# Information Contained In Material Safety Data Sheets

by Robert Turkington, courtesy of Haztech Systems, Inc.

The regulations which implement the Hazardous Substances Information and Training Act do not specify the format to be used when writing an MSDS. Despite the inclusion of model MSDS provided in the regulation, many manufacturers and formulators have developed their own formats. Because of the differences between various formats, careful reading and an understanding of some scientific terms may be required to find and understand needed information in an MSDS.

As of this printing a world wide voluntary standard seems to be emerging based on the American National Standards Institute (ANSI) recommendation. ANSI is the U.S. representative to the International Organization for Standardization, who write the ISO 9000 and ISO 14000 standards.

Haztech Systems, Inc., utilizes the ANSI format for MSDS created after June, 2001.

ANSI standards are voluntary, however, OSHA now recommends that the ANSI format be utilized. OSHA cannot mandate this without a change in the federal legislation.

Significantly, the ANSI format has all of the information required by the OSHA 174 format sheets and other useful information. The information on an ANSI format sheet is arranged in a consistent format whereas OSHA has no format requirements, only content requirements. ANSI format is likely to be consistent from country to country, possibly permitting one to use the same MSDS in different markets without modification.

ANSI standard Z400.1-1998 "Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation" is the voluntary standard used to construct MSDS.

The ANSI standard MSDS contains 16 sections:

1. Substance identity and company contact information
2. Chemical composition and data on components
3. Hazards identification
4. First aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls and personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulations
16. Other information

Since MSDS format is decidedly not standardized, the following explanation of topics is intended to assist the reader in doing what an MSDS is meant to do: provide information. It is loosely based on the OSHA requirements, but the topics are appropriate to any MSDS.

We hope that the following will help you read an MSDS with greater understanding.

The MSDS provides the manufacturer's name, trade mark, product identification, a contact phone number, and often a contact person.

There are no specified qualifications for the person writing an MSDS. This can lead to problems when a person who may well be versed on many of the aspects writes an incorrect MSDS due to lack of knowledge in some specific area. Areas where a well-meaning person can make major errors by taking information from a label or another MSDS commonly include (but are not limited to) the sections on first aid and decomposition products. Some MSDS may be produced by totally unqualified persons. These may be very inaccurate. If the information required in a certain section of an MSDS is not available, it is proper to state so. It is not uncommon, however, for MSDS writers to guess or put in their best estimate. This can be very deceptive. In one case, a major, reputable, American company listed a tape as having a vapor pressure of 273 mmHg at 30°C because one component of the glue was acetone. The acetone was not even detectable coming off of the tape.

There is no way to know if the phone number listed on an MSDS is operable without calling. You may find that the person that answers the phone is NOT knowledgeable regarding the product. Below are some possible back-up numbers/useful emergency phone numbers:

Institute Makers of Explosives
212-689-3237

Oil Spills
800-852-7550

Pesticides
513-961-4300

ERDA
415-273-4237

Center for Disease Control
404-633-5313

CHEMTREC
800-424-9300

DOT Trans-shipment Information
202-462-9280

Poison Control Center
800-523-2222

24 Hour CAS Number Information
800-848-3747

Trade secrets are allowed under the law. An exemption from revealing specific ingredients due to fear of exposing "trade secrets" can not be claimed if standard lab procedures can identify the components of the product. Generally, if a laboratory fails to identify the product with standard methods, the material is either fairly well-reacted or tied up chemically (and will be non-hazardous), or unidentifiable due to a lack of available data. Very few claims for trade secrets hold up when challenged by OSHA, especially hazardous materials.

The MSDS must list the hazardous ingredients and the Permissible Exposure Limits. Sometimes listed, but required only in some states, is the CAS number. The percentage of ingredients also occasionally appears on the MSDS, but is not legally required.

