

TRAINING DATA SHEET:

UNDERSTANDING MSDSs

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The following can be used to interpret data on MSDSs. The information may be in a different order, but each subject listed here should be covered if the MSDS is legally complete. However, compliance with OSHA MSDS rules has been almost nonexistent for decades. You may not find the data you seek. OSHA has proposed adopting the Globally Harmonized System of MSDSs developed by the United Nations. These forms are now used in the European Union and would greatly improve MSDSs.

SECTION I

IDENTITY OF THE PRODUCT. The identifying chemical name or product name should be the same as that on the container label.

EMERGENCY TELEPHONE NUMBER. A 24-hour, U.S. phone number must be included. It does not need to be toll-free.

TELEPHONE NUMBER FOR INFORMATION. It may be the same number as above for small companies.

NAME OF MANUFACTURER OR IMPORTER. Be sure that this name is exactly the same as the name of the manufacturer listed on the product label. Small manufacturers sometimes send out MSDS from the primary manufacturer of the raw materials they used to make the product or that they repackaged which is improper. An importer is the "manufacturer of record" in the US and is responsible for the product.

ADDRESS OF THE MANUFACTURER. Be sure this address is a U.S. address and complete: street or box, town, state, zip.

DATE PREPARED. MSDSs prepared more than three years ago are acceptable in the U.S., but they are invalid in Canada. In the U.S. manufacturers must revise MSDSs to include new data within 3 months. It is common for manufacturers to provide old, outdated MSDSs.

SIGNATURE OF THE PREPARER is optional.

SECTION II - HAZARDOUS INGREDIENTS / IDENTITY DATA

SPECIFIC CHEMICAL NAME/IDENTITY. If the product is a single chemical, the name should be the same as on Section 1.

COMMON NAME(S), synonyms, and chemical class if it has one.

CAS # (CHEMICAL ABSTRACTS SERVICE REGISTRY NUMBER, optional). Good MSDSs provide this identification number which is assigned to each chemical by this international research agency.

Some state laws, e.g., the NJS Right-to-Know law, require it on MSDSs and labels. Manufacturers who sell to states that require it must include CAS #s on the MSDS.

CHEMICALS IN PRODUCTS THAT ARE MIXTURES. It used to be common for MSDSs to list only ingredients which had TLVs or PELs.

Today any chemical for which there is even one study showing it may be capable of causing harm should be listed. Toxic chemicals comprising more than 1 % of the product by weight must be listed. Cancer-causing chemicals comprising 0.1% or more by weight of the product must be listed. In some states such as California and New Jersey (for state employees) chemicals that cause reproductive and certain other chronic hazards also must be listed at 0.1% or even lower.

If exposure to amounts even smaller than the required 1.0 or 0.1 % is known to be hazardous, manufacturers also must list these ingredients. **In practice, however, such hazardous ingredients often go unlisted.** For example, trace amounts of extremely toxic dioxins and PCBs in many pigments and in ball clays usually are not reported.

TRADE SECRET EXEMPTIONS. The identity of ingredients can be withheld by the manufacturer if they are trade secrets or proprietary. The MSDS should have a trade secret registration number if it is sold in states that require one. If there is no number, it may be possible that the company is not legally withholding the identity of the ingredients. **Trade secret products should be avoided whenever possible since it is difficult and time-consuming for medical personnel to get this data if there is an accident or illness.** Even then, medical professionals must withhold the identity of the trade secret chemical from the victim and usually must sign a legally binding confidentiality agreement with the company.

OSHA PEL. These permissible exposure limits (PELs) should be listed. They can be eight-hour time-weighted averages (PEL-TWA), 15 minute short term exposure limits (PEL-STEL) or ceiling (PEL-C) limits. PELs are enforced by OSHA. These limits were intended to be the amounts of the substance in the air to which most healthy adult workers may be exposed each work day for the assigned time limit over a 40-hour work week for years without adverse effect. **Unfortunately, most of OSHA's PELs were set in the 1970s and are no longer considered protective.** OSHA has tried several times to update them.

