inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

7. "*Target organ effects.*" The following is a target organ categorization of effects which may occur, including examples of signs and symptoms and chemicals which have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all-inclusive.

a. Hepatotoxins: Chemicals which produce liver damage
Signs & Symptoms: Jaundice; liver enlargement
Chemicals: Carbon tetrachloride; nitrosamines

b. Nephrotoxins: Chemicals which produce kidney damage
Signs & Symptoms: Edema; proteinuria
Chemicals: Halogenated hydrocarbons; uranium

c. Neurotoxins: Chemicals which produce their primary toxic effects on the nervous system
Signs & Symptoms: Narcosis; behavioral changes; decrease in motor functions
Chemicals: Mercury; carbon disulfide

d. Agents which act on the blood or hematopoietic system: Decrease hemoglobin function; deprive the body tissues of oxygen
Signs & Symptoms: Cyanosis; loss of consciousness
Chemicals: Carbon monoxide; cyanides

e. Agents which damage the lung: Chemicals which irritate or damage pulmonary tissue
Signs & Symptoms: Cough; tightness in chest; shortness of breath
Chemicals: Silica; asbestos

f. Reproductive toxins: Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)
Signs & Symptoms: Birth defects; sterility
Chemicals: Lead; DBCP

g. Cutaneous hazards: Chemicals which affect the dermal layer of the body
Signs & Symptoms: Defatting of the skin; rashes; irritation
Chemicals: Ketones; chlorinated compounds

h. Eye hazards: Chemicals which affect the eye or visual capacity
Signs & Symptoms: Conjunctivitis; corneal damage
Chemicals: Organic solvents; acids

1910.1200 Appendix B - Hazard Determination (Mandatory)

The quality of a hazard communication program is largely dependent upon the adequacy and accuracy of the hazard determination. The hazard determination requirement of this standard is performance-oriented. Chemical manufacturers, importers, and employers evaluating chemicals are not required to follow any specific methods for determining hazards, but they must be able to demonstrate that they have adequately ascertained the hazards of the chemicals produced or imported in accordance with the criteria set forth in this Appendix.

Hazard evaluation is a process which relies heavily on the professional judgment of the evaluator, particularly in the area of chronic hazards. The performance-orientation of the hazard determination does not diminish the duty of the chemical manufacturer, importer or employer to conduct a thorough evaluation, examining all relevant data and producing a scientifically defensible evaluation. For purposes of this standard, the following criteria shall be used in making hazard determinations that meet the requirements of this standard.

1. "Carcinogenicity:" As described in paragraph (d)(4) of this section and Appendix A of this section, a determination by the National Toxicology Program, the International Agency for Research on Cancer, or OSHA that a chemical is a carcinogen or potential carcinogen will be considered conclusive evidence for purposes of this section. In addition, however, all available scientific data on carcinogenicity must be evaluated in accordance with the provisions of this Appendix and the requirements of the rule.

2. "Human data:" Where available, epidemiological studies and case reports of adverse health effects shall be considered in the evaluation.

3. "Animal data:" Human evidence of health effects in exposed populations is generally not available for the majority of chemicals produced or used in the workplace. Therefore, the available results of toxicological testing in animal populations shall be used to predict the health effects that may be experienced by exposed workers. In particular, the definitions of certain acute hazards refer to specific animal testing results (see Appendix A).

4. "Adequacy and reporting of data." The results of any studies which are designed and conducted according to established scientific principles, and which report statistically significant conclusions regarding the health effects of a chemical, shall be a sufficient basis for a hazard determination and reported on any material safety data sheet. In vitro studies alone generally do not form the basis for a definitive finding of hazard under the HCS since they have a positive or negative result rather than a statistically significant finding.

The chemical manufacturer, importer, or employer may also report the results of other scientifically valid studies which tend to refute the findings of hazard.

