59: *Chemical Hazard Communication*.

(ii) Hazardous chemical packages shall be transported with associated SDSs in accordance with NIST S 7101.59: *Chemical Hazard Communication*.

(iii) Hazardous chemical packages shall not be carried on the person, in carry-on baggage, or in baggage that has been checked onto public transportation (e.g., bus, train, airplane).

c. Chemical Storage

(1) Hazardous chemicals shall be stored:

(a) In accordance with the requirements of this subsection and additional requirements in Appendix B;

(b) In a manner (e.g., in a flammable cabinet, toxic gas cabinet, water-proof cabinet, inert environment, explosion-proof safe, refrigerator, or freezer) that controls/addresses

any unique hazardous properties (e.g., fire or explosion potential, temperature sensitivity, water reactivity, etc.) of the chemicals;

(c) In permissible storage locations in accordance with the requirements specified in NFPA400, *Hazardous Materials Code* and/or additional fire codes or regulations, when applicable, and as determined by the Authority Having Jurisdiction (NIST AHJ at sites owned and operated by NIST);

(d) On storage shelving that meets the following criteria, when applicable:

i. Constructed to carry the design loads; and

ii. Treated, coated, or constructed of materials that are compatible with the hazardous chemicals stored on the shelving;

(e) In sealed containers, preferably the original manufacturer containers;

(f) In containers that are made from material that is compatible with the chemicals being stored within;

(g) In containers that have been labeled in accordance with NIST S 7101.59: *Chemical Hazard Communication*; and,

(h) In storage tanks, piping, valves, fittings, and containers protected from vehicles, when applicable, in accordance with the requirements specified in NFPA 400, *Hazardous Materials Code*.

(2) Hazardous chemicals shall not be stored:

(a) In service galleys or outdoor locations unless the NIST AHJ has reviewed and approved the hazardous chemical quantities to be stored in such locations;

(b) In administrative spaces or common areas (e.g., offices, conference rooms, break rooms, coffee rooms, hallways, stairwells, etc.);

(c) In refrigerators or freezers together with food or drink;

(d) In walk-in coolers or cold rooms not designed and intended for chemical storage; or

(e) In direct sunlight or near localized heat sources.

(3) Hazardous chemicals should be stored:

(a) In locations that prevent unauthorized entry or that are posted "Authorized Personnel Only";

(b) At heights no greater than 5 feet from the ground, where feasible, especially when the hazardous chemicals are liquids;

(c) In secondary containment (e.g., in spill trays or bins composed of materials compatible with the chemicals to be contained and of sufficient volume capacity to contain the volume of the largest container being stored within); and

(d) On shelving provided with a lip, guard, sliding glass doors that are kept closed except when chemicals are being removed or replaced, or some other mechanism that prevents stored containers from sliding off of the storage shelves, except where storage is located in approved storage cabinets or on furniture specifically designed for the storage of hazardous chemicals.

(4) Hazardous chemicals should not be stored:

(a) In laboratory fume hoods, biosafety cabinets, or other engineering controls, unless specifically designed and intended for chemical storage;

(b) On cabinets, equipment, or work surfaces;

(c) On the floor or ground; or

(d) Under sinks or near other water sources.

(5) Refrigerators, freezers, and other cooling equipment located in a laboratory work areas designated as "Class I Locations" (see definition of "Class I Locations") shall be approved for Class I, Division 1 or 2 locations and shall be installed in accordance with Article 501 of NFPA 70 (Contact OSHE for assistance in meeting refrigeration equipment requirements.).

(6) Refrigerators, freezers, and other cooling equipment used to store or cool flammable liquids shall be listed as special purpose units for use in laboratories or equipment listed for Class I, Division 1 locations, as described in Article 501 of NFPA 70 (Contact OSHE for assistance in meeting refrigeration equipment requirements.).

(7) Refrigerators, freezers, and other cooling equipment used to store hazardous chemicals:

(a) Shall be prominently marked to indicate whether they meet the NFPA requirements for safe storage of flammable liquids;

(b) Shall include signage on the exterior surface (e.g., door) of such equipment to indicate hazardous chemicals are stored inside and that food and beverages shall not be stored inside (see Figure 1); and

Figure 1: Example Sign (Refrigeration Equipment for Hazardous Chemical Storage)

(c) Should include chemical inventory lists that identify the chemical identities and quantities stored inside of such equipment posted on exterior surfaces of such equipment.

(8) Storage cabinets used to store flammable liquids shall be constructed and labeled in accordance with OSHA 29 CFR 1910.106 and NFPA 30 (see CMP SWP on Flammable Liquids).

d. Chemical Inventory

(1) Hazardous chemical containers present in each NIST work area shall be inventoried in accordance with the requirements of NIST S 7101.59: *Chemical Hazard Communication*.

e. Hazard Communication

(1) The hazards of all chemicals resident at a NIST workplace shall be determined/classified and communicated to employees and covered associates in the form of container labels,

appropriate warnings, Material Safety Data Sheets (MSDSs)/SDSs, and training in accordance with NIST S 7101.59: *Chemical Hazard Communication*.

f. Hazard Review and Control

(1) Hazard reviews for all activities involving hazardous chemicals shall be conducted, reviewed, and approved in accordance with NIST S 7101.20: *Work and Worker Authorization Based on Hazard Reviews*.

(a) Applicable chemical regulations (see Appendix C and Appendix G) shall be consulted during the hazard identification and assessment process.

(b) PHSs shall be identified during the hazard identification and assessment process and the following hazard control measures shall be considered and implemented where appropriate:

i. Establishment of a designated area;

ii. Use of containment devices such as fume hoods or glove boxes;

iii. Procedures for safe removal of contaminated waste; and

iv. Decontamination procedures.

(c) Additional references [see CMP Safe Work Practices (SWPs)[6] and Appendix D] may be consulted during the hazard identification and assessment process, as necessary.

(2) Hazard control measures shall be implemented to keep employee and covered associate exposures to hazardous chemicals below the applicable OSHA PEL or ACGIH TLV, whichever is lower (see Appendix E). In the absence of both an OSHA PEL and an ACGIH TLV, a NIOSH REL shall be used, if available.

(3) Hazard control measures shall be implemented to prohibit eye and skin contact where specified in an applicable OSHA Chemical-Specific Health Standard (see Appendix G).

(4) Hazard control measures shall be implemented in accordance with applicable regulatory requirements (see Appendix C and Appendix G).

[6] The CMP SWPs, which are separate resource documents, describe the hazards of particular chemicals and classes of chemicals and provide general practices for using, handling, storing, transporting, and disposing of them safely.

(5) Hazard control measures shall be implemented according to the hierarchy of controls in the following order: Elimination, Substitution/Minimization, Engineering Controls, Administrative Controls, and PPE.

(a) Elimination

i. Hazardous chemicals should be eliminated from activities, when possible and feasible to do so.

(b) Substitution/Minimization

i. Hazardous chemicals that cannot be eliminated from activities should be substituted with less hazardous chemicals (e.g., different chemicals, compositions, concentrations, physical states), when possible and feasible to do so.

ii. Hazardous chemicals that cannot be eliminated from activities should be procured, used, and stored in the minimum quantities necessary to conduct each activity (e.g., in quantities necessary to perform work for 6-12 months).

(c) Engineering Controls

i. Engineering controls shall be selected and implemented based upon applicable chemical regulations (see Appendix C and Appendix G), OU/division policies, and work area considerations (e.g., supply/exhaust ventilation, lab design).

ii. Non-laboratory local exhaust ventilation systems and ducted laboratory special purpose hoods shall meet the design, construction, installation, commissioning, performance testing, and maintenance requirements of ANSI/AIHA Z9.2, *Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems* (most recent edition).

iii. Non-laboratory local exhaust ventilation systems and ducted laboratory special purpose hoods meeting the requirements of ANSI/AIHA Z9.2 shall be labeled, tagged, or marked to indicate that such equipment is “In Service” (See definition of “In Service”).

iv. Non-laboratory local exhaust ventilation systems and ducted laboratory special purpose hoods <u>not</u> meeting the requirements of ANSI/AIHA Z9.2 shall be labeled, tagged, or marked to indicate that the such equipment is “Out of Service” (See definition of “Out of Service”). Such devices shall not be used.

v. Laboratory ventilation, ducted laboratory fume hoods, and other ducted laboratory containment devices shall meet the design, construction, installation, commissioning, performance testing, and maintenance requirements of ANSI/AIHA Z9.5, *Laboratory Ventilation* (most recent version).

vi. Ducted laboratory fume hoods, and other ducted laboratory containment devices meeting the requirements of ANSI/AIHA Z9.5 shall be labeled, tagged, or marked to indicate that the such equipment is "In Service".

vii. Ducted laboratory fume hoods, and other ducted laboratory containment devices not meeting the requirements of ANSI/AIHA Z9.5 shall be labeled, tagged, or marked to indicate that the such equipment is "Out of Service". Such devices shall not be used.

viii. Non-ducted laboratory containment devices shall be installed and maintained in accordance with manufacturer specifications.

ix. Laboratory fume hoods or other containment devices shall be implemented for activities with the potential for exposure to airborne hazardous chemicals in excess of applicable OSHA PELs or ACGIH TLVs [see Section 6h(1)].

x. Laboratory fume hoods or other containment devices should be implemented for:

(i) Activities performed indoors involving venting hazardous chemical gases or vapors from equipment;

(ii) Activities involving PHSs that present an inhalation hazard (e.g., gas, vapor, dust, or mist) or generate hazardous gases upon contact with other chemicals or materials in the immediate work area;

(iii) Activities involving chemical synthesis or reaction; and

(iv) Activities involving uncontained, non-hazardous odiferous compounds.

(d) Administrative Controls

i. Administrative controls shall be selected and implemented based upon applicable chemical regulations (see Appendix C and Appendix G), OU/division policies, and work area considerations.

ii. "Designated Areas" should be established and implemented for activities involving PHSs.

iii. General hazard signage shall be posted at each work area in accordance with NIST S 7101.22: *Hazard Signage* and indicate the chemical hazards present, minimum PPE required, and other entry requirements.

iv. Specific hazard signage shall be posted at each work area in accordance with NIST S 7101.22: *Hazard Signage* when required by this suborder to indicate mandatory actions, prohibited actions, and additional requirements beyond those addressed by the work area's general hazard signage.

v. Signage shall be posted at each work area in accordance with ANSI Z 358.1, *American National Standard for Emergency Eyewash and Shower Equipment* to indicate the location of emergency eyewash equipment and emergency showers, when applicable.

(e) PPE

i. PPE shall be selected and implemented in accordance with NIST S 7101.21: *Personal Protective Equipment* and NIST S 7101.58: *Respiratory Protection*, based upon applicable chemical regulations (see Appendix C and Appendix G), and OU/division policies.

g. Hazardous Chemical Work

(1) Engineering Controls (General Requirements)

(a) When hazardous chemical work is required to be performed inside a laboratory fume hood or other containment device, the work shall be performed inside a fume hood or other containment device that is functioning properly.

(b) When it is required that hazardous chemical work be performed inside a laboratory fume hood, the work shall be:

i. Performed by NIST employees or covered associates who have been trained on the proper use of the specific laboratory fume hood or other containment device and who can recognize when such a device is not functioning properly;[7]

ii. Performed with the fume hood's sash opening set at or below its Designated Sash Position (i.e., maximum sash opening designated when the fume hood was last tested and approved for use);

iii. Performed inside of a laboratory fume hood in a manner that does not allow a NIST employee's or covered associate's head to enter the work area of the laboratory fume hood unless approved by OSHE; and

iv. Performed in a manner that does not include intentionally venting hazardous chemicals as a means of chemical disposal.

(c) Equipment and chemicals located inside a laboratory fume hood should be:

i. Placed at least 6 inches behind the sash plane to improve containment of hazardous chemicals within the fume hood;

ii. Located in such a manner as to avoid obstructing the airflow into the face of or out the back of the laboratory fume hood to the exhaust ductwork; and,

iii. Minimized to reduce air turbulence within the fume hood.

(d) Electrically-powered equipment located inside a laboratory fume hood shall be connected to electrical receptacles located outside of the laboratory fume hood and/or in a manner that mitigates the risk of chemical or electrical fire presented by the electrical equipment and the chemicals present.

(2) Administrative Controls (General Requirements)

(a) Hazardous chemical work shall be authorized work and performed only by authorized employees and covered associates in accordance with NIST S 7101.20: *Work and Worker Authorization Based on Hazard Reviews*.

(3) PPE (General Requirements)

[7] Malfunctioning devices should be communicated immediately to line management and the responsible site facilities organization. At sites owned and operated by NIST, it is recommended that the issue also be communicated to OSHE.

(a) PPE shall be worn in accordance with the work area-specific, minimum PPE requirements indicated on the work area's signage and in accordance with the applicable hazard review for the activity.

(4) Work Practice Controls (General Requirements)

(a) Housekeeping

i. Work areas should be cleaned at the completion of a work activity or at the end of the work shift as needed.

ii. Work areas should be kept clean and free of obstructions.

iii. Access to work area exits, emergency equipment, and other control equipment shall be maintained.

iv. Containers of hazardous chemicals shall be closed when not being used, unless conditions (e.g., chemical reactivity) exist such that the container would experience a pressure increase if closed.

v. Containers of hazardous chemicals should be returned to designated chemical storage locations at the completion of a work activity or at the end of the work shift.

vi. Drips or residues of chemicals should be cleaned from the outer surfaces of containers and other work area surfaces (e.g., counters, bench tops, floors) to maintain a clean work area and minimize chemical exposures.

(b) Personal Hygiene

i. Chemical gloves should be removed and properly disposed of after completion of the activity and before leaving the laboratory.

ii. Hands should be washed immediately after working with hazardous chemicals and prior to contacting other body parts, common items (e.g., computers, door knobs, work phones), personal items (e.g., cell phones, eye glasses, keys), and personal consumables.

(c) Personal Consumables

i. Equipment (e.g., refrigerators, freezers, cold rooms, microwave ovens, and ovens) used for hazardous chemical manipulation or storage shall not be used for the manipulation or storage of personal consumables (e.g., food or beverages). Such equipment shall be clearly labeled "No Food or Drink" or equivalent.

ii. Food and beverages should not be consumed or stored in work areas where hazardous chemicals are used or stored.

iii. Drinking and eating utensils should not be used or stored in areas where hazardous chemicals are handled or stored.

