Michigan Technological University
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Civil and Environmental Engineering Department

MIOSHA Laboratory Standard

CHEMICAL HYGIENE PLAN

Michigan Occupational Health and Hazardous Work in Laboratories Standard
Michigan Health Rule R325.70101 et.seq

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FOREWORD

On 31 January 1990 the Michigan Occupational Safety and Health Administration (OSHA) promulgated a final rule for occupational exposure to hazardous chemicals in laboratories. Included in the standard, which became effective on 1 May 1990 is a requirement for all employers covered by the standard to develop and carry out the provisions of a Chemical Hygiene Plan (CHP). The standard requires that the CHP must be developed and implemented by [January 31, 1991] January 2 1992.

A CHP is defined as a written program which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace. Components of the CHP must include standard operating procedures for safety and health, criteria for the implementation of control measures, measures to ensure proper operation of engineering controls, provisions for training and information dissemination, permitting requirements, provisions for medical consultation, designation of responsible personnel, and identification of particularly hazardous substances.

This [plan] is the Chemical Hygiene Plan developed for the Civil and Environmental Engineering Department located at Michigan Technological University. This CHP is maintained readily available to laboratory employees in the Department Office. All laboratory personnel must know and follow the procedures outlined in this plan. All operations performed in the laboratory must be planned and executed in accordance with the enclosed procedures. In addition, each employee is expected to develop safe personal chemical hygiene habits aimed at the reduction of chemical exposures to themselves and coworkers and follow all requirements detailed in the MTU Safety Manual (http://www.sas.it.mtu.edu/fm/oshs/manual.htm).

This document was developed to comply with [paragraph (e)] of the referenced [OSHA 1910.1450 standard] Michigan Occupational Health and Hazardous Work in Laboratories Standard R325.70101 et.seq.. The Chemical Hygiene Officer will monitor the maintenance of the facilities and procedures employed in the laboratory compatible
with current knowledge and regulations in laboratory safety. This CHP will be reviewed, evaluated and updated at least annually and is readily available to employees, their representatives and any representative of the Assistant Secretary of Labor for OSHA.

This Chemical Hygiene Plan does not cover the receipt, use or disposal of radioactive chemicals. The handling of radioactive chemicals is under the control of the Radiation Safety Officer and the Designated Responsible User.

David Hand
Civil and Environmental Engineering Department
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1.0 MIOSHA Laboratory Standard

OSHA issued the Laboratory Standard for employees working in laboratories (including academic laboratories). The term "laboratory" is defined as "a facility where the laboratory use of hazardous chemicals occurs". It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

Most employees are covered by another standard called the Hazard Communication Standard. However, because of the dangers and uniqueness inherent in laboratory work, employers are required to cover laboratory workers under the Laboratory Standard.

The Laboratory Standard is performance based. This means that OSHA provides the basic outline requirements and then each employer writes a plan tailored to their needs, all plans must address standard operating procedures.

The Hazard Communication Standard is a Federal Law, also called the Right to Know Law, that states all who work with or around chemicals have the right to know the following information about the chemicals that they may potentially be exposed to. While the MIOSHA Laboratory Standard supercedes the Hazard Communication Standard in chemical laboratories the following tenants are defined in both.

- The employee must be informed on what is Present in the work environment.
- The employee must be trained on the proper use and selection of Protective equipment.
- The employee must be informed of what Effects the chemical may have as a result of exposure to the chemical.
- The employee must be trained in methods to Detect the presence of the chemical in their work environment.

In general, the proper guidance for these topics to be trained on is found in the safety data sheet. A safety data sheet (SDS) is a database on a chemical. Found in this database are such things as substance identification, physical data, fire and explosion data, toxicity, health effects, reactivity, spill and leak procedures, and protective equipment. As this information is vital to proper handling of chemicals it is mandatory that you read and understand each SDS for each chemical that you work with. Failure to understand the hazards of the chemicals you work with will...
result in the suspension of your laboratory work until the situation is corrected. See appendix “Sample Safety Data Sheet” for an example. SDS are available from MSDS https://msdsmanagement.msdsonline.com

2.0 Laboratory-Specific Standard Operating Procedures

Each laboratory is responsible for developing laboratory-specific standard operating procedures that include, at a minimum, 1) an inventory of chemicals to be used for the procedure, 2) the hazards associated with their use, and 3) the measures to be taken to prevent exposures or control of the hazards. See appendix “Sample Standard Operating Procedure” for an example.

3.0 Chemical Procurement

The decision to purchase a chemical shall be a commitment to handle and use the chemical properly from receipt to disposal.

Requests for procurement of new chemicals should be initiated by contacting the Chemical Hygiene Officer. The requestor’s supervisor shall determine if the chemical to be purchased can be handled safely by the Department and insure that training has been provided to the users of the new chemical. In the event that the chemical cannot be purchased through Chemistry Stores, located in the basement of the Chemical Sciences and Engineering Building, the requestor’s supervisor shall assist with arrangements for safe procurement and receipt of the new chemical. All involved personnel prior to the procurement of the chemical shall understand information on proper handling, storage and disposal.

If a chemical cannot be delivered to Chemical Stores personnel who receive these chemical shipments shall be knowledgeable of the proper procedures for receipt, see Occupational Safety and Health Services for these procedures. It is important that chemicals are not left unattended. Chemical containers shall not be accepted without accompanying labels, safety data sheets and packaging in accordance with all appropriate regulations. All chemical shipments must be dated when received and again when opened.
4.0 Chemical Storage

Generally, all chemicals, with the exception of radioactive chemicals, shall be stored collectively in room 818 Dow Environmental Sciences and Engineering Building. Chemicals used in laboratories shall not exceed quantities needed for four to six weeks. The purpose of this is to minimize the risk associated with chemicals in the laboratory and to maintain safe storage of chemicals by equipping one storage room with the proper storage containment systems. In the case of high purity chemicals or chemicals that are packaged in very small quantities it may not be reasonable to transfer these to a secondary container. In this situation special provisions must be made.

- Received chemicals shall be immediately moved to the designated storage area, room 818 Dow Environmental Sciences and Engineering. All glass containers shall be placed in carrying containers or remain in the original shipping containers during transportation, for example the cardboard box that the shipment was received in.

- The storage area shall be well illuminated, with all storage maintained below eye level. Large bottles shall be stored no more than two feet from ground level. No containers shall be placed on top of storage cabinets.

- Chemicals shall be segregated by hazard classification and compatibility in a well-identified area, with local exhaust ventilation. The Flynn Scientific, Inc, P.O. Box219, 131 Flynn St., Batavia, IL 60510, suggested shelf storage pattern, as presented in Appendix “Chemical Storage and Classification System” shall be followed.

- Mineral acids shall be separated from flammable and combustible materials. Separation is defined by NFPA 49 as storage within the same fire area but separated by as much space as practical or by intervening storage from incompatible materials.

- Acid-sensitive materials such as cyanides and sulfides shall be separated from acids or protected from contact with acids.

- The storage area shall not be used as a preparation or repackaging area.

- The storage area in Chemical Stores is typically accessible during normal working hours. The storage area is under the control of the Manager of Chemical Stores. The storage area in room 818 Dow Environmental Sciences and Engineering Building is accessible
during normal working hours. The storage area in 818 is under the control of Chemical Hygiene Officer. This area has limited access; please make sure that you make arrangements to obtain your chemicals during normal working hours. Do not forget that entering the storage area requires the presence of two trained people and is considered work of a hazardous nature.

- When chemicals are taken from the storage area, they shall be placed in a secondary container or bucket.
- Storage of chemicals in laboratories at the lab bench or other work areas shall be limited to those amounts necessary for ongoing research or teaching activities. The amount of chemicals at lab benches shall be as small as practical. Chemicals in the workplace shall not be exposed to excessive sunlight or heat.
- Stored chemicals shall be examined at least annually, by the person in charge of the laboratory or storeroom, for replacement/deterioration/container integrity. The inspection should determine whether any corrosion, deterioration, or damage has occurred to the storage facility as a result of leaking chemicals. Unneeded items shall be properly discarded or returned to Chemical Stores, if they will accept them.

5.0 Chemical Handling

Each laboratory employee with the training, education and resources provided by supervision shall develop and implement work habits consistent with this CHP to minimize personal and coworker exposure to the chemicals in the laboratory. Based on the realization that all chemicals inherently present hazards in certain conditions, exposure to all chemicals shall be minimized.

General precautions that shall be followed for the handling and use of all chemicals are:

- Skin contact with all chemicals shall be avoided.
- All employees shall wash all areas of exposed skin prior to leaving the laboratory.
- Mouth suction for pipetting or starting a siphon is prohibited.
- Eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present shall not be
permitted. These areas have been posted. Hands shall be thoroughly washed prior to performing these activities.

- Storage, handling and consumption of food or beverages shall not occur in chemical storage areas, laboratories, or refrigerators, nor shall any glassware or utensils also used for laboratory operations be used in the handling of food or beverages.

- Any chemical mixture shall be assumed to be as toxic as its most toxic component. For example EPA says that benzene in water can be safe to drink at concentrations below 1.0 ppb, but if we know benzene is in the water, we will give that sample the safety rating associated with benzene.

- Substances of unknown toxicity shall be assumed to be toxic.

- Laboratory employees shall be familiar with the symptoms of exposure for the chemicals with which they work and the precautions necessary to prevent exposure. This is accomplished by understanding the information found in the safety data sheet/standard operating procedure for the chemical/process that you are working with.

- In all cases of chemical exposure the Permissible Exposure Limits (PELs) of MIOSHA shall not be exceeded.

- Specific precautions based on the toxicological characteristics of individual chemicals shall be implemented as deemed necessary by the Chemical Hygiene Officer (see 8.2). These special precautions are listed in Section 21.0.

### 6.0 Laboratory Equipment and Glassware

Laboratory workers shall keep the work area clean and uncluttered. All chemicals and equipment shall be properly labeled in accordance with Section 9.0. At the completion of each workday or operation, the work area shall be thoroughly cleaned and all equipment properly cleaned and stored.

In addition, the following procedures shall apply to the use of laboratory equipment:

- All laboratory equipment shall be used only for its intended purpose. For example do not use a scoopula as a screwdriver or a beaker as a hammer.
All glassware will be handled and stored with care to minimize breakage; all broken glassware will be immediately disposed of in a broken glass container, see Appendix “Glassware Disposal”.

All evacuated or pressurized glass apparatuses shall be shielded to contain chemicals and glass fragments should implosion or explosion occur. If performing experiments at elevated pressure prior approval must be given, see Prior Approval of Laboratory Activities section 18.0.

All laboratory equipment shall be inspected on a periodic basis as specified and replaced or repaired as necessary.

7.0 Personal Protective Equipment

Personal protective equipment (PPE) assessments are required for every workspace, see appendix “Personal Protective Equipment Assessment Forms”. These are to be performed by the laboratory supervisor (assistance will be provided by the Safety Officer and CHO as requested). Upon the determination that PPE is required for a workspace it will be the area supervisor’s responsibility to enforce and train on the use of the indicated PPE for that work area. Training shall include the selection, use, decontamination of, and deterioration of PPE. The Safety Officer will train supervisors and assistance will be provided by the CHO when chemical hazards are present. After the initial assessment is made the area supervisor must notify the Safety Officer when work functions change in that work area so that a new assessment can be made based on the new tasks being performed in that work area. Periodic inspections will be made of the work area by the Safety Officer to ensure that the appropriate PPE is being used and in working order. It is the intent of this program to minimize the amount of PPE required by maximizing engineering controls and administrative controls. Wherever possible employees will not be required to wear PPE other than safety eyewear, routine hand protection, and laboratory coats. When additional PPE is required, if possible, only the area supervisor will be required to perform these tasks and use the indicated PPE. PPE assessments are kept on file by the Safety Officer.

PPE should never be worn in public areas. Hazards must be contained in public areas.

Eye protection meeting the ANSI Z87.1 standard is required for employees and visitors to the laboratory and will be worn at all times. Safety glasses are the minimum protection permitted. Contact lenses are permitted in the laboratory, if approved by the laboratory supervisor. Eye protection devices meeting the ANSI Z87.1 are required in addition to
contact lenses. Note: Safety lenses and frames in standard eyeglasses do not meet the ANSI standard. Safety eyewear is stamped with the manufacturer’s initials and Z87.1 if the manufacturer has certified that the device meets the ANSI criteria.

