

**PREPARING,  
UNDERSTANDING  
AND USING**

**MATERIAL  
SAFETY  
DATA  
SHEETS**

## INTRODUCTION

Material Safety Data Sheets (MSDSs) are the cornerstone of the Hazard Communication Standard. They provide information about the chemical substances within a product, safe handling procedures, first aid measures and procedures to be taken when the product is accidentally spilled or released.

The responsibility for preparing or obtaining Material Safety Data Sheets lies with the chemical manufacturers or importers. An MSDS must be provided to employers and distributors with the initial shipment and with the first shipment after it is updated. If the chemical manufacturer or importer becomes aware of new significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the Material Safety Data Sheet within three months. Distributors must provide MSDSs to their customers also.

Employers are required to have Material Safety Data Sheets for each hazardous chemical they use. They must maintain copies of the MSDSs and ensure that employees have access to them during all work shifts.

There is no format specified for Material Safety Data Sheets. They must, however, be written in English and include the following information:

1. The identity of the chemical used on the label.
2. Except for trade secrets, the specific chemical name and common names for the hazardous ingredients.
3. Physical and chemical characteristics.
4. Physical hazards.
5. Health hazards.
6. Primary route(s) of entry.
7. OSHA PEL, ACGIH TLV, and any other recommended exposure limit.
8. Whether the chemical is listed as a confirmed or potential carcinogen by NTP, IARC or OSHA.
9. Applicable precautions for safe handling and use.
10. Applicable control measures.
11. Emergency and first aid procedures.
12. Date of preparation or latest revision.
13. Name, address and telephone number of manufacturer, importer or other responsible party.

The Material Safety Data Sheet plays an important role in an employer's overall chemical safety and health program. It provides information for employee training, emergency planning and hazard evaluation.

**Training**—The employee information and training section of the Hazard Communication Standard (29 CFR 1910.1200(h)) requires employees who are exposed to hazardous chemicals to be trained in their safe handling and use. A key element of the training program includes an explanation of the MSDS.

**Emergency Planning**—The MSDS can also be used for chemical emergency planning. Valuable information such as precautions for safe handling and storage, steps to be taken if the material is spilled or released, incompatibilities and special fire fighting procedures are included on the MSDS.

Under Section 311 of the Superfund Amendments and Reauthorization Act of 1986 (SARA), there is an MSDS reporting requirement. It requires that facilities covered under the Hazard Communication Standard must submit MSDSs or a list to three agencies for each hazardous chemical that exceeds the established Threshold Quantity.

The three agencies that must receive MSDSs are: the State Emergency Response Commission (SERC), the Local Emergency Response Committee (LERC), and the Local Fire Department (LFD). The MSDS information is beneficial for the Hazardous Materials Incident Responders so they can develop a strategy for an emergency at these facilities.

**Hazard Evaluation**—The MSDS allows an evaluation of the potential physical and health hazards of chemicals being considered or presently used at a facility. By evaluating the MSDSs of several chemicals, it may be possible to select a less hazardous substitute. Also, a health professional can use the MSDS to aid in health monitoring and health surveys.

## PREPARING AND UNDERSTANDING MATERIAL SAFETY DATA SHEETS

Material Safety Data Sheets contain information concerning hazardous materials used in the workplace. The information contained in this booklet has been obtained from a variety of sources. It is intended to aid in compliance with U.S. Department of Labor Occupational Safety and Health Administration (OSHA) standards and yet be flexible enough that state and local requirements, which may be different, can also be met.

Information for preparing Material Safety Data Sheets must be gathered from reliable sources, and the sheets should be reviewed and updated as new information becomes available. Manufacturers, suppliers and current literature should be consulted. If physical or toxicology information is not available for a chemical or mixture, it may be possible to obtain this information through a Testing Laboratory.

Whenever the desired or required data cannot be accommodated on the printed sheet, an addendum—extra sheets of blank paper—should be used.

Blank spaces are not permitted. Where information is not available from published sources or by normal test procedures, the fact is indicated by inserting the word "unknown" or "unk." If information is not applicable to the material under consideration, the letters "NA" (not applicable) should be inserted.

For the purpose of preparing Material Safety Data Sheets, OSHA has defined a hazardous chemical as any chemical which is a physical hazard or health hazard.

The Hazards Table below lists the physical hazards and health hazards recognized by OSHA for inclusion on MSDSs.

### Physical Hazards

Combustible Liquid	Organic Peroxide
Compressed Gas	Oxidizer
Explosive	Pyrophoric
Flammable: 1. Aerosol	Unstable (Reactive)
2. Gas	Water Reactive
3. Liquid	
4. Solid	

### Health Hazards

Carcinogen	Hepatotoxin (liver)
Toxic Agent	Nephrotoxin (kidney)
Highly Toxic Agent	Neurotoxin (nervous system)
Reproductive Toxin	Agents which act on the hematopoietic (blood) system.
Irritant	Agents that damage lungs, skin, eyes or mucous membranes.
Corrosive (to tissue)	
Sensitizer	

OSHA has recognized a group of chemicals that must be included on MSDSs. These chemicals are listed either in OSHA Safety and Health Standards (29 CFR 1910) or by the American Conference of Governmental Industrial Hygienists (ACGIH). ACGIH publishes Threshold Limit Values (TLVs) for chemical substances in the workplace and updates them annually.