(d) Outdoor Hazardous Chemical Work

i. Work involving hazardous chemical use outdoors:

(i) Shall be performed in a manner to prevent chemical release to the environment[8];

(ii) Should be performed in a manner that accounts for the weather conditions, elevation, surface conditions, and the work proximity to building ventilation intakes and exhausts, ignition sources, and local traffic; and,

(iii) Shall not be performed unless the applicable approved hazard review indicates that the work may be performed outdoors.

(e) Environmental Aspects[9]

i. Releases to a Sanitary Sewer or Storm Sewer

(i) Hazardous chemicals shall not be intentionally poured into a sanitary sewer or storm sewer. If it is necessary to intentionally release any hazardous chemicals to a sanitary sewer or storm sewer, the chemical release shall be approved by the responsible site environmental organization at the specific NIST workplace (OSHE at sites owned and operated by NIST) prior to any release and performed in accordance with the waste water or storm water permit for the specific NIST workplace.

[8] Exceptions may apply but excepted releases shall be controlled and in compliance with regulatory requirements; contact OSHE for assistance.

[9] NIST personnel working at sites not owned and operated by NIST will need to address the items in this subsection in accordance with the requirements established by the parties responsible for operating those sites.

(ii) Accidental releases of any chemical to a sanitary sewer or storm sewer shall be reported immediately to the responsible site environmental organization at the specific NIST workplace (OSHE at sites owned and operated by NIST).

ii. Air Emissions

(i) Hazardous chemicals shall not be intentionally released or evaporated into the open air or inside a laboratory fume hood as a means of chemical disposal. If it is necessary to intentionally release any hazardous chemicals for the purpose of disposal, the chemical release shall be approved by the responsible site environmental organization (OSHE at sites owned and operated by NIST) prior to the release and performed in accordance with the air permit for the specific NIST workplace[10].

(ii) Air emissions resulting from the authorized and proper use of a laboratory fume hood are permitted.

(iii) Air emissions of refrigerants and other ozone depleting substances (e.g., chlorofluorocarbons) shall comply with applicable Federal and State regulations; contact OSHE for assistance.

(iv) Accidental releases of any chemical to the open air shall be reported immediately to the responsible site environmental organization at the specific NIST workplace (OSHE at sites owned and operated by NIST).

iii. Releases to Ground, Soil, or Pavement

(i) Hazardous chemicals shall not be intentionally released to the ground, soil, or pavement. If it is necessary to intentionally release any hazardous chemicals to the ground, soil, or pavement, the chemical release shall be approved by the responsible site environmental organization at the specific NIST workplace (OSHE at sites owned and operated by NIST).

(ii) Accidental releases of any chemical to the ground, soil, or pavement shall be reported immediately to the responsible site environmental organization at the specific NIST workplace (OSHE at sites owned and operated by NIST).

[10] In general, laboratory scale activities (e.g., chemical releases into a laboratory fume hood) are exempt from air emissions requirements and therefore such chemical releases do not require approval from OSHE; however, air emissions should be minimized from all sources. Any questions regarding air emissions shall be directed to OSHE.

(f) Chemical Disposal and Hazardous Waste

i. All spent, expired, or otherwise "waste" chemicals shall be contained, labeled, and turned in for disposal in accordance with the requirements of the responsible site environmental organization at the specific NIST workplace (OSHE at sites owned and operated by NIST).

h. Hazardous Chemical Exposure

(1) Exposure Limits

(a) Hazardous chemical exposures shall not exceed the applicable OSHA PEL or ACGIH TLV, whichever is lower (see Appendix E).[11]

(b) In the absence of both an OSHA PEL and an ACGIH TLV, a National Institute of Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL) shall be used, if available.

(c) Eye and skin contact shall be prohibited where specified in an OSHA Chemical-Specific Health Standard (see Appendix G).

(2) Exposure Monitoring – General Considerations

(a) If there is reason to believe (e.g., by signs or symptoms of exposure) that a hazardous chemical exposure level routinely exceeds the applicable exposure limit, OSHE shall be contacted.

(b) Employees or covered associates concerned about potential hazardous chemical exposures should consult with OSHE on the need for and conduct of exposure monitoring.

(3) Exposure Monitoring for Hazardous Chemicals Regulated by OSHA Chemical-Specific Health Standards (see Appendix G)

(a) Hazardous Chemical Uses that Meet the Definition of "Laboratory Use"

[11] At NIST, employee and covered associate exposures shall be kept below the applicable OSHA PEL or ACGIH TLV, whichever is lower; employee and covered associate exposures to OSHA-regulated substances shall be limited to below the specific exposure limits published in any applicable OSHA health standard, unless that standard states otherwise; in the absence of an OSHA PEL, employee and covered associate exposures shall be limited to below the specific exposure limits published in the ACGIH TLVs.

i. If there is reason to believe (e.g., by signs or symptoms of exposure) that exposure levels routinely exceed an action level (or in the absence of an action level, the PEL) specified in an applicable OSHA Chemical-Specific Health Standard, OSHE shall be contacted.

(b) Hazardous Chemical Uses that Do Not Meet the Definition of "Laboratory Use"

i. When exposure monitoring is required by an applicable OSHA Chemical-Specific Health Standard, OSHE shall be contacted.

(4) Medical Consultation and Examination[12]

(a) General

i. Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous chemical exposure, the affected employee or covered associate shall be provided an opportunity for a medical consultation for the purpose of determining the need for a medical examination.

ii. Whenever an employee or covered associate develops signs or symptoms associated with a hazardous chemical to which they may have been exposed in the NIST work area, the employee or covered associate shall be provided an opportunity to receive an appropriate medical examination.

(b) Hazardous Chemical Uses that Meet the Definition of "Laboratory Use"

i. Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for a hazardous chemical regulated by an OSHA Chemical-Specific Health Standard (see Appendix G) for which there are exposure monitoring and medical surveillance requirements, the affected employee or covered associate shall receive medical surveillance in accordance with the applicable OSHA Chemical-Specific Health Standard.

(c) Hazardous Chemical Uses that Do Not Meet the Definition of "Laboratory Use"

[12] 29 CFR 1910.1450 requires that the employer of the employee is responsible for ensuring that these medical consultation and examinations requirements have been met with the exception of 6h(4)(c), which applies to "Non-Laboratory Uses", and 6h(4)(g), which applies to medical consultations and examinations for NIST employees only.

i. When medical consultations and examinations are required by an applicable OSHA Chemical-Specific Health Standard (see Appendix G), affected employees and covered associates shall be provided with medical consultations and examinations in accordance with the applicable OSHA Chemical-Specific Health Standard.

(d) Medical consultations and examinations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee or covered associate, without loss of pay, and at a reasonable time and place.

(e) The information provided to physicians who perform or directly supervise medical consultations and examinations shall include the following:

i. The identity of the hazardous chemical(s) to which the employee or covered associate may have been exposed;

ii. A description of the conditions under which the exposure occurred, including quantitative exposure data, if available; and

iii. A description of the signs and symptoms of exposure that the employee or covered associate is experiencing, if any.

(f) Written opinions including the following shall be obtained from physicians who perform or directly supervise medical consultations and examinations:

i. Any recommendation for further medical follow-up;

ii. The results of the medical examination and any associated tests;

iii. Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous workplace; and

iv. A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

(g) Written opinions obtained from physicians who perform or directly supervise medical consultations and examinations for NIST employees shall be provided to OSHE.

i. Emergency Equipment and Chemical Incident Response Procedures

(1) Emergency Equipment

(a) Emergency Showers, Eyewash Equipment, Eye/Face Wash Equipment, Combination Units, and Supplemental Equipment

i. Eyewash equipment, eye/face wash equipment, or a combination unit containing an eyewash equipment component or an eye/facewash equipment component shall be available in the work area when:

(i) A direct exposure to ethyleneimine or beta-propiolactone may occur; or

(ii) The eyes of an employee or covered associate may be exposed to injurious corrosive chemicals, solutions containing 0.1 percent or greater of formaldehyde, or solutions containing 0.1 percent or greater of methylene chloride.

ii. Eyewash equipment, eye/face wash equipment, or a combination unit containing an eyewash equipment component or an eye/facewash equipment component should be available in the work area when hazardous chemicals present an exposure hazard to the eyes of an employee or covered associate.

iii. An emergency shower or a combination unit containing an emergency shower component shall be available in the work area when:

(i) A direct exposure to ethyleneimine or beta-propiolactone may occur;

(ii) The body of an employee or covered associate may be exposed to injurious corrosive chemicals, solutions containing 1 percent or greater of formaldehyde, or solutions containing 0.1 percent or greater of methylene chloride.

iv. An emergency shower or a combination unit containing an emergency shower component should be available in the work area when hazardous chemicals present an exposure hazard to the body of an employee or covered associate.

v. Supplemental equipment (e.g., personal wash unit, drench hose) may be available in the work area to provide additional flushing support; however, supplemental

equipment shall not replace emergency showers, eyewash equipment, eye/face wash equipment or such components in combination units.

vi. Emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplementary equipment shall meet the performance and installation requirements in accordance with ANSI Z 358.1, *Emergency Eyewash and Shower Equipment* (most recent version) in order to be "Commissioned" and placed "In Service".

vii. Emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplementary equipment shall meet the following maintenance requirements in order to remain "In Service".

(i) Plumbed eyewash equipment, eye/face wash equipment, combination unit components that are eyewash equipment or eye/face wash equipment, and supplementary equipment shall be:[13]

[i] Activated weekly for a period long enough to verify operation and ensure that flushing fluid is available; and,

[ii] Inspected annually to ensure conformance with the performance and installation requirements of ANSI Z 358.1 [At sites owned and operated by NIST, OFPM shall perform or supervise all inspections of plumbed equipment (see Section 9)].

(ii) Plumbed emergency showers and combination unit components that are emergency showers shall be:[14]

[i] Inspected annually to ensure conformance with the performance and installation requirements of ANSI Z 358.1 [At sites owned and operated by NIST, OFPM shall perform or supervise all inspections plumbed equipment (see Section 9)].

[13] Equipment that has been "Commissioned" and originally placed "In Service" may be taken "Out of Service", when no activity in the work area presents hazards that would require such equipment. "Out of Service" equipment does not have to be activated weekly or inspected annually; however, "Out of Service" equipment shall be inspected prior to being placed back "In Service" and shall be activated weekly and inspected annually as long as it remains "In Service".

[14] Equipment that has been "Commissioned" and originally placed "In Service" may be taken "Out of Service", when no activity in the work area presents hazards that would require such equipment. "Out of Service" equipment does not have to inspected annually; however, "Out of Service" equipment shall be inspected prior to being placed back "In Service" and shall be inspected annually as long as it remains "In Service".

(iii)Self-contained equipment shall be:

[i] Checked visually on a weekly basis to determine if the flushing fluid needs to be changed or supplemented and flushing fluid shall be added in accordance with the manufacturer's instructions, when required; and,

[ii] Inspected annually to ensure conformance with the performance and installation requirements of ANSI Z 358.1.

viii. Emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplementary equipment that have been "Commissioned" but do not meet the maintenance requirements above [see Section 6i(1)(a)(vii.)] shall be designated as "Out of Service" and the site organization responsible for plumbed emergency equipment at the specific site [OFPM at sites owned and operated by NIST] shall be notified. Such devices shall not be used.

ix. Emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplementary equipment shall be labeled, tagged, or marked to indicate the status (i.e., "In Service" or "Out of Service") of the equipment [At sites owned and operated by NIST, OFPM shall perform or supervise all labeling, tagging, or marking of plumbed equipment (see Section 9)].

(2) Chemical Incident Response Procedures[15]

(a) Chemical incident (e.g., exposure, release, and spill) responses should be performed in accordance with the response procedures described in the Occupant Emergency Plan for the specific workplace, the CMP SWP: *Chemical Incident Response Procedures*, and the applicable activity-specific incident response plan.

(b) All chemical exposures, releases, and spills in which any of the following, individually or in combination, occurred or could have occurred: an injury or illness; an unauthorized spill or release of hazardous or regulated material to the environment; damage or loss of equipment or property shall be reported in accordance with NIST S 7101.24: *Incident Reporting and Investigation*.

[15] Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees or covered associates in the immediate release area, or by maintenance personnel, are not considered to be emergency responses within the scope of 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

j. Information and Training

(1) Training shall be provided, documented, and recorded in accordance with the requirements of the NIST S 7101.23: *Safety Education and Training*.

(2) Employees and covered associates to whom this suborder applies shall receive the following information and training at the time of their initial assignment to a NIST work area where hazardous chemicals are present and prior to assignments involving new chemical exposure situations:

(a) Training provided by OSHE covering the following topics:

i. The applicable details of this suborder (i.e., NIST's written CHP);

ii. The physical and health hazards of chemicals in the work area;

iii. The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and

iv. Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.).

(b) Information provided by OSHE covering the following topics:

i. The location and availability of this suborder;

ii. The location and availability of the CMP SWPs;

(i) It is recommended that employees and covered associates, prior to performing work with hazardous chemicals, review applicable CMP SWPs to understand the general hazards of specific chemicals (e.g., hydrofluoric acid, perchloric acid) and chemical classes (e.g., corrosives, flammables, oxidizers, peroxides and peroxidizables, PHSs, pyrophorics, and water-reactives) and practices for using, handling, storing, transporting, and disposing of them safely;

iii. The contents and availability of 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*, including its appendices (see Appendix F);

iv. The permissible exposure limits for OSHA regulated substances and recommended exposure limits for other hazardous chemicals where there are no applicable OSHA standards (see Appendix E);

v. The signs and symptoms associated with exposures to hazardous chemicals used in their NIST work areas; and

vi. The location and availability of known references on the hazards, safe handling, storage, and disposal of hazardous chemicals (see Appendix D).

(c) Information provided by the OU/division covering the following topics, as applicable:

i. Work area-specific procedures for hazardous chemical procurement, receipt, storage, inventory, use, disposal, and emergency response;

ii. Workplace-specific procedures for hazardous chemical transporting and shipping; and,

iii. Workplace-specific procedures for obtaining exposure determination/monitoring and medical consultation/surveillance.

(3) Employees and covered associates (excluding NIST Gaithersburg Package Services Group) who will receive hazardous chemical packages at a NIST workplace shall complete, prior to receiving hazardous chemical packages at a NIST workplace, either (a) the training provided by OSHE on this suborder or (b) the training provided by OSHE on receiving hazardous chemical packages at a NIST workplace.

(4) Employees and covered associates whose job duties require responding to hazardous chemical exposures, releases, or spills not in their immediate work area shall complete training in accordance with 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*.

(5) NIST Gaithersburg Package Services Group to whom this suborder applies who will perform pre-transportation, transportation, or receiving functions for hazardous chemical packages shall complete and maintain training, and receive information, in accordance with the requirements of the HMR prior to preforming any pre-transportation, transportation, or receiving functions.

