

FESHM 4110: Hazard Communication

Revision History

Author	Description of Change	Revision Date
Rob Bushek	<ul style="list-style-type: none">• Updated frequency of training• How to obtain new labels	December 2017
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1.0 INTRODUCTION

The purpose of this program is to ensure that hazardous chemicals used at Fermilab are evaluated for their hazards and that this information, along with information about appropriate protective measures, is communicated to employees.

2.0 DEFINITIONS

Article - a manufactured item other than a fluid or particle which is formed to a specific shape or design during manufacture, which has end use function(s) dependent in whole or in part upon its shape or design during end use, and which does not release or otherwise result in exposure to hazardous chemicals under normal conditions of use.

If the hazardous chemicals will remain bound in the article "under normal conditions of use," then the article is exempt from the Hazard Communication Standard. The following examples would generally be considered "articles":

- Stainless steel tables
- Vinyl upholstery
- Tires
- Typewriter ribbons
- Copying machines

However, the following examples are not "articles" since there is a significant chance for exposure to hazardous chemicals under normal use:

- Metal ingots that will be melted
- Fabric treated with formaldehyde that may "off gas"
- Mercury switches that may break

Chemical manufacturer - means an employer with a workplace where chemical(s) are produced for use or distribution. Fermilab is not considered a chemical manufacturer.

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

Consumer product - any consumer product or hazardous chemical as defined in the Consumer Product Safety Act (15 U.S.C. 2051) and Federal Hazardous Substances Act (15 U.S. C. 1261) respectively. Such products are exempt from the Hazard Communication Standard where the ESH&Q Section can demonstrate it is used in the workplace in the same manner as normal consumer use, and which use

results in a duration and frequency that is not greater than exposures experienced by consumers. Containers of chemically hazardous consumer products are labeled with the names of the hazardous components, a signal word ("DANGER," "WARNING," "CAUTION"), a statement of the principal hazard(s) ("Flammable," "Combustible," "Absorbed Through Skin"), actions to be avoided, first aid treatment, handling and storage instructions, and other information as appropriate.

Hazard category - means the division of criteria within each hazard class, e.g., oral acute toxicity and flammable liquids include four hazard categories. These categories compare hazard severity within a hazard class and should not be taken as a comparison of hazard categories more generally.

Hazardous chemical - means any chemical which is classified as a physical hazard or a health hazard, a simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise classified.

The following are specifically excluded from the Hazard Communication Standard:

- Hazardous Wastes (see [FESHM 8020](#), General program Statement on Waste Management)
- Tobacco or tobacco products
- Wood and wood products
- "Articles" (see above)
- "Consumer products" (see above)
- Foods, drugs, cosmetics, or alcoholic beverages in a retail establishment that are packaged for sale to consumers.

Synthesis - creation of a substance which either duplicates a natural product or is a unique material not found in nature, by means of one or more chemical reactions, or (for elements) by a nuclear change.

Work area - a room or defined space in a workplace where hazardous chemicals are produced or used, and where employees are present.

Workplace - an establishment, job site, or project, at one geographical location containing one or more work areas. Fermilab is considered a workplace and consists of multiple work areas.

3.0 RESPONSIBILITIES

3.1 Division Safety Officers (DSOs)

- a. Submit new Safety Data Sheets (SDS's) to the ESH&Q Section for database inclusion.
- b. Review SDSs received within their division/section for accuracy and completeness in accordance with the SDS checklist in Appendix A. If an SDS is found deficient, the DSO may request that the ESH&Q Section IH Group contact the manufacturer

requesting the SDS be revised to include the correct information or the division/section may use another product.

- c. Make this written Hazard Communication Program available, upon request, to all employees.

3.2 Supervisors

- a. Ensure hazardous chemicals in work areas under their responsibility are properly labeled.
- b. Ensure that all new chemicals introduced or used in work areas under their responsibility have SDSs readily accessible and inform employees of how to access them using the Fermilab online SDS database.
- c. Send all new chemical SDSs to the DSO for review.
- d. Ensure that employees under their supervision who work with hazardous chemicals and/or whose work area contains hazardous chemicals receive the general hazard communication training when hired, and receive work area specific training prior to their initial assignment of working with and/or being exposed to hazardous chemical(s) in work area. This includes any new chemical hazards introduced in the work area subsequent to initial training, those associated with non-routine tasks, and those introduced by non-Fermilab personnel (subcontractors, experimenters, etc.).