Many MSDS will also list non-hazardous materials, however, this is not required by law. In California, a material is considered to be hazardous if it appears on the Director's List. Under Federal law the material must meet one of several criteria in order to appear on the MSDS.

An ingredient must be listed if it is more than 1% of the total end product and it is a hazardous material or if it is more than 0.1% and one of several regulated carcinogens. If the percentage of the ingredients is not shown, it is difficult to assess the hazard of the total product. An example of this can be seen in Chloroseptic® which contains 1.6% phenol. The MSDS for this product would read the same as an MSDS for a 90% industrial solution. One is a throat medicine, and the other a highly toxic DOT corrosive. Removing the percentage of ingredient removes the concept of dose.

The CAS (Chemical Abstract Service) number is only required in California but often appears on the MSDS no matter what its point, origin or destination. This number is a way to cross-reference a chemical in the event that the name listed is one that is not familiar to you. Usually the most commonly used name will be listed along with several synonyms. If you are not familiar with the names listed (many industries have a pet name for a material) the material can be cross referenced by the CAS number. For example, phenyl alcohol, benzalcohol, phenol and carbolic acid are all the same materials and have the same CAS number. A 24-hour CAS Number Information Service is listed above.

TLV/PEL/MAC/NIOSH or a local PEL may all be listed.

The PEL (Permissible Exposure Limit) is the legal OSHA standard for the airborne worker exposure to a material, as averaged over an 8-hour work-day so long as a ceiling limit has not been exceeded.

The TLV (Threshold Limit Value) is a suggested exposure limit to airborne contaminants provided by the American Conference of Governmental Hygienists. This is a far more flexible system than the PEL and a difference between the PEL and the TLV usually reflects a difference in current thinking from the time that the PEL was established. It is the quicker response to new information that makes the TLV an important resource.

The MAC (Maximum Allowable Concentration) was an old version of the PEL used by some states prior to the passage of OSHA. This term is generally being replaced but still appears in some older MSDS.

NIOSH (National Institute of Occupational Safety and Health) is the research agency for OSHA. They will do research on a substance and publish a suggested PEL.

Local PELs are found in many state OSHA plans. Each state has the option to have stricter PELs than are in OSHA. If you are under a state OSHA plan, then the legal standard in your particular case is not the OSHA standard, but the state plan standard.

All of the above are supposed to have a protection factor of from 10 to 100 built-in. This means that a person exposed to the PEL is exposed to factor of from 10 to 100 less than would harm a worker exposed 8 hours a day, 5 days a week for a period of 20 years. Not all PELs are based on a large body of scientific information, and unless there is complete understanding on how the specific PEL was derived, the PEL should not be used as an absolute indicator of relative hazard. When there is an absence of a PEL for a particular material some manufacturers will provide an LD50 (Lethal Dose to 50% exposed). The LD50 is usually more scientific, but may still be deceptive in that usually these are based on animal studies, which may or may not translate directly to human experience. Another drawback to LD50 is that most industrial exposure is by inhalation, whereas the LD50 measures exposure by ingestion. Usually LD50 data will specify an animal, and a route of entry. This can provide some idea of the relative toxicity of a material. The chart below gives the ratings of materials depending upon the LD50. LC50 (Lethal Concentration in air to 50% exposed) may also appear on the MSDS. This corresponds more closely to the PEL or the IDLH (Immediately Dangerous to Life and Health) as these are all airborne concentrations. LD50s tend to be ingestion or skin contact exposures.

The LD50 and the PEL are designed to provide a relative level of toxicity. A toxicity rating of 1 on a material says that there is a chance of poisoning associated with even the slightest possibility of ingestion. A toxicity of 6 would require consumption of more than a quart to cause problems through ingestion.

It is difficult even for a person well-versed in occupational health to assess the hazard of a product without some idea of the percentage of the ingredient in the product. A poison is defined by the dose. The dose is dependent on level of exposure and the duration of the exposure. A pound of salt will kill a person upon ingestion, however, salt enhances the flavor of potato chips. All of us will certainly consume a pound of salt in our lifetimes.