7. DEFINITIONS

Definitions common to all NIST OSH suborders can be found in Section 6 of NIST O 7101.00: Occupational Safety and Health Management System. The definitions specific to this suborder are as follows:

a. Action Level – A concentration designated in 29 CFR Part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as additional exposure monitoring, evaluation of controls and medical surveillance. In the absence of an Action Level specified in 29 CFR Part 1910, one half of the permissible exposure limit shall be considered the action level for chemical exposures at NIST.

b. Activity – An experiment, operation, process, or job, often comprising subtasks, conducted to achieve a specific outcome.

c. Authority Having Jurisdiction (AHJ) – An individual, office, or organization responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

d. Biohazard – A biological material or agent that presents potential risk to the health of humans or other organisms either directly through infection or indirectly through damage to the environment. Biohazards include, but are not limited to, bacteria; fungi; viruses; parasites; rickettsia; biological toxins; prions; non-human mammalian cell lines and tissues; human specimens such as human blood, serum, plasma, blood products, primary and continuous human cell lines, unfixed human tissues, fecal materials, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva, tears, sweat, breast milk, and urine; and recombinant DNA materials such as inserts or vectors that are known to express toxins, oncogenes, and/or virulent factors. Non-toxic proteins and commercially available enzymes, cell culture medium and supplements, reagents such as monoclonal antibodies, and random DNA base pairs are not considered biohazards.

e. Biohazardous Material – See definition of biohazard.

f. Acute Toxicity (HCS2012) – Adverse effects occurring following oral or dermal administration of a single dose of a substance, or multiple doses given within 24 hours, or an inhalation exposure of 4 hours.

g. Carcinogenicity (HCS2012) – *Carcinogen* means substance or a mixture of substances which induce cancer or increase its incidence. Substances and mixtures which have induced benign and malignant tumors in well-performed experimental studies on animals are considered also to be presumed or suspected human carcinogens unless there is strong evidence that the mechanism of tumor formation is not relevant for humans.

h. Chemical – Any substance or mixture of substances.

i. Chemical Abstract Service – A division of the American Chemical Society that assigns CAS registry numbers.

j. Chemical Owners – Employees and covered associates who are responsible for ensuring hazardous chemicals they own are promptly and properly stored, inventoried, and managed from receipt to disposal in accordance with applicable NIST OSH suborders.

k. Chemical Hygiene Plan – A written program developed and implemented by the employer which sets forth procedures, equipment, PPE and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of 29 CFR 1910.1450. This suborder (NIST S 7101.60: *Chemical Management*) constitutes the NIST chemical hygiene plan.

l. Chemical Name – The scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature, or a name that will clearly identify the chemical for the purpose of conducting a hazard classification.

m. Class I Locations – Locations in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I locations include the following:

(1) Class I, Division 1. A Class I, Division 1 location is a location:

(a) In which ignitable concentrations of flammable gases or vapors may exist under normal operating conditions; or

(b) In which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or

(c) In which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors, and might also cause simultaneous failure of electric equipment.

(2) Class I, Division 2. A Class I, Division 2 location is a location:

(a) In which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the hazardous liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in the event of accidental rupture or breakdown of such containers or systems, or as a result of abnormal operation of equipment; or

(b) In which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operations of the ventilating equipment; or

(c) That is adjacent to a Class I, Division 1 location, and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

n. Combination Unit – An interconnected assembly of emergency equipment supplied by a single source of flushing fluid and containing at least two of the following components: drench hose, eyewash, eye/face wash, and emergency shower, as defined in ANSI Z 358.1.

o. Commerce – Trade or transportation in the jurisdiction of the United States within a single state; between a place in a state and a place outside of the state; that affects trade or transportation between a place in a state and place outside of the state; or on a United States-registered aircraft.

p. Designated Area – An area which may be used for work with a Particularly Hazardous Substance (see definition "Particularly Hazardous Substance"). A designated area may be the entire work area, a location in the work area, or a device such as the laboratory fume hood in the work area.

q. Designated Sash Position – The maximum open area of the laboratory fume hood face that achieves the desired face velocity and may be used when working with hazardous chemicals in the fume hood. The Designated Sash Position is determined after fume hood testing to confirm its ability to capture and contain airborne contaminants. The Designated Sash Position is indicated of each fume hood along with the date when it was determined.

r. Dose – The amount and duration that a chemical contacts a living system, resulting in an exposure.

s. Drench Hose – A supplemental device consisting of a flexible hose connected to a flushing fluid supply and used to provide fluid to irrigate and flush face and body areas; drench hoses shall not replace emergency eyewash equipment or emergency showers.

t. Emergency – A chemical exposure, release, or spill for which:

(1) The chemical exposure, release, or spill creates a safety or health hazard condition that is immediately dangerous to employees and covered associates, property, or the environment; or,

(2) The response effort requires emergency responders from outside the immediate release area.

u. Emergency Eyewash Equipment – An eyewash, an eye/face wash, or a combination unit containing at least one eyewash or eye/face wash component, as defined in ANSI Z 358.1.

v. Emergency Responder – Any employee, covered associate, or other personnel who performs emergency response[16] procedures.

w. Emergency Shower – An emergency shower or a combination unit containing at least one emergency shower component, as defined in ANSI Z 358.1.

x. Exposure or Exposed – An employee is subjected in the course of employment to a chemical that is a physical or health hazard, and includes potential (e.g. accidental or possible) exposure. "Subjected" in terms of health hazards includes any route of entry (e.g. inhalation, ingestion, skin contact or absorption.

y. Exposure Limit – A value that represents the maximum concentration over a specified period of time that a worker may be exposed to a particular chemical, published by:

[16] Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees or covered associates in the immediate release area, or by maintenance personnel, are not considered to be emergency responses within the scope of 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

(1) The American Conference of Governmental Industrial Hygienists (ACGIH) in "Threshold Limit Values and Biological Exposure Indices (current version); or

(2) The National Institute for Occupational Safety and Health (NIOSH) in "NIOSH Recommendations for Occupational Health Standards" (current version); or

(3) The Occupational Safety and Health Administration (OSHA) in 29 CFR Part 1910, Subpart Z.

z. Germ Cell Mutagenicity (HCS2012) – A *mutation* is defined as a permanent change in the amount or structure of the genetic material in a cell. The term mutation applies both to heritable genetic changes that may be manifested at the phenotypic level and to the underlying DNA modifications when known (including, for example, specific base pair changes and chromosomal translocations). The term *mutagenic* and *mutagen* will be used for agents giving rise to an increased occurrence of mutations in populations of cells and/or organisms. The more general terms *genotoxic* and *genotoxicity* apply to agents or processes which alter the structure, information content, or segregation of DNA, including those which cause DNA damage by interfering with normal replication processes, or which in a non-physiological manner (temporarily) alter its replication. Genotoxicity test results are usually taken as indicators for mutagenic effects.

aa. GL (General License) – A license provided by regulation that grants authority to a person for certain activities involving byproduct material, source material, or SNM and is effective without the filing of an application with the NRC or the issuance of a licensing document to a particular person. See 10 CFR 31, 40, and 70, and the applicable license for authorizations, limitations, and restrictions.

bb. Hazard Analysis and Control – The process of defining the scope of the work; identifying and analyzing the hazards; identifying and implementing controls to mitigate the hazards; performing work within controls; and continually gathering information on the adequacy of controls and taking actions to improve the safety of the work (NIST S 7101.20, *Work and Worker Authorization Based on Hazard Reviews*).

cc. Hazardous Chemical – Any chemical which is classified as a physical hazard or a health hazard, a simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise, classified in accordance with 29 CFR 1910.1200, *Hazard Communication*.

dd. Hazardous Chemical Transport Vehicles – Government-owned, cargo-carrying vehicles (e.g., automobiles, vans, tractors, trucks, semitrailers, tank cars or rail cars) used for the

transportation of hazardous chemical cargo. Hazardous chemical transport vehicles shall not be privately-owned vehicles or public transportation vehicles.

ee. Hazardous Waste – Hazardous wastes are wastes that cause or significantly increase mortality or serious irreversible or incapacitating reversible illness or that pose a substantial present or potential hazard to human health or the environment when improperly managed.

ff. Health Hazard – A chemical which is classified as posing one of the following hazardous effects: acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); or aspiration hazard. The criteria for determining whether a chemical is classified as a health hazard are detailed in 29 CFR 1910.1200-Appendix A. Health hazard definitions not appearing in this suborder may be found in NIST S 7101.59, *Chemical Hazard Communication* and 29 CFR 1910.1200.

gg. In Service – A term used to designate that a specific piece of "Commissioned" equipment conforms to applicable design, performance, installation, and maintenance requirements.

hh. Laboratory – For the purposes of this program, a facility where the "Laboratory Use" (see definition below) of hazardous chemicals occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

ii. Laboratory Scale – Scale of work in which the procedures/containers used for reactions, transfers, and other handling of chemicals are designed to be easily and safely carried out/manipulated by one person. "Laboratory Scale" excludes work whose purpose is to produce commercial quantities of materials.

jj. Laboratory-type Hood (Laboratory Fume Hood) – A device located in a laboratory, enclosed on five sides with a movable sash or fixed partial enclosed on the remaining side. It is constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory, and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

kk. Laboratory Use – For the purposes of this program, use of hazardous chemicals in which all of the following conditions are met:

(1) Chemical manipulations are carried out on a "Laboratory Scale" (see definition above);

(2) Multiple chemical procedures or chemicals are used[17];

(3) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(4) "Protective Laboratory Practices and Equipment" (see definition below) are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

ll. LC RAM (Limited Control RAM) – RAM that is:

(1) Byproduct material exempted under 10 CFR 30;

(2) Unimportant quantities of source material as per 10 CFR 40.13;

(3) RAM such as that described in 10 CFR 31.8, 10 CFR 40.22, and 10 CFR 70.19 that is not part of a GL device;

(4) Incidentally-Activated RAM; or

(5) Any other RAM determined by the RSO to warrant some degree of control for RSP purposes.

mm. Median Lethal Concentration (LC50) – The concentration of a substance (expressed in mg/m3 or ppm), determined from exposure to the substance by inhalation, that is expected to kill 50 percent of the animals exposed to the substance in a defined experimental animal population for a defined exposure time.

nn. Median Lethal Dose (LD50) – The dose of a substance (expressed in mg/m3 or ppm), as determined from exposure to the substance by any route other than inhalation, that is expected to kill 50 percent of the animals exposed to the substance in a defined experimental animal population for a defined exposure time.

oo. Medical Consultation – A consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

[17] OSHA LOI # 20164 describes that "Multiple chemical procedures or chemicals are used" means "using chemicals in laboratory procedures", which includes scenarios involving a single chemical or single procedure.

pp. Mutagen – A chemical that causes permanent changes in the amount or structure of the genetic material in a cell (see definition of "Germ Cell Mutagenicity (HCS2012)"). Chemicals classified as mutagens in accordance with 29 CFR 1910.1200 shall be considered mutagens for the purposes of this suborder.

qq. NIST Authority Having Jurisdiction (AHJ) – A Fire Protection Engineer in OSHE designated by the Chief Safety Officer to enforce the NIST-adopted codes and standards relevant to fire, electrical, and life safety on NIST-owned and operated sites.

rr. NIST Chemical Hygiene Officer – An employee designated by the NIST Chief Safety Officer and qualified by training and/or experience to provide technical guidance in the development and implementation of the provisions of NIST Chemical Hygiene Plan (i.e., NIST S 7101.60: *Chemical Management*).

ss. NIST Workplace – An establishment at one geographical location at which work-related activities are conducted by NIST employees and covered associates. NIST workplaces include sites owned and operated by NIST and by other organizations.

tt. Out of Service – A term used to designate that a specific piece of "Commissioned" equipment does not conform to applicable design, performance, installation, and maintenance requirements and therefore shall not be used.

uu. Package – Any packaging plus its contents.

vv. Packaging – A receptacle and any other components or materials necessary for the receptacle to perform its containment function in conformance with the minimum packing requirements in 49 CFR Part 171-180.

ww. Particularly Hazardous Substance (PHS) – A chemical that is particularly hazardous to an exposed employee or covered associate and meets any of the following definitions: acute toxicity, carcinogenicity, germ cell mutagenicity, reproductive toxicity, respiratory or skin sensitization, select carcinogen, or specific target organ toxicity-single exposure (See definitions and CMP SWP for Particularly Hazardous Substances).

xx. Permissible Exposure Limit (PEL) – Exposure limits published by the Occupational Safety and Health Administration (OSHA) in 29 CFR Part 1910, Subparts G and Z.

yy. Personal Wash Unit – A supplementary device that supports plumbed and/or self-contained units, by delivering immediate flushing fluid to the eyes or body.

zz. Physical Hazard – A chemical that is classified as posing one of the following hazardous effects: explosive; flammable (gases, aerosols, liquids, or solids); oxidizer (liquid, solid or gas); self-reactive; pyrophoric (liquid or solid); self-heating; organic peroxide; corrosive to metal; gas under pressure; or in contact with water emits flammable gas. The criteria for determining whether a chemical is classified as a physical hazard are detailed in 29 CFR 1910.1200-Appendix B. Physical hazard definitions not appearing in this suborder may be found in NIST S 7101.59, *Chemical Hazard Communication* and 29 CFR 1910.1200.

aaa. Plumbed Equipment – Equipment connected to building plumbing.

bbb. Pre-Transportation Function – Any hazardous material, package, pre-transportation function as described in 49 CFR 171, which includes but is not limited to: determining the material's hazard class, selecting the packaging, filling a package, securing the closure of a filled or partially-filled package, marking a package, labeling a package, preparing/reviewing a shipping paper for a package, certifying a hazardous material or package is in proper condition for transportation, and providing/maintaining emergency response information for the package.

ccc. Protective Laboratory Practices and Equipment – Those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

ddd. RAM (Radioactive Material) – Material permitted at NIST Gaithersburg under SNM-362, a GL, or as LC RAM.

eee. Recommended Exposure Limits (RELs) – Exposure limits published by the National Institute for Occupational Safety and Health (NIOSH) in "NIOSH Recommendations for Occupational Health Standards" (current version).

fff. Release – Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment, including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance or pollutant or contaminant except vehicle emissions, application of fertilizer, and permitted releases.