1910.1200 Appendix D - Definition of "Trade Secret" (Mandatory)

The following is a reprint of the "Restatement of Torts" section 757, comment b (1939):

b. "Definition of trade secret." A trade secret may consist of any formula, pattern, device or compilation of information which is used in one's business, and which gives him an opportunity to obtain an advantage over competitors who do not know or use it. It may be a formula for a chemical compound, a process of manufacturing, treating or preserving materials, a pattern for a machine or other device, or a list of customers. It differs from other secret information in a business (see s759 of the Restatement of Torts which is not included in this Appendix) in that it is not simply information as to single or ephemeral events in the conduct of the business, as, for example, the amount or other terms of a secret bid for a contract or the salary of certain employees, or the security investments made or contemplated, or the date fixed for the announcement of a new policy or for bringing out a new model or the like. A trade secret is a process or device for continuous use in the operations of the business. Generally it relates to the production of goods, as, for example, a machine or formula for the production of an article. It may, however, relate to the sale of goods or to other operations in the business, such as a code for determining discounts, rebates or other concessions in a price list or catalogue, or a list of specialized customers, or a method of bookkeeping or other office management.

"Secrecy." The subject matter of a trade secret must be secret. Matters of public knowledge or of general knowledge in an industry cannot be appropriated by one as his secret. Matters which are completely disclosed by the goods which one markets cannot be his secret. Substantially, a trade secret is known only in the particular business in which it is used. It is not requisite that only the proprietor of the business know it. He may, without losing his protection, communicate it to employees involved in its use. He may likewise communicate it to others pledged to secrecy. Others may also know of it independently, as, for example, when they have discovered the process or formula by independent invention and are keeping it secret. Nevertheless, a substantial element of secrecy must exist, so that, except by the use of improper means, there would be difficulty in acquiring the information. An exact definition of a trade secret is not possible. Some factors to be considered in determining whether given information is one's trade secret are: (1) The extent to which the information is known outside of his business; (2) the extent to which it is known by employees and others involved in his business; (3) the extent of measures taken by him to guard the secrecy of the information; (4) the value of the information to him and his competitors; (5) the amount of effort or money expended by him in developing the information; (6) the ease or difficulty with which the information could be properly acquired or duplicated by others.

"Novelty and prior art." A trade secret may be a device or process which is patentable; but it need not be that. It may be a device or process which is clearly anticipated in the prior art or one which is merely a mechanical improvement that a good mechanic can make. Novelty and invention are not requisite for a trade secret as they are for patentability. These requirements are essential to patentability because a patent protects against unlicensed use of the patented device or process even by one who discovers it properly through independent research. The patent monopoly is a reward to the inventor. But such is not

the case with a trade secret. Its protection is not based on a policy of rewarding or otherwise encouraging the development of secret processes or devices. The protection is merely against breach of faith and reprehensible means of learning another's secret. For this limited protection it is not appropriate to require also the kind of novelty and invention which is a requisite of patentability. The nature of the secret is, however, an important factor in determining the kind of relief that is appropriate against one who is subject to liability under the rule stated in this Section. Thus, if the secret consists of a device or process which is a novel invention, one who acquires the secret wrongfully is ordinarily enjoined from further use of it and is required to account for the profits derived from his past use. If, on the other hand, the secret consists of mechanical improvements that a good mechanic can make without resort to the secret, the wrongdoer's liability may be limited to damages, and an injunction against future use of the improvements made with the aid of the secret may be inappropriate.

1910.1200 Appendix E - Guidelines for Employer Compliance (Advisory)

The Hazard Communication Standard (HCS) is based on a simple concept - that employees have both a need and a right to know the hazards and identities of the chemicals they are exposed to when working. They also need to know what protective measures are available to prevent adverse effects from occurring. The HCS is designed to provide employees with the information they need.

Knowledge acquired under the HCS will help employers provide safer workplaces for their employees. When employers have information about the chemicals being used, they can take steps to reduce exposures, substitute less hazardous materials, and establish proper work practices. These efforts will help prevent the occurrence of work-related illnesses and injuries caused by chemicals.

The HCS addresses the issues of evaluating and communicating hazards to workers. Evaluation of chemical hazards involves a number of technical concepts, and is a process that requires the professional judgment of experienced experts. That's why the HCS is designed so that employers who simply use chemicals, rather than produce or import them, are not required to evaluate the hazards of those chemicals. Hazard determination is the responsibility of the producers and importers of the materials. Producers and importers of chemicals are then required to provide the hazard information to employers that purchase their products.

