

## HOW TO READ AND UNDERSTAND A MATERIAL SAFETY DATA SHEET

An example MSDS is attached. This sample will be referred to in the following discussion. Some MSDSs may not be as complete or accurate as the example. If you have questions on a particular MSDS, you should contact your DTI or Radiological & Environmental Management.

### GUIDELINES FOR READING AND UNDERSTANDING AN MSDS

Not all Material Safety Data Sheets will contain all of the information discussed in this article and the information will vary depending upon the degree to which the material is hazardous. This will give you an idea of the kind of information you should expect to find when you read an MSDS. The MSDS for ethyl alcohol is attached as the example MSDS.

An MSDS should have no blanks. N/As may be used if the information is “not applicable” or “not available”. By cross checking the information in various sections, you can determine what you need to know about the hazards of the material.

#### I. 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 on 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 II.

#### II. HAZARDOUS INGREDIENTS

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

- (i) 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances;
- (ii) Threshold Limit Values for Substances and Physical Agents in the Work Environment, American Conferences of Government Industrial Hygienists (ACGIH, latest edition).

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

Toxic hazard data should be stated in terms of concentration, mode of exposure or text, and animal used; i.e., 100 ppm LC<sub>50</sub> (lethal concentration) rat, 25 mg/M<sup>3</sup> LD<sub>50</sub> (lethal dose) oral mouse or permissible exposure limit from published sources such as:

- (i) National Toxicology Program (NTP), Annual Report on Carcinogens (latest edition);
- (ii) International Agency for Research on Cancer (IARC), Monographs (latest edition);
- (iii) National Institute for Occupational Safety and Health (NIOSH), The Registry of Toxic Effects of Chemical Substances. Note: This publication indicates whether a chemical has been found by NTP or IARC to be a potential carcinogen.

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

If the concentration of material in the mixture is 1% or greater and/or has a TLV (Threshold Limit Value) or a PEL (Permissible Exposure Limit), check it against:

1. Section III - Physical Hazard Data. All of this section should be filled in if the substance is a solvent, catalyst, or vehicle.
2. Section IV - Fire and Explosion Data. All of this section should be filled in with either numbers or procedures if the substance is either a solvent, catalyst, vehicle, oxidizer, or explosive metal.
3. Section V - Health Hazard Information. If a substance has a TLV, it most likely presents a health hazard. Be sure the "effects of overexposure" line lists both the long term (chronic) and the short term (acute) consequences of exposure. This is especially true for substances that have some sort of toxic rating, such as LD<sub>50</sub>, either in Section I or Section II.
4. Section VI- Reactivity Data. This section should be filled out if the substance is a catalyst, a polymer, a copolymer, a concentrated acid, base or other reactive substance. Also, a chemical may be incompatible with some other substances. The other substances should be listed on the "incompatibility" line.
5. Section VII - Spill, Leak, and Disposal Procedures. Procedures to follow in the event of a spill or leak should be outlined in this section.
6. Section VIII - Special Protection. If the substance has a TLV, this section should always have some information in it no matter what kind of substance it is because it will either pose a breathing hazard or a skin or eye hazard. This section must give information on protection against any or all of these kinds of exposures.
7. Section IX - Special Precautions. If the substance is flammable, highly reactive, corrosive, explosive, or has some other dangerous properties, this section must have information on special handling and storage.

### **III. 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 alarmed 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** is a measure of the pressure exerted by a saturated vapor above its liquid phase in a closed container. A high vapor pressure indicates that a liquid will evaporate easily.

**VOLATILE** is used to describe a liquid that evaporates easily. This is important to know because 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 with poor air circulation. Vapor pressures are measured in torr units or millimeters of mercury (mm Hg) at a certain temperature. Xylene with a vapor pressure of 10 mm Hg at 27-32°C and toluene with a vapor pressure of 36 mm Hg at 30°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 concentrations 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 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 which 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; if it 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 which evaporates very quickly or to butyl acetate which 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 slowly 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.