ACGIH TLV. The American Conference of Governmental Industrial Hygienists (ACGIH) limits should be listed here. These also can be stated as eight-hour time-weighted averages (TLV-TWA), short term (STEL) or ceiling (C) limits. The **TLVs are updated regularly and usually more protective than the OSHA PELs.** In general, the smaller the TLV, the more toxic the substance is to inhale, although other exposure factors such as evaporation rate should be considered. TLVs are guidelines and are not enforced by OSHA except when OSHA uses the General Duty Clause.

OTHER LIMITS (OPTIONAL). Good manufacturers will list other limits here such as the NIOSH RELs (Recommended Exposure Limits), the American Industrial Hygiene Association's WEELs, MRLs (manufacturer's recommended limits), and the MAKs (Federal Republic of Germany Maximum Concentration Values in the Workplace)s.

ODOR THRESHOLD (optional). The odor threshold (OT) is required on Canadian MSDSs when known. It is sometimes included by U.S. manufacturers who sell to both countries. **OTs are useful. They are the concentrations in air at which most people can smell the substance. If the OT is smaller than the TLV, then the chemical provides warning before health effects are expected. If the OT is larger than the TLV, one is already at risk by the time the odor can be detected.**

PERCENT (optional). If the percentages of each ingredient are listed, check to see if they add up to 100 %. Check to see if toxic substances are a small or large proportion of the product.

SECTION III – PHYSICAL / CHEMICAL CHARACTERISTICS

This section provides a physical profile of the chemical through its various characteristics. Some physical data may be omitted on the MSDSs when it is not applicable. For example, some chemicals have no boiling point because they do not boil. However, this same chemical may dissociate (break down) with heat, and this fact and the chemicals into which it dissociates should appear on a good MSDS. If data does not exist, the line on the MSDS where it ordinarily would appear must be filled in to indicate this. Blank spaces are not allowed.

BOILING POINT (BP). The BP is the temperature at which the substance changes rapidly, usually with bubbling, from a liquid to a vapor. Sometimes called the "vaporization point," liquids with low BPs usually expose workers to large amounts of the vapor. **If the vapor is also flammable, liquids with low BPs are also fire hazards.** A common error is assuming that no vapor is formed by substances such as metals or glass until their BPs are reached. However, vapor is formed at temperatures near their melting points (see below). They are similar to water which boils at 212 oF, but evaporates at room temperature.

MELTING POINT. This is only applicable to solid materials. The MP is the temperature at which a solid changes to a liquid. Vaporization of small amounts of substances such as metals usually begins at the melting point and increases as the temperature is increased. **Some solids, e.g. mothballs, volatilize significantly below their melting points.**

VAPOR PRESSURE (mm Hg). VP is the pressure exerted by a saturated vapor above its own liquid in a closed container. VPs combined with evaporation rates are useful in determining how quickly materials become airborne, and thus how quickly a worker is exposed to it. They are usually reported in millimeters of mercury (mm Hg) at 68 o F (20 o C) unless otherwise stated. **Substances with VPs above 20 mm Hg may present a hazard due to their extreme volatility.**

VAPOR DENSITY (AIR = 1). VD is the weight of a vapor or gas compared to an equal volume of air. Materials with a VD less than 1.0 are lighter than air. Materials with a VD greater than 1.0 are heavier than air. While all vapors and gases will mix with air and disperse, **large quantities of unmixed vapor or gas in locations without much air movement such as storage rooms will tend to rise or sink depending on their VD. Flammable vapors that are heavier than air can spread to sources of ignition and flash back to the source.**

SOLUBILITY IN WATER. This term represents the amount by weight that will dissolve in water at ambient temperatures. Solubility is important in determining suitable clean up and extinguishing methods. Solubility is usually reported in grams per liter (g/l) or general categories such as:

negligible or insoluble	= < 0.1 percent
slight	= 0.1 - 1.0 percent
moderate	= 1 - 10 percent
appreciable	= > 10 percent
complete	= soluble in all proportions

APPEARANCE AND ODOR. Comparing this description to the actual product is a way to be sure the right MSDSs has been obtained.

SPECIFIC GRAVITY (SG). The SG describes the heaviness of a material compared to a reference substance. When the reference substance is water ($H_2O = 1$), it indicates whether it will float or sink in water. SG for solids and liquids compared to water numerically equals density (see above). SG for gases does not equal density because the density of air is not 1.0, but 1.29.