Employers that don't produce or import chemicals need only focus on those parts of the rule that deal with establishing a workplace program and communicating information to their workers. This appendix is a general guide for such employers to help them determine what's required under the rule. It does not supplant or substitute for the regulatory provisions, but rather provides a simplified outline of the steps an average employer would follow to meet those requirements.

1. "Becoming Familiar With The Rule."

OSHA has provided a simple summary of the HCS in a pamphlet entitled "Chemical Hazard Communication," OSHA Publication Number 3084. Some employers prefer to begin to become familiar with the rule's requirements by reading this pamphlet. A copy may be obtained from your local OSHA Area Office, or by contacting the OSHA Publications Office at (202) 523-9667.

The standard is long, and some parts of it are technical, but the basic concepts are simple. In fact, the requirements reflect what many employers have been doing for years. You may find that you are already largely in compliance with many of the provisions, and will simply have to modify your existing programs somewhat. If you are operating in an OSHA-approved State Plan State, you must comply with the State's requirements, which may be different than those of the Federal rule. Many of the State Plan States had hazard communication or "right-to-know" laws prior to promulgation of the Federal rule. Employers in State Plan States should contact their State OSHA offices for more information regarding applicable requirements.

The HCS requires information to be prepared and transmitted regarding all hazardous chemicals. The HCS covers both physical hazards (such as flammability), and health hazards (such as irritation, lung damage, and cancer). Most chemicals used in the workplace have some hazard potential, and thus will be covered by the rule.

One difference between this rule and many others adopted by OSHA is that this one is performance-oriented. That means that you have the flexibility to adapt the rule to the needs of your

workplace, rather than having to follow specific, rigid requirements. It also means that you have to exercise more judgment to implement an appropriate and effective program.

The standard's design is simple. Chemical manufacturers and importers must evaluate the hazards of the chemicals they produce or import. Using that information, they must then prepare labels for containers, and more detailed technical bulletins called material safety data sheets (MSDS).

Chemical manufacturers, importers, and distributors of hazardous chemicals are all required to provide the appropriate labels and material safety data sheets to the employers to which they ship the chemicals. The information is to be provided automatically. Every container of hazardous chemicals you receive must be labeled, tagged, or marked with the required information. Your suppliers must also send you a properly completed material safety data sheet (MSDS) at the time of the first shipment of the chemical, and with the next shipment after the MSDS is updated with new and significant information about the hazards.

You can rely on the information received from your suppliers. You have no independent duty to analyze the chemical or evaluate the hazards of it.

Employers that "use" hazardous chemicals must have a program to ensure the information is provided to exposed employees. "Use" means to package, handle, react, or transfer. This is an intentionally broad scope, and includes any situation where a chemical is present in such a way that employees may be exposed under normal conditions of use or in a foreseeable emergency.

The requirements of the rule that deal specifically with the hazard communication program are found in this section in paragraphs (e), written hazard communication program; (f), labels and other forms of warning; (g), material safety data sheets; and (h), employee information and training. The requirements of these paragraphs should be the focus of your attention. Concentrate on becoming familiar with them, using paragraphs (b), scope and application, and (c), definitions, as references when needed to help explain the provisions.

There are two types of work operations where the coverage of the rule is limited. These are laboratories and operations where chemicals are only handled in sealed containers (e.g., a warehouse). The limited provisions for these workplaces can be found in paragraph (b) of this section, scope and application. Basically, employers having these types of work operations need only keep labels on containers as they are received; maintain material safety data sheets that are received, and give employees access to them; and provide information and training for employees. Employers do not have to have written hazard communication programs and lists of chemicals for these types of operations.