Carcinogens or potential carcinogens to be included are those reported by the National Toxicology Program (NTP) **Annual Report on Carcinogens** (latest edition), International Agency for Research on Cancer (IARC) **Monographs** (latest edition) or by OSHA in its publication 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances. The NIOSH **Registry of Toxic Effects of Chemical Substances** (RTECS) lists the findings of NTP, IARC and OSHA.

***Following is the information that must appear on an MSDS. All information is to be written in English.***

The hazardous chemical is identified on the MSDS in the same manner as shown on the label. This may be a chemical name, code name, number or trade name.

**Manufacturer**—Shows the manufacturer, importer, employer or other responsible party preparing or distributing the Material Safety Data Sheet. The person or organization shown should be an available source from which additional information on the hazardous chemical and appropriate emergency procedures can be obtained. This section also includes the mailing address, telephone number for general information, emergency telephone number and TELEX number.

**MSDS Number (Optional)**—Space available for cross referencing an MSDS file. A list of chemicals in the workplace is required by OSHA. If this is done in numbered sequence, the cross reference number should be placed here.

**CAS Number (Optional)**—Chemical Abstract Service Number. Provides an additional reference for information concerning specific chemicals. The number identifies the specific compound and allows identification regardless of the name or naming system used.

**Date Prepared**—The date the MSDS was prepared. Also provides a reference when an updated MSDS has been prepared.

**Prepared By (Optional)**—The name of the responsible person who prepared the MSDS.

### SECTION 1—Material Identification & Hazard Components

The chemical and common names of all ingredients which have been determined to be reportable health hazards are listed.

If the hazardous chemical is a single substance, its chemical name and common names (synonyms) are listed. The common names listed should be those ordinarily in use for that product.

If the hazardous chemical is a mixture which has been tested as a whole to determine its hazardous properties, the chemical and common names of the ingredients that contribute to those known hazards are listed, along with the common names for the mixture.

If the hazardous chemical is a mixture which has not been tested as a whole, the chemical and common names are listed for all ingredients that are:

1. Determined to be health hazards and which comprise 1% or more of the mixture.
2. Identified as carcinogens and present at 0.1% or greater.
3. Determined to be a physical hazard when present in the mixture.

Inclusion of the percentage composition is optional.

OSHA PEL values can be found in the General Industry Standards, specifically OSHA Safety and Health Standards (29 CFR 1910.1000).

ACGIH TLVs are found in **Threshold Limit Values and Biological Exposure Indices**, which is updated by the American Conference of Governmental Industrial Hygienists (ACGIH) on an annual basis.

Where other sources have recommended exposure limits, these are to be included in the section "Other Limits Recommended."

Units used for these measurements are usually milligrams per cubic meter (mg/m<sup>3</sup>) or parts per million (ppm).

### SECTION 2—Physical/Chemical Characteristics

These data tell what the material or mixture is like and how it behaves. The conditions of testing—including the temperature scale used (°C or °F)—are shown for each entry. This information is useful for the design of ventilation systems and for providing adequate fire and spill containment equipment and procedures.

**Boiling Point**—The temperature at which a material boils, in degrees F, under ordinary atmospheric pressure (1 atmosphere = 760 mm Hg). If the material is a mixture, a boiling range may be given.

**Vapor Pressure**—How much vapor the material may give off. It refers to the pressure of saturated vapor above the liquid and is usually measured at 20°C (68°F) and given in millimeters of mercury (mm Hg). The vapor pressure and the temperature where measured are listed. A high vapor pressure indicates that a liquid will evaporate easily.

**Vapor Density**—The weight of the pure gaseous form of the material in relation to air. The weight of a given volume of a vapor or gas (with no air present) is compared with the weight of an equal volume of air. Values should be given in the ambient temperature range of 60° to 90°F to facilitate field usage. High vapor densities pose a particular problem because these vapors will collect in the bottom of tanks.

#### VAPOR DENSITY TABLE

1.0 . . . . .	Vapor is the same weight as air
above 1.0 . . . . .	Vapor is heavier than air
below 1.0 . . . . .	Vapor is lighter than air

**Water Solubility**—The solubility of the material in distilled water at 50°F. Solubility may be given in weight percent, or the following terms may be used instead of numbers:

Negligible . . . . .	less than 0.1 percent solubility
Slight . . . . .	0.1 to 1 percent solubility
Moderate . . . . .	1 to 10 percent solubility
Appreciable . . . . .	more than 10 percent solubility
Complete . . . . .	soluble in all proportions

**Specific Gravity**—How heavy the material is compared to water. This indicates whether the material will float or sink. The weight of a given volume of material is compared to the weight of an equal volume of water at 39.2°F (4°C).

#### SPECIFIC GRAVITY TABLE

- 1.0 . . . . . The material is the same weight as water  
above 1.0 . . . . . The material is heavier than water  
below 1.0 . . . . . The material is lighter than water

**Evaporation Rate**—The rate at which a material changes from a liquid or solid state to its gaseous form. Caution must be used in interpreting evaporation rate data. The method of calculation must be known. When ethyl ether is used as a basis for highly volatile solvents and time required for evaporation is recorded, values greater than one indicate less rapid evaporation than ether. When butyl acetate is used for less volatile solvents, weights may be recorded for equal times of evaporation. In this case, values greater than one indicate evaporation rates greater than butyl acetate.

**Water Reactive**—Indicates if the chemical reacts with water to release a gas that is flammable or presents a health hazard.