Remember, how hazardous a material actually is depends on how likely it is to make contact with YOU! You must consider the information on relative toxicity provided in Section 2 along with the information on vapor pressure in Section 3. For example, a bar of beryllium (an extremely toxic inhalation hazard metal) with a very low PEL and almost no vapor pressure is not normally as dangerous as an open cup of acetone which has a very high PEL but also has a very high vapor pressure.

There are generally some differences as to what is in any section of an MSDS from this point on. What follows is a general format which may or may not fit any given MSDS.

In the standard there is no legal requirement to rank the information in order or importance. Some of this information is far more important in helping the user understand the hazards that a material possesses. The listing of the information might be in the order of how important the manufacturer feels the information is in terms of emergency response.

## LD50 Toxicity Ratings By Various Routes

| Toxicity Rating | Common Term | LD50 Single Oral Dose (rat) | Inhalation, 4 Hr. LC50 (rat) | LD50 Skin (rabbit) | Probable LD50 (man) |
|---|---|---|---|---|---|
| 1 | Extremely toxic | < 1 mg/kg | < 10 ppm | < 5 mg/kg | a taste |
| 2 | Highly toxic | 1-50 mg/kg | 10-100 ppm | 5-43 mg/kg | 1 tsp. |
| 3 | Moderately toxic | 50-500 mg/kg | 100 - 1,000 ppm | 44-340 mg/kg | 1 oz. |
| 4 | Slightly toxic | 0.5-5 g/kg | 1,000 - 10,000 ppm | 350 mg - 2.81 g/kg | 1 pt. |
| 5 | Practically non-toxic | 5-15 g/kg | 10,000 - 100,000 ppm | 2.81-22.59 g/kg | 1 qt. |
| 6 | Relatively harmless | > 15 g/kg | > 100,000 ppm | >22.6 g/kg | > 1 qt. |

Vapor pressure is unfortunately NOT standardized and may be presented in any of several units and at any temperature.  Since temperature and vapor pressure are not linear, knowing the vapor pressure at one temperature does not necessarily give an indication of the vapor pressure at another temperature.  Even in the use of such standard reference books such as the NIOSH Pocket Guide to Chemical Hazards we find that we can not compare vapor pressures as they are listed at various temperatures.  It is possible to graph vapor pressure against flash point, which factors out the variables in units and allows relative flash points to give an indication of relative vapor pressure.  (Some flash points, for example chlorinated hydrocarbons, do not fit on the curve for most organics).  Most organic liquids will conform the graph below, with the exception of chlorinated solvents.

Any material that has a flash point below 100° F has sufficient vapor pressure to cause it to be an inhalation hazard.  Vapor pressures between 10 and 20 mmHg at 30°C correspond to a flash point near 100°F.  For reference, water has a vapor pressure of 30 mmHg at 100°F, and acetone has a vapor pressure of 275 mmHg at 100°F.  In order to convert units of vapor pressure we have included the information below.

°C = 5/9 x  (F°-32)

