University of New Mexico
Chemical Hygiene Plan

and

Laboratory-Specific
Templates & Information

Prepared by UNM Chemical Hygiene Plan Update Subcommittee

Reviewed and Approved by UNM Chemical & Laboratory Safety Committee

Maintained by UNM Environmental Health & Safety Department

Revision 5, Approved on May 1, 2025

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Revision Log

Revision Number	Date Approved	Description	Pages Replaced
0	12/13/2017	Initial release of the UNM Chemical Hygiene Plan	N/A

1	12/17/2020	Periodic review & update:
		• Added a preamble
		• Added an Acronyms & Abbreviations Table
		• Added new sections:
		  ○ Classes of Hazardous Chemicals
		  ○ How to Reduce Exposures to Hazardous Chemicals
		  ○ Non-Chemical Hazard Management
		• Added new subsections:
		  ○ Health Hazards
		  ○ Laboratory Hazard Assessment Tool
		  ○ Nanoparticles
		  ○ Wastes That Require Special Handling
		• Added a Compatibility Table
		• Other:
		  ○ Updated SOP Templates
		  ○ Added Job Hazard Analysis Template
		  ○ Updated List of Trainings
		  ○ Beefed-up Hazard Communication references
		  ○ Added concept of de minimis quantities
			Multiple pages added

2	12/6/21	Periodic review & update:	N/A

		• Section 2.2 – changed language to reflect that Deans, Dept. Heads and Center Directors will assign a Deputy CHO • Section 4.0 – changed language to be more clear about JHA documentation • Section 7.4 – added information to be more clear about how to label workplace containers	
3	12/22/22	Annual review & update: Added Culture of Safety language and updated the "How to Use this Document" section and section 1. Changed "Chemical Hygiene Officer" to "Deputy Chemical Hygiene Officer" Updated Section 1. Purpose by introducing the requirement that labs maintain a CHP binder Updated Section 1.2 Scope – "Exceptions to or deviations from this plan must be approved by the ~~UNM President~~ UNM Chemical & Laboratory Safety Committee" Changed all references to "EH&S" to "EHS" Updated Section 2. Responsibilities by removing redundancies Updated Section 3. Information & Training to add more detail and clarify SOP requirements Updated Section 4. SOPs and Hazard Analyses to include links to lists of chemicals that require a SOP and removed redundancies Updated Section 6.2 Engineering Controls by specifying the fume hood face velocity that is consistent with industry standards and other UNM documents that reference the fume hood face velocity Updated Section 7.2 Chemical Inventory to include statement about EHS providing chemical inventory services twice annually to main campus labs	N/A

		Added more detail to Section 7.5 Chemical Storage Added more detail to Section 9.1 Training Added more detail to Section 12.1 Minor and Major Spills Added more detail and removed redundancies to Section 12.2 Accidents/Incidents	
4	12/6/2023	Annual review & update: Updated safety culture language to be consistent with other EHS safety programs Added new subsection: Controlled Substances (subsection 5.6) Added new subsection: Storing Controlled Substances (subsection 7.5g) Added link to DEA regulations in References Section 13.1 Added information about oxygen sensors to section 8.4a Cryogens Added information about Hazardous Waste Determination Form to subsection 9.2 Waste Identification/Characterization Added detail to subsection 9.4 Waste Storage Added detail to subsection 9.5 Waste Disposal Added new subsection: Safety Liaison for all labs (subsection 11.3) Added detail to section 12.1a Small Spills and 12.1b Major Spills Added frequency of required trainings to Section 3.0 and to Attachment 2 – Required Trainings	
5	12/6/2024	Annual review and update:	

		Updated Definitions to remove redundancies Updated Responsibilities section; added responsibilities of Safety Liaison Section 4 – SOPs and Hazard Analysis – updated language and added details Section 5 – Chemical Hazard Class - added examples of chemicals in each hazard class Section 7 – Chemical Storage - Updated language and added detail Section 9 – Hazardous Waste Management – updated language including replacing "hazardous waste" with "chemical waste" where applicable, added definition of "acutely hazardous waste" and reference to EPA P-List Section 12.3 – Emergency Response Equipment – updated language with new guidance on frequency of activation of eyewash stations Attachments – added three new attachments: • Permeation/Degradation Resistance Guide for Gloves • EPA P-List • List of Peroxide Formers	

How to Use this Document

The UNM Chemical Hygiene Plan (CHP) is both a compliance and a guidance document. It was created to comply with the OSHA Laboratory Standard (29 CFR 1910.1450) and it is intended to be used as a guide to assist Principal Investigators (PIs) and lab managers with protecting lab workers from the diverse hazards encountered in laboratories.

All laboratories at UNM should maintain a binder in which a copy of the CHP, along with copies of lab-specific Standard Operating Procedures (SOPs), training records and annual self-audits are kept. The Environmental Health & Safety Department (EHS) will review each lab's CHP binder during annual lab inspections.

Familiarity with the CHP and lab-specific SOPs demonstrates a commitment to safety and helps establish a Culture of Safety at UNM.

The attachments beginning on page 62 include a Job Hazard Analysis (JHA) template and a Laboratory Hazard Assessment Tool (LHAT). PIs and lab managers may use these templates or they may create their own.

All information after page 11 is standardized for the entire University. These responsibilities and requirements apply to all UNM laboratories. All laboratory personnel must be familiar with the contents of the UNM Chemical Hygiene Plan and the Standard Operating Procedures for their laboratories.

List of Acronyms and Abbreviations

List of Acronyms and Abbreviations	
ACGIH	American Congress of Governmental Industrial Hygienists
ACS	American Chemical Society
ANSI	American National Standards Institute
BSC	Biological Safety Cabinet
BSL	Biological Safety Level
CDC	Centers for Disease Control
CFR	Code of Federal Regulations
CHO	Chemical Hygiene Officer
CHP	Chemical Hygiene Plan
CLSC	Chemical & Lab Safety Committee

CSA	Controlled Substances Act
DEA	Drug Enforcement Agency
DNA	Deoxyribonucleic Acid
rDNA	Recombinant Deoxyribonucleic Acid
DOT	Department of Transportation
EHS	Environmental Health & Safety
EPA	Environmental Protection Agency
HEPA	High Efficiency Particulate Air
IARC	International Agency for Research on Cancer
IACUC	Institutional Animal Care and Use Committee
IATA	International Air Transport Association
LHAT	Laboratory Hazard Assessment Tool
NFPA	National Fire Protection Association
NMED	New Mexico Environment Department
NIH	National Institutes of Health
NTP	National Toxicology Program
OPIM	Other Potentially Infectious Material
OSHA	Occupational Safety & Health Administration
PEL	Permissible Exposure Limit
PHS	Particularly Hazardous Substance
PI	Principle Investigator
PPE	Personal Protective Equipment
PPM	Parts Per Million
RCRA	Resource Conservation and Recovery Act
RSO	Radiation Safety Officer
SAA	Satellite Accumulation Area
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
TLV	Threshold Limit Value
TWA	Time-Weighted Average

Definitions

Action level – A concentration designated by OSHA (29 CFR 1910) for a specific substance, calculated as an 8-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Acutely hazardous waste – A type of hazardous waste that can cause serious illness, disabling injuries, or death. It is more dangerous than other hazardous wastes. Any waste that contains 0.1% or more by volume of a chemical listed on the EPA's P-List is considered acutely hazardous waste.

Article – A manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end-use functions(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical and does not pose a physical hazard or health risk to employees.

Authorized Chemical Worker – UNM faculty, staff, student, or visitor whose manager or supervisor has determined that they have the training, knowledge, skill, and abilities to safely perform the chemical work to which they are assigned.

Carcinogen – Any substance or mixture of substances that meets one of the following criteria:

- It is regulated by OSHA as a carcinogen; or
- 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
- It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest edition); or
- It is listed in either Group 2A or 2B by IARC (https://monographs.iarc.who.int/agents-classified-by-the-iarc/) or under the "reasonably anticipated to be carcinogens" category by NTP (https://ntp.niehs.nih.gov/whatwestudy/assessments/cancer/completed/roc) and causes statistically significant tumor incidence in experimental animals under specific conditions.
- A mixture shall be classified as a carcinogen when at least one ingredient has been classified as a carcinogen and is present at or above 0.1%.

Chemical – Any element, compound, or mixture of elements and compounds.

Chemical Hygiene Officer (CHO) – A UNM employee designated by his/her management who is qualified, either by education, training and/or experience, to provide guidance in the development and implementation of the provisions of the UNM Chemical Hygiene Plan.

Chemical and Laboratory Safety Committee (CLSC): A committee comprised of UNM faculty and staff members whose purpose is to review lab safety-related issues and incidents, prepare, review, and approve of lab safety-related programs, provide guidance on lab safety issues, and assist with enforcement of the provisions of the UNM Chemical Hygiene Plan.

Container – Any sealable bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like used for storing materials.

Controlled Substance – Compounds containing any quantity of substances with a stimulant, depressant, or hallucinogenic effect on the higher functions of the central nervous system and that tend to promote abuse or physiological dependence.

Corrosive – A chemical or material that causes visible destruction or permanent damage to human skin tissue at the site of contact.

Chemical Owner – An authorized chemical worker assigned ownership and responsibility for a chemical container in the UNM chemical inventory system.

De minimis quantity – In the context of lab work, it is a quantity of a hazardous material that, due to a dilute concentration or negligible amount, is not considered to be dangerous or harmful to human health.

Designated area – An area that shall be established and posted for work with Particularly Hazardous Substances (PHS) and to which access is administratively restricted to authorized personnel. A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory fume hood.

Emergency – In the context of lab work, any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an injury or uncontrolled release of a hazardous chemical into the workplace or environment.

Globally Harmonized System (GHS) – OSHA revised its Hazard Communication Standard in 2012 to bring it into harmony with the International Hazard Communication Standards promulgated by the United Nations. This requires a standardization of labeling, formats for Safety data Sheets (SDS), reporting requirements, and other hazard communications between suppliers and users world-wide.

Hazardous chemical – Any chemical which is classified by OSHA (1910.1200) as a physical hazard or a health hazard, a simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise classified. If a hazardous chemical comprises 1% (0.1% for

carcinogens) or greater of a compound or mixture, the compound or mixture will be treated as a hazardous chemical.

Hazardous Waste – Defined by EPA as "A liquid, solid, contained gas, or sludge waste that contains properties that are dangerous or potentially harmful to human health or the environment". EPA further defines hazardous waste as:

- Waste exhibiting at least one of four characteristics: ignitability, corrosivity, reactivity, or toxicity; or
- Waste appearing in one of the EPA lists (P-List, F-List, K-List, U-List).

For a more detailed definition of hazardous waste, go to the EPA Hazardous Waste website (www.epa.gov/hw).

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.

High Acute Toxicity – Substances that may be fatal or cause damage to target organs as a result of a single exposure of short duration. Chemicals with high acute toxicity are those that fall within any of the following OSHA-defined categories:

- A chemical with a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to certain test populations.
- A chemical with an LD50 of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours to certain test populations.
- A chemical with a median lethal concentration (LC50) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

Immediate use – The chemical will be under the control of and used only by the person who transfers/decants it from a labeled container and only within the work shift in which it was transferred.

Laboratory – A workplace where relatively small quantities of hazardous chemicals are used on a non-production basis, chemical manipulations are carried out on a "laboratory scale", and multiple chemical procedures or chemicals are used.

Laboratory scale – Work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

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

Must – Designates a contractual or policy requirement or a regulatory mandate.

Mutagen – A chemical that causes permanent changes in the amount or structure of the genetic material in a cell.

Occupational Exposure Limit (OEL) – Occupational Exposure Limit values are set by competent national authorities or other relevant national institutions as limits for concentrations of hazardous compounds to which employees are exposed in the workplace. For purposes of this document, the applicable OELs are OSHA PELs and ACGIH Threshold Limit Values (see definitions below).

Particularly Hazardous Substances (PHS) –The OSHA Laboratory Standard defines a PHS as being a select carcinogen, reproductive toxin, or a substance with a high degree of acute toxicity. There is no comprehensive list of PHS but there are several methods to determine if a chemical is a PHS. Areas where PHS are used must be posted with designated use area signage and SOPs for their safe use must be available to all employees who use them.

Permissible Exposure Limit (PEL) – The maximum concentration (set by OSHA) of an airborne contaminant that shall not be exceeded over an 8-hour time-weighted average period.

Physical hazard – A factor or condition in the workplace that can cause physical harm or injury to workers. Examples of physical hazards include noise, radiation, temperature extremes, vibration, materials under pressure, electricity, and fire.

Professional Visitor – An individual with an advanced science, engineering or related education, who has experience working independently in a laboratory, and who will be temporarily working independently in a UNM laboratory.

Safety Data Sheet (SDS, previously known as Material Safety Data Sheet) – A document prepared by chemical manufacturers that provides detailed information about the chemical, including hazards and hazard controls necessary to protect the user.

Short-Term Exposure Limit (STEL) – The maximum concentration (set by OSHA) of an airborne contaminant that shall not be exceeded over a 15-minute time-weighted average period.

Standard Operating Procedure (SOP) – Documented/written procedures relevant to safety and health and including hazards and hazard controls for the procedure, to be followed when laboratory work involves the use of hazardous chemicals and/or processes.

Reproductive toxins - Chemicals that affect reproductive capabilities, which includes adverse effects on sexual function and fertility in adults and/or adverse effects on developing offspring.

Secondary/working container – Any chemical container used to store decanted chemicals or mixtures of chemicals beyond a single workday. (*Note:* This definition should not be confused with secondary containment for chemical release prevention control.)

Shall – Designates a UNM policy or regulatory mandate.

Should – Designates a recommendation contained in the regulations or a recommendation from a recognized industry standard.

Threshold Limit Values (TLVs) – Threshold Limit Values, which are established by the American Conference of Governmental Industrial Hygienists (ACGIH), refer to airborne concentrations of chemical substances and represent conditions under which it is believed that *nearly all* workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects. These include: 8-hour time-weighted averages (TLV–TWAs), short-term 15-minute time-weighted averages (TLV–STELs), and ceiling limits (TLV–Cs).

Threshold Limit Value—Time–Weighted Average (TLV–TWA) – The time-weighted average concentration that should not be exceeded for a conventional 8-hour workday and a 40-hour workweek.

Threshold Limit Value—Short-Term Exposure Limit (TLV–STEL) – A 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the 8-hour TWA is within the TLV–TWA.

Threshold Limit Value—Ceiling (TLV–C) – The concentration that should not be exceeded during any part of the workday.

Will – Designates a UNM policy or standard practice or regulatory mandate.

1.0 PURPOSE

Safety is a core value of the University of New Mexico and UNM leadership is committed to establishing and fostering a culture of safety within the UNM community. Part of demonstrating this commitment is providing guidelines and resources that are specific to work that involves the use of chemicals. This document is intended to function as the core of a laboratory's safety plan. However, each person and lab group must internalize and carry out the values of a safety culture in order to minimize risks while working in laboratories.

The UNM Chemical Hygiene Plan (CHP) establishes a formal written program for managing the risks associated with the use of hazardous chemicals in laboratories. This CHP describes the proper use, handling, storage, and disposal practices and procedures to be followed by faculty, staff, students, visiting scholars and all other personnel working with hazardous chemicals at UNM. This document addresses the requirements of the OSHA Laboratory Standard (29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories)* and is a broad overview of the information necessary to protect laboratory workers potentially exposed to hazardous chemicals.

In addition to maintaining a readily accessible copy of this document, laboratories must develop and follow laboratory-specific Standard Operating Procedures (SOPs) that address the hazards specific to the lab, and the procedures that must be used to control the hazards. All SOPs must include a section on hazards and/or have an accompanying Job Hazard Analysis (JHA). A variety of SOP Templates are available on the EHS website. A stand-alone JHA template is included as an attachment to this plan.

1.1 Plan Description

This plan addresses the five major elements of the OSHA Laboratory Standard:

- Hazard identification
- Chemical Hygiene Plan
- Information and training
- Exposure monitoring
- Medical consultation and examinations

It also addresses the following topical areas:

- Regulatory Requirements
- Responsibilities
- Standard Operating Procedures (SOPs)

- Chemical Procurement
- Chemical Inventory
- Safety Data Sheets (SDSs)
- Chemical Labels
- Hazardous Chemical Storage
- Hazardous Waste Management
- Hazardous Chemical Transportation
- Chemical Exposure Control
- Chemical Exposure Assessment
- Medical Consultation
- Medical Surveillance
- Laboratory Audits
- Hazardous Chemical Spills, Accidents and Emergency Response

1.2 Scope

This plan applies to all UNM facilities engaged in the laboratory use of hazardous chemicals and all individuals who work in these facilities. Uses of hazardous chemicals which do not meet the definition of laboratory use shall comply with the relevant standard in 29 CFR 1910, Subpart Z (OSHA Toxic and Hazardous Substances) even if such use occurs in a laboratory. Exceptions to or deviations from this plan must be approved by the UNM Chemical & Laboratory Safety Committee.

1.3 Regulatory Requirements

The regulatory requirements for the policies, procedures, and work practices outlined in this Chemical Hygiene Plan include but are not limited to:

- OSHA 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories
- OSHA 29 CFR 1910.1200, Hazard Communication
- OSHA 29 CFR 1910.132, Personal Protective Equipment
- OSHA 29 CFR 1910.133, Eye and Face Protection
- OSHA 29 CFR 1910.134, Respiratory Protection
- OSHA 29 CFR 1910.138, Hand Protection
- EPA 40 CFR 261.33 Discarded commercial chemical products

2.0 RESPONSIBILITIES

2.1. The Provost, the Executive Vice-President of Academic Affairs and the Vice-President for Research and Economic Development are responsible for ensuring that departments/centers/units under their authority engaged in the use of hazardous chemicals comply with the UNM Chemical Hygiene Program.

2.2 Deans, Department Heads and Center Directors are responsible for:

- Ensuring departmental compliance with the CHP.
- Assigning a Deputy Chemical Hygiene Officer (CHO) for designated work area(s).
- Establishing a Laboratory Safety Committee that meets at least quarterly for each school, college, or operating unit.
- Providing the Deputy Chemical Hygiene Officers with the support necessary to implement and maintain the CHP.
- Ensuring that safety audit findings are resolved within a reasonable timeframe.
- Notifying Environmental Health & Safety (EHS) when changes in Deputy CHO appointments occur.
- Ensuring safety issues and concerns are communicated, in writing, to EHS.
- Approving lab shutdowns when safety concerns warrant such action by EHS.

2.3 The Chemical and Laboratory Safety Committee (CLSC) is responsible for:

- Approving the overall format of and the annual updates to the CHP.
- Selecting and assigning members to staff a subcommittee to review and suggest changes to the CHP on an annual basis.
- Advising the Provost and the Executive Vice President for Research on chemical and laboratory safety issues.
- Communicating chemical safety issues, concerns, and guidance to lab personnel within their organizations.

2.4 The Environmental Health & Safety Department is responsible for:

- Developing a University-wide Chemical Hygiene Plan.
- Conducting an annual review of the CHP and updating as needed.
- Assigning a Chemical Hygiene Officer.
- Developing and maintaining an updated Laboratory Inspection Program.
- Scheduling and conducting annual inspections of all laboratories.

- Developing and maintaining a uniform chemical inventory system accessible by all UNM laboratories.
- Developing and providing training and training materials relevant to chemical and laboratory safety.
- Assisting PIs and lab managers with developing customized/tailored training.
- Assisting PIs and lab managers with the development of lab-specific SOPs.
- Developing and maintaining laboratory self-audit forms.
- Conducting exposure assessments and evaluating exposure control measures.
- Providing or coordinating emergency response for hazardous chemical spills.
- Investigating hazardous chemical incidents and filing the appropriate reports.
- Reporting chemical and laboratory safety non-compliance issues to the Provost, to the Executive Vice-President for Academic Affairs, and the Executive Vice-President for Research.
- Reporting trends in laboratory compliance and safety to the CLSC.

2.5 Chemical Hygiene Officer (CHO)

- Developing and maintaining a variety of chemical safety programs relating to compliance with local, state, and federal agencies.
- Managing the University's hazardous waste program and coordinating the removal and proper disposal of all chemical waste.
- Coordinating the University's laboratory inspection program
- Responding to and investigation of incidents, accidents, near-misses, and hazardous or potentially hazardous conditions, and making recommendations on actions to be taken to mitigate potential safety, health, and environmental risks.
- Serving on designated committees and advisory boards to maintain open communications with faculty, staff, and other constituent groups.
- Communicating guidance on chemical and laboratory safety with faculty, PIs and research staff.
- Providing access to and training on the use of Research Material Management (RMM) for tracking of laboratory chemicals

2.6 Deputy Chemical Hygiene Officer or their designee is responsible for:

- Working with administrators, faculty, and staff to develop and implement appropriate chemical safety policies and SOPs for their laboratories. Monitoring and documenting chemical and laboratory safety issues in their laboratories.
- Communicating guidance on chemical and laboratory safety with faculty, PIs, and research staff.
- Monitoring procurement, use and disposal of chemicals used in their laboratories.

- Providing lab-specific chemical safety training and information for procedures, protocols, and the Chemical Hygiene Plan for the laboratory to faculty, staff, and students prior to their performing laboratory operations with hazardous chemicals, with EHS providing lab-specific training assistance as requested.
- Notifying EHS if a new risk assessment is required (due to introduction of a new chemical risk, change in engineering controls that could impact laboratory worker exposure, significant changes in quantities or processes).
- Assisting in maintaining an up-to-date inventory and SDSs for all hazardous chemicals in their laboratories.
- Conducting and documenting an annual self-audit to assess compliance with the Chemical Hygiene Plan.
- Coordinating the development of lab-specific Chemical Hygiene Plan(s) for their laboratories.
- Coordinating an annual review of the laboratory Chemical Hygiene Plan(s) with all lab personnel.
- Providing access to the laboratory's Chemical Hygiene Plan, relevant SOPs, and emergency action and reporting requirements to all professional visitors.

2.7 Principal Investigator/Supervisor or their designee is responsible for:

- Ensuring that faculty, staff, students, and visitors comply with the UNM Chemical Hygiene Plan.
- Developing lab-specific SOPs for the most hazardous materials and processes used in their laboratories.
- Ensuring that the lab-specific SOPs are read, understood, signed, and dated by all lab personnel prior to beginning their work in the lab.
- Ensuring that all training provided to lab personnel is documented (such as signed and dated SOPs).
- Maintaining a binder that contains a copy of the UNM CHP, lab-specific SOPs, training records and laboratory self-audits; the binder must be accessible to lab personnel and available for inspection by EHS during annual lab inspections.
- Providing unrestricted access to Safety Data Sheets (SDSs) for all chemicals in the lab.
- Developing SDSs for chemicals produced in the laboratory.
- Maintaining an up-to-date inventory of hazardous chemicals present in their laboratories via the use of RMM.
- Ensuring that PPE is available and properly used.
- Conducting an annual laboratory self-audit and maintaining self-audit documentation in the lab-specific CHP binder.

