Fermilab

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Memorandum

January 5, 2009

To: Bruce Chrisman

From: Nancy Grossman

Subject: Revised FESHM Chapter 5051 – Hazard Communication

FESHM chapter 5051, Hazard Communication was reviewed and updated as part of its 5 year review.

After final approval, please return this approval page to Elizabeth Bancroft at MS119 for posting on the web.

Encl.

Recommended for Approval:

Bruce Chrisman — Date 1/7/09

Approved:

Piermaria Oddone — Date 1/9/09

HAZARD COMMUNICATION

PURPOSE

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 transmitted to employees.

APPLICABLE STANDARDS

29 CFR 1910.1200 Hazard Communication (general industry)

29 CFR 1926.59 Hazard Communication (construction industry)

DEFINITIONS

Article - a manufactured item 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 a 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 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:

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- 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 ES&H 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.

Hazardous chemical - a chemical or mixture of chemicals that can produce adverse health effects (e.g., dermatitis, cancer) or adverse physical effects (e.g., fire, explosion). Most materials can present hazardous chemical properties in at least some conditions of use.

The following are specifically excluded from the Hazard Communication Standard:

- Hazardous Wastes (see Chapter 8020 series, Regulated Chemical Waste Disposal)
- Tobacco or tobacco products
- Wood and wood products
- "Articles" (see above)

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- "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.

SPECIAL RESPONSIBILITIES

1. Division/Section ES&H Groups

   a. Maintain a list of hazardous chemicals used or stored in their division/section

   b. Submit new material safety data sheets (MSDS's) to the ES&H Section for database inclusion.

   c. If you are not relying on the on-line MSDS database you must obtain and maintain copies of (MSDS), as required, for each hazardous chemical used or stored in division/section work areas and make them accessible to employees during each work shift.

   d. Review MSDSs received within their division/section for accuracy and completeness in accordance with the MSDS checklist in Appendix A. If an MSDS is found deficient, the division/section ES&H groups may send a letter to the manufacturer requesting the MSDS be revised to include the correct information or the division/section may use another product.

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

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2. Supervisors

   a. Ensure hazardous chemicals are properly labeled.

   b. Ensure that all new chemicals introduced or used in work areas under their responsibility have MSDSs readily accessible and inform employees of these locations.

   c. 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. ES&H Section

   a. Maintains a Labwide file of material safety data sheets (i.e., the master file) for all hazardous chemicals on site (see also Subcontractors).

   b. Maintains a list of all hazardous chemicals (i.e., the master list) used and stored on site in a central computer file on the ESH Webpage and a paper copy at Site 40 (see also Subcontractors).

   c. Reviews and updates Fermilab's stock chemical hazard warning labels and create new labels as required.

   d. Develops and presents general hazard communication training material.

   e. Provide all new employees with general hazard communication training.

4. Business Services Section Shipping & Receiving Department

   a. Ensures containers of chemicals received and distributed have the appropriate hazard communication labeling. See Procedure 2 below for label requirements.

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b. Forwards MSDSs received with shipments to the ES&H Section for further distribution. See the flowchart entitled Procedure for obtaining MSDSs under Procedure 3 below.

5. Business Services Section 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.

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 Business Services Section 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. MSDSs 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.

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 ES&H group about any hazardous chemicals they bring to the Fermilab site. Where possible, this should be done prior to the arrival of the chemicals.

PROCEDURES

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1. Hazard Determination

The Laboratory relies on chemical manufacturers and vendors for hazard information contained on Material Safety Data Sheets (MSDSs) 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 MSDS 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.

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 warning(s), including physical & health hazard information, target organs affected (if known) and carcinogen information where applicable. See Appendix B Health Hazard Definitions. Also, hazard warning information can usually be obtained from sections 3 - 6 of the MSDS.

- 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.

- 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

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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 ES&H group.

b. Manufacturer's Labels

- Labels on shipped/incoming containers of hazardous chemicals must have the chemical identity and hazard warnings appropriate for employee protection, including target organ(s). In addition, the name and address of the manufacturer, importer, or other responsible party of the hazardous chemical must be present on the label.

- Removal of labels on incoming containers of hazardous materials is strongly discouraged. In addition, they shall not be removed or defaced unless immediately replaced with a label having equivalent or superior information.