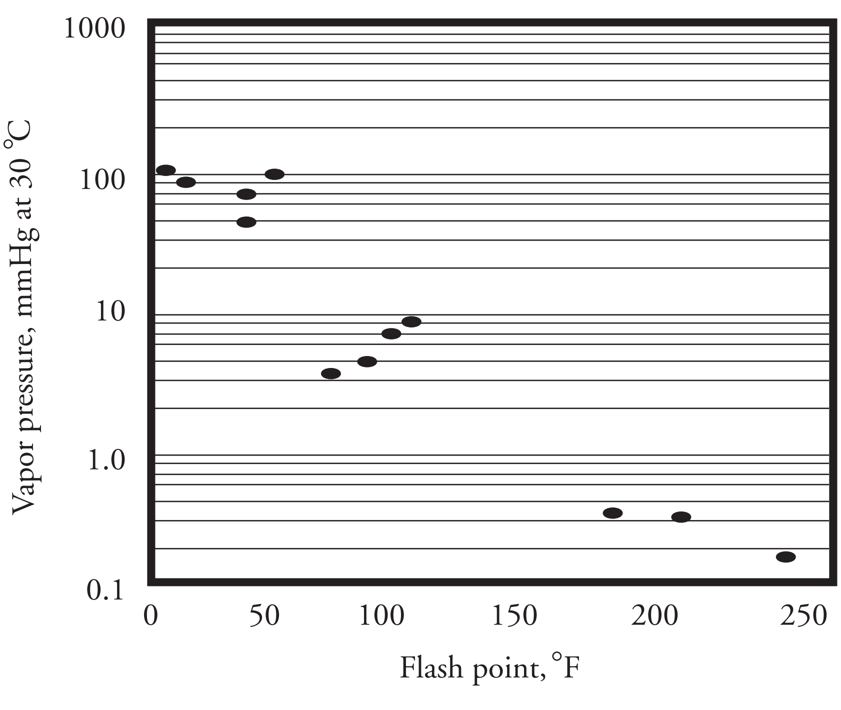
760 mmHg = 1 ATM

1.867 mmHg = 1 inch of water

0.350 mmHg = 1 LB/sq. ft

Vapor pressure should always be considered along with toxicity when considering how dangerous the material is.  For instance, consider acetone and sodium hydroxide.

## Vapor Pressure vs. Flash Point



Comparing their relative toxicity by PEL you come up with the following:

| | |
|---|---|
| Acetone | 1800 mg/M3 |
| Sodium hydroxide | 2 mg/M3 |

This would indicate that OSHA is willing to accept roughly 1000 times more acetone in a worker's body than sodium hydroxide. Sodium hydroxide is obviously the more toxic. However, the vapor pressure of sodium hydroxide is listed at 0 mmHg at 30°C while acetone has a vapor pressure of 180 mmHg at 30°C. If both were spilled into a small space, the vapor pressure would be far more critical than the toxicity. Generally, high vapor pressures indicate a high probability that a material can come to you. A material with a low vapor pressure and high toxicity may be much safer to work with than a material with a high vapor pressure and low toxicity. Always keep in mind the route of entry when considering these two properties. The most common route of entry for a hazardous material in industry is inhalation. In the case of sodium hydroxide, skin or eye contact would be a primary consideration when considering how dangerous the material is in the operation where you are using the material.

Vapor density indicates how likely the material is to lay around once it has been released to the atmosphere. All gases and vapors will eventually dissipate, however, initially the likelihood for a gas or vapor to stay or how likely it is to form pockets will depend upon a number of factors, including the temperature of both the atmosphere and the gas, the atmospheric turbulence, the volume of gas released, and the amount of confinement. Most gases and all vapors are heavier than air. The exceptions are hydrogen, helium, carbon monoxide, methane, ethane, and acetylene. A vapor density of 1 indicates that the gas is very similar physically to air. Materials that are liquids at room temperature will always have a vapor density greater than 1. If super cooled, all gases including hydrogen will lay on the ground as the cooling causes them to be denser.

Vapor densities near atmosphere generally do not much have much significance, however a vapor density of 5 can have great significance indicating that the gas has a very high possibility of being an asphyxiant. Freon 113 with a PEL of 1000 ppm, a vapor pressure of 285 mmHg at 30°C and a vapor density of 5 has asphyxiated a large number of workers. For Freon 113 the combination of vapor pressure and vapor density are far more important in understanding the hazard than are the LD50 or the PEL.

pH is rarely seen on an MSDS. The EPA presently classifies a pH less than 2 as an acid, and a pH of greater than 12.5 as a caustic. The DOT definition of a corrosive is a liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of contact, or in the case of leakage from its packaging, a liquid that causes a severe corrosion rate to that package or to steel. Although there are some field tests for the determination of DOT corrosives, generally it is easiest to look up the designation in CFR 49. The EPA is soon to incorporate a DOT type definition for corrosive. Generally pH is an indicator of a skin or eye contact hazard. Volatile materials such as ammonia may not quite be caustic per the EPA definition, however they are very hazardous by inhalation. Materials with low or high pH and a high vapor pressure should be considered very hazardous.