3.3 ESH&Q Section

- a. Maintains a list of all hazardous chemicals (i.e., the master list) used and stored on site in a central computer file on the ESHQ Webpage.
- b. Create new labels as required for secondary/transfer containers.
- c. Develops and presents general hazard communication training material.
- d. Provide all new employees with general hazard communication training.

3.4 Shipping & Receiving Department

- a. Ensures containers of chemicals received and distributed have the appropriate hazard communication labeling.
- b. Forwards SDSs received with shipments to the ESH&Q Section for further distribution. See the flowchart entitled Procedure for obtaining SDSs below.

3.5 Contracts Department

Provides a summary of this Hazard Communication Program to subcontractors who will perform work onsite. This may be accomplished by attachment to the contract or at pre-construction meetings.

3.6 Subcontractors

- a. Because the Laboratory uses and stores hazardous chemicals on-site in a way that the employees of other employer(s) may be exposed (for example, employees of a construction subcontractor working on-site), the Contracts Department shall enclose a summary of this Hazard Communication Program in subcontracts involving work onsite. Alternatively, this summary may be provided to subcontractors in pre-construction meetings.
- b. Subcontractors performing work on-site shall include a copy of their hazard communication program in their site safety and health plan if they intend to bring any hazardous chemicals to the premises. SDSs for these hazardous chemicals shall be maintained by the subcontractor and provided to Fermilab in accordance with Exhibit A of FESHM Chapter's [7010](#) and [7020](#), and with Fermilab's Subcontract Terms and Conditions (FL-3) contract document.

3.7 Experimenters

- a. Experimenters shall follow all procedures in this policy as it applies to them. In addition, they shall be provided general hazard communication and operation specific training if, as part of their job, they use hazardous chemicals and/or are exposed to hazardous chemicals. Training shall be coordinated by their liaison physicist or Fermilab contact person.
- b. Experimenters shall inform the appropriate division/section DSO about any hazardous chemicals they bring to the Fermilab site. Where possible, this should be done prior to the arrival of the chemicals.

4.0 PROCEDURES

4.1 Hazard Determination

The Laboratory relies on chemical manufacturers and vendors for hazard information contained on Safety Data Sheets (SDSs) and chemical labels. However, for those hazardous chemicals that are synthesized at the Laboratory, health and physical hazards of the chemicals must be determined and an SDS must be prepared if they are shipped off-site. Uncharacterized chemicals should be labeled as toxic and handled accordingly. All routes of entry should be assumed.

Other hazardous properties, such as flammability, corrosivity, and stability shall also be considered and appropriate precautions taken.

4.2 Labeling

a. Employer (In-House) Labels

- Labels are required on all containers of chemicals in the workplace that identify its contents. In addition, if the chemical leaves the area the label must also contain the hazardous chemical's appropriate hazard pictogram(s), signal word, and hazard statement. See Appendix B Health Hazard Definitions.
- Labels shall be written in the English language, although additional languages are permitted as long as the English version is also present.
- The Fermilab stock system has acceptable labels for the most common hazardous chemicals used on site. The Division Safety Officer or the Industrial Hygiene Group can be contacted to generate a label for hazardous chemicals that are not commonly used, but will be transferred to a secondary/transfer container.
- Labels shall be available during all shifts to employees. Location of the labels shall be determined by the appropriate supervisor.
- Pipes containing hazardous chemicals shall be labeled.
- Chemical warning labels shall be adhered to all containers of small quantity hazardous chemicals, (e.g., small test tubes, reaction vessels). Chemicals that are synthesized shall be evaluated to determine their hazards and appropriate warning labels shall also be placed on their containers. A warning sign shall be posted on all entrance doors leading to a chemical laboratory. This sign shall read "Authorized Personnel Only." The responsible manager of the area shall maintain a list of the personnel authorized to access the chemical laboratory and submit a copy to the division/section DSO.
- Labels are not required on portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for immediate use of the employee who performs the transfer.

b. Manufacturer's Labels

- Labels on shipped/incoming containers of hazardous chemicals must have the signal word, hazard pictograms, manufacturer information, precautionary statements, hazard statements, and product name or identifiers.
- Removal of labels on incoming containers of hazardous materials is prohibited. In addition, they shall not be removed or defaced unless immediately replaced with a label having equivalent or superior information.