3. Material Safety Data Sheets

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

a. MSDS Availability

MSDSs for hazardous chemicals in an employees work area must be readily accessible to employees during each work shift.

b. MSDS Distribution

See Flowchart on following page.

MSDSs for Stockroom materials are routinely acquired and entered into the master file and database maintained by the ES&H Section. Use the same flow chart to obtain these MSDSs.

c. MSDS Review

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Review the MSDS to ensure that all pages are received and each space on the MSDS is complete (e.g. none, n/a - not applicable, n/d - none detected). The MSDS must also be written in English and be understandable.

The chemical name (identity) and hazard information on the MSDS 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 MSDS shall also match the label information of a portable container into which a hazardous chemical has been transferred.

The MSDS must contain the physical and chemical properties of a substance, as well as the physical and health hazards, routes of exposure, precautions for safe handling and use, emergency and first-aid procedures and control measures. See Appendix C, Guidelines for Reading and Understanding an MSDS, for information required in each section. Also, see Appendix A, sample MSDS Checklist.

d. MSDS Preparation

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

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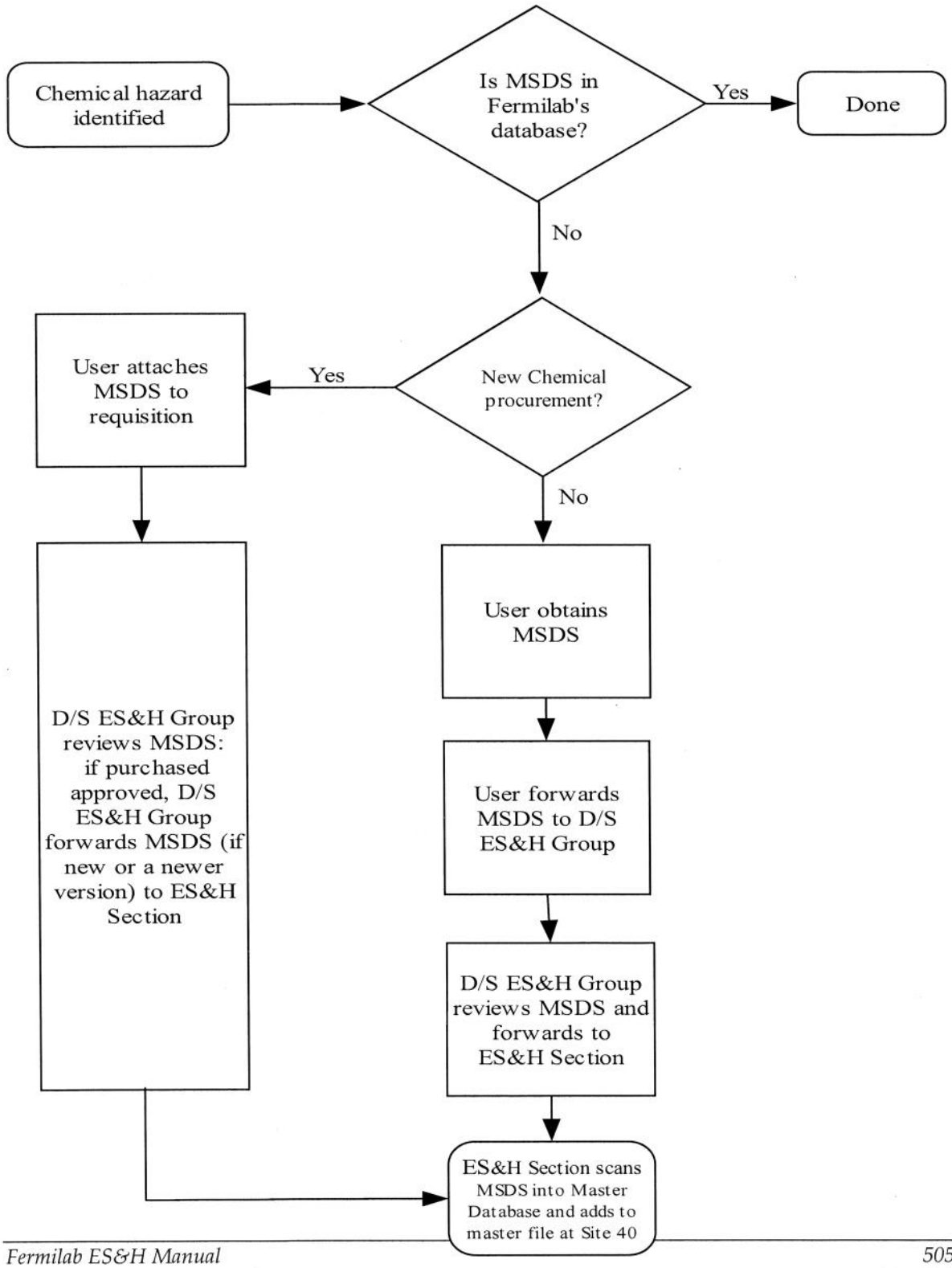
Procedures for obtaining MSDS's