Appearance and odor can be subjective. Odor thresholds are difficult to find. Most manufacturers and producers do not wish to list odor thresholds as there is a large range of human response to odor. A listing of at least an average threshold would be useful because odor threshold is one of the criteria in deciding if a person can use an air purifying respirator. The appearance of a material may give some indication if what you have is as it should be.

Boiling point is the temperature at which a liquid changes to a vapor, because it has the same vapor pressure as the atmosphere above it. Generally, the lower the boiling point of a flammable liquid, the greater the vapor pressure and the greater the fire hazard. In MSDS, the atmospheric pressure is assumed to be at sea level. As the atmospheric pressure decreases so does the boiling point.

Solubility in water is usually written as either soluble or insoluble, or as the percentage of material by weight that will dissolve in water at ambient temperature. Solubility information can be useful in determining spill procedures as well as determining fire extinguishing agents and methods.

Specific gravity is the ratio of the weight of the material compared to an equal volume of water. Insoluble materials with specific gravity's of less than 1 will float on or in water, while a specific gravity of more than 1 will sink in water.

Melting point is the temperature at which a solid substance changes to a liquid state. For mixtures a melting range may be given. The melting point is very close to (and is sometimes called) the freezing point.

A section describes factors that should be considered when encountering a fire or the potential for ignition of the material.

Flash point gives a good idea of how likely something is to be ignited should there be an available spark source in the area. The flash point is the lowest temperature which will cause vapor to be given off in sufficient quantity to ignite in the presence of an ignition source. Since flash points vary with the test method, the method is often shown (although not always). Tag Closed Cup (PMCC), Open Cup, and Setaflash (SETA) are some of the more common methods. The EPA Laboratory Manual SW-846 references Pensky-Martens Closed-Cup and the Setaflash methods for determining ignitability. Open cup flash points will be higher than closed cup flash points. Flash point is directly related to the vapor pressure, with a flash point of 100°F indicating a vapor pressure of between 10 and 20 mmHg at 30°C.

The flash point has many specific legal definitions found in several regulations:

Less than 30°F: Extremely Flammable, OSHA, Consumer products

Less than 100°F: Flammable, OSHA, Consumer products

Less than 140°F: Flammable, DOT, Hazardous Waste, Ignitable

Less than 240°F: Combustible

Flammable or Explosive Limits, (LEL, UEL, LFL, UFL) are far more descriptive of the actions of a gas or vapor than most people understand.

Lower Explosive Limit (LEL) is the lowest percentage of a vapor or a gas in air at which if a spark is introduced, combustion will occur. If the gas or vapor is located in a confined space an explosion may occur.

Lower Flammable limit (LFL) is the same as LEL.

Upper Explosive Limit (UEL) is the level at which the vapor is too richly mixed in the air to ignite.

Upper Flammable Limit (UFL) is the same as UEL.

LELs and UELs are expressed as percent. This can be confusing as they are expressed in percent of a percent. For instance if the LEL for methane is 5%, then 10% of the LEL (the level at which OSHA does not allow entry) is actually 0.5% of methane in the air, which is 5,000 ppm. Knowing the LEL provides very little information without some additional information and understanding.

If the vapor pressure of the material is very low, and the atmosphere is very cold where the material is located then the LEL will have less significance. However, if the flash point is close to the ambient temperature, and the vapor pressure is high, the LEL is likely to be reached quickly in a closed space.