4.3 Safety Data Sheets

The OSHA hazard communication standard requires that employers maintain a complete and accurate SDS for each hazardous chemical at their facility. In addition, the employer must ensure that every employee has access to SDSs for all hazardous chemicals in their work area.

a. SDS Availability

SDSs for hazardous chemicals in an employee's work area must be readily accessible to employees during each work shift. SDSs are available through the ESH&Q web page.

b. SDS Distribution

See Flowchart on following page. SDSs for Stockroom materials are routinely acquired and entered into the master file and database maintained by the ESH&Q Section. Use the same flow chart to obtain these SDSs.

c. SDS Review

Review the SDS to ensure that all pages are received and each space on the SDS is complete (e.g. none, n/a - not applicable, n/d - none detected). The SDS must also be written in English, be understandable and be in the 16 section format (see Technical Appendix A). See Appendix C Understanding Safety Data Sheets.

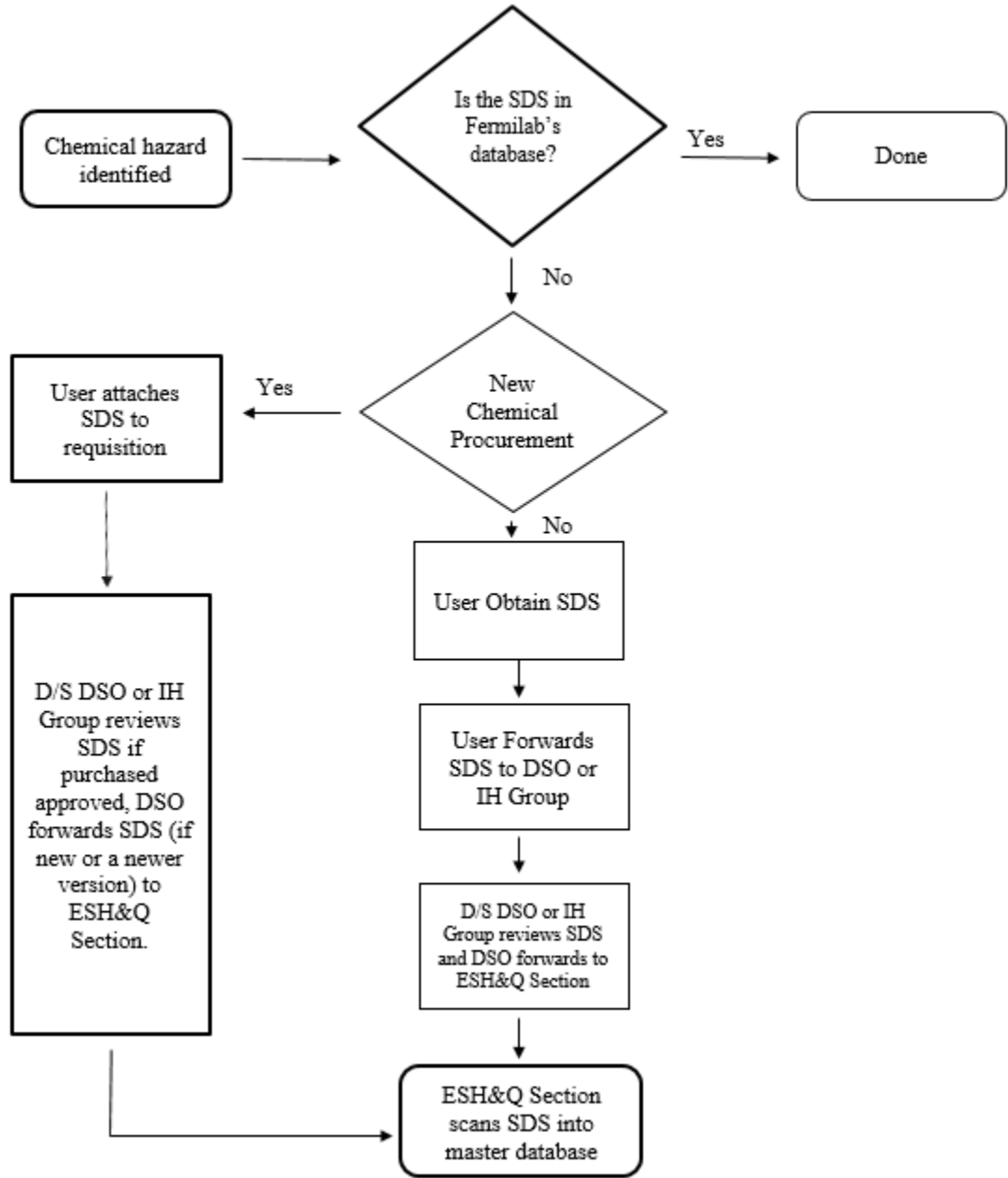
The chemical name (identity) and hazard information on the SDS shall match the chemical name (identity) and hazard information on the container label of the incoming shipment of a hazardous chemical. The chemical name (identity) and hazard information on the SDS shall also match the label information of a portable container into which a hazardous chemical has been transferred. (Note: The label on a container into which a hazardous chemical has been transferred does not require manufacturer information.)