### SECTION 3—Fire and Explosion Hazard Data

**Flash Point and Method\***—The minimum temperature at which a liquid will give off enough flammable vapor to ignite. The “closed cup” values should be given, but “open cup” methods are also used. The results of the two methods can vary by several degrees. The method used to determine the flash point should also be stated.

Methods recognized by OSHA are:

1. Tagliabue closed tester
2. Pensky-Martens closed tester
3. Setaflash closed tester

\*Note: Organic peroxides which undergo autoaccelerating thermal decomposition are excluded from any of the flash point determination methods specified.

**Autoignition Temperature**—The minimum temperature needed to cause self-sustained combustion in the absence of a spark or flame. The temperature and temperature scale are given.

Example: (Phenol) 1319° F

**Flammable Limits in Air**—The range of gas or vapor concentrations (percent by volume of air) which will burn or explode if an ignition source is present. Lower and upper limits are noted. Knowledge of the lower limit will aid in determining the volume of ventilation needed for an enclosed space to prevent fires and explosions. The units used in measuring concentration and the temperature at which the test was conducted are given. If the material tested was in the form of a dust in air, this fact is also noted.

Example: (2-Butanol)

Flammability Limits in Air % by Volume	at 212°F	LEL	UEL
		1.7	9.8

**Extinguishing Media**—The fire fighting extinguishing media suitable for use on the burning material. Special formulations, in addition to standard agents, are available for extinguishing certain types of chemical fires. These should be indicated by generic name. The standard fire fighting agents are water fog, foam, alcohol foam, CO<sub>2</sub> and dry chemical.

Example: (p-Xylene)

Extinguishing Media: Dry chemical, foam or CO<sub>2</sub>

**Special Fire Fighting Procedures**—If water is unsuitable, the fire fighting media to be used is specified. Also listed is any necessary personal protective equipment including respirator selection, protective clothing, eye protection and/or self-contained breathing apparatus (SCBA).

Example: (Sodium Potassium Alloy)

Special Fire Fighting Procedures: Use dry soda ash, dry sodium chloride or Ansul's Met-L-X. Fire fighters should use self-contained breathing apparatus and full protective clothing.

**Unusual Fire and Explosion Hazards**—Indicates if the material presents an unusual hazard and any special conditions that might affect it. If evacuation is necessary, that fact should be indicated.

Example: (p-Xylene)

Unusual Fire and Explosion Hazard: Dangerous fire hazard, moderate explosion hazard when exposed to heat or flame. Vapors heavier than air and may flow along ground to distant ignition sources. Water stream may scatter flames.

## SECTION 4—Reactivity Hazard Data

This information will aid in safe storage and handling of hazardous or unstable substances. Instability or incompatibility to common substances such as water, direct sun, metals used in piping or containers, acid, alkalis, etc. should be listed.

**Stability**—The ability of a material to remain unchanged under normal conditions. Unstable (reactive) means a chemical which in the pure state or as produced or transported will vigorously polymerize, decompose, condense or become self-reactive under conditions of shock, pressure or temperature.

A check or cross is used to show whether the material is stable or unstable under "reasonable, foreseeable conditions." If the material is unstable, the conditions under which a dangerous reaction may occur are given.

**Incompatibility**—Provides information on common materials and contaminants with which the material may reasonably come in contact to produce a reaction which would release large amounts of energy. If no such incompatibility exists, enter "none."

Example: Oxidizing agents react with reducing agents. Acids react with bases.

**Hazardous Decomposition Products**—Hazardous materials produced in dangerous amounts by burning, oxidation or heating are listed. Thermal decomposition products might include CO, CO<sub>2</sub>, SO<sub>3</sub>, NH<sub>3</sub>, NO, oxides of nitrogen, phosgene, aniline, etc.

Example: Carbon tetrachloride undergoes thermal oxidation to produce phosgene and hydrogen chloride.

**Hazardous Polymerization**—Hazardous polymerization is that which takes place at a rate which releases large amounts of energy. A check or cross is used to indicate whether or not hazardous polymerization can occur. If it can occur, the reasonably foreseeable storage conditions which would start the polymerization are listed. Included is the expected time period in which the inhibitors may be used up. Conditions to avoid are listed. They might include catalysts that cause polymerization, heat or temperature (be specific), sunlight, etc.

## SECTION 5—Health Hazard Data

**Primary Route of Entry**—The potential routes of exposure to the hazardous chemical during the course of normal usage or a foreseeable emergency. A "foreseeable emergency" is one which would normally be planned for as a presumed potential occurrence determined by the nature of the work. Equipment failure and rupture of containers should be considered. If the chemical is not hazardous, this is also indicated.

**Carcinogen Listed In**—Shows by check or cross whether the hazardous chemical:

1. Is listed in the National Toxicology Program (NTP) **Annual Report on Carcinogens** (latest edition);
2. Has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) **Monographs**; or
3. Has been found to be a potential carcinogen by OSHA.

If the chemical is not listed, this is also indicated.

**Health Hazards**—Acute and/or chronic hazards that result from exposure to the hazardous chemical. Acute hazards are quickly apparent effects of the chemical as a result of short-term exposure and are of short duration. Tissue damage or irritation sensations and lethal dose are among those things considered.

