
Safety Data Sheets (SDS)

SDS Learning Module Instructor Guide

Note to Instructor

Being able to locate and interpret a Safety Data Sheet (SDS) is important to anyone involved in the fabrication of MEMS devices. MEMS (microelectromechanical systems) and microtechnology fabrication requires several hazardous chemicals. SDSs are available that explain the potential hazards of these chemicals and all chemicals used in a fabrication facility. They also provide information necessary to protect one's self from unnecessary exposure as well as other valuable information. One should always study a chemical's SDS prior to working around or handling a chemical.

The purpose of this learning module is to provide information on the requirements and content of Safety Data Sheets (SDS), how to locate a SDS, and how to interpret a SDS. Activities allow students to demonstrate their ability to find a specific SDS and to extract and interpret important safety information from the SDS.

The Safety Data Sheets Primary Knowledge unit provides the basic information on the content of Safety Data Sheets. It is recommended that it be completed prior to the SDS Activities.

Below are the units of the SDS Learning Module:

- SDS Knowledge Probe
- **SDS Primary Knowledge**
- SDS Internet Research Activity
- SDS Activity for KOH
- SDS Activity Assessment for KOH
- SDS Final Assessment (assesses knowledge and skill in locating, interpreting and applying the information on a SDS)

A PowerPoint presentation is provided for a classroom presentation. The PowerPoint is a summary of the PG.

For more safety learning module and more modules related to microtechnology, visit the SCME website (<http://scme-nm.org>).

Description and Estimated Time to Complete

Being able to locate and interpret a Safety Data Sheet (SDS) is important to anyone involved in the fabrication of MEMS (microelectromechanical systems) and any micro or nano-sized devices. Micro and nanotechnology fabrication require several hazardous chemicals. SDSs are available for each chemical used in these facilities.

A SDS explains the potential hazards of a chemical. It also provides information necessary to protect you from unnecessary exposure as well as other valuable safety information. You should always study a chemical's SDS prior to working around or handling a chemical.

The purpose of this SDS learning module is to provide information on the requirements and content of Safety Data Sheets (SDS), how to locate a SDS, and how to interpret a SDS. Activities allow you to demonstrate your ability to find a specific SDS and to extract and interpret important safety information from the SDS.

This PK unit provides content information about **Safety Data Sheets (SDS)**, data contained within a SDS, and interpretation of that data. This information will assist in extracting specifics from a SDS and interpreting the information. This unit has been updated to the new OSHA Hazard Communication Standard 29CFR 1910.1200 [<http://bit.ly/1yYUaBz>] that became effective May 25, 2012. This standard was revised to better align the United States with the UN Globally Harmonized System of Classification and Labeling of Chemicals (GHS), Revision 3.

It would be helpful to download two different SDS's prior to beginning this lesson.

Suggestion: Isopropyl Alcohol and Chlorine.

To download a specific SDS, just do a search for "Isopropyl Alcohol SDS". Your search will return many websites to choose from. Laboratories and suppliers are the best sources.

Estimated Time to Complete

Allow at least 15 minutes

Introduction



Pouring Acid under a fume hood

In order to work safely in a laboratory or manufacturing facility in which hazardous materials are found, you must understand the purpose of a SDS and how to extract information about a chemical. The knowledge in this unit will provide information about a SDS that can be used to investigate any chemical.

A Safety Data Sheet (SDS) is a document that provides vital information about a chemical for all those that use it, transport it, store it, or work around it in any manner. A SDS is required by Federal law to be prepared for each chemical imported or produced in this country. It is the chemical manufacturer's responsibility to supply a SDS with each chemical it sells. It is the employer's responsibility to maintain an updated SDS for all chemicals on the premises, and to make them readily accessible to all employees. This responsibility extends to chemicals such as Super Glue, Elmers, and Scotch Guard. If such chemicals are on the premises, a SDS must be available.

A SDS contains information on the hazards associated with a particular chemical, handling information, emergency procedures for spills or human contact, and data associated with its flammability and reactivity. Before storing, handling or working with a chemical in any manner, you should become familiar with the information provided in the chemical's SDS.

OSHA's* (HazCom standard (29 CFR 1910.1200)[<http://bit.ly/1yYUaBz>] identifies all 16 elements that must be on a SDS. Those elements are briefly discussed in this unit.