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The organization synthesizing the chemical is responsible for preparing an MSDS in accordance with 29 CFR 1910.1200. The division/section ES&H group and the ES&H Section will provide assistance as needed.

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.

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 MSDS and an explanation of each section on an MSDS.
- Review of the labeling system used by Fermilab.
- Demonstrate ability to identify specific information on an MSDS 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.

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Work area specific training should be conducted by the supervisor or local ES&H department. It should include the following elements:

- Specific location of the area's MSDSs 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 ES&H department. Documentation of such training is at the discretion of the ES&H Group.

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Appendix A

Material Safety Data Sheet Checklist

You must ensure that each MSDS contains the following information:

1. Product or chemical identity used on the label.
2. Manufacturer's name and address.
3. Chemical and common names of each hazardous ingredient.
4. Name, address, and phone number for hazard and emergency information.
5. Preparation or revision date.
6. The hazardous chemical's physical and chemical characteristics, such as vapor pressure and flashpoint.
7. Physical hazards, including the potential for fire, explosion, and reactivity.
8. Known health hazards.
9. OSHA permissible exposure limit (PEL), ACGIH threshold limit value (TLV) or other exposure limits.
10. Emergency and first-aid procedures.
11. Whether OSHA, NTP or IARC lists the ingredient as a carcinogen.
12. Precautions for safe handling and use.
13. Control measures such as engineering controls, work practices, hygienic practices or personal protective equipment required.
14. Primary routes of entry.
15. Procedures for spills, leaks, and clean-up.

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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.

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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

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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

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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

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Chemicals: Ketones; chlorinated compounds

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

Signs & Symptoms: conjunctivitis; corneal damage

Chemicals: Organic solvents; acids

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Appendix C

Understanding Material Safety Data Sheets

Guidelines for Reading and Understanding an MSDS

Not all Material 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 MSDS.

If the MSDS 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 MSDSs 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.

1. Product Identification

The manufacturer or distributor listed should be able to provide detailed information on the hazards of the material(s) covered by the MSDS.

Does the trade name on the MSDS agree with the one on the label of the container?

The synonyms should be those most commonly used for the product.

Make sure the chemical name and the formula are listed for single substances and that the trade or brand name and the chemical family are listed if the substance is a mixture. You will find ingredient information in Section 2.

2. Hazardous Ingredients

The materials listed should be those in the product which are individually listed in:

a) CFR 1910, Subpart Z, Toxic and Hazardous Substances;

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b) Threshold Limit Values for Substances and Physical Agents in the Work Environment.

American Conference of Government Industrial Hygienists (ACGIH) (latest edition).

One component of a multi-component product might be listed because of its toxicity (the health hazard it poses) another for its flammability, and a third for its reactivity.

Toxic hazard data should be stated in terms of concentration, mode of exposure, or test, and animal used; i.e., 100 ppm LC50 (lethal concentration) rat, 25 mg/M^3 LD50 (lethal dose) oral mouse or permissible exposure limit from published sources such as:

a) National Toxicity Program (NTP), Annual Report on Carcinogens;
b) International Agency for Research on Cancer (I.A.R.C.);
c) National Institute for Occupational Safety and Health (NIOSH), The Registry of Toxic Effects of Chemical Substances

Flammable or reactive data should be included as well as flash point, shock sensitivity, or brief data to indicate the nature of the hazard.