Chronic effects generally result from long-term exposure. The effects may not be immediately apparent and are likely to be of long duration. Long-term changes in the body should be included. Some of these characteristics of the chemicals are:

Carcinogen (cancer causing)  
Teratogen (tumor causing)  
Mutagen (genetic changes)  
Blood dyscrasias (anemia)  
Chronic bronchitis  
Liver atrophy (degeneration)  
Kidney damage

**Signs and Symptoms of Exposure**—The most common sensations that an exposed person will feel and his/her appearance are described. Symptoms of exposure can be varied and many can depend on individual susceptibility, concentration and the type of material. Attention should be given to effects caused by eye contact, skin contact, inhalation and ingestion.

**Medical Conditions Generally Aggravated by Exposure**—Those medical conditions that are recognized as being aggravated by exposure should be listed.

**Emergency First Aid Procedures**—The immediate temporary steps to be taken in case of eye contact, skin contact, inhalation and ingestion are given. These are emergency procedures only—the victim should be examined by a doctor as soon as possible after exposure. Procedures for removing contamination from skin and eyes, neutralization, treatment for inhalation (including use of oxygen or artificial respiration) and what to do in case of ingestion are given.

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## SECTION 6—Control and Protective Measures

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The personal protective equipment to be worn, type of ventilation to be used and precautions to be taken when using the material for its intended purpose are given.

**Respirator Protection**—Indicates the type of respirator to be used.

**Protective Gloves**—Indicates the type of glove to be used, including the materials of construction.

**Eye Protection**—Indicates the type of eye protection to be used, such as face shield or safety goggles.

**Ventilation**—Indicates the type of ventilation required in work areas and under what conditions it is suitable.

For very volatile and low TLV materials, local exhaust, which captures fumes at their source, is probably the most effective control. Mechanical (general) or dilution ventilation would not be recommended.

Example: Local Exhaust—where material is heated or mists.  
Mechanical: (General)—all use areas.

**Other Protective Clothing and Equipment**—When special suits or other clothing, clothing of special material and/or construction or other special handling is required for personal protection, it should be indicated here.

**Hygienic Work Practices**—Indicates personal hygienic steps to be taken when handling the chemical. Washing hands after use, not smoking, or disposing of or laundering contaminated clothing may be indicated here.

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## SECTION 7—Precautions for Safe Handling & Use/Leak Procedures

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**Steps To Be Taken if Material Is Spilled or Released**—Any applicable precautions to be taken in the event of spills or leaks are given. These would include such things as “avoid breathing gases and vapor,” “avoid skin contact with liquid or solid,” and “remove sources of ignition.” Special equipment used for cleanup, such as glass or plastic scoops and type of containers, is listed. Also listed: specific absorbents, neutralization materials, decontamination materials, need for evacuation or safety personnel, etc.

**Waste Disposal Method**—Gives methods for disposal of spilled solids or liquids. Methods must always follow federal, state and local regulations. They may include incineration with or without scrubbing of the waste gases, landfill burial, licensed waste disposal firm, scrap recovery, flushing with water, return of material to original container, etc. The manufacturer or supplier may provide specific recommendations. Cautions concerning disposal such as “do not flush to sewer” or “do not incinerate” may be included in this section.

**Precautions To Be Taken in Handling and Storage**—This section gives any special precautions to be taken in storage and handling such as avoiding reaction hazards with oxidizing agents, reducing agents, acids, etc. Conditions for storage such as temperature, ventilation and “no smoking or other sources of ignition” are also given. When applicable, the safe storage life is indicated.

**Other Precautions**—Lists any other general precautions to be taken that have not previously been mentioned.

**NFPA Rating (Optional)**—The National Fire Protection Association (NFPA) has developed a system for indicating the health, flammability and reactivity hazards of chemicals in prevention and control of fires and explosions. In addition, a special precaution symbol may be used where necessary.

## RATING SUMMARY

### HEALTH

- 4—Materials that on very short exposure could cause death or major residual injury.
  - 3—Materials that on short exposure could cause serious temporary or residual injury.
  - 2—Materials that on intense or continued but not chronic exposure could cause temporary incapacitation or possible residual injury.
  - 1—Materials that on exposure would cause irritation but only minor residual injury.
  - 0—Materials that on exposure under fire conditions would offer no hazard beyond that of an ordinary combustible material.
- Health hazard describes short-term contact or inhalation hazard only.*

### FLAMMABILITY

- 4—Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature, or that are readily dispersed in air and that will burn readily.
- 3—Liquids and solids that can be ignited under almost all ambient temperature conditions.
- 2—Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.

1—Materials that must be pre-heated before ignition can occur.

0—Materials that will not burn.

### REACTIVITY

4—Materials that in themselves are readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.

3—Materials that in themselves are capable of detonation or of explosive decomposition or reaction but require a strong initiating source or which must be heated under confinement before initiation or which react explosively with water.

2—Materials that readily undergo violent chemical change at elevated temperatures and pressures or which react violently with water or which may form explosive mixtures with water.

1—Materials that in themselves are normally stable, but which can become unstable at elevated temperatures and pressures.

0—Materials that in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.

### SPECIAL

W — Reacts violently with water. Avoid use of water.

R — Radioactivity

OX—Oxidizing properties.

**HMIS Ratings (Optional)**—The National Paint and Coatings Association has proposed the Hazardous Material Identification System. Ratings are given for Health, Flammability, Reactivity and Personal Protection. These ratings are similar to the NFPA ratings.