d. SDS Preparation

SDSs are required for new chemicals synthesized at Fermilab, if such chemicals are to be shipped offsite.

The organization synthesizing the chemical is responsible for preparing an SDS in accordance with 29 CFR 1910.1200. The division/section DSO and the ESH&Q Section will provide assistance as needed.

Procedures for obtaining SDS's



4.4 Training

a. General Hazard Communication Training

This training shall be provided as follows:

- New employees and users shall receive general hazard communication training during New Employee ES&H Orientation and an online refresher course every three years.

Training shall address the following:

- The purpose of the training and the requirements of the Hazard Communication Standard and how they are implemented at Fermilab as established in this written program.
- Discussion of the health hazards associated with working with common categories of chemicals, i.e., carcinogens, corrosives, irritants, sensitizers, toxics, etc.
- The detection and control measures employees may use to detect the presence of a hazardous chemical and protect themselves from the hazards of potential exposures.
- The purpose of the SDS and an explanation of each section on an SDS.
- Review of the labeling system used by Fermilab.
- Demonstrate ability to identify specific information on an SDS and/or label.

b. Work Area Specific Training

Employees who work with hazardous chemicals and/or work in an area where chemical hazards exist shall receive work area specific training in addition to the general hazard communication training. Training shall be completed prior to the employee working with or being exposed to hazardous chemicals.

Work area specific training should be conducted by the supervisor or local DSO. It should include the following elements:

- Specific information on how to access the online SDS database and local chemical emergency procedures including location of the employee's work areas' eyewash stations.

- Appropriate methods and PPE that should be used for protection from chemical hazards, e.g. fume hoods, gloves, coveralls, chemical goggles, etc.
- Methods and observations that may be used to detect the presence or release.

Additional training should also be provided to employees when a new hazard is encountered in their work area. Training may be presented informally, by the supervisor, or with consultation and assistance from the local DSO. Documentation of such training is at the discretion of the DSO.

5.0 REFERENCES

APPLICABLE STANDARDS

29 CFR 1910.1200 Hazard Communication (general industry)

29 CFR 1926.59 Hazard Communication (construction industry)

Technical Appendix A

Safety Data Sheet Checklist

You must ensure that each SDS contains the following information:

Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.

Section 2, Hazard(s) identification includes all hazards regarding the chemical; required label elements.

Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.

Section 4, First-aid measures includes important symptoms/ effects, acute, delayed; required treatment.

Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.

Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.

Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.

Section 8, Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); ACGIH Threshold Limit Values (TLVs); and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the SDS where available as well as appropriate engineering controls; personal protective equipment (PPE).

Section 9, Physical and chemical properties lists the chemical's characteristics.

Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.

Section 11, Toxicological information includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.

Section 12, Ecological information

Section 13, Disposal considerations

Section 14, Transport information

Section 15, Regulatory information

Section 16, Other information, includes the date of preparation or last revision.

Technical Appendix B

Health Hazard Definitions

(Equivalent to OSHA 1910.1200 Appendix A)

Although safety hazards related to the physical characteristics of a chemical can be objectively defined in terms of testing requirements (e.g. flammability), health hazard definitions are less precise and more subjective. Health hazards may cause measurable changes in the body - such as decreased pulmonary function. These changes are generally indicated by the occurrence of signs and symptoms in the exposed employees - such as shortness of breath, a non-measurable, subjective feeling. Employees exposed to such hazards must be apprised of both the change in body function and the signs and symptoms that may occur to signal that change.

The determination of occupational health hazards is complicated by the fact that many of the effects or signs and symptoms occur commonly in non-occupationally exposed populations, so that effects of exposure are difficult to separate from normally occurring illnesses. Occasionally, a substance causes an effect that is rarely seen in the population at large, such as angiosarcomas caused by vinyl chloride exposure, thus making it easier to ascertain that the occupational exposure was the primary causative factor. More often, however, the effects are common, such as lung cancer. The situation is further complicated by the fact that most chemicals have not been adequately tested to determine their health hazard potential, and data do not exist to substantiate these effects.