Make these checks. The boiling point, vapor pressure, % volatile, and evaporation rate are all characteristics of a substance which gives off vapor 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°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 II. 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 greater and therefore more hazardous.
2. Check Section IV 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 flash point of less than 140° F and low LEL (less than 2%) can be a dangerous fire hazard, especially if the % volatile is also high.
3. Check Section V, "effects of overexposure", to see if breathing the vapors of the substance can be harmful.
4. Check Section VIII, "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 IX Special Precautions, especially if the substance has a vapor density that is heavier than air.

#### IV. FIRE AND EXPLOSION DATA

If you are 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, that should be stated in this section.

Some terms you need to know are:

**FLASH POINT** is the lowest temperature at which a liquid gives off enough vapor to make an ignitable

**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 III. 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. Otherwise this line must always be filled out.

**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 II to see if the material is a catalyst, and check Section VI for reactivity with water and polymerization in water or air.

## V. 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. Sections II - A mixture may be unstable if the ingredients include catalysts and vehicles, peroxides, explosives, and other unstable or highly reactive substances.
2. Section IV - Are there unusual fire and explosive hazards?
3. Section IX - 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 listed here. Conditions to avoid should also be listed. Sections IV and IX may contain information on incompatibility not listed in Section VI.

**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 IV for fire and explosion hazards regarding these chemicals.

## VI. 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<sub>50</sub> might be used.

**ROUTES OF EXPOSURE** lists common effects of exposure to the chemical. Chronic and acute effects should be listed. Information on carcinogenicity, teratogenicity, or mutagenicity may also be provided. The basis for the information might be animal studies, analogy to similar products, or human exposure.

Typical comments might be:

skin contact, single short contact - no 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 II 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 which cause drowsiness and unconsciousness. Check Sections I and VI for this information.

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

Section III - 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 VII - 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 VIII should list proper protective equipment (gloves, eyes, 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 or individuals trained in first aid.

Any substance with a TLV should have emergency first aid procedures listed for acute exposure, especially if the material has a low TLV. Check Section IV 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 preplacement and periodic medical examinations, diagnostic procedures, and medical management of overexposed employees.

## VII. 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 II 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 III for volatility and vapor pressure. A high vapor pressure indicates a greater volatility and a greater hazard.
3. Check Section IV for fire and explosive data (combustible and flammable?).
4. Check Section V for health data (inhalation hazard? skin contact hazard?).
5. Check Section VI for reactivity (incompatibility? hazardous polymerization? unstable?).
6. Check Section VIII for information on personal protective equipment.

For example, if a material has a low TLV, is highly volatile, and flammable 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 cleanup procedures or media (such as water).

**WASTE DISPOSAL METHODS:** If labeling and special handling of cleanup residue is necessary, that should be stated along with the appropriate method of disposal, for instance, sanitary landfill, incineration, etc.

1. Check Section III. If hazardous materials are listed, there should be specific procedures for waste disposal.
2. Check Section IV, VI, and IX to make sure that the waste disposal method doesn't create another problem.

## VIII. SPECIAL PROTECTION INFORMATION

### RESPIRATORY PROTECTION:

1. Check Section V to see if inhalation is a probable means of exposure.
2. Check Section III 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:**

1. Check Sections II, III, and V, 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 II for TLV of substance and Section V to determine if the skin is a primary route of exposure.
2. If gloves are recommended, the type should be specified. Check Section I for chemical family to make sure proper gloves are being recommended. A separate chart may need to be consulted for this information.

### **EYE PROTECTION:**

1. Check Section V 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.

## **IX. 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 which has not been covered in other sections of the MSDS.

1. Check Section III for volatility, Section IV for flash point and flammability, Section V for exposures, and Section VI for reactivity. If all of them are left blank or filled with N/A, but Section IX 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.

References to published guides or procedures for more specific information for identification, handling or storage of the product might be listed here. Other information such as Department of Transportation markings and classification and other freight, handling or storage requirements and environmental control procedures might be listed here.

It is essential that the name and address of the responsible person who prepared the MSDS and the date the information was compiled be included in the MSDS so that you can contact that person for additional information if necessary.