➢ Chemical splash goggles and/or a full-face shield shall be worn during chemical transfer and handling operations as procedures dictate or when in a chemical storage area.

➢ Sandals, sneakers and bare feet are prohibited. Safety shoes, per ANSI 47 are required where employees routinely lift objects over 65 lbs.

➢ Lab coats or aprons are recommended for wear in the laboratory. Laboratory coats shall be removed immediately upon discovery of significant contamination.

➢ Appropriate chemical-resistant gloves based on the Table in Appendix “Glove Selection” and the manufacture’s glove-specific chemical resistance data shall be worn at all times when there may be skin contact with chemicals. Used gloves shall be inspected and washed prior to re-use. Damaged or deteriorated gloves will be immediately replaced. Gloves shall be washed prior to removal from the hands. Disposable gloves shall not be reused.

➢ Thermal-resistant gloves shall be worn for operations involving the handling of cryogenic, heated materials and exothermic reaction vessels. Thermal-resistant gloves shall be non-asbestos and shall be replaced when damaged or deteriorated.

➢ All respirator use, including paper dust masks, shall be approved by the Director of Occupational Safety and Health Services. A separate approval is required for each type of exposure. Respirator use must comply with Michigan’s version of 29CFR1910.134.

8.0 Personal Work Practices

➢ Laboratory supervision must ensure that each employee knows and follows the rules and procedures established in this plan.

➢ All employees shall remain vigilant to unsafe practices and conditions in the laboratory and shall immediately report such practices and/or conditions to the laboratory supervisor. The supervisor must correct unsafe practices and or conditions promptly.
- Long hair and loose-fitting clothing shall be confined close to the body to avoid being caught in moving machine/equipment parts.
- Use only those chemicals appropriate for the ventilation system.
- Avoid unnecessary exposure to all chemicals by any route.
- Do not intentionally smell or taste any chemicals.
- Encourage safe work practices in coworkers by setting the proper example. Horseplay is strictly forbidden.
- Seek information and advice from knowledgeable persons, standards and codes about the hazards present in the laboratory. Plan operations, equipment and protective measures accordingly.
- Inspect personal protective equipment prior to use, and wear appropriate protective equipment as procedures dictate and when necessary to avoid exposure. Personal protective equipment should not be your primary safety guard; instead engineering controls should be your first line of defense. If PPE becomes contaminated the process should be halted and evaluated to determine means for preventing this contamination. PPE is your last line of defense.

9.0 Labeling

All containers in the laboratory shall be labeled, blank labels are provided by the Department. This includes sample containers and waste containers. The label shall be informative, durable and include the information provided below. Directions for assigning Hazard Statements can be found in appendix labeled Hazard Statement. For information on storage codes see appendix Chemical Storage and Classification System (Flinn Scientific Inc.). For information on EPA Waste Codes see appendix labeled Definition of Hazardous Waste.

Exemptions for labeling requirements shall be made for chemical transfers from a labeled container into a container that is intended only for the immediate use of the employee who performed the transfer. At no time shall the employee leave an unattended container that is unlabeled, not even to use the restroom.
Required Information:

- Contents (IUPAC or DOT chemical name – no abbreviations)
- Date
- Faculty or Staff Responsible for the Chemical

Suggested Information:

- Hazard Statement
- Storage Code
- EPA Waste Code
- User

Contents
Date
Owner (Faculty/Staff)
Hazard Statement
Storage Code
EPA Waste Code
User
Misc.

Information on Labeling: http://www.civil.mtu.edu/docu/CHP
Civil and Environmental Engineering, Michigan Technological Uni.

10.0 Laboratory Signs

All laboratories shall have signs posted on or near the door to the laboratory identifying the location of the SDS(s) for that laboratory. This sign should also indicate the hazards present, names and phone numbers of the responsible persons for this laboratory, see Appendix “Emergency Phone Numbers”.

For unattended operations see Appendix “Unattended Operations Notice”

11.0 Off Campus Transportation and Receipt of Chemicals, Wastes, Samples or Testing Material for Treatability Studies.

Prior to shipping or receiving any chemical, waste or sample Occupational Safety and Health Services needs to be notified. There are extensive fines and possible imprisonment for violation of State and Federal Laws associated with hazardous materials shipping. Fines typically range upward from five figures and are assessed against the person offering the material for shipment and the employer. In order to be able to ship a
package containing chemicals from MTU, an employee that is certified in Hazmat Shipping must sign the Shipper Certification Form, see Appendix “Off-Campus Shipping of Chemicals, Wastes, Samples, or Testing Materials”.

### 12.0 Waste Generation, Storage and Disposal

- **Waste Generation**

  Prior to generating any waste, it is suggested that, whether thought to be hazardous or not (except for office-type wastes), notification as to:
  - What the waste is composed of
  - Quantity and Frequency of Generation
  - Location of Generation
  - Reason for Generating the Waste
  - Proposed Disposal Technique for the Waste

  be made to Occupational Safety and Health Services. It is unlawful to treat any waste prior to disposal.

- **Waste Storage**

  The following are some general guidelines and requirements for the handling, accumulation, and storage of hazardous wastes that need to be followed.
  - All persons involved with handling hazardous wastes must be trained in safe handling, proper accumulation and storage procedures, emergency response procedures and spill cleanup procedures.
  - Never mix waste types; see appendix “Definition of Hazardous Waste” for waste disposal guidelines. This guideline does not eliminate the need for collecting and sorting wastes by compatibility. Hazardous reactions can occur if incompatible wastes are mixed. The compatibility of
wastes can be verified by reviewing the SDS under the section incompatibilities.

- Keep incompatible wastes separated by distance or a physical barrier (secondary container).

- Hazardous waste must be properly labeled and stored at the location where it has been generated. In addition to the required content label, a hazardous waste label must be affixed which includes the words “Hazardous Waste”, the accumulation start date, and the EPA waste code. See appendix “Hazardous Waste Label” for sample.

Waste Disposal

The following is taken directly from the Michigan Technological University Safety Manual that can be found at the following website address: http://www.mtu.edu/osh/safety-programs/required/waste-disposal/

Hazardous Waste Disposal Procedures

February 2010

Introduction to Waste Disposal

Most wastes generated in the laboratories and shops located on campus are prohibited from disposal in the regular trash or down the drain. Many of these wastes are regulated under the federal Resource Conservation and Recovery Act (RCRA).

The term hazardous waste is defined under RCRA as solids, liquids, and gases that exhibit certain characteristics or are specifically listed in the rules. Hazardous waste is regulated under a "cradle to grave" concept, meaning that the waste is tracked via written records from the time it becomes a waste, and that ownership remains with the generator forever. Therefore, the best method to reduce the risk of future remediation costs is to reduce the amount of hazardous waste generated. It is essential to consider the amounts and types of wastes that will be generated when a project is in the proposal stage in order to ensure that a disposal method exists that is both legal and affordable—and to minimize the amount of waste generated. Every person responsible for the generation of waste at Michigan Tech must understand the proper disposal procedures and the requirements of the Michigan hazardous waste rules under RCRA.

Rules for Hazardous Waste Accumulation

- A generator must perform a “waste determination” to see if a waste is regulated under RCRA. That determination can be based on the generator’s knowledge of the waste composition or through chemical analysis if the composition is unknown. The waste determination must be made no later than the moment a substance becomes a waste. Documentation supporting this waste determination must be kept on file for three years.

- Hazardous waste must be accumulated and stored at the point of generation until removed by Occupational Safety and Health Services (OSHS) and must be:
Collected in a container that is compatible with its contents under all conditions that it might be subjected to during accumulation, storage, and shipment.
- Kept tightly sealed except when adding waste to the container.
- Handled only by personnel trained in the requirements of these hazardous waste rules.
- Removed from the accumulation area within three days if the quantity of any one waste exceeds fifty-five gallons. (From a safety perspective, no more than five gallons should be accumulated in a laboratory or shop.)
- Labeled with the words “hazardous waste,” the waste identification number (see below), the accumulation start date, and a chemical description.

Hazardous Waste Determination

Waste determination involves comparing the characteristics and composition of the waste to the descriptions and tables contained in the hazardous waste rules. The basic process involves answering the following questions:

- Is the waste specifically listed in any of the tables (see Waste Descriptions)?
- Does the waste meet the definition of ignitability (see Waste Descriptions)?
- Does the waste meet the definition of corrosivity (see Waste Descriptions)?
- Does the waste meet the definition of reactivity (see Waste Descriptions)?
- Does the waste meet the definition of toxicity (see Waste Descriptions)?

If the answer to any of these questions is yes, the waste is regulated and the rules in 2 (a-e), above, apply. If the answer to all of the questions is no, the rules in 2 (a-e) apply except that the words “hazardous waste” and the waste identification number may be omitted from the label.

13.0 Air monitoring

- Air sampling for evaluating employee exposure to chemical substances shall be conducted if deemed necessary based on Permissible Exposure Limits (PEL). Of particular concern are the chemicals sighted in Michigan Occupational Safety and Health Rule 2301 and Group 1 Human Carcinogen (EPA) see Appendix “Class 1 Carcinogens”. Air sampling should be conducted following a chemical spill.

- Air sampling should be initiated if there is no appropriate means for determining the presence or release of a chemical in use in the work environment. OSHS can assist in determining safe work environments.

- Upon addition of new chemicals or changes in control procedures, additional air sampling may be considered to determine the exposures. Air sampling should be conducted if there is reason to believe that exposure levels for regulated substances, that require sampling, routinely exceed the action level, or in the absence of an action level, the PEL. Air sampling will be implemented when usage of highly toxic substances outside of fume hoods or glove boxes exceeds three times per week.
The results of air sampling studies performed in the laboratory must be posted in the work area.

Air sampling must be performed whenever workers exhibit symptoms of exposure.

14.0 Housekeeping

Each laboratory worker is directly responsible for the cleanliness of his or her workspace, and jointly responsible for common areas of the laboratory. Laboratory management shall insist on the maintenance of housekeeping standards.

The following procedures apply to the housekeeping standards of the laboratory:

- All spills on lab benches or floors shall be immediately cleaned and properly disposed of; this applies only if the spill can be cleaned up safely. The determination of what size of spill can be cleaned up safely must be determined prior to the use of the chemical and should be stated in the SOP. In the event that it cannot be cleaned up safely, the MTU emergency response plan for chemical spills shall be implemented.

- Lab benches shall be kept clear of equipment and chemicals except those necessary for the work currently being performed.

- Work areas shall be cleaned at the end of each operation or each day.

- All apparatus(s) shall be thoroughly cleaned and returned to storage upon completion of usage.

- Floors, aisles, exits, fire-extinguishing equipment, eyewashes, showers, electrical disconnect and other emergency equipment shall remain unobstructed.

- Labels shall face front.

- Chemical containers shall be clean, properly labeled and returned to storage upon completion of usage.

- Chemical wastes will be disposed of in accordance with the waste disposal plan.
15.0 Safety and Emergency Equipment

Telephone numbers of emergency personnel, supervisors and other workers as deemed appropriate must be posted. Some emergency phone numbers are listed in Appendix “Emergency Phone Numbers”.

- A fire extinguisher shall only be used if the fire is no larger than a wastebasket or if the fire blocks the exit. Upon use of a fire extinguisher, the fire alarm shall be activated. Prior to the procurement of new chemicals, the purchaser (with assistance from the Chemical Hygiene Officer and/or Safety Officer) shall verify that existing extinguishers and other emergency equipment are appropriate for such chemicals. Employees who have not received training in the use of portable fire extinguishers must follow the MTU emergency evacuation procedure and are not required to use a fire extinguisher.

- All employees who might be exposed to chemical splashes shall be instructed in the location and proper usage of emergency showers and eyewashes. The eyewash and emergency shower shall be inspected annually. Occupational Safety and Health Services Office shall perform these inspections. The Safety Officer shall provide training to laboratory supervisors. Supervisors shall provide training to those they supervise.

- Location signs for safety and emergency equipment must be posted.

16.0 Engineering Controls

- Intent

The engineering controls installed in the laboratory are intended to minimize employee exposure to chemical and physical hazards in the workplace. These controls must be maintained in proper working order for this goal to be realized.

- Modification

No modification of engineering controls will occur unless testing indicates that worker protection will continue to be adequate. Any modifications shall be made only an authorized person.
Improper Function

Improper function of engineering controls must be reported to the Safety Officer, or Occupational Safety and Health Services immediately. The system shall be taken out of service utilizing tagout/lockout procedures at the immediate point of control until proper repairs have been executed.