There have been many attempts to categorize effects and to define them in various ways. Generally, the terms "acute" and "chronic" are used to delineate between effects on the basis of severity or duration. "Acute" effects usually occur rapidly as a result of short-term exposures, and are of short duration. "Chronic" effects generally occur as a result of long-term exposure, and are of long duration.

The acute effects referred to most frequently are those defined by the American National Standards Institute (ANSI) standard for Precautionary Labeling of Hazardous Industrial Chemicals (Z129.1-1988) - irritation, corrosivity, sensitization and lethal dose. Although these are important health effects, they do not adequately cover the considerable range of acute effects which may occur as a result of occupational exposure, such as, for example, narcosis.

Similarly, the term chronic effect is often used to cover only carcinogenicity, teratogenicity, and mutagenicity. These effects are obviously a concern in the workplace, but again, do not adequately cover the area of chronic effects, excluding, for example, blood dyscrasias (such as anemia), chronic bronchitis and liver atrophy.

The goal of defining precisely, in measurable terms, every possible health 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. Appendix B (*of 1910.1200*), which is also mandatory, outlines the principles and procedures of hazard assessment.

For purposes of this section, any chemicals which meet any of the following definitions, as determined by the criteria set forth in Appendix B (*of 1910.1200*) are health hazards. However, this is not intended to be an exclusive categorization scheme. If there are available scientific data that involve other animal species or test methods, they must also be evaluated to determine the applicability of the HCS.

1. **Carcinogen:** A chemical is considered to be a cancer causing agent 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 or,
2. **Corrosive:** A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact.
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 between 2 and 3 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 one 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

chemicals 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. 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.
 - b. 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) 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 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 and 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 of 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: Edems; 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

Chemicals: Mercury; carbon disulfide

- 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 the pulmonary tissue

Signs & Symptoms: cough; tightness in chest; shortness of breath

Chemicals: Silica; asbestos

- f. Reproductive toxins: Chemicals which affect the reproductive capabilities including 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: Defatting of the skin; rashes; irritation

Chemicals: Ketones; chlorinated compounds

- h. Eye hazards: Chemicals which affect the eye or visual capacity

Signs & Symptoms: conjunctivitis; corneal damage

Chemicals: Organic solvents; acids

Technical Appendix C

Understanding Safety Data Sheets

Guidelines for Reading and Understanding an SDS

Not all Safety Data Sheets will contain all of the information discussed in this article and information will vary, depending upon the degree to which the material is hazardous. But this will give you an idea of the kind of information you should expect to find when you read an SDS.

If the SDS is blank or has only a trade name and a lot of N.A.'s ("not applicable") on it, it is not going to be useful. Most SDSs have a least some of the information filled in. By cross checking the information in various sections, you can determine what you need to know about the hazards of the material.

Section 1, Identification

This section identifies the chemical on the SDS as well as the recommended uses. It also provides the essential contact information of the supplier. The required information consists of:

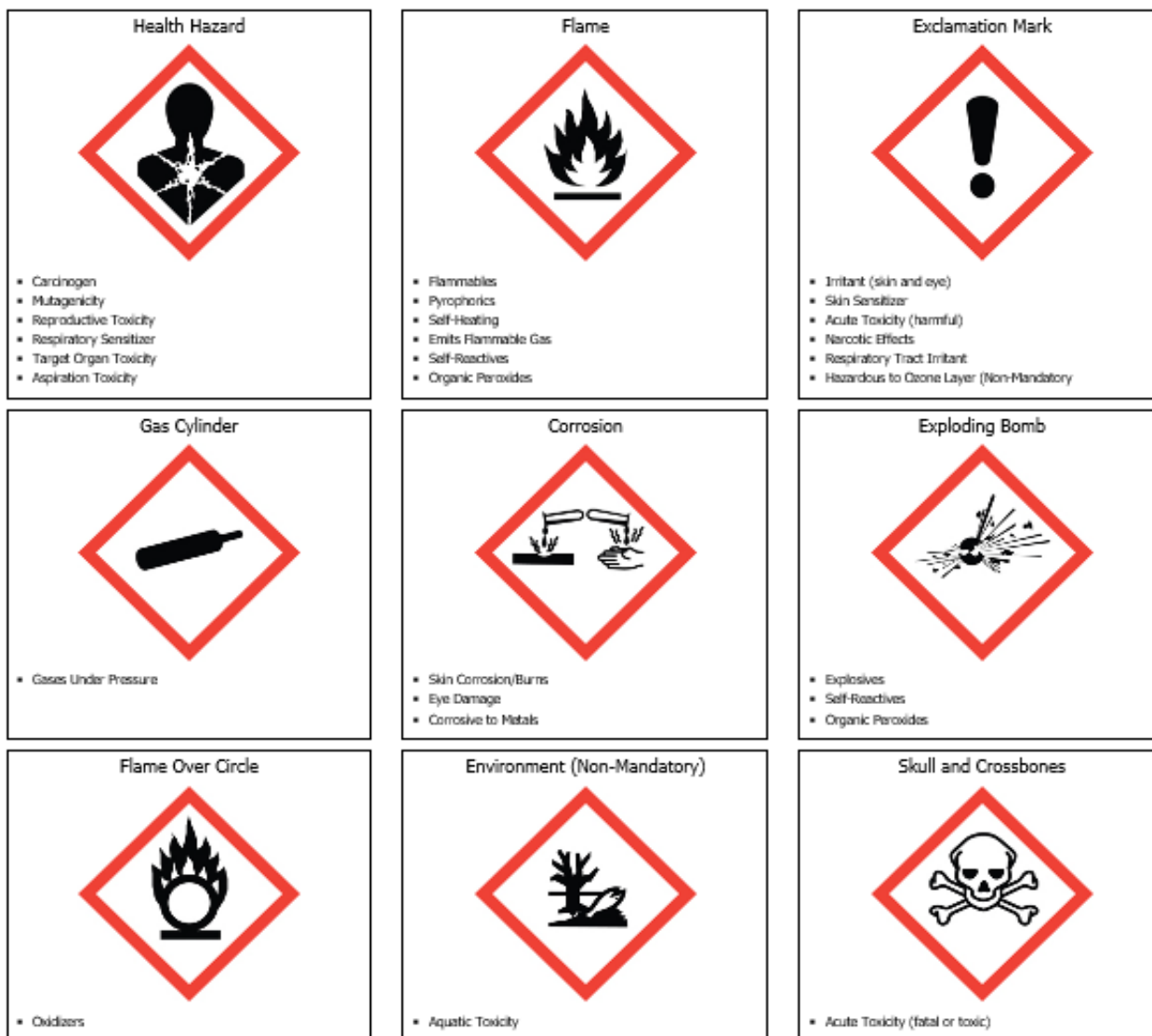
- Product identifier used on the label and any other common names or synonyms by which the substance is known.
- Name, address, phone number of the manufacturer, importer, or other responsible party, and emergency phone number.
- Recommended use of the chemical (e.g., a brief description of what it actually does, such as flame retardant) and any restrictions on use (including recommendations given by the supplier)

Section 2, Hazard(s) identification

This section identifies the hazards of the chemical presented on the SDS and the appropriate warning information associated with those hazards. The required information consists of:

- The hazard classification of the chemical (The hazard classification of the chemical (e.g., flammable liquid, category)
- Signal word.
- Hazard statement(s).
- Pictograms (the pictograms or hazard symbols may be presented as graphical reproductions of the symbols in black and white or be a description of the name of the symbol (e.g., skull and crossbones, flame).
- Precautionary statement(s).
- Description of any hazards not otherwise classified.

- For a mixture that contains an ingredient(s) with unknown toxicity, a statement describing how much (percentage) of the mixture consists of ingredient(s) with unknown acute toxicity. Please note that this is a total percentage of the mixture and not tied to the individual ingredient(s).



Section 3, Composition/information on ingredients

This section identifies the ingredient(s) contained in the product indicated on the SDS, including impurities and stabilizing additives. This section includes information on substances, mixtures, and all chemicals where a trade secret is claimed. The required information consists of:

Substances

- Chemical name.
- Common name and synonyms.
- Chemical Abstracts Service (CAS) number and other unique identifiers.
- Impurities and stabilizing additives, which are themselves classified and which contribute to the classification of the chemical.

