

Hazard Communication

■ 29 CFR 1910.1200



“ The DOSH hazard communication (“hazcom”) regulations are found in their Core Rules – WAC 296-800-170. We have copies if you wish to see them. It is also called chemical hazard communication.”

What is hazard communication?

Hazard communication or “hazcom” is our program where we tell you about the hazardous chemicals used in our workplace.

We will also train you on how to protect yourself from the effects of these hazardous chemicals.



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What is a “hazardous chemical”?

A hazardous chemical is any chemical that can do harm to your body.

Most industrial chemicals can harm you at some level.

It depends how much gets into your body.



“Some chemicals are more toxic than others. Just a little bit of some chemicals entering your body could harm you. Others are much less toxic and it would take great amounts entering your body to do any harm. This training will also show that exposure to chemicals can come from a variety of sources.”

How do hazardous chemicals affect the body?

It depends on several factors:

How the chemical enters the body

The physical form of the chemical

The amount of chemical that actually enters the body - the dose

How toxic (poisonous) the chemical is



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“A poisonous chemical will not do you any harm, obviously, if it does not enter your body.”

How Chemicals Enter the Body

There Are Three Routes of Entry:

Ingestion – swallowing the chemical



Inhalation – breathing in the chemical



Absorption – the chemical soaks through the skin



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“Inhalation is typically the most common way chemicals can enter the body in a work situation. Skin absorption is less common, but can occur with some solvents and pesticides. Ingestion is usually not a major problem in the workplace except in certain situations.”

Inhalation (Breathing)

Chemicals in the air are breathed in through the mouth or nose.

Gases & vapors are absorbed through the lungs directly into the bloodstream.

The size of dust particles or mist droplets can affect where the chemical settles in the respiratory tract.



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“Where the particles or mist settles in the respiratory tract determines what symptoms or diseases will develop. Some chemicals settle in the nose and throat, some go deeper into the lungs. The chemicals that go deeper in the lungs often cause more damage. Fine dust usually goes deep into the lungs”

Skin Absorption

Some chemicals can pass through the skin into the body.



These chemicals can then cause various health effects.



“Some chemicals are absorbed through the skin more easily than others. Many insecticides and some solvents are easily absorbed through the skin. Also, some chemicals will have a direct effect on the skin without being absorbed through the skin. More about that later.”

Ingestion (Swallowing)

Chemicals that are swallowed are absorbed in the digestive tract.

Chemicals can rub off dirty hands and contaminate food, drinks or tobacco products.

Chemicals in the air can settle on food or drink and be swallowed.



“This is another good reason to wash your hands before eating, drinking or smoking.”

The Three Forms of Chemicals

All chemicals exists in one of three forms:

Solid



Gas



Liquid



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“The physical form of the hazardous chemical can affect how hazardous it is and how it enters the body.”

Hazardous Chemicals - Dusts

Some chemicals are solids in the form of powders or dust.



Dust can be released into the air by cutting, drilling, grinding or sanding.



Dust can also be stirred up by dry sweeping and inhaled.



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“Dust or powders can be inhaled when they become airborne. For example, cutting brick or cinder block without water can generate lots of airborne dust that contains quartz (silica). Dry sweeping can do the same. If silica dust is inhaled it can scar the lungs and cause breathing problems.”

Hazardous Chemicals - Dust

Dust in the air can settle out on work surfaces, cups, plates, utensils, and food.

The settled dust can be swallowed with food or drinks.

If the dust is hazardous, it can cause health problems.



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“This is real problem with lead dust.”

Solids – Fumes and Fibers

Fumes are extremely small droplets of metal formed when the metal has been vaporized by high temperatures (usually welding)



Some solids are fibers which can be similar to dusts but they have an elongated shape (like asbestos or fiberglass)



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“Metal fumes are formed during welding. Because of their tiny size, they are easily inhaled deep into the lungs and can be absorbed into the blood stream. Sometimes the word “fumes” is used for chemicals gases or smoke in the air, but this is the more accurate definition.”

“Asbestos is one of the most hazardous dust in fiber form because of the damage it can do to the lungs. Fiberglass does not damage the lungs, but can be irritating to the nose and throat.”

Hazardous Chemicals - Liquids

Liquid chemicals in direct contact with the skin can cause skin problems.