Usage

All employees shall follow proper work practices when using the engineering controls.

Local Exhaust Ventilation (Elephant Trunks, Flexible Tubing)

The following procedures shall apply to the use of local exhaust ventilation:

- Openings of trunk or tubing shall be placed as close as possible to sources of the air contaminant.

- After using trunk/tubing ventilation the fan should be operated for an additional period of time sufficient to clear residual contaminants from the ductwork.

- The ventilation system shall be inspected annually by Occupational Safety and Health Services. The duct velocity shall be maintained at 3500 feet per minute, minimum.

- Prior to a change in chemicals or procedures Occupational Safety and Health Services shall determine the adequacy of the ventilation system.

Laboratory Hoods

The laboratory hoods shall be utilized for all chemical procedures that might result in release of hazardous chemical vapors or dust. As a general rule, the hood shall be used for all chemical procedures involving substances that are appreciably volatile and have a permissible exposure limit (PEL) less than 50 ppm. The Safety Officer shall provide training on the use of hoods to supervisors. Supervisors will train those they supervise.
The following work practices shall apply to the use of hoods:

- Confirm adequate hood ventilation performance prior to opening chemical containers inside the hood. An inward flow of air can be confirmed by holding a piece of paper at the face of the hood and observing the movement of the paper. Most hoods are not locally controlled and are operated by facilities. Some hoods are on a timed schedule for being turned on and off. Prior to use, the schedule should be checked to determine if this schedule is compatible with the work to be performed in the hood. Hoods in Dow ESE are scheduled for 24-hour continuous operation.

- Keep the sash of the hood closed at all times except when adjustments within the hood are being made. At these times, maintain the sash height as low as possible. Some hoods have red arrows indicating the maximum that the hoods sash can be opened and maintain the needed linear velocity for the hood.

- Storage of chemicals and equipment inside the hood shall be kept to a minimum.

- Minimize interference with the inward flow of air into the hood. This is accomplished by keeping items a distance of six inches from the walls and sashes.

- Leave the hood operating when it is not in active use if hazardous chemicals are contained inside the hood or if it is uncertain whether adequate general laboratory ventilation will be maintained when the hood is non-operational.

- The ventilation system shall be inspected annually. The hood face velocity shall be maintained between 75 and 150 feet per minute, the fume hoods in the Dow Building have velocity monitors mounted on them and should be used to determine that adequate velocity is being maintained during the use of the hood. Occupational Safety and Health Services shall maintain a record of each inspection.

- The hood shall not be used as a means of disposal for volatile chemicals.
Glove Boxes and Isolation Rooms

The exhaust air from a glove box or isolation room may pass through scrubbers or other treatment before being released into the regular exhaust system, if the chemicals or substances used require this action.

Cold Rooms and Warm Rooms

If procedures differ for these facilities from the standard procedures stated in this Chemical Hygiene Plan, as determined by the project officer, a copy of the SOP must be posted outside of the facility and a copy be submitted to the Chemical Hygiene Officer/Safety Officer for approval.

Storage Cabinets

Storage cabinets for flammable and hazardous chemicals will be ventilated as needed.

17.0 Employee Information and Training

Hazard Information

All employees will be apprised of the hazards presented by the chemicals in use in the laboratory. Each employee shall receive training at the time of initial assignment to the laboratory and prior to assignments involving new exposure situations. This will be performed via implementation of this CHP/SOP and validated by written testing.
Training

- The Chemical Hygiene Officer shall provide new employee training covering the contents of this Chemical Hygiene Plan. This training should occur prior to starting work in any chemical laboratory and should be refreshed annually. The following topics are to be presented during this training:

- Right-to-Know Law
- Laboratory Specific Standard Operating Procedures
- Chemical Procurement, Storage, Handling
- PPE
- Labeling
- Waste Handling
- Housekeeping
- Engineering Controls
- Permit System
- Emergency Action Plan

- Training supplied by the Laboratory Supervisor shall include the following.

- Introduction to operations where chemical and physical hazards are present/types of hazards encountered.
- Required work practices
- PPE
- Emergency procedures
- Detection of chemical hazards
- Location and training on SOP(s), SDS(s), and CHP
- Labeling system

18.0 Prior Approval of Laboratory Activities

- Permit System

A permit system shall be used for laboratory activities that present specific, foreseeable hazards to the employees. It is the responsibility of principal investigators, laboratory stewards, and laboratory supervisors to submit a Laboratory Operations Permit Request Form, see Appendix “Laboratory Operations Permit”, for these activities. These activities include sole occupancy of laboratory (when chemical hazards are present and when not in verbal contact with another knowledgeable employee) and other hazardous operations as outlined below are present.
• Greater than 2.0 liters of organic solvent with a flash point of less than 20°C is used,

• More than 10 grams of reactive metal is used in one experiment,

• Reagents know to be category I carcinogens are used (see Appendix “Class 1 Carcinogens” for a list),

• Materials that are explosive are generated or used in the experiment,

• Reaction has the potential to become uncontrolled,

• Poisonous gases are used or produced,

• Experiment is carried out at elevated pressures,

• Radioisotopes are used in the experiment.

• Unattended operations,

• Children in laboratories, see Appendix “Children in Laboratories”.

➢ Sole Occupancy

At no time shall any work involving chemicals, mechanical equipment, or electrical devices other than computers be performed in the laboratory when the only knowledgeable person within hearing distance is the laboratory person performing the work. A second person that is knowledgeable of the work must be in verbal contact with the worker. Under unusual conditions, crosschecks, periodic Public Safety checks, closed circuit television, or other measures may be taken when permitted.

➢ Hazardous Work

All hazardous operations, as determined by the Laboratory Supervisor, or as defined as a hazardous operation above, are to be performed during a time when at least two personnel are present at the laboratory. At no time shall a laboratory person, while working alone in the laboratory, perform work that is considered hazardous.
Unattended Operations

When laboratory operations are performed which will be unattended by laboratory personnel (continuous operations, overnight reactions, etc.), the following procedures will be employed:

- The permit system shall be utilized.

- The laboratory supervisor will review work procedures to ensure the safe completion of the operation.

- An appropriate sign will be posted at all entrances to the laboratory. The sign must include the name of the operator, types of hazards present, dates and times of operation, emergency procedures, and phone numbers to contact in case of emergency or questions.

- Precautions shall be made for the interruption of utility service during the unattended operation (loss of water pressure, electricity, etc.).

- The person responsible for the operation will return to the laboratory at the conclusion of the operation to assist in the dismantling of the apparatus and should be available in case of emergency.

19.0 Medical Consultations and Examinations

- An opportunity to receive medical attention is available to all employees who work with hazardous chemicals in the laboratory. The opportunity for medical attention will be made available to employees under the following circumstances:

  - Whenever an employee develops signs or symptoms associated with a hazardous chemical, to which the employee may have been exposed in the laboratory,

  - Medical surveillance programs will be established where exposure monitoring reveals an exposure level above the action level for an MIOSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, and/or,
Whenever an event takes place in the laboratory such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure the employee will be provided an opportunity for medical consultation for the purpose of determining the need for medical examination.

These medical consultations and examinations shall be provided without cost to the employees, without loss of pay and at a reasonable time and place.

These medical consultations and examinations shall be administered by or under the direct supervision of a licensed physician. Employees seeking the opportunity of medical consultation should notify the Occupational Safety and Health Services Office.

20.0 Chemical Hygiene Responsibilities

- **Department Chair**

  David W. Hand, Ph.D. has the ultimate responsibility for chemical hygiene throughout the Department and with assistance of other program administrators, will provide continued support for chemical hygiene.

- **Chemical Hygiene Officer**

  The Chemical Hygiene Officer shall:
  
  - perform regular, formal chemical hygiene and housekeeping inspections,
  
  - help project directors develop precautions and adequate facilities,
  
  - review and improve the Chemical Hygiene Plan on an annual basis,
Laboratory Workers (Principal Investigators, Faculty, Graduate Students)

The laboratory workers are individually responsible for

- planning and conducting each laboratory operation in accordance with the Chemical Hygiene Plan,
- developing good personal chemical hygiene habits.
- developing laboratory-specific standard operating procedures

21.0 Special Precautions (Working with Allergens, Embryotoxins, Highly Corrosive/Flammable/Reactive Materials, etc.)

When laboratory procedures change to require the use of additional classifications of chemicals (allergens, embryotoxins, teratogens, carcinogens, etc.), additional special precautions shall be implemented as deemed necessary by the Laboratory Supervisor. The permit system shall be utilized for all special activities.

- Suitable gloves to prevent hand contact shall be worn when exposed to allergens or substances of unknown allergen activity. Allergens are particularly hazardous compounds as they can cause the exposed person to have a life threatening allergic reaction to the compound or enhance an existing allergy.

- Women of child-bearing age may be replaced with a male to handle embryotoxins, and they will only work with them in a hood with confirmed satisfactory performance and will use protective equipment to prevent skin contact.

- Embryotoxins will be stored in adequately ventilated areas in unbreakable secondary containers.

- The supervisor will be notified of spills and other exposure incidents. A physician will be consulted when appropriate.

22.0 Accident Investigation

- The immediate supervisor will conduct incident investigations with assistance from other personnel as deemed necessary.

- Incident reports need to be completed within 24 hours by the supervisor and forwarded to OSHS.
A copy of each incident and injury report shall be sent to the Department Chair.

23.0 Emergency Action Plan for Spills, Releases, and Accidents

If it is determined that the nature and/or quantity of the spilled chemical will affect anyone outside of the immediate area, the procedure for the evacuation of the building must be initiated. That procedure is as follows:

- Sound the alarm at the fire alarm box if there is a threat to the entire building otherwise only evacuate the threatened area.
- Dial either 911 or 8911 on the nearest campus phone.
- Identify yourself to the operator and explain the nature of the incident. Be certain to specify if a fire or explosion hazard exists and/or the need for emergency medical assistance.
- If an employee is injured notify Public Safety. Public Safety will either call an ambulance for transporting the individual or Public Safety will transport the individual. At no time should an employee transport a sick or injured person other than Public Safety. Individuals should not transport themselves other than under the direction of Public Safety.
- Request the assistance of Occupational Safety and Health Services.
- Restrict access to the area to prevent bystanders, etc., from entering the building or area that has been evacuated.
- Proceed to the outer entrance of the building or area and wait for the arrival of Public Safety.
- Describe the nature of the spill to emergency responders with emphasis on the hazard associated with the material. Have SDS ready for reference.
- The appropriate SDS should accompany the victim of a chemical exposure sent to an emergency medical facility or should arrive shortly thereafter to help ensure proper treatment.
Emergency Action Plan for Fires or Responding to Fire Alarms

MTU Policy
Department Member Responsibilities for Emergencies

- The signal to evacuate the building in case of emergency is the building fire alarm.

- The evacuation must be orderly. Walk to exits. It is the Department member’s responsibility to direct students to the safest exit.

- Certain safety precautions are necessary before actually departing, such as: turn off gas and lights and close windows/doors, etc.

- Building elevators are not to be used for evacuation.

- Elevators are for use of rescue workers, police, and fire fighters. The building custodian brings the elevators to the first floor. Personnel could become trapped in them by nature of the emergency.

- Personnel are not to congregate in or around the building exits or doorways, once they are outside the building or emergency area.

- Personnel must be at least 100 feet away from the building in case of falling debris and to enable rescue or responding vehicles and personnel to get to the site of the emergency.

- Personnel may re-enter the building only when the Public Safety Officer at the scene of the emergency situation gives the “All Clear”. The Public Safety Officer promptly informs building evacuees of the reason for the evacuation.

- Department Chairs must make arrangements for the safe evacuation of staff with mobility impairments. Faculty are responsible for making arrangements for their student with such impairments.

- Students and employees who need assistance are to wait until the others have evacuated so as not to cause delays at exit openings and stairs.
• Persons in wheel chairs are to be assisted to a designated safe refuge area (usually the landing of an enclosed stairway) if evacuation is necessary from other than a ground level floor. A designated person will direct fire fighters to the location of anyone waiting for assistance in a safe refuge area.

24.0 Annual Chemical Hygiene Plan Audit

The Chemical Hygiene Officer will routinely conduct an audit of the Chemical Hygiene Plan. Results will be provided to the ranking official. The laboratory Supervisors are responsible for taking corrective action.