EVAPORATION RATE. This is the rate at which a material will vaporize (volatilize, evaporate) from the liquid or solid state when compared to another material. The two common liquids used for comparison are butyl acetate and ethyl ether.

WHEN BUTYL ACETATE = 1.0

> 3.0 = FAST

0.8 - 3.0 = MEDIUM

< 0.8 = SLOW

WHEN ETHYL ETHER = 1.0

< 3.0 = FAST

3.0 - 9.0 = MEDIUM

> 9.0 = SLOW

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT. This is 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. Combustion does not continue. **The lower the flash point, the more hazardous the liquid.** The METHOD USED should also be designated here. There are various tests for determining flash point and these should also be designated here for accuracy. The four test methods recognized by the National Fire Protection Association are: Tag Open Cup test, Tag Closed-Cup test, Cleveland Open Cup, and Pensky-Martens closed cup.

FLAMMABLE LIMITS. Only applicable to flammable liquids and gases, these are the minimum and maximum concentrations in air between which ignition can occur. Concentrations below the lower flammable limit (LFL) are too lean to burn, while concentrations above the upper flammable limit (UFL) are too rich and will burn. All concentrations in between can flash or explode. (Sometimes called lower and upper explosion limits--LEL and UEL.)

EXTINGUISHING MEDIA. The type of extinguisher or suppression system needed to put out a fire involving the substance.

SPECIAL FIRE FIGHTING PROCEDURES. Lists any special methods needed to fight fires involving the substance. Peroxides like those used to cure polyester resins, for example, supply oxygen when burned and cannot be extinguished by ordinary methods that smother or cut off air.

UNUSUAL FIRE AND EXPLOSION HAZARDS apply to substances such as some organic peroxides or ethyl ether that ignite spontaneously under certain conditions or that become explosive when old.

SECTION V - REACTIVITY DATA

This section must be completely understood before doing any kind of experimenting with the material. **Artists also should be aware that the manufacturers usually have no liability for damages caused when their products are not used as directed.**

STABILITY: Stability is the ability of the material to remain unchanged under reasonable conditions of storage and use.

CONDITIONS TO AVOID. Conditions which will render a material more unstable, e.g., storage at above room temperature causes certain materials to change rapidly. Some become explosive.

INCOMPATIBILITY. Here the MSDS should list substances which will react dangerously with the product. Workers can use this to determine which substances also should not be stored in proximity to each other.

HAZARDOUS DECOMPOSITION PRODUCTS. This section should list any hazardous chemicals given off when the product burns or when it degrades or decomposes without burning. However, manufacturers often only report the results of high temperature incineration with all the oxygen necessary for complete combustion. Under these conditions, most organic chemicals will give off carbon dioxide, water, and a few other low molecular weight chemicals. Actual burning in open air, heating with torches, hot wire cutting, or other methods of rapid decomposition usually will produce very different results. Workers should be aware that this section may not be relevant to the way in which the product is actually burned or decomposed.

Failure to report decomposition products fully is especially common and egregious when the product is a two-component pyrotechnic. These companies usually report decomposition of each component separately should they be involved in a fire. However, it is the smoke created when the product is used as directed about which data is needed.

HAZARDOUS POLYMERIZATION. Polymerization is the process by which the molecules of a chemical can combine to form larger molecules. Examples include the setting up of epoxy or polyester resins. Polymerization is hazardous if during the reaction excessive heat, gases, or some other byproduct is given off in amounts sufficient to cause fires, burst containers, or cause some other kind of harm. If high temperatures must be avoided to prevent polymerization, this should be stated in the Conditions to Avoid (see above).

SECTION VI - HEALTH HAZARD DATA

ROUTES OF ENTRY are the ways chemicals can enter the body.

INHALATION is the most common route. For example, vapors or dusts can be inhaled and absorbed by the body.

SKIN. If this route is checked, the material can be absorbed by the skin in significant amounts. Often it is also checked if it only damages the skin itself. Good MSDSs clarify whether skin damage and/or absorption can occur.

INGESTION. If this route is indicated, the material can be eaten, drunk, or swallowed, or inhaled particles can be expelled from the lungs and swallowed.