**U.S. Occupational Safety and Health Administration (OSHA), an agency of the U.S. Department of Labor.*

Learning Module Objectives

- Interpret the contents of at least three SDSs for specific chemicals.
- Identify the applications of at least three chemicals in microtechnology fabrication processes.
- Define the basic terms used by a SDS to describe a chemical's hazards

Dependencies

A basic understanding of Hazardous Materials terminology would enhance learning.
(See SCME's Hazardous Materials I and II)

SDS Requirements

BEFORE storing, handling or working with a chemical in any manner, you should become familiar with the information provided in that chemical's SDS. You should *always know* how to properly handle a chemical, how to prevent exposure, how to recognize the symptoms of overexposure, and the emergency procedure for overexposure.

It is the employer's responsibility as well as the employee's to ensure that all safety precautions are used and all safety procedures are followed. SAFETY FIRST!

Sixteen sections required in a SDS (OSHA's* HazCom standard (29 CFR 1910.1200)
[<http://bit.ly/1yYUaBz>]

1. Identification
2. Hazard(s) identification
3. Composition/information on ingredients
4. First-aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information*
13. Disposal considerations*
14. Transport information*
15. Regulatory information*
16. Other information including date of preparation or last revision

**Non-mandatory*

To see the specific information required in each of these sections, click on the following link.

[Appendix D to 1910.1200 – Safety Data Sheets \(Mandatory\)](https://www.osha.gov/dsg/hazcom/hazcom-appendix-d.html)
[<https://www.osha.gov/dsg/hazcom/hazcom-appendix-d.html>]

Keep this table accessible as you go through the rest of this learning module.

SDS Terminology

Much of the terminology found in a SDS is related to the hazardous characteristics of a chemical. This includes terms such as toxicity, flashpoint, and reactivity. You will also find terminology related to regulations such as the TLV or Threshold Limit Values for toxicity.

There are several SDS glossaries that provide definitions for most of these terms. The SDS Hyperglossary (<http://www.ilpi.com/msds/ref/index.html>) is a great reference.

As we go through the information and terminology of a SDS, locate the information on each of your SDS's.

Chemical Information / Composition / Exposure Controls

The following terms / acronyms are different ways of identifying the chemical on the SDS. Not all terms are used in a SDS.

Product Name - The manufacturer's name for the chemical or the chemical mixture. In some cases the "product name" is protected as a trademark. An example is Clorox®. Clorox is a trademark for chlorine bleach manufactured by the Clorox Company.

Chemical Name - The name of the chemical (the element, chemical compound or mixture). The scientific designation of a chemical that clearly identifies the chemical for the purpose of conducting a hazardous evaluation.

The chemical name in this label is "Boron Trichloride".

CAS # - The Chemical Abstract Service registry number which identifies the chemical. What is the CAS for BCL3?

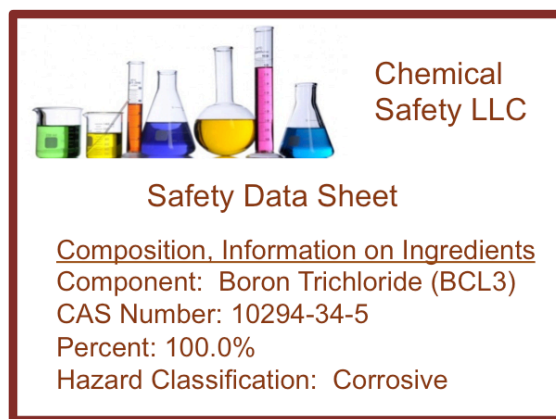
EPA # - The number assigned to the chemical for regulatory purposes by the Environmental Protection Agency (EPA).

Generic Name, Synonyms - Other names the chemical is commonly known by. For example, chlorine bleach is also referred to as bleach.

TLV or Threshold Limit Value - The airborne concentration of a chemical. A TLV is the concentration in ppm (parts per million) under which workers may be repeatedly exposed day after day without adverse effects. TLV's are revised yearly by the American Conference of Governmental Industrial Hygienists'.

PEL or permissible exposure limit - Similar to TLV, but is determined by OSHA.