ggg. Reproductive Toxicity (HCS2012) – Adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on development of the offspring. Some reproductive toxic effects cannot be clearly assigned to either impairment of sexual function and fertility or to developmental toxicity. Nonetheless, chemicals with these effects shall be

classified as reproductive toxicants. Adverse effects on sexual function and fertility means any effect of chemicals that interferes with reproductive ability or sexual capacity. This includes, but is not limited to, alterations to the female and male reproductive system, adverse effects on onset of puberty, gamete production and transport, reproductive cycle normality, sexual behavior, fertility, parturition, pregnancy outcomes, premature reproductive senescence, or modifications in other functions that are dependent on the integrity of the reproductive systems. Adverse effects on development of the offspring means any effect of chemicals which interferes with normal development of the conceptus either before or after birth, which is induced during pregnancy or results from parental exposure. These effects can be manifested at any point in the life span of the organism. The major manifestations of developmental toxicity include death of the developing organism, structural abnormality, altered growth and functional deficiency. Adverse effects on or via lactation are also included in reproductive toxicity.

hhh. Reproductive toxins – A chemical that affects the reproductive capabilities including adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on the development of the offspring (see definition of "Reproductive Toxicity (HCS2012)"). Chemicals classified as reproductive toxins in accordance with the 29 CFR 1910.1200 shall be considered reproductive toxins for purposes of this suborder.

iii. Respiratory or Skin Sensitization (HCS2012) – *Respiratory sensitizer* means a chemical that will lead to hypersensitivity of the airways following inhalation of the chemical. *Skin sensitizer* means a chemical that will lead to an allergic response following skin contact.

jjj. Safety Data Sheet (SDS) – Written or printed material concerning a hazardous chemical that is prepared in accordance with paragraph (g) of 29 CFR 1910.1200, *Hazard Communication*.

kkk. Select Carcinogen – Any substance which meets one of the following criteria:

(1) It is regulated by OSHA as a carcinogen; or

(2) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or

(3) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or

(4) It is listed in either Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogens" by NTP and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(a) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3;

(b) After repeated skin application of less than 300 (mg/kg of body weight) per week; or

(c) After oral dosages of less than 50 mg/kg of body weight per day.

lll. Self-Contained Equipment – Equipment as a stand-alone device (i.e., not connected to building plumbing) containing flushing fluid.

mmm. Shipped Container – Any container that leaves a NIST workplace.

nnn. Shall/Should/May –

(1) Shall (Must or Will): Indicates that the performance of an item is mandatory.

(2) Should: Indicates that the performance of an item is not mandatory, but the full implications of not performing that item must be understood and either justified or carefully weighed before choosing a different course.

(3) May: Indicates that the performance of an item is at the discretion of the individual responsible for the action.

ooo. SNM-362 – A NRC license authorizing acquisition, use, transfer, and disposal of any chemical or physical form of the byproduct material specified in the license, but not exceeding quantities specified in the license, for purposes authorized by the license.

ppp. Specific Target Organ Toxicity (Single Exposure) (HCS2012) – Specific, non-lethal target organ toxicity arising from a single exposure to a chemical. All significant health effects that can impair function, both reversible and irreversible, immediate and/or delayed and not specifically addressed in HCS2012 (A.1 to A.7 and A.10).

qqq. Substance – Chemical elements and their compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product and any impurities deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

rrr. Supplemental Equipment – A drench hose or personal wash unit.

sss. Threshold Limit Values – Exposure limits published by the American Conference of Governmental Industrial Hygienists (ACGIH) in "Threshold Limit Values and Biological Exposure Indices (current version).

ttt. Transport – The movement of chemicals from one NIST workplace to another, or from one work area to another at a single NIST workplace, including loading, unloading, or storage incidental to that movement.

uuu. Use – To package, handle, react, emit, extract, generate as a byproduct, or transfer.

vvv. Work Area – A defined space in a workplace where hazardous chemicals are produced or used to which there is a reasonable likelihood that workers present in the space could be exposed.

www. Workplace – See definition "NIST Workplace".

8. ACRONYMS

Acronyms common to all NIST OSH suborders can be found in Section 7 of NIST O 7101.00: Occupational Safety and Health Management System. The acronyms specific to this suborder are as follows:

a. ACGIH – American Conference of Governmental Industrial Hygienists

b. AIHA – American Industrial Hygienists Association

c. AHJ – Authority Having Jurisdiction

d. ANSI – American National Standards Institute

e. ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

f. ATF – Bureau of Alcohol, Tobacco, Firearms, and Explosives

g. CAS – Chemical Abstracts Service

h. CFR – Code of Federal Regulations

i. CGA – Compressed Gas Association

j. CHO – Chemical Hygiene Officer

k. CHP – Chemical Hygiene Plan

l. CMP – Chemical Management Program

m. DEA – Drug Enforcement Agency

n. DHS – Department of Homeland Security

o. DOT – Department of Transportation

p. EPA – Environmental Protection Agency

q. HCS – OSHA 29 CFR 1910.1200, *Hazard Communication in General Industry*

r. HMR – Hazardous Materials Regulations

s. HSI – Health and Safety Instruction

t. IARC – International Agency for Research on Cancer

u. LC50 – Median Lethal Concentration

v. LD50 – Median Lethal Dose

w. MSDS – Material Safety Data Sheet

x. NFPA – National Fire Protection Association

y. NIOSH – National Institute of Occupational Safety and Health

z. NIST – National Institute of Standards and Technology

aa. NTP – National Toxicology Program

bb. OFPM – Office of Facilities and Property Management

cc. OSHA – Occupational Safety and Health Administration

dd. OSHE – Office of Safety, Health, and Environment

ee. OU – Organizational Unit

ff. PEL – Permissible Exposure Limit

gg. PHS – Particularly Hazardous Substance

hh. PHMSA – Pipeline and Hazardous Materials Safety Administration

ii. PPE – Personal Protective Equipment

jj. SDS – Safety Data Sheet

kk. SWP – Safe Work Practices

ll. TLV – Threshold Limit Value published by ACGIH

mm. TWA – Time Weighted Average

9. RESPONSIBILITIES

Roles and responsibilities common to all NIST OSH suborders can be found in Section 8 of NIST O 7101.00: Occupational Safety and Health Management System. The roles and responsibilities specific to this suborder are as follows:

a. OU Directors are responsible for:

(1) Establishing policies and procedures, as needed, for the requirements of this program to be met as it applies to their employees and covered associates and to hazardous chemicals in their OU-assigned space and ensuring that those policies and procedures are implemented; and

(2) Ensuring subordinate managers have the authority, resources, and training needed to implement OU-established policies and procedures.

b. Employees and Covered Associates Whose Job Duties include Responding to Hazardous Chemical Exposures, Releases, or Spills Not in their Immediate Work Area are responsible for:

(1) Maintaining and implementing emergency response procedures involving hazardous chemicals in accordance with 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*.

c. NIST Chemical Hygiene Officer is responsible for:

(1) Serving as the program manager for this program;

(2) Establishing safety guidance, rules, and policies pertaining to chemical management;

(3) Reviewing and evaluating this suborder at least annually and updating it when necessary to ensure its effectiveness in protecting employees and covered associates from the hazards of chemicals at NIST workplaces; and

(4) Making this suborder available to employees, covered associates, and upon request.

d. NIST Gaithersburg Package Services Group are responsible for:

(1) Performing pre-transportation and transportation functions in accordance with the requirements of this suborder.

e. OFPM is responsible for:[18]

(1) Coordinating with work area occupants in advance of performing work on emergency equipment (plumbed eyewash equipment, eye/face wash equipment, combination unit components that are eyewash equipment or eye/face wash equipment, supplementary equipment, and any building components that would affect the performance of such systems), ventilation equipment (ducted laboratory fume hoods, ducted special purpose hoods, ducted laboratory containment devices, local exhaust ventilation systems, and any building components that would affect the performance of such ventilation equipment), or other facilities to obtain authorization to access the space, to understand the safety requirements that must be met in that space, to ensure that all workers can be informed of the expect impact to the performance of the emergency equipment and ventilation

[18] The OFPM responsibilities described in this suborder apply only for NIST workplaces that are owned and operated by NIST. It is understood that OFPM contractors may perform some of these items. When that is the case, OFPM is responsible for ensuring that all applicable requirements are met.

equipment for the space during the work and take appropriate precautions to mitigate the associated hazards during the work, and to ensure completion of the work in a timely manner;

(2) Consulting with OSHE and OU representatives regarding equipment selection, installation, and other safety requirements prior to procuring, installing, or modifying plumbed emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment;

(3) Procuring plumbed emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment that have been certified in accordance with ANSI Z 358.1;

(4) Performing or supervising all installations and modifications of plumbed emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment in accordance with the performance and installation requirements of ANSI Z 358.1;

(5) Performing or supervising inspections of plumbed emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment during the commissioning process, prior to placing equipment "In Service", and annually thereafter to ensure "In Service" equipment conform with the performance and installation requirements in accordance with ANSI Z 358.1;

(6) Ensuring that plumbed emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment not meeting the performance and installation requirements in accordance with ANSI Z 358.1 shall be "Out of Service";

(7) Performing or supervising all labeling, tagging, or marking of plumbed emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment to indicate that the equipment is "In Service" or "Out of Service";

(8) Establishing, maintaining, and making available accurate records providing equipment description (type, make, model), location (building, room, additional information), installation data, commissioning data, maintenance/inspection data, and equipment status ("In Service" or "Out of Service") for plumbed emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment;

(9) Consulting with OSHE and OU representatives regarding equipment selection, equipment location, and additional safety requirements prior to the acquisition, installation, or modification of local exhaust ventilation, ducted laboratory fume hoods, ducted special purpose hoods, or other ducted containment devices;

(10) Performing or supervising the installation or modification of all local exhaust ventilation, laboratory ventilation, ducted laboratory fume hoods, ducted laboratory special purpose hoods, or other ducted containment devices;

(11) Ensuring that non-laboratory local exhaust ventilation systems and ducted laboratory special purpose hoods are designed, installed, commissioned, labeled, performance tested, and maintained in accordance with ANSI/AIHA Z9.2 (most recent version);

(12) Labeling, tagging, or marking non-laboratory local exhaust ventilation systems and ducted laboratory special purpose hoods meeting the installation, commissioning, and performance testing requirements of ANSI/AIHA Z9.2 to indicate that the systems and hoods are "In Service";

(13) Labeling, tagging, or marking non-laboratory local exhaust ventilation systems and ducted laboratory special purpose hoods not meeting the installation, commissioning, and performance testing requirements of ANSI/AIHA Z9.2 to indicate that the systems and hoods are "Out of Service";

(14) Ensuring that laboratory ventilation, ducted laboratory fume hoods, and other ducted laboratory containment devices are designed, installed, commissioned, labeled, performance tested, and maintained in accordance with ANSI/AIHA Z9.5 (most recent version);

(15) Labeling, tagging, or marking ducted laboratory fume hoods and other ducted laboratory containment devices meeting the installation, commissioning, and performance testing requirements of ANSI/AIHA Z9.5 to indicate that the devices are "In Service";

(16) Labeling, tagging, or marking ducted laboratory fume hoods and other ducted laboratory containment devices not meeting the installation, commissioning, and performance testing requirements of ANSI/AIHA Z9.5 to indicate that the devices are "Out of Service";

(17) Establishing, maintaining, and making available accurate records providing equipment description (type, make, model), location (building, room, additional information), as-built drawings, testing and balancing reports, testing/commissioning/certification data,

maintenance data, problems reported, modification or replacement data, and inspection data for all local exhaust ventilation systems, ducted laboratory fume hoods, and other ducted laboratory containment devices;

(18) Coordinating with work area occupants prior to performing any work (e.g., demolition, renovation) to ensure that all hazardous chemicals and hazardous wastes have been removed and that all visible residues have been cleaned;

(19) Coordinating with work area occupants prior to performing any work that may impact the ventilation or other systems and negatively affect containment or control of the hazardous chemicals in the work area;

(20) Coordinating construction, renovation, and demolition activities for work areas involving the use the hazardous chemicals to ensure design review and approval has been performed in a manner that ensures chemical work areas and equipment will be in accordance with applicable regulations, codes, policies, safety considerations, and user needs;

(21) Notifying building occupants of pending and in-progress construction, renovation, and demolition for work areas involving hazardous chemicals;

(22) Performing or supervising the decommissioning of plumbed emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment; and

(23) Performing or supervising the decommissioning of ducted laboratory fume hoods, laboratory special purpose hoods, or other containment devices and associated ventilation systems.

f. Gaithersburg Fire Protection Group is responsible for:

(1) Maintaining and implementing emergency response procedures involving hazardous chemicals in accordance with 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*.

g. OSHE is responsible for:

(1) Providing the OSHE-provided training required by Section 6j;

(2) Providing guidance regarding chemical management at a NIST workplace;

(3) Maintaining and supporting the implementation of procedures for hazardous chemical disposal at sites owned and operated by NIST;

(4) Maintaining and implementing emergency response procedures involving hazardous chemicals in accordance with 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response* at sites owned and operated by NIST;

(5) Responding to reports of chemical odors, releases, and spills at sites owned and operated by NIST;

(6) Providing exposure determinations for employees;

(7) Performing exposure monitoring and notifying employees of any monitoring results in accordance with the requirements of 29 CFR 1910.1450(d), when applicable, and any OSHA Chemical-Specific Health Standards (29 CFR 1910.1001-1053), when applicable, at sites owned and operated by NIST;

(8) Communicating to the responsible site occupational safety and health organization NIST's exposure monitoring requirements at sites not owned and operated by NIST;

(9) Establishing, maintaining, transferring, and making available records in accordance with 29 CFR 1910.1020, *Access to Employee Exposure and Medical Records* of any measurements taken to monitor chemical exposures and any medical consultations and examinations, including tests or written opinions, when required by 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories* or any OSHA Chemical-Specific Health Standard (29 CFR 1910.1001-1053), when applicable;

(10) Advising OFPM and OU representatives regarding equipment selection, equipment location, and additional safety requirements for the installation or modification of local exhaust ventilation, ducted laboratory fume hoods, ducted special purpose hoods, other ducted containment devices, emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment at sites owned and operated by NIST;

(11) Communicating to the responsible site occupational safety and health organization NIST's requirements regarding equipment selection, equipment location, and additional safety requirements for the installation or modification of local exhaust ventilation, ducted laboratory fume hoods, ducted special purpose hoods, other ducted containment devices, emergency showers, eyewash equipment, eye/face wash equipment,

combination units, and supplemental equipment at sites not owned and operated by NIST; and

(12) Reviewing the responsible site occupational safety and health organization's requirements regarding equipment selection, equipment location, and additional safety requirements for the installation or modification of local exhaust ventilation, ducted laboratory fume hoods, ducted special purpose hoods, other ducted containment devices, emergency showers, eyewash equipment, eye/face wash equipment, combination units, and supplemental equipment at sites not owned and operated by NIST.

h. NIST AHJ is responsible for:

(1) Reviewing and approving the storage of hazardous chemicals in service galleys and outdoor locations.