The following may be of help in understanding how LELs and UELs (especially the range between the LEL and UEL) can affect the characteristics of a material.

Acetic acid and hydrazine have flash points and vapor pressures which are about the same, but hydrazine has a wide range, between the LEL and the UEL while acetic acid has a narrow range.

The flash point of acetic acid is 102°F. Vapor pressure: 11 mmHg at 30°C.

The flash point of hydrazine is 99°F. Vapor pressure: 10 mmHg at 30°C.

Using the flash points one would assume that hydrazine and acetic acid would be similar in their flammability characteristics. However, comparing their LELs and UELs we find:

Hydrazine LEL = 2.9% and UEL = 98%

Acetic acid LEL = 4% and UEL = 19.9%

With hydrazine 95% of all of its potential atmospheres ignite, while with acetic acid only 16% of its atmospheres will ignite. Here, neither the flash point nor the vapor indicate the likelihood that hydrazine is going to burn, more readily, however the LEL, UEL range identifies the fire danger related to hydrazine, which is not found in acetic acid.

The lower the LEL, the greater the chance that the LEL can be reached. So if the range is similar, as with benzene and ammonia:

Ammonia is a gas at room temperature (therefore no flash point is assigned). LEL: 15%. UEL: 28%.

Benzene Flash Point:12°F. Vapor Pressure: 75 mmHg at 30°C. LEL: 1.3%. UEL: 7.9%

With ammonia being a gas, one would expect it to be the more flammable of the two, especially with it already being the more volatile. The ranges are almost the same. With benzene, 6.6% of the atmospheres will burn, with ammonia the percentage is 10.3%. However in the case of ammonia, one has to reach 15% to burn.

The width of the range also indicates how the material will react. Methane and hydrogen are both flammable gases. Hydrogen has a range of 12% to 75%, methane has a range from 5% to 12%. 62% of hydrogen's atmospheres will explode, where as only 7% of methane's atmosphere will explode. The differences in the two flammable gases manifest themselves as follows:

Hydrogen gas lines must be purged or there is a high likelihood of explosion.

Methane gas lines need not be purged. Methane is more likely to cause a room to explode, where hydrogen is more likely to cause a pipe or reactor explosion.

Extinguishing media is dependent on physical characteristics. The media must be chosen not only to extinguish a fire, but to not increase the problems associated with a fire.

Class A extinguishers are best for wood paper, rags and rubbish. They work through the cooling effect of water. Multi-purpose dry chemicals also provide quick knock down and tend to retard further combustion.

Class B extinguishers are for the vapor-air mixtures over the surface of flammable liquids. These work by limiting oxygen, or by combustion-inhibiting effects. These include dry chemical, carbon dioxide, foam and halogenated hydrocarbons.

Class C extinguishers are for electrical equipment.

Class D extinguishers are for combustible metals such as sodium or magnesium. These generally can not be put out with any of the above and should be listed as special case. For more information concerning these unusual materials consult NFPA Standards 49 and 325, Hazardous Chemicals Data and Fire Hazard Properties of Flammable Liquids, Gases, Volatile Solids.

Unusual fire-fighting procedures must be described. If there are no special procedures nothing will be listed here. This is a difficult section in that although there may be special aspects of the product which remain constant, the use amount transport and containment of the product may greatly change how a fire might affect a product in any given operation.

Unusual fire and explosion hazards including hazardous by-products of high heat, fire or chemical decomposition should be identified if known. This is an area where considerable research still needs to be done and is often an area of the MSDS where questionable statements are found or where inadequate information is likely. Fires create so many breakdown products that often the hazards come mostly from non-hazardous (materials not requiring an MSDS) components of the fire. Wool, for instance, produces cyanide and many plastics produce lethal amounts of hydrochloric acid in smoke.