Some liquids can be absorbed into the body through the skin.

Liquids can be sprayed and form mists or evaporate and form vapors which can be inhaled.



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“Typical hazardous liquids are various types of solvents. These chemicals can dry the skin out, cause an allergic reaction or have other direct effects on the skin. Some liquid solvents are flammable and can be a fire hazard as well.”

Liquids (Mists)

Mists can also be inhaled.

Mists can settle on the skin and be absorbed into the body.

Airborne mists can also settle out and contaminate food or drink.



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“The most common exposure to mists is from inhalation. A common example of a mist exposure at work is paint overspray.”

Gases and Vapors

Gases are chemicals that are in the gas phase at room temperature.

Vapors evaporate from substances that are liquids or solids at room temperature.

Gases and vapors enter the body by inhalation.



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“Chlorine and methane are examples of gases. Most liquid solvents release vapors. Examples are acetone, paint thinner and gasoline. Gases do not normally pass through the skin.”

Toxicity: how poisonous are chemicals?

Dose - The effects of any toxic chemical depends on the amount of a chemical that actually enters the body.

Acute Toxicity - the measure of how toxic a chemical is in a single dose over a short period of time.

Chronic Toxicity - the measure of the toxicity of exposure to a chemical over a long period of time.



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[Optional slide. These terms are often used in SDSs.] “Some chemicals can cause problems immediately, others may not hurt you until you have been exposed for a long time”

Chronic Toxicity and Acute Toxicity

Some chemicals will only make you sick if you get an 'acute' or high dose all at once. **Example – ammonia**



Some chemicals are mainly known for their chronic or long-term effects. **Example – asbestos**



Most chemicals have both acute and chronic effects. **Example – carbon monoxide**



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“Ammonia smells terrible and irritates the nose, but doesn't really hurt you except at very high levels where it can burn your lungs. At lower levels, it has no long-term effects. Asbestos has no immediate effects, but over the long-run causes breathing problems or lung cancer. Carbon monoxide can kill you in minutes at a high enough level, but also give you headaches and eventually damage your heart if you breathe it day after day at low levels.”

Chemical Exposure Limits

Many chemicals have exposure limits, or allowable amounts of a chemical in the air.

These limits are often called "Permissible Exposure Limits" or "Threshold Limit Values".

They are based on 8-hour average exposure or ceiling or peak levels.

Levels must be kept below these limits for safety.

A 3D graphic consisting of the letters 'PEL' in pink and 'TLV' in yellow, both in a bold, sans-serif font. The letters are positioned on a blue, wavy, reflective surface that recedes into the distance.

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Permissible exposure limits are also called PELs and threshold limit values are called TLVs. DOSH regulations have PELs for about 600 chemicals. Often the SDS will list the OSHA PEL which can be different from the DOSH PEL. The limits are usually expressed as parts per million (ppm) or milligrams per cubic meter (mg/cu. meter). Your exposure to chemicals cannot exceed these limits.”

Carcinogens

Carcinogens are cancer-causing compounds.

Some chemicals are known human carcinogens, others are only suspected as carcinogens.

OSHA has regulations covering the general use of carcinogens, and has specific regulations for several known human carcinogens.



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“A manufacturer is required to list any carcinogens in their product even if the amount is as low as 0.1% of the product. The allowable exposure limits for carcinogens are either extremely low or at zero.”

Other Groups of Toxic Chemicals

Teratogens

Teratogens are compounds that can harm the developing fetus, causing birth defects or death.

Mutagens

Mutagens cause genetic mutations or changes. These mutations can cause birth defects or other problems in following generations or may lead to cancer in the exposed person.



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“As an example of a teratogen, some you may remember, the drug Thalidomide taken by pregnant woman in the 1950’s that cause babies to be born without arms or legs. Fortunately, there are few chemicals in common use today that are in this group.”

Corrosive Chemicals

Acids and bases (caustics) are common corrosive chemicals.

Corrosive chemicals are capable of damaging eyes, skin and the respiratory system.



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“Corrosive chemicals may or may not have an internal effect on the body, but usually affect the skin or eyes, irritating or destroying tissue. This can also happen in the lungs if corrosive chemical vapors are inhaled.”