25.0 References and Recommended Reading


Freeman, N.T., Introduction to Safety in the Chemical Laboratory, Academy Press, 1982.


#1 PROCESS

Extracting petroleum asphalt from pavement samples.

#2 HAZARDOUS CHEMICALS/CLASS OF HAZARDOUS CHEMICALS

Trichloroethylene (TCE)

#3 PERSONAL PROTECTIVE EQUIPMENT

<table>
<thead>
<tr>
<th>Suggested Glove Type</th>
<th>Model Number</th>
<th>Thickness</th>
<th>Breakthrough Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVA</td>
<td>Edmont 25-545</td>
<td>0.38 mm</td>
<td>480 min</td>
</tr>
<tr>
<td>Viton</td>
<td>North F-091</td>
<td>0.25 mm</td>
<td>390 min</td>
</tr>
<tr>
<td>Butyl rubber</td>
<td>North B-174</td>
<td>0.64 mm</td>
<td>10 min</td>
</tr>
<tr>
<td>Nitrile</td>
<td>North LA-142G</td>
<td>0.36 mm</td>
<td>4 min</td>
</tr>
</tbody>
</table>

Apron– Nitrile or Neoprene

Wear above listed personal protective equipment when working with Trichloroethylene.

#4 ENGINEERING/VENTILATION CONTROLS

Use in ventilated area.

#5 SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

Keep containers closed when not in use.

#6 SPILL AND ACCIDENT PROCEDURES
EYE CONTACT: Immediately flush eyes with cool flowing water continuously for 15 minutes, lifting eyelids occasionally. Immediately call for medical attention.  
SKIN CONTACT: Remove contaminated clothing. Wash contact area with mild soap and water. Rinse thoroughly. Seek medical attention if skin rash persists.  
IF INHALED: remove to fresh air.  
**Small Spill:** Do not attempt cleanup if you feel unsure of your ability to do so or if you perceive the risk to be greater than normal laboratory operations. Do not exceed the PEL of 100 ppm or the ceiling limit of 300 ppm during cleanup activities. If you are confident in your ability to clean up the spill, pick up the liquid with absorbent and place in appropriate storage containers (see CHP 2.2.2). Make sure spilled chemical is compatible with other chemicals that may be in designated storage container.  
**Large Spill:** Notify others in area of spill. Evacuate area, dial 911, notify second knowledgeable source, remain in area in safe location to restrict access and assist with response.  

**#7 WASTE DISPOSAL**  
Disposal of liquid/solid spilled waste: Hold for waste disposal authorization/pickup by MTU OSHS per MTU Civil & Env. Engineering Chemical Hygiene Plan.  

**#8 PERMIT APPROVAL REQUIRED**  
YES (carcinogen and possible mutagen)  

**#9 DECONTAMINATION**  
Wash area with soap and water. Ventilate area. Wash clothing before reuse.  

**#10 DESIGNATED AREA**  
YES (carcinogen and possible mutagen)
Material Safety Data Sheet (example)

TRICHLOROETHYLENE

MSDS Number: T4940 --- Effective Date: 09/14/00

1. Product Identification

    Synonyms: Trichloroethene; TCE; acetylene trichloride; Ethinyl trichloride
    CAS No.: 79-01-6
    Molecular Weight: 131.39
    Chemical Formula: C2HCl3
    Product Codes:
    J.T. Baker: 5376, 9454, 9458, 9464, 9473, 9474
    Mallinckrodt: 8598, 8600, 8633

2. Composition/Information on Ingredients

    Ingredient                                CAS No         Percent   Hazardous
    Trichloroethylene                     79-01-6          100%       Yes

3. Hazards Identification

    Emergency Overview
    --------------------------
    WARNING! HARMFUL IF SWALLOWED OR INHALED. AFFECTS HEART, CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. CAUSES SEVERE SKIN IRRITATION. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

    J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)
    ---------------------------------------------------------------
    Health Rating: 3 - Severe (Cancer Causing)
    Flammability Rating: 1 - Slight
    Reactivity Rating: 1 - Slight
    Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Vapors can irritate the respiratory tract. Causes depression of the central nervous system with symptoms of visual disturbances and mental confusion, incoordination, headache, nausea, euphoria, and dizziness. Inhalation of high concentrations could cause unconsciousness, heart effects, liver effects, kidney effects, and death.

Ingestion:
Cases irritation to gastrointestinal tract. May also cause effects similar to inhalation. May cause coughing, abdominal pain, diarrhea, dizziness, pulmonary edema, unconsciousness. Kidney failure can result in severe cases. Estimated fatal dose is 3-5 ml/kg.

Skin Contact:
Cause irritation, redness and pain. Can cause blistering. Continued skin contact has a defatting action and can produce rough, dry, red skin resulting in secondary infection.

Eye Contact:
Vapors may cause severe irritation with redness and pain. Splashes may cause eye damage.

Chronic Exposure:
Chronic exposures may cause liver, kidney, central nervous system, and peripheral nervous system effects. Workers chronically exposed may exhibit central nervous system depression, intolerance to alcohol, and increased cardiac output. This material is linked to mutagenic effects in humans. This material is also a suspect carcinogen.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, cardiovascular disorders, impaired liver or kidney or respiratory function, or central or peripheral nervous system disorders may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Call a physician.

Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.

5. Fire Fighting Measures

Fire:
Autoignition temperature: 420C (788F)
Flammable limits in air % by volume:
lel: 8; uel: 12.5

Explosion:
A strong ignition source, e.g., a welding torch, can produce ignition. Sealed containers may rupture when heated.

Fire Extinguishing Media:
Use water spray to keep fire exposed containers cool. If substance does ignite, use CO2, dry chemical or foam.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e.g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection
Airborne Exposure Limits:
Trichloroethylene:
  - OSHA Permissible Exposure Limit (PEL):
    100 ppm (TWA), 200 ppm (Ceiling),
    300 ppm/5min/2hr (Max)
  - ACGIH Threshold Limit Value (TLV):
    50 ppm (TWA) 100 ppm (STEL);
    listed as A5, not suspected as a human carcinogen.

Ventilation System:
A system of local and/or general exhaust is recommended to keep
employee exposures below the Airborne Exposure Limits. Local
exhaust ventilation is generally preferred because it can control the
emissions of the contaminant at its source, preventing dispersion of it
into the general work area. Please refer to the ACGIH document,
Industrial Ventilation, A Manual of Recommended Practices, most
recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not
feasible, wear a supplied air, full-facepiece respirator, airlined hood,
or full-facepiece self-contained breathing apparatus. Breathing air
quality must meet the requirements of the OSHA respiratory
protection standard (29CFR1910.134). This substance has poor
warning properties. Where respirators are required, you must have a
written program covering the basic requirements in the OSHA
respirator standard. These include training, fit testing, medical
approval, cleaning, maintenance, cartridge change schedules, etc.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat,
apron or coveralls, as appropriate, to prevent skin contact. Neoprene
is a recommended material for personal protective equipment.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Chloroform-like odor.

Solubility:
Practically insoluble in water. Readily miscible in organic solvents.

Specific Gravity:
1.47 @ 20C/4C

pH:
No information found.
% Volatiles by volume @ 21C (70F): 100

Boiling Point:
87C (189F)

Melting Point:
-73C (-99F)
Vapor Density (Air=1): 4.5

Vapor Pressure (mm Hg):
57.8 @ 20C (68F)

Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Will slowly decompose to hydrochloric acid when exposed to light and moisture.
Hazardous Decomposition Products:
May produce carbon monoxide, carbon dioxide, hydrogen chloride and phosgene when heated to decomposition.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Strong caustics and alkalis, strong oxidizers, chemically active metals, such as barium, lithium, sodium, magnesium, titanium and beryllium, liquid oxygen.

Conditions to Avoid:
Heat, flame, ignition sources, light, moisture, incompatibles

11. Toxicological Information

Toxicological Data:
Trichloroethylene: Oral rat LD50: 5650 mg/kg; investigated as a tumorigen, mutagen, reproductive effector.

Reproductive Toxicity:
This material has been linked to mutagenic effects in humans.

--------\Cancer Lists\------------------------------------------------------------
---NTP Carcinogen---

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Known</th>
<th>Anticipated</th>
<th>IARC Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trichloroethylene (79-01-6)</td>
<td>No</td>
<td>Yes</td>
<td>2A</td>
</tr>
</tbody>
</table>

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater.
When released into the soil, this material is expected to quickly evaporate.
When released to water, this material is expected to quickly evaporate. This material has an experimentally-determined bioconcentration factor (BCF) of less than 100. This material is not expected to significantly bioaccumulate. When released into the air,
this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.

Environmental Toxicity:
The LC50/96-hour values for fish are between 10 and 100 mg/l. This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

**Domestic (Land, D.O.T.)**

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 5GL

**International (Water, I.M.O.)**

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 5GL

International (Air, I.C.A.O.)

-----------------------------
Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 5GL

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                       TSCA  EC   Japan  Australia
Trichloroethylene (79-01-6)           Yes    Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
--Canada--
Ingredient                                       Korea  DSL   NDSL  Phil.
Trichloroethylene (79-01-6)            Yes      Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\--------------
-SARA 302-    ------SARA 313------
Ingredient                                 RQ    TPQ     List  Chemical Catg.
Trichloroethylene (79-01-6)      No     No       Yes        No

--------\Federal, State & International Regulations - Part 2\--------------
-RCRA-    -TSCA-
Ingredient                                  CERCLA     261.33     8(d)
Trichloroethylene (79-01-6)                100        U228       No

Chemical Weapons Convention:  No  TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes Fire: No     Pressure: No
Reactivity: No          (Pure / Liquid)

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE
STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: No information found.
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 2 Flammability: 1 Reactivity: 0
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED OR INHALED. AFFECTS HEART, CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. CAUSES SEVERE SKIN IRRITATION. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep away from heat and flame.

Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician.

Note to physician: Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.

Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8, 11.

Disclaimer:
******************************************************************************
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******************************************************************************
Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)
Chemical Storage and Classification System (Flinn Scientific Inc. System)

Suggested Shelf Storage Pattern – Inorganic

The following order presented should be from the top shelf of the cabinet to bottom shelf.

Cabinet 1

I – 10
Sulfur, Phosphorous, Arsenic, Phosphorous Pentoxide

I – 2
Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Acetates

I – 3
Amides, Nitrates (not Ammonium Nitrate), Nitrites, Azides

I – 1
Metals and Hydrides

I – 4
Hydroxides, Oxides, Silicates, Carbonates, Carbon

Cabinet 2

I – 7
Arsenates, Cyanides, Cyanates

I – 5
Sulfides, Selenides, Phosphides, Carbines, Nitrides

I – 8
Borates, Chromates, Manganates, Permangantes
I – 6
Bromates, Chlorates, Perchlorates, Chlorites, Perchloric Acid, Peroxides, Hypochlorites, Hydrogen Peroxide

Cabinet 3

I – 9
Acids, except Nitric

Cabinet 4

O – 2
Alcohols, Glycols, Amines, Amides, Imines, Imides

O – 3
Hydrocarbons, Esters, Aldehydes

O – 4
Ethers, Ketones, Detenes, Halogenated Hydrocarbons, Ethylene Oxide

O – 5
Epoxy Compounds, Isocyanates

O – 7
Sulfides, Polysulfides, etc.

Cabinet 5

O – 8
Phenols, Cresols

O – 6
Peroxides, Azides, Hydroperoxides

O – 1
Acids, anhydrides, Peracides

Cabinet 6

O – 2
Alcohols, Glycols, etc.

O – 3
Hydrocarbons, Esters, etc.

O – 4
Ethers, Ketones, etc.

Cabinet 6

Severe Poisons
Glassware Disposal

Date: November 9, 1993

TO: Faculty, Graduate Students and Staff in the Chemical Engineering, Chemistry & Environmental Engineering Departments

From: Chemical Sciences & Engineering Building Safety Committee

RE: Revised Policy for Teaching/Research Laboratory Glassware Disposal

Signed WM Blumhardt

In order to reduce the numerous steps currently involved in the laboratory glass disposal process and associated risk of a serious accident to either our Building Custodians and/or other individuals in our building, listed below is a revised policy for glassware disposal from our teaching/research laboratories.

1. An appropriate glass disposal box (GDB) for broken glassware needs to be located within each teaching/research lab.

2. A GDB can be purchased for $5.31 from Chem Stores, Catalog #00142.

3. Each GDB can only be used one time – you cannot keep replacing only the liner as in the past.

4. All broken glassware should be immediately disposed of in the GDB.

Large unbroken empty glass jugs, which have been rinsed with water, can be placed next to the GDB for collection by the custodian. DO NOT PLACE IN THE HALLWAYS.