INJECTION is not a common route but may be included.

HEALTH HAZARDS, ACUTE AND CHRONIC. **This section usually varies greatly in quality.** Some manufacturers supply detailed data on both chronic and acute health effects. Others provide very little. **Workers should not consider this section sufficient and should supplement it from additional references.**

When there is very little data, it is likely that the chemical has never been studied for toxicity. Workers must understand that the majority of the roughly 80,000 chemicals used in the workplace and in

consumer products have never, ever, been studied for chronic effects. We literally do not know what effects they may have.

ACUTE. Information about short term exposure hazards belong here. Many MSDSs report OSHA and ACGIH short term exposure limits (STELs) and Ceiling limits (C) here. The OSHA PEL-STEL and the ACGIH TLV-STEL are for 15 minute exposures, while the Ceiling limits (PEL-C and TLV-C) are limits not to be exceeded at any time. The Odor Threshold (OT) if provided is also useful. Chemicals provide warning if their odor can be detected before their TLVs.

Other data commonly found here are LD50s and LC50s. The LC50 is the concentration in the air that will kill 50 % of the test animals when administered in a single exposure in a specific time period, usually one hour. LD50 is the single dose that will kill 50 % of the test animals by routes other than inhalation such as by ingestion or by skin contact. These tests establish the degree to which a chemical is acutely hazardous and determine if it is designated "non-toxic," "toxic," or "highly toxic" (see table below).

LABEL DEFINITIONS OF TOXICITY IN THE U.S. & CANADA

label term	LD50	LC50
Nontoxic	>5.0 g/kg*	> 20,000 ppm**
Toxic	0.05-5.0 "	200-20,000 "
Highly Toxic	< 0.05 "	< 200 "

* grams per kilogram of body weight.

** part per million: part of substance in 1 million parts of air.

As defined by the Federal Hazardous Substances Act (FHSA) in the U.S., and the Federal Hazardous Products Act in Canada, "non-toxic" means the substance passes the LD50 and LC50 acute or short term animal tests. Long term damage such as cancer and birth defects are not detected by these tests. For example, powdered asbestos passes these tests and is technically "non-toxic" because it doesn't cause cancer in animals in two weeks (the duration of the tests).

This is one reason that the FHSA has been amended to provide chronic hazard labeling for consumer product art materials. (This rule has now been extended to all U.S. consumer products, but as yet there is little or no compliance.) Art material labels must identify any known chronic hazards associated with the product. Unfortunately, many ingredients including almost all the organic pigments used in art materials have never been studied for chronic effects. And **in the US, chemicals for which there is no data, can be labeled "non-toxic" even if they are related to known toxic substances or carcinogens.**

CHRONIC. This section should report known chronic hazards such as cancer, reproductive or developmental damage, neurological or other organ damage to animals or humans related to repeated or long term exposure. **However, most chemicals used in paints, dyes, and other art and theater materials have never been studied for long term hazards. Failure to see data in this section should never be interpreted to mean that the material has no chronic hazards. Instead, care should be taken with all materials including those labeled 'nontoxic.'**

CARCINOGENICITY. There are three agencies whose opinions regarding carcinogenicity must be reported on MSDSs. These are:

* NTP (the National Toxicology Program);

* IARC (the International Agency for Research on Cancer); and

* OSHA. The categories for these agencies are as follows:

NTP: K – Known to be a human carcinogen.

R – Reasonably anticipated to be a carcinogen, with limited evidence in humans, sufficient evidence in experimental animals or some combination of these.

IARC: 1 – Carcinogenic to humans: sufficient evidence of carcinogenicity.

2A – Probably carcinogenic to humans; limited human evidence; sufficient evidence in experimental animals.

2B – Possibly carcinogenic to humans; limited human evidence in the absence of sufficient evidence in experimental animals.

3 – Unclassifiable as to carcinogenicity to humans.

4 – Probably not carcinogenic to humans.

OSHA: X – Carcinogen defined with no further categorization.