Autoignition temperature is the approximate lowest temperature at which a flammable gas or vapor-air mixture will spontaneously ignite without a spark or flame. An autoignition temperature anywhere near or below 140°F indicates a very hazardous material. Autoignition temperature is not related to the flash point and the temperature range between these two points varies considerably from chemical to chemical.

A section describes any tendency or potential of the material to undergo a chemical change and release energy. Undesirable effects such as temperature increase and formation of toxic, corrosive, or flammable gases and by-products due to heating or as a result of contact with other materials will be described here. DOT hazard categories, which should always be in this section, include, but are not limited to:

Explosives

Water Reactive

Oxidizers

Corrosives

Other materials which should be noted in this section include plastic pre-polymers and chemicals which are unstable (or unstable under certain conditions) such as catalysts or strong reducing agents.

Stability of a material to remain unchanged during storage varies. Materials that can spontaneously generate heat, polymerize, expand, form a gas or detonate should be noted in this section. A material can be unstable and not dangerous. Rubber, for example, can rot while standing.

Incompatibility of materials which should not be stored with your specific material due to the possibility of reactivity are also listed. Everything will react with something. In one scheme there are 104 incompatible groupings. HazCat lists 6 groups of acids, and 9 types of incompatible oxidizers. In a good MSDS the type of reaction that might occur and the by-products of that reaction will be listed. Do not assume that because nothing is listedthere are no incompatible materials.

Hazardous decomposition products of a material are not necessarily related to heat, fire, or any physical stress to the material. Hypochlorite will give off chlorine while decomposing as part of a natural degrading process. While there is no PEL for calcium hypochlorite in the MSDS, in fact, the worker is exposed to the decomposition product, which has a PEL that should be listed here.

A section provides information on the ways the chemical may enter the body. Generally in industry the routes of entry are:

*Inhalation* This is generally the most common route of entry.

*Skin absorption* This is the second most likely route in industry.

*Injection* Can occur when sharp objects are contaminated with the substance.

*Ingestion* Occurs when employees smoke or eat near a material.

*Eye absorption* is rare, but must be considered, as eye transport of a material can be very efficient.

The routes of entry must be carefully considered by the person using the product, as the person providing the product may have no knowledge of how it is being used in the specific operation. Once the most likely or most hazardous route of entry is established the operation should be looked at in terms of such a likelihood occurring.

Health hazard effects of exposure include the symptoms for chronic and acute effects of a material. Local effects are easier to understand for most workers, systemic effects on the body may not be so obvious. Hopefully, by reading this section a worker can be warned if there is a breakdown in the protective measures provided in an operation.

Acute exposures, especially local acute exposures, offer the most warning. Any acute exposure is an indication that worker protection has broken down. Using acute exposure as a measure of hazard is NOT very effective, as it implies that no consideration has been given to the properties of the product, and that the worker is being used as a test animal. Symptoms of acute exposure should be well-understood by the worker. Acute exposures are of short duration, and more related to safety than health.

Chronic exposures are more subtle. It is not uncommon to find even “experts” in the field who mix the symptoms of chronic and acute exposure when discussing a material. Chronic effects are due to long, sub-clinical exposures. Since the symptoms of chronic exposures are IRREVERSIBLE these should never be used as a measure of overexposure. This section of the MSDS should be part of a workers own files, as the chronic effects may not show up for a period of time, and a workers claim for compensation due to a chronic exposure may occur long after the exposure is over. Since in systemic chronic exposures the cause and effect may not be obvious, the worker should know what parts of the body are affected by a material.

Carcinogenicity of a material must be noted if the material is listed by NTP, IARC, or is on the OSHA list of cancer suspects. This should always be addressed, even if only to establish that the material is NOT a carcinogen.

Medical conditions that are aggravated by exposure is a difficult section, and unless there is a specific body of published information about a material, this section is usually more noted for its absence from the MSDS. The PELs are based on the effects a material will have on a healthy average worker. There is rarely any attempt to deal with the supersensitive person, who in some cases just should not be around a certain material. This section is very difficult as it requires insight into certain medical conditions which may predispose a person toward having problems when working with a certain material. An example of a supersensitive person would be an asthmatic, who simply should not work around TDI.