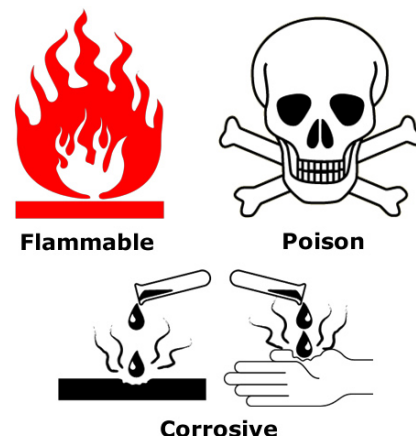
Find this information within your SDS's.



Classification and Mixture

Hazard Classification - The nature and degree of the predominant hazard associated with the chemical. Such classifications include flammable, poison, corrosive, oxidizer, combustible, and reactive.

Material and Percentage of Mixture - The chemical ingredients by their percent (for chemicals that are mixtures). All ingredients that have been determined to be physical or health hazards and comprise 1.0% or more of the composition must be listed. Chemicals that have been identified as carcinogens must be identified if the concentrations are 0.1% or greater.



Physical Data

Boiling Point - The temperature at which the vapor pressure of a liquid equals atmospheric pressure or at which the liquid changes to a vapor.

Freezing Point - The temperature at which the liquid takes on a solid state.

Evaporation Rate - The rate at which a material converts to a vapor at any given temperature and pressure.

Odor and Appearance – What it looks like (e.g., color, transparency) and what it smells like (e.g., odorless, moldy, pungent).

Percent Volatile by volume - The percent of a material (by volume) that will evaporate at an ambient temperature of 70°F. Surface area, length of time, and other factors influence percent volatile; no standard procedures exist.

Solubility in Water - The solubility of a product by weight in water at ambient temperature as expressed in the following terms:

- Negligible - less than 0.1%
- Slight - 0.1 – 1.0%
- Moderate – 1.0 to 10%
- Appreciable - More than 10%
- Complete - 100%

Solubility information is useful in determining effective fire extinguishing methods and spill clean-up procedures.

Specific Gravity (Water = 1) - The ratio of the weight of a volume of material to the weight of an equal volume of water. How heavy the material is in comparison to water. A ratio of less than 1 means the material is lighter than water and will float on the surface. Most flammables are less than one.

Vapor Pressure - The pressure of a saturated vapor above a liquid, in millimeters of mercury @ 20° C.

Vapor Density - The relative density or weight of a vapor or gas compared to an equal amount of air. Air is rated at 1.0. Therefore, a number greater than 1.0 indicates a vapor or gas heavier than air, and vice versa. Concentrated vapors that are heavier than air can accumulate in low places such as along floors and pits. They can also settle in the lower lung.

Vapor Pressure = 760 mmhg@13 C

Pungent Odor

Colorless

Boiling Point = 54.5 F (12.5 C)

Physical Data for BCL3

Find this information within your SDS's.

Fire and Explosion Hazard Data / Fire-Fighting Measures

Flammability Data - A flammable, combustible, pyrophoric.

Flashpoint - The lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture with air and produce a flame when a source of ignition is present.

LEL and UEL - For flammable liquids, the lower explosive limit (LEL) is the minimum concentration of the liquid's vapor in the air, below which, a flame does not occur on contact with an ignition source. The upper explosive limit (UEL) is the maximum concentration of the liquid's vapor in air, above which, a flame does not occur.

Negligible Fire Hazard

**Extinguishing Media:
Carbon dioxide, dry chemical**

Flashpoint: Not Flammable

Fire and Explosion Data for BCL3

Suitable extinguishing materials

Personal Protective Equipment (PPE) for fire fighters.

Toxicity

Nature of Hazard and Toxicity Data - The nature of the hazard (e.g. irritant, corrosive, carcinogen) and significant animal studies that determine the chemical's toxicity commonly based on the LD50 (Lethal Dose, 50%). Toxicity data also includes the dose relative to the length of time exposed, such as the TLV and PEL. TLV and PEL are both legal limits.

LD50 - The value that indicates the quantity of material that, if administered to a population of test animals, will cause 50% of the animals to perish. The LD50 is typically expressed in mg of material per kg of subject-body-weight.