10. AUTHORITIES

There are no authorities specific to this suborder alone. For authorities applicable to all NIST OSH suborders, see section 9 of NIST O 7101.00: Occupational Safety and Health Management System.

11. DIRECTIVE OWNER

Chief Safety Officer

12. APPENDICES

A. Revision History

B. Hazardous Chemical Storage

C. Regulated Chemicals and Processes

D. Chemical Hazard References

E. Chemical Exposure Limits

F. 29 CFR 1910.1450 - Occupational Exposure to Hazardous Chemicals in Laboratories

G. Chemicals Regulated in OSHA Chemical-Specific Health Standards

Appendix A. Revision History

Revision No.	Approval Date	Effective Date	Brief Description of Change; Rationale
0	03/29/2017	03/29/2017	• None – Initial document
1	06/12/2017	06/12/2017	• Format revisions to the Table of Contents, Section 6, Appendix B, and Appendix D to ensure consist font, bullets, and indents.
2	11/08/2017	11/08/2017	• Section 6b(1)(a)(i) was revised to require NIST Gaithersburg Package Services Group personnel who receive hazardous chemical packages from transporters to have met the applicable HMR training requirements. • Section 6b(3)(b)(iii) was added to require NIST Gaithersburg Package Services personnel who transport hazardous chemical packages from the NIST workplace shall perform transportation functions in accordance with the HMR for the specific hazardous chemical packages being transported. • Section 6j was revised to clarify training that NIST Gaithersburg Package Services Personnel who perform hazardous chemical pre-transportation, transportation, or receiving functions must meet applicable HMR information and training requirements. • Section 6j was revised to clarify training requirements for receivers of hazardous chemical packages who are not Gaithersburg Package Services Group personnel. • Section 6j was revised to remove the training requirements for personnel (other than NIST Gaithersburg Package Services Personnel) who transport hazardous chemical packages from a NIST workplace because such training content is to be provided in the general program training course. • Section 8 was revised to include additional acronyms utilized in the suborder.
3	1/8/2021	April Camenisch	• Updated CFR and Suborder links.

Appendix B. Hazardous Chemical Storage

This appendix provides a chemical compatibility chart and additional information that may be used as general guidance when determining safe storage conditions for the hazardous chemicals at NIST workplaces. The information provided in this appendix should be used in conjunction with specific storage information provided by the chemical manufacturer on the associated product-specific safety data sheet, in information provided by the resources listed below, and additional requirements provided in Section 6c.

1. Chemical Compatibility

a. General

(1) Hazardous chemicals should be stored in accordance with the manufacturer's recommended storage conditions described on the product-specific container label and safety data sheet.

(2) Hazardous chemicals should be stored according to the compatibility storage group and not alphabetically (see Table 1). Alphabetical storage, if desired, should only be used within a specific compatibility storage group.

Table 1 – Chemical Compatibility Chart

	Acid, Inorganic (Non-Oxidizer)	Acid, Inorganic (Oxidizer)	Acid, Organic	Base, Inorganic	Base, Organic	Flammable Liquids	Oxidizers	Peroxides / Peroxidizables	Pyrophorics	Water-Reactives
Acid, Inorganic (Non-Oxidizer)		X	X	X	X	X	X	X	X	X
Acid, Inorganic (Oxidizer)	X		X	X	X	X	X	X	X	X
Acid, Organic	X	X		X	X	X	X	X	X	X
Base, Inorganic	X	X	X		X	X	X	X	X	X
Base, Organic	X	X	X	X		X	X	X	X	X
Flammable Liquids	X	X	X	X	X		X	X	X	X
Oxidizers	X	X	X	X	X	X			X	X
Peroxides / Peroxidizables	X	X	X	X	X	X			X	X
Pyrophorics	X	X	X	X	X	X	X	X		
Water-Reactives	X	X	X	X	X	X	X	X		

Note: *An "X" indicates an incompatibility between storage groups*.

(3) Hazardous chemicals should be stored in secondary containment (e.g., a spill tray or bin, comprised of material that is compatible with the chemical to be contained and of sufficient volume capacity to contain the volume of the largest container being stored within).

(4) Hazardous chemicals in a specific secondary containment bin or tray shall be from the same compatibility storage group (see Table 1).

(5) Incompatible chemicals should not be stored within the same cabinet; however, acids may be stored together in the same cabinet provided that each acid type (e.g., Inorganic Acid (Oxidizer)) has been segregated from the other types (e.g., Inorganic Acid, Organic Acid) and stored in its own secondary containment bin or tray.

(6) Incompatible chemicals, when stored in containers having a capacity ≥ 5 lb (2.268 kg) or ½ gal (1.89 L), shall be segregated by employing one of the following methods:

(a) A distance of ≥ 20 ft (6.1m);

(b) A non-combustible partition extending ≥ 18 in. (457 mm) above and to the sides of the stored chemical or by a noncombustible partition that interrupts the line of sight between the incompatible chemicals;

(c) Storing liquid and solid chemicals in approved storage cabinets dedicated to specific chemical compatibility classes; or

(d) Storing compressed gases in approved gas cabinets or exhausted enclosures dedicated to specific chemical compatibility classes.

2. Resources for Chemical Reactivity and Storage Information

a. Electronic Materials

(1) NOAA's Chemical Reactivity Worksheet - A free program that allows users to investigate the reactivity of substances or mixtures of substances. CRW includes a database of reactivity information for more than 5,000 common hazardous chemicals and offers a way to virtually "mix" chemicals—as well as water—to discover what chemical combinations are reactive. CRW also allows users to build a "Custom Chemical Database" containing all the unique materials that are present at a particular facility.

b. Print Materials

(1) *Bretherick's Handbook of Reactive Chemical Hazards*, Bretherick, L., Butterworth and Company, Boston, MA.

(2) Clark, D. E., Journal of Chemical Health and Safety, 2001, 8 (6) 7-13.

(3) Kelly, R. J. *"Review of Safety Guidelines for Peroxidizable Organic Chemicals,"*, Journal of Chemical Health & Safety, Sept./Oct. 1996, pp 28-36.

(4) *NFPA® 30: Flammable and Combustible Liquids Code*, National Fire Protection Association, Quincy, MA (2008).

(5) *NFPA® 45: Fire Protection for Laboratories Using Chemicals*, National Fire Protection Association, Quincy, MA (2015).

(6) *NFPA® 55: Compressed Gases and Cryogenic Fluids Code,* National Fire Protection Association, Quincy, MA (2016).

(7) *NFPA® 400: Hazardous Materials Code*, National Fire Protection Association, Quincy, MA (2016).

(8) *NFPA® 432: Code for the Storage of Organic Peroxide Formulations,* National Fire Protection Association, Quincy, MA (2002).

(9) Pipitone, D. A., *"Safe Storage of Laboratory Chemicals"*, 2nd ed., Wiley-Interscience, New York, 1991, ISBN 0-471-51581-7.
(10) *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards*, National Research Council, National Academies Press, Washington, DC (2011).
(11) *Wiley Guide to Chemical Incompatibilities*, Pohanish, R. P., Green, S. A., John Wiley & Sons, Inc., Hoboken, NJ.
(12) *Sax's Dangerous Properties of Industrial Materials*, Richard J. Lewis (editor), Wiley and Sons, Inc., Hoboken, NJ.

Appendix C. Regulated Chemicals and Processes

This appendix provides information regarding a number of U.S. regulatory agencies and associated regulations that may pertain to the use of hazardous chemicals at NIST workplaces.

During the hazard review process for a specific activity involving hazardous chemicals at a NIST workplace, each hazardous chemical and activity shall be identified accurately and completely to ensure that each hazardous chemical shall be procured, used, stored, and disposed in compliance with any applicable regulatory requirements.

Hazardous chemicals that may have specific regulatory requirements include OSHA Regulated Substances, DEA Controlled Substances and Listed Chemicals, DHS Chemicals of Interest, EPA Extremely Hazardous Substances, EPA Ozone Depleting Chemicals, EPA Pesticides, EPA Toxic Release Inventory, ATF Explosives, and ATF Alcohol (Denatured, Tax-Exempt).

1. OSHA Regulated Substances

OSHA has numerous standards that govern the use of chemical substances in the workplace. An OSHA regulated substance is a substance that specifically is listed in any OSHA standard by chemical name, by process, or applicability as specified in any OSHA standard. The following is a representative list of each standard. The list is not intended to be comprehensive and therefore all OSHA standards should be consulted in their entirety prior to performing the use or handling of any hazardous chemical in the workplace. Appendix G of this suborder should be consulted regarding chemicals regulated in by OSHA in 29 CFR 1910 Subpart Z, Chemical-Specific Health Standards (29 CFR 1910.1001-1053).

a. 29 CFR 1910 Subpart H – Hazardous Materials
   (1) 29 CFR 1910.101 - Compressed gases (general requirements).
   (2) 29 CFR 1910.102 - Acetylene.
   (3) 29 CFR 1910.103 - Hydrogen.
   (4) 29 CFR 1910.104 - Oxygen.
   (5) 29 CFR 1910.105 - Nitrous oxide.
   (6) 29 CFR 1910.106 - Flammable liquids.
   (7) 29 CFR 1910.107 - Spray finishing using flammable and combustible materials.
   (8) 29 CFR 1910.109 - Explosives and blasting agents.
   (9) 29 CFR 1910.110 - Storage and handling of liquefied petroleum gases.
   (10) 29 CFR 1910.111 - Storage and handling of anhydrous ammonia.
   (11) 29 CFR 1910.119 - Process safety management of highly hazardous chemicals.
   (12) 29 CFR 1910.120 - Hazardous waste operations and emergency response.
   (13) 29 CFR 1910.123 - Dipping and coating operations: Coverage and definitions.
   (14) 29 CFR 1910.124 - General requirements for dipping and coating operations.

(15) 29 CFR 1910.125 - Additional requirements for dipping and coating operations that use flammable liquids or liquids with flashpoints greater than 199.4 *F (93 *C).
(16) 29 CFR 1910.126 - Additional requirements for special dipping and coating operations.

b. 29 CFR 1910 Subpart M – Compressed Gas and Compressed Air Equipment
(1) 29 CFR 1910.169 - Air receivers.

c. 29 CFR 1910 Subpart Q – Welding, Cutting, and Brazing
(1) 29 CFR 1910.252 - General requirements.
(2) 29 CFR 1910.253 - Oxygen-fuel gas welding and cutting.
(3) 29 CFR 1910.254 - Arc welding and cutting.
(4) 29 CFR 1910.255 - Resistance welding.

d. 29 CFR 1910 Subpart Z – Toxic and Hazardous Substances
(1) 29 CFR 1910.1000 - Air contaminants. Tables Z-1, Z-2, or Z-3.
(2) 29 CFR 1910.1001 - Asbestos.
(3) 29 CFR 1910.1003 - 13 Carcinogens.
(4) 29 CFR 1910.1017 - Vinyl chloride.
(5) 29 CFR 1910.1018 - Inorganic arsenic.
(6) 29 CFR 1910.1025 - Lead.
(7) 29 CFR 1910.1026 - Chromium (VI).
(8) 29 CFR 1910.1027 - Cadmium.
(9) 29 CFR 1910.1028 - Benzene.
(10) 29 CFR 1910.1029 - Coke oven emissions.
(11) 29 CFR 1910.1043 - Cotton dust.
(12) 29 CFR 1910.1044 - 1,2-dibromo-3-chloropropane.
(13) 29 CFR 1910.1045 - Acrylonitrile.
(14) 29 CFR 1910.1047 - Ethylene oxide.
(15) 29 CFR 1910.1048 - Formaldehyde.
(16) 29 CFR 1910.1050 - Methylenedianiline.
(17) 29 CFR 1910.1051 - 1,3-Butadiene.
(18) 29 CFR 1910.1052 - Methylene chloride.
(19) 29 CFR 1910.1053 - Respirable crystalline silica.
(20) 29 CFR 1910.1200 - Hazard communication.
(21) 29 CFR 1910.1201 - Retention of DOT markings, placards, and labels.
(22) 29 CFR 1910.1450 - Occupational exposure to hazardous chemicals in laboratories.

2. DEA Controlled Substances (Schedules I-V) and Listed Chemicals (Lists I and II)

The DEA Controlled Substances Act (21 USC Controlled Substances Act) and FDA (21 CFR Chapter II, parts 1300-1321) – apply to activities such as manufacturing, distributing, importing, exporting, dispensing, and performing research or chemical analysis when such activities involve any controlled substance or any listed chemical. A "controlled substance" is any substance that appears in schedule I-V of 21 USC Section 812 and 21 CFR 1308. A "listed chemical" is any

chemical that appears on list I or list II in 21 USC Section 802 and 21 CFR 1310.02 (a) or 21 CFR 1310.02 (b).