The limited coverage of laboratories and sealed container operations addresses the obligation of an employer to the workers in the operations involved, and does not affect the employer's duties as a distributor of chemicals. For example, a distributor may have warehouse operations where employees would be protected under the limited sealed container provisions. In this situation, requirements for obtaining and maintaining MSDSs are limited to providing access to those received with containers while the substance is in the workplace, and requesting MSDSs when employees request access for those not received with the containers. However, as a distributor of hazardous chemicals, that employer will still have responsibilities for providing MSDSs to downstream customers at the time of the first shipment and when the MSDS is updated. Therefore, although they may not be required for the employees in the work operation, the distributor may, nevertheless, have to have MSDSs to satisfy other requirements of the rule.

2. "Identify Responsible Staff"

Hazard communication is going to be a continuing program in your facility. Compliance with the HCS is not a "one shot deal." In order to have a successful program, it will be necessary to assign responsibility for both the initial and ongoing activities that have to be undertaken to comply with the rule. In some cases, these activities may already be part of current job assignments. For example, site supervisors are frequently responsible for on-the-job training sessions. Early identification of the responsible employees, and involvement of them in the development of your plan of action, will result in a more effective program design. Evaluation of the effectiveness of your program will also be enhanced by involvement of affected employees.

For any safety and health program, success depends on commitment at every level of the organization. This is particularly true for hazard communication, where success requires a change in behavior. This will

only occur if employers understand the program, and are committed to its success, and if employees are motivated by the people presenting the information to them.

3. "Identify Hazardous Chemicals in the Workplace."

The standard requires a list of hazardous chemicals in the workplace as part of the written hazard communication program. The list will eventually serve as an inventory of everything for which an MSDS must be maintained. At this point, however, preparing the list will help you complete the rest of the program since it will give you some idea of the scope of the program required for compliance in your facility.

The best way to prepare a comprehensive list is to survey the workplace. Purchasing records may also help, and certainly employers should establish procedures to ensure that in the future purchasing procedures result in MSDSs being received before a material is used in the workplace.

The broadest possible perspective should be taken when doing the survey. Sometimes people think of "chemicals" as being only liquids in containers. The HCS covers chemicals in all physical forms - liquids, solids, gases, vapors, fumes, and mists - whether they are "contained" or not. The hazardous nature of the chemical and the potential for exposure are the factors which determine whether a chemical is covered. If it's not hazardous, it's not covered. If there is no potential for exposure (e.g., the chemical is inextricably bound and cannot be released), the rule does not cover the chemical.

Look around. Identify chemicals in containers, including pipes, but also think about chemicals generated in the work operations. For example, welding fumes, dusts, and exhaust fumes are all sources of chemical exposures. Read labels provided by suppliers for hazard information. Make a list of all chemicals in the workplace that are potentially hazardous. For your own information and planning, you may also want to note on the list the location(s) of the products within the workplace, and an indication of the hazards as found on the label. This will help you as you prepare the rest of your program.

Paragraph (b) of this section, scope and application, includes exemptions for various chemicals or workplace situations. After compiling the complete list of chemicals, you should review paragraph (b) of this section to determine if any of the items can be eliminated from the list because they are exempted materials. For example, food, drugs, and cosmetics brought into the workplace for employee consumption are exempt. So rubbing alcohol in the first aid kit would not be covered.

Once you have compiled as complete a list as possible of the potentially hazardous chemicals in the workplace, the next step is to determine if you have received material safety data sheets for all of them. Check your files against the inventory you have just compiled. If any are missing, contact your supplier and request one. It is a good idea to document these requests, either by copy of a letter or a note regarding telephone conversations. If you have MSDSs for chemicals that are not on your list, figure out why. Maybe you don't use the chemical anymore. Or maybe you missed it in your survey. Some suppliers do provide MSDSs for products that are not hazardous. These do not have to be maintained by you.

You should not allow employees to use any chemicals for which you have not received an MSDS. The MSDS provides information you need to ensure proper protective measures are implemented prior to exposure.

4. "Preparing and Implementing a Hazard Communication Program"

All workplaces where employees are exposed to hazardous chemicals must have a written plan which describes how the standard will be implemented in that facility. Preparation of a plan is not just a paper exercise - all of the elements must be implemented in the workplace in order to be in compliance with the rule. See paragraph (e) of this section for the specific requirements regarding written hazard communication programs. The only work operations which do not have to comply with the written plan requirements are laboratories and work operations where employees only handle chemicals in sealed containers. See paragraph (b) of this section, scope and application, for the specific requirements for these two types of workplaces.