Mixtures

- Same information required for substances.
- The chemical name and concentration (i.e., exact percentage) of all ingredients which are classified as health hazards and are:
 - Present above their cut-off/concentration limits or
 - Present a health risk below the cut-off/concentration limits.
- The concentration (exact percentages) of each ingredient must be specified except concentration ranges may be used in the following situations:
 - A trade secret claim is made,
 - There is batch-to-batch variation, or
 - The SDS is used for a group of substantially similar mixtures.

Chemicals where a trade secret is claimed

- A statement that the specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret is required.

Section 4, First-aid measures

This section describes the initial care that should be given by untrained responders to an individual who has been exposed to the chemical. The required information consists of:

- Necessary first-aid instructions by relevant routes of exposure (inhalation, skin and eye contact, and ingestion).
- Description of the most important symptoms or effects, and any symptoms that are acute or delayed.
- Recommendations for immediate medical care and special treatment needed, when necessary.

Section 5, Fire-fighting measures

This section provides recommendations for fighting a fire caused by the chemical. The required information consists of:

- Recommendations of suitable extinguishing equipment, and information about extinguishing equipment that is not appropriate for a particular situation.
- Advice on specific hazards that develop from the chemical during the fire, such as any hazardous combustion products created when the chemical burns.
- Recommendations on special protective equipment or precautions for firefighters

Section 6, Accidental release measures

This section provides recommendations on the appropriate response to spills, leaks, or releases, including containment and cleanup practices to prevent or minimize exposure to people, properties, or the environment. It may also include recommendations distinguishing between responses for large and small spills where the spill volume has a significant impact on the hazard. The required information may consist of recommendations for:

- Use of personal precautions (such as removal of ignition sources or providing sufficient ventilation) and protective equipment to prevent the contamination of skin, eyes, and clothing.
- Emergency procedures, including instructions for evacuations, consulting experts when needed, and appropriate protective clothing.
- Methods and materials used for containment (e.g., covering the drains and capping procedures).
- Cleanup procedures (e.g., appropriate techniques for neutralization, decontamination, cleaning or vacuuming; adsorbent materials; and/or equipment required for containment/clean up).

Section 7, Handling and storage

This section provides guidance on the safe handling practices and conditions for safe storage of chemicals. The required information consists of:

- Precautions for safe handling, including recommendations for handling incompatible chemicals, minimizing the release of the chemical into the environment, and providing advice on general hygiene practices (e.g., eating, drinking, and smoking in work areas is prohibited).
- Recommendations on the conditions for safe storage, including any incompatibilities. Provide advice on specific storage requirements (e.g., ventilation requirements).

Section 8, Exposure controls/personal protection

This section indicates the exposure limits, engineering controls, and personal protective measures that can be used to minimize worker exposure. The required information consists of:

- OSHA Permissible Exposure Limits (PELs), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet, where available.

- Appropriate engineering controls (e.g., use local exhaust ventilation, or use only in an enclosed system).
- Recommendations for personal protective measures to prevent illness or injury from exposure to chemicals, such as personal protective equipment (PPE) (e.g., appropriate types of eye, face, skin or respiratory protection needed based on hazards and potential exposure).
- Any special requirements for PPE, protective clothing or respirators (e.g., type of glove material, such as PVC or nitrile rubber gloves; and breakthrough time of the glove material).

Section 9, Physical and chemical properties

This section identifies physical and chemical properties associated with the substance or mixture. The minimum required information consists of:

- Appearance (physical state, color, etc.);
- Upper/lower flammability or explosive limits;
- Odor;
- Vapor pressure;
- Odor threshold;
- Vapor density;
- pH;
- Relative density;
- Melting point/freezing point;
- Solubility(ies);
- Initial boiling point and boiling range;
- Flash point;
- Evaporation rate;
- Flammability (solid, gas);
- Partition coefficient: n-octanol/water;
- Auto-ignition temperature;
- Decomposition temperature; and
- Viscosity.

The SDS may not contain every item on the above list because information may not be relevant or is not available. When this occurs, a notation to that effect must be made for that chemical property. Manufacturers may also add other relevant properties, such as the dust deflagration index (Kst) for combustible dust, used to evaluate a dust's explosive potential.

Section 10, Stability and reactivity

This section describes the reactivity hazards of the chemical and the chemical stability information. This section is broken into three parts: reactivity, chemical stability, and other. The required information consists of:

Reactivity

- Description of the specific test data for the chemical(s). This data can be for a class or family of the chemical if such data adequately represent the anticipated hazard of the chemical(s), where available.