- Ensuring that emergency equipment and engineering controls are maintained and function properly.
- Ensuring EHS is notified if a new risk assessment is required due to the introduction of a new chemical risk or a change in engineering controls is needed.
- Contacting the appropriate person(s) to report problems with the facilities or engineering controls.
- When providing access for professional visitors:
    - Providing access to the laboratory's Chemical Hygiene Plan, relevant SOPs, the list of hazards and controls, including emergency action and reporting requirements.
    - Obtaining a signed acknowledgment and sending a copy of the signed acknowledgment to EHS.
- Assigning a Safety Liaison for their laboratory.

2.8 Safety Liaisons are responsible for:

- Maintaining the lab's safety and training documentation.
- Participating in the annual EHS laboratory inspection.
- Communicating with EHS on lab safety issues, and for questions and guidance.

2.9 Professional Visitors engaged in the use of hazardous chemicals are responsible for:

- Acknowledging receipt and understanding of the laboratory's Chemical Hygiene Plan, relevant SOPs, and emergency procedures.

2.10 Students and Visitors engaged in the use of hazardous chemicals are responsible for:

- Remaining with their escort and following their instructions

OR

- Reading and understanding the requirements of the UNM Chemical Hygiene Plan and lab-specific SOPs.
- Planning and conducting operations in accordance with the UNM Chemical Hygiene Plan and applicable laboratory-specific SOPs.
- Using all required engineering controls and PPE.
- Notifying the Deputy Chemical Hygiene Officer or supervisor of any hazardous conditions or unsafe work practices in the work area.
- Reporting all accidents, incidents and near misses to the Deputy CHO or supervisor and EHS.
- Abiding by and promoting good housekeeping practices in the laboratory or work area.

3.0 INFORMATION AND TRAINING

PIs, supervisors, and/or lab managers, in consultation with EHS, shall provide information and training to inform all lab workers and students of the physical and health hazards of the chemicals in their work and/or learning area, and the methods by which they are to protect themselves from the hazards. The information and training must be provided to the worker or student:

- at the time of their initial assignment to work and/or learning involving the use of hazardous chemicals
- prior to assignments involving new exposure situations
- upon changes in the procedures and/or chemicals that present new hazards
- annually thereafter

Requiring lab workers and students to read, understand, sign and date lab-specific SOPs is one way to satisfy the training requirements (including annual refreshers). The signed and dated SOPs and any other training documentation must be kept in the lab's CHP binder. General lab safety trainings taken via Learning Central are documented in the user's Learning Central training history and tracked by EHS. A list of the trainings required for all UNM lab workers is included as an attachment.

Basic chemical safety training will include the following information:

- The location of relevant OSHA Standards: 29 Code of Federal Regulations (CFR) 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*, as well as 29 Code of Federal Regulations (CFR) 1910.1200, *Hazard Communication*; and how they can access the standards. This information is addressed in Hazard Communication Training on Learning Central.
- How to use SDSs, SOPs, and chemical labels to identify and mitigate hazards in the lab, per the Hazard Communication Standard. This information is addressed in Hazard Communication Training on Learning Central.
- Explanation of UNM's Chemical Hygiene Plan, including labeling system, SDSs, and how employees can obtain chemical hazard information and OSHA occupational exposure limits. This information is addressed in this document.
- Methods and observations that may be used to detect the release of a hazardous chemical in the work area. This information is lab-specific and is to be provided by the PI or lab manager.
- General guidance on the selection of protective measures to reduce chemical exposure. This information is provided in a chemical's SDS and the lab-specific SOPs.
- Information on safety resources.

- General emergency procedures to be used in the event of accidental exposure to hazardous chemicals, including emergency phone numbers.

In addition to basic chemical safety training, lab workers and students must be provided with *area- and/or lab-specific* training and information by the PI, supervisor, or lab manager. This training will include:

- The specific physical and health hazards of chemicals used in their work areas, including signs and symptoms of exposure.
- The specific protective measures required when using the chemicals in their work area.
- The specific methods and observations that may be used to detect the presence or release of a hazardous chemical in their work area.
- The location of eye washes and safety showers, and how to use them in the event of a chemical exposure.
- Training on the applicable details of the Chemical Hygiene Plan relevant to their laboratory.

All training must be documented. Documentation shall include the training material used (such as an SOP), the training date, and the name and signatures of those trained. Training documents will be requested during annual lab inspections by EHS.

4.0 STANDARD OPERATING PROCEDURES AND HAZARD ANALYSIS

SOPs must be developed by the PI or lab manager for procedures involving any chemical included on the following lists:

- OSHA's List of Highly Hazardous Chemicals, Toxics and Reactives
- OSHA’s Table Z-1 List of Toxic and Hazardous Substances
- Department of Homeland Security's Chemicals of Interest

The SOP for chemicals on these lists must include:

- Establishment of a designated area of use
- Required engineering controls such as fume hoods or glove boxes
- Required PPE
- Procedures for disposal

SOPs may also be required for chemicals *not* appearing on these lists if they are particularly hazardous (such as carcinogens and reproductive toxins). Contact EHS at chemsafety-L@list.unm.edu for guidance on SOPs.

All SOPs must include a section that identifies the hazards of the chemical or process, and a section that lists the methods to protect users from the hazards. Alternatively, a Job Hazard Analysis (JHA), which identifies the task(s), the hazard for each task, and the controls for mitigating the hazards (engineering controls, administrative controls, personal protective equipment controls) can accompany a SOP. SOP Templates that include a JHA section are available on the EHS website. A separate JHA template, included as an attachment, should be attached to any SOP that does not have a JHA section. A SOP may be one of three different types:

- **Hazardous Chemical**: a SOP specific to an individual chemical such as nitric acid, ethylene oxide, or any chemical appearing on the aforementioned lists. A hazardous chemical SOP for a chemical used in *de minimis* quantity should identify that the chemical, though hazardous, can be safely handled in *de minimis* quantities.
- **Hazardous Process:** a SOP for a process such as distillation, synthesis, etc.
- **Hazard Class**: a SOP for a hazard class of chemicals such as oxidizers, flammables, corrosives, etc. Hazard class information is provided in the next section of this plan.

The choice of SOP type/format and the number of SOPs is left to the discretion of the PI/laboratory supervisor. Copies of all SOPs will be kept in the lab's CHP binder.

5.0 CLASSES OF HAZARDOUS CHEMICALS

Chemicals pose health and safety hazards to personnel due to inherent chemical, physical, and toxicological properties. Chemicals can be grouped into several different hazard classes. The hazard class will determine how similar materials should be stored and handled and which special equipment and procedures are needed to use them safely. It is essential that all personnel who work with chemicals be trained to understand and identify the types of chemical hazards and the associated risks, to recognize the potential routes of exposure, and to be familiar with the major hazard classes of chemicals.

5.1 Flammability and Combustibility Hazards

Highly flammable liquids and combustible liquids are common throughout UNM laboratories. The main difference between the two materials is the flashpoint, which is the minimum temperature at which the vapors from a flammable or combustible liquid can ignite. Flammable liquids have a flashpoint of less than 100°F (37°C) and combustible liquids have a flashpoint between 100° and 200 °F (93°C). Careful handling of these materials and use of a

fume hood is typically sufficient to prevent exposure to vapors from these materials. Flame-resistant laboratory coats must be worn when working with large volumes of flammable materials (>1L) and/or with procedures that include a significant risk of fire (e.g. working with an open flame or with pyrophorics). Particular attention should be given to preventing static electricity and sparks when handling flammable liquids. Ensure that containers are properly bonded and grounded before transferring flammable liquids between metal containers or equipment. Examples of flammable liquids include:

- Fuels (gasoline, kerosene)
- Solvents (acetone, alcohols, ethers)
- Paint thinners (mineral spirits, linseed oil, turpentine)

5.2 Reactivity and Stability Hazards

Materials that are reactive and/or unstable may violently decompose, rapidly condense, vigorously polymerize, or become self-reactive under conditions of shock, friction, temperature, pressure, light, or contact with other materials, with the subsequent release of large volumes of gas or heat. These materials pose an immediate hazard and procedures for their safe use must be carefully reviewed and followed. Reactive materials must be stored in a manner that protects them from light, heat, shock, friction, static discharge, contact with a catalyst, or other conditions to which they are sensitive. Examples of reactive materials include:

- Azo and azido compounds
- Organic peroxides (benzoyl peroxide, methyl ethyl ketone peroxide, peroxyacetic acid)
- Ammonium perchlorate
- Picric acid that has dried out and picrate salts
- Perchloric acid that has crystallized
- Alkali metals (sodium, potassium, lithium) and metals in powder form
- Pyrophorics (tert-butyl lithium, sodium hydride, silane gas, diborane gas)

5.3 Oxidizers

Oxidizers are liquids or solids that readily give off oxygen or other oxidizing substances, such as bromine, chlorine, or fluorine. Oxidizers present a fire and/or explosion hazard when they come in contact with flammable or combustible materials or other fuels. Oxidizers can:

- Speed the development of a fire and increase its intensity
- Cause substances which are normally stable in air to rapidly burn
- Lead to spontaneous combustion of materials without an obvious ignition source

Oxidizers are classified on a scale of 1-4 by the National Fire Protection Association (NFPA), based on their potential to initiate spontaneous combustion, with 1 being the lowest hazard and 4 being the highest hazard. In addition to the flammability hazards posed by oxidizers, they can also be corrosive or toxic. Examples of oxidizers include:

- Oxygen
- Hydrogen peroxide (especially >8%)
- Nitric acid
- Permanganates
- Halogens (bromine, chlorine, fluorine)
- Ammonia and ammonium nitrate
- Nitrous oxide

5.4 Health Hazards

A health hazard is defined by OSHA as “a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.” The term "health hazard" includes chemicals classified as corrosives, irritants, sensitizers, and agents which damage the lungs, skin, eyes, or mucous membranes. Each of these are explained below.

5.4.a Corrosives

Corrosive substances cause destruction of living tissue by chemical action at the site of contact. Corrosive substances may also corrode materials they come in contact with and may be highly reactive with other substances. Symptoms of inhalation exposure include burning in the throat and lungs, coughing, laryngitis, shortness of breath, nausea, and vomiting. Symptoms of eye exposure with corrosives includes pain, tearing and blurring of vision. Symptoms of dermal exposure include reddening, pain, inflammation, blistering, bleeding, and burns. Examples of corrosive substances include:

- Strong acids – sulfuric, nitric, hydrochloric acids
- Strong bases – sodium hydroxide, potassium hydroxide, ammonium hydroxide
- Dehydrating agents – phosphorous pentoxide, calcium oxide
- Oxidizing agents – hydrogen peroxide, chlorine, bromine, perchloric acid

5.4.b Irritants

Irritants are non-corrosive chemicals that cause reversible inflammatory effects on living tissue by chemical action at the site of contact. A wide variety of organic and inorganic compounds, including many chemicals that are in a powder or crystalline form, are irritants. Consequently, eye and skin contact with all laboratory chemicals should **always** be avoided. Smoke is a common example of an irritant that can irritate the nasal passages and respiratory system. Symptoms of exposure can include reddening or discomfort of the skin and irritation to respiratory systems. Examples of chemical irritants include:

- Ammonia
- Chlorine
- Formaldehyde
- Benzene
- Toluene
- Acids and alkalis
- Solvents

5.4.c Sensitizers

A sensitizer (allergen) is a substance that causes exposed people to develop an allergic reaction in normal tissue after repeated exposure to the substance. Sensitizer exposure can lead to all of the symptoms associated with allergic reactions or can exacerbate an individual's existing allergies. Examples of chemical sensitizers include:

- Diazomethane
- Chromium
- Nickel
- Formaldehyde
- Isocyanates
- Phenol derivatives
- Latex proteins

5.4.d Hazardous Substances with Specific Target Organ Toxicity (STOT)

Substances or agents that damage specific organs such as the lungs, skin, eyes, or mucous membranes include:

- Hepatotoxins – substances that cause liver damage, such as carbon tetrachloride and nitrosamines.
- Nephrotoxins – agents that cause damage to the kidneys, such as certain halogenated hydrocarbons.

- Neurotoxins – substances that adversely affect the nervous system, such as mercury, acrylamide, and carbon disulfide.
- Agents that act on the hematopoietic system – such as carbon monoxide and cyanides which decrease hemoglobin function and deprive the body tissues of oxygen.
- Agents which damage lung tissue – such as asbestos and silica.

5.5 Particularly Hazardous Substances

OSHA recognizes that some classes of chemical substances pose a greater health and safety risk than others. To differentiate this risk characteristic, OSHA created the Particularly Hazardous Substances (PHS) category. There are three primary types of PHS:

5.5.a Carcinogens

Chemical or physical agents capable of causing cancer or tumor development. Generally, they cause damage after repeated or long-term (chronic) exposure and their effects may only become evident after a long latency period. Chronic toxins are particularly insidious because they may have no immediately apparent harmful effects. Examples of carcinogens include formaldehyde and dichloromethane.

5.5.b Acute Toxins

OSHA classifies chemical agents as acutely toxic based on the number of deaths that occur following brief (acute) exposure of rodents. The difference in the two categories is strictly the dose at which the toxicity (death) occurs. Exposure is by the three major workplace exposure routes - mouth (oral), skin (dermal), or breathing (inhalation). The analysis is based on the LD_{50} (median lethal dose by *oral or dermal* exposure) and LC_{50} (median lethal *inhalation* concentration for a one-hour exposure). The LD_{50} and LC_{50} represent the dose or concentration, respectively, at which 50% of the test animals (and supposedly humans) will be expected to die. Examples include benzene, toluene, and isocyanates.

5.5.c Reproductive Toxins

Reproductive toxins include any chemical that may affect reproductive capabilities, including causing chromosomal damage (mutagenesis), effects on fetuses (teratogenesis) and adverse effects on sexual function and fertility. Reproductive toxins can affect the reproductive health of both men and women if proper procedures and controls are not used. Exposure to reproductive toxins during pregnancy can cause adverse effects on the fetus, including lethality (death of the fertilized egg, embryo, or fetus), malformations (teratogenic effects), and postnatal functional defects. Examples of reproductive toxins are lead (Pb) and 1,2-Dibromo-3-chloropropane (DBCP). UNM

personnel who are pregnant or intending to become pregnant should consult with their personal physician, supervisor and EHS before working with substances that are suspected to be reproductive toxins.

5.6 DEA Controlled Substances

Although not a "class" of hazardous chemical, controlled substances pose health and safety risks due to their potential for abuse and dependence liability. Legitimate use of controlled substances in research labs is subject to registration and licensing by the Drug Enforcement Agency (DEA). Registrants/owners of controlled substances must also abide by strict storage, security, and disposal requirements, per 21 CFR 1301.

5.6.a Registration and Licensing

PIs using controlled substances in their lab research must register with the DEA to obtain a license for use that remains active for one year. Copies of all registration and licensing documentation must be maintained by the PI. EHS will ask for this information during the lab's annual inspection.

5.6.b Storage and Security

In order to guard against theft or diversion, all controlled substances must be kept under lock and key, in a safe or substantially-constructed cabinet that is bolted to the building's infrastructure (walls and/or floor), and accessible only to authorized personnel. The room in which the safe or cabinet is located must have limited access during working hours and be locked and secure after hours.

5.6.c Disposal

Controlled substances may *only* be disposed of by the registrant/owner, by either of these two methods:

1. Ship the controlled substance to a reverse distributor's registered location by common or contract carrier pick-up or by reverse distributor pick-up at the registrant's/owner's registered location. One such reverse distributor is National Pharmaceutical Returns, Inc.

2. Request assistance from the local DEA office. For this option, the registrant must contact the EHS department – 505-277-2753 or chemsafety-L@list.unm.edu.

6.0 HOW TO REDUCE EXPOSURES TO HAZARDOUS CHEMICALS

6.1 Routes of Exposure

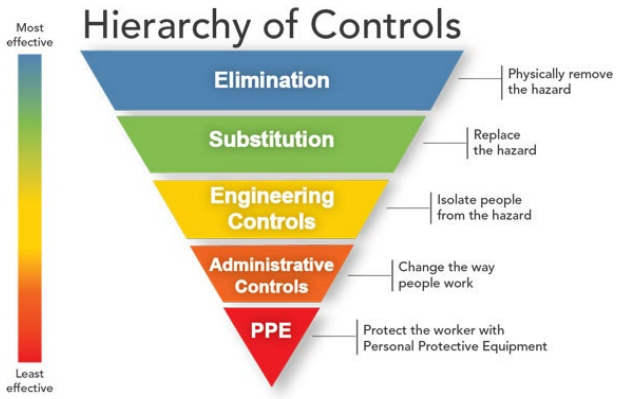
There are four primary routes of exposure to chemicals:

1. Inhalation
2. Absorption (through the skin or eyes)
3. Ingestion
4. Injection (skin being punctured by a contaminated sharp object or uptake through an existing open wound)

The most likely route of exposure in the laboratory is via inhalation. However, exposures may occur via more than one of these exposure routes, so it is critical that protective measures are in place for each of these routes of exposure.

6.2 Hierarchy of Controls

The methodology for controlling exposures to hazardous chemicals typically proceeds through the following hierarchy (next page):



6.2.a Elimination

The most effective method of reducing a hazard is to eliminate the hazard. Inexpensive and simple to implement when in the design or development stage of a process.

6.2.b Substitution

Along with elimination, substitution is a preferred and very effective method of reducing hazards. In the context of hazardous chemicals, substituting a suitable chemical that is non-hazardous or less hazardous for one that is more hazardous should be done when feasible.

6.2.c Engineering Controls

Engineering controls are designed to mitigate the hazard at the source, before it comes in contact with the worker. Examples of common engineering controls found in laboratories include chemical fume hoods, biosafety cabinets, and glove boxes.

> **Chemical Fume Hoods**: At UNM, all chemical fume hoods must be certified by an EHS-approved third party vendor on an annual basis. Certification includes an assessment of the condition of the fume hood and a quantitative test of the face velocity. Face velocity must be 100 (± 20) feet per minute (fpm) at a sash height of 18 inches for a chemical fume hood to be certified.
>
> If a fume hood does not pass certification, it will be labeled with a red "DO NOT USE" sticker and a Service Request will be submitted by EHS to FM. Hoods that do not pass will receive priority maintenance. FM will notify EHS when the hood is repaired and EHS will arrange for the hood to be re-tested for certification.

6.2.d Administrative Controls

Administrative Controls are work practices and procedures that reduce the duration, frequency, and severity of exposure to hazards. Examples of common administrative controls in a laboratory setting include policies that prohibit mouth pipetting and recapping of needles.

6.2.e Personal Protective Equipment

When the hazards of a process or chemical cannot be eliminated or sufficiently reduced with engineering and administrative controls, the worker must use PPE to mitigate the hazards. PPE is considered the last line of defense and a last resort and should always be used in conjunction with other controls. Examples of common PPE in the laboratory include lab coats, safety goggles and gloves.

Basic PPE requirements for working in a lab at UNM include:

- Full-length pants and closed-toe shoes, or equivalent
- Lab coat, gloves and eye protection when working with or adjacent to someone working with hazardous chemicals
- Flame-resistant lab coats when working with pyrophoric and high-hazard flammable materials (NFPA 4 and/or Category 1 flammables)

Additional and/or more protective PPE, such as respiratory protection, is required when working with certain materials.

Respiratory Protection: Typically, respiratory protection is not needed in a laboratory because safe work practices and engineering controls (fume hoods, biosafety cabinets, and general ventilation) adequately protect laboratory workers from chemical and biological hazards. However, under certain circumstances, respiratory protection may be needed.

Personnel who are required to wear a respirator at UNM shall do so only after obtaining medical clearance from a physician and attending an in-person training and fit-testing session. Contact EOHS to obtain medical clearance. Contact EHS for assistance with training on respiratory protection and fit-testing. More information can be found in the EHS Respiratory Protection Program, located on the EHS website:

https://ehs.unm.edu/occupational-safety/ehs-respiratory-protection-program.html

6.3 Laboratory Hazard Assessment Tool (LHAT)

Reducing the risk of exposure to hazardous chemicals can only be accomplished if the hazards are known. If, for example, a *de minimis* quantity of a hazardous chemical is used in a particular process, the risk to the user is low and accidental exposure procedures are different from those for personnel exposed to a larger quantity or higher concentration of the same chemical. Personnel who work with hazardous chemicals should know the *de minimis* quantity of the chemical they are working with. For guidance on hazardous chemical *de minimis* quantities, contact EHS at 505-277-2753.

To facilitate the identification of hazards and the appropriate PPE to use to mitigate the hazards, PIs and lab managers are encouraged to utilize the Laboratory Hazard Assessment Tool. A copy of the LHAT is included as an attachment and is also available under the Research Safety tab on the EHS website.

Additionally, OSHA has developed an interactive, online, game-based training tool for teaching users how to find hazards in their workplaces. PIs and lab managers are encouraged to utilize OSHA's Hazard Identification Training Tool, which can be found here: OSHA's Hazard Identification Training Tool

7.0 CHEMICAL HAZARD MANAGEMENT

7.1 Chemical Procurement

There are three ways to purchase chemicals for use at UNM:

1. From Chemical & Research Laboratory Supplier (CRLS), located in room 146 in Clark Hall. An index number is required to make a purchase at CRLS.
2. Via the Research Materials Manager (RMM) punchout in LoboMart, using a UNM-issued Purchase Card (P-card) or a PO and index number. RMM is a web-based chemical inventory management system which hosts catalogs for many different chemical vendors. Chemicals purchased this way are delivered to the purchaser's lab by CRLS and the chemicals are automatically added to the purchaser's RMM chemical inventory. More information on RMM is provided in the Chemical Inventory section of this plan.
3. Directly from a vendor, outside of CRLS or RMM. Hazardous chemicals purchased using this method must be immediately barcoded and added to the purchaser's RMM chemical inventory by the purchaser. Contact EHS for barcodes.

Before a decision is made to acquire a chemical, the purchaser will determine whether:

- A Safety Data Sheet is available
- The proposed quantity is an appropriate amount for the activity
- There is a less hazardous or non-hazardous chemical available
- There is a surplus chemical available from another chemical owner
    - Contact EHS to locate chemicals that belong to other owners

7.2 Chemical Inventory

PIs or their designees are required to maintain an accurate, up-to-date inventory of all hazardous chemicals in their laboratories via Research Material Management (RMM, formerly ERM). RMM is a web-based program with a variety of features and functions, including a chemical inventory system. For access to and training on RMM, contact EHS at 505-277-2753 or chemsafety-L@list.unm.edu.

EHS assists with this responsibility by providing chemical inventory services for all UNM laboratories up to twice per year. Contact EHS for information on when this service is scheduled for any particular lab.

7.3 Safety Data Sheets (SDS)

Safety Data Sheets (SDSs) are required for all hazardous chemicals in the laboratory. PIs/lab managers are responsible for keeping SDSs current and making them available to all lab employees. SDSs must be kept in a central location that can be accessed immediately in the event of an emergency. Electronic copies are acceptable as long as the location is known by and accessible to all lab employees.