Corrosive Chemicals - Skin

Corrosives can cause visible skin burns or damage.



The extent of skin damage depends on how long the corrosive is on the skin and how concentrated the corrosive is.



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“The longer the corrosive is on your skin, the greater the injury. The more concentrated the corrosive, the greater the damage.”

Corrosive Chemicals - Inhalation and Eyes

Inhalation of corrosive mists or vapors can cause severe bronchial irritation.



Corrosives are especially damaging to the eyes.



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“Goggles are essential to protect the eyes when handling strong corrosives. Eyewashes are required where corrosives are handled. Damage to the eyes can be minimized by quick and thorough rinsing of the eyes. The photo shows an eye severely damaged by a corrosive”

Properties of Flammable Liquids

The vapor of a flammable liquid ignites and causes fire or explosion – not the liquid itself.

The flammability of a liquid depends on its physical properties:

- Vapor Pressure
- Flash Point
- Limits of Flammability
- Vapor Density



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“Flammable liquids include fuels like gasoline and various types of solvents.”

Flammable Liquids –Vapor Pressure

Vapor pressure is a measure of how fast a liquid evaporates.

The higher the vapor pressure the more rapidly the liquid will evaporate.

Vapor pressure goes up and down with the temperature of the liquid.



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“Usually, the higher the vapor pressure, the more flammable the liquid is. However, some chemicals have high vapor pressure, but don’t burn. An example is methylene chloride, a chemical used in many paint strippers.”

Flammable Liquids - Flashpoint

The flash point is the lowest temperature that a flammable liquid can generate enough vapor to form a mixture with air that will ignite.



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“For example, gasoline has a much lower flash point than motor oil. The lower the flashpoint, the more easily the liquid will burn or catch fire.”

Limits of Flammability

The limits of flammability is the range that a mixture of air and vapor is flammable.

Mixtures can be too lean (not enough vapor) or too rich (too much vapor) to ignite and burn.



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“An example is an automobile engine. Even though gasoline is very flammable, the car won’t run if the mixture is too rich (too much gasoline vapor) or too lean in the carburetor or fuel injection system.”

Flammable Limits Example

Methane



An open flame or a spark will cause an explosion when methane amount is between 5.3%, the lower flammable limit (LFL) and 15%, the upper flammable limit (UFL). These are also sometimes called lower explosive limit and upper explosive limit.”

Flammable Liquids Lower Flammable Limit (LFL)

In most work situations, the "lower flammable limit" (LFL) is the main concern.

Vapors from flammable liquids can be found in the workplace, but are often too diluted to catch fire or explode.

However, these vapors can quickly go above the LFL in small room or confined space like a tank.



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“Vapors that exceed the LFL are usually toxic as well, and lower the amount of oxygen. So if the explosion or fire doesn’t harm you, the toxicity or lack of oxygen probably will. LFL is sometimes called LEL – lower explosive limit.”

Flammable Liquids - Vapor Density

“Vapor density” is a measure of how heavy a vapor is compared to air.

Vapors with a density greater than air can flow like a liquid collect near the floor.

This may create a fire or explosion hazard if the vapor flows to an ignition source.



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“An example of vapors heavier than air include propane. A leak from a propane tank will often settle in the lowest part of building or ground.”

Hazards of Metals

Metals can be both physical hazards and health hazards.

Some metals can ignite and explode – magnesium, or dusts/filings of other metals such as aluminum

Some metals are almost non-toxic – iron, aluminum

Others are very toxic – mercury, lead, cadmium, beryllium



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“Metals can present different hazards from poisoning to explosions and fire. Metals can cause health effects such as elevated blood pressure, brain damage, kidney failure and death. Pieces or articles of metal are not usually hazardous, it’s when they are found in other products or are welded, cut or grinded, creating dust or fume that can then be inhaled. A few metals can actually burn rapidly and intensely if they are in a powder form. Airborne dusts and filings of some metal such as aluminum, can explode when ignited. Some metals are carcinogenic – ex. chromates found in paints or in metal plating”

How do you get information about hazardous chemicals?

You can get information two ways:

from the product label,

from the product
Safety Data Sheet.



SDS

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“Labels are sketchy and don’t have all the information about the hazards of chemicals in a product. SDSs usually provide much more information, although it may not always be easy to understand.”

