Reading Safety Data Sheets

The Hazard Communication Standard (HCS) of the U.S. Occupational Safety and Health Administration (OSHA) requires companies that manufacture or distribute hazardous chemicals to provide Safety Data Sheets (SDSs)* to their customers. An SDS was formerly known as a Material Safety Data Sheet (MSDS). The SDS provides a wealth of information on such things as the various names used for a chemical, procedures for safe handling and storage, exposure risks, appropriate personal protective equipment (PPE), exposure limits, and emergency response measures.

An SDS has 16 major sections. This document explains the organization of and information provided by an SDS. Emphasis is placed on those sections that are usually most helpful and other sections that may be difficult to interpret. The goal is to help a chemical engineer working in an MIT laboratory glean as much information as possible from an SDS.

Sections 1 – 3 What is the material and what are its characteristics

The first three sections provide the identification of the chemical or material and its provider, the composition, and a summary of the hazards associated with the chemicals.

Sections 1 and 2 - Chemical name, alternative names, and the CAS#

The CAS# is the unique identifier of each chemical so make sure that the CAS#s in the SDS agree with those on the bottle or container you have.

Section 3 - Perhaps the most important section

Visual appearance and odor, if any

Summary of significant concerns when using the material, including flammability, reactivity, adverse health effects, and storage requirements

Many of these topics are discussed more fully in subsequent sections.

Sections 4 – 6 What to do if a hazardous situation occurs

Section 4 - Immediate first aid measures in case of an incident with a hazardous chemical.

More information on reactivity and stability of the chemical can be found in Section 10. Always follow up first aid with professional medical care as soon as possible. It is wise to send a copy of the SDS with the victim to the hospital emergency room.

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* The Hazard Communication Standard (HCS) of OSHA has been modified to conform to the United Nations' Globally Harmonized System (GHS)of Classification and Labeling of Chemicals. These modifications have resulted in the renaming of MSDS to SDS with a specified format and redefinition of terms.

Section 5 – Volatility, flammability, and reactivity (reactivity is discussed in more detail in **Section 10**) of the chemical material including any explosion hazards should the material come in contact with other materials and chemicals

Although the information in this section is meant primarily for firefighters the data presented are necessary for designing and running experiments safely.

Liquids chemicals are divided into Class I (Flammable) and Class II and III (Combustible) depending on their flash point. The flash point is the lowest temperature at which there is enough vapor such that a flame will form in the presence of an ignition source. See Table 1 for the specific definitions of each of the subcategories of flammable and combustible liquids.

Table 1. Definitions of Flammable and Combustible Liquids

Flammable Liquids (Class I) - Liquids having a flash point below 100 °F (37 °C) and a vapor pressure less than or equal to 40 psi at 100 °F

Class	Flash Point (FP)and Boiling Point (BP)
IA	FP below 73 °F and BP below 100 °F
IB	FP below 73 °F and BP at or above 100 °F
IC	FP at or above 73 °F and below 100 °F

Combustible Liquids (Class II and III) - Liquids having a flash point at or above 100 °F

Class	Flash Points
II	FP at or above 100 °F and below 140 °F
IIIA	FP at or above 140 °F and below 200 °F
IIIB	FP at or above 200 °F

Work with liquid chemicals having low flash and boiling points should be done in a hood and away from all possible ignition sources. It is easy to build up toxic and combustible concentrations of these chemicals in air.

Section 5 also provides the fire point, the auto ignition temperature (AIT), the lower flammability limit (LFL) and upper flammability limit (UFL).

Fire point – Temperature at which the material will burn for five or more seconds once ignited.

AIT - Lowest temperature at which the material will self-ignite in the presence of air. The AIT of a compound will be lower in the presence of stronger oxidizers than air.

LFL - Lowest concentration, measured as volume percent, in air at room temperature that can be ignited.

UFL - Maximum concentration, measured in volume percent, in air at room temperature that can be ignited.

The LFL and UFL are also referred to as the lower explosion limit (LEL) and upper explosion limit (UEL), respectively.

The National Fire Protection Association (NFPA) diamond (See Figure 1) may appear in **Section 5**. Alternatively, the diamond may appear at the top of the first page of the SDS. The diamond displays the health and fire hazards and reactivity in colored squares with specific hazards in a white square. Each of the colored squares has a number from 0 (very low hazard) to four (high hazard) and the white square has abbreviations for the specific hazard involved.

Section 6 - How to clean up a spill.

Always err on the side of caution. Additional pertinent information on spills appears in **Sections 8** to **13**.

Sections 7 – 11 How to prevent a hazardous situation from occurring

Section 7 - Special precautions for handling and storing the material.

Items include temperature sensitivity, flammability, compatibility with other chemicals, UV sensitivity, and toxicity.