5. Glassware which contain chemicals such as mercury in thermometers must be disposed of in their own containers, labeled appropriately as well as covered by a lid, and disposed of in accordance with University OSHS procedures. DO NOT PUT IN THE GDB.

6. When the GDB is full please leave a note on the outside of the GDB for the custodian that it is ready to be picked up for disposal.

CUSTODIANS HAVE BEEN INSTRUCTED TO ONLY PICK UP GLASS FOR DISPOSAL WHICH IS CONTAINED IN A GDB.

7. All hallways and exits have to be kept free from obstructions in the event of a building emergency evacuation. Boxes or other refuse should be placed next to the GDB in your lab and labeled trash on the outside for the custodian who will pick it up for disposal.

8. Any materials being stored prior to disposal should be placed in the loading dock area. Special care should be taken to not obstruct access to the gas cylinder storage cages.

Thank you for your cooperation

C: Building Custodians
Unattended Operations Notice

Operation: (example) Heat conditioning Diffusion Denuder under constant nitrogen purge.

Start Date/Time:
End Date/Time:

Location: (example) Dow 835, Inside Hood

Hazard: (example) Compressed Gas (nitrogen)
Electrical Shock
High Temperature (300C)

In Case of Emergency Contact Public Safety ext. 911

For question or concerns, contact:

John Doe
Office Dow 830
Phone 7-2222 (work)
        483-2222 (home)

Jane Dow
Office Dow 831
Phone 7-5555 (work)
        483-5555 (home)
Personal Protective Equipment Assessment Form
Civil and Environmental Engineering Department

Date:
Room:

Types of Hazards and Associated Sources

☐ Impact
Chipping, grinding, machining, woodworking, sawing, drilling

Specific Equipment Required ____________________________________________

☐ Chemical Exposure
Acid and chemical handling, vapors, degreasing solvents, battery handling, etc.

Specific Equipment Required ____________________________________________

☐ Sharp Objects
Broken or chipped glass, handling sharp edged parts, objects which may pierce or cut a foot or hand, etc.

Specific Equipment Required ____________________________________________

☐ Temperature Extremes
Working areas where hot temperatures could cause burns, eye injury or ignite PPE and working areas where cold temperatures could cause frostbite or hypothermia.

Specific Equipment Required ____________________________________________

☐ Rolling Objects
Working in areas where the potential for rolling objects to pinch or crush hands or feet exists.

Specific Equipment Required ____________________________________________

☐ Falling, Dropping or Bumping Objects
Working in areas where the potential for falling objects and/or bumping hazards exists.

Specific Equipment Required ____________________________________________

☐ Light or Radiation
Welding, cutting, brazing, torch soldering, heat treating, high intensity lights, x-rays, handing of radioisotopes, etc.

Specific Equipment Required

☐ **Respiratory**
Any harmful dust, mist, fume or vapor that could become airborne, posing an inhalation hazard.

Specific Equipment Required

☐ **Electrical**
Direct or indirect contact with electricity.

Specific Equipment Required

☐ **Does the facility layout and co-worker position or location pose a hazard? If yes, describe the hazard that exists.**

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Specific Equipment Required
Glove Selection

Proper glove selection can be performed by accessing the following website.

http://www.grainger.com/content/qt-health-chemical-resistance-guide-gloves-166

It is very important when selecting a glove to purchase the exact glove referenced by the manufacture as this data is specific to the manufacturer. It is possible to purchase nearly the identical glove from a different manufacturer but you must verify the rating with that manufacturer as manufacturers may use different manufacturing process, such as different techniques for sealing seams on gloves, that could significantly affect the performance of the glove.

Quick Tips #166 (www.Grainger.com)

Choosing Chemical-Resistant Gloves

Chemical-resistant gloves are an important piece of personal protective equipment when working with chemicals. A Material Safety Data Sheet (MSDS) is the first and usually the best place to find a recommendation for which glove is appropriate for the chemical you're using. The test data is generally from a laboratory environment and with one specific chemical. Glove manufacturers generally do not test chemical mixtures and don't consider other variables in your application, such as hot or cold temperatures and cut hazards. Below are chemical guide links of the larger glove manufacturers distributed by Grainger. MAPA
North
Ansell
ShowaBest Glove
Microflex

On these chemical-resistance guide charts, you will find gloves made from many different materials. Different glove materials can react differently to individual chemicals. An important consideration when choosing a protective glove for working with chemicals is how the specific chemical reacts with the glove material. An MSDS that only specifies an acid-resistant glove is misleading because one glove material might work fine with hydrochloric acid, but provide little or no protection from nitric acid. Gloves are generally tested and rated in three categories for chemical compatibility: degradation, breakthrough time and permeation rate. All three should be considered when selecting a glove.
Hazard Statement

The goal of defining precisely, in measurable terms, every possible health or physical effect that may occur in the workplace as a result of chemical exposures cannot realistically be accomplished. This does not negate the need for employees to be informed of such effects and protected from them. The following outlines principles and procedures of hazard assessment.

For purposes of this section; any chemical which meets any of the following definitions are considered hazards and should be labeled with the following words defined below in bold.

(1) "Carcinogen:"

A chemical is considered to be a carcinogen if:

(a) It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or

(b) It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or,

(c) It is regulated by OSHA as a carcinogen.

(2) "Corrosive:"

A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U. S. Department of Transportation in appendix A to 49 CFR part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term shall not refer to action on inanimate surfaces.

(3) "Highly toxic:"

A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
(b) A chemical that has a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within hour) to albino rats weighing between 200 and 300 grams each.

(4) "Irritant:"

A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

(5) "Sensitizer:"

A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(6) "Toxic:"

A chemical falling within any of the following categories:

A chemical that has a median lethal dose (LD50) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(A) A chemical that has a median lethal dose (LD50) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) when the bare skin of albino rabbits weighing between two and three kilograms each.

(B) A chemical that has a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 2,000 parts per
million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 or 300 grams each.

(7) "Target organ effects."

The following is a target organ categorization of effects which may occur, including examples of signs and symptoms and chemicals which have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all-inclusive.

(A) Hepatotoxins: chemicals which produce liver damage. Signs & Symptoms: Jaundice; liver enlargement. Chemicals: Carbon tetrachloride; nitrosamines.

(B) Nephrotoxins: Chemicals which produce kidney damage. Signs & symptoms: Edema; proteinuria. Chemicals: Halogenated hydrocarbons; uranium.

(C) Neurotoxins: Chemicals which produce their primary toxic effects on the nervous system. Signs & Symptoms: Narcosis; behavioral changes; decrease in motor functions.

(D) Agents which act on the blood or hematopoietic system: Decrease hemoglobin function; deprive the body tissues of oxygen. Signs & Symptoms: Cyanosis; loss of consciousness. Chemicals: Carbon monoxide; cyanides.

(E) Agents which damage the lung: Chemicals which irritate or damage pulmonary tissue. Signs & Symptoms: Cough; tightness in chest; shortness of breath. Chemicals: Silica; asbestos.

(F) Reproductive toxins: Chemicals which affect the reproductive capabilities include chromosomal damage (mutations) and effects on fetuses (teratogenesis). Signs & Symptoms: Birth defects; sterility. Chemicals: Lead; DBCP.

(G) Cutaneous hazards: Chemicals which affect the dermal layer of the body. Signs & Symptoms: Birth defects; sterility. Chemicals: Lead; DBCP.
(H) Eye hazards: chemicals which affect the eye or visual capacity. Signs & symptoms: Conjunctives; corneal damage. Chemicals: Organic solvents; acids.

(8) "Compressed gas":

(A) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or

(B) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg. C) regardless of the pressure at 70 deg. F (21.1 deg. C); or

(C) A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 deg. C) as determined by ASTM D-323-72.

(9) "Explosive":

(A) A chemical that causes a sudden almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

(10) "Flammable":

A chemical that falls into one of the following categories:

(A) "Aerosol, flammable"

An aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(B) "Gas, flammable:

(1) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of thirteen (13) percent by volume or less; or

(2) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than twelve (12) percent by volume, regardless of the lower limit;

(C) "Liquid, flammable"
Any liquid having a flashpoint below 100 deg. F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. F (37.8 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(D) "Solid, flammable"

A solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

(11) "Organic peroxide"

An organic compound that contains the bivalent-O-O-structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

(12) "Oxidizer"

Chemical other than a blasting agent or explosive as defined in 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

(13) "Pyrophoric"

A chemical that will ignite spontaneously in air at a temperature of 130 deg. F (54.4 deg. C) or below.

(14) "Unstable (reactive)"

A chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

(15) "Water-reactive"

A chemical that reacts with water to release a gas that is either flammable or presents a health hazard.
Emergency Phone Numbers

If an emergency occurs please contact the following persons or departments in the order presented:

Campus Emergency Number 911
Public Safety

Dr. Niemi 487-2118
Manager, Occupational Safety and Health Services 482-9017 (home)

David Perram 487-2713
Chemical Hygiene Officer 337-1786 (home)

Chris Wojick 487-1623
Safety Officer 482-6075 (home)

Dr. Hand 487-2777
Department Head, CEE 337-1952 (home)
Off-Campus Shipping of Chemicals, Wastes, Samples, or Testing Materials

http://www.admin.mtu.edu/fm/oshs/section10.htm

10.5 Shipping Hazardous Materials

Shipments of hazardous materials such as explosives, compressed gases, flammable solids and liquids, oxidizers, toxic and infectious materials, radioactive materials, corrosive substances, and environmental pollutants are regulated by the Department of Transportation, DOT, regardless of quantity. Employees who offer such materials for shipment as well as those responsible for receiving shipments must be trained in accordance with DOT regulations. Contact Occupational Safety and Health Services for information and assistance with training and shipments of materials that could potentially be regulated.
Definition of Hazardous Waste

EPA Waste Codes Identification – Complete and Accurate Definitions found in Code of Federal Regulations Title 40 CFR; Subpart C, Section 261. Found in the CFR are specifically named chemicals except for D001 to D003.

D001: Flash point less than 60°C

D002: pH less than 2 or greater than 12.5

D003: 1) normally unstable  
2) readily undergoes violent changes without detonation  
3) reacts violently, forms explosive mixture and/or generates toxic gases with water  
4) cyanide or sulfur bearing waste

D004 – D043: Table of compounds, commonly known as the Toxicity Characteristic Leaching Procedure (TCLP) list.

P-List: Unused chemical (i.e. discarded commercial chemicals, container residues, spill residues, etc. not mixed with second active ingredient) which are present in quantities less than or equal to 1 liter or 1 kilogram

U-List: Unused chemical wastes (similar to P-List) which are present in quantities greater than 1 liter or 1 kilogram

F-List: Hazardous wastes (reaction products)
Hazardous Waste Label

Federal Laws Prohibit Improper Disposal
If found, contact the nearest police or Public Safety Authority or the U.S. Environmental Protection Agency

Generator Information:
Name: Michigan Technological University
Address: 1400 Townsend Drive
City: Houghton State: Michigan Zip: 49931

EPA Identification Number: MID065453268
EPA Waste Number:

Accumulation Start Date:
Waste Chemical Collection Request Form

How to View the Form

Due to the complexity of the Waste Chemical Collection Request Form, only certain browsers display this file properly. If you have trouble viewing the form, please right click on the link and download the form on a desktop computer. Then, open the file in Acrobat Reader.