New Requirements Overview

- Rule modifies MSDS requirements, labeling, classifications, and requires retraining of all employees.
- The HazCom/GHS includes the following basic elements:
 - harmonized criteria for classifying substances and mixtures according to their health, environmental and physical hazards; and
 - harmonized hazard communication elements, including requirements for labeling and material safety data sheets.

Overview

- **Hazard classification:** Provides specific criteria for classification of health and physical hazards, as well as classification of mixtures.
- **Labels:** Chemical manufacturers and importers will be required to provide a label that includes a harmonized signal word, pictogram, and hazard statement for each hazard class and category.
- **Precautionary statements** must also be provided.
- **Safety Data Sheets:** Will now have a specified 16-section format.
- **Information and training:** The Final HCS will require that workers are trained within two years of the publication of the final rule to facilitate recognition and understanding of the new labels and safety data sheets.

OSHA – Final Rule

- Effective Dates:
 - 12/1/13: All employees must be trained on new label elements and SDS format
 - 6/1/15: Manufacturers and distributors must comply with all modified provisions except that distributors have until 12/1/15 to provide revised labels for all products shipped.
 - 6/1/16: OSHA enforcement starts: Employers must update all labels and HAZCOM program, provide additional training for workers on newly identified physical or health hazards

OSHA – Final Rule

- System has 16 physical hazard classifications and 10 health hazard classifications, which determine label elements, pictograms, hazard statement, signal words and precautionary statement required.

GHS Hazard Classification

■ Physical Hazards (16)

- Explosives
- Flammable Gases
- Flammable Aerosols
- Oxidizing Gases
- Gases Under Pressure
- Flammable Liquids
- Flammable Solids
- Self-Reactive Substances
- Pyrophoric Liquids
- Pyrophoric Solids
- Self-Heating Substances
- Substances which, in contact with water, emit flammable gases
- Oxidizing Liquids
- Oxidizing Solids
- Organic Peroxides
- Corrosive to Metals

GHS Hazard Classification

■ Health Hazards (10)

- Acute Toxicity
- Skin Corrosion/Irritation
- Serious Eye Damage/Eye Irritation
- Respiratory or Skin Sensitization
- Germ Cell Mutagenicity
- Carcinogenicity
- Reproductive Toxicology
- Target Organ Systemic Toxicity – Single Exposure
- Target Organ Systemic Toxicity – Repeated Exposure
- Aspiration Toxicity

HCS Pictograms and Hazards

<p style="text-align: center;">Health Hazard</p>  <ul style="list-style-type: none"> · Carcinogen · Mutagenicity · Reproductive Toxicity · Respiratory Sensitizer · Target Organ Toxicity · Aspiration Toxicity 	<p style="text-align: center;">Flame</p>  <ul style="list-style-type: none"> · Flammables · Pyrophorics · SelfHeating · Emits Flammable Gas · SelfReactives · Organic Peroxides 	<p style="text-align: center;">Exclamation Mark</p>  <ul style="list-style-type: none"> · Irritant (skin and eye) · Skin Sensitizer · Acute Toxicity (harmful) · Narcotic Effects · Respiratory Tract Irritant · Hazardous to Ozone Layer (Non Mandatory)
<p style="text-align: center;">Gas Cylinder</p>  <ul style="list-style-type: none"> · Gases under Pressure 	<p style="text-align: center;">Corrosion</p>  <ul style="list-style-type: none"> · Skin Corrosion/ burns · Eye Damage · Corrosive to Metals 	<p style="text-align: center;">Exploding Bomb</p>  <ul style="list-style-type: none"> · Explosives · SelfReactives · Organic Peroxides
<p style="text-align: center;">Flame over Circle</p>  <ul style="list-style-type: none"> · Oxidizers 	<p style="text-align: center;">Environment (Non Mandatory)</p>  <ul style="list-style-type: none"> · Aquatic Toxicity 	<p style="text-align: center;">Skull and Crossbones</p>  <ul style="list-style-type: none"> · Acute Toxicity (fatal or toxic)

Transport Pictograms



Hazard Statements

- A single harmonized hazard statement for each level of hazard within each hazard class
 - Example: Flammable liquids
 - Category 1: Extremely flammable liquid and vapour
 - Category 2: Highly flammable liquid and vapour
 - Category 3: Flammable liquid and vapour
 - Category 4: Combustible liquid