Chemical stability

- Indication of whether the chemical is stable or unstable under normal ambient temperature and conditions while in storage and being handled.
- Description of any stabilizers that may be needed to maintain chemical stability.
- Indication of any safety issues that may arise should the product change in physical appearance.

Other

- Indication of the possibility of hazardous reactions, including a statement whether the chemical will react or polymerize, which could release excess pressure or heat, or create other hazardous conditions. Also, a description of the conditions under which hazardous reactions may occur.
- List of all conditions that should be avoided (e.g., static discharge, shock, vibrations, or environmental conditions that may lead to hazardous conditions).
- List of all classes of incompatible materials (e.g., classes of chemicals or specific substances) with which the chemical could react to produce a hazardous situation.
- List of any known or anticipated hazardous decomposition products that could be produced because of use, storage, or heating. (Hazardous combustion products should also be included in Section 5 (Fire-Fighting Measures) of the SDS.)

Section 11, Toxicological information

This section identifies toxicological and health effects information or indicates that such data are not available. The required information consists of:

- Information on the likely routes of exposure (inhalation, ingestion, skin and eye contact). The SDS should indicate if the information is unknown.
- Description of the delayed, immediate, or chronic effects from short- and long-term exposure.
- The numerical measures of toxicity (e.g., acute toxicity estimates such as the LD50 (median lethal dose)) - the estimated amount [of a substance] expected to kill 50% of test animals in a single dose.
- Description of the symptoms. This description includes the symptoms associated with exposure to the chemical including symptoms from the lowest to the most severe exposure.
- Indication of whether the chemical is listed in the National Toxicology Program (NTP) Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International

Agency for Research on Cancer (IARC) Monographs (latest editions) or found to be a potential carcinogen by OSHA.

Section 12, Ecological information (non-mandatory)

This section provides information to evaluate the environmental impact of the chemical(s) if it were released to the environment. The information may include:

- Data from toxicity tests performed on aquatic and/or terrestrial organisms, where available (e.g., acute or chronic aquatic toxicity data for fish, algae, crustaceans, and other plants; toxicity data on birds, bees, plants).
- Whether there is a potential for the chemical to persist and degrade in the environment either through biodegradation or other processes, such as oxidation or hydrolysis.
- Results of tests of bioaccumulation potential, making reference to the octanol-water partition coefficient and the bio concentration factor (BCF), where available.
- The potential for a substance to move from the soil to the groundwater (indicate results from adsorption studies or leaching studies).
- Other adverse effects (e.g., environmental fate, ozone layer depletion potential, photochemical ozone creation potential, endocrine disrupting potential, and/or global warming potential).

Section 13, Disposal considerations (non-mandatory)

This section provides guidance on proper disposal practices, recycling or reclamation of the chemical(s) or its container, and safe handling practices. To minimize exposure, this section should also refer the reader to Section 8 (Exposure Controls/Personal Protection) of the SDS. The information may include:

- Description of appropriate disposal containers to use.
- Recommendations of appropriate disposal methods to employ.
- Description of the physical and chemical properties that may affect disposal activities.
- Language discouraging sewage disposal.
- Any special precautions for landfills or incineration activities

Section 14, Transport information (non-mandatory)

This section provides guidance on classification information for shipping and transporting of hazardous chemical(s) by road, air, rail, or sea. The information may include:

- UN number (i.e., four-figure identification number of the substance).
- UN proper shipping name.
- Transport hazard class (es).
- Packing group number, if applicable, based on the degree of hazard².

- Environmental hazards (e.g., identify if it is a marine pollutant according to the International Maritime Dangerous Goods Code (IMDG Code)).
- Guidance on transport in bulk (according to Annex II of MARPOL 73/78 and the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (International Bulk Chemical Code (IBC Code))).
- Any special precautions which an employee should be aware of or needs to comply with, in connection with transport or conveyance either within or outside their premises (indicate when information is not available).

Section 15, Regulatory information (non-mandatory)

This section identifies the safety, health, and environmental regulations specific for the product that is not indicated anywhere else on the SDS. The information may include:

- Any national and/or regional regulatory information of the chemical or mixtures (including any OSHA, Department of Transportation, Environmental Protection Agency, or Consumer Product Safety Commission regulations)

Section 16, Other information

This section indicates when the SDS was prepared or when the last known revision was made. The SDS may also state where the changes have been made to the previous version. You may wish to contact the supplier for an explanation of the changes. Other useful information also may be included here.