SDSs are also required for hazardous chemicals that are produced/synthesized in the lab. The owner of the produced/synthesized chemical is responsible for preparing its SDS. Exceptions to

developing an SDS may apply for chemicals that are produced in the laboratory solely for in-house use in the lab. See OSHA letter of interpretation located at: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=24782

Contact your department's Deputy Chemical Hygiene Officer or Environmental Health & Safety at 505-277-2753 or chemsafety-L@list.unm.edu for assistance in developing an SDS.

7.4 Labels

All containers of hazardous chemicals in the workplace shall be labeled in accordance with OSHA's Hazard Communication Standard (29 CFR 1910.1200). Chemical labels shall be maintained in legible condition and shall not be removed or defaced. Labeling requirements are summarized below.

- Original, manufacturer's container labels must have:
  - The product identifier/name of the hazardous chemical
  - Appropriate hazard warning information for worker protection (hazard statement(s), pictogram(s) and precautionary statement(s)
  - The name and address of the chemical manufacturer or other responsible party

- Portable, secondary or other in-house workplace containers* (containers used for storing chemicals that are not in the original, manufacturer's packaging, such as spray bottles) must have labels that display:
  - The product identifier/name of the chemical
  - Appropriate hazard warnings for worker protection

- Laboratory-prepared solutions of hazardous chemicals, analytical samples containing hazardous chemicals, and new synthesized compounds must have labels that display:
  - The product identifier/name of the chemical/compound
  - Appropriate hazard warnings for worker protection
  - The identity of the owner of the chemical/compound

*For situations in which secondary/workplace containers are too small to add both the name and the hazards of the chemical within, it is acceptable to label the container with acronyms or symbols that are understood by lab personnel, or to add a label to a larger container in which the smaller container is stored.

If a system of abbreviations is used within the laboratory for labeling, the abbreviations and their meanings must be posted in a conspicuous location. Alternative labeling systems such as National Fire Protection Association (NFPA) diamonds or the Hazardous Material Information

System (HMIS) are allowed for workplace labels as long as they are consistent with the OSHA Hazard Communication Standard. Further explanation of the labeling components can be found at https://www.osha.gov/dsg/hazcom/index.html.

- Containers that are being used to for hazardous waste accumulation must have labels that display:
    - The words "Hazardous Waste"
    - The contents of the container, including concentrations and percentages for each constituent
    - Words or pictograms indicating the hazards

Contact EHS for a hazardous waste label template. Additional information about chemical/hazardous waste is provided in the Hazardous Waste Management section (section 9.0) of this plan.

7.5 Chemical Storage

All chemicals must be stored by hazard class, with incompatible chemicals segregated to prevent accidental contact. Acceptable chemical storage locations may include flammable cabinets, corrosive cabinets, and lab shelves/cabinets. Laboratory shelves used for chemical storage must have a raised lip along the outer edge or a railing to prevent containers from falling. Chemicals stored on shelves that lack a raised lip or railing must be stored in trays with sides tall enough to prevent containers from falling out. Hazardous chemicals should not be stored above a height of five feet.

Fume hoods should not be used as general storage areas for chemicals, as this may impair the ventilating capacity and increase the risk of exposures. Chemicals should not be routinely stored on bench tops or on the floor. Chemicals should never be stored in direct sunlight or near heat sources.

Refrigerators and freezers used for storing flammable liquids must be specifically designed for that purpose (e.g. explosion proof, laboratory-grade). No food or drink shall be stored in refrigerators and freezers used to store chemicals. These refrigerators are to be labeled "NO FOOD OR DRINK TO BE STORED IN THIS REFRIGERATOR," or similar wording. General guidelines for storing chemicals are provided below. A chemical storage compatibility table is included as an attachment.

7.5.a Storing Flammable and Combustible Liquids

Large quantities of flammable or combustible materials should not be stored in the laboratory.

- No more than **10 gallons** of flammable or combustible liquids, including flammable/combustible hazardous waste, are allowed to be kept outside a flammable storage cabinet, safety can, or approved refrigerator/freezer.
- No more than **60 gallons** of Class 1A flammable liquids are allowed to be stored within a flammable storage cabinet. Class 1A flammable liquids have a flash point below 73°F and a boiling point below 100°F.
- No more than **120 gallons** of flammable and combustible liquids are allowed to be stored in one flammables cabinet.

Flammable materials must **never** be stored in domestic-type refrigerators/freezers and should not be stored in a refrigerator/freezer if the chemical has a flash point below the temperature of the equipment. Flammable or combustible liquids must not be stored on the floor or in any exit way. **Always** segregate flammable or combustible liquids from oxidizers, including oxidizing acids (e.g. nitric, perchloric, chromic, sulfuric).

7.5.b Storing Oxidizers

Oxidizers (e.g. hydrogen peroxide, halogens, potassium permanganate, ferric chloride, potassium dichromate, sodium nitrate, etc.) should be stored in a cool, dry place and kept away from flammable and combustible materials, such as wood, paper, Styrofoam, plastics, flammable organic chemicals, and away from reducing agents (e.g. zinc, alkaline metals, metal hydrides, formic acid). Oxidizers should never be stored in a flammables cabinet unless the cabinet is used exclusively for storage of oxidizers.

7.5.c Storing Corrosives

Corrosives (e.g. acids, bases) must be stored below a height of five feet and within secondary containment (a spill tray).

- Acids and bases must be segregated either by distance or in separate spill trays. These materials may be stored in the same corrosives cabinet but must be within separate spill trays.
- Acids must be stored away from reactive metals (e.g. sodium, potassium, magnesium)
- Acids must be stored away from chemicals which could produce toxic gases upon contact (e.g. sodium cyanide, iron sulfide, potassium ferricyanide)
- Mineral acids (e.g. hydrochloric, sulfuric, nitric, phosphoric) must be stored away from organic acids (e.g. formic, acetic, propionic, lactic). These materials may be stored in the same corrosives cabinet but must be within separate spill trays.
- Oxidizing acids (e.g. nitric, concentrated sulfuric, perchloric, chromic) must be stored away from flammable and combustible materials

- Picric acid must be stored wet, with at least 30% water, in a cool, dry, well-ventilated area away from heat sources and away from oxidizers, metals, reducing agents and bases.
- Picric acid containers should be inspected every six months and rehydrated as needed, as it will become unstable and potentially explosive if allowed to dry out

7.5.d Storing Pyrophorics and Water-Reactives

Pyrophorics are materials that will spontaneously ignite upon contact with air. Water-reactives are materials that will spontaneously ignite and/or produce toxic gases upon contact with water. Both pyrophorics and water-reactive materials are extremely dangerous and have caused fatal accidents in laboratories. Extreme caution must be used when handling these materials. Handling within a glovebox with an inert atmosphere and/or in manner that rigorously excludes air and/or moisture is required.

Examples of water-reactive and pyrophoric chemicals include metal alkyls (tert-butyllithium, lithium carbonyl); metal powders (cobalt, iron, zinc); metal hydrides (sodium hydride, lithium aluminum hydride); and alkali metals (lithium, potassium, sodium).

Only minimal amounts of reactive chemicals should be used in experiments or stored in the laboratory. These chemicals must be stored as recommended in the material's SDS. All users of pyrophoric and water-reactive materials at UNM must know and follow the guidance provided in the lab-specific SOP and SDS and know the appropriate quenching methods. **Use of these materials is prohibited while working alone.**

Suitable storage locations may include inert gas-filled desiccators, glove boxes or in a refrigerator or freezer rated for the storage of flammable liquids. Do not store reactive chemicals in a flammable storage cabinet with other flammable liquids. A flammable storage cabinet may be used but it must be dedicated to storing pyrophoric or water-reactive materials only.

7.5.e Storing Peroxide-Forming Chemicals

Containers of materials that might become hazardous during prolonged storage (i.e. peroxide-forming chemicals) must be dated upon arrival in the lab and dated each time the container is opened. Six months after opening, the material will be evaluated or tested for the presence of peroxides for continued safe use. Material that is found to be safe or that can be stabilized to be made safe must be re-dated and retained for an additional six-month period, or according to manufacturer's instructions, whichever is more stringent. All other material will be safely and compliantly discarded. Contact EHS for assistance with testing peroxide-forming chemicals. Additional information on peroxide-forming chemicals is in section 9.6.b. A list of peroxide formers is included as an attachment.

7.5.f Storing Compressed Gas Cylinders

All compressed gas cylinders, whether in use or in storage, empty or full, shall be:

- Labeled with the contents of the cylinder
- Secured to a rack, frame, cabinet or cylinder cart by a chain, strap or other fastening device to prevent the cylinder from falling over
- Stored upright, with the valve protection cap on when not in use
- Stored where they will not be subject to extreme temperatures (acceptable temperature range is -20°F/-29°C to 125°F/52°C)

All users of compressed gas must also be familiar with and abide by the UNM Compressed Gas Cylinder Safety Program, located here on the EHS website:

https://ehs.unm.edu/ehs-standards-and-guidelines.html

7.5.g Storing Controlled Substances

DEA registrants are responsible for providing and maintaining secure storage of the controlled substances in their inventory and must abide by the federally mandated DEA requirements outlined in 21 CFR Part 1301.72. Storage requirements include:

- **Schedule I,II**: Store in a locked drug safe, vault, or steel cabinet or drawer attached to the building structure (bolted to wall and/or floor), within a lockable room
- **Schedule III-V**: Store in a locked, substantially-constructed cabinet or drawer without wheels, within a lockable room
- **Usage and Disposal Logs**: Store in locked storage unit with corresponding controlled substances

7.6 Transporting Chemicals

7.6.a On-Campus Transport of Hazardous Chemicals

Precautions must be taken when transporting hazardous chemicals between laboratories and buildings. Chemicals must be transported in durable, *secondary containment* such as commercially available bottle carriers made of rubber, metal, or plastic, that include carrying handle(s) and which are large enough to hold the contents of the chemical container in the event of breakage. Large (10-gallon) chemical transport bins are available to borrow from EHS. A spill kit should be readily available when transporting chemicals.

When transporting cylinders of compressed gases, **always** secure the cylinder with straps or chains onto a suitable hand truck (dolly) and ensure that the valve protection

cap is in place. Avoid dragging, sliding, or rolling cylinders and use a freight elevator when possible. **Never transport a cylinder with a regulator attached.**

7.6.b Off-Campus Transport of Hazardous Chemicals

The transportation of hazardous chemicals and compressed gases over public roads or by air is regulated by a variety of governmental agencies, including the U.S. Department of Transportation (DOT) and the International Air Transport Association (IATA).

However, in accordance with 49 CFR 171.1(d)(5), the Hazardous Materials Regulations do not apply to the transportation of hazardous materials in a motor vehicle, aircraft, or vessel operated by a Federal, State, or Local government employee solely for noncommercial Federal, State, or Local governmental purposes. This means that UNM employees are permitted to transport hazardous chemicals in a UNM-owned vehicle solely for noncommercial Federal, State or Local governmental purposes. Individuals who wish to transport hazardous chemicals or compressed gases off-campus should contact EHS at 505-277-2753.

The shipping of hazardous materials via a *commercial carrier* is strictly governed by DOT and IATA. Any person who prepares and/or ships hazardous materials must ensure compliance with pertinent regulations regarding training, quantity limits, packaging, labeling, documentation, and hazard communication. **Without proper training, it is illegal to ship hazardous materials.** Those who violate the hazardous materials shipment regulations are subject to criminal investigation and penalties. UNM personnel who sign hazardous materials manifests, shipping papers, or those who package hazardous material for shipment, must be properly trained and certified. Individuals who wish to ship hazardous materials or compressed gases off-campus must contact EHS at 505-277-2753 for assistance.

7.7 Chemical Disposal

All chemicals at UNM must be disposed of in accordance with local, state, and federal regulations. UNM's Environmental Health & Safety Department strives to make the chemical disposal process as easy as possible by providing container label templates, weekly waste pickups, free waste containers* and training on how to manage chemical waste.

In general, most laboratory chemicals that need to be disposed of (excess chemicals, expired chemicals, unwanted chemicals, etc.) are considered "hazardous waste."

Guidance on chemical disposal procedures is provided in the Hazardous Waste Management section (section 9.0).

*Limited supply of previously-used but clean containers in sizes ranging from 1L to 55 gallons.

8.0 NON-CHEMICAL HAZARD MANAGEMENT

8.1 Fire

Fire is the most common physical hazard faced by researchers in a typical laboratory. While proper procedures and training can minimize the chances of an accidental fire, laboratory workers should still be prepared to deal with a fire emergency should it occur.

Small bench-top fires in laboratory spaces are not uncommon. Large laboratory fires are rare. However, the risk of severe injury or death is significant because fuel load and hazard levels in labs are typically very high. Laboratories, especially those using solvents in any quantity, have the potential for flash fires, explosion, rapid spread of fire, and high toxicity of products of combustion (heat, smoke, and flame).

To avoid such hazards, follow these best practices:

- Plan your work. Know the worst-case scenario and how you would respond. Have a written emergency plan for your space and/or operation.
- Minimize materials in the work area and purchase only the minimum quantities necessary. Not only does this minimize fire risk, it reduces costs and waste.
- Keep work areas uncluttered and clean. Put unneeded materials back in storage promptly. Keep aisles, doors, and access to emergency equipment unobstructed at all times.
- Know where the nearest emergency equipment (i.e. fire extinguisher, fire alarm box, exit(s), telephone, emergency shower/eyewash, first-aid kit, spill kit, etc.) are located.
- Be aware of restrictions on equipment (i.e., keeping solvents only in an explosion-proof refrigerator).
- Keep barriers in place (shields, hood doors, lab doors).
- Wear proper clothing and personal protective equipment.
- Avoid working alone.
- Store solvents in flammable liquid storage cabinets.
- Shut doors behind you when evacuating.
- Limit use of open flames to within fume hoods and never leave unattended.
- Keep combustibles away from open flames.
- Do not heat solvents using hot plates.
- Know the evacuation routes and assembly points for your laboratory/building.
- Remember the “RACE” rule in case of a fire.
    - R= Rescue/remove all occupants
    - A= Activate the alarm system
    - C= Confine the fire by closing doors

- E= Evacuate/extinguish

8.2 Electrical Hazards

In the laboratory, researchers may be exposed to hazards such as electric shock, arc blasts, electrocutions, fires and explosions. Potential exposures to electrical hazards can result from faulty electrical equipment/instrumentation or wiring, damaged receptacles and connectors, or unsafe work practices.

To avoid such hazards, follow these best practices:

- Do not perform work on electrical infrastructure. Work such as installing circuit breakers, wiring, lighting, electrical outlets, etc. must only be done by Facilities Management personnel.
- Always follow manufacturer's recommendations for using electrical equipment.
- Do not use electrical equipment to perform a task for which it is not designed.
- Most equipment includes either a 3-prong/grounded plug or double insulation. Equipment that lacks these features is less safe. Avoid using it. You will not be protected from electric shock if a 3-prong/grounded plug is not inserted into a 3-prong/grounded outlet.
- If you plug more than two pieces of low-demand equipment into a standard outlet, use a fused power strip that will shut off if too much power is used.
- Make sure that any electrical outlet within six feet a sink or other water source is Ground-Fault Circuit Interrupter (GFCI) protected. If you have a GFCI, periodically test it by plugging something into it and pushing the "test" button.
- Do not disable any electrical safety feature.
- Before turning equipment on, check that all power cords are in good condition.
- Do not use extension cords as a substitute for permanent wiring.
- Build experimental apparatus with safety interlocks so equipment can't be energized prematurely.
- If you see a person being electrocuted, *DO NOT TOUCH THEM*, as the current may pass through to you. If possible, turn off the power (pull the plug or trip the circuit breaker) or use an item made of non-conductive material (e.g., wooden broom handle) to pry them away from the contact. Call 911 immediately.

8.3 Compressed Gases

Compressed gases are pressurized and are therefore capable of releasing a vast amount of energy in a fraction of a second. Using compressed gases in the laboratory can be a dangerous situation if they are handled improperly. Many gases can be explosive, flammable, corrosive, and toxic. Because the gases are under high pressure (compressed) in tanks and cylinders, any release can spread quickly and endanger lab personnel—including the possibility of injury from explosion or asphyxiation. Less serious hazards include physical injuries from mishandling tanks, especially to the hands, feet, and lower back.

To avoid hazards, follow these best practices:

- Use the correct regulator. DO NOT try to adapt a regulator to a cylinder for which it was not intended. (see https://www.sisweb.com/referenc/tools/cgafitt.htm for a list of regulator connections)
- Always store cylinders with the valve protection cap in place when not in use.
- Regularly inspect cylinders, cylinder valves, regulators and delivery lines for wear or damage. If any are found to be damaged, remove them from service.
- Use a pressure relief valve to reduce the risk of rupturing a delivery line or damaging equipment.
- NEVER use Teflon tape on regulator threads.
- Check for leaks when swapping tanks or regulators or installing new gas delivery lines.
- Always use a three or four-wheeled cart when transporting gas cylinders.
- Secure cylinders using appropriate tank mounts attached to stable substrates.
- Segregate flammable and combustible gases.
- Consider installing gas monitors and alarms.

8.4 Thermal Hazards

8.4.a Cryogens

Cryogens are substances used to produce very low temperatures [below -153°C (-243°F)], such as liquid nitrogen (LN_2) which has a boiling point of -196°C (-321°F), that are commonly used in laboratories. Cryogens can be hazardous to researchers if not handled properly.

To avoid hazards, follow these best practices when working with cryogenic materials:

- Avoid eye or skin contact.
- Use cryogenic rated gloves.
- Where a face shield and safety glasses.
- Wear a lab coat or long sleeves and an apron.
- Never store a cryogen in a sealed, air-tight container above its boiling point; the pressure resulting from gas production may lead to an explosion.
- Do not use or store cryogens in confined areas, walk-in refrigerators, environmental chambers, or rooms without ventilation. A leak in such an area can cause an oxygen-deficient atmosphere, leading to asphyxiation.
    - Oxygen sensors have been installed in most labs that store and use large quantities of liquid nitrogen. The oxygen sensors will go into alarm mode if the oxygen concentration drops below 19.5%. Occupants must leave the room and call EHS and/or UNM Police when an oxygen sensor alarm is activated.

8.4.b High-Temperature Hazards

Laboratory work frequently involves processes conducted at elevated temperatures. One of the more common pieces of equipment used in labs is also one that is involved in

numerous accidents—the hotplate. It is essential that lab employees be cognizant of the hazards associate with high-temperature processes and how to mitigate them.

To mitigate the hazards, follow these best practices when working with high-temperature processes and/or equipment:

- High-temperature processes should be continuously monitored.
- Post signage that alerts those entering the lab of the presence of equipment or processes operating at high temperatures.
- High-temperature equipment should be isolated to the extent possible, such as inside a fume hood.
- Use heat-resistant gloves when handling hot items.
- Wear appropriate eye protection.
- When heating liquids, use a stir bar or other similar device to prevent superheating and boil-overs.
- Never leave high-temperature processes unattended, particularly if they involve reactive chemicals.
- Do not store or use flammable materials near high-temperature equipment.

8.5 Nanoparticles

Although insufficient information exists to predict the health hazards posed by the exposure to nanoparticles, current research indicates that exposure via inhalation and skin contact can result in these particles entering the body. Results from human and animal studies show inhaled nanoparticles can deposit in the respiratory tract. Animal studies also show nanoparticles can enter the bloodstream and translocate to other organs. Nanoparticles have the greatest potential to enter the body if they are in the form of individual particles, agglomerates of nanoparticles, and particles from nanostructured materials that become airborne or come into contact with the skin. According to NIOSH the following workplace tasks may increase the risk of exposure to nanoparticles:

- Working with nanoparticles in liquid media without adequate protection (e.g., gloves) will increase the risk of skin exposure.
- Working with nanoparticles in liquid media during pouring or mixing operations, or where a high degree of agitation is involved, will lead to an increased likelihood of inhalation and respirable droplets being formed.
- Generating nanoparticles in the gas phase in non-enclosed systems will increase the chances of aerosol release to the workplace.
- Handling nanostructured powders will lead to the possibility of aerosolization.
- Maintenance on equipment and processes used to produce or fabricate nanoparticles will pose a potential exposure risk to workers performing these tasks.

- Cleaning of dust collection systems used to capture nanoparticles will pose a potential for both skin and inhalation exposure.

8.5.a Approvals for Nanoparticles

If you or your lab has not worked with unbound nanoparticles before and you are considering a procedure that requires you to do so, contact EHS for guidance.

All work that involves the handling or transfer of nanoparticles requires the approval of the PI. The PI must ensure that lab personnel who work with nanoparticles are aware of the hazards, how to protect themselves from the hazards, and have received adequate training and supervision for the procedure(s) involving nanoparticles.

EHS review is required for any work with unbound nanoparticles in open systems such as the weighing and transferring of free nanoparticles that are not in solution, suspension, or bound to a solid medium.

For any task that requires safety controls beyond those specified in this document, a task-specific Hazard Control Plan (HCP) must be written. The HCP must be sent to EHS for review. These include acutely hazardous, radioactive and/or pyrophoric nanoparticles.

8.5.b Nanoparticle Facility Requirements

General Ventilation

Labs that handle nanoparticles must have non-recirculating ventilation systems (preferably 100% exhaust air) with ventilation rates of 6-12 air changes per hour. Lab pressurization must be negative to the hallway.

Emergency Irrigation

Emergency irrigation (safety shower, eyewash) must be accessible within the area where the work is performed.

Isolation of Workspaces

Offices and general-purpose work desks may not be located inside the laboratories that handle nanoparticles.

Signage and Labeling

Signage indicating the use of nanoparticles needs to be posted at the entryways of laboratories that use nanoparticles. Safety Data Sheets containing the hazard information must be present at the facility for all nanoparticle materials.

If nanoparticles are transferred from the original container to a secondary, working container, the container must be labeled in accordance with section 7.4 of this plan.

8.5.c Engineering Controls for Nanoparticles

Chemical Fume Hoods, Glove Boxes, HEPA-Filtered Cabinets

Activities that are likely to release nanoparticles (such as the opening and emptying of reactors, glass furnace tubes, weighing of dry nanoparticles) shall not be performed on the open bench. These activities shall be performed in a chemical fume hood (or other vented enclosure), biological safety cabinet, glove box or a vented HEPA-filtered enclosure.

Furnace Exhaust

Exhaust from all furnaces used to produce nanoparticles must be trapped and connected to a local exhaust source.

Vacuum Protection

Mechanical vacuum pumps must include a filter to prevent particulate release. The pump exhaust must be vented into an approved exhaust duct or chemical fume hood.

Hazardous Nanoparticles

Certain nanoparticles comprised of hazardous substances must be handled in a glove box or glove bag rather than a fume hood or partially open cabinet. If a glove box is not available, contact EHS to determine whether the risks can be adequately controlled using alternative controls.

8.5.d Nanoparticle Work Practices

Considerations for Purchase

- Do not use nanoparticles if less hazardous alternatives are available.
- Purchase, dispense, and use the smallest quantity of nanoparticles needed.
- Purchase the lowest concentration of nanoparticles that will meet your research needs.
- Purchase nanoparticles in solution or suspension, if possible, to reduce the risk of dispersing dry nanoparticles during handling.