Hazard Statements

- Flammable (and Combustible) Liquid Criteria

Table 2: GHS Flammable (and Combustible) Liquid Criteria

Criteria	GHS Category	Transport Class / Packing Group
Flash point < 73°F(23°C) and initial boiling point ≤ 95°F(35°C)	1	3, I
Flash point < 73°F(23°C) and initial boiling point > 95°F(35°C)	2	3, II
Flash point ≥ 73°F(23°C) and ≤ 140°F(60.5°C)	3	3, III
Flash point > 140°F(60.5°C) and ≤ 199.4°F(93°C)	4	Combustible Liquid, PG III [DOT uses <200°F(93°C)]

GHS Hazard Classification

- Defined criteria are used to assign a hazard classification
 - Physical Hazards
 - 16 categories
 - Health Hazards
 - 10 categories
 - Environmental Hazards
- Mixtures
 - GHS classification guidance for when chemicals are mixed

GHS Hazard Classification

- Hazardous to the Aquatic Environment
 - Acute aquatic toxicity
 - Chronic aquatic toxicity
 - Bioaccumulation potential
 - Rapid degradability

GHS Hazard Communication

- Labels
 - Symbols (hazard pictograms) with red border
 - Examples:



GHS Hazard Communication

- Labels (cont.)
 - Nine symbols
 - Includes "Environment"

<p><u>Flame over circle</u></p>  <ul style="list-style-type: none"> • Oxidizers 	<p><u>Flame</u></p>  <ul style="list-style-type: none"> • Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self Reactives • Organic Peroxides 	<p><u>Exploding bomb</u></p>  <ul style="list-style-type: none"> • Explosives • Self Reactives • Organic Peroxides
<p><u>Skull and crossbones</u></p>  <ul style="list-style-type: none"> • Acute toxicity (severe) 	<p><u>Corrosion</u></p>  <ul style="list-style-type: none"> • Corrosives 	<p><u>Gas cylinder</u></p>  <ul style="list-style-type: none"> • Gases under pressure
<p><u>Health Hazard</u></p>  <ul style="list-style-type: none"> • Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity 	<p><u>Environment</u></p>  <ul style="list-style-type: none"> • Aquatic Toxicity 	<p><u>Exclamation mark</u></p>  <ul style="list-style-type: none"> • Irritant • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic effects • Respiratory Tract Irritation • Hazardous to Ozone Layer

GHS Hazard Communication

- Labels (cont.)
 - Signal Words
 - “Danger” or “Warning”
 - Hazard Statements
 - Example: “Toxic if swallowed”
 - Other
 - Precautions, identification, supplier, supplemental

GHS Hazard Communication

- Labels (cont.)
 - GHS Label Elements for Flammable Liquids

Table 3: GHS Label Elements for Flammable (and Combustible) Liquids

	Category 1	Category 2	Category 3	Category 4
Symbol				No symbol
Signal Word	Danger	Danger	Warning	Warning
Hazard Statement	Extremely flammable liquid and vapor	Highly flammable liquid and vapor	Flammable liquid and vapor	Combustible liquid

GHS label example



ToxiFlam (Contains: XYZ)

Danger! Toxic If Swallowed, Flammable Liquid and Vapor



Do not eat, drink or use tobacco when using this product. Wash hands thoroughly after handling. Keep container tightly closed. Keep away from heat/sparks/open flame. – No smoking. Wear protective gloves and eye/face protection. Ground container and receiving equipment. Use explosion-proof electrical equipment.

Take precautionary measures against static discharge. Use only non-sparking tools. Store in cool/well-ventilated place.

IF SWALLOWED: Immediately call a POISON CONTROL CENTER or doctor/physician. Rinse mouth.

In case of fire, use water fog, dry chemical, CO₂, or “alcohol” foam.

See Material Safety Data Sheet for further details regarding safe use of this product

MyCompany, MyStreet, MyTown, NJ 00000, Tel. 444 999 9999

NFPA labels

The National Fire Protection Association (NFPA) utilizes a diamond divided into four color coded sections:

- Blue - Health Hazard
- Red - Flammability
- Yellow - Reactivity Hazard
- White - Other Hazard Information



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“A label of course may have lots of other information not related to its hazards – amounts, advertising, directions for use, etc. But the label must include a list of the hazardous ingredients, a hazard warning and name and address of the manufacturer. Sometimes this information is on the back or side of the container.”