Synergism, the ability of one material to greatly effect the toxicity of another material, may be discussed. An example: if a person is exposed to large amounts of asbestos the chances of asbestos-related cancer triple, however if the person smokes and is exposed to high levels of asbestos, the person has 95 times more chance of incurring an asbestos-related lung cancer.

Pregnancy provides a route for the industrial exposure to reach a person for which no PEL has been established. Certain chemicals are known to affect the fetus, others are known to affect the parent in such a way that reproduction can be interrupted or stressed to the point a fetus will not be healthy.

Emergency and First Aid should be based on anticipated effects. Be aware that especially in older labels and MSDSs there are emergency procedures which if applied could actually cause death. Examples include the recommendation to cause vomiting for a person who has drunk a volatile hydrocarbon, or cleaning phenol skin contact with alcohol. These are examples of the worse possible plan of action.

Certain materials may require antidotes which some hospitals may not have. There are recorded cases of arriving at a hospital only to find the only immediately available antidote was in the first aid box at the plant. Examples of unusual antidotes are amyl nitrate for cyanide exposures, and calcium glutamate for skin contacts with hydrofluoric acid. The Matheson Gas Company publishes a very good book with antidotes for many very toxic materials.

Steps to be taken in case a material is released or spilled are difficult to write into an MSDS. Local jurisdictions will have different regulations, and the amount spilled can have a significant effect on how to manage the event. This section describes how to properly contain and handle the material in the event of spill or leaks that may harm nearby persons, lead to a dangerous or destructive situation (the release of large amounts of flammable vapor, for example) or damage the environment. This section should include recommendations on clean-up procedures and materials, as well as personal protective clothing, including gloves and respirators.

Waste disposal is difficult to write into an MSDS. Local jurisdictions will have different regulations, and the amount spilled can have a significant effect on how to manage the event. We strongly recommend that local authorities be contacted for recommendations on disposal.

Special precautions provide information regarding special measures for storage and/or handling which were not covered in other sections.

Control measure recommendations are given regarding types of control measures and protective devices that may be necessary. Recommendations will include:

Personal protective equipment (PPE) including respirators

Administrative controls, such as limiting the time of exposure

Engineering controls, such as ventilation systems.

Unless the control of an exposure is not feasible or the operation is so short and transitory that an engineering control is not reasonable, OSHA will require engineering control as the method of worker protection.

Often the MSDS will simply recommend respirators or ventilation. Such recommendations are not much help without knowing the operation in which the material will be used. Controls should only be recommended after understanding possible routes of exposure and the levels of exposure.

Other items which might appear include:

- NFPA diamonds. These are divided into four sections, three of which display numbers. 4 is very hazardous, 0 is relatively little hazard.

- DOT (Department of Transportation) information such as required hazard labeling and placards.

- EPA (Environmental Protection Agency) information including whether or not the material is considered a hazardous waste by the EPA or the hazardous waste classification.

- CAS (Chemical Abstract Service) number.

- Monitoring methods. The types of sampling equipment, or sampling media necessary for measuring the airborne concentrations of a chemical, in order to insure that the employee working with the material is in fact exposed to zero, low or safe levels of the airborne chemical.

- Issue information, the date the sheet was issued or last updated, and the name and credentials of the person preparing the MSDS.

- Warning labels:

  DANGER highly toxic,

  WARNING moderately toxic

  CAUTION slightly toxic

REMEMBER! Not all MSDS are written by experts and no expert knows everything that should go on an MSDS. The law allows for the information blanks where the information is not available, but some people may guess. You are better off knowing there is an information gap instead of believing a guess. There are examples of MSDS produced by substantial companies where the MSDS is deceptive because they have tried to fill in all the blanks.