Considerations for Workspaces

- Use disposable work surface covers (“bench protectors”) in areas where nanoparticles are handled to prevent contamination of work surface. Change bench protectors daily when nanoparticles are used, and properly dispose of contaminated covers.
- Clean bench tops using a cleaning solution after each work activity. Spills of dry nanoparticles may be cleaned with a HEPA vacuum. Dry sweeping must not be used. Large spills must be cleaned by EHS. Daily vacuuming of benches and floors with a HEPA vacuum should be performed in labs that handle nanoparticles.

Considerations for Handling

- Respiratory personal protective equipment alone is generally not sufficient for safely working with nanoparticles. Proper fume hoods, glove boxes or filtered cabinets are needed to ensure personnel protection.
- Do not handle nanoparticles when working alone.
- Immediately close all containers of nanoparticles after use.
- Due to the risk of splashes and equipment failures, do not use a syringe and needle to perform transfers of nanoparticles in volumes of greater than 5 mL.
- When dispensing or transferring small volumes via syringe, luer-lock or integrated-needle syringes should be used instead of luer-slip syringes. These devices prevent the needle from detaching from the syringe barrel during use.
- Do not dispense nanoparticles directly onto a laboratory balance in the general lab space. Instead, transfer the material into a sealable pre-tared container inside the fume hood; then take the sealed container to the balance. Adjust the amount of material inside the container until the desired mass is reached. Make all adjustments inside the fume hood.
- Restrict the handling of nanoparticles to areas well within the lab.
- Transport dry nanoparticles in closed containers. Handle solutions containing nanoparticles over disposable bench covers.
- Aerosol producing activities (such as sonication, vortex mixing and centrifuging) may not be conducted on the open bench. Perform these activities in a fume hood, biological safety cabinet, glove box or a vented filtered enclosure.
- Hand washing must be performed after handling nanoparticles.
- Do not use conventional vacuum cleaners to clean nanoparticle spills; in general, wet cleanup methods with proper handling and disposal of waste materials is preferable.
- Be aware of the enhanced reactivity and flammability of many nanoparticle materials. Always educate yourself in the additional hazards associated with nanoparticles in addition to the bulk material hazards.

8.5.e Nanoparticle Personal Protective Equipment

Consider the potential routes of exposure and health consequences when selecting personal PPE for tasks involving unbound nanoparticles.

In addition to the minimum lab apparel and PPE requirements, other protective equipment may be necessary to reduce risks. When additional equipment (such as tight-fitting chemical splash goggles, chemical-resistant gloves, or disposable lab coats) are required, a Hazard Control Plan must be written to document the risk assessment and controls.

- Arm protectors/sleeves are required where high levels of exposure or splashes of solutions containing nanoparticles are anticipated.

- Gloves (disposable nitrile) must be worn when handling nanomaterials. Because skin penetration is a concern, gloves must cover the wrist and any skin on the arm not covered by the lab coat.
- Respirators may be required for activities that cannot be controlled using ventilation. Contact EHS for information on respirators and respiratory protection. All users of respirators will comply with UNM's Respiratory Protection Program.

Contact EHS for assistance with risk assessments, glove compatibility, and other PPE selection.

8.5.f Nanoparticle Waste and Decontamination

Wash hands thoroughly with soap and water after handling any chemical and whenever you leave the lab. Use good housekeeping practices to avoid contamination of surfaces, garments, personal belongings, and self.

Clean bench tops using a cleaning solution after each work activity. Daily vacuuming of benches and floors with a HEPA vacuum should be performed in labs that handle nanoparticles.

Decontaminate all surfaces that have come in contact with nanoparticles and clean up small spills promptly. See the chemical Safety Data Sheet or contact EHS for assistance with determining an appropriate decontamination method.

Nanoparticle waste must be collected in suitable containers, labeled according to the constituents within the waste container, and disposed of properly. Contact EHS for assistance with nanoparticle waste disposal.

8.5.g Nanoparticle Spills

Spills of dry nanoparticles may be cleaned with a HEPA-filtered vacuum but never a conventional vacuum. Dry sweeping must not be used. Large spills must be cleaned by EHS.

General procedures for chemical spill response can be found in the Hazardous Chemical Spill, Accidents and Emergency Response section (section 12.0).

Do not hesitate to call EHS for assistance with spill cleanup of nanomaterials.

Contact University Police at 505-277-2241 or 911 only if the spill involves a fire, imminent risk of fire, an injury requiring an ambulance, or if there is a hazard that may affect others in the building.

9.0 CHEMICAL WASTE MANAGEMENT

Chemical waste, which can be chemicals still in their original/manufacturer's container or chemicals (usually mixtures) generated during experiments, research, and teaching activities,

must be collected, labeled, stored, and disposed of in accordance with federal and state hazardous waste regulations. In the context of disposal, chemical waste is either hazardous waste or non-hazardous waste. It is the responsibility of laboratory personnel to determine if their waste is considered hazardous waste or non-hazardous waste and for subsequently labeling, properly storing, and coordinating the disposal of their chemical waste. The following are guidelines on proper chemical waste management.

9.1 Training

All personnel who are responsible for handling, managing, or coordinating the disposal of chemical waste must complete EHS's Chemical Waste Management training **prior** to working with chemical waste. A live training session must be attended either in-person or online (via Zoom or similar online meeting format). Sign up for the 30-minute training course on UNM's Learning Central or attend the training via Zoom on the first Thursday of each month at 3:00. Zoom meeting details are available on the "Training" tab of the EHS website.

9.2 Waste Identification/Determination

It is very important that *all chemical constituents*, including those in trace quantities, are accurately identified, characterized, and included on the label of containers used to hold the waste. This is a critical safety issue for both laboratory personnel and hazardous waste technicians who handle the waste once it is turned over to EHS.

To facilitate accurate identification and characterization of lab-generated waste, EHS has created the **Hazardous Waste Determination Form**. This form is required for all lab-generated wastes. *This form is not required for expired or unwanted chemicals still in their original containers*. The form is available on the Waste Disposal section of the EHS website.

If there is uncertainty about the composition of a waste stream resulting from an experimental process, laboratory personnel must consult with the PI or the lab manager. In most cases, careful documentation and review of all chemical products used in the experimental protocol will result in accurate waste characterization. If the waste characteristics cannot be determined, contact EHS at 505-277-2753 or chemsafety-L@list.unm.edu.

9.3 Waste Labeling

Per EPA regulations, all containers of chemical waste that is hazardous (ignitable/flammable, corrosive, reactive and/or toxic) must have a label that includes the following information:

- The words "HAZARDOUS WASTE"
- A list of *all constituents* (including non-hazardous constituents) in the container
- Words or pictograms indicating the hazards of the waste

Waste chemicals that are in the original, manufacturer's container with an intact, original label, only need the words "HAZARDOUS WASTE" to be added to the label. Acceptable formats include writing the words by hand using permanent marker, printing the words on a sticker that is applied to the container or applying a commercially-available label or sticker. In all cases, it is important that no part of the original, manufacturer's label is obscured.

An easy to use, hazardous waste label template is available on the EHS website: https://ehs.unm.edu/assets/documents/hazardous-waste/hazardous-waste-label---editable.pdf

9.4 Waste Storage

Each laboratory that generates hazardous chemical waste is considered a Satellite Accumulation Area (SAA) by the EPA. There are very specific regulations that govern SAAs. Each lab should have a designated waste storage area in a location that is out of the way of lab activities, such as under a counter or in a cabinet. Storing waste in a fume hood is acceptable *only if the quantity is such that it does not interfere with the fume hood's ability to operate properly*. The waste storage area should be posted with a sign, such as "HAZARDOUS WASTE STORAGE AREA" or "SATELLITE ACCUMULATION AREA". Other SAA requirements include the following:

- Hazardous waste containers must not be moved from one lab/room/SAA to another; *waste must be stored at or near the point of generation*.
- Containers of hazardous waste must be labeled at all times; see previous section for labeling requirements.
- Containers of hazardous waste must be kept closed when not in use; "in use" means actively adding waste to the container. *Do not leave a funnel in the mouth of a waste container.*
- Containers of liquid hazardous waste must be stored in secondary containment (spill trays) at all times.
- Containers of hazardous waste must be in good condition with leak-proof lids.
- Containers of hazardous waste must not be filled to more than 90% capacity; leave 10% head space.
- Hazardous waste mixtures must have compatible constituents and must be compatible with the containers in which they are stored.
- The maximum quantity of hazardous waste that can be stored in a SAA is 55 gallons of hazardous waste or one liter/2.2 pounds of *acutely* hazardous waste. Acutely hazardous waste is waste that contains at least 0.1% of any chemical(s) listed on the EPA's P-List. The P-List is included as an attachment.
- The maximum quantity of flammable solvents allowed to be stored in a laboratory is 60 gallons, including waste solvents.

- As with all hazardous chemicals, ensure that incompatible wastes are segregated and/or stored in separate spill trays (i.e. acids and bases, oxidizers and flammables).

9.5 Waste Disposal

The EHS department coordinates the pickup and disposal of all chemical waste at UNM. For your waste to be picked up, you must:

1. Fill out a *Chemical Waste Pickup Request Form*
    a. EHS needs to know exactly *what* and *how much* is being picked up
2. Submit the form to EHS
    a. Upon receipt of the form, you will be notified of the next pickup date
    b. EHS will screen the form and notify you if a *Hazardous Waste Determination Form* is required
3. Ensure all containers being picked up are properly labeled (see section 9.3)
    a. Unlabeled and insufficiently-labeled containers cannot be picked up/transported

Additional information, as well as the *Chemical Waste Pickup Request Form,* the *Hazardous Waste Determination Form*, and waste container label templates, can be found by clicking on the Waste Disposal tile on the EHS website, located here:

https://ehs.unm.edu/waste-management/index.html

9.6 Wastes That Require Special Handling

9.6.a Unknowns

Unlabeled chemical containers and unknown/unlabeled waste containers are considered “unknowns” and must be labeled as such upon discovery. Before unknowns can be transported for disposal, they must undergo hazardous characterization testing. Contact EHS at 505-277-2753 or chemsafety-L@list.unm.edu to coordinate testing and disposal of unknowns.

9.6.b Peroxide Formers

Certain chemicals can form dangerous concentrations of peroxides when exposed to air, moisture or light and upon prolonged storage. The peroxides that form may explode with extreme violence when concentrated by evaporation or distillation, when combined with other compounds or when disturbed by unusual heat, shock or friction. Peroxide formation is accelerated in opened and partially emptied containers.

Peroxide formers fall under one of four classes:

Class A – Severe Peroxide Hazard. Extremely hazardous. Chemicals that form explosive levels of peroxides without concentration and are capable of peroxide formation even when unopened. *Discard three months after receiving the container. Do not test if suspected or known to contain peroxides, as opening the container may cause a reaction*. Examples include butadiene, divinyl ether, isopropyl ether, potassium metal, sodium amide, tetrafluoroethylene.

Class B – Concentration Hazard. Chemicals that form explosive levels of peroxides after concentration. *Test for presence of peroxides monthly after opening and reduce peroxides if present after 12 months.* Examples include acetaldehyde, benzyl alcohol, cyclohexene, diethyl ether, dioxanes, furan, tetrahydrofuran, vinyl ethers, secondary alcohols.

Class C – Shock and Heat Sensitive. Chemicals that are highly reactive and can auto-polymerize as a result of internal peroxide accumulation. The peroxides formed in these reactions are extremely shock- and heat-sensitive. Examples include acrylic acid, butadiene gas, chloroprene, styrene, vinylpyridene.

Class D – Potential Peroxide-Forming Chemicals. May form peroxides but cannot be clearly categorized in Class A, B, or C. Examples include acrolein, allyl ether, benzyl ether, isoamyl ether, 1-pentene.

Ensure containers of peroxide-forming chemicals are kept tightly sealed to avoid unnecessary evaporation, as this inhibits the stabilizers that are sometimes added. Visually inspect containers periodically to ensure they are free of exterior contamination or crystallization. **If crystallization is present within or on the exterior of a container, do not handle the container and contact EHS immediately.** Secure the immediate area and restrict access to the container until it can be evaluated by EHS personnel.

Each container of peroxide-forming chemicals should be dated upon arrival in the laboratory and dated each time the container is opened and/or tested. It is imperative that all lab personnel who work with peroxide formers are aware of the hazards and know how to handle and store the material safely. Use of any peroxide former at UNM requires a lab-specific SOP.

9.6.c Biohazardous and Medical Waste

Biohazardous and medical waste includes material such as:

- Sharps waste (used needles, lancets, scalpels, razor blades, broken glass)
- Human and non-human primate blood, tissue, bodily fluids and cell lines
- Cultures and stocks of pathogenic agents

- Recombinant DNA (rDNA)
- Animal waste, carcasses and body parts that have been exposed to rDNA or any pathogenic agents
- Human pathological waste

PIs and lab personnel are responsible for identifying, packaging, and properly decontaminating biohazardous waste generated in their laboratories prior to disposal. For assistance with biohazardous waste assessments and classifications, contact the Biosafety Office at 505-272-8001. For assistance with coordinating biohazardous waste disposal, contact EHS at 505-277-2753.

10.0 CHEMICAL EXPOSURE MONITORING & MEDICAL SURVEILLANCE

10.1 Regulatory Requirements

OSHA requires that all employers measure an employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance exceed the action level or the exposure limit. Some of the substances which have a specific OSHA standard include:

- Asbestos
- Benzene
- Beryllium
- Formaldehyde
- Lead
- Dichloromethane
- Radioactive Materials
- Particularly Hazardous Substances

OSHA has established Permissible Exposure Limits (PELs) for these (and many other) substances. PELs are based on an 8-hour Time Weighted Average (TWA) exposure. PELs are the maximum TWA concentration of an airborne contaminant that a worker can be exposed to in an 8-hour day without the use of respiratory protection. OSHA has also established Short Term Exposure Limits (STELs) as the maximum TWA concentration that a worker can be exposed to during any 15-minute period, provided the daily PEL is not exceeded, and the Ceiling (C) concentration, which is the concentration that cannot be exceeded at any time.

10.2 Chemical Exposure Assessment

All UNM employees require protection from exposure to hazardous chemicals above PELs, STELs and Ceiling concentrations. PIs, lab managers and supervisors are responsible for assessing the hazards. For concerns about chemical exposure, contact EHS for a consultation. In the event that EHS determines chemical exposure monitoring is necessary, a UNM-contracted industrial hygienist will be brought in to provide these services.

10.3 Medical Surveillance

In the event that chemical exposure monitoring determines an employee exposure to be over the Action Level or the PEL for a substance with a specific OSHA standard (e.g. formaldehyde, lead, etc.), the medical surveillance provisions of that standard shall be followed. It is the responsibility of the PI or supervisor to ensure that any necessary medical surveillance requirements are met. When necessary, EHS will make recommendations regarding adjustments to engineering controls or administrative procedures to maintain exposure below any applicable PEL. If the use of a respirator is necessary to maintain exposure below PELs, UNM will provide, at no cost to the employee, the proper respiratory equipment and training.

10.4 Medical Consultation

All UNM employees who work with hazardous chemicals shall have an opportunity to receive a free medical evaluation, including supplemental examinations which the evaluating physician determines necessary, under the following circumstances:

- Whenever they develop signs or symptoms associated with a hazardous chemical to which the worker may have been exposed in a laboratory.
- Where exposure monitoring reveals an exposure level routinely above the OSHA action level (or in the absence of an OSHA action level, the PEL or recommended exposure levels established by the National Institute for Occupational Safety & Health (NIOSH) or the American Conference of Governmental Industrial Hygienists (ACGIH).
- Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of hazardous exposure.

All medical examinations and consultations will be performed by or under the direct supervision of a licensed physician and be provided without cost to the employee, without loss of pay and at a reasonable time and place.

Employees may obtain free medical consultation regarding concerns about chemical or other occupational exposures by contacting Employee Occupational Health Services (EOHS) at 505-272-8043. Students with concerns about chemical or other occupational exposures should contact Student Health Services at 505-277-3136.

11.0 LABORATORY AUDITS & INSPECTIONS

11.1 Self-Audits

The PI, lab manager, or Deputy Chemical Hygiene Officer shall conduct and document an annual self-audit to assess laboratory compliance with the Chemical Hygiene Plan. A copy of the self-audit must be emailed to EHS (chemsafety-L@list.unm.edu) and should be kept in the lab's CHP binder. The UNM Laboratory Self-Audit Form is included as an attachment.

11.2 Annual Inspections

As required by the New Mexico Environment Department, EHS conducts annual inspections of all UNM laboratories. In general, the inspection process includes:

1. Initial notification and scheduling of the inspection
2. Document request and review (training documents, SOPs, self-audits, lab-specific CHP binder)
3. On-site inspection of the laboratory
4. Issuance of the inspection report
5. Follow-up inspection, if warranted

Inspection findings are documented in a web-based software system that subsequently issues an inspection report to the PI, the Department Chair and the Dean. Follow-up inspections are conducted when warranted. The inspection form used for annual inspections is the same as the Laboratory Self-Audit Form.

11.3 Safety Liaison

Each lab group must have an assigned safety liaison who is responsible for meeting with EHS during the annual inspection and who acts as the go-to person for EHS for safety-related lab issues. The safety liaison should be a faculty member, a staff scientist or engineer, or a lab manager who is familiar with all laboratory operations. Graduate students should not be designated as a safety liaison.

12.0 HAZARDOUS CHEMICAL SPILLS, ACCIDENTS & EMERGENCY RESPONSE

Each laboratory should create an emergency response plan that includes instructions on what to do in the event of a chemical spill, accident, medical emergency, fire, or unintended release of energy. The plan should be specific to the work done in the laboratory and should include emergency contact phone numbers, types of chemicals present, possible sources of injury, and location of spill kits.

All lab workers, including students, must be trained on the lab's spill response procedures before working with the lab's hazardous chemicals. It is the responsibility of the PI, lab supervisor and/or Deputy Chemical Hygiene Officer to provide training, spill control clean-up materials, and PPE appropriate for the chemicals being handled in the lab.

12.1 Hazardous Chemical Spills

12.1.a Minor Spills

A minor chemical spill (1L or less) is one that does not present an imminent danger to people, property, or the environment, and the staff where the spill occurred is capable of cleaning it up without the assistance of EHS and/or emergency personnel (no additional PPE or personnel are required beyond normal operations). Laboratories should develop procedures specific to their work for the clean-up of minor spills. This should include what qualifies as a minor spill. If you need help developing a plan, contact EHS.

All lab personnel shall be trained by the PI, lab manager or supervisor on how to clean up a minor spill using the lab's spill kit. Spill kits must contain absorbents, trash bags for spill cleanup materials disposal, PPE (gloves, splash goggles) and blank waste labels.

12.1.b Major Spills

A major spill is a large spill (greater than 1L) or a spill of any size of an acutely toxic substance. A major spill presents an imminent danger to people, property, or the environment, and is not easily controlled by the worker. Lab personnel should only clean up major spills after they have received appropriate training and when appropriate spill cleanup materials and PPE are readily available. Major spills should be defined within a laboratory's spill clean-up plan.

If a chemical spill occurs outside a building and the spill has the potential for adversely impacting storm water quality (i.e. the spill may reach a storm drain), immediately contact UNM Police at 505-277-2241 and EHS at 505-277-2753.

Manage all materials used to clean up a hazardous chemical spill as though they contain the hazardous chemical, and in accordance with the requirements of the Hazardous Waste Management section (section 9.0) of this plan.

In the event of a major spill for which personnel *are not* trained and prepared, and particularly if any person has been significantly exposed, contaminated or injured to such an extent that medical or other outside assistance is required, follow the E.A.R. steps:

Evacuate affected area and close doors;

Alert Campus Police by calling 911; and

Remain close to the phone, if requested to do so, until contacted by emergency responders.

12.2 Accidents/Incidents

12.2.a Reporting

Despite our best efforts to be careful and safe, accidents and incidents occur. In order to improve the safety of our workplace, we need the opportunity to learn why an accident or incident occurred. This is why it is very important that you report these occurrences, whether they are big or small, major or minor. Reporting is also a vital step in the process of fulfilling a Worker's Compensation claim.

Accidents and incidents that should be reported include, but are not limited to, *all* work-related injuries and illnesses (e.g. falls, cuts, chemical exposures); anything that causes property damage (e.g. fires, floods); and spills greater than 1L of hazardous chemicals.

Accidents and incidents must be immediately reported to the supervisor and to EHS when safe to do so. Priority must always be the safety and health of those impacted by an accident or incident. To report an accident, incident, spill or near-miss to EHS:

- During normal business hours, call 505-277-2753
- After hours or weekends, dial 505-951-0194 (this is a pager), then enter your callback number after the beep
- Anytime, via the EHS Accident, Incident, Near Miss & Spill Reporting Form (https://ehs.unm.edu/accident-incident-spill-reporting/index.html)

12.2.b Medical Care & Injuries

Medical care for laboratory personnel may be required in the event of physical and/or chemical-related injuries such as:

- Chemical inhalation
- Chemical burns
- Cryogenic burns

- Cuts or punctures
- Electrical shocks

Minor Injuries

If comfortable doing so, lab personnel may treat minor injuries such as superficial cuts and scrapes with medical supplies from the lab's first aid kit. If not comfortable doing so or if a first aid kit is not available, lab personnel with minor injuries may receive medical treatment at:

- Employee Occupational Health Services (for UNM employees) – within the Family Practice Center (UNM Building #248), 505-272-8043
- Student Health and Counseling (for UNM students) – SHAC – (UNM Building #73), 505-277-3136

Major Injuries

Major injuries are basically any injury that requires immediate medical treatment at an emergency room or hospital. Lacerations, burns, broken bones, eye injuries, and chemical exposures are some examples of major injuries. Any UNM employee or student suffering from a major injury should go to UNMH immediately.

If there is a chemical exposure that results in a medical emergency, a non-injured employee should call the hospital to report the chemical name, concentration, CAS number, apparent injury, and any other pertinent information. If possible, a copy of

the SDS for the chemical to which the injured person was exposed should be made available to medical personnel.

- UNMH emergency room charge nurse -- 505-604-9349

12.3 Emergency Response

12.3.a Emergency Equipment

Safety Showers and Eyewash Stations

Laboratories in which hazardous materials are used must be equipped with plumbed safety showers and eyewash stations. Safety showers and eyewash stations must be located such that they are accessible, require no more than ten (10) seconds to reach from the location of the hazard and are within 55 feet of the potential hazard (10 feet where strong corrosives are the hazard).

"Accessible" means that nothing can be stored beneath, around or in such a manner that would block access to this emergency equipment.

Safety showers must be activated at least **monthly** by lab personnel and/or FM. Eyewash stations (sink-mounted) must be activated at least **weekly** by **lab personnel**. The only exception to this is for eyewash stations that are part of a safety shower/eyewash station combo unit. These units typically drain to the floor and therefore it is not practical for lab personnel to activate them weekly. A tag showing the inspection/activation dates must be attached to each safety shower and eyewash station and available for inspection by EHS.