The following information is a brief summary of the some of the requirements. This information is not intended to be comprehensive and therefore the entire regulations/standards shall be consulted prior to acquiring or performing any activity with a controlled substance or listed chemical.

a. Controlled Substances:
   (1) 21 CFR 1300-1308 provides requirements for activities such as manufacturing, distributing, importing, exporting, dispensing, and performing research or chemical analysis involving any controlled substance listed in schedules I-V and include:
      (a) Submitting DEA Form-225 to and registering with the local DEA office prior to performing any activity (listed above) with controlled substances (more information at DEA Diversion Control Program, (800) 882-9539, or 21 CFR 1321.01),
      (b) Submitting separate registrations for each principal place of business and each group of activities,
      (c) Prohibiting performance of any activity requiring registration until after the application for registration has been granted and a Certificate of Registration has been issued, and
      (d) Security,
         i. Effective controls and procedures shall be provided to guard against theft and diversion;
         ii. Controlled substances shall be secured as prescribed for each schedule I-V (see 21 CFR 1301.71-77), which may include requirements for:
            (i) Storage, use, limiting access, reporting suspicious orders, reporting theft or loss, shipping, distributing, acceptance of delivery, and personnel restrictions.
      (e) Employee screening,
      (f) Employee responsibility to report drug diversion,
      (g) Labeling (see 21 CFR 1302),
      (h) Quotas (production, procurement, manufacturing) and inventory allowances (see 21 CFR 1303),
      (i) Records and Reports of Registrants (see 21 CFR 1304)
         i. Inventory (General)
            (i) Shall maintain a complete and accurate record of all controlled substances on hand, maintain a separate inventory for each registered location and each independent activity, and be taken initially then biennially and whenever a substance in inventory has been added to the controlled substance list.
         ii. Inventory (Researchers)

(i) Shall maintain an inventory that meets the general requirements above and contains:
1. A record for each controlled substance in finished form in inventory shall include:
a. The name of the substance, the finished form of the substance, the number of units or volume of finished form in commercial container, and the number of commercial containers of such finished form; and,
2. A record for each controlled substance not in finished form in inventory shall include:
a. The name of the substance, the total quantity of the substance, the reason for maintaining the substance, and whether the substance is capable of use in manufacture of a controlled substance in finished form.
3. Records shall be maintained to include:
a. The name of the substance, each finished form of the substance, the number of units of finished form and/or commercial containers acquired from other persons (including the date of and number of units and/or commercial containers in each acquisition to inventory and the name address and DEA registration number of the person from whom the units were acquired), the number of commercial containers distributed to other persons (including the date of and number of containers in each reduction from inventory and the name, address and DEA registration number of the person to whom the containers were distributed), the number of units of finished forms and/or commercial containers distributed or disposed of in any other manner by the registrant (including the date and manner of the distribution or disposal, the name, address, and registration number of the person to whom distributed, and the quantity in finished for distributed or disposed).

iii. Inventory (Chemical Analysts)
(i) Shall maintain an inventory that meets the general requirements above and contains:
1. A record for each controlled substance in finished form in inventory shall include:
a. The name of the substance, the finished form of the substance, the number of units or volume of finished form in commercial container, and the number of commercial containers of such finished form; and,
2. A record for each controlled substance not in finished form in inventory shall include:

a. The name of the substance, the total quantity of the substance, the reason for maintaining the substance, and whether the substance is capable of use in manufacture of a controlled substance in finished form.

3. A record does not need to be maintained if:
   a. less than 1kg of a controlled substance on Schedule I or
   b. less than 20g of a hallucinogenic substance listed in Schedule I (other than lysergic acid diethylamide) or
   c. less than 0.5g of lysergic acid diethylamide is on hand at the time of inventory.
4. Records shall be maintained to include:
   a. The name of the substance, the form or forms in which the substance is received, imported, or manufactured by the registrant, the total number of the forms received, imported or manufactured (including the date and quantity of each receipt, importation, or manufacture and the name, address, and registration number, if any, of the person from whom the substance was received), and the quantity distributed, exported, or destroyed in any manner (except quantities used in chemical analysis or other laboratory work) by the registrant (including the date and manner of distribution, exportation, or destruction, and the name, address, and registration number, if any, of each person to whom the substance was distributed or exported),
   b. Records of controlled substances used in chemical analysis or other laboratory work are not required;
   c. Records relating to known or suspected controlled substances received as evidentiary material for analysis are not required.
5. No inventory is required for known or suspected controlled substances received as evidentiary materials for analysis.

(j) Ordering and distributing of controlled substances (see 21 CFR 1305)

(k) Disposal of controlled substances (see 21 CFR 1307.21)

i. Any person in possession of any controlled substance and desiring or required to dispose of such substance shall request assistance from the Special Agent in Charge of the Administration in the area (more information at U. S. Department of Justice, Drug Enforcement Administration, Office of Diversion Control, (800) 882-9539, or 21 CFR 1321.01), in which the person is located for authority and instructions to dispose of such substance.

(2) 21CFR 1301.18 provides specific requirements for research protocols for research with controlled substances listed in schedule I under the following conditions:

(a) To conduct research with control substances listed in Schedule I,

(b) To conduct clinical investigation with controlled substances listed in Schedule I,

(c) In the event that a registrant desires to increase the quantity of a controlled substance used for an approved research project, and

(d) In the event that a registrant desires to conduct research beyond the variations provided in the registrant's approved protocol.

b. Listed Chemicals:

DEA registration, record keeping and suspicious order reporting requirements apply to importers, exporters, manufacturers, distributors and certain retailers of 41 listed chemicals. The chemicals are found in two lists, 21 CFR 1310.02 Substance Covered Listed Chemicals).

(1) For orders of chemicals listed at 21 CFR 1310.04 Maintenance of Records (Listed Chemicals) above the threshold by volume or weight, a DEA registration shall be made.

(2) Each regulated person who imports a listed chemical that meets or exceeds the threshold quantities identified in the list above or is a listed chemical for which no threshold has been established as identified in the list above, shall notify the Administrator of the importation not later than 15 days before the transaction is to take place.

(3) Reporting must be made by each regulated person to the Special Agent in Charge of the DEA Divisional Office for the area in which the regulated person making the report is located, as follows:

(a) Any regulated transaction involving an extraordinary quantity of a listed chemical, an uncommon method of payment or delivery, or any other circumstance that the regulated person believes may indicate that the listed chemical will be used in violation of this part.

(b) Any proposed regulated transaction with a person whose description or other identifying characteristic the Administration has previously furnished to the regulated person.

(c) Any unusual or excessive loss or disappearance of a listed chemical under the control of the regulated person. The regulated person responsible for reporting a loss in-transit is the supplier.

(4) 21 CFR 1309 – applies to manufacturers, distributors, importers, and exporters of List I chemicals.

(a) Provides requirements to register with the DEA and defines the application, registration, and security requirements.

(5) 21 CFR 1310 – applies to any person who manufactures, distributes, imports, or exports a listed chemical, a tableting machine, or an encapsulating machine or who acts as a broker or trader for an international transaction involving a listed chemical, a tableting machine, or an encapsulating machine to create/maintain records and file reports to the DEA.

(a) Provides requirements for maintenance of records and reports, identifies thresholds (weights or volume) below which records and reports may not be required (21 CFR 1310.04), identifies listed chemicals that may be exempted based concentration limits (21 CFR 1310.12), identifies listed chemical products that may be exempted (21 CFR

1310.16), and provides requirements for sales by Federal departments or agencies of chemicals which could be used to manufacture controlled substances (21 CFR 1310.21).

3. EPA Ozone Depleting Chemicals

a. Phase-out of ozone-depleting substances is regulated in 40 CFR 82 -- Protection of Stratospheric Ozone.
   (1) Class I substances are banned from production and import while Class II substances are being phased out of production and importation.
   (2) The Stationary Refrigeration and Air-Conditioning section requires maintenance on leaking equipment using ozone-depleting substances (ODS) be performed only by a certified technician. The refrigerant shall not be vented but must be recovered and recycled by an EPA-certified reclaimer, who shall report all recycled substances. Refrigerators, air-conditioners and dehumidifiers must be checked for ozone-depleting substances before excessing or disposal.
   (3) Containers of class I or class II substances shall be labeled with the words "Warning: Contains XX, a substance which harms public health", where XX is the name of the ozone-depleting substance, in a clearly legible and conspicuous location on the container, if the container is to be distributed or sold. If containers are received with such labeling, the label shall not be removed or defaced while it contains the ODS.
   (4) The Exemption for Laboratory and Analytical Uses allows for continued production and import of small amounts of class I ozone depleting substances for chemicals used in essential laboratory and analytical methods. Distributors must:
      (a) Report quarterly the quantity received of each controlled substance from each producer or importer;
      (b) Report quarterly the quantity of each controlled substance purchased by each laboratory customer whose certification was previously provided to the distributor; and
      (c) Maintain as records copies of certifications from laboratory customers provided.

b. Laboratory customers purchasing controlled substances under the global laboratory essential-use exemption must provide the producer, importer or distributor of the chemical with a one-time-per-year certification (http://www.epa.gov/ozone/record/downloads/LabCert_ClassI.pdf) for each controlled substance, that the substance will be only be used for essential laboratory applications and will not be resold or used in manufacturing.

4. EPA Pesticides

a. The Federal Insecticide, Fungicide and Rodenticide Act regulations, 40 CFR 150-189, require:
   (1) All pesticides must be used only as directed on the label;

(2) All pesticide uses must be classified as “restricted” or “general”,
(3) Persons who buy or use restricted-use pesticides must be certified as competent pesticide applicators or must be directly supervised by a certified applicator. Certification is issued by each state for pesticide purchasers and/or applicators.

5. ATF Explosives

a. 27 CFR 555, *Commerce in Explosives*

(1) Provides definitions of explosive materials and requirements for interstate or foreign commerce in explosive materials. It also provides licensing, permitting, storage and reporting requirements for the use of explosives. Industrial and laboratory chemicals which are intended for use as reagents and which are packaged and shipped pursuant to U.S. Department of Transportation regulations, 49 CFR Parts 100 to 177, which do not require explosives hazard warning labels are exempted from these regulations.

6. ATF Distribution and Use of Denatured Alcohol

a. 27 CFR 20, *Distribution and Use of Denatured Alcohol* provides requirements regarding obtaining a permit and ordering, receiving, storing, using, and disposing of specially denatured alcohol. 27 CFR 20 (Subpart N) describes requirements applicable to the United States government.

7. ATF Tax-Free Alcohol

a. 27 CFR 22, *Distribution and Use of Tax-Free Alcohol* provides requirements regarding obtaining a permit and ordering, receiving, storing, using, and disposing of tax-free alcohol. 27 CFR 22 (Subpart N) describes requirements applicable to the United States government.

Appendix D. Chemical Hazard References

This appendix describes known references for use in collecting data regarding chemical identity, chemical and physical properties, health effects, and procedures for safe handling, storage, and disposal of hazardous chemicals. This list in not intended to be comprehensive.

1. Electronic Materials

a. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA)
   (1) OSHA Occupational Chemical Database - A chemical database of 800 chemicals that is searchable by chemical name or CAS# and provides: chemical name, CAS#, synonyms, formula, physical properties, reactivity, emergency response, first aid, exposure limits, carcinogen designation, exposure control/PPE, exposure routes/symptoms, and target organs.
   (2) OSHA-Topic Page (Carcinogens) - A webpage that provides information and links to webpages pertaining to standards for general industry, shipyard employment, the construction industry, and the identification, classification, and regulation of carcinogens.

b. U.S. Department of Health and Human Services (DHHS), National Toxicology Program (NTP)
   (1) Report on Carcinogens - A webpage that provides links to the chemicals classified by the NTP as "known human carcinogens" and "reasonably anticipated human carcinogens".

c. National Library of Medicine (NLM)
   (1) TOXNET: Toxicology Data Network - Databases on toxicology, hazardous chemicals, environmental health, and toxic releases.
      (a) ChemIDplus Lite - A free, web-based search system that provides access to structure and nomenclature authority files used for the identification of chemical substances cited in National Library of Medicine (NLM) databases, including the TOXNET® system. ChemIDplus also provides structure searching and direct links to many biomedical resources at NLM and on the Internet for chemicals of interest. The database contains over 390,000 chemical records, of which over 300,000 include chemical structures, and is searchable by Name, Synonym, CAS Registry Number, Molecular Formula, Classification Code, Locator Code, Structure, Toxicity, and/or Physical properties.
      (b) Hazardous Substances Data Bank (HSDB) - A free web-based search HSDB for toxicology data files on the National Library of Medicine's (NLM) Toxicology Data Network (TOXNET®). It focuses on the toxicology of potentially hazardous chemicals. It is enhanced with information on human exposure, industrial hygiene, emergency handling procedures, environmental fate, regulatory requirements, nanomaterials, and related areas. All data are referenced and derived from a core set of books, government documents, technical reports and selected primary journal literature. HSDB is peer-reviewed by the Scientific Review Panel (SRP), a committee

of experts in the major subject areas within the data bank's scope. HSDB is organized into individual chemical records, and contains over 5000 such records.

(c) TOXLINE - A bibliographic database for toxicology, a varied science encompassing many disciplines. TOXLINE records provide bibliographic information covering the biochemical, pharmacological, physiological, and toxicological effects of drugs and other chemicals. It contains over 4 million bibliographic citations, most with abstracts and/or indexing terms and CAS Registry Numbers. TOXLINE references are drawn from various sources organized into component sub-files which are searched together but which may be used to limit searches as well.

(d) Development and Reproductive Toxicology (DART) Database - A searchable database that references to developmental and reproductive toxicology literature.

(e) Genetic Toxicology Data Bank (GENE-TOX) - A searchable database that contains peer-reviewed genetic toxicology test data for over 3,000 chemicals.

(2) WISER - A system designed to assist first responders in hazardous material incidents. WISER provides a wide range of information on hazardous substances, including substance identification support, physical characteristics, human health information, and containment and suppression advice.

(3) Centers for Disease Control and Prevention-Chemical Safety – A webpage that provides links to NIOSH databases and other resources.

(4) Agency for Toxic Substances & Disease Registry - A database searchable by chemical name or CAS# that provides identity, hazard, exposure route, physical properties, incompatibilities, health effects, emergency response, and toxicology information.

d. National Institute for Occupational Safety and Health (NIOSH)

(1) NIOSH Pocket Guide to Chemical Hazards - A source of general industrial hygiene information on several hundred chemicals/classes found in the work environment. Key data provided for each chemical/substance includes name (including synonyms/trade names), structure/formula, CAS/RTECS Numbers, DOT ID, conversion factors, exposure limits, IDLH, chemical and physical properties, measurement methods, personal protection, respirator recommendations, symptoms, and first aid.

(2) International Chemical Safety Cards (ICSC) - IPCS cards summarize essential health and safety information on chemicals for their use at the "shop floor" level by workers and employers in factories, agriculture, construction and other work places.

(3) The Emergency Response Safety and Health Database (ERSH-DB) – A searchable database developed by NIOSH for the emergency response community, The ERSH-DB contains accurate and concise information on high-priority chemical, biological and radiological agents that could be encountered by personnel responding to a terrorist event.

e. American Conference of Governmental Industrial Hygienists

(1) American Conference of Governmental Industrial Hygienists (ACGIH) "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment," (latest

edition). - A guide for evaluation and control of workplace exposures to chemical substances and physical agents. Threshold Limit Value (TLV®) occupational exposure guidelines are recommended for more than 700 chemical substances and physical agents. There are more than 50 Biological Exposure Indices (BEIs®) that cover more than 80 chemical substances. Chemical Abstract Service (CAS) registry numbers are listed for each chemical. Introductions to each section and appendices provide philosophical bases and practical recommendations for using TLVs® and BEIs®.

f. U.S. Department of Transportation

(1) Emergency Response Guidebook - Provides first responders with a go-to manual to help deal with hazmat accidents during the critical first 30 minutes.

g. U.S. Department of Commerce, National Oceanic and Atmospheric Administration

(1) CAMEO Chemicals - A database of hazardous chemicals that emergency responders and planners can use to get response recommendations and predict hazards, such as explosions or chemical fires.