3. Physical Data

This section is one of the most important and useful sections on the MSDS both for assessing how hazardous the substance is and how completely the MSDS is filled out. This is especially true for solvents, and that is why solvents are used as an example throughout this article.

The data in this section should be for the total mixture or product. Don't be put off by the terms. Once you know the definitions of the terms, you can make cross checks.

TERMS:

Boiling Point is the temperature in degrees Fahrenheit or Celsius at which liquid boils (or becomes gas). Ranges are given for mixtures.

Vapor Pressure. A high vapor pressure indicates that a liquid will evaporate easily.

The term "volatile" is used to describe a liquid that evaporates easily. This is important to know because it indicates that air concentrations can build up quickly when the material is worked with in its liquid form. Materials with high vapor pressures can be especially hazardous if you are working with them in an enclosed area or in an area

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with poor air circulation. Vapor-pressures are measured in torr units or millimeters of mercury (mm fig) at a certain temperature. Xylene with a vapor pressure of 10 mm Hg at 27-32 degrees C and toluene with a vapor pressure of 36 mm Hg at 30 degrees C are two solvents, for instance, the use of which can lead to hazardous air concentrations. However, even materials with lower vapor pressures may pose an inhalation hazard because the method of handling (for example, spraying versus brushing) also affects the concentration in air.

Vapor Density is the relative density or weight of a vapor or gas compared with an equal volume of air. If the vapor density of a substance is less than one, it will tend to rise in air; if the vapor density is greater than one, it will fall in air, Substances with high vapor densities pose a particular problem because they will collect in the bottom of tanks.

Solubility in water refers to the percentage by weight of the substance that can be dissolved in water. Less than 0.1% is considered negligible; 0.1-1% is slight; 1-10% is moderate; more than 10% is appreciable; and if it can be dissolved in all proportions, it has complete solubility.

Appearance & Odor may help you identify the substance you are working with. Do not rely on odor to indicate whether there is a hazardous concentration of the substance in air. Some substances can reach hazardous levels and not have a noticeable odor.

Specific Gravity refers to the ratio of the weight of a volume of liquid to the weight of an equal volume of water at a specified temperature. If a substance has a specific gravity greater than one, it will sink in water; it if has a specific gravity less than one, it will float in water.

Percent Volatile by Volume refers to the percentage of a liquid or solid that evaporates at room temperature. The higher the percentage the faster the substance will evaporate.

Evaporation Rate is the rate at which the material evaporates compared either to ether that evaporates very quickly or to butyl acetate that evaporates very slowly. The chemical which is used for comparison (ether or butyl acetate) should be listed, If a substance has an evaporation rate greater than one, it evaporates more easily than the chemical it is compared to; if the rate is less than one, it evaporates more slowly than the chemical it is compared to.

The information in the Physical Data section is useful for the control of toxic vapors. Boiling point, vapor density, percent volatile, vapor pressure and evaporation are all useful for designing proper ventilation systems. This information is also useful for design and use of adequate fire and spill containment equipment and procedures.

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Make these checks. The boiling point, vapor pressure, % volatile, and evaporation rate are all characteristics of a substance that gives off vapors into the air. If one of these characteristics has been listed, all of them should be filled out.

If a material has a % volatile greater than 10%, a boiling point below 100 degrees C, and a vapor pressure over 5 or 6 millimeters of mercury (mm Hg), check the following sections to make sure they are filled out and for information.

1. Check the TLV in Section 2. A low TLV (i.e., less than 10) means that the material can be very hazardous, you may be better off using a highly volatile substance, like acetone, with a high TLV, than a less volatile substance like benzene with a low TLV. In fact, a useful way to compare the hazards of solvents when selecting a solvent to use is to divide the evaporation rate by the TLV and see which one is higher and therefore more hazardous,

2. In Section 4, check to see that the Flash Point and Flammable Limits are filled out. A substance with a vapor pressure of over 5 mm Hg at room temperature and an evaporation rate of greater than 1 and a flash point of less than 140 degrees F and low LEL (less than 2%) can be a dangerous fire hazard especially if the % volatile is also high.

3. Check Section 6 "effects of overexposure" to see if breathing the vapors of the substance can be harmful

4. Check Section 8 Special Protection Information, to see whether there are recommendations for respiratory protection and/or ventilation controls. If the substance has a TLV and is volatile, this section must be filled out.

