



INTRODUCTION TO MATERIAL SAFETY DATA SHEETS (MSDS)

An understanding on how to interpret an MSDS is your best defense against accidents and injury. On the following pages are descriptions of the sections contained in an MSDS, and short notes that will help you find and interpret the information the Occupational Safety and Health Administration (OSHA) requires on a typical good-quality sheet.

There is no single mandatory format for the MSDS. Therefore each MSDS may look a little different, but all will provide, *at a minimum*, the required information as mandated by OSHA I S Hazard Communication Standard. Variety will occur in the section titles, and contents of sections. Some manufacturers may be more explicit with their information than others.

I. CHEMICAL IDENTIFICATION

This section, (also denoted as Product Information or Material Identification) identifies the chemical or trade name product on the label, and its supplier. The manufacturers name, address, telephone number, and emergency telephone number will be located here. This section may also contain descriptive terms to further help identify the material, such as chemical family, molecular weight; and chemical formula. The material identity, including its chemical, common names and synonyms will be found in this section. For example, brand name or trade name: Clorox; chemical name: sodium hypochlorite; common name: bleach.

II. COMPONENTS OR INGREDIENTS

Chemical names and percentages of the chemicals that comprise the product will be identified in this section. Some manufacturers *may* only list those components that present a physical or health hazard and are present at or above *11to* in the mixture. If a component is identified *as a* carcinogen by the National Toxicology Program (NT), the International Agency for Research on Cancer (IARC), or by OSHA, it will generally be noted here, or footnoted in this section, when present at or above 0.1% in the product. Some manufacturers use a separate section for noting carcinogenicity, or may include this status in the "Health Hazard" section. The only time you won't find the identity of a chemical component listed here is when the company has claimed it as *a* trade secret. The MSDS will still describe hazards and safety precautions of the trade secret chemicals.

III. PHYSICAL AND CHEMICAL DATA

This section describes the product appearance, odor, and other physical and chemical characteristics. Some of the following items may be applicable to the



material:

Boiling Point (BP): The boiling point is the temperature at which a liquid turns into a vapor. Flammable materials with low BPs generally present fire hazards. In the case of a chemical mixture, the manufacturer may either list the BP value as a range of temperatures or that of the component with the lowest value.

Melting Point:

The melting point is the temperature at which a solid changes to a liquid. Boiling Point and Melting Points are helpful in preventing dangerous changes in state, such as from a liquid to a breathable gas.

Vapor Pressure:

Vapor pressures are useful in learning how quickly a material becomes airborne within the workplace and thus how quickly a worker is exposed to it. Vapor pressures reported on MSDS are *in* millimeters of mercury (mm Hg) at 68° F (20° C), unless otherwise stated. In the case of a chemical mixture, the manufacturer may list the value as a range or that of the component with the highest value. For example: values less than 1.0mmHg at 20°C would be considered "non-volatile" and above 100 would be considered "highly volatile".

Vapor Density:

The vapor density is compared to air which equals 1. Materials lighter than air have vapor densities less than one. Materials heavier than air have vapor densities greater than one. All vapors and gases mix with air, but the lighter materials tend to rise and dissipate (unless confined). Heavier vapors and gases are likely to concentrate in low or enclosed places, and may create toxic, fire or explosion hazards.

Evaporation Rate:

The evaporation rate is the rate at which a material vaporizes from the liquid or solid state when compared to a known material's vaporization rate. This rate is useful in evaluating a material's health and fire hazards.

Specific Gravity:

The specific gravity is an expression of the density (or heaviness) of a material as compared to water =1. Insoluble materials with specific gravity of greater than one will sink in water. Insoluble materials with a specific gravity less than one will float on water, which is an important consideration for fire suppression and spill cleanup.



Water Solubility:

Water solubility expresses the percentage of a material that will dissolve in water. Water solubility is useful in determining cleanup methods for spills and fire extinguishing methods for a material.

pH: The pH value represents a scale from 0-14 that describes the acidity or alkalinity of a material. Water has a pH of 7. pH is an important consideration when determining corrosive properties. Materials on the low end of the scale will be more acidic, materials on the high end of the scale will be more alkaline or caustic.