### RATING SUMMARY

#### HEALTH

0—Minimal Hazard No significant risk to health.

1—Slight Hazard Irritation or minor reversible injury possible.

2—Moderate Hazard Temporary or minor injury may occur.

3—Serious Hazard Major injury likely unless prompt action is taken and medical treatment is given.

4—Severe Hazard Life-threatening major or permanent damage may result from single or repeated exposures.

#### FLAMMABILITY

0—Minimal Hazard Materials which are normally stable and will not burn unless heated.

1—Slight Hazard Materials that must be preheated before ignition will occur. Flammable liquids in this category will have flash points at or above 200°F (OSHA Class IIIB).

2—Moderate Hazard Material which must be moderately heated before ignition will occur, including flammable liquids with flash points at or above 100°F and below 200°F (OSHA Class II and Class IIIA).

3—Serious Hazard Materials capable of ignition under almost all normal temperature conditions, including flammable liquids with flash points below 73°F and boiling points at or above 100°F as well as liquids with flash points between 73°F and 100°F. (OSHA Classes IB and IC).

4—Severe Hazard Very flammable gases or very volatile flammable liquids with flash points between 73°F and 100°F (OSHA Class IA).

### REACTIVITY

0—Minimal Hazard Materials which are normally stable, even under fire conditions, and which will not react with water.

1—Slight Hazard Materials which are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy violently.

2—Moderate Hazard Materials which in themselves are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water.

3—Serious Hazard Materials which are readily capable of detonation or explosive decomposition or reaction but which require a strong initiation source or which must be heated under confinement before initiation. These materials may react explosively with water without requiring heat or confinement.

4—Severe Hazard Materials which are readily capable of detonation or explosive decomposition or explosive reaction at normal temperature and pressure.

### PERSONAL PROTECTION (Indicated by letter designation)

A. Safety Glasses

B. Safety Glasses, Gloves

C. Safety Glasses, Gloves, Apron

D. Face Shield, Gloves, Apron

E. Safety Glasses, Gloves, Dust Respirator, Apron

F. Splash Goggles, Gloves, Apron, Vapor Respirator

G. Splash Goggles, Gloves, Vapor and Dust Respirator, Apron

H. Gloves, Air Line Hood or Mask, Full Suit, Boots

X. Use only with direct supervision. Standard operating procedures must be developed to handle these very hazardous chemicals.



## GLOSSARY OF TERMS USED ON THE MSDS

The following terms have the meanings defined herein for the development and preparation of an MSDS. For additional identification and definition of hazards, refer to the regulations cited in the definition.

**Acute**—A short-term period of action measured in seconds, minutes, hours or days.

**Acute Effects of Overexposure**—The adverse effects that normally are evident immediately or shortly after the exposure to a hazardous material without implying a degree of severity.

**Asphyxiant**—A vapor or gas that can cause injury by reducing the amount of oxygen available for breathing.

**Carcinogen**—A chemical which has been demonstrated to cause cancer in humans, or to cause cancer in animals, and, therefore, is considered capable of causing cancer in humans. A chemical is considered to be a carcinogen if:

1. it has been evaluated by the Internal Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen;
2. 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
3. it is regulated by OSHA as a carcinogen.

**Chronic**—A long-term period of action in weeks, months or years.

**Chronic Effects of Overexposure**—The adverse effects that develop slowly over a long period of time or upon repeated prolonged exposure to a hazardous material without implying a degree of severity.

**Combustible Liquid**—A liquid having a flash point at or above 100°F (37.8°C) but below 200°F (93.3°C), except that this term does not include any liquid mixture that has one or more components with a flash point above 200°F (93.3°C) which make up 99% or more of the total volume of the mixture. (For test method, see definition of "Flash Point.") 1910.106(a)(18); 49 CFR 173.115(b).

**Compressed Gas**—(1) a gas or mixture of gases having in a container an absolute pressure exceeding 40 pounds per square inch (psi) at 70°F (21.1°C); or (2) a gas or mixture of gases having in a container an absolute pressure exceeding 104 psi at 130°F (54.4°C), regardless of the pressure at 70°F (21.1°C); or (3) a flammable liquid having a vapor pressure exceeding 40 psi absolute pressure at 100°F (37.8°C), as determined by the American National Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method) Z11.44-1973 (ASTM D 323-72).

**Corrosive Material**—A chemical liquid or solid that causes visible destruction or irreversible alteration in human skin tissue at the site of contact.

Example: A material is considered to be destructive or to cause irreversible alteration in skin tissue if, when tested on the intact skin of the albino rabbit by the method described in Appendix A of 49 CFR Part 173, the structure of the tissue at the site of contact is destroyed or changed irreversibly after an exposure period of 4 hours or less.

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

**Exposure**—Occurs when an employee is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.), and includes potential (e.g., accidental or possible) exposure.

**Flammable Material**—A chemical substance that falls within any of the following categories:

1. **Flammable Aerosol.** A chemical substance or mixture dispensed from its container as a mist, spray or foam by a propellant under pressure, which, 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 valve opening.
2. **Flammable Gas.** A gas which, at atmospheric temperature and pressure, forms a flammable mixture with air when present at a concentration of 13% or less by volume, or that forms a range of flammable mixtures with air wider than 12%, regardless of lower limit. (See Flammable Aerosol.)
3. **Flammable Liquid.** A liquid having a flash point below 100°F (37.8°C), except that this does not include any liquid mixture having one or more components with a flash point at or above 100°F (37.8°C) which make up 99% or more of the total volume of the mixture. (For test method, see definition of "Flash Point.") 1910.106(a)(19); 49 CFR 173.115(a).
4. **Flammable Solid.** A solid, other than an explosive, that can cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or that can be readily ignited, and when ignited, will continue to burn or be consumed after removal of the source of ignition. 49 CFR 173.150.