TLV or Threshold Limit Value - The airborne concentration of a chemical. A TLV is the concentration in ppm (parts per million) under which workers may be repeatedly exposed day after day without adverse effects. TLVs are revised yearly by the American Conference of Governmental Industrial Hygienists.

PEL or permissible exposure limit - Similar to TLV, but is set by OSHA.

Reactivity

Conditions or Materials to Avoid – Handling conditions to avoid when using a specific chemical, such as extreme temperatures, shaking, inappropriate storage, or dropping. Also, materials that this chemical should not come in contact with due to chemical reactions. Materials such as water and metals or common "materials to avoid."

Hazardous Decomposition Products - Hazardous materials produced from a reaction by burning, oxidation, heating or reaction with other chemicals.

Reactivity Data for BCL3

Find this information within your SDS's.

PPE (Personal Protective Equipment)

Safety equipment (if required) when working around or handling a chemical. Safety equipment could include goggles, face shield, chemical gloves (corrosive or solvent), aprons, shoes, or self-contained breathing apparatus (SCBA).

**May react with evolution
of heat on contact with water**

Incompatibilities:
Combustible Materials



Glossary of Key Terms

Flammability - A measure of the extent to which a material will support combustion. Also known as inflammability.

SDS (Safety Data Sheet) - A document that provides the necessary information about a chemical for all those that use it, store it, or work around it in any manner.

PPE (Personal Protective Equipment) - Equipment employees wear that provides an effective protective barrier between the employee and MSD hazard.

Reactivity - A description of the tendency of a substance to undergo chemical reaction with the release of energy. The conditions that cause the reaction, such as heat, or direct contact with other chemicals, are specified as "Conditions to avoid" when a chemical's reactivity is discussed on SDS.

Toxicity - The effect a chemical has on the health of a human being under certain concentrations and exposure times. A chemical's toxicity depends on the duration of exposure and the chemical's concentration.

Other terms can be found in the SDS Hyperglossary (<http://www.ilpi.com/msds/ref/index.html>).

Summary

A SDS is your information source about a chemical. Before working with or around a chemical, you should always study the appropriate SDS. Know where the SDS notebook or resource is located and know how to locate a SDS on the internet.

Related Units or Activities

- Hazardous Materials Learning Module
- SDS Internet Research Activity
- SDS – KOH Activity
- Chemical Labels Learning Module

Review Questions

1. What does OSHA stand for? _____

Answer: *Occupational Safety and Health Administration*

2. OSHA requires specific sections to be contained in a SDS. How many specific sections are required?
- a. 6
 - b. 8
 - c. 12
 - d. 16

Answer: *16 specific elements are required.*

3. Which of the following would be considered a product name?
- a. Isopropyl Alcohol
 - b. Fingernail polish remover
 - c. Acetone
 - d. Chlorine

Answer: *Fingernail Polish Remover is a product name. All the others are chemical names.*

4. An ingredient that has been determined to be a physical or health hazard, must be listed on a SDS if its composition is equal to or greater than what percent?
- a. 0.1%
 - b. 0.5%
 - c. 0.75%
 - d. 1.0%

Answer: *Greater than or equal to 1.0% is correct.*

6. What is meant by a “chemical’s reactivity” characteristic?

Answer: *A chemical’s reactivity characteristic is its ability to be mixed with water. Chemicals that are highly reactive undergo a violent reaction when mixed with water.*

Matching Activity

Match the following components with their functions.

		Component		Function
E	1	Flashpoint	A	Reactivity
D	2	PPE	B	Physical Data
F	3	Chemical Name	C	Hazardous Characteristics
A	4	Substances to avoid	D	Control Measures
B	5	Appearance and odor	E	Fire and Explosion Data
C	6	PEL	F	Product Information

Table 1: SDS Contents

References

The OSHA Hazard Communication Standard (HCS), 29 CFR 1910.1200.

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10099

The SDS HyperGlossary. Interactive Learning Paradigms Incorporated. 2008.

<http://www.ilpi.com/SDS/ref/index.html>

Disclaimer

The information contained herein is considered to be true and accurate; however the Southwest Center for Microsystems Education (SCME) makes no guarantees concerning the authenticity of any statement. SCME accepts no liability for the content of this unit, or for the consequences of any actions taken on the basis of the information provided.

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