5. Make sure that there are some recommendations for storage and handling in Section 9, Special Precautions, especially if the substance has a vapor density that is heavier than air.

4. Fire and Explosion Data

If you're working with flammables, solvents, peroxides, explosives, metal dusts and other unstable substances, this section is important. If the product does not pose a fire hazard, which should be stated in this section.

Some terms you need to know are:

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Flash Point is the lowest temperature at which a liquid gives off enough vapor to make an ignitable mixture of vapor in air in a test container. Flash Point and auto ignition should be listed in temperature degrees Fahrenheit or Centigrade, or both. Liquids with flash points below 140 degrees F are specially classified liquids by OSHA and require special precautions. Check Section 9, Special Precautions, to see what they are.

Flammable liquids-LEL (lower explosive limit) and UEL (upper explosive limit) are the lower and upper limits of vapor and air concentration, given as percent, which can cause an explosion. The flash point and flammable limits are the most important when related to the boiling point, vapor pressure, % volatile and evaporation rate in Section 3. If any one of these items is listed all of the items should be listed in order to provide enough information about the hazards of the material.

Extinguishing Media means what kind of fire extinguisher to use. If the substance is not flammable and/or is completely inert, the MSDS should say so.

Special Fire Fighting Procedures and Unusual Fire and Explosion Hazards would need to be described for any combustible material. Some-concentrated corrosives, calcium carbide or reactive metals, must not have water applied in case of fire. Check Section 2 to see if the material is a catalyst, and check Section 5 for reactivity with water and polymerization in water or air.

5. Reactivity Data

The information in this section will assist in determining safe storage and handling of hazardous, unstable substances. Instability or incompatibility of the product to common substances such as water, direct sunlight, metals used in piping or containers, acids alkalis, etc., should be listed here.

Stability-Cross check with other sections:

1. Section 2: A mixture may be unstable if the ingredients include catalysts and vehicles, peroxides, explosives, and other unstable or highly reactive substances.

2. Section 3: Are there unusual fire and explosive hazards?

3. Section 9. If there are very specific instructions in this section regarding precautions to take in handling and storage, it may indicate that the material is unstable.

Incompatibility- Common materials or contaminants which the specific material could be expected to come into contact with and which could produce a reaction should be

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listed here. Conditions to avoid should also be listed. Sections 4 and 9 may contain information on incompatibility not listed in Section 5.

Hazardous Decomposition Products should list products released if the substance is exposed to aging, heating, burning, oxidation, or allowed to react. The product's shelf life should also be listed in this section when applicable. Although some materials are innocuous in their original form, when they are exposed to the conditions such as aging, burning etc., they may form hazardous products.

1. Check Section 4 for fire and explosion hazards regarding these chemicals.

Hazardous Polymerization is a reaction with extremely high or uncontrolled release of energy. If this section is checked, the conditions under which it could occur should be explained.

1. Check Section 2. If the substance contains any catalyst and vehicle it may indicate that hazardous polymerization can occur.

6. Health Hazard Information

Health Hazard Data should be the combined estimate of the hazard of the total product. This might be stated as a time weighted average concentration, permissible exposure limit (PEL) or TLV. Other data, such as LD 50, might be used.

Routes of Exposure should contain information about the potential hazard from absorption of the product, the severity of the effect, and the basis for that determination. The basis might be animal studies, analogy with similar products, or human exposure.

Typical comments might be:

- skin contact, single short contact--not adverse effects likely
- prolonged or repeated skin contact-mild irritation and possibly some blistering
- eye contact--some pain and mild transient irritation. No corneal scarring.

Check Section 2 to see if TLVs are listed for any of the ingredients. If TLVs are listed there, they should also be listed in this section; make sure the numbers are the same. If the substance is a mixture of several compounds and a TLV for the mixture is listed in this section, this is only appropriate if all of the ingredients in the mixture contributing to the TLV have the same harmful health effects, such as petroleum solvent vapors that cause drowsiness and unconsciousness. Check Sections 1 and 6 for this information.