(2) Chemical Reactivity Worksheet (CRW) - A free program that allows users to investigate the reactivity of substances or mixtures of substances. CRW includes a database of reactivity information for more than 5,000 common hazardous chemicals and offers a way to virtually "mix" chemicals—as well as water—to discover what chemical combinations are reactive. CRW also allows users to build a "Custom Chemical Database" containing all the unique materials that are present at a particular facility.

h. U.S. Environmental Protection Agency

(1) Emergency Management - An EPA webpage that makes available numerous databases and tools related to emergency management. These resources are designed to help first responders address emergency situations, assist facilities in complying with emergency management regulations, and give the public an improved understanding of chemicals in their community.

(2) Searchable EPCRA/CERCLA/CAA §112(r) Consolidated List of Lists database -An EPA webpage that allows searching by chemical name or CAS# to identify whether a chemical is regulated by the EPA under CERCLA, EPCRA, RCRA, and TRI.

i. World Health Organization (WHO), International Agency for Research on Cancer (IARC)

(1) Monographs on the Evaluation of Carcinogenic Risk for Humans - A webpage that provides links to the chemicals classified by the IARC for carcinogenicity; links provides viewing of IARC classification lists by alphabetical order, CAS#, classification group, or cancer site.

j. European Chemicals Agency

(1) Information on Chemicals - A webpage that allows searching for chemical data regarding chemicals manufactured and imported into Europe. C & L Inventory provides a page that allows searching for chemical data, including substances that have a harmonized hazard classification in Europe. Data supporting a particular classification may be provided. Registered Substances provides a page that allows searching for chemical data pertaining

to chemicals registered in Europe and search results include general information, classification and labeling, environmental data, physical and chemical properties data, guidance of safe use, reference substances, and toxicological data; toxicological data is presented with respect to hazard class and provided data may include information regarding study type, reliability, bibliography, and rationale supporting hazard classification derived from the study.

2. Print Materials

a. *Bretherick's Handbook of Reactive Chemical Hazards*, Bretherick, L., Butterworth and Company, Boston, MA.

b. *CRC Handbook of Chemistry and Physics*, W.M. Haynes (editor-in-chief), CRC Press, Boca Raton, FL.

c. *Fire Protection Guide to Hazardous Materials*, National Fire Protection Association, Quincy, MA.

d. *Guidelines for Laboratory Design: Health and Safety Considerations*, 3rd edition, DiBerardinis, L. J., et al., John Wiley & Sons, Inc., New York, NY (2001).

e. *Handbook of Laboratory Safety*, A. Keith Furr (editor), CRC Press Inc., Boca Raton, FL.

f. *Hawley's Condensed Chemical Dictionary*, Richard J. Lewis (editor), Van Nostrand Reinhold, New York, NY.

g. *Laboratory Design, Construction, and Renovation: Participants, Process, and Product*, National Research Council, National Academies Press, Washington, DC (2010).

h. *NFPA® 30, Flammable and Combustible Liquids Code*, National Fire Protection Association, Quincy, MA (2008).

i. *NFPA® 45, Fire Protection for Laboratories Using Chemicals*, National Fire Protection Association, Quincy, MA (2011).

j. *NFPA® 325M, Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids*, National Fire Protection Association, Quincy, MA (1984) (Note 1994 was the last edition; this data standard is no longer maintained by NFPA committee).

k. *NFPA® 491M, Manual of Hazardous Chemical Reactions*, National Fire Protection Association, Quincy, MA (1991).

l. *NFPA® 704, Standard System for the Identification of the Hazards of Materials for Emergency Response*, National Fire Protection Association, Quincy, MA (2007).

m. *Prudent Practices for Disposal of Chemicals from Laboratories*, National Research Council, National Academy Press, Washington, DC (1983).

n. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, National Research Council, National Academies Press, Washington, DC (2011).

o. Wiley Guide to Chemical Incompatibilities, Pohanish, R. P., Green, S. A., John Wiley & Sons, Inc., Hoboken, NJ.

p. *Safety in Academic Chemistry Laboratories*, American Chemical Society, Washington, DC (1990).

q. *Safety in Academic Chemistry Laboratories*, 7th edition, American Chemical Society, Washington, DC (2003)
r. *Sax's Dangerous Properties of Industrial Materials*, Richard J. Lewis (editor), Wiley and Sons, Inc., Hoboken, NJ.
s. *Sittig's Handbook of Toxic and Hazardous Chemicals and Carcinogens*, Richard P. Pohanish, Elsevier, Inc., Waltham, MA.
t. *Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs)*, ACGIH, Cincinnati, Ohio.

Appendix E. Chemical Exposure Limits

This appendix provides information regarding chemical hazards, toxicity, exposure routes, and exposure limits that should be used as general guidance when determining the potential exposure routes, the applicable exposure limits, and the appropriate control measures that shall be implemented for activities involving the use of hazardous chemicals at NIST workplaces.

The hazards and toxicity presented by a hazardous chemical are similar but differing concepts. A chemical's hazards (health, physical, and/or environmental) are a result of the specific chemical's physical properties, reactivity, and ability to do harm to the physical environment or any exposed individuals; a chemical's hazards are intrinsic (i.e., always present) in the chemical, regardless of how the chemical is used by individuals. A chemical's toxicity refers to the chemical's ability to cause adverse effects to individuals as a result of chemical exposure; chemical exposure occurs when a chemical makes contact with the outer boundary of an organism (e.g., skin, lungs, gut). A chemical's human toxicity is directly related to the chemical's health hazards and may include systemic damage to human tissue (e.g. an organ system, such as the kidneys or liver), disruption of a biochemical process (e.g. blood-forming mechanism), or disturbance of an enzyme system at a site removed from the original exposure site.

Some chemicals are toxic by nature while others are metabolically or chemically converted into a more toxic form in the human body; conversely, some chemicals are converted to a less toxic form in the human body. Some toxic chemicals are toxic to specific cells or tissue while others are toxic to any cells or tissues contacted.

The risk of toxic effects to a worker is related to the inherent toxicity of the chemical and the extent of the worker exposure to the chemical, where the extent of exposure is defined by the route, duration, frequency, and dose of the exposure.

Worker exposure to chemicals may occur by any of the following four, exposure routes: inhalation, contact/absorption, ingestion, and injection. An understanding of potential, exposure routes and methods that can be taken to prevent exposure is imperative in minimizing the toxic effects from chemical exposures.

An exposure limit is a value that represents the maximum concentration over a specified period of time that a worker may be exposed to a particular chemical. Typically, exposure limits are not based on human exposure data but rather represent extrapolations from animal (e.g. rabbit, rat) exposure data to determine human exposure limits; additionally, dose-response relationships vary with respect to chemical and person exposed; therefore, it should not be assumed that a human exposure below a given exposure limit is safe.

Exposure limits are provided as a time-weighted average (TWA), as a short-term exposure limit (STEL), or as a ceiling value. TWA refers to a concentration that is measured over time, typically defined as an average concentration measured during one work shift (8-10 hours) in one work week (40 hours). STEL refers to a concentration that is measured over a shorter period of time, typically defined as an average concentration measured over a short time (15 minutes) in one work day (8-10 hours); a STEL is a 15-minute TWA and shall not be exceeded, even if the 8-10 hour TWA has not been exceeded. Ceiling value refers to a concentration that is measured instantaneously; in the absence of instantaneously monitoring, a ceiling value may be assessed as a STEL (a 15min. TWA); a ceiling value represents a concentration that shall at no time be exceeded.

The following information identifies the three organizations that publish occupational exposure limits in the United States and includes information on how to access each organization's published exposure limits.

1. American Conference of Industrial Hygienists Threshold Limit Values (ACGIH TLVs)

a. ACGIH TWA (8 hour TWA in 40-hour work week)

b. ACGIH STEL (15 min. TWA)

A complete list of ACGIH TLVs may be found by contacting OSHE or by purchasing the latest edition of *Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs)*.

2. U.S. National Institute for Occupational Safety and Health Recommended Exposure Limits (NIOSH RELs)

a. NIOSH TWA (up to a 10 hour TWA in 40-hour work week)

b. NIOSH Ceiling (15 min. TWA)

A complete list of available NIOSH RELs may be found at NIOSH Pocket Guide to Chemical Hazards by selecting the chemical of interest and reviewing the corresponding, NIOSH REL data.

3. U.S. Occupational Safety and Health Administration Permissible Exposure Limits (OSHA PELs) and Action Levels

a. OSHA TWA (8 hour TWA in 40-hour work week)

(1) Limit may not be exceeded

b. OSHA Ceiling Value (instantaneously measured or 15 min. TWA)

(1) Limit may not be exceeded at any time

c. OSHA Acceptable Ceiling Concentration (8-hour work shift)

(1) Limit may be exceeded up to a concentration not exceeding the maximum duration and concentration allowed in the column under "acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift" in 29 CFR 1910.1000, Table Z-2

d. OSHA Action Levels (8 hour TWA)

(1) A concentration of a specific substance, which initiates certain required activities such as exposure monitoring and medical surveillance

PELs for OSHA-regulated substances are listed in 29 CFR 1910.1000-1096. The majority of PELs are listed in 29 CFR 1910.1000-Air Contaminants, Tables Z1-Z3, which may be found at Table Z-1, Table Z-2, and Table Z-3. Additional OSHA PELs and Action Levels are designated in substance-specific standards 29 CFR 1910.1001-1096, which may be found at OSHA Regulations-General Industry. Additionally, OSHA maintains a Permissible Exposure Limits – Annotated Tables website that provides some background information regarding exposure limits and direct access to the OSHA, NIOSH, and California Division of Occupational Safety and Health published exposure limits.

OSHA PELs are regulatory limits describing the amount or concentration of a substance that an employee or covered associate may be exposed to. Because the OSHA PELs have not been updated for some time, NIST has adopted a more protective approach. At NIST, employee and covered associate exposures shall be kept below the applicable OSHA PEL or ACGIH TLV, whichever is lower. Employee and covered associate exposures to OSHA-regulated substances shall be limited to below the specific exposure limits published in any applicable OSHA chemical-specific health standard, unless that standard states otherwise; where a chemical-specific health standard specifies the prohibition of eye and skin contact, such prohibitions shall be observed (see Appendix G). In the absence of an OSHA PEL, employee and covered associate exposures shall be limited to below the specific exposure limits published in the ACGIH TLVs.

Exposure limits for specific chemical products are described in the specific product's safety data sheet.

Contact OSHE for any questions or assistance regarding exposure limits.

Appendix F. 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories

This appendix provides information regarding the primary OSHA regulation pertaining to the laboratory use of hazardous chemicals, its requirements, and where its requirements are addressed in this suborder to aid NIST employees and covered associates in understanding the regulation.

In 1990, OSHA enacted 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*, which often is referred to as the "Laboratory Standard" (LS), to serve as the primary, federal regulation to protect workers from the health hazards associated with hazardous chemicals in a laboratory workplace. The complete standard is available electronically at 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories* or available in print from the NIST Chemical Hygiene Officer upon request.

The LS defines requirements that must be met by employers engaged in the laboratory use of hazardous chemicals to protect personnel from the health hazards presented by hazardous chemicals in the laboratory workplace.

1. LS Requirements:

a. Ensure proper hazard identification of chemicals by:
   (1) With respect to labels and material safety data sheets (MSDSs):
      (a) Ensuring that labels of incoming containers of hazardous chemicals shall not be removed or defaced.
      (b) Maintaining material safety data sheets (MSDSs) that are received with incoming shipments of hazardous chemicals and ensuring that the MSDSs are readily available to laboratory employees.
   (2) With respect to chemical substances produced or developed in the laboratory:
      (a) For chemicals of known composition:
         i. Determine if the chemical is hazardous; if hazardous, shall provide LS-required training.
      (b) For chemicals of unknown composition:
         i. Assume that chemical is hazardous and implement CHP.
      (c) For chemicals produced for another user outside the laboratory:
         i. Comply with 29CFR1910.1200-Hazard Communication.

b. Ensure that laboratory employees' exposure to OSHA-regulated substances does not exceed the corresponding permissible exposure limits (PELs) specified in 29CFR1910, subpart Z.

c. Ensure that proper respiratory equipment shall be provided (at no cost to the employee), selected, and used in accordance with 29CFR1910.134-Respirator Protection when respirator use is necessary to maintain exposures to below PELs.

d. Perform employee exposure determinations under the following circumstances:
   (1) Initial monitoring for employee exposure to a substance regulated by an OSHA standard which requires monitoring, if there is reason to believe exposure levels routinely exceed the action level (or PEL, in the absence of an action level) for the substance.
   (2) Periodic monitoring, if initial monitoring discloses exposure over the action level (or PEL, in the absence of an action level).
e. Develop and carry out the provisions of a written CHP capable of:
   (1) Protecting employees from health hazards associated with hazardous chemicals in the laboratory.
   (2) Keeping exposures below the PELs specified in 29CFR1910, subpart Z.
f. Ensure that the CHP is readily available to employees, employee representatives, and the Assistant Secretary of Labor upon request.
g. Ensure that the CHP shall indicate specific measures to be taken to ensure laboratory employee protection.
h. Review and evaluate the effectiveness of the CHP at least annually and update the CHP as necessary.

2. CHP Requirements:

a. Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals.
b. Criteria used to determine and implement control measures to reduce employee exposure to hazardous chemicals, where particular attention shall be given to the selection of control measures for chemicals known to be extremely hazardous.
c. A requirement that fume hoods and other protective equipment shall function properly, and definition of specific measures that shall be taken to ensure proper and adequate performance of such protective equipment.
d. Provisions for employee information and training in accordance with 29 CFR 1910.1450(f).
e. The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation.
f. Provisions for medical consultation and medical examinations in accordance with 29 CFR 1910.1450(g).
g. Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer, and, if appropriate, establishment of a Chemical Hygiene Committee.
h. Provisions for additional employee protection for work with particularly hazardous substances.

The following information provides a reference to the location in NIST S 7101.60: *Chemical Management* where specific sections of 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories* are addressed.