PIs, lab managers and/or supervisors must provide training on the location and proper use of the safety shower and eyewash station to all lab personnel who may be exposed to potentially injurious materials in the lab.

Fire Extinguishers

EHS inspects and maintains all fire extinguishers on UNM property. Discharged or damaged fire extinguishers must be replaced immediately; notify EHS for a replacement fire extinguisher. Do not block access to fire extinguishers within a laboratory. Do not relocate an extinguisher without first notifying EHS. If your laboratory needs a special type of fire extinguisher (i.e. CO_2, halotron), contact EHS.

More information on general fire safety and fire extinguisher use is available in the Fire Safety section of the EHS website, located here: https://ehs.unm.edu/fire-safety/index.html

13.0 RESOURCES & REFERENCES

13.1 Regulatory Guidance

OSHA 29 CFR 1910.1450 - Occupational Exposure to Hazardous Chemicals in Laboratories

OSHA 29 CFR 1910.1200 - Hazard Communication

OSHA 29 CFR 1910.132 - Personal Protective Equipment

OSHA 29 CFR 1910.134 - Respiratory Protection

OSHA 21 CFR 1301 - DEA Controlled Substances

13.2 Chemical Laboratory Safety

National Research Council, *Prudent Practices in the Laboratory*, The National Academies Press, Washington, 2011 (https://www.nap.edu/catalog/12654/prudent-practices-in-the-laboratory-handling-and-management-of-chemical)

American Chemical Society, Safety in Academic Chemistry Laboratories, 8th Ed., (www.acs.org)

13.3 Occupational Exposure Limits

OSHA 29 CFR 1910.1000, Air Contaminants, Table Z - list of OSHA PELs for hazardous chemicals

American Conference of Governmental Industrial Hygienists, *Guide to Occupational Exposure Values* (http://www.acgih.org/)

American Conference of Governmental Industrial Hygienist, *ACGIH Threshold Limit Values and Biological Exposure Indices* (http://www.acgih.org/)

13.4 Properties of Hazardous Chemicals

NIOSH Pocket Guide to Chemical Hazards - Industrial hygiene information on several hundred chemicals/classes including information on OSHA PELs, exposure routes, exposure symptoms, target organs, and first aid. Also contains personal protective equipment recommendations including respiratory protection. Available free online as either an online resource or downloadable format. (http://www.cdc.gov/niosh/npg/)

ToxNet - National Library of Medicine online toxicology, hazardous chemicals, environmental health, and toxic release databases. Available free online. (http://toxnet.nlm.nih.gov/)

HazMap - National Library of Medicine online information on the adverse effects of workplace exposures to chemical and biological agents. HazMap links hazardous chemicals, job tasks, industries and occupational diseases. Available free online. (http://hazmap.nlm.nih.gov/)

The Merck Index, 14th Edition - An encyclopedia of chemicals, drugs, and biologicals. Contains information on chemical and physical properties, hazards and therapeutic category, if applicable.

The Merck Index, Online: The Merck Index Online

Sax's Dangerous Properties of Industrial Materials, 12th Edition - Hazard reference source for 28,000 substances encountered in industry. Contains data on toxicology, flammability, reactivity, explosive potential, and regulatory information.

Bretherick's Handbook of Reactive Chemical Hazards, 7th Edition - Considered to be the best source of information on reactivity risks such as fire, explosion, toxic material releases or high energy events of chemicals, alone and in combination. Contains more

than 5,000 entries on single elements or compounds, and 5,000 entries on interactions between two more compounds.

14.0 ATTACHMENTS

ATTACHMENT 1

JHA TEMPLATE

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Enter information electronically in shaded areas, name Word document file, and save to device.
Or print document to enter information manually.

Job Hazard Analysis

Name of Lab:	**Department:** Click to enter text.
Activity or Process: Click to enter text.	**Building/Room:** Click to enter text.
Job Title: Click to enter text.	**Supervisor:** Click to enter text.
Prepared By: Click to enter text.	**Date:** Click to enter a date.

This document is the certification of hazard assessment for PPE for the workplace.

TASKS/STEPS	HAZARDS - CONSEQUENCES	CONTROLS (SAFEGUARDS)	PHOTO
1 Click to add first task/step.	• Click to add a hazard and consequence. • Click to add a hazard and consequence. • Click to add a hazard and consequence.	• Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control.	
2 Click to add second task/step.	• Click to add a hazard and consequence. • Click to add a hazard and consequence. • Click to add a hazard and consequence.	• Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control.	
3 Click to add third task/step.	• Click to add a hazard and consequence. • Click to add a hazard and consequence. • Click to add a hazard and consequence.	• Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control.	

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Enter information electronically in shaded areas, name Word document file, and save to device.
Or print document to enter information manually.

4 Click to add fourth task/step.	• Click to add a hazard and consequence. • Click to add a hazard and consequence. • Click to add a hazard and consequence.	• Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control.	
5 Click to add fifth task/step.	• Click to add a hazard and consequence. • Click to add a hazard and consequence. • Click to add a hazard and consequence.	• Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control. • Click to add a control.	

Required Training	**Required PPE**
Click to add required training. Click to add required training. Click to add required training. Click to add required training.	Click to add eye and face protection. Click to add head protection. Click to add body (foot, leg, hand, or arm) protection. Click to add hearing protection. Click to add respiratory protection.

I have read and understand the contents of the job hazard analysis and the controls required to mitigate the risks from the idenitified hazards

Name	**Date**
Click to enter text.	Click to enter a date.
Click to enter text.	Click to enter a date.
Click to enter text.	Click to enter a date.
Click to enter text.	Click to enter a date.
Click to enter text.	Click to enter a date.

ATTACHMENT 2

LIST OF TRAININGS

Required Trainings

The following trainings, which are available on Learning Central, must be taken **annually** by all UNM personnel who work in laboratories:

1. Laboratory Safety (35 minutes)
2. Hazard Communication/Chemical Safety (17 minutes)
3. Eyewashes & Safety Showers (7 minutes)

The following trainings, which are available on Learning Central, must be taken **annually** by all UNM personnel who work with these specific materials and/or equipment:

4. Fume hood Safety (20 minutes)
5. Biosafety Cabinets (20 minutes)
6. Introduction to Biosafety (20 minutes)
7. Bloodborne Pathogens (30 minutes)
8. Formaldehyde Safety (10 minutes)
9. Laboratory Compressed Gas Safety (20 minutes)
10. Laser Safety (20 minutes)
11. Liquid Nitrogen Safety (20 minutes)
12. Recombinant DNA (20 minutes)
13. Sharps Safety (20 minutes)
14. Handling Radioactive Material (20 minutes)
15. Introduction to Radiation Safety (20 minutes)
16. X-Ray Safety (15 minutes)

Lab-specific training, such as reading and signing lab-specific SOPs, will be conducted by the PI **annually** to ensure lab personnel are aware of lab-specific hazards and how to protect themselves from those hazards. These trainings must be documented by signing the signature page of the SOP and/or by using the following area:

Name of Training	**Name of Individual**	**Date**

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Name of Training	Name of Individual	Date

ATTACHMENT 3

LABORATORY HAZARD ASSESSMENT TOOL

LABORATORY HAZARD ASSESMENT TOOL

This Laboratory Hazard Assessment Tool (LHAT) facilitates identification of hazards and appropriate Personal Protective Equipment (PPE) to ensure the safety of lab personnel during work activities. The LHAT must be updated as hazards and personnel change, and at least once every 12 months, irrespective of changes to hazards or personnel. The LHAT will provide a summary report of hazards present in the laboratory and PPE recommended for laboratory workers.

Objectives for the Principal Investigator (PI)*:

- Identify hazards that are present in the lab
- Communicate lab hazards to personnel
- Identify what PPE is needed based on the hazard assessment
- Provide PPE training to lab personnel
- Maintain records of PPE assessment and training

Objectives for Lab Personnel:

- Receive information about hazards present in the lab
- Receive information about PPE needed to work in the lab
- Receive training on the necessary PPE

*For the purposes of this LHAT, all Faculty Principal Investigators, Chemical Hygiene Officers, Laboratory Supervisors, Department Laboratory Coordinators, Laboratory Managers, Instrumentation Laboratory Supervisors and Laboratory Administrators will be called “Principal Investigators”.

LABORATORY HAZARD ASSESMENT TOOL

The PI should conduct hazard assessments specific to activities in their laboratories at least once each calendar year. The Laboratory Hazard Assessment Tool identifies hazards to personnel and specifies personal protective equipment (PPE) to protect employees during work activities. The person conducting the assessment must verify at that end that it is complete and reflective of activities in their laboratories.

EHS personnel are available to assist with completing the Hazard Assessment form or with reviewing it once it has been completed. EHS may also be consulted for specific questions regarding PPE requirements.

Principal Investigator:		
Department:		
Principal Investigator phone:		
Principal Investigator email:		
Laboratory Safety Contact:		
Laboratory Safety Contact phone:		
Laboratory Safety Contact email:		
Laboratory name:		
Laboratory Locations: building(s) / room(s):		

The majority of PIs will only have one laboratory, which may encompass multiple rooms, but in rare cases PIs may have multiple laboratories with substantially different hazards (e.g., nanofabrication and biological testing laboratories). In these cases, the PI must have separate hazard assessments for each laboratory.

Activity Hazard Assessment

In this section, the Principal Investigator will:

- Conduct a hazard assessment of this laboratory to identify activities when PPE is needed to protect the laboratory personnel
- Certify the hazard assessment for the laboratory

The final assessment report will summarize the PPE applicable for the hazards identified in the laboratory.

The LHAT is a PPE selection tool only; administrative and engineering controls for specific activities are contained in your laboratory specific or local SOPs.

For activities that are described in a laboratory-specific Standard Operating Procedure the PPE specified in that SOP/UA shall take precedence.

Under UNM Policy, full length pants (or equivalent) and closed-toed/closed-heel shoes must be worn at all times by all individuals who are occupying or entering a laboratory or technical area.

All Laboratories ☐ This laboratory has been approved and posted as free of physical or chemical hazards. Skip all other sections.	
Active Researcher Attire (direct manipulation)	**Adjacent Individuals Attire**
✓ Long pants or equivalent ✓ Closed-toed/closed-heel shoes Note: Tights and panty hose are considered undergarments.	All personnel in laboratory room: ✓ Long pants or equivalent ✓ Closed-toed/closed-heel shoes

Note: The adjacent area flyover will read:

The distance (radius) for the adjacent area depends on the material hazards, the lab activity, and the lab configuration. Each laboratory can set distances according to their unique situation, but some examples of suggested distances are:

For pipetting small volumes (10 microliters) of acute toxins, the hazardous zone could be 1 meter.

For pouring small volumes (1 liter) of acidic solutions, the splash zone could be 2 meters.

For working with modest volumes (4 liters) of flammable liquids, the flash fire zone could be 3 meters.

For working with materials under pressure, the hazardous zone could be 10 meters.

For working with explosives, the danger zone is the entire laboratory.

Activity performed		Chemical Hazards			
Yes	**No**	**Activity in lab**	**Potential Hazards**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	C01. Working with small volumes (≤ 4L) of corrosive (e.g. acids, bases, etc.) liquids or solids	• Eye or skin damage • Low probability for a splash hazard	✓ Safety glasses ✓ Chemical-resistant gloves ✓ Lab coat	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	C02. Working with large volumes (>4L) of corrosive (e.g. acids, bases, etc.) liquids or solids	• Eye or skin damage. • Low probability for a splash hazard	✓ Safety glasses ✓ Chemical-resistant gloves ✓ Lab coat ✓ Chemical-resistant apron	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	C03. Working with corrosive or acutely toxic liquids or other materials which create a splash hazard	• Potential for poisoning, increased potential for eye and skin damage	✓ Chemical splash safety goggles ✓ Chemical-resistant gloves ✓ Lab coat ✓ Chemical-resistant apron	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	C04. Working with small volumes (≤ 1L) of flammable solvents/materials when no reasonable ignition sources are present	• Skin or eye damage, potential for poisoning through skin contact	✓ Safety glasses ✓ Chemical-resistant gloves ✓ Lab coat	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	C05. Working with large volumes (> 1L) of flammable solvents/materials	• Major Fire • Major skin or eye damage, potential for poisoning through skin contact	✓ Safety glasses ✓ Flame-resistant outer gloves ✓ Chemical-resistant inner gloves ✓ Flame-resistant lab coat (NFPA 2112)	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	C06. Working with any quantity of flammable materials (including solvents) when there is a risk of ignition; or areas where flammable vapors or gas may be present	• Major Fire • Major skin or eye damage, potential for poisoning through skin contact	✓ Safety glasses ✓ Flame-resistant outer gloves ✓ Chemical-resistant inner gloves ✓ Flame-resistant lab coat (NFPA 2112)	All personnel in lab/room: ✓ Safety glasses ✓ Flame-resistant lab coat (NFPA 2112)
☐	☐	C07. Working with toxic or hazardous chemicals (solid, liquid, or gas) (Including but not limited to GHS H301, H302, H311, H312, H331 H332)	• Skin or eye damage, potential for poisoning through skin contact	✓ Safety glasses (chemical splash goggles for large quantities) ✓ Chemical-resistant gloves ✓ Lab coat	In adjacent area: ✓ Safety glasses ✓ Lab coat

Activity performed		Chemical Hazards			
Yes	**No**	**Activity in lab**	**Potential Hazards**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	C08. Working with acutely toxic chemicals (GHS H300, H310, H330)	• Spills, splashes, ingestion, inhalation, absorption • Chemicals pose a high level of immediate health risk	✓ Safety glasses ✓ Chemical-resistant gloves ✓ Lab coat (plus chemical protective apron for H330)	All personnel in lab/room: ✓ Safety glasses ✓ Lab coat
☐	☐	C09. Working with pyrophoric (air reactive) chemicals or chemicals that in contact with water release flammable gases (water reactive) (GHS H25x and H26x)	• Severe skin and eye damage • Fire	For work outside of glove boxes: ✓ Safety glasses ✓ Face shield ✓ FR-rated outer gloves ✓ Chemical-resistant inner gloves ✓ Flame-resistant lab coat (NFPA 2112) Work in inert atmosphere when possible	All personnel in lab/room: ✓ Safety glasses ✓ Flame-resistant lab coat (NFPA 2112)
☐	☐	C10. Working with potentially explosive chemicals (e.g., nitrates, perchlorates, azides, nitrites, etc.)	• Splash, detonation, flying debris, skin and eye damage, fire	✓ Safety glasses ✓ Face shield, and/or use blast shield ✓ Chemical-resistant gloves ✓ Flame-resistant lab coat (NFPA 2112)	All personnel in lab/room: ✓ Safety glasses (or chemical splash goggles) ✓ Flame-resistant lab coat (NFPA 2112)
☐	☐	C11. Working with known or suspect human carcinogens (GHS H350, H351)	• Spills, splashes, ingestion, inhalation, absorption • High hazard cancer-causing agents	✓ Safety glasses ✓ Chemical-resistant gloves ✓ Lab coat	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	C12. Working with reproductive toxins (GHS H340, H341, H360, H361)	• Spills, splashes, ingestion, inhalation, absorption • Agents that affect reproductive capabilities, cause mutation and adversely affect fetal development	✓ Safety glasses ✓ Chemical-resistant gloves ✓ Lab coat	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	C13. Minor chemical spill cleanup	• Skin or eye damage, respiratory damage	✓ Safety glasses ✓ Chemical-resistant gloves ✓ Shoe covers ✓ Chemical-resistant apron ✓ Lab coat	In adjacent area: ✓ Safety glasses ✓ Lab coat

Activity performed		Chemical Hazards			
Yes	**No**	**Activity in lab**	**Potential Hazards**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	C14. Major chemical spill cleanup	• Multiple hazards	Call EHS for assistance	All personnel must evacuate lab
☐	☐	C15. Working with engineered nanomaterials	• Inhalation, exposure, dermal exposure	✓ Chemical splash goggles ✓ Chemical-resistant gloves ✓ Lab coat	All personnel in lab/room: ✓ Safety glasses ✓ Lab coat

Note: In all cases, chemical splash goggles can be substituted for safety glasses. For splash or impact protection, either chemical splash goggles or safety glasses need to be worn under face shields.

Note: All chemical spills need careful evaluation for the hazards presented and course of action. “Minor” and “Major” chemical spills might be determined by the quantities of material spilled or the health hazard presented.

Activity performed		Physical Hazards			
Yes	**No**	**Activity in lab**	**Potential Hazard**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	P01. Working with cryogenic liquids	• Major skin, tissue, or eye damage	✓ Safety glasses (chemical splash goggles for large volumes) ✓ Face shield ✓ Cryogenic protective gloves ✓ Lab coat	N/A
☐	☐	P02. Working with very cold equipment, dry ice or liquid nitrogen	• Frostbite, hypothermia	✓ Safety glasses ✓ Cryogenic protective gloves ✓ Lab coat (possibly warm clothing)	N/A
☐	☐	P03. Removing sealed vials from liquid nitrogen	• Vials may explode upon rapid warming • Cuts to face/neck and frostbite to hands	✓ Safety glasses ✓ Face shield ✓ Cryogenic protective gloves ✓ Lab coat	N/A
☐	☐	P04. Working with scalding liquids or hot equipment (e.g., autoclave, water bath, oil bath)	• Burns resulting in skin or eye damage	✓ Safety glasses (chemical splash goggles for large volumes) ✓ Thermal protective gloves (impermeable insulated gloves for liquids and steam) ✓ Lab coat	N/A
☐	☐	P05. Glassware washing	• Lacerations, chemical splash	✓ Safety glasses ✓ Chemical-resistant gloves ✓ Lab coat	N/A
☐	☐	P06. Working with loud equipment, noises, sounds, alarms, etc.	• Potential ear damage and hearing loss	✓ Hearing protection (consult EHS for SNR factor as needed)	✓ Hearing protection (consult EHS for SNR factor as needed)
☐	☐	P07. Working with a centrifuge	• Imbalanced rotor can lead to broken vials, cuts, exposure	✓ Safety glasses ✓ Disposable gloves ✓ Lab coat	N/A
☐	☐	P08. Working with a sonicator	• Ear damage, exposure	✓ Safety glasses ✓ Disposable gloves ✓ Hearing protection, as necessary (consult EHS for SNR factor as needed) ✓ Lab coat	N/A

Activity performed		Physical Hazards			
Yes	**No**	**Activity in lab**	**Potential Hazard**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	P09. Working with sharps (e.g. needles, razor blades, scalpels)	• Cuts, exposure	✓ Safety glasses ✓ Cut-resistant gloves ✓ Lab coat	N/A
☐	☐	P10. Working with an apparatus containing materials under pressure or vacuum	• Eye or skin damage	✓ Safety glasses ✓ Face shield (for high risk activities) ✓ Chemical-resistant gloves ✓ Lab coat ✓ Chemical-resistant apron (for high risk activities)	In adjacent area: ✓ Safety glasses ✓ Lab coat

Activity performed		Biological Hazards ☐ The laboratory has a BUA that addresses all of these items. Skip to next section.			
Yes	**No**	**Activity in lab**	**Potential Hazard**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	B01. Working with human or non-human primate blood, body fluids, tissues, cells or other potentially infectious material (OPIM) which may contain human bloodborne pathogens (BBP)	• Exposure to infectious material, sharps injuries	✓ Eye and mucous membrane protection (as appropriate for operations) ✓ Disposable gloves ✓ Disposable lab coat impervious to fluids	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	B02. Working with microbial agents (bacteria, virus, parasites, yeast, fungi, prions), recombinant DNA and/ or biological materials (cells, tissues, fluids) exposed to or likely to contain Risk Group 1 microbial agents or recombinant DNA (BSL-1)	• Eye irritation, sharps injury • Exposure of infectious material to those who may have personal health issues which make them more susceptible to infection; cross contamination of animal or extra laboratory areas	✓ Safety glasses ✓ Disposable gloves ✓ Lab coat	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	B03. Working with microbial agents, recombinant DNA and/or biological materials (cells, tissues, fluids) exposed to or likely to contain Risk Group 2 microbial agents or recombinant DNA (BSL-2)	• Exposure to infectious material, particularly through broken skin or mucous membranes, sharps injuries	✓ Safety glasses ✓ Double layer of disposable gloves ✓ Lab coat	All personnel in lab/room: ✓ Safety glasses ✓ Lab coat
☐	☐	B04. Working with microbial agents, recombinant DNA and/or biological materials (cells, tissues, fluids) exposed to or likely to contain Risk Group 2 microbial agents or recombinant DNA for which Biosafety Level 3 practices are required (BSL-2+)	• Exposure to infectious materials with high risk of exposure by contact with skin or mucous membranes and/or other potential or unknown routes of entry and/or increased consequences of exposure • Sharps injuries	✓ Safety glasses ✓ Double layer disposable gloves ✓ Lab coat or disposable lab coat	All personnel in lab/room: ✓ Safety glasses ✓ Lab coat or disposable lab coat

Activity performed		Biological Hazards			
Yes	**No**	**Activity in lab**	**Potential Hazard**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	B05. Working with microbial agents, recombinant DNA and/or biological materials (cells, tissues, fluids) exposed to or likely to contain Risk Group 3 microbial agents or recombinant DNA (BSL-3)	• Exposure to infectious materials with high risk of exposure, particularly through the inhalation route	✓ Safety glasses ✓ Double layer disposable gloves ✓ Shoe cover or dedicated shoe ✓ Bloodborne pathogen barrier coat or coveralls (preferred)	All personnel in lab/room: ✓ Respirator (N95 minimum, for some work a higher level may be required) ✓ Safety glasses ✓ Double layer disposable gloves ✓ Disposable shoe covers or dedicated shoe ✓ Bloodborne pathogen barrier coat or coveralls (preferred)
☐	☐	B06. Working with live animals- alone or in conjunction with Risk Group 1 microbial agents or recombinant DNA (ASBL-1)	• Animal bites, allergies, eye irritation, sharps injury • Exposure of infectious material to those who may have personal health issues which make them more susceptible to infection; cross contamination of animal or extra laboratory areas	✓ Safety glasses ✓ Disposable gloves ✓ Lab coat Additional PPE (e.g. puncture-resistant gloves) may be required based on risk assessment by the IBC & IACUC. Additional gowning (shoe covers, face mask) may be required for animal welfare purposes.	All personnel in lab/room: ✓ Safety glasses ✓ Lab coat
☐	☐	B07. Working with infected or potentially infectious live animals—alone or in conjunction with Risk Group 2 microbial agents or recombinant DNA (or materials exposed to RG-2 agents) (ABSL-2)	• Animal bites, exposure to infectious material, allergies, sharps injury	✓ Safety glasses ✓ Disposable gloves ✓ Bouffant/hair net ✓ Lab coat Additional PPE (e.g. puncture-resistant gloves) may be required based on risk assessment by the IBC & IACUC. Additional gowning (shoe covers, face mask) may be required for animal welfare purposes.	All personnel in lab/room: ✓ Safety glasses ✓ Bouffant/hair net ✓ Lab coat