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Routes of Exposure should list common effects by route of exposure, usually by inhalation or absorption by skin contact. It should include chronic and acute effects; as well as information on carcinogenicity, teratogenicity, or mutagenicity. Many MSDS lack information on chronic effects.

If inhalation is a primary route of exposure, check the following sections:

Section 3 because this section can help you determine how great the hazard might be. Chemicals with high vapor pressure, and high volatility usually pose more of an inhalation problem than chemicals with low vapor pressure and low volatility.

Section 8 because this section should give information on proper respiratory protective devices (with type specified and/or necessary ventilation requirements).

If skin contact or absorption is a problem, Section 8 should list proper protective equipment (gloves and eye and skin protection).

Effects of Overexposure should indicate relevant signs, symptoms, and diseases that could result from acute and chronic exposure to the hazardous substances.

Emergency and First Aid Procedures should contain treatment information that could be used by paramedics and individuals trained in first aid.
Any substance with a TLV should have emergency first aid procedures listed for acute exposures, especially if the material has a low TLV. Check Section 4 to see if the chemical presents any unusual fire or explosive Hazards.

Note to Physician should include special information which would be important to a doctor including required or recommended pre-placement and periodic medical examination, diagnostic procedures, and medical management of overexposed employees.

7. Spill or Leak Procedures

Detailed procedures and protective clothing and equipment and/or ventilation to be used for cleaning up a spill and safe disposal should be indicated here.

1. Check Section 2 for TLV. A low TLV such as HCN (with a TLV of 10 ppm) indicates greater health hazard than a high TLV such as acetone (with a TLV of 750 ppm).
2. Check Section 3 for volatility and vapor pressure. A high vapor pressure indicates a greater volatility and a greater hazard.
3. Check Section 4 for fire and explosive data (combustible and flammable?)

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4. Check Section 5 for reactivity (incomparability? hazardous polymerization? unstable?)

5. Check Section 6 for health data (inhalation hazard? skin contact hazard?)

6. Check Section 8 for information on personal protective equipment.

For example, if a material has a low TLV, is highly volatile, is flammable, unstable and has severe effects of overexposure listed then very specific procedures on handling a spill or leak need to be spelled out. This section should state whether the substance is incompatible with common clean up procedures or media (such as water).

Waste Disposal Methods: If labeling and special handling of clean-up residue is necessary, that should be stated along with the appropriate method of disposal-for instance, sanitary landfill, incineration, etc.

1. Check Section 2. If hazardous materials are listed, there should be specific procedures for waste disposal

2. Check Section 4, 5, and 9 to make sure that the waste disposal method doesn't create another problem.

8. Special Protection Information

Respiratory Protection:

1. Check Section 6 to see if inhalation is a probable means of overexposure.

2. Check Section 3 to see how volatile the substance is, to determine the potential degree of hazard.

- If respirators are required or recommended, the type and class should be stated, such as "supplied air" or "organic vapor cartridges" or suitable for dust no more toxic than lead, etc.

- If protective clothing is required, the type and material of that clothing should be indicated.

Ventilation:

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1. Check Sections 2, 3, and 6, volatility and route of exposure to assess the degree of inhalation hazard. If the substance is very volatile and the TLV is low, local exhaust ventilation, which captures contaminants at the point where they are generated, is probably the most effective control. Mechanical, general or dilution ventilation is not recommended for chemicals with a low TLV, especially if they are highly volatile or have high evaporation rates.

Protective gloves:

1. Check Section 2 for TLV of substance and Section 6 to determine if the skin is a primary route of exposure.

2. If gloves are recommended, the type should be specified. Check Section 1 for chemical family to make sure proper gloves are being recommended.

Eye Protection:

1. Check Section 6 for information regarding hazards to the eye. First aid procedures may be listed, such as flooding with water. If splashes may occur, eye protection and eyewash facilities should be recommended.

9 Special Precautions:

How to label the substance, or required signs to be posted might be listed here, as well as any information on safety or health that has not been covered in other sections of the MSDS.

1. Check Section 3 for volatility, Section 4 for flash point and flammability, Section 6 for exposures and Section 5 for reactivity. If all of them are left blank or filled with NA, but this Section 9 is filled out in detail, it should make you question the completeness and accuracy of the MSDS. In that case, you may need to check back with the manufacturer of the product.

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