The preceding information is taken directly from:

Carcinogens

http://ehp.niehs.nih.gov/roc/

Know to be human carcinogens:

Aflatoxins
Alcoholic Beverage Consumption
4-Aminobiphenyl (4-aminodiphenyl)
2-Aminonaphthalene (see 2-Naphthylamine)
Analgesic Mixtures Containing Phenacetin
Arsenic Compounds, Inorganic
Asbestos
Azathioprine
Benzene
Benzidine
Bis(Chloromethyl) Ether
Busulfan (see 1,4-Butanediol Dimethylsulfonate)
1,3-Butadiene
1,4-Butanediol Dimethylsulfonate (Myleran; Busulfan)
Cadmium (under cadmium and cadmium compounds)
Cadmium Chloride (under cadmium and cadmium compounds)
Cadmium Oxide (under cadmium and cadmium compounds)
Cadmium sulfate (under cadmium and cadmium compounds)
Cadmium Sulfide (under cadmium and cadmium compounds)
Chlorambucil
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (MeCCNU)
Chloromethyl Methyl Ether
Chromium Hexavalent Compounds (under Chromium Hexavalent Compounds)
Coal Tar (under Tars and Mineral Oils)
Coke Oven Emissions
Creosote (Coal) (under Tars and Mineral Oils)
Creosote (Wood) (under Tars and Mineral Oils)
Cristobalite (under Silica, Crystaline (Respirable Size))
Cyclophosphamide
Cyclosporin A (Cyclosprine A; Circlesporia)
Diethylstibestrol
Direct Black 38
Direct Blue 6
Dyes that Metabize to Benzidine
Environmental Tobacco Smoke
Erionite
Ethylene Oxide
Lead Chromate (under Chromium Hexavalent Compounds)
Melphalan
Methoxsalen (under Methoxsalen with Ultraviolet A Therapy (PUVA))
(methoxsalen not carcinogenic alone)
Mineral Oils
Mustard Gas
Myleran (see 1,4-Butanediol Dimethylsulfonate)
2-Naphthylamine (Beta-Naphthylamine; 2-aminonaphthalene)
Piperazine Estrone Sulfate (under Conjugated Estrogens)
Quartz (under Silica, Crystalline (Respirable Size))
Radon
Silica, Crystalline (Respirable Size)
Smokeless Tobacco
Sodium Equilin Sulfate (under Conjugated Estrogens)
Sodium Estrogen Sulfate (under Conjugated Estrogens)
Solar Radiation and Exposure to Sunlamps and Sunbeds
Soots
Strong Inorganic Acid Mists Containing Sulfuric Acid
Strontium Chromate (under Chromium Hexavalent Compounds)
Tamoxifen
Tars
Thiotepa (in 7th ARC as tris(1-Aziridinyl)phosphine Sulfide)
Thorium Dioxide
Tobacco Smoking
Tridymite (under Silica, Crystalline (Respirable Size)
Tris(1-aziridinyl)phosphine Sulfide (Thiotepa)
Vinyl Chloride
Zinc Chromate (under Chromium Hexavalent Compounds)

http://monographs.iarc.fr/

Overall Evaluations of Carcinogenicity to Humans

**Group 1:** Carcinogenic to humans

This list contains all agents, mixtures and exposures evaluated as being in Group 1 to date. Where appropriate, chemical abstract numbers are given [in square brackets]. For details of the evaluation, the relevant Monograph should be consulted (volume number given in round brackets, followed by year of publication of latest evaluation). Use a free-text search to find a particular compound.

Agents and groups of agents

Aflatoxins, naturally occurring [1402-68-2] (Vol. 56; 1993)
4-Aminobiphenyl [92-67-1] (Vol. 1, Suppl. 7; 1987)

Arsenic [7440-38-2] and arsenic compounds (Vol. 23, Suppl. 7; 1987)
(NB: This evaluation applies to the group of compounds as a whole and not necessarily to all individual compounds within the group)

Asbestos [1332-21-4] (Vol. 14, Suppl. 7; 1987)

Azathioprine [446-86-6] (Vol. 26, Suppl. 7; 1987)

Benzene [71-43-2] (Vol. 29, Suppl. 7; 1987)

Benzidine [92-87-5] (Vol. 29, Suppl. 7; 1987)

Beryllium [7440-41-7] and beryllium compounds (Vol. 58; 1993)
(NB: Evaluated as a group)

N,N-Bis(2-chloroethyl)-2-naphthylamine (Chlornaphazine) [494-03-1] (Vol. 4, Suppl. 7; 1987)

Bis(chloromethyl)ether [542-88-1] and chloromethyl methyl ether [107-30-2] (technical-grade)
(Vol. 4, Suppl. 7; 1987)

1,4-Butanediol dimethanesulfonate (Busulphan; Myleran) [55-98-1] (Vol. 4, Suppl. 7; 1987)

Cadmium [7440-43-9] and cadmium compounds (Vol. 58; 1993)
(NB: Evaluated as a group)

Chlorambucil [305-03-3] (Vol. 26, Suppl. 7; 1987)

1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCNU; Semustine) [13909-09-6] (Suppl. 7; 1987)

Chromium[VI] compounds (Vol. 49; 1990)
(NB: Evaluated as a group)

Ciclosporin [79217-60-0] (Vol. 50; 1990)

Cyclophosphamide [50-18-0] [6055-19-2] (Vol. 26, Suppl. 7; 1987)

Diethylstilboestrol [56-53-1] (Vol. 21, Suppl. 7; 1987)

Epstein-Barr virus (Vol. 70; 1997)
Erionite [66733-21-9] (Vol. 42, Suppl. 7; 1987)

Ethylene oxide [75-21-8] (Vol. 60; 1994)
(NB: Overall evaluation upgraded from 2A to 1 with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Etoposide [33419-42-0] in combination with cisplatin and bleomycin (Vol. 76; 2000)

[Gamma Radiation: see X- and Gamma (g)-Radiation]

Helicobacter pylori (infection with) (Vol. 61; 1994)

Hepatitis B virus (chronic infection with) (Vol. 59; 1994)

Hepatitis C virus (chronic infection with) (Vol. 59; 1994)

Human immunodeficiency virus type 1 (infection with) (Vol. 67; 1996)

Human papillomavirus type 16 (Vol. 64; 1995)

Human papillomavirus type 18 (Vol. 64; 1995)

Human T-cell lymphotropic virus type I (Vol. 67; 1996)

Melphalan [148-82-3] (Vol. 9, Suppl. 7; 1987)

8-Methoxypsoralen (Methoxsalen) [298-81-7] plus ultraviolet A radiation (Vol. 24, Suppl. 7; 1987)

MOPP and other combined chemotherapy including alkylating agents (Suppl. 7; 1987)

Mustard gas (Sulfur mustard) [505-60-2] (Vol. 9, Suppl. 7; 1987)

2-Naphthylamine [91-59-8] (Vol. 4, Suppl. 7; 1987)

Neutrons (Vol. 75; 2000)
(NB: Overall evaluation upgraded from 2B to 1 with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Nickel compounds (Vol. 49; 1990)
(NB: Evaluated as a group)

Oestrogen therapy, postmenopausal (Vol. 72; 1999)
Oestrogens, nonsteroidal (Suppl. 7; 1987)
(NB: This evaluation applies to the group of compounds as a whole and not necessarily to all individual compounds within the group)

Oestrogens, steroidal (Suppl. 7; 1987)
(NB: This evaluation applies to the group of compounds as a whole and not necessarily to all individual compounds within the group)

Opisthorchis viverrini (infection with) (Vol. 61; 1994)

Oral contraceptives, combined (Vol. 72; 1999)
(NB: There is also conclusive evidence that these agents have a protective effect against cancers of the ovary and endometrium)

Oral contraceptives, sequential (Suppl. 7; 1987)

Phosphorus-32, as phosphate (Vol. 78; 2001)

Plutonium-239 and its decay products (may contain plutonium-240 and other isotopes), as aerosols (Vol. 78; 2001)

Radioiodines, short-lived isotopes, including iodine-131, from atomic reactor accidents and nuclear weapons detonation (exposure during childhood) (Vol. 78; 2001)

Radionuclides, a-particle-emitting, internally deposited (Vol. 78; 2001)
(NB: Specific radionuclides for which there is sufficient evidence for carcinogenicity to humans are also listed individually as Group 1 agents)

Radionuclides, b-particle-emitting, internally deposited (Vol. 78; 2001)
(NB: Specific radionuclides for which there is sufficient evidence for carcinogenicity to humans are also listed individually as Group 1 agents)

Radium-224 and its decay products (Vol. 78; 2001)

Radium-226 and its decay products (Vol. 78; 2001)

Radium-228 and its decay products (Vol. 78; 2001)

Radon-222 [10043-92-2] and its decay products (Vol. 78; 2001)

Schistosoma haematobium (infection with) (Vol. 61; 1994)

Silica [14808-60-7], crystalline (inhaled in the form of quartz or cristobalite from occupational sources) (Vol. 68; 1997)
Solar radiation (Vol. 55; 1992)

Talc containing asbestiform fibres (Vol. 42, Suppl. 7; 1987)

Tamoxifen [10540-29-1] (Vol. 66; 1996)
(NB: There is also conclusive evidence that this agent (tamoxifen) reduces the risk of contralateral breast cancer)

2,3,7,8-Tetrachlorodibenzo-p-dioxin [1746-01-6] (Vol. 69; 1997)
(NB: Overall evaluation upgraded from 2A to 1 with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Thiotepa [52-24-4] (Vol. 50; 1990)

Thorium-232 and its decay products, administered intravenously as a colloidal dispersion of thorium-232 dioxide (Vol. 78; 2001)

Treosulfan [299-75-2] (Vol. 26, Suppl. 7; 1987)

Vinyl chloride [75-01-4] (Vol. 19, Suppl. 7; 1987)

X- and Gamma (g)-Radiation (Vol. 75; 2000)

Mixtures

Alcoholic beverages (Vol. 44; 1988)

Analgesic mixtures containing phenacetin (Suppl. 7; 1987)

Betel quid with tobacco (Vol. 37, Suppl. 7; 1987)

Coal-tar pitches [65996-93-2] (Vol. 35, Suppl. 7; 1987)

Coal-tars [8007-45-2] (Vol. 35, Suppl. 7; 1987)

Mineral oils, untreated and mildly treated (Vol. 33, Suppl. 7; 1987)

Salted fish (Chinese-style) (Vol. 56; 1993)

Shale-oils [68308-34-9] (Vol. 35, Suppl. 7; 1987)

Soots (Vol. 35, Suppl. 7; 1987)

Tobacco products, smokeless (Vol. 37, Suppl. 7; 1987)

Tobacco smoke (Vol. 38, Suppl. 7; 1987)
Wood dust (Vol. 62; 1995)

Exposure circumstances

Aluminium production (Vol. 34, Suppl. 7; 1987)

Auramine, manufacture of (Suppl. 7; 1987)

Boot and shoe manufacture and repair (Vol. 25, Suppl. 7; 1987)

Coal gasification (Vol. 34, Suppl. 7; 1987)

Coke production (Vol. 34, Suppl. 7; 1987)

Furniture and cabinet making (Vol. 25, Suppl. 7; 1987)

Haematite mining (underground) with exposure to radon (Vol. 1, Suppl. 7; 1987)

Iron and steel founding (Vol. 34, Suppl. 7; 1987)

Isopropanol manufacture (strong-acid process) (Suppl. 7; 1987)

Magenta, manufacture of (Vol. 57; 1993)

Painter (occupational exposure as a) (Vol. 47; 1989)

Rubber industry (Vol. 28, Suppl. 7; 1987)

Strong-inorganic-acid mists containing sulfuric acid (occupational exposure to) (Vol. 54; 1992)

Last updated: 5 April 2000

Overall Evaluations of Carcinogenicity to Humans

**Group 2A:** Probably carcinogenic to humans

This list contains all agents, mixtures and exposures evaluated as being in Group 2A to date. Where appropriate, chemical abstract numbers are given [in square brackets]. For details of the evaluation, the relevant Monograph should be consulted (volume number given in round brackets, followed by year of publication of latest evaluation). Use a free-text search to find a particular compound.
Agents and groups of agents

Acrylamide [79-06-1] (Vol. 60; 1994)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Adriamycin [23214-92-8] (Vol. 10, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Androgenic (anabolic) steroids (Suppl. 7; 1987)

Azacitidine [320-67-2] (Vol. 50; 1990)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Benz[a]anthracene [56-55-3] (Vol. 32, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Benzidine-based dyes (Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Benzo[a]pyrene [50-32-8] (Vol. 32, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Bischloroethyl nitrosourea (BCNU) [154-93-8] (Vol. 26, Suppl. 7; 1987)

1,3-Butadiene [106-99-0] (Vol. 71; 1999)

Captafol [2425-06-1] (Vol. 53; 1991)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Chloramphenicol [56-75-7] (Vol. 50; 1990)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

a-Chlorinated toluenes (benzal chloride [98-87-3], benzotrichloride [98-07-7], benzyl chloride [100-44-7]) and benzoyl chloride [98-88-4] (combined exposures) (Vol. 29, Suppl. 7, Vol. 71; 1999)
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU) [13010-47-4] (Vol. 26, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