**Flash Point**—The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows: 1910.106(a)(14); 49 CFR 173.115(d).

1. **Tagliabue Closed Tester** (see American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24-1979 (ASTM D 56-77)). For liquids with a viscosity of less than 45 Saybolt University Seconds (SUS) at 100°F (37.8°C), that do not contain suspended solids,

or that have a tendency to form a surface film under test;

2. **Pensky-Martens Closed Tester** (see American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D93-79)). For liquids with a viscosity equal to or greater than 45 SUS at 100°F (37.8°C), or that contain suspended solids, or that have a tendency to form a surface film under test; or
3. **Setaflash Closed Tester** (see American National Standard Method of Test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)). NOTE: For mixtures, if the result of any test method is above 100°F (37.8°C), a fresh sample shall be evaporated to 90% of the original volume and retested. The lower of the two values shall be taken as the flash point.

**Foreseeable Emergency**—Any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace.

**Hazardous Chemical Substance or Mixture**—A substance that is one or more of the following: an extremely toxic material, a highly toxic material, a toxic material, a corrosive material, an irritant, a strong sensitizer, a dangerously reactive material, an extremely flammable material, a combustible liquid, a pyrophoric material, a strong oxidizer, a pressure-generating material or a compressed gas.

**Health Hazard**—A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term health hazard includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes or mucous membranes.

**Highly Toxic**—A chemical falling within any of the following categories:

1. A chemical that has a median lethal dose (LD<sub>50</sub>) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose (LD<sub>50</sub>) 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 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration (LD<sub>50</sub>) 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.

**Irritant**—A chemical substance or mixture other than a corrosive which on immediate, prolonged or repeated contact with normal living tissues induces a local inflammatory response in the skin, eyes or mucous membranes. 16 CFR 1500.41.

**Median Lethal Concentration LC<sub>50</sub>**—The concentration in air of gas, vapor, mist, fume or dust for a given period of time that is most likely to kill one-half of a group of test animals using a specified test procedure. Inhalation is the route of exposure, and the value LC<sub>50</sub> is usually expressed as parts per million or milligrams per cubic meter (ppm or mg/m<sup>3</sup>).

**Median Lethal Dose LD<sub>50</sub>**—The dosage of a substance or mixture that is most likely to kill one-half of a group of test animals using a specified test procedure. The dose is expressed as the amount per unit of body weight, the most common expression being milligrams of material per kilogram of body weight (mg/kg of body weight). Usually refers to oral or skin exposure.

**LEL (Lower Explosive Limit)**—The lowest concentration of gas or vapor (% by volume in air) which will burn or explode if an ignition source is present.

**Material Safety Data Sheet (MSDS)**—A document that contains information and instructions on the chemical and physical characteristics of a substance, its hazards and risks, the safe handling requirements and actions to be taken in the event of fire, spill, overexposure, etc.

**Mutagen**—Those chemicals or physical effects which can alter genetic material in an organism and result in physical or functional changes in all subsequent generations.

**Oxidizer**—A chemical other than a blasting agent or explosive that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

**Physical Hazard**—A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, organic peroxide, oxidizer, pyrophoric, unstable (reactive) or water-reactive.

**Pyrophoric Material**—A chemical substance or mixture that will ignite spontaneously in dry or moist air at or below 130°F (54.4°C).

**Reactive Material**—A chemical substance or mixture that may vigorously polymerize, decompose, condense, or become self-reactive under conditions of shock, pressure or temperature and includes a chemical substance or mixture that falls within any of the following categories:

1. **Explosive Material.** A chemical substance or mixture that causes sudden, almost instantaneous release of pressure, gas and heat when subjected to sudden shock, pressure or high temperature.

2. **Organic Peroxide.** An organic compound that contains the bivalent -O-O- structure which may be considered a structural derivative of hydrogen peroxide, in which one or both of the hydrogen atoms has been replaced by an organic radical.
3. **Pressure-Generating Material.** A chemical substance or mixture which may spontaneously polymerize, with an increase in pressure, unless protected by the addition of an inhibitor, or by refrigeration or other thermal control; may decompose to release gas in its container; or comprises the contents of a self-pressurized container.
4. **Water-Reactive Material.** A chemical substance or mixture that reacts with water to release heat or gas which is flammable, highly toxic or toxic.

**Sensitizer**—A chemical substance or mixture that causes a substantial number of persons to develop an allergic reaction in normal tissue after repeated exposure.