NFPA labels

Within each section, a number ranks the degree of hazard:

- 0 - No or Minimal Hazard
- 1 - Slight Hazard
- 2 - Moderate Hazard
- 3 - Serious Hazard
- 4 - Extreme Hazard



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NFPA labels

The white section alerts the user to special hazards that a material may possess, such as:

- Water reactivity
- Strong oxidizer
- Corrosive
- Radioactivity



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SDS Requirements

1. Identification of the substance or mixture and of the supplier
2. Hazards identification
3. Composition/information on ingredients Substance/Mixture
4. First aid measures
5. Firefighting 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
12. Ecological information (non mandatory)
13. Disposal considerations (non mandatory)
14. Transport information (non mandatory)
15. Regulatory information (non mandatory)
16. Other information including information on preparation and revision of the SDS

What is a **Safety Data Sheet?**

Safety Data Sheets or “SDSs” are information sheets on products that:

- tells what chemicals are in the product,
- what the hazards of the chemicals are,
- how to protect yourself from the hazards.

A large, 3D, yellow and orange graphic of the letters 'SDS' is positioned on the right side of the slide. The letters are bold and have a slight shadow, giving them a three-dimensional appearance. They are set against a dark blue background with some light blue wavy lines at the bottom.

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“The chemical hazard communication standard requires that producers and importers of hazardous chemicals develop Safety Data Sheets for their products. These SDSs contain information on the hazardous chemicals in a product and come with every chemical product we use.”

SDSs – what information do they have?

1. Product and Company Identification,

Acetone- Sciencelab, Inc.
14025 Smith Rd.
Houston, Texas 77396

2. Hazard Identification,

Acute- Eye irritation
Chronic- Carcinogen

3. Composition/Information on Ingredients,

Acetone, CAS# 67-64-1, 100% by weight

4. First Aid Measures,

Eyes: flush
with water for
15 minutes

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[optional slide – you can print out the previous slide or use your own SDS sheets, and go over it section by section with your employees. The information in red on the right is from the previous SDS slide.]

SDSs – what information do they have?

5. Fire Fighting Measures,

Flammable &
highly volatile

6. Accidental Release Measures,

Dilute with
water

7. Handling and Storage,

Store in Flammable
storage container

8. Exposure Control/ Personal
Protection,

Wear
respirator,
rubber gloves

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[optional slide – you can print out the previous slide or use your own SDS sheets, and go over it section by section with your employees. The information in red on the right is from the previous SDS slide.]

SDSs – what information do they have?

9. Physical and Chemical properties,

Clear Liquid,
dissolves in
water

10. Stability and Reactivity,

Unstable when exposed to
excessive heat

11. Toxicological Information,

Absorbed
through
skin

12. Ecological Information,

Toxic in water

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[optional slide – you can print out the previous slide or use your own SDS sheets, and go over it section by section with your employees. The information in red on the right is from the previous SDS slide.]

Safety Data Sheets (continued)

13. Disposal Considerations,

In accordance with
Federal and state laws

14. Transport Information,

Class 3 Flammable
Liquid

15. Regulatory Information,

California Special
Handling Procedures

16. Other information.

SDS Last update June 2012

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[optional slide]

You can protect yourself from hazardous chemicals by:

Knowing what is in the product you work with,



Using the smallest amount of a chemical to do the job,



Maintaining machinery and equipment to prevent leaks or releases,



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“When using chemicals, more is not always better. Smaller amounts mean less goes into the air and less is spilled or splashed.

“ Equipment needs to be maintained to prevent or minimize leaks or releases of chemicals into the work area”

Protect yourself from hazardous chemicals by:

Using available ventilation to reduce amounts of chemicals in the air,



Keeping lids, doors or covers closed on chemical processes,



Wearing necessary personal protective equipment.



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“Personal protective equipment includes gloves, goggles, safety glasses, aprons, coveralls, Tyvek as well as respirators. PPE is the last resort for protection when there is no other means of reducing chemical exposure.

Any Questions?