4-Chloro-ortho-toluidine [95-69-2] (Vol. 77; 2000)

Chlorozotocin [54749-90-5] (Vol. 50; 1990)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Cisplatin [15663-27-1] (Vol. 26, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Clonorchis sinensis (infection with) (Vol. 61; 1994)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Dibenz[a,h]anthracene [53-70-3] (Vol. 32, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

1,2-Dimethylhydrazine [540-73-8] (Vol. 4, Suppl. 7, Vol. 71; 1999)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Dimethyl sulfate [77-78-1] (Vol. 4, Suppl. 7, Vol. 71; 1999)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)
N-Ethyl-N-nitrosourea [759-73-9] (Vol. 17, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Etoposide [33419-42-0] (Vol. 76; 2000)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Formaldehyde [50-00-0] (Vol. 62; 1995)

(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Human papillomavirus type 31 (Vol. 64; 1995)

Human papillomavirus type 33 (Vol. 64; 1995)

IQ (2-Amino-3-methylimidazo[4,5-f]quinoline) [76180-96-6] (Vol. 56; 1993)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Kaposi's sarcoma herpesvirus/human herpesvirus 8 (Vol. 70; 1997)

5-Methoxypsoralen [484-20-8] (Vol. 40, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

4,4´-Methylene bis(2-chloroaniline) (MOCA) [101-14-4] (Vol. 57; 1993)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

N-Methyl-N´-nitro-N-nitrosoguanidine (MNNG) [70-25-7] (Vol. 4, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

N-Methyl-N-nitrosourea [684-93-5] (Vol. 17, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Nitrogen mustard [51-75-2] (Vol. 9, Suppl. 7; 1987)
N-Nitrosodiethylamine [55-18-5] (Vol. 17, Suppl. 7; 1987)  
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

N-Nitrosodimethylamine [62-75-9] (Vol. 17, Suppl. 7; 1987)  
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Phenacetin [62-44-2] (Vol. 24, Suppl. 7; 1987)

Procarbazine hydrochloride [366-70-1] (Vol. 26, Suppl. 7; 1987)  
(NB: Overall evaluation upgraded from 2B to 2A with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Styrene-7,8-oxide [96-09-3] (Vol. 60; 1994)

Overall Evaluations of Carcinogenicity to Humans

**Group 2B**: Possibly carcinogenic to humans

This list contains all agents, mixtures and exposures evaluated as being in Group 2B. Where appropriate, chemical abstract numbers are given [in square brackets].

For details of the evaluation, the relevant Monograph should be consulted (volume number given in round brackets, followed by year of publication of latest evaluation). Use a free-text search to find a particular compound.

Agents and groups of agents


Acetaldehyde [75-07-0] (Vol. 36, Suppl. 7, Vol. 71; 1999)


Acrylonitrile [107-13-1] (Vol. 71; 1999)

AF-2 [2-(2-Furyl)-3-(5-nitro-2-furyl)acrylamide] [3688-53-7] (Vol. 31, Suppl. 7; 1987)

Aflatoxin M1 [6795-23-9] (Vol. 56; 1993)

para-Aminoazobenzene [60-09-3] (Vol. 8, Suppl. 7; 1987)

ortho-Aminoazotoluene [97-56-3] (Vol. 8, Suppl. 7; 1987)
2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole [712-68-5] (Vol. 7, Suppl. 7; 1987)

Amsacrine [51264-14-3] (Vol. 76; 2000)

ortho-Anisidine [90-04-0] (Vol. 73; 1999)


Aramite® [140-57-8] (Vol. 5, Suppl. 7; 1987)

Auramine [492-80-8] (technical-grade) (Vol. 1, Suppl. 7; 1987)

Azaserine [115-02-6] (Vol. 10, Suppl. 7; 1987)

(NB: Overall evaluation upgraded from 3 to 2B with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Benzo[b]fluoranthene [205-99-2] (Vol. 32, Suppl. 7; 1987)

Benzo[j]fluoranthene [205-82-3] (Vol. 32, Suppl. 7; 1987)

Benzo[k]fluoranthene [207-08-9] (Vol. 32, Suppl. 7; 1987)


Benzyl violet 4B [1694-09-3] (Vol. 16, Suppl. 7; 1987)

2,2-Bis(bromomethyl)propane-1,3-diol [3296-90-0] (Vol. 77; 2000)

Bleomycins [11056-06-7] (Vol. 26, Suppl. 7; 1987)
(NB: Overall evaluation upgraded from 3 to 2B with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Bracken fern (Vol. 40, Suppl. 7; 1987)


Butylated hydroxyanisole (BHA) [25013-16-5] (Vol. 40, Suppl. 7; 1987)

b-Butyrolactone [3068-88-0] (Vol. 11, Suppl. 7, Vol. 71; 1999)


Carbon black [1333-86-4] (Vol. 65; 1996)
Ceramic fibres (Vol. 43; 1988)
Chlordane [57-74-9] (Vol. 79; 2001)
Chlordecone (Kepone) [143-50-0] (Vol. 20, Suppl. 7; 1987)
Chlorendic acid [115-28-6] (Vol. 48; 1990)
para-Chloroaniline [106-47-8] (Vol. 57; 1993)
Chloroform [67-66-3] (Vol. 73; 1999)
Chlorophenoxy herbicides (Vol. 41, Suppl. 7; 1987)
4-Chloro-ortho-phenylenediamine [95-83-0] (Vol. 27, Suppl. 7; 1987)
Chloroprene [126-99-8] (Vol. 71; 1999)
Chlorothalonil [1897-45-6] (Vol. 73; 1999)
Cl Acid Red 114 [6459-94-5] (Vol. 57; 1993)
Cl Basic Red 9 [569-61-9] (Vol. 57; 1993)
Cl Direct Blue 15 [2429-74-5] (Vol. 57; 1993)
Citrus Red No. 2 [6358-53-8] (Vol. 8, Suppl. 7; 1987)
Cobalt [7440-48-4] and cobalt compounds (Vol. 52; 1991)
(NB: Evaluated as a group)
para-Cresidine [120-71-8] (Vol. 27, Suppl. 7; 1987)
Cycasin [14901-08-7] (Vol. 10, Suppl. 7; 1987)
Dacarbazine [4342-03-4] (Vol. 26, Suppl. 7; 1987)
Dantron (Chrysazin; 1,8-Dihydroxyanthraquinone) [117-10-2] (Vol. 50; 1990)
Daunomycin [20830-81-3] (Vol. 10, Suppl. 7; 1987)
DDT [p,p''-DDT, 50-29-3] (Vol. 53; 1991)
N,N'-Diacetylbenzidine [613-35-4] (Vol. 16, Suppl. 7; 1987)
2,4-Diaminoanisole [615-05-4] (Vol. 79; 2001)
4,4'-Diaminodiphenyl ether [101-80-4] (Vol. 29, Suppl. 7; 1987)
2,4-Diaminotoluene [95-80-7] (Vol. 16, Suppl. 7; 1987)
Dibenz[a,h]acridine [226-36-8] (Vol. 32, Suppl. 7; 1987)
Dibenz[a,j]acridine [224-42-0] (Vol. 32, Suppl. 7; 1987)
7H-Dibenzo[c,g]carbazole [194-59-2] (Vol. 32, Suppl. 7; 1987)
Dibenzo[a,h]pyrene [189-64-0] (Vol. 32, Suppl. 7; 1987)
Dibenzo[a,i]pyrene [189-55-9] (Vol. 32, Suppl. 7; 1987)
Dibenzo[a,l]pyrene [191-30-0] (Vol. 32, Suppl. 7; 1987)
1,2-Dibromo-3-chloropropane [96-12-8] (Vol. 20, Suppl. 7, Vol. 71; 1999)
2,3-Dibromopropan-1-ol [96-13-9] (Vol. 77; 2000)
3,3'-Dichlorobenzidine [91-94-1] (Vol. 29, Suppl. 7; 1987)
3,3'-Dichloro-4,4'-diaminodiphenyl ether [28434-86-8] (Vol. 16, Suppl. 7; 1987)
1,2-Dichloroethane [107-06-2] (Vol. 20, Suppl. 7, Vol. 71; 1999)
Dichloromethane (methylene chloride) [75-09-2] (Vol. 71; 1999)
1,3-Dichloropropene [542-75-6] (technical-grade) (Vol. 41, Suppl. 7, Vol. 71; 1999)
1,2-Diethylhydrazine [1615-80-1] (Vol. 4, Suppl. 7, Vol. 71; 1999)

Dihydrosafrole [94-58-6] (Vol. 10, Suppl. 7; 1987)

Diisopropyl sulfate [2973-10-6] (Vol. 54, Vol. 71; 1999)

3,3'-Dimethoxybenzidine (ortho-Dianisidine) [119-90-4] (Vol. 4, Suppl. 7; 1987)

para-Dimethylaminoazobenzene [60-11-7] (Vol. 8, Suppl. 7; 1987)

trans-2-[(Dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)-vinyl]-1,3,4-oxadiazole [25962-77-0] (Vol. 7, Suppl. 7; 1987)

2,6-Dimethylaniline (2,6-Xylidine) [87-62-7] (Vol. 57; 1993)

3,3'-Dimethylbenzidine (ortho-Tolidine) [119-93-7] (Vol. 1, Suppl. 7; 1987)

1,1-Dimethylhydrazine [57-14-7] (Vol. 4, Suppl. 7, Vol. 71; 1999)

3,7-Dinitrofluoranthe [105735-71-5] (Vol. 65; 1996)


1,6-Dinitropyrene [42397-64-8] (Vol. 46; 1989)

1,8-Dinitropyrene [42397-65-9] (Vol. 46; 1989)

2,4-Dinitrotoluene [121-14-2] (Vol. 65; 1996)

2,6-Dinitrotoluene [606-20-2] (Vol. 65; 1996)

1,4-Dioxane [123-91-1] (Vol. 11, Suppl. 7, Vol. 71; 1999)

Disperse Blue 1 [2475-45-8] (Vol. 48; 1990)


Ethylbenzene [100-41-4] (Vol. 77; 2000)

Ethyl methanesulfonate [62-50-0] (Vol. 7, Suppl. 7; 1987)
Foreign bodies, implanted in tissues (Vol. 74; 1999)

Polymeric, prepared as thin smooth films (with the exception of poly(glycolic acid))
  Metallic, prepared as thin smooth films
    Metallic cobalt, metallic nickel and an alloy powder containing 66-67% nickel, 13-16% chromium and 7% iron

2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)thiazole [3570-75-0] (Vol. 7, Suppl. 7; 1987)

Furan [110-00-9] (Vol. 63; 1995)

Glasswool (Vol. 43; 1988)

Glu-P-1 (2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole) [67730-11-4] (Vol. 40, Suppl. 7; 1987)

Glu-P-2 (2-Aminodipyrido[1,2-a:3',2'-d]imidazole) [67730-10-3] (Vol. 40, Suppl. 7; 1987)


Griseofulvin [126-07-8] (Vol. 79; 2001)

HC Blue No. 1 [2784-94-3] (Vol. 57; 1993)

Heptachlor [76-44-8] (Vol. 79; 2001)

Hexachlorobenzene [118-74-1] (Vol. 79; 2001)

Hexachloroethane [67-72-1] (Vol. 73; 1999)

Hexachlorocyclohexanes (Vol. 20, Suppl. 7; 1987)


Human immunodeficiency virus type 2 (infection with) (Vol. 67; 1996)

Human papillomaviruses: some types other than 16, 18, 31 and 33 (Vol. 64; 1995)


Indeno[1,2,3-cd]pyrene [193-39-5] (Vol. 32, Suppl. 7; 1987)


Lasiocarpine [303-34-4] (Vol. 10, Suppl. 7; 1987)

Lead [7439-92-1] and lead compounds, inorganic (Vol. 23, Suppl. 7; 1987) (NB: Evaluated as a group)

Magenta [632-99-5] (containing CI Basic Red 9) (Vol. 57; 1993)

Magnetic fields (extremely low-frequency) (Vol. 80; 2002)

MeA-a-C (2-Amino-3-methyl-9H-pyrido[2,3-b]indole) [68006-83-7] (Vol. 40, Suppl. 7; 1987)

Medroxyprogesterone acetate [71-58-9] (Vol. 21, Suppl. 7; 1987)

MeIQ (2-Amino-3,4-dimethylimidazo[4,5-f]quinoline) [77094-11-2] (Vol. 56; 1993)