**Strong Oxidizer**—A chemical substance or mixture that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

**Teratogen**—A chemical which has been demonstrated to cause physical defects in the developing embryo.

**Threshold Limit Values (TLV)**—The airborne concentration of the substance which represents conditions under which it is believed nearly all workers may be repeatedly exposed day after day without adverse effects. There are three categories of Threshold Limit Values:

1. **Time-Weighted Average (TWA).** The concentration for a normal eight-hour work day or 40-hour work week to which nearly all workers may be exposed, day after day, without adverse effects.
2. **Short-Term Exposure Limit (STEL).** The maximum concentration to which workers can be exposed for a period up to 15 minutes continuously without suffering from: (1) irritation, (2) chronic or irreversible tissue change or (3) narcosis of sufficient degree to increase accidental injury, impair self-rescue, or materially reduce work efficiency, provided that no more than four excursions per day are permitted, with at least 60 minutes between exposure periods, and provided that the daily TWA also is not exceeded.
3. **Ceiling (C).** The concentration that should not be exceeded even for an instant.

**Toxic**—A chemical falling within any of the following categories:

1. A chemical that has a median lethal dose ( $LD_{50}$ ) 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.
2. A chemical that has a median lethal dose ( $LD_{50}$ ) of more than 200 milligrams per kilogram but not more than 1000 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 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration ( $LC_{50}$ ) in air of more than 200 parts per million but not more than 2000 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.

**Unstable**—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 shock, pressure or temperature.

## REFERENCES

*The information contained in this booklet was obtained from the following references. Check your local, state and federal laws for any changes in Material Safety Data Sheet requirements.*

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"Hazardous Materials Identification System Implementation Manual," National Paint and Coatings Association.

"Material Safety Data Sheets," U.S. Department of Labor, OSHA, 1977.

"Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices," American Conference of Governmental Industrial Hygienists, 1992-1993.

*Information for completing Material Safety Data Sheets may be obtained from the following sources which can be purchased directly from Lab Safety Supply Inc.*

"Code of Federal Regulations, OSHA Safety and Health Standards," 29 CFR 1910.  
Order No. 5033-1 29 CFR 1910.1 to 1910.999  
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"Dangerous Properties of Industrial Materials," Sax, N.I., 4368 pages, 1992.  
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## ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
AQTX	Aquatic Toxicity
atm	Atmosphere
ca	(circa) about
CAR	Carcinogenic effects
cc	Cubic centimeter
CC	Closed Cup
CFR	Code of Federal Regulations
CNS	Central nervous system
COC	Cleveland Open Cup
conc	Concentration
cu m or m <sup>3</sup>	Cubic meter
CWA	Clean Water Act
decomp.	Decompose or decomposition
DOT	Department of Transportation
EPA	Environmental Protection Agency
FR	Federal Register
G.I. or GI	Gastrointestinal
g or gm	Gram
HW	Hazardous waste
I	Intermittent
IARC	International Agency for Research on Cancer
inhl	Inhalation
insol	Insoluble
IRDS	Primary irritation dose
IRR	Irritant effects (systemic)
kg	Kilogram
l	Liter
LEL	Lower explosive limit
LFM	Linear feet per minute
m <sup>3</sup>	Cubic meter
MESA	Mining Enforcement and Safety Administration
mg	Milligram
ml	Milliliter
mm Hg	Millimeters of Mercury
MLD	Mild irritation effects
MSDS	Material Safety Data Sheet
MW	Molecular weight
NEO	Neoplastic effects
NIOSH	National Institute of Occupational Safety and Health
NOx	Oxides of Nitrogen
NTP	National Toxicology Program
OSHA	Occupational Safety & Health Administration

PEL	Permissible Exposure Limit
PMCC	Pensky-Martens Closed Cup
POx	Oxides of Phosphorus
ppb	Parts per billion
pH	Symbol used to express acid concentration
ppm	Parts per million
ppt	Parts per trillion
PUL	Pulmonary systems effects
RCRA	Resources Conservation and Recovery Act
RQ	Reportable Quantity
SCBA	Self-Contained Breathing Apparatus
SCC	Setflash Closed Cup
soln	Solution
SOx	Oxides of Sulfur
SYS	Systemic effects
TCC	Tag Closed Cup
temp	Temperature
TER	Teratogenic effects
TFX	Toxic effects
TLV	Threshold Limit Value
TOC	Tag Open Cup
torr	mm Hg pressure
TSCA	Toxic Substances Control Act
UEL	Upper explosive limit
>	Greater than
<	Less than

## GLOSSARY

Acute	Disease symptoms of high severity quickly coming to a crisis.
Alopecia	Loss of hair.
Analgesia	Loss of sensitivity to pain.
Anesthesia	Loss of sensation or feeling.
Anhydride	A chemical compound derived from an acid by elimination of a molecule of water.
Anhydrous	An inorganic compound that does not contain water either adsorbed on its surface or combined as water of crystallization.
Anosmia	Loss of the sense of smell.
Anoxia	A lack of oxygen from inspired air.
Anorexia	Loss of appetite.
Aqueous	A water-based solution.
Asphyxia	Unconsciousness due to interference with the oxygenation of the blood.
Ataxia	A loss of the power of muscular coordination.
Atrophy	A wasting or diminution in the size of a part of the body.
Bradycardia	A slow heartbeat. Rate below 60.
Bronchitis	Inflammation of the bronchial tubes in the lungs.
Calorie	Heat required to raise 1 gm of water from 15 to 16°C.
Carcinoma	A malignant tumor or cancer.
Catalyst	A substance which changes the rate of a chemical reaction without itself being used up.
Cataract	A loss of transparency of the crystalline lens of the eye or of its capsule.
Chemiluminescence	Emission of light during a noncombustion chemical reaction.
Chronic	Disease symptoms which develop slowly or which recur.
Conjunctivitis	Inflammation of the membranes that line the eyelids and cover the eyeballs.
Comea	Transparent structure of the external layer of the eye.
Cutaneous	Pertaining to the skin.
Cyanosis	Purplish coloration of the skin and the mucous membrane due to
(Cyanotic)	deficient oxygenation of the blood.
Dermatitis	Inflammation of the skin.
Dyspnea	Difficulty in breathing.
Edema	An accumulation of fluid in the tissues.
Electrolyte	Any substance that, in solution, conducts an electric current.
Embolism	Obstruction of a blood vessel by clot, mass of bacteria or other foreign material.