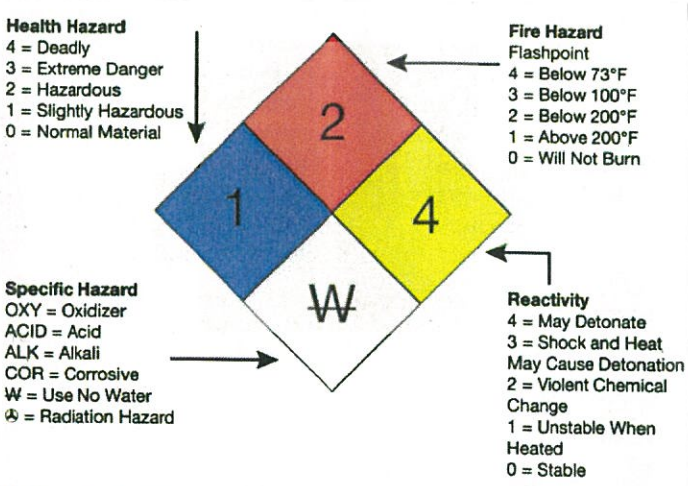
Section 8 - Ways to control and limit exposure to the material

Methods to keep airborne concentration low, the need for eyewash stations and safety showers, suggested personal protective equipment (PPE), and exposure limits are given in this section. When selecting protective equipment make sure that the type you choose is suitable for the chemical or material you are using.

The exposure limits given in **Section 8** use several common abbreviations: TWA, PEL, and TLV and the recommended limits are often given for different countries and organizations (OSHA, NIOSH, and ACGIH). Exposure limits are commonly given in parts per million by volume (ppm) or mg/m^3.

The definitions of the abbreviations used above are, as follows:

TWA	Time-Weighted Average: The average exposure over the course of eight hours
PEL	Permissible Exposure Limit: The maximum amount or concentration of a chemical to which a person can be exposed under OSHA regulations
TLV	Threshold Limit Value: The maximum concentration of chemical to which a person can be exposed day after day
OSHA	Occupational Safety and Health Administration
NIOSH	National Institute for Safety and Health
ACGIH	American Conference of Governmental Industrial Hygienists



▲ **Figure 1.** The NFPA diamond displays general hazard information for chemicals, including hazards related to fire (red), health (blue), reactivity (yellow), and any special hazards (white).

Copied from Willey, R.J., CEP, June 2012, p 29

Section 9 - Summary of physical and chemical properties of the hazardous material

These properties are important to know and understand before using the material in the laboratory since they impact the way you design and carry out experiments. They are also relevant to other sections of the SDS, including those that deal with reactivity, compatibility, and flammability. Most of the values in this section assume ambient conditions (20 – 25 °C) but specific gravity is based on liquid water at 4 °C.

Section 10 - Summary of the stability and reactivity of the hazardous chemical or material

The stability at room and elevated temperatures, other conditions that can cause instability, incompatibility with other substances, corrosivity, and special remarks on reactivity and corrosivity are covered. Of particular concern are conditions under which high temperature and pressures can occur, reactions can proceed spontaneously, or unstable chemicals can form upon storage. Some classic examples of special stability and reactivity issues include chemicals such as acetylene and ethylene that have positive Gibbs free energies of formation and chemicals like diethyl or isopropyl ether that form shock-sensitive peroxides when exposed to oxygen (air).

Section 11 - Important toxicological information

This section covers routes of entry to the human body, toxicity on animals, short and long term toxicity for humans, and special toxic and chronic effects for humans such as carcinogenicity.

Chemicals can enter the body by inhalation, absorption through the skin, ingestion, and injection. The toxicity of a material or chemical is usually expressed as Median Lethal Dose (LD_{50}), Median Lethal Concentration (LC_{50}), and Threshold Limit Value (TLV). The LD_{50} is a measure of the oral or dermal toxicity upon ingestion or administration and is the dose, given all at once, required to kill half of the test population of animals over a given period of time. The type of animal used (such as rat or mouse) is usually specified and the value reported is expressed as grams or milligrams of chemical per kilogram of body weight. The LC_{50} is a measure of the inhalation toxicity and is the concentration in the air, expressed in milligrams per cubic meter over a period of time (usually 4 hr). The TLV is given in ppm by volume for gases and milligrams per cubic meter for dust and particulates. There are three types of TLVs for chemical substances:

1) time weighted average (TWA) over an eight-hour day for a five-day workweek,
2) short-term exposure limit (STEL), such as 15 min., and
3) the ceiling limit, a value that should never be exceeded since this level is immediately dangerous to life and health (IDLH).

Much of the data reported for chronic concerns, such as carcinogenetic and reproductive effects, come from the International Agency for Research on Cancer (IARC), OSHA, ACGIH, and the Registry of Toxic Effects of Chemical Substances (RTECS).

Sections 12 – 16 How Dispose of and Transport the Chemical plus Regulatory Information

Section 12 - Ecological effects

The toxicity for different types of fish and the chemical and biological oxygen demands (COD) and (BOD), respectively, are presented.

Section 13 - Considerations for waste disposal

Generally, this section says to follow state and federal rules and laws. You should follow the rules and requirements set forth by the EHS Office and presented the Chemical Engineering Department Chemical Hygiene Plan when disposing of chemical substances.

Section 14 - Information on the shipping and transportation of the chemical or material

You are not qualified to ship chemicals so if you need to send a chemical to someone outside of MIT you should elicit the help of the experts in the EHS Office.

Section - 15 - Regulatory information for the US, various states, Canada, Europe and the rest of the world

Section 16 – Administrative information

Typical examples are the date when the MSDS was last updated and the issuing company or organization.