- pH 1-5 - strongly acidic (For comparison Coke & Pepsi have a pH of around 3.4)
- pH 5-7 - weakly acidic
- pH 7-9 - weakly basic/caustic
- pH 9-14 - strongly basic /caustic

Appearance and Odor:

Appearance and odor refer to the general characteristics of the material, e.g. powder, colorless liquid, aromatic odor. The visual appearance of a product is also useful as an aid in verifying the product and that it is correctly labeled.

IV. PHYSICAL HAZARDS

This section gives potential flammability and explosion hazards, recommended procedures in handling these hazards, and storage considerations. This section also contains reactivity data. Many manufacturers divide the physical hazards category into two sections, the "Fire and Explosion Data" and "Reactivity Data"

A. FIRE AND EXPLOSION DATA

Flash Point:

The flash point is defined by the National Fire Protection Association (NFPA) as the lowest temperature at which a flammable liquid gives off sufficient vapor to form an ignitable mixture with air near its surface or within a vessel. Special precautions should be taken when the product has a low flash point. Materials having a low flash point are a greater fire hazard than materials having a high flash point.

Flammable Limits (Explosive Limits):

Flammable limits refer to the range of flammable gas or vapor concentrations between which ignitions will occur if an ignition source is present. LFL (or LEL) is the lower flammable limit. UFL (or UEL) is the upper flammable limit. All



concentrations between LFL and UFL are in the flammable range, and special precautions are needed to prevent ignition or explosion.

Ignition Temperature:

The ignition temperature is the lowest temperature at which a combustible material ignites in air and continues to burn independently of the source of heat.

Autoignition Temperature:

Autoignition temperature describes the minimum temperature to which a substance must be heated, without the application of a flame or spark, which will cause that substance to ignite.

Hazardous Decomposition Products:

This area will describe the known or expected hazardous products resulting from heating, burning, or other reactions.

Extinguishing Media:

Extinguishing media specifies the firefighting agents that should be used to extinguish fires. Some chemicals react violently in the presence of water, so other methods, such as the use of foam or CO₂ (carbon dioxide) should be followed.

Firefighting Equipment:

This will describe equipment used to protect firefighters from toxic products of vaporization, combustion, or decomposition in fire situations.

Firefighting Methods:

If unusual fire hazards are involved or special firefighting procedures mandated, this will be specified here.

NFPA Codes:

Fire Diamond - National Fire Protection Association -NFPA Hazard Rating. Per uNFPA 704" publication. A visual system, as illustrated on the following pages, that provides a general idea of the inherent hazards, and their severity, of materials relating to fire prevention exposure, and control. The NFPA fire diamond is read in the preferred order; (A) Health, (B) Flammability. (C) Reactivity, (D) Special.

Position A - Health Hazard (Blue).

DEGREE OF HAZARD; LEVEL OF SHORT TERM PROTECTION

0 : Ordinary Combustible Hazards in a Fire



Exposure to materials under fire, conditions will offer no hazard beyond that of ordinary combustible material.

1: Slightly Hazardous

Exposure to material will cause irritation but only minor residual injury even if no treatment is given.

2: Hazardous

Intense or continued exposure to material can cause temporary incapacitation or possible, residual injury unless prompt medical treatment is given.

3: Extreme Danger

Short exposure to material can cause serious temporary or residual injury even *if* prompt medical treatment is given.

4: Deadly

Very short exposure to material can cause death or major residual injury even if prompt medical treatment is given.

Position B - Flammability (Red).

SUSCEPTIBILITY TO BURNING

0: Will Not Burn Material that will not burn.

1: Will Ignite if Preheated Flash point above 200°F. Material that must be preheated before ignition can occur.

2: Will Ignite if Moderately Heated Flash point below 200°F. Material that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.

3: Will Ignite at Most Ambient Conditions

Flash point below 70°F. A liquid or solid can be ignited under almost all ambient temperature conditions.

4: Burns Readily at Ambient Conditions Flash point below 73°F. Material will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature. or will burn readily when dispersed in air.

Position C - Reactivity~ Instability (Yellow),

**ENERGY RELEASED IF BURNED, DECOMPOSED,
OR MIXED**

0: Stable and Not Reactive with Water Material is normally stable, even under fire exposure conditions, and is not reactive with water.

1: Unstable if Heated Material is normally stable, but can become unstable at elevated temperatures and pressures or may react with water with some release of energy but not violently.