2709 Table 9 – Location of LS Requirements in NIST S 7101.60, *Chemical Management*

29 CFR 1910.1450 Section	Location in this Document
1910.1450(a)(1)	Section 3
1910.1450(a)(2)(i)	Section 6h(1)(a), Appendix G
1910.1450(a)(2)(ii)	Section 6h(1)(c), Appendix G
1910.1450(a)(2)(iii)	Section 6h(3), Appendix G
1910.1450(b) Definitions	Section 7
1910.1450(c) Permissible exposure limits	Section 6f(2)
1910.1450(d) Employee exposure determination	Section 6h(3)(a), Section 9g(6-7)
1910.1450(e) Chemical hygiene plan	Entire document
1910.1450(e)(1)	Entire document and associated program tools
1910.1450(e)(2)	Section 9c(4)
1910.1450(e)(3)(i)	Entire document and associated program tools
1910.1450(e)(3)(ii)	Section 6f
1910.1450(e)(3)(iii)	Section 6f(5)(c)(ii)-(viii), Section 9e(9-17)
1910.1450(e)(3)(iv)	Section 6j
1910.1450(e)(3)(v)	Section 6g(2)(a)
1910.1450(e)(3)(vi)	Section 6h(4), Section 9g(9)
1910.1450(e)(3)(vii)	Section 9
1910.1450(e)(3)(viii)	Section 6f(1)(b), Section 6f(5)(d)(ii), Section 6f(5)(c)(x)(ii), Section 6g(4)(f)
1910.1450(e)(4)	Section 9c(3)
1910.1450(f) Employee information and training	Section 6j
1910.1450(g) Medical consultation and examinations	Section 6h(4), Section 9g(9)
1910.1450(h) Hazard identification	Section 6e
1910.1450(i) Use of respirators	Section 6f(5)(e)
1910.1450(j) Recordkeeping	Section 9g(9)

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Appendix G. Chemicals Regulated in OSHA Chemical-Specific Health Standards

This appendix provides basic information regarding whether a chemical is within the scope and application of the OSHA Chemical-Specific Health Standards. The OSHA Chemical-Specific Health Standards (29 CFR 1910.1001 - 29 CFR 1910.1053) provide numerous requirements (e.g., hazard communication, information and training, permissible exposure limits, and exposure monitoring/medical surveillance) for specific chemicals. The application and therefore applicable requirements of the OSHA Chemical-Specific Health Standards are determined by criteria such as chemical concentration, physical form, and use. The OSHA Chemical-Specific Health Standards should be consulted for detailed information regarding the applicable requirements. The NIST Chemical Hygiene Officer or another OSHE staff member will provide assistance upon request.

1. "Laboratory Use":

a. When the use of a chemical at a NIST workplace meets the definition of "Laboratory Use" and is within the scope and application of an OSHA Chemical-Specific Health Standard, OSHA 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories* supersedes the requirements of the particular OSHA Chemical-Specific Health Standard, except as follows:

(1) 1910.1450(a)(2)(i) For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of 1910.1450(a)(2)(iii) apply (see below);

(2) 1910.1450(a)(2)(ii) Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed (see 29 CFR 1910.1017, *Vinyl Chloride*,29 CFR 1910.1044, *1,2-dibromo-3-chloropropane*,29 CFR 1910.1045, *Acrylonitrile*);

(3) 1910.1450(a)(2)(iii) Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements of 1910.1450(d) and 1910.1450(g)(1)(ii) shall apply.

Note: *29 CFR 1910.1450 does provide exposure determination/monitoring and medical consultation/surveillance requirements that under certain scenarios would be required to comply with the corresponding requirements in an OSHA Chemical-Specific Health Standard (see Section 6j).*

2. Not "Laboratory Use":

a. When the use of a chemical at a NIST workplace does not meet the definition of "Laboratory Use" and is within the scope and application of an OSHA Chemical-Specific Health Standard, all requirements of the particular OSHA Chemical-Specific Health Standard are applicable.

3. Scope and Application of OSHA Chemical-Specific Health Standards:

a. 29 CFR 1910.1001 - Asbestos.

(1) This section applies to all occupational exposures to asbestos in all industries covered by the Occupational Safety and Health Act, except:

(a) This section does not apply to construction work as defined in 29 CFR 1910.12(b). (Exposure to asbestos in construction work is covered by 29 CFR 1926.1101.); and

(b) This section does not apply to ship repairing, shipbuilding and shipbreaking employments and related employments as defined in 29 CFR 1915.4. (Exposure to asbestos in these employments is covered by 29 CFR 1915.1001).

b. 29 CFR 1910.1003 - 13 Carcinogens.

(1) This section applies to any area in which the 13 carcinogens addressed by this section are manufactured, processed, repackaged, released, handled, or stored, but shall not apply to transshipment in sealed containers, except for the labeling requirements under paragraphs (e)(2), (3) and (4) of this section. The 13 carcinogens are the following: 4-nitrobiphenyl, Chemical Abstracts Service Register Number (CAS No.) 92933; alpha-naphthylamine, CAS No. 134327; methyl chloromethyl ether, CAS No. 107302; 3,3'-Dichlorobenzidine (and its salts) CAS No. 91941; bis-chloromethyl ether, CAS No. 542881; beta-naphthylamine, CAS No. 91598; benzidine, CAS No. 92875; 4-Aminodiphenyl, CAS No. 92671; Ethyleneimine, CAS No. 151564; beta-Propiolactone, CAS No. 57578; 2-Acetylaminofluorene, CAS No. 53963; 4-Dimethylaminoazo-benzene, CAS No. 60117; and N-nitrosodimethylamine, CAS No. 62759.

(2) This section shall not apply to the following:

(a) Solid or liquid mixtures containing less than 0.1 percent by weight or volume of 4-Nitrobiphenyl; methyl chloromethyl ether; bis-chloromethyl ether; beta-naphthylamine; benzidine or 4-Aminodiphenyl; and

(b) Solid or liquid mixtures containing less than 1.0 percent by weight or volume of alpha-naphthylamine; 3,3'-Dichlorobenzidine (and its salts); Ethyleneimine; beta-Propiolactone; 2-Acetylaminofluorene; 4-Dimethylaminoazobenzene, or N-nitrosodimethylamine.

c. 29 CFR 1910.1017 - Vinyl chloride.

(1) This section applies to the manufacture, reaction, packaging, repackaging, storage, handling or use of vinyl chloride or polyvinyl chloride, but does not apply to the handling or use of fabricated products made of polyvinyl chloride.

(2) This section applies to the transportation of vinyl chloride or polyvinyl chloride except to the extent that the Department of Transportation may regulate the hazards covered by this section.

d. 29 CFR 1910.1018 - Inorganic arsenic.

(1) This section applies to all occupational exposures to inorganic arsenic except that this section does not apply to employee exposures in agriculture or resulting from pesticide

application, the treatment of wood with preservatives or the utilization of arsenically preserved wood.

e. 29 CFR 1910.1025 - Lead.

(1) This section applies to all occupational exposure to lead, except:

(a) This section does not apply to the construction industry or to agricultural operations covered by 29 CFR Part 1928.

f. 29 CFR 1910.1026 - Chromium (VI).

(1) This standard applies to occupational exposures to chromium (VI) in all forms and compounds in general industry, except:

(a) Exposures that occur in the application of pesticides regulated by the Environmental Protection Agency or another Federal government agency (e.g., the treatment of wood with preservatives);

(b) Exposures to Portland cement; or

(c) Where the employer has objective data demonstrating that a material containing chromium or a specific process, operation, or activity involving chromium cannot release dusts, fumes, or mists of chromium (VI) in concentrations at or above 0.5 µg/m3 as an 8-hour time-weighted average (TWA) under any expected conditions of use.

g. 29 CFR 1910.1027 - Cadmium.

(1) This standard applies to all occupational exposures to cadmium and cadmium compounds, in all forms, and in all industries covered by the Occupational Safety and Health Act, except the construction-related industries, which are covered under 29 CFR 1926.63.

h. 29 CFR 1910.1028 - Benzene.

(1) This section applies to all occupational exposures to benzene. Chemical Abstracts Service Registry No. 71-43-2, except:

(a) The storage, transportation, distribution, dispensing, sale or use of gasoline, motor fuels, or other fuels containing benzene subsequent to its final discharge from bulk wholesale storage facilities, except that operations where gasoline or motor fuels are dispensed for more than 4 hours per day in an indoor location are covered by this section.

(b) Loading and unloading operations at bulk wholesale storage facilities which use vapor control systems for all loading and unloading operations, except for the provisions of 29 CFR 1910.1200 as incorporated into this section and the emergency provisions of paragraphs (g) and (i)(4) of this section.

(c) The storage, transportation, distribution or sale of benzene or liquid mixtures containing more than 0.1 percent benzene in intact containers or in transportation pipelines while sealed in such a manner as to contain benzene vapors or liquid, except for the provisions of 29 CFR 1910.1200 as incorporated into this section and the emergency provisions of paragraphs (g) and (i)(4) of this section.

(d) Containers and pipelines carrying mixtures with less than 0.1 percent benzene and natural gas processing plants processing gas with less than 0.1 percent benzene.

(e) Work operations where the only exposure to benzene is from liquid mixtures containing 0.5 percent or less of benzene by volume, or the vapors released from such liquids until September 12, 1988; work operations where the only exposure to benzene is from liquid mixtures containing 0.3 percent or less of benzene by volume or the vapors released from such liquids from September 12, 1988, to September 12, 1989; and work operations where the only exposure to benzene is from liquid mixtures containing 0.1 percent or less of benzene by volume or the vapors released from such liquids after September 12, 1989; except that tire building machine operators using solvents with more than 0.1 percent benzene are covered by paragraph (i) of this section.

(f) Oil and gas drilling, production and servicing operations.

(g) Coke oven batteries.

(h) The cleaning and repair of barges and tankers which have contained benzene are excluded from paragraph (f) methods of compliance, paragraph (e)(1) exposure monitoring-general, and paragraph (e)(6) accuracy of monitoring. Engineering and work practice controls shall be used to keep exposures below 10 ppm unless it is proven to be not feasible.

i. 29 CFR 1910.1029 - Coke oven emissions.

(1) This section applies to the control of employee exposure to coke oven emissions, except that this section shall not apply to working conditions with regard to which other Federal agencies exercise statutory authority to prescribe or enforce standards affecting occupational safety and health.

j. 29 CFR 1910.1044 - 1,2-dibromo-3-chloropropane.

(1) This section applies to occupational exposure to 1,2-dibromo-3-chloropropane (DBCP), except:

(a) Exposure to DBCP which results solely from the application and use of DBCP as a pesticide; or

(b) The storage, transportation, distribution or sale of DBCP in intact containers sealed in such a manner as to prevent exposure to DBCP vapors or liquid, except for the requirements of paragraphs (i), (n) and (o) of this section.

k. 29 CFR 1910.1045 - Acrylonitrile.

(1) This section applies to all occupational exposures to acrylonitrile (AN), Chemical Abstracts Service Registry No. 000107131, except:

(a) This section does not apply to exposures which result solely from the processing, use, and handling of the following materials:

i. ABS resins, SAN resins, nitrile barrier resins, solid nitrile elastomers, and acrylic and modacrylic fibers, when these listed materials are in the form of finished polymers, and products fabricated from such finished polymers;

ii. Materials made from and/or containing AN for which objective data is reasonably relied upon to demonstrate that the material is not capable of releasing AN in airborne concentrations in excess of 1 ppm as an eight (8)-hour time-weighted average, under the expected conditions of processing, use, and handling which will cause the greatest possible release; and

iii. Solid materials made from and/or containing AN, which will not be heated above 170 deg. F during handling, use, or processing.

l. 29 CFR 1910.1047 - Ethylene oxide.

(1) This section applies to all occupational exposures to ethylene oxide (EtO), Chemical Abstracts Service Registry No. 75-21-8, except:

(a) This section does not apply to the processing, use, or handling of products containing EtO where objective data are reasonably relied upon that demonstrate that the product is not capable of releasing EtO in airborne concentrations at or above the action level under the expected conditions of processing, use, or handling that will cause the greatest possible release.

m. 29 CFR 1910.1048 - Formaldehyde.

(1) This standard applies to all occupational exposures to formaldehyde, i.e. from formaldehyde gas, its solutions, and materials that release formaldehyde.

n. 29 CFR 1910.1050 - Methylenedianiline.

(1) This section applies to all occupational exposures to methylenedianiline (MDA), Chemical Abstracts Service Registry No. 101-77-9, except:

(a) Except as provided in paragraphs (a)(8) and (e)(5) of this section, this section does not apply to the processing, use, and handling of products containing MDA where initial monitoring indicates that the product is not capable of releasing MDA in excess of the action level under the expected conditions of processing, use, and handling which will cause the greatest possible release; and where no "dermal exposure to MDA" can occur.

(b) Except as provided in paragraph (a)(8) of this section, this section does not apply to the processing, use, and handling of products containing MDA where objective data are reasonably relied upon which demonstrate the product is not capable of releasing MDA under the expected conditions of processing, use, and handling which will cause the greatest possible release; and where no "dermal exposure to MDA" can occur.

(c) This section does not apply to the storage, transportation, distribution or sale of MDA in intact containers sealed in such a manner as to contain the MDA dusts, vapors, or liquids, except for the provisions of 29 CFR 1910.1200 and paragraph (d) of this section.

(d) This section does not apply to the construction industry as defined in 29 CFR 1910.12(b). (Exposure to MDA in the construction industry is covered by 29 CFR 1926.60).

(e) Except as provided in paragraph (a)(8) of this section, this section does not apply to materials in any form which contain less than 0.1 percent MDA by weight or volume.

(f) Except as provided in paragraph (a)(8) of this section, this section does not apply to "finished articles containing MDA."

o. 29 CFR 1910.1051 - 1,3-Butadiene.

(1) This section applies to all occupational exposures to 1,3-Butadiene (BD), Chemical Abstracts Service Registry No. 106-99-0, except as provided in paragraph (a)(2) of this section.

p. 29 CFR 1910.1052 - Methylene chloride.

(1) This section applies to all occupational exposures to methylene chloride (MC), Chemical Abstracts Service Registry Number 75-09-2, in general industry, construction and shipyard employment.

q. 29 CFR 1910.1053 - Respirable crystalline silica.

(1) This section applies to all occupational exposures to respirable crystalline silica, except:

(a) Construction work as defined in 29 CFR 1910.12(b) (occupational exposures to respirable crystalline silica in construction work are covered under 29 CFR 1926.1153);

(b) Agricultural operations covered under 29 CFR part 1928; and

(c) Exposures that result from the processing of sorptive clays.

(2) This section does not apply where the employer has objective data demonstrating that employee exposure to respirable crystalline silica will remain below 25 micrograms per cubic meter of air (25 μg/m3) as an 8-hour time-weighted average (TWA) under any foreseeable conditions.

(3) This section does not apply if the employer complies with 29 CFR 1926.1153 and:

(a) The task performed is indistinguishable from a construction task listed on Table 1 in paragraph (c) of 29 CFR 1926.1153; and

(b) The task will not be performed regularly in the same environment and conditions.