Some MSDSs state cancer data in words rather than listing categories. **If the MSDS says that "this chemical is not considered to be a carcinogen by NTP, IARC, or OSHA," it is most likely that these agencies have never evaluated the chemical because there is little or no data. Never assume the chemical has been evaluated by these agencies and found safe. If it were studied and found safe, the chemical would have an IARC 4 rating.**

REPRODUCTIVE HAZARDS. Chemicals such as lead and many solvents are teratogens (cause birth defects) and cause reproductive system damage. **But very few chemicals have been studied for these effects.** Pregnant women should avoid all unnecessary chemical exposures.

SIGNS AND SYMPTOMS OF EXPOSURE. These are usually acute or subacute manifestations of the chemical, since chronic exposure often produces no clear symptoms for years. If chronic symptoms are given they usually are identified as such.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE. Here the MSDS should list medical conditions which are known or suspected to be exacerbated by the chemical. For example, chemicals which are respiratory irritants may aggravate chronic lung conditions such as asthma or emphysema.

EMERGENCY AND FIRST AID PROCEDURES should be listed here. In some cases the recommendations will include actual first aid products that should be on hand. For example, MSDSs on glass etching creams or liquids should tell users to have calcium gluconate or benzalkonium chloride in the first aid kit.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING / USE

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED. The MSDS should list preferred methods for spill control (e.g. chemical absorbants, fuller's earth, etc.) and protective equipment (respirators, gloves, emergency ventilation, etc.) needed to keep workers safe during clean up of large spills or accidents. Some manufacturers have begun including more detailed disposal information such as advising that spills or releases of some substances such as lead, cadmium and certain solvents must be reported to the EPA almost immediately.

WASTE DISPOSAL METHOD. Unless the material can be rendered completely innocuous, MSDSs usually only advise users to dispose of the material in accordance with local, state, and federal regulations. Disposal has become extraordinarily complex because state, county, and municipal regulations may vary greatly. For this reason, disposal usually cannot be addressed in a few lines on

an MSDS. It is the user's responsibility to research local sewer, water, and waste rules before disposing of the products they use.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING. Here the MSDS should list safe storage conditions (e.g. cool, dry area).

OTHER PRECAUTIONS, if needed, should include any special equipment that would be needed or which is required to be in a storage area with the material.

SECTION VIII - CONTROL MEASURES

This section should provide information about protective equipment needed for normal use of the product. The manufacturer decides what constitutes "normal use." If there is any doubt about what is normal, or if any unusual or experimental use is contemplated, the employer should contact the manufacturer about additional protection. Manufacturers are usually not liable for damages if their products are used other than directed. Questions about the hazards of using the product in unusual ways should be answered in writing by the manufacturer or by a consulting industrial hygienist.

RESPIRATORY PROTECTION (SPECIFIC TYPE). If needed during normal use, a good MSDS tells the user whether or not there is a filter or cartridge capable of collecting the substance or if an air-supplied system will be necessary. However, the MSDS cannot be completely specific about respiratory protection because the type of respirator is determined by the concentration of the substance in the air. The manufacturer cannot predict the concentration because he/she does not know the conditions in the users facility under which the product will be used. It is the user's responsibility to personally monitor the workers to determine their exposures and to select the appropriate respirator.

VENTILATION. If needed during normal use, a good MSDS specifies the type of ventilation system that provides proper protection. This includes recommendations about the use of general (mechanical) ventilation, local exhaust (which captures the contaminants at their source), or any special ventilation system which might be needed.

PROTECTIVE GLOVES. Good MSDSs list the specific type of glove material needed (rubber, nitrile, etc.) and other glove attributes such as length and thickness. Workers should know that many chemicals penetrate gloves without changing the glove's appearance. It is the user's responsibility to contact the technical department of their glove supplier and obtain precise information about glove permeability.

EYE PROTECTION. Good MSDSs indicate the type of eyewear needed by their ANSI Z87.1 standard classification. For example, MSDSs may indicate whether vented or unvented chemical splash goggles, glasses rated for impact, or other specific types are needed.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT, such as aprons, boots, face shields, or eye wash stations should be listed here if needed.

WORK/HYGIENIC PRACTICES. Practices such as proper daily clean up methods and equipment after normal use should be detailed here.

TERMS NOT ON THIS DATA SHEET: Don't hesitate to call or write your Safety Officer about terms not found on this data sheet or for additional information about your products' MSDSs.