2: Violent Chemical Change Material is normally unstable and readily undergoes violent chemical change but does not detonate. Also may react violently with water or may form potentially explosive mixtures with water.



3: Shock and Heat May Detonate Material is capable of detonation or explosive reaction but requires a strong initiating source; or which must be heated under confinement before initiation; or may react explosively with water.

4: May Detonate Material is readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.

Position D - Special Hazard (White).

O = Oxidizer

ACID = Acid

ALKALI = Alkali

COR = Corrosive

-W- = Use No Water, reacts!

B. REACTIVITY DATA:

This area will describe chemical incompatibilities and whether or not the substance is stable. This section is important in determining which situations and substances to keep the product away from to avoid unfavorable conditions.

Chemical Incompatibilities:

This section will list the chemicals that might cause the product to burn, explode, release dangerous byproducts or otherwise "react" unfavorably, when they come in contact with the product.

Chemical Instabilities:

This section will describe environmental conditions to avoid, such as heat or direct sunlight, to prevent hazardous reactions.

Hazardous Polymerization:

This area will tell you if the material will polymerize, or react with itself. Hazardous polymerization is a reaction which takes place at a rate which produces rapid buildup of large amounts of energy (heat and pressure) that can lead to explosion. This section indicates whether hazardous polymerization may or may not occur, and under what storage conditions.

V. HEALTH HAZARDS

Manufacturers provide data on health hazards under a variety of section titles, including health effects, and first aid procedures. At Q minimum this information should include corrosion information regarding signs and symptoms of overexposure, primary routes of entry, first aid and emergency procedures, as well as medical conditions aggravated by overexposure.



Exposure Recommendations:

Exposure recommendations may be listed here or under the "Components or Ingredients" section. These recommendations are descriptors establishing the concentration of the chemical to which you can be safely exposed. They are often listed as permissible exposure limit (PEL) or threshold limit value (TLV).

PEL:

Permissible exposure limit is a term established by OSHA that may be expressed as a Time Weighted Average (TWA) or as a ceiling exposure limit. The PEL indicates the permissible concentration of oil" contaminants to which nearly all workers may be repeatedly exposed eight hours a day forty hours a week, over a working lifetime (30 years) without adverse health effects.

TLV.

Threshold Limit Value is a term used by ACGIH to express airborne concentration of a material to which almost all workers can be exposed without adverse effects. ACGIH expressed TLVs in three ways:

TLV-TWA: The allowable Time-weighted Average concentration for a normal 8hour workday or 40-hour work week.

TLV-STEL: The Short-Term Exposure Limit, or maximum concentration for a continuous 15-minute exposure period (maximum of four such periods per day, with at least 60 minutes between exposure periods, and provided the daily TLV-TWA is not exceeded).

TLV-C: The ceiling exposure limit-the concentration that should not be exceeded even instantaneously.

Emergency and First Aid Procedures:

This section will describe how to administer first aid and emergency procedures in case of eye and skin contact, ingestion, and inhalation.

Primary Routes of Entry:

The MSDS will explain the most likely route of exposure and entry into your body based on properties and expected usages of the chemical or trade name product. This may include, inhaling, swallowing, or absorption through your skin.

Acute and chronic health effects:

These sections will explain what signs and symptoms to watch out for, e.g. headache, dizziness, nausea, or rashes.



Acute health effects or acute exposure is an adverse effect due to a single or short-term overexposure, with symptoms developing rapidly. It refers to the most common effects that would be expected to occur from direct contact (eye, skin inhalation, or ingestion) of the product. OSHA's definition of highly toxic and toxic are included on the following page:

A highly toxic; substance is one having:

1. An oral LD₅₀ of 50 mg/kg or less.
2. A dermal LD₅₀ of 200 mg/kg or less.
3. An inhalation LC₅₀ of 200 ppm or less of gas or vapor: or 2 mg/l or less of mist, fume or dust.

A toxic substance is one having:

1. An oral LD₅₀ between 50 and 500 mg/kg.
2. A dermal LD₅₀ between 200 and 1000 mg/kg.
3. An inhalation LC₅₀ between 200 ppm. 2000 ppm of gas or vapors, or between end 20 mg/l of mist fume or dust.

Chronic health effects or chronic exposure refer to the adverse effects that are most likely to occur from repeated, prolonged or long term exposure. It describes symptoms that develop over a long period of time, or that recur frequently.