Emphysema . . . . . A swelling due to presence of air in the connective tissues of the lungs.

Epistaxis . . . . . Nosebleed; hemorrhage from the nose.

Gangrene . . . . . Death of tissue combined with putrefaction.

Gastroenteritis . . . . . Inflammation of the stomach and intestines.

Hematuria . . . . . Blood in the urine.

Hygroscopic . . . . . Absorbs moisture from the air.

Hypoxia . . . . . Insufficient oxygen reaching body cells.

Inflammation . . . . . Redness and swelling of tissue due to some irritation.

Ingestion . . . . . The taking in of a substance through the mouth.

Inhibitor . . . . . A chemical used to prevent an unwanted chemical change from occurring.

Iridocyclitis . . . . . Inflammation of both iris and ciliary body.

Isomer . . . . . Chemical compounds which have the same molecular weight and atomic composition, but differ in molecular structure.

Ketosis . . . . . The condition marked by excessive production of ketone bodies in the body.

Lacrimation . . . . . Discharge of tears.

Lavage . . . . . A washing of a hollow organ, such as the stomach.

Malaise . . . . . A feeling of general discomfort, distress or uneasiness.

Metabolism . . . . . The chemical changes whereby the body functions.

Narcosis . . . . . Stupor or unconsciousness produced by a narcotic drug.

Nausea . . . . . Feeling of sickness to the stomach.

Necrosis . . . . . Local death of tissue.

Nystagmus . . . . . Spasmodic, involuntary motion of the eyeballs.

Oliguria . . . . . Low volume of urine.

Oxidizing Agent . . . . . A chemical which supplies oxygen in a chemical reaction.

Polymerization . . . . . Chemical reaction in which two or more small molecules combine to form larger molecules.

Pulmonary Edema . . . . . Fluid in the lungs.

Pyrolysis . . . . . A chemical decomposition produced by heating.

Reactivity . . . . . A measure of the tendency of a substance to undergo chemical reaction with the release of energy.

Reducing Agent . . . . . A chemical which absorbs oxygen in a chemical reaction.

Sensitization . . . . . An allergic response reaction. A person previously exposed to a certain material is more sensitive when further contact with this material is encountered.

Solubility . . . . . A measure of the amount of the substance that will dissolve in a given amount of water or other substance.

Spasm . . . . . An involuntary, convulsive, muscular contraction.

Spontaneous Heating . . . . . An increase in temperature of a substance due to a chemical or physical change without the application of external heat.

Stability . . . . . A measure of the ability of a substance to be handled and stored without undergoing unwanted chemical changes.

Stupor . . . . . Partial or nearly complete unconsciousness.

Tachycardia . . . . . Excessively rapid heartbeat. Pulse rate above 100.

Thermal Decomposition . . . . . Chemical breakdown of a material due to exposure to heat.

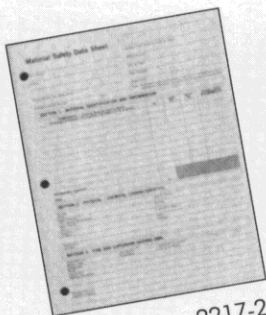
Tinnitus . . . . . A ringing or singing sound in the ears.

Toxicity . . . . . The measure of the adverse effect exerted on the human body by a poisonous material.

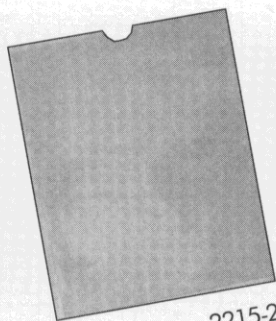
Urticaria . . . . . Nettle-rash; hives; elevated, itching white patches.

Vertigo . . . . . A feeling of revolving in space; dizziness, giddiness.

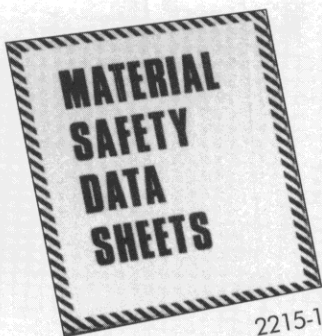
Viscosity . . . . . Measurement of the flow properties of a material.



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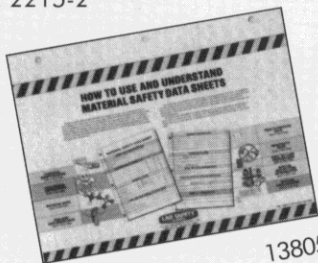
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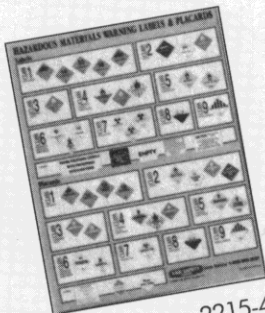
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