		Radiological Hazards ☐The laboratory has a RUA and/or MUA that addresses all of these. Skip to next section.			
Yes	**No**	**Activity in lab**	**Potential Hazard**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	R01. Working with unsealed radioactive materials including generally licensed radioactive material or devices (e.g., uranyl acetate, uranyl nitrate, thorium, nitrate)	• Cell damage, potential spread of radioactive materials	✓ Safety glasses ✓ Impermeable gloves or chemical-resistant gloves ✓ Lab coat	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	R02. Working with unsealed radioactive materials in hazardous chemicals (corrosives, flammables, liquids, powders, etc.)	• Cell damage or spread of contamination plus hazards for the specific chemical	✓ Safety glasses (chemical splash goggles for splash hazard) ✓ Chemical-resistant gloves ✓ Lab coat *Note: Select gloves for applicable chemical hazards above.*	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	R03. Working with sealed radioactive sources or devices containing sources of radioactive materials (e.g., liquid scintillation counters, gas chromatographs/electron capture detectors, static eliminators, etc.)	• If sealed source is compromised due to removal from equipment or physical abuse: cell damage, potential spread of radioactive materials	PPE is not necessary under normal operating instructions *Note: Source may not be removed form device except by EHS or manufacturer.*	N/A

Activity performed		Laser Hazards ☐ The laboratory has an LUA that addresses all of these. Skip to next section.			
Yes	**No**	**Activity in lab**	**Potential Hazard**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	L01. Open Beam - Performing alignment, trouble-shooting or maintenance that requires working with an open beam and/or defeating the interlock(s) on any Class 3 or Class 4 laser system	• Eye damage	✓ Optical density and wavelength-specific safety glasses based on individual beam parameters	All personnel in laser use room: ✓ Optical density and wavelength-specific safety glasses based on individual beam parameters
☐	☐	L02. Open Beam - Viewing a Class 3R laser beam with magnifying optics	• Eye damage	✓ Optical density and wavelength-specific safety glasses based on individual beam parameters	N/A
☐	☐	L03. Open Beam - Working with a Class 3B laser open beam system with the potential for producing direct or specular reflections	• Eye damage	✓ Optical density and wavelength-specific safety glasses based on individual beam parameters ✓ Lab coat or appropriate clothes	All personnel in laser use room: ✓ Optical density and wavelength-specific safety glasses based on individual beam parameters ✓ Lab coat or appropriate clothes
☐	☐	L04. Open Beam - Working with a Class 4 laser open beam system with the potential for producing direct, specular or diffuse reflections	• Eye damage, skin damage	✓ Optical density and wavelength-specific safety glasses based on individual beam parameters ✓ Lab coat or appropriate clothes	All personnel in laser use room: ✓ Optical density and wavelength-specific safety glasses based on individual beam parameters ✓ Lab coat or appropriate clothes
☐	☐	L05. Non-Beam - Handling dye laser materials, such as dyes, chemicals, and solvents	• Cancer, explosion, fire	✓ Gloves, safety glasses, NFPA 2112 flame-resistant lab coat or coveralls	In adjacent area: ✓ Safety glasses ✓ Lab coat
☐	☐	L06. Non-Beam - Maintaining and repairing power sources for large Class 3B and Class 4 lasers	• Electrocution, explosion fire	✓ Electrical isolation mat ✓ Electrical protection lab coat (NPFA 70E) or coveralls	N/A
☐	☐	L07. Enclosed Beam - Using a Class 1 device housing a Class 3B or Class 4 enclosed or embedded laser with the potential for beam exposure during a Service Event	• Eye damage, skin damage	✓ Optical density and wavelength-specific safety glasses based on individual beam parameters ✓ Lab coat or appropriate clothes	All personnel in laser use room: ✓ Optical density and wavelength-specific safety glasses based on individual beam parameters ✓ Lab coat or appropriate clothes

Activity performed		Non-Ionizing Radiation Hazards			
Yes	**No**	**Activity in lab**	**Potential Hazard**	**Active Researcher PPE (Direct Manipulation)**	**Adjacent Individuals PPE**
☐	☐	N01. Working with sources of ultraviolet radiation.	• Conjunctivitis, corneal damage, skin redness	✓ UV face-shield ✓ Gloves ✓ Lab coat	In adjacent area with direct line of sight: ✓ UV face shield ✓ Lab coat
☐	☐	N02. Working with infrared emitting equipment (e.g. glass blowing).	• Cataracts, burns to cornea	✓ Appropriate shaded glasses ✓ Lab coat	In adjacent area with direct line of sight: ✓ Appropriate shaded glasses ✓ Lab coat

Unique or Lab-Specific Activities

If your lab conducts any additional or unique activities that are not listed above, identify the potential hazards and appropriate PPE then add these activities to the table below. If a lab activity is similar to but somewhat different than one of the common activities listed, include it in this section as well.

Activity in lab	Potential Hazard	Active Researcher PPE (Direct Manipulation)	Adjacent Individuals PPE

Hazard Assessment Certification: This certifies that you have conducted the hazard assessment.

Name and title of person conducting assessment

Name: _____ **Title:** _

Date assessment completed: _____

The following laboratory personnel have reviewed the Laboratory Hazard Assessment Tool specific to this laboratory and have received the following training:

1. What hazards are present in this laboratory
2. When PPE is necessary
3. What PPE is recommended
4. How to properly don, doff, adjust and wear PPE
5. Limitations of PPE
6. Proper care, maintenance, useful life, and disposal of PPE
7. General PPE safety practices (e.g. not wearing PPE outside the laboratory)

Lab Name:

Name	Training Date

Maintain a copy of the signed hazard assessment with lab safety records.

At this point in the application, the PI will be able to print:

- The Laboratory Hazard Assessment
- A Laboratory Roster
- An Individual Lab Personnel's Certification

End of Laboratory Hazard Assessment

ATTACHMENT 4

LAB SELF-AUDIT CHECKLIST

THE UNIVERSITY OF NEW MEXICO

CHEMICAL HYGIENE PLAN – ATTACHMENT 5

Laboratory Self-Audit Checklist

Email Completed Form to chemsafety-L@list.unm.edu

Building Name:			
Lab/Room Number:			
Department:			
Audited By:			
Date of Audit:			
#	**Item**	**Yes**	**Corrections Needed/Comments**
1	**Signage & Postings**		
1a	Warning/Restriction signs posted (or NA)		
1b	Emergency phone #s posted		
1c	PI and Lab Manager phone #s posted		
2	**Personal Protective Equipment (PPE)**		
2a	Gloves available		
2b	Eye protection available		
2c	Lab coats available		
2d	Rubber apron available (or NA)		
2e	Long pants, closed-toe shoes only		
3	**General Hazards**		
3a	Minimum of 28" clearance in aisles		
3b	Doorways unobstructed		
3c	No excess combustibles (empty boxes, etc.)		
3d	No eating or drinking in lab		
4	**Safety Equipment**		
4a	Fire extinguisher within 75'		
4b	Fire extinguisher is mounted & unobstructed		
4c	Fire extinguisher is inspected & charged		
4d	Safety shower within 55' or 10 seconds		
4e	Safety shower is unobstructed		
4f	Safety shower inspected monthly		
4g	Eyewash station within 55' or 10 seconds		
4h	Eyewash station is mounted & unobstructed		
4i	Eyewash station inspected monthly		
4j	First aid kit available		
4k	Emergency lighting available		
5	**Fume Hoods & Biosafety Cabinets**		
5a	Fume hood working		
5b	Fume hood inspected annually		
5c	Fume hood sash kept closed when not in use		
5d	No excess storage in fume hood		

5e	Biosafety cabinet inspected annually		
6	**Electrical Hazards**		
6a	Extension cords temporary only		
6b	Extension cords not daisy-chained		
6c	Extension cords not a trip hazard		
6d	Power strips for computer equipment only		
6e	GFCI outlets within 6' of water source		
6f	Electrical panels unobstructed		
7	**Refrigerators & Freezers**		
7a	Posted with "No Food or Drink" signage (or NA)		
7b	No food or drink stored in unit		
7c	No flammables unless explosion-proof unit		
8	**Chemical Storage**		
8a	Stored by hazard class		
8b	Incompatibles stored separately		
8c	Corrosives & solvents stored in spill trays		
8d	Flammables stored in flammable cabinet		
8e	PHS & radioactives stored in secure area		
8f	Peroxide formers dated when last opened		
8g	All chemical containers properly labeled		
9	**Chemical Inventory**		
9a	Up-to-date inventory in RMM		
9b	SDS available (electronic or paper)		
10	**Waste Chemicals**		
10a	All waste containers properly labeled		
10b	Waste containers closed (no funnels in mouth)		
10c	Waste containers stored in lab where created		
11	**Spill Procedures**		
11a	Spill kits available		
11b	Spill procedures established		
12	**Compressed Gases**		
12a	Cylinders properly labeled		
12b	Posted with "Empty" or "In Use" signage		
12c	Secured with straps or chains		
12d	Valve protection cap in place when not in use		
12e	O2 cylinders stored away from oils, combustibles		
13	**Hydrofluoric Acid**		

13a	Rubber/chemical resistant PPE available		
13b	Safety goggles available		
13c	Fume hood available		
13d	Calcium gluconate available		
13e	HF exposure procedures in place		
14	**Training & Lab-Specific CHP**		
14a	Required trainings & refreshers complete		
14b	Training documentation available		
14c	Lab-Specific CHP available		

Additional notes or comments:

ATTACHMENT 5

CHEMICAL COMPATIBILITY CHART

DANGEROUS GOODS & COMBUSTIBLE LIQUIDS STORAGE COMPATIBILITY CHART

Class or Subsidiary Risk		FLAMMABLE GAS 2	NON-FLAMMABLE NON-TOXIC GAS 2	TOXIC GAS 2	OXIDIZING GAS 2	FLAMMABLE LIQUID 3	FLAMMABLE SOLID 4	SPONTANEOUSLY COMBUSTIBLE 4	DANGEROUS WHEN WET 4	OXIDIZING AGENT 5.1	ORGANIC PEROXIDE 5.2	TOXIC 6	CORROSIVE 8
FLAMMABLE GASES		OK TO STORE TOGETHER	OK TO STORE TOGETHER	SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 3m	ISOLATE	SEGREGATE At least 3m	SEGREGATE At least 5m
NON TOXIC NON FLAMMABLE GASES		OK TO STORE TOGETHER	OK TO STORE TOGETHER	OK TO STORE TOGETHER	OK TO STORE TOGETHER	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 3m	ISOLATE	SEGREGATE At least 3m	SEGREGATE At least 5m
TOXIC GAS		SEGREGATE At least 3m	OK TO STORE TOGETHER	MAY NOT BE COMPATIBLE CHECK MSDS AND NOTES	SEGREGATE At least 3m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 3m	ISOLATE	SEGREGATE At least 3m	SEGREGATE At least 5m
OXIDIZING GAS		SEGREGATE At least 3m	OK TO STORE TOGETHER	SEGREGATE At least 3m	OK TO STORE TOGETHER	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 3m	ISOLATE	SEGREGATE At least 3m	SEGREGATE At least 5m
FLAMMABLE LIQUIDS + COMBUSTIBLE LIQUIDS		SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	OK TO STORE TOGETHER	SEGREGATE At least 3m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	ISOLATE	SEGREGATE At least 5m	SEGREGATE At least 3m
FLAMMABLE SOLID		SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 3m	OK TO STORE TOGETHER	SEGREGATE At least 3m	SEGREGATE At least 5m	SEGREGATE At least 3m	ISOLATE	SEGREGATE At least 3m	MAY NOT BE COMPATIBLE CHECK MSDS AND NOTES
SPONTANEOUSLY COMBUSTIBLE		SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 3m	OK TO STORE TOGETHER	SEGREGATE At least 5m	SEGREGATE At least 5m	ISOLATE	SEGREGATE At least 3m	SEGREGATE At least 3m
DANGEROUS WHEN WET		SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	OK TO STORE TOGETHER	SEGREGATE At least 5m	ISOLATE	SEGREGATE At least 3m	SEGREGATE At least 5m
OXIDIZING AGENT		SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 5m	KEEP APART	SEGREGATE At least 5m	SEGREGATE At least 5m	MAY NOT BE COMPATIBLE CHECK MSDS AND NOTES	ISOLATE	SEGREGATE At least 3m	SEGREGATE At least 3m
ORGANIC PEROXIDE		ISOLATE	ISOLATE	ISOLATE	ISOLATE	ISOLATE	ISOLATE	ISOLATE	ISOLATE	ISOLATE	OK TO STORE TOGETHER	ISOLATE	SEGREGATE At least 3m
TOXIC SUBSTANCES		SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 5m	SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 3m	ISOLATE	OK TO STORE TOGETHER	SEGREGATE At least 5m
CORROSIVE		SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 5m	SEGREGATE At least 3m	MAY NOT BE COMPATIBLE CHECK MSDS AND NOTES	SEGREGATE At least 3m	SEGREGATE At least 5m	SEGREGATE At least 3m	SEGREGATE At least 3m	SEGREGATE At least 5m	MAY NOT BE COMPATIBLE CHECK MSDS AND NOTES

ATTACHMENT 6

PERMEATION/DEGRADATION RESISTANCE GUIDE FOR CHEMICAL RESISTANT GLOVES

Chemical Resistance Guide

8th EDITION

Permeation & Degradation Data

Ansell

Fisher Safety

Permeation/Degradation Resistance Guide for Ansell Chemical Resistant Gloves

Introduction to the 8th Edition

When reviewing the following recommendations, remember that tests are conducted under laboratory conditions, and that actual workplace conditions usually dictate a *combination* of performance capabilities. A product's resistance to cuts, punctures, and abrasion must also be taken into account as a critical usage factor. A glove with excellent permeation resistance may not be adequate if it tears or punctures easily. Always factor in the physical performance requirements of the job or application when selecting a chemical-resistant glove.

Ansell's ASTM standard permeation and degradation tests are presented on the following pages as an aid in determining the general suitability of various products for use with specific chemicals. Because the conditions of ultimate use are beyond our control, and because we cannot run permeation tests in all possible work environments and across all combinations of chemicals and solutions, these recommendations are advisory only. THE SUITABILITY OF THE PRODUCT FOR A SPECIFIC JOB MUST BE DETERMINED BY TESTING BY THE PURCHASER.

Definition of Key Terms

Permeation is a process by which a chemical can pass through a protective film without going through pinholes, pores, or other visible openings. Individual molecules of the chemical enter the film, and "squirm" through by passing between the molecules of the glove compound or film. In many cases the permeated material may appear unchanged to the human eye.

Chemical permeation can be described in simple terms by comparing it to what happens to the air in a balloon after several hours. Although there are no holes or defects, and the balloon is tightly sealed, the air gradually passes through (permeates) its walls and escapes. This simple example uses gas permeation, but the principle is the same with liquids or chemicals.

Permeation data are presented in two values: **Breakthrough** time and **Rate.** Breakthrough times (min.) are the times observed from the start of the test to first detection of the chemical on the other side of the sample (for test methodology, see the outside back cover of this guide). These times represent how long a glove can be expected to provide effective permeation resistance when totally immersed in the test chemical.

Permeation rates are the highest *flow rates* recorded for the permeating chemicals through the glove samples during a six-hour or eight-hour test. These qualitative ratings are comparisons of permeation rates to each other.

Degradation is a reduction in one or more physical properties of a glove material due to contact with a chemical. Certain glove materials may become hard, stiff, or brittle, or they may grow softer, weaker, and swell to several times their original size. If a chemical has a significant impact on the physical properties of a glove material, its permeation resistance is quickly impaired. For this reason, glove/chemical combinations rated "Poor" are usually not tested for permeation resistance, and combinations rated "Not Recommended" are never tested for permeation resistance. Please note, however, that permeation and degradation do not always correlate.

The overall Degradation **Rating** for each chemical is explained in "How To Read The Charts."

How to Read the Charts

Three categories of data are represented for each Ansell product and corresponding chemical: 1) overall degradation resistance rating; 2) permeation breakthrough time, and 3) permeation rate.

Standards for Color-Coding

A glove-chemical combination receives **GREEN** if either set of the following conditions is met:

- The Degradation Rating is Excellent or Good
- The Permeation Breakthrough Time is 30 minutes or greater
- The Permeation Rate is Excellent, Very Good, or Good

OR

- The Permeation Rating is not specified
- The Permeation Breakthrough Time is 240 minutes or greater
- The Degradation Rating is Excellent, or Good

A glove-chemical combination receives **RED** if either set of the following conditions is met:

- The Degradation Rating is Poor or Not Recommended

OR

- The Degradation Rating is Degrades with Delamination (DD)
- The Permeation Breakthrough Time is less than 20 minutes

All other glove-chemical combinations receive **YELLOW**. In other words, any glove-chemical combination not meeting either set of conditions required for Green, and not having a Red degradation rating of either Poor or Not Recommended, receives a **YELLOW** rating.

Why is a product with a shorter breakthrough time sometimes given a better rating than one with a longer breakthrough time?

One glove has a breakthrough time of just 4 minutes. It is rated "very good," while another with a breakthrough time of 30 minutes is rated only "fair." Why? The reason is simple: in some cases the ***rate*** is more significant than the ***time.***

Imagine connecting two hoses of the same length but different diameters to a faucet using a "Y" connector. When you turn on the water, what happens? Water goes through the smaller hose first because there is less space inside that needs to be filled. But when the water finally gets through the larger hose it really gushes out. In only a few minutes, the larger hose will discharge much more water than the smaller one, even though the smaller one started first.

The situation is similar with gloves. A combination of a short breakthrough time and a low permeation rate may expose a glove wearer to less chemical than a combination of a longer breakthrough time and a much higher breakthrough rate, if the glove is worn long enough.

Key to Permeation Rate

	Drops/hr Through a Glove (eyedropper-size drops)
E – Excellent; permeation rate of less than 0.9 µg/cm²/min.	0 to 1/2 drop
VG – Very Good; permeation rate of less than 9 µg/cm²/min.	1 to 5 drops
G – Good; permeation rate of less than 90 µg/cm²/min.	6 to 50 drops
F – Fair; permeation rate of less than 900 µg/cm²/min.	51 to 500 drops
P – Poor; permeation rate of less than 9000 µg/cm²/min.	501 to 5000 drops
NR – Not Recommended; permeation rate greater than 9000 µg/cm²/min.	5001 drops up

Key to Permeation Breakthrough

>Greater than (time) <Less than (time)

Key to Degradation Ratings

E– Excellent; fluid has very little degrading effect.

G– Good; fluid has minor degrading effect.

F– Fair; fluid has moderate degrading effect.

P– Poor; fluid has pronounced degrading effect.

DD–Degrades the outer layer and delaminates it.

NR– Not Recommended; fluid has severe degrading effect.

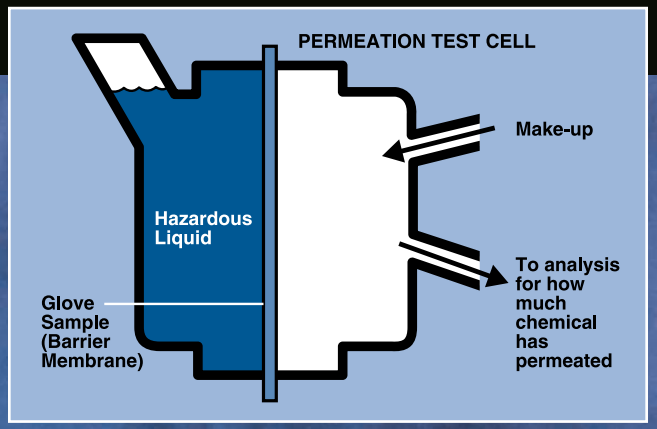
DD is a new degradation rating that applies to Viton/butyl gloves versus certain chemicals. It means "Degrades and Delaminates". If a chemical causes severe swelling of Viton but has little effect on butyl, the adhesion between these two rubber layers can be overcome under the relatively severe continuous liquid contact that is part of an ASTM or CEN standard permeation test. The end result of this stress is Viton "blisters" or even complete layer separation. The damage is likely to be permanent.

In cases such as these the butyl layer is providing most of the protection. But if the end use involves only the possibility of splash or intermittent contact so that the Viton layer never absorbs enough chemical to swell and delaminate, Viton/butyl gloves might still be the best choice. The ultimate decision on when to use plain butyl and when to use Viton/butyl will depend on the overall chemical mix in your facility and on the degree of exposure to each.

Specific Gloves Used for Testing

	Degradation and Permeation
Laminated LCP™ Film	Barrier® 2-100 (2.5 mil/0.06 mm)
Nitrile	Sol-Vex® 37-165 (22 mil/0.56 mm)
Neoprene Unsupported	29-865 (18 mil/0.46 mm)
Polyvinyl Alcohol Supported	PVA™
Polyvinyl Chloride Supported	Snorkel®
Natural Rubber Latex	Canners 343 (20 mil/0.51 mm)
Neoprene/Latex Blend	Chemi-Pro® 224 (27 mil/0.68 mm)
Butyl Unsupported	ChemTek® 38-320 (20 mil/0.51 mm)
Viton/Butyl Unsupported	ChemTek® 38-612 (12 mil/0.30 mm)

Methodology



Permeation Testing

Ansell conducts permeation testing in accordance with ASTM Method F 739 standards. A specimen is cut from the glove and clamped into a test cell as a barrier membrane (see illustration). The "exterior" side of the specimen is exposed to a hazardous chemical. At timed intervals, the unexposed "interior" side of the test cell is checked for the presence of the permeated chemical and the extent to which it may have permeated the glove material.

This standard allows a variety of options in analytical technique and collection media. At Ansell, dry nitrogen is the most common medium and gas chromatography with FID detection is the most common analytical technique. Our Research Department also uses liquids such as distilled water and hexane as collecting media, and techniques such as conductivity, colorimetry, and liquid chromatography for analysis of the collecting liquid.

Degradation Testing

Patches of the test material are cut from the product. These patches are weighed and measured, and then completely immersed in the test chemical for 30 minutes. The percentage of change in size is determined, and the patches are then dried to calculate the percentage of weight change. Observed physical changes are also reported. Ratings are based on the combined data.

Fisher Safety

For customer service, call 1-800-772-6733.
To fax and order, use 1-800-772-7702.
To order online: www.fishersafety.com

Ansell

Ansell Healthcare

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UNITED STATES- 200 Schulz Dr.; Red Bank, NJ 07701; Tel. 800 800 0444 Fax. 800 800 0445

8th EDITION Permeation/Degradation Resistance Guide for Ansell Gloves

The first square in each column for each glove type is color coded to provide an overall rating for both Degradation and Permeation. The letter in each colored square is for Degradation alone.

- GREEN: The glove is very well suited for application with that chemical.
- YELLOW: The glove is suitable for that application under careful control of its use.
- RED: Avoid use of the glove with this chemical.

SPECIAL NOTE: The chemicals in this guide highlighted in BLUE are experimental carcinogens, according to the ninth edition of Sax' *Dangerous Properties of Industrial Materials.* Chemicals highlighted in GRAY are listed as suspected carcinogens, experimental carcinogens at extremely high dosages, and other materials which pose a lesser risk of cancer.