LC₅₀ Lethal Concentration 50, or median lethal concentration:

The concentration of a material in air that on the basis of laboratory tests (respiratory route) is expected to kill 50% of a group of test animals when administered as a single exposure in a specific time period, usually one hour. The LC₅₀ is expressed as parts of material per million parts of air, by volume (ppm) for gases and vapors, as micrograms of material per liter of air (ug/l), or milligrams of material per cubic meter of air (mg/m³) for dusts and mists, as well as for gases and vapors.

LC low Lethal Concentration Low:

The lowest concentration of a substance in air reported to have caused death in humans or animals. The reported concentrations may be entered for periods of exposure that are less than 24 hours (acute) or greater than 24 hours (subacute and chronic).

LD₅₀ Lethal Dose 50:

The single dose of a substance that causes the death of 50% of an animal population from exposure to the substance by any route other than inhalation. Other lethal-dose percentages, such as LD₁, LD₁₀, LD₃₀, and LD₉₉ may be in



the scientific literature. LD₅₀ is usually expressed as milligrams or grams of material per kilogram of animal weight (mg/kg or g/kg).

LDLo Lethal Dose Low:

The lowest dose of a substance introduced by any route other than inhalation, reported to have caused death in humans or animals.

HMIS Codes:

The Hazardous Materials Identification System, HMIS, was developed by the National Paint & Coatings Association (NPCA) to help employers comply with OSHA I S Hazard Communication (HCS). 29 CFR 1910.1200

The system utilizes colored bars, numbers and symbols to convey the hazards of chemicals used in the workplace.

Do not confuse HMIS® labels (colored bars) with NFPA labels (colored diamonds). The two systems are similar but not identical.

Health (BLUE)

The Health section conveys the health hazards of the material. In the latest version of HMIS®, the blue Health bar has two spaces, one for an asterisk and one for a numeric hazard rating. If present, the asterisk signifies a chronic health hazard, meaning that long-term exposure to the material could cause a health problem such as emphysema or kidney damage. NFPA lacks this important information because the NFPA system is meant only for emergency or acute (short-term) exposures.

According to NPCA, the numeric hazard assessment procedure is different than that used by NFPA. However, there was no publicly available information explaining the differences. On a qualitative level, the numbering systems are more or less identical with a 0 to 4 scale where 0 indicates minimal hazard and 4 indicates an extreme hazard.

Flammability (RED)

According to the NPCA, the criteria used to assign numeric values (Below hazard to 4=high hazard) are identical to those used by NFP. In other words, in this category, the systems are identical.

Reactivity (YELLOW)

According to the NPCA, the criteria used to assign numeric values (0=low hazard to 4=high hazard) are identical to those used by NFPA. In other words, in this category, the systems are identical.



Personal Protection (WHITE)

This is by far the largest area of difference between the NFPA and HMIS@ systems. In the NFPA system, the white area is used to convey special hazards whereas HMIS® uses the white section to indicate what personal protective equipment (PPE) should be used when working with the material.

VI. SPILL OR LEAK PROCEDURES

This section will describe precautions and actions to be taken in the event of a spill or leak and methods of clean-up and disposal.

VII. PROCEDURES AND PRECAUTIONS FOR SAFE HANDLING, STORAGE AND USE:

This section may alternatively be titled Special Protection, Personal Protective Equipment, or Safe Handling and Storage Requirements. This area of the MSDS contains control measures such as personal protective equipment recommendations, engineering controls and work practices that are necessary for the safe handling and use of the product. If protective equipment is needed, this section will list the specific types that are recommended, such as respirators, gloves, and goggles. Specific steps and precautions to take to safeguard your health, such as proper ventilation requirements, also are described here.

Ventilation is described using two terms; local or general. Local ventilation refers an exhaust duct system with a hood or' enclosure. General ventilation refers to a dilution fan in the wall or ceiling. Storage and handling requirements addressed in this section may include such things as grounding containers during a transfer of flammables to prevent static electricity as an ignition source.

VIII. SPECIAL. PRECAUTIONS OR OTHER COMMENTS:

The manufacturer may describe special precautions if there is something other than standard information the user should be aware of. Regulatory compliance issues such as Department of Transportation (DOT) policies for handling and transportation, or Resource Conservation and Recovery Act (RCRA) classification for proper disposal may also be addressed here.