MeIQx (2-Amino-3,8-dimethylimidazo[4,5-f]quinoxaline) [77500-04-0] (Vol. 56; 1993)

Merphalan [531-76-0] (Vol. 9, Suppl. 7; 1987)

2-Methylaziridine (Propyleneimine) [75-55-8] (Vol. 9, Suppl. 7, Vol. 71; 1999)

Methylazoxymethanol acetate [592-62-1] (Vol. 10, Suppl. 7; 1987)

5-Methylchrysene [3697-24-3] (Vol. 32, Suppl. 7; 1987)

4,4’-Methylene bis(2-methylaniline) [838-88-0] (Vol. 4, Suppl. 7; 1987)

4,4’-Methylenedianiline [101-77-9] (Vol. 39, Suppl. 7; 1987)

Methylmercury compounds (Vol. 58; 1993) (NB: Evaluated as a group)

2-Methyl-1-nitroanthraquinone [129-15-7] (uncertain purity) (Vol. 27, Suppl. 7; 1987)

N-Methyl-N-nitrosoureaethane [615-53-2] (Vol. 4, Suppl. 7; 1987)

Methylthiouracil [56-04-2] (Vol. 79; 2001)
Metronidazole [443-48-1] (Vol. 13, Suppl. 7; 1987)

Mirex [2385-85-5] (Vol. 20, Suppl. 7; 1987)

Mitomycin C [50-07-7] (Vol. 10, Suppl. 7; 1987)

Mitoxantrone [65271-80-9] (Vol. 76; 2000)

Monocrotaline [315-22-0] (Vol. 10, Suppl. 7; 1987)

5-(Morpholinomethyl)-3-[(5-nitrofurfurylidene)amino]-2-oxazolidinone [3795-88-8] (Vol. 7, Suppl. 7; 1987)

Nafenopin [3771-19-5] (Vol. 24, Suppl. 7; 1987)

Nickel, metallic [7440-02-0] and alloys (Vol. 49; 1990)

Niridazole [61-57-4] (Vol. 13, Suppl. 7; 1987)

Nitrilotriacetic acid [139-13-9] and its salts (Vol. 73; 1999) (NB: Evaluated as a group)

5-Nitroacenaphthene [602-87-9] (Vol. 16, Suppl. 7; 1987)

2-Nitroanisole [91-23-6] (Vol. 65; 1996)

Nitrobenzene [98-95-3] (Vol. 65; 1996)

6-Nitrochrysene [7496-02-8] (Vol. 46; 1989)

Nitrofen [1836-75-5] (technical-grade) (Vol. 30, Suppl. 7; 1987)


1-[(5-Nitrofurfurylidene)amino]-2-imidazolidinone [555-84-0] (Vol. 7, Suppl. 7; 1987)

N-[4-(5-Nitro-2-furyl)-2-thiazolyl]acetamide [531-82-8] (Vol. 7, Suppl. 7; 1987)

Nitrogen mustard N-oxide [126-85-2] (Vol. 9, Suppl. 7; 1987)

Nitromethane [75-52-5] (Vol. 77; 2000)


1-Nitropyrene [5522-43-0] (Vol. 46; 1989)

N-Nitrosodi-n-butylamine [924-16-3] (Vol. 17, Suppl. 7; 1987)

N-Nitrosodietanolamine [1116-54-7] (Vol. 17, Suppl. 7, Vol. 77; 2000)

N-Nitrosodi-n-propylamine [621-64-7] (Vol. 17, Suppl. 7; 1987)

3-(N-Nitrosomethylamino)propionitrile [60153-49-3] (Vol. 37, Suppl. 7; 1987)

4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK) [64091-91-4] (Vol. 37, Suppl. 7; 1987)

N-Nitrosomethylethylamine [10595-95-6] (Vol. 17, Suppl. 7; 1987)

N-Nitrosomethylvinylamine [4549-40-0] (Vol. 17, Suppl. 7; 1987)

N-Nitrosomorpholine [59-89-2] (Vol. 17, Suppl. 7; 1987)

N’-Nitrosonornicotine [16543-55-8] (Vol. 37, Suppl. 7; 1987)

N-Nitrosopiperidine [100-75-4] (Vol. 17, Suppl. 7; 1987)

N-Nitrosopyrrolidine [930-55-2] (Vol. 17, Suppl. 7; 1987)

N-Nitrososarcosine [13256-22-9] (Vol. 17, Suppl. 7; 1987)


Oestrogen-progestogen therapy, postmenopausal (Vol. 72; 1999)

Oil Orange SS [2646-17-5] (Vol. 8, Suppl. 7; 1987)

Oxazepam [604-75-1] (Vol. 66; 1996)

Palygorskite (attapulgite) [12174-11-7] (long fibres, > 5 micrometers) (Vol. 68; 1997)

Panfuran S [794-93-4] (containing dihydroxymethylfuratrizine) (Vol. 24, Suppl. 7; 1987)

Phenazopyridine hydrochloride [136-40-3] (Vol. 24, Suppl. 7; 1987)

Phenobarbital [50-06-6] (Vol. 79; 2001)
Phenolphthalein [77-09-8] (Vol. 76; 2000)

Phenoxybenzamine hydrochloride [63-92-3] (Vol. 24, Suppl. 7; 1987)


Phenytoin [57-41-0] (Vol. 66; 1996)

PhIP (2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine) [105650-23-5] (Vol. 56; 1993)


Ponceau MX [3761-53-3] (Vol. 8, Suppl. 7; 1987)

Ponceau 3R [3564-09-8] (Vol. 8, Suppl. 7; 1987)

Potassium bromate [7758-01-2] (Vol. 73; 1999)

Progestins (Suppl. 7; 1987)

Progestogen-only contraceptives (Vol. 72; 1999)

1,3-Propane sultone [1120-71-4] (Vol. 4, Suppl. 7, Vol. 71; 1999)

b-Propiolactone [57-57-8] (Vol. 4, Suppl. 7, Vol. 71; 1999)

Propylene oxide [75-56-9] (Vol. 60; 1994)

Propylthiouracil [51-52-5] (Vol. 79; 2001)

Rockwool (Vol. 43; 1988)

Safrole [94-59-7] (Vol. 10, Suppl. 7; 1987)

Schistosoma japonicum (infection with) (Vol. 61; 1994)

Slagwool (Vol. 43; 1988)


Sterigmatocystin [10048-13-2] (Vol. 10, Suppl. 7; 1987)

Streptozotocin [18883-66-4] (Vol. 17, Suppl. 7; 1987)
Styrene [100-42-5] (Vol. 60; 1994)
(NB: Overall evaluation upgraded from 3 to 2B with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Sulfallate [95-06-7] (Vol. 30, Suppl. 7; 1987)

Tetrafluoroethylene [116-14-3] (Vol. 19, Suppl. 7, Vol. 71; 1999)

Tetranitromethane [509-14-8] (Vol. 65; 1996)

Thioacetamide [62-55-5] (Vol. 7, Suppl. 7; 1987)

4,4'-Thiodianiline [139-65-1] (Vol. 27, Suppl. 7; 1987)

Thiouracil [141-90-2] (Vol. 79; 2001)


Toxins derived from Fusarium moniliforme (Vol. 56; 1993)

Trichloromethine (Trimustine hydrochloride) [817-09-4] (Vol. 50; 1990)

Trp-P-1 (3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole) [62450-06-0] (Vol. 31, Suppl. 7; 1987)

Trp-P-2 (3-Amino-1-methyl-5H-pyrido[4,3-b]indole) [62450-07-1] (Vol. 31, Suppl. 7; 1987)

Trypan blue [72-57-1] (Vol. 8, Suppl. 7; 1987)

Uracil mustard [66-75-1] (Vol. 9, Suppl. 7; 1987)

Urethane [51-79-6] (Vol. 7, Suppl. 7; 1987)


4-Vinylcyclohexene [100-40-3] (Vol. 60; 1994)

4-Vinylcyclohexene diepoxide [106-87-6] (Vol. 60; 1994)

Zalcitabine [7481-89-2] (Vol. 76; 2000)

Zidovudine (AZT) [30516-87-1] (Vol. 76; 2000)

Mixtures
Bitumens [8052-42-4], extracts of steam-refined and air-refined (Vol. 35, Suppl. 7; 1987)

Carrageenan [9000-07-1], degraded (Vol. 31, Suppl. 7; 1987)

Chlorinated paraffins of average carbon chain length C12 and average degree of chlorination approximately 60% (Vol. 48; 1990)

Coffee (urinary bladder) (Vol. 51; 1991)
(NB: There is some evidence of an inverse relationship between coffee drinking and cancer of the large bowel; coffee drinking could not be classified as to its carcinogenicity to other organs)

Diesel fuel, marine (Vol. 45; 1989)
(NB: Overall evaluation upgraded from 3 to 2B with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Engine exhaust, gasoline (Vol. 46; 1989)

Fuel oils, residual (heavy) (Vol. 45; 1989)

Gasoline (Vol. 45; 1989)
(NB: Overall evaluation upgraded from 3 to 2B with supporting evidence from other data relevant to the evaluation of carcinogenicity and its mechanisms)

Pickled vegetables (traditional in Asia) (Vol. 56; 1993)

Polybrominated biphenyls [Firemaster BP-6, 59536-65-1] (Vol. 41, Suppl. 7; 1987)

Toxaphene (Polychlorinated camphenes) [8001-35-2] (Vol. 79; 2001)

Welding fumes (Vol. 49; 1990)

Exposure circumstances

Carpentry and joinery (Vol. 25, Suppl. 7; 1987)

Dry cleaning (occupational exposures in) (Vol. 63; 1995)

Printing processes (occupational exposures in) (Vol. 65; 1996)

Textile manufacturing industry (work in) (Vol. 48; 1990)

Last updated: 8 March 2002
The following chemicals are included in the Michigan Occupational Safety and Health Rule 2301:

Vinyl Chloride
Methylenedianaline
Ethylene Oxide
Formaldehyde
Acrylonitrile
Inorganic Arsenic
Cadmium
Lead
Benzene
Lab Specific Training Form

Name ________________________________  MTU ID M- ____________________________

Position ________________________________  Supervisor __________________________

1. Topics Addressed by Laboratory Supervisor
   a. Introduction to operation hazards present in labs, physical and/or chemical, types of hazards encountered, and required work practices
   b. Personal Protection Equipment (PPE)
   c. General emergency procedures
   d. Specific emergency procedures for labs with chemicals, and detection of chemical hazards
   e. As appropriate for labs, MSDSonline, SOP(s), and/or CHP and labeling system

2. Training Provided (place mark next to room number/name indicating training for this space).

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<th>Grover C. Dillman (14)</th>
<th>Waste Management Resources Recovery (49)</th>
<th>Great Lakes Research Center (100)</th>
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<td>B005 K. Melo-Silva</td>
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Lab Supervisor Signature ____________________________  Date ______________

Employee Signature ____________________________  Date ______________

Signatures acknowledge that the above topics have been adequately communicated  Revision 03-MAR-15
Laboratory Operations Permit

Date:

Name of Employee Requesting Permit:

Work Area where Permitted Operation will Occur:

Name of Supervisor for the Work Area:

Names of Employee to be Included in Permitted Operation:

Time Period for which the Requested Permit will be Issued for:

Summary of Reason for Requesting Permit:

Attach a complete description of all activities that will be occurring in the laboratory during the time period of these proposed permitted activities, including those that the permit will cover.

Submit completed form to the Chemical Hygiene Officer.
Children in Laboratories

3.2 Children at Michigan Technological University

**Policy:** It is the policy of Michigan Technological University that children under the age of 12 are not permitted in work areas (e.g., offices, classrooms, shops), except those spaces specifically intended for public use, without the written permission of the department chair or director. Children under the age of 12 who are not enrolled in a Michigan Tech class or program are not permitted in laboratories at any time. Children under the age of 16 must be under the direct supervision of the laboratory supervisor while visiting or participating in University-sponsored activities in laboratories containing hazardous chemicals or equipment.

**Additional Information:** It is the intent of this policy that the department chair or director will verify that a student or employee has a workable plan to provide age-appropriate supervision and protection from foreseeable safety and health hazards before allowing a child to be brought into a campus work area. Children must not be allowed to roam the building unsupervised. Permission may not be given for a child under 12 to enter a laboratory or other area with hazardous substances, machinery or tools—except as part of an organized event where special provisions have been made to prevent exposure to these hazards.