CHEMICAL	LAMINATE FILM BARRIER™ Style: 2-100 ASPN: 902212 FISHER NUMBER: 19-048-754			NITRILE SOL-VEX® Style: 37-165 ASPN: 117209 FISHER NUMBER: 11-391-138C			UNSUPPORTED NEOPRENE 29-SERIES Style: 29-865 ASPN: 116313 FISHER NUMBER: 11-391-130C			SUPPORTED POLYVINYL ALCOHOL PVA™ Style: 15-554 ASPN: 214306 FISHER NUMBER: 19-018-120			POLYVINYL CHLORIDE (Vinyl) SNORKEL® Style: 4-412 ASPN: 211134 FISHER NUMBER: 19-014-903			NATURAL RUBBER *CANNERS AND HANDLERS™ Style: 343 ASPN: 193435 FISHER NUMBER: 19-019-602			NEOPRENE/ NATURAL RUBBER BLEND *CHEMI-PRO® Style: 224 ASPN: 192245 FISHER NUMBER: 19-014-486			BUTYL UNSUPPORTED CHEMTEK™ BUTYL Style: 38-320 ASPN: 189026 FISHER NUMBER: 19-161-435			VITON/BUTYL UNSUPPORTED CHEMTEK™ VITON/BUTYL Style: 38-612 ASPN: 189033 FISHER NUMBER: 19-161-442		
	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate
1. Acetaldehyde	■	380	E	P	—	—	E	10	F	NR	—	—	NR	—	—	E	13	F	E	10	F	—	—	—	—	—	—
2. Acetic Acid, Glacial, 99.7%	■	150	—	G	158	—	E	390	—	NR	—	—	F	45	G	E	110	—	E	263	—	E	>480	—	DD	>480	—
3. Acetone	▲	>480	E	NR	—	—	G	10	F	P	143	G	NR	<5	—	E	10	F	G	12	G	E	>480	E	DD	93	VG
4. Acetonitrile	▲	>480	E	F	30	F	E	20	VG	■	150	G	NR	—	—	E	4	VG	E	13	VG	E	>480	E	DD	70	E
5. Acrylic Acid	—	—	—	G	120	—	E	395	—	NR	—	—	NR	—	—	E	80	—	E	67	—	—	—	—	—	—	—
6. Acrylonitrile	▲	>480	E	—	—	—	—	—	—	▲	>480	—	—	—	—	E	5	F	—	—	—	E	>480	—	E	>480	—
7. Allyl Alcohol	▲	>480	E	F	140	F	E	140	VG	P	—	—	P	60	G	E	10	VG	E	20	VG	E	>480	—	E	>180	—
8. Ammonia Gas	■	19	E	▲	>480	E	▲	>480	—	—	—	—	—	—	—	—	—	—	■	27	E	—	—	—	—	—	—
9. Ammonium Fluoride, 40%	▲	>480	E	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
10. Ammonium Hydroxide, Conc. (28-30% Ammonia)	E	30	—	E	>360	—	E	250	—	NR	—	—	E	240	—	E	90	—	E	247	—	E	>480	—	E	>480	—
11. n-Amyl Acetate	▲	470	E	E	198	G	NR	—	—	G	>360	E	P	—	—	NR	—	—	P	—	—	E	128	G	F	<10	F
12. Amyl Alcohol	▲	>480	E	E	>480	E	E	348	VG	G	180	G	G	12	E	E	25	VG	E	52	VG	E	>480	E	E	>480	E
13. Aniline	▲	>480	E	NR	—	—	E	145	F	F	>360	E	F	62	G	E	25	VG	E	82	G	E	>480	E	E	>480	E
14. Aqua Regia	—	—	—	F	>360	—	G	>480	—	NR	—	—	G	120	—	NR	—	—	G	193	—	E	>480	—	E	>480	—
15. Benzaldehyde	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	G	10	VG	G	27	F	E	>480	E	E	100	E
16. Benzene (Benzol)	▲	>480	E	P	—	—	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	E	20	F	E	253	VG
17. Benzotrichloride	▲	>480	E	E	>480	E	NR	—	—	—	—	—	G	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—
18. Benzotrifluoride	▲	>480	E	E	170	G	—	—	—	—	—	—	G	<10	F	P	50	G	P	—	—	—	—	—	—	—	—
19. Bromine Water	—	—	—	E	>480	E	E	>480	E	NR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20. 1-Bromopropane (Propyl Bromide)	▲	>480	E	▼	23	F	▼	<10	P	▲	>480	E	▼	<10	F	▼	<10	P	▼	<10	P	▼	10	P	■	182	VG
21. 2-Bromopropionic Acid	▲	>480	—	F	120	—	E	460	—	—	—	—	G	180	—	E	190	—	G	190	—	—	—	—	—	—	—
22. n-Butyl Acetate	▲	>480	E	F	75	F	NR	—	—	G	>360	E	NR	—	—	NR	—	—	P	—	—	E	80	G	DD	<10	F
23. n-Butyl Alcohol	▲	>480	E	E	>360	E	E	270	E	F	75	G	G	180	VG	E	35	VG	E	75	VG	E	>480	E	E	>480	E
24. Butyl Carbitol	—	—	—	E	>323	E	G	188	F	E	>480	E	E	397	VG	E	44	G	E	148	G	—	—	—	—	—	—
25. Butyl Cellosolve	▲	>480	E	E	470	VG	E	180	G	■	120	G	P	60	G	E	45	G	E	48	G	E	>480	—	E	>480	—
26. gamma-Butyrolactone	▲	>480	E	NR	—	—	E	245	G	E	120	VG	NR	—	—	E	60	G	E	104	F	E	>480	E	E	>480	E
27. Carbon Disulfide	▲	>480	E	G	30	F	NR	—	—	E	>360	E	NR	<5	—	NR	—	—	NR	—	—	▼	7	G	■	138	E
28. Carbon Tetrachloride	—	—	—	G	150	G	NR	—	—	E	>360	E	F	25	F	NR	—	—	NR	—	—	F	53	P	—	—	—
29. Cellosolve® (Ethyl Glycol Ether, 2-Ethoxyethanol)	E	>480	E	G	293	G	E	128	G	■	75	G	P	38	G	E	25	VG	E	25	VG	E	>480	E	E	465	E
30. Cellosolve Acetate® (2-Ethoxyethyl Acetate, EGEAA)	▲	>480	E	F	90	G	G	40	F	■	>360	E	NR	—	—	E	10	G	E	23	G	E	>480	E	DD	105	VG

CHEMICAL	BARRIER			SOL-VEX			29-SERIES			PVA			SNORKEL			CANNERS AND HANDLERS*			CHEMI-PRO*			CHEMTEK BUTYL			CHEMTEK VITON/BUTYL		
31. Chlorine Gas	▲	>480	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
32. Chlorobenzene	▲	>480	E	NR	—	—	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	P	9	P	F	>480	E
33. 4-Chlorobenzotrifluoride	—	—	—	E	320	VG	F	50	F	F	—	—	F	—	—	P	—	—	P	—	—	■	75	F	■	48	F
34. 2-Chlorobenzyl Chloride	E	120	E	—	—	—	F	200	E	E	>480	E	F	65	E	F	20	F	—	—	—	E	>480	E	E	>480	E
35. Chloroform	E	20	G	NR	—	—	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	P	5	P	■	212	VG
36. 1-Chloronaphthalene	▲	>480	E	P	—	—	NR	—	—	G	>360	E	NR	—	—	NR	—	—	P	—	—	E	>480	E	E	>480	E
37. 2-Chlorotoluene	▲	>480	E	G	120	G	NR	—	—	—	—	—	—	—	—	NR	—	—	NR	—	—	NR	—	—	—	—	—
38. 4-Chlorotoluene	▲	>480	E	P	—	—	NR	—	—	—	—	—	P	—	—	NR	—	—	NR	—	—	▼	30	F	▲	>480	E
39. "Chromic Acid" Cleaning Solution	—	—	—	F	240	—	NR	—	—	NR	—	—	G	>360	—	NR	—	—	NR	—	—	E	>480	—	E	>480	—
40. Citric Acid, 10%	—	—	—	E	>360	—	E	>480	—	F	50	—	E	>360	E	E	>360	—	E	>480	—	—	—	—	—	—	—
41. Cyclohexane	—	—	—	▲	>360	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	G	30	F	▲	>480	—
42. Cyclohexanol	▲	>480	E	E	>360	E	E	390	VG	G	>360	E	E	360	E	E	103	VG	E	47	G	E	>480	E	▲	>480	E
43. Cyclohexanone	▲	>480	E	F	103	G	P	23	F	E	>480	E	NR	—	—	P	—	—	P	—	—	E	>480	—	▼	150	—
44. 1,5-Cyclooctadiene	▲	>480	E	E	>480	E	NR	—	—	—	—	—	NR	—	—	NR	—	—	NR	—	—	P	—	—	—	—	—
45. Diacetone Alcohol	▲	>480	E	G	240	E	E	208	VG	■	150	G	NR	—	—	E	43	VG	E	60	VG	E	>480	—	DD	—	—
46. Dibutyl Phthalate	—	—	—	G	>360	E	F	132	G	E	>360	E	NR	—	—	E	20	—	G	>480	E	—	—	—	—	—	—
47. 1,2-Dichloroethane (Ethylene Dichloride, EDC)	▲	>480	E	NR	—	—	NR	—	—	E	>360	E	NR	—	—	P	—	—	P	—	—	—	—	—	—	—	—
48. Diethylamine	▲	>480	E	F	51	F	P	—	—	NR	—	—	NR	—	—	NR	—	—	NR	—	—	F	18	—	▼	19	—
49. Diisobutyl Ketone (DIBK)	▲	>480	E	E	263	G	P	—	—	G	>360	E	P	—	—	P	—	—	P	—	—	E	231	G	DD	15	G
50. Dimethyl Sulfoxide (DMSO)	▲	>480	E	E	240	VG	E	398	G	NR	—	—	NR	—	—	E	180	E	E	150	E	E	>480	—	DD	>480	—
51. Dimethylacetamide (DMAC)	▲	>480	E	NR	—	—	NR	—	—	NR	—	—	NR	—	—	E	15	G	E	30	G	E	>480	—	DD	>480	—
52. Dimethylformamide (DMF)	▲	>480	E	NR	—	—	E	45	F	NR	—	—	NR	19	—	E	25	VG	E	40	G	E	>480	E	DD	>480	E
53. Dioctyl Phthalate (DOP, DEHP)	▲	>480	E	G	>360	E	G	>480	E	E	30	F	NR	—	—	P	—	—	E	>360	E	—	—	—	—	—	—
54. Di-n-Octyl Phthalate (DNOP)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	>480	—	—	—	—
55. 1,4-Dioxane	▲	>480	E	NR	—	—	NR	—	—	P	—	—	NR	—	—	F	5	F	F	18	F	E	>480	—	—	—	—
56. Electroless Copper Plating Solution	—	—	—	E	>360	—	E	>360	—	NR	—	—	E	>360	—	E	>360	—	—	—	—	—	—	—	—	—	—
57. Electroless Nickel Plating Solution	—	—	—	E	>360	—	E	>360	—	NR	—	—	E	>360	—	E	>360	—	—	—	—	—	—	—	—	—	—
58. Epichlorohydrin	▲	>480	E	NR	—	—	P	—	—	E	300	E	NR	—	—	E	5	F	E	17	VG	E	>480	—	—	—	—
59. Ethidium Bromide, 10%	▲	>480	E	▲	>480	E	—	—	—	NR	—	—	—	—	—	—	—	—	—	—	—	E	>480	—	E	>480	—
60. Ethyl Acetate	▲	>480	E	NR	—	—	F	10	P	F	>360	E	NR	—	—	G	5	F	F	10	F	E	196	G	DD	10	G
61. Ethyl Alcohol, Denatured, 92% Ethanol	▲	>480	E	E	240	VG	E	113	VG	NR	—	—	G	60	VG	E	15	VG	E	37	VG	E	>480	E	E	>480	E
62. Ethylene Glycol	▲	>480	E	E	>360	E	E	>480	E	F	120	VG	E	>360	E	E	>360	E	E	>480	E	—	—	—	—	—	—
63. Ethylene Oxide Gas	■	234	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
64. Ethyl Ether	▲	>480	E	E	95	G	F	<10	F	G	>360	E	NR	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—
65. Ethyl L-Lactate	E	>480	E	E	273	G	E	125	VG	E	125	G	E	15	G	E	15	VG	E	28	VG	E	>480	E	E	>480	E
66. Formaldehyde, 37% in 1/3 Methanol/Water	▲	>480	E	E	>360	E	E	39	VG	P	—	—	E	100	E	E	10	G	E	32	E	E	>480	—	E	>480	—
67. Formic acid, 90%	▲	>480	—	F	240	—	E	>480	—	NR	—	—	E	>360	—	E	150	—	E	>360	—	E	>480	—	—	—	—
68. Furfural	▲	>480	E	NR	—	—	E	40	P	F	>360	E	NR	—	—	E	15	VG	E	43	VG	E	>480	—	G	>480	—
69. Freon TF	—	—	—	E	>360	E	E	240	E	G	>360	E	NR	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—
70. Gasoline, Unleaded (Shell Premium winter blend)	▲	170	E	E	>480	E	NR	—	—	G	>360	E	P	—	—	NR	—	—	NR	—	—	F	20	F	E	>480	E
71. Glutaraldehyde, 25%	—	—	—	E	>360	E	E	>480	E	P	<10	F	E	>360	E	E	210	VG	—	—	—	—	—	—	—	—	—
72. HCFC-141B	▲	>480	E	E	92	F	F	33	F	P	—	—	NR	—	—	NR	—	—	NR	—	—	F	40	F	F	<10	F
73. n-Heptane	▲	>480	E	—	—	—	—	—	—	▲	>480	—	NR	—	—	—	—	—	—	—	—	P	10	F	E	>480	E
74. Hexamethyldisilazine	▲	>480	E	E	>360	—	E	42	—	G	>360	—	P	—	—	F	15	F	F	43	G	■	305	G	■	>480	G
75. n-Hexane	▲	>480	E	E	>480	E	E	48	G	G	>360	E	NR	—	—	NR	—	—	P	—	—	P	5	F	E	>480	E
76. HFE 7100	▲	>480	E	E	>480	E	E	>480	E	P	—	—	E	>480	E	E	120	E	—	—	—	—	—	—	—	—	—
77. HFE 71DE	■	164	E	F	10	F	F	<10	F	F	>480	E	NR	—	—	NR	—	—	—	—	—	—	—	—	—	—	—
78. Hydrazine, 65%	—	—	—	E	>480	—	E	386	—	NR	—	—	E	>360	—	E	150	VG	E	>360	—	E	>480	—	—	—	—
79. Hydrobromic Acid, 48%	▲	>480	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—

80. Hydrochloric Acid, 10%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
81. Hydrochloric Acid, 37% (Concentrated)	▲	>480	—	E	>480	—	E	>480	—	NR	—	—	E	300	—	E	290	—	E	>360	—	—	—	—	—	—	—
82. Hydrofluoric Acid, 48%	▲	>480	—	E	334	—	■	>480	—	NR	—	—	■	155	—	▲	>480	—	—	—	—	E	>480	—	▲	>480	—
83. Hydrofluoric Acid, 95%	▲	>480	E	—	—	—	■	342	VG	—	—	—	—	—	—	—	—	—	—	—	—	▲	>480	E	—	—	—
84. Hydrogen Fluoride Gas	▲	>480	E	■	<15	P	—	—	—	—	—	—	■	2	—	■	15	F	■	<15	F	—	—	—	—	—	—
85. Hydrogen Peroxide, 30%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	G	>360	—	—	—	—	▲	>480	—
86. Hydroquinone, saturated solution	—	—	—	E	>360	E	E	108	E	NR	—	—	E	>360	E	G	>360	E	E	>360	E	—	—	—	—	—	—
87. Hypophosphorus Acid, 50%	—	—	—	E	>480	—	E	>240	—	NR	—	—	E	—	—	E	>480	—	—	—	—	—	—	—	—	—	—
88. Isobutyl Alcohol	▲	>480	E	E	>360	E	E	478	E	P	—	—	F	10	VG	E	15	VG	E	52	E	E	>480	E	E	>480	E
89. Isooctane	▲	>480	E	E	>360	E	E	268	VG	E	>360	E	P	—	—	NR	—	—	P	—	—	■	58	F	▲	>480	E
90. Isopropyl Alcohol	▲	>480	E	E	>360	E	E	110	E	NR	—	—	G	150	E	E	35	VG	E	57	E	—	—	—	—	—	—
91. Kerosene	▲	>480	E	E	>360	E	E	185	G	G	>360	E	F	>360	E	NR	—	—	P	—	—	G	82	—	E	>480	—
92. Lactic Acid, 85%	▲	>480	—	E	>360	—	E	>480	—	F	>360	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
93. Lauric Acid, 36% in Ethanol	—	—	—	E	>360	—	E	>480	—	NR	—	—	F	15	—	E	>360	—	E	>360	—	—	—	—	—	—	—
94. d-Limonene	▲	>480	E	E	>480	E	NR	—	—	G	>480	E	G	125	G	NR	—	—	NR	—	—	F	57	F	F	>480	E
95. Maleic Acid, saturated solution	—	—	—	E	>360	—	E	>480	—	NR	—	—	G	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
96. Mercury	—	—	—	▲	>480	E	—	—	—	—	—	—	▲	>480	E	▲	>480	E	—	—	—	—	—	—	—	—	—
97. Methyl Alcohol (Methanol)	▲	>480	E	E	103	VG	E	73	VG	NR	—	—	G	45	G	E	12	VG	E	22	E	E	>480	—	DD	363	—
98. Methylamine, 40%	▲	>480	E	E	>360	E	E	153	G	NR	—	—	E	135	VG	E	55	VG	E	100	E	E	>480	—	E	>480	—
99. Methyl Amyl Ketone (MAK)	▲	>480	E	F	53	F	F	10	F	E	>360	E	NR	—	—	F	<10	F	F	<10	F	E	155	G	DD	17	F
100. Methyl-t-Butyl Ether (MTBE)	E	>480	E	E	>360	E	P	—	—	G	>360	E	NR	—	—	NR	—	—	NR	—	—	G	38	F	—	—	—
101. Methyl Cellosolve®	■	470	F	F	208	G	E	10	F	E	30	G	P	55	G	E	20	VG	—	—	—	▲	>480	E	▲	>480	E
102. Methylene Bromide (DBM)	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	NR	—	—	NR	—	—	E	70	F	E	>480	E
103. Methylene Chloride (DCM)	E	20	VG	NR	—	—	NR	—	—	G	>360	E	NR	—	—	NR	—	—	NR	—	—	G	13	P	E	29	G
104. Methylene bis(4-Phenylisocyanate) (MDI)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	▲	>480	E	▲	>480	E	—	—	—	—	—	—
105. Methyl Ethyl Ketone (MEK)	▲	>480	E	NR	—	—	P	—	—	F	90	VG	NR	—	—	F	5	F	P	<10	F	E	183	G	DD	20	G
106. Methyl Ethyl Ketone (MEK)/Toluene, 1/1	▲	>480	E	—	—	—	—	—	—	—	—	—	—	—	—	F	5	F	—	—	—	F	60	—	—	—	—
107. Methyl Iodide (Iodomethane)	▲	>480	E	NR	—	—	NR	—	—	F	>360	E	NR	—	—	NR	—	—	NR	—	—	F	15	P	G	215	VG
108. Methyl Isobutyl Ketone (MIBK)	▲	>480	E	P	45	F	NR	—	—	F	>360	E	NR	—	—	P	—	—	P	—	—	E	245	G	DD	30	G
109. Methyl Methacrylate (MMA)	▲	>480	E	P	35	P	NR	—	—	G	>360	E	NR	—	—	P	—	—	NR	—	—	E	85	G	DD	10	F
110. N-Methyl-2-Pyrrolidone (NMP)	▲	>480	E	NR	—	—	NR	—	—	NR	—	—	NR	—	—	E	75	VG	F	47	VG	E	>480	—	DD	—	—
111. Mineral Spirits, Rule 66	▲	>480	E	E	>480	E	E	125	G	E	>360	E	F	150	VG	NR	—	—	G	23	G	—	—	—	—	—	—
112. Monoethanolamine	—	—	—	E	>360	E	E	400	E	E	>360	E	E	>480	E	E	50	E	E	57	E	—	—	—	■	>120	—
113. Morpholine	▲	>480	E	NR	—	—	P	—	—	G	90	G	NR	—	—	G	20	G	E	43	G	E	>480	E	DD	235	VG
114. Naphtha, VM&P	▲	>480	E	E	>360	E	G	103	G	E	420	E	F	120	VG	NR	—	—	NR	—	—	—	—	—	—	—	—
115. Nitric Acid, 10%	▲	>480	—	E	>360	—	E	>480	—	NR	—	—	G	>360	—	G	>360	—	E	>360	—	—	—	—	—	—	—
116. Nitric Acid, 70% (Concentrated)	E	>480	—	NR	—	—	▲	>480	—	NR	—	—	F	109	—	NR	—	—	NR	—	—	—	—	—	—	—	—
117. Nitric Acid, Red Fuming	▲	>480	E	NR	—	—	NR	—	—	NR	—	—	P	—	—	P	—	—	NR	—	—	—	—	—	—	—	—
118. Nitrobenzene	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	F	15	G	F	42	G	E	>480	—	E	>480	—
119. Nitromethane	▲	>480	E	F	30	F	E	60	G	G	>360	E	P	—	—	E	10	G	E	30	E	E	>480	E	E	249	E
120. 1-Nitropropane	■	368	E	NR	—	—	F	30	G	E	>480	G	NR	—	—	E	15	G	E	25	G	E	>480	E	DD	255	E
121. 2-Nitropropane	▲	>480	E	NR	—	—	F	25	F	E	>360	E	NR	—	—	E	5	G	E	30	VG	—	—	—	—	—	—
122. n-Octyl Alcohol	—	—	—	E	>360	E	E	218	E	G	>360	E	F	>360	E	E	30	VG	E	53	G	—	—	—	—	—	—
123. Oleic Acid	—	—	—	E	>360	E	F	13	VG	G	60	E	F	90	VG	F	>360	E	G	120	—	—	—	—	—	—	—
124. Oxalic Acid, saturated solution	—	—	—	E	>360	—	E	>480	—	P	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
125. Pad Etch® 1 (Ashland Chemical)	—	—	—	E	>360	—	E	>360	—	F	34	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
126. Palmitic Acid, saturated solution	—	—	—	G	30	—	E	>480	—	P	—	—	G	75	—	G	5	—	E	193	—	—	—	—	—	—	—
127. Pentachlorophenol, 5% in Mineral Spirits	—	—	—	E	>360	E	E	151	F	E	5	F	F	180	E	NR	—	—	—	—	—	—	—	—	—	—	—
128. n-Pentane	E	>480	E	E	>360	E	G	30	G	G	>360	E	NR	—	—	P	—	—	E	13	G	—	—	—	—	—	—

129. Perchloric Acid, 60%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	F	>360	—	E	>360	—	—	—	—	—	—	—	—
130. Perchloroethylene (PERC)	▲	>480	E	G	361	VG	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	P	<10	F	E	>480	E
131. Phenol, 90%	▲	>480	E	NR	—	—	E	353	G	F	>360	E	G	75	VG	E	90	—	E	180	E	E	>480	—	E	>480	—
132. Phosphoric Acid, 85% (Concentrated)	▲	>480	—	E	>360	—	G	>360	—	NR	—	—	G	>360	—	F	>360	—	G	>360	—	—	—	—	—	—	—
133. Potassium Hydroxide, 50%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
134. Propane Gas	—	—	—	▲	>480	E	▲	>480	E	—	—	—	■	7	VG	—	—	—	—	—	—	—	—	—	—	—	—
135. n-Propyl Acetate	—	—	—	F	20	G	P	—	—	G	120	VG	NR	—	—	P	—	—	P	—	—	E	135	G	DD	<10	F
136. n-Propyl Alcohol	E	>480	E	E	>360	E	E	323	E	P	—	—	F	90	VG	E	23	VG	E	30	E	E	>480	—	E	>480	—
137. Propylene Glycol Methyl Ether Acetate (PGMEA)	▲	>480	E	E	200	F	G	37	F	E	>360	E	P	—	—	G	13	F	G	18	F	▲	>480	E	■	334	E
138. Propylene Glycol Monomethyl Ether (PGME)	—	—	—	—	—	—	P	—	—	—	—	—	P	—	—	—	—	—	—	—	—	▲	>480	E	▲	>480	E
139. Propylene Oxide	▲	>480	E	NR	—	—	NR	—	—	G	35	G	NR	—	—	P	—	—	P	—	—	■	43	F	DD	<10	F
140. Pyridine	▲	>480	E	NR	—	—	NR	—	—	G	10	F	NR	—	—	F	10	F	P	10	F	▲	465	E	DD	40	—
141. Rubber Solvent	—	—	—	E	>360	E	E	43	G	E	>360	E	NR	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—
142. Silicon Etch	▲	>480	E	NR	—	—	E	>480	—	NR	—	—	F	150	—	NR	—	—	P	—	—	—	—	—	—	—	—
143. Skydrol® 500B-4	▲	>480	E	NR	—	—	NR	—	—	—	—	—	NR	—	—	NR	—	—	NR	—	—	E	>480	E	DD	>480	E
144. Sodium Hydroxide, 50%	E	>480	—	E	>360	—	E	>480	—	NR	—	—	G	>480	—	E	>360	—	E	>360	—	E	>480	—	E	>480	—
145. Stoddard Solvent	▲	>480	E	E	>360	E	E	139	G	E	>360	E	F	57	G	NR	—	—	G	10	G	—	—	—	—	—	—
146. Styrene	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	NR	—	—	NR	—	—	G	26	—	E	>480	—
147. Sulfur Dichloride	—	—	—	P	>480	E	NR	—	—	—	—	—	—	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—
148. Sulfuric Acid, 47% (Battery Acid)	—	—	—	E	>360	—	E	>360	—	NR	—	—	G	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
149. Sulfuric Acid, 95-98% (Concentrated)	E	>480	E	NR	—	—	F	24	—	NR	—	—	G	26	—	NR	—	—	NR	—	—	E	>480	—	E	>480	—
150. Sulfuric Acid, 120% (Oleum)	▲	>480	E	—	—	—	F	53	G	NR	—	—	▼	25	G	—	—	—	—	—	—	—	—	—	—	—	—
151. Tannic Acid, 65%	—	—	—	E	>360	—	E	>480	E	P	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
152. Tetrahydrofuran (THF)	▲	>480	E	NR	—	—	NR	—	—	P	115	F	NR	—	—	NR	—	—	NR	—	—	F	13	F	DD	10	F
153. Toluene (Toluol)	▲	>480	E	F	34	F	NR	—	—	G	>1440	E	NR	—	—	NR	—	—	NR	—	—	P	20	F	E	313	—
154. Toluene Diisocyanate (TDI)	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	P	—	—	G	7	G	G	65	VG	E	>480	—	E	>480	—
155. Triallylamine	▲	>480	E	▲	>480	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
156. Trichloroethylene (TCE)	▲	>480	E	NR	—	—	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	NR	—	—	DD	204	VG
157. Tricresyl Phosphate (TCP)	—	—	—	E	>360	E	F	253	F	G	>360	E	F	>360	E	E	45	E	E	>360	E	E	>480	—	E	>480	—
158. Triethanolamine (TEA)	—	—	—	E	>360	E	E	170	VG	G	>360	E	E	>360	E	G	>360	E	—	—	—	—	—	—	—	—	—
159. Turpentine	▲	>480	E	E	>480	E	NR	—	—	G	>360	E	P	—	—	NR	—	—	NR	—	—	■	58	—	■	>480	E
160. Vertrel® MCA	▲	>480	E	E	110	G	E	23	G	F	>360	E	G	13	F	G	<10	F	G	<10	F	■	173	VG	DD	20	G
161. Vertrel® SMT	E	10	G	P	—	—	F	<10	F	G	17	G	G	<10	F	F	<10	F	P	<10	P	▼	18	F	DD	<10	F
162. Vertrel® XE	E	105	E	E	>480	E	E	47	G	F	40	VG	G	303	E	E	17	VG	E	43	VG	E	>480	E	DD	398	E
163. Vertrel® XF	E	>480	E	E	>480	E	E	>480	E	F	387	VG	E	>480	E	E	337	VG	E	204	G	E	>480	E	DD	>480	E
164. Vertrel® XM	E	>480	E	E	>480	E	E	105	E	F	10	G	P	55	G	E	23	VG	E	30	VG	—	—	—	—	—	—
165. Vinyl Acetate	▲	>480	E	F	18	F	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	NR	—	—
166. Vinyl Chloride Gas	▲	>480	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
167. Xylenes, Mixed (Xylol)	▲	>480	E	G	96	F	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	P	27	F	E	>480	E

▲ A degradation test against this chemical was not run. However, since its breakthrough time is greater than 480 minutes, the Degradation Rating is expected to be **Good** to **Excellent**. ■ A degradation test against this chemical was not run. However, in view of degradation tests performed with similar compounds, the Degradation Rating is expected to be **Good** to **Excellent**. ▼ A degradation test against this chemical was not run. However, in view of data obtained with similar compounds, the Degradation Rating is expected to be **Fair** to **Poor**. ***CAUTION:** This product contains natural rubber latex which may cause allergic reactions in some individuals.

NOTE:

These recommendations are based on laboratory tests, and reflect the best judgement of Ansell in the light of data available at the time of preparation and in accordance with the current revision of ASTM F 739. They are intended to guide and inform qualified professionals engaged in assuring safety in the workplace. Because the conditions of ultimate use are beyond our control, and because we cannot run permeation tests in all possible work environments and across all combinations of chemicals and solutions, these recommendations are advisory only. The suitability of a product for a specific application must be determined by testing by the purchaser.

The data in this guide are subject to revision as additional knowledge and experience are gained. Test data herein reflect laboratory performance of partial gloves and not necessarily the complete unit. Anyone intending to use these recommendations should first verify that the glove selected is suitable for the intended use and meets all appropriate health standards. Upon written request, Ansell will provide a sample of material to aid you in making your own selection under your own individual safety requirements.

NEITHER THIS GUIDE NOR ANY OTHER STATEMENT MADE HEREIN BY OR ON BEHALF OF ANSELL SHOULD BE CONSTRUED AS A WARRANTY OF MERCHANTABILITY OR THAT ANY ANSELL GLOVE IS FIT FOR A PARTICULAR PURPOSE. ANSELL ASSUMES NO RESPONSIBILITY FOR THE SUITABILITY OR ADEQUACY OF AN END-USER'S SELECTION OF A PRODUCT FOR A SPECIFIC APPLICATION.

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ATTACHMENT 7

EPA P-LIST

EPA P-Listed Chemicals - Considered Acutely Hazardous Waste

Substance Name	CAS No.	Waste Code
Acetaldehyde, chloro-	107-20-0	P023
Acetamide, N-(aminothioxomethyl)-	591-08-2	P002
Acetamide, 2-fluoro-	640-19-7	P057
Acetic acid, fluoro-, sodium salt	62-74-8	P058
1-Acetyl-2-thiourea	591-08-2	P002
Acrolein	107-02-8	P003
Aldicarb	116-06-3	P070
Aldicarb sulfone	1646-88-4	P203
Aldrin	309-00-2	P004
Allyl alcohol	107-18-6	P005
Aluminum phosphide	20859-73-8	P006
5-(Aminomethyl)-3-isoxazolol	2763-96-4	P007
4-Aminopyridine	504-24-5	P008
Ammonium picrate	131-74-8	P009
Ammonium vanadate	7803-55-6	P119
Argentate(1-), bis(cyano-C)-, potassium	506-61-6	P099
Arsenic acid H3AsO4	7778-39-4	P010
Arsenic oxide As2O3	1327-53-3	P012
Arsenic oxide As2O5	1303-28-2	P011
Arsenic pentoxide	1303-28-2	P011
Arsenic trioxide	1327-53-3	P012
Arsine, diethyl-	692-42-2	P038
Arsonous dichloride, phenyl-	696-28-6	P036
Aziridine	151-56-4	P054
Aziridine, 2-methyl-	75-55-8	P067
Barium cyanide	542-62-1	P013
Benzenamine, 4-chloro-	106-47-8	P024
Benzenamine, 4-nitro-	100-01-6	P077
Benzene, (chloromethyl)-	100-44-7	P028
1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-	51-43-4	P042
Benzeneethanamine, alpha,alpha-dimethyl-	122-09-8	P046
Benzenethiol	108-98-5	P014
7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate	1563-66-2	P127
Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8ahexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1)	57-64-7	P188
2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%	81-81-2	P001
Benzyl chloride	100-44-7	P028
Beryllium powder	7440-41-7	P015
Bromoacetone	598-31-2	P017
Brucine	357-57-3	P018
2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime	39196-18-4	P045

Calcium cyanide	592-01-8	P021
Calcium cyanide Ca(CN)2	592-01-8	P021
Carbamic acid, [(dibutylamino)- thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester	55285-14-8	P189
Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]- 5-methyl-1H- pyrazol-3-yl ester	644-64-4	P191
Carbamic acid, dimethyl-, 3-methyl-1- (1-methylethyl)-1H- pyrazol-5-yl ester	119-38-0	P192
Carbamic acid, methyl-, 3-methylphenyl ester	1129-41-5	P190
Carbofuran	1563-66-2	P127
Carbon disulfide	75-15-0	P022
Carbonic dichloride	75-44-5	P095
Carbosulfan	55285-14-8	P189
Chloroacetaldehyde	107-20-0	P023
p-Chloroaniline	106-47-8	P024
1-(o-Chlorophenyl)thiourea	5344-82-1	P026
3-Chloropropionitrile	542-76-7	P027
Copper cyanide	544-92-3	P029
Copper cyanide Cu(CN)	544-92-3	P029
m-Cumenyl methylcarbamate	64-00-6	P202
Cyanides (soluble cyanide salts), not otherwise specified		P030
Cyanogen	460-19-5	P031
Cyanogen chloride	506-77-4	P033
Cyanogen chloride (CN)Cl	506-77-4	P033
2-Cyclohexyl-4,6-dinitrophenol	131-89-5	P034
Dichloromethyl ether	542-88-1	P016
Dichlorophenylarsine	696-28-6	P036
Dieldrin	60-57-1	P037
Diethylarsine	692-42-2	P038
Diethyl-p-nitrophenyl phosphate	311-45-5	P041
O,O-Diethyl O-pyrazinyl phosphorothioate	297-97-2	P040
Diisopropylfluorophosphate (DFP)	55-91-4	P043
1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro- 1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-	309-00-2	P004
1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro- 1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-	465-73-6	P060
1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta, 7aalpha)-	60-57-1	P037
2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta, 7aalpha)-, & metabolites	72-20-8	P051
Dimethoate	60-51-5	P044
alpha,alpha-Dimethylphenethylamine	122-09-8	P046
Dimetilan	644-64-4	P191
4,6-Dinitro-o-cresol, & salts	534-52-1	P047
2,4-Dinitrophenol	51-28-5	P048
Dinoseb	88-85-7	P020
Diphosphoramide, octamethyl-	152-16-9	P085

Diphosphoric acid, tetraethyl ester	107-49-3	P111
Disulfoton	298-04-4	P039
Dithiobiuret	541-53-7	P049
1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O- [(methylamino)-carbonyl]oxime	26419-73-8	P185
Endosulfan	115-29-7	P050
Endothall	145-73-3	P088
Endrin & metabolites	72-20-8	P051
Epinephrine	51-43-4	P042
Ethanedinitrile	460-19-5	P031
Ethanimidothioic acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester	23135-22-0	P194
Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester	16752-77-5	P066
Ethyl cyanide	107-12-0	P101
Ethyleneimine	151-56-4	P054
Famphur	52-85-7	P097
Fluorine	7782-41-4	P056
Fluoroacetamide	640-19-7	P057
Fluoroacetic acid, sodium salt	62-74-8	P058
Formetanate hydrochloride	23422-53-9	P198
Formparanate	17702-57-7	P197
Fulminic acid, mercury salt	628-86-4	P065
Heptachlor	76-44-8	P059
Hexaethyl tetraphosphate	757-58-4	P062
Hydrazinecarbothioamide	79-19-6	P116
Hydrazine, methyl-	60-34-4	P068
Hydrocyanic acid	74-90-8	P063
Hydrogen cyanide	74-90-8	P063
Hydrogen phosphide	7803-51-2	P096
Isodrin	465-73-6	P060
Isolan	119-38-0	P192
3-Isopropylphenyl N-methylcarbamate	64-00-6	P202
3(2H)-Isoxazolone, 5-(aminomethyl)-	2763-96-4	P007
Manganese, bis(dimethylcarbamodithioato-S,S')-	15339-36-3	P196
Manganese dimethyldithiocarbamate	15339-36-3	P196
Mercury, (acetato-O)phenyl-	62-38-4	P092
Mercury fulminate	628-86-4	P065
Methanamine, N-methyl-N-nitroso-	62-75-9	P082
Methane, isocyanato-	624-83-9	P064
Methane, oxybis[chloro-	542-88-1	P016
Methane, tetranitro-	509-14-8	P112
Methanethiol, trichloro-	75-70-7	P118
Methanimidamide, N,N-dimethyl-N'-[3-[[(methylamino)-carbonyl]oxy]phenyl]-, monohydrochloride	23422-53-9	P198
Methanimidamide, N,N-dimethyl-N'-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-	17702-57-7	P197

6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10- hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide	115-29-7	P050
4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro- 3a,4,7,7a-tetrahydro-	76-44-8	P059
Methiocarb	2032-65-7	P199
Methomyl	16752-77-5	P066
Methyl hydrazine	60-34-4	P068
Methyl isocyanate	624-83-9	P064
2-Methyllactonitrile	75-86-5	P069
Methyl parathion	298-00-0	P071
Metolcarb	1129-41-5	P190
Mexacarbate	315-8-4	P128
alpha-Naphthylthiourea	86-88-4	P072
Nickel carbonyl	13463-39-3	P073
Nickel carbonyl Ni(CO)4	13463-39-3	P073
Nickel cyanide	557-19-7	P074
Nickel cyanide Ni(CN)2	557-19-7	P074
Nicotine & salts	54-11-5	P075
Nitric oxide	10102-43-9	P076
p-Nitroaniline	100-01-6	P077
Nitrogen dioxide	10102-44-0	P078
Nitrogen oxide NO	10102-43-9	P076
Nitrogen oxide NO2	10102-44-0	P078
Nitroglycerine	55-63-0	P081
N-Nitrosodimethylamine	62-75-9	P082
N-Nitrosomethylvinylamine	4549-40-0	P084
Octamethylpyrophosphoramide	152-16-9	P085
Osmium oxide OsO4	20816-12-0	P087
Osmium tetroxide	20816-12-0	P087
7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid	145-73-3	P088
Oxamyl	23135-22-0	P194
Parathion	56-38-2	P089
Phenol, 2-cyclohexyl-4,6-dinitro-	131-89-5	P034
Phenol, 2,4-dinitro-	51-28-5	P048
Phenol, 2-methyl-4,6-dinitro- & salts	534-52-1	P047
Phenol, 2-(1-methylpropyl)-4,6-dinitro-	88-85-7	P020
Phenol, 2,4,6-trinitro-, ammonium salt	131-74-8	P009
Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester)	315-18-4	P128
Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate	2032-65-7	P199
Phenol, 3-(1-methylethyl)-, methyl carbamate	64-00-6	P202
Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate	2631-37-0	P201
Phenylmercury/phenylmercuric acetate	62-38-4	P092
Phenylthiourea	103-85-5	P093
Phorate	298-02-2	P094
Phosgene	75-44-5	P095
Phosphine	7803-51-2	P096
Phosphoric acid, diethyl 4-nitrophenyl ester	311-45-5	P041

Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester	298-04-4	P039
Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester	298-02-2	P094
Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester	60-51-5	P044
Phosphorofluoridic acid, bis(1-methylethyl) ester	55-91-4	P043
Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester	56-38-2	P089
Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester	297-97-2	P040
Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester	52-85-7	P097
Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester	298-00-0	P071
Physostigmine	57-47-6	P204
Physostigmine salicylate	57-64-7	P188
Plumbane, tetraethyl-	78-00-2	P110
Potassium cyanide	151-50-8	P098
Potassium cyanide K(CN)	151-50-8	P098
Potassium silver cyanide	506-61-6	P099
Promecarb	2631-37-0	P201
Propanal, 2-methyl-2-(methylthio)-,O-[(methylamino)carbonyl]oxime	116-06-3	P070
Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl]oxime	1646-88-4	P203
Propanenitrile	107-12-0	P101
Propanenitrile, 3-chloro-	542-76-7	P027
Propanenitrile, 2-hydroxy-2-methyl-	75-86-5	P069
1,2,3-Propanetriol, trinitrate	55-63-0	P081
2-Propanone, 1-bromo-	598-31-2	P017
Propargyl alcohol	107-19-7	P102
2-Propenal	107-02-8	P003
2-Propen-1-ol	107-18-6	P005
1,2-Propylenimine	75-55-8	P067
2-Propyn-1-ol	107-19-7	P102
4-Pyridinamine	504-24-5	P008
Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)- & salts	54-11-5	P075
Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl- ,methylcarbamate (ester), (3aS-cis)-	57-47-6	P204
Selenious acid, dithallium salt	12039-52-0	P114
Selenourea	630-10-4	P103
Silver cyanide	506-64-9	P104
Silver cyanide Ag(CN)	506-64-9	P104
Sodium azide	26628-22-8	P105
Sodium cyanide	143-33-9	P106
Sodium cyanide Na(CN)	143-33-9	P106
Strychnidin-10-one & salts	57-24-9	P108
Strychnidin-10-one, 2,3-dimethoxy-	357-57-3	P018
Strychnine & salts	57-24-9	P108
Sulfuric acid, dithallium salt	7446-18-6	P115
Tetraethyldithiopyrophosphate	3689-24-5	P109
Tetraethyl lead	78-00-2	P110
Tetraethyl pyrophosphate	107-49-3	P111
Tetranitromethane	509-14-8	P112

Tetraphosphoric acid, hexaethyl ester	757-58-4	P062
Thallic oxide	1314-32-5	P113
Thallium oxide Tl2O3	1314-32-5	P113
Thallium(I) selenite	12039-52-0	P114
Thallium(I) sulfate	7446-18-6	P115
Thiodiphosphoric acid, tetraethyl ester	3689-24-5	P109
Thiofanox	39196-18-4	P045
Thioimidodicarbonic diamide [(H2N)C(S)]2NH	541-53-7	P049
Thiophenol	108-98-5	P014
Thiosemicarbazide	79-19-6	P116
Thiourea, (2-chlorophenyl)-	5344-82-1	P026
Thiourea, 1-naphthalenyl-	86-88-4	P072
Thiourea, phenyl-	103-85-5	P093
Tirpate	26419-73-8	P185
Toxaphene	8001-35-2	P123
Trichloromethanethiol	75-70-7	P118
Vanadic acid, ammonium salt	7803-55-6	P119
Vanadium oxide V2O5	1314-62-1	P120
Vanadium pentoxide	1314-62-1	P120
Vinylamine, N-methyl-N-nitroso-	4549-40-0	P084
Warfarin & salts, when present at concentrations greater than 0.3%	81-81-2	P001
Zinc, bis(dimethylcarbamodithioato-S,S')-,	137-30-4	P205
Zinc cyanide	557-21-1	P121
Zinc cyanide Zn(CN)2	557-21-1	P121
Zinc phosphide Zn3P2, when present at concentrations greater than 10%	1314-84-7	P122
Ziram	137-30-4	P205

ATTACHMENT 8

LIST OF PEROXIDE FORMERS

	A	B	C
1	**Class A - Peroxides Form Over Time Severe Peroxide Hazard**	**Class B - Peroxides Form When Heated Moderate Peroxide Hazard**	**Class C - Shock & Heat Sensitive Low Peroxide Hazard**
2	Butadiene	Acetal	Acrylic acid
3	Chloroprene	Acetaldehyde	Acrylonitrile
4	Divinyl acetylene	Benzyl alcohol	Butadiene (gas)
5	Divinyl ether	Cumene	Chlorobutadiene
6	Isopropyl ether/diisopropyl ether	Cyclohexanol	Chloroprene
7	Potassium amide	Cyclohexene	Chlorotrifluoroethylene (gas)
8	Potassium metal	Decahydronaphthalene/decalin	Methyl methacrylate
9	Sodium amide/sodamide	Diacetylene/butadiene	Styrene
10	Tetrafluoroethylene	Dicyclopentadiene	Tetrafluoroethylene (gas)
11	Vinylidene chloride/1,1-dichloroethylene	Ethyl ether/diethyl ether	
12		Diethylene glycol dimethyl ether	
13		Dioxanes	
14		Ethylene glycol ether acetates	
15		Furan	
16		Methyl isobutyl ketone	
17		Methylacetylene (gas)	
18		Methylcyclopentane	
19		Tetrahydrofuran	
20		Tetrahydronaphthalene/tetralin	
21		Vinyl ethers	
22		1-phenylethanol	
23		2-butanol	
24		2-Cyclohexen-1-ol	
25		2-Hexanol	
26		2-pentanol	
27		2-propanol	
28		2-phynylethanol	
29		3-methyl-1-butanol	
30		4-Heptanol	
31		4-methyl-2-pentanol	
32		4-penten-1-ol	
33			
34	**Class A Peroxide Formers** - After opening, should be discarded or tested for peroxides within 3 months	**Class B Peroxide Formers** - After opening, should be discarded or tested for peroxides within 1 year	**Class C Peroxide Formers** - After opening, material WITHOUT INHIBITOR should be discarded within 24 hours; material WITH inhibitor should be discarded or tested for peroxides within 1 year
35	**Peroxide Concentrations Assessment:**		
36	<25 ppm = Considered safe for general use		
37	25-100 ppm = Not recommended for distilling or otherwise concentrating		
38	100+ ppm = Avoid handling and contact EHS for disposal		