The plan does not have to be lengthy or complicated. It is intended to be a blueprint for implementation of your program - an assurance that all aspects of the requirements have been addressed.

Many trade associations and other professional groups have provided sample programs and other assistance materials to affected employers. These have been very helpful to many employers since they tend to be tailored to the particular industry involved. You may wish to investigate whether your industry trade groups have developed such materials.

Although such general guidance may be helpful, you must remember that the written program has to reflect what you are doing in your workplace. Therefore, if you use a generic program it must be adapted to address the facility it covers. For example, the written plan must list the chemicals present at the site, indicate who is to be responsible for the various aspects of the program in your facility, and indicate where written materials will be made available to employees.

If OSHA inspects your workplace for compliance with the HCS, the OSHA compliance officer will ask to see your written plan at the outset of the inspection. In general, the following items will be considered in evaluating your program.

The written program must describe how the requirements for labels and other forms of warning, material safety data sheets, and employee information and training, are going to be met in your facility. The following discussion provides the type of information compliance officers will be looking for to decide whether these elements of the hazard communication program have been properly addressed:

A. "Labels and Other Forms of Warning"

In-plant containers of hazardous chemicals must be labeled, tagged, or marked with the identity of the material and appropriate hazard warnings. Chemical manufacturers, importers, and distributors are required to ensure that every container of hazardous chemicals they ship is appropriately labeled with such information and with the name and address of the producer or other responsible party. Employers purchasing chemicals can rely on the labels provided by their suppliers. If the material is subsequently transferred by the employer from a labeled container to another container, the employer will have to label that container unless it is subject to the portable container exemption. See paragraph (f) of this section for specific labeling requirements.

The primary information to be obtained from an OSHA-required label is an identity for the material, and appropriate hazard warnings. The identity is any term which appears on the label, the MSDS, and the list of chemicals, and thus links these three sources of information. The identity used by the supplier may be a common or trade name ("Black Magic Formula"), or a chemical name (1,1,1,-trichloroethane). The hazard warning is a brief statement of the hazardous effects of the chemical ("flammable," "causes lung damage"). Labels frequently contain other information, such as precautionary measures ("do not use near open flame"), but this information is provided voluntarily and is not required by the rule. Labels must be legible, and prominently displayed. There are no specific requirements for size or color, or any specified text.

With these requirements in mind, the compliance officer will be looking for the following types of information to ensure that labeling will be properly implemented in your facility:

1. Designation of person(s) responsible for ensuring labeling of in-plant containers;
2. Designation of person(s) responsible for ensuring labeling of any shipped containers;
3. Description of labeling system(s) used;
4. Description of written alternatives to labeling of in-plant containers (if used); and,
5. Procedures to review and update label information when necessary.

Employers that are purchasing and using hazardous chemicals - rather than producing or distributing them - will primarily be concerned with ensuring that every purchased container is labeled. If materials are transferred into other containers, the employer must ensure that these are labeled as well, unless they fall under the portable container exemption (paragraph (f)(7) of this section). In terms of labeling systems, you can simply choose to use the labels provided by your suppliers on the containers. These will generally be verbal text labels, and do not usually include numerical rating systems or symbols that require special training. The most important thing to remember is that this is a continuing duty - all in-plant containers of hazardous chemicals must always be labeled. Therefore, it is important to designate someone to be responsible for ensuring that the labels are maintained as required on the containers in your facility, and that newly purchased materials are checked for labels prior to use.

B. "Material Safety Data Sheets"

Chemical manufacturers and importers are required to obtain or develop a material safety data sheet for each hazardous chemical they produce or import. Distributors are responsible for ensuring that their customers are provided a copy of these MSDSs. Employers must have an MSDS for each hazardous chemical which they use. Employers may rely on the information received from their suppliers. The specific requirements for material safety data sheets are in paragraph (g) of this section. There is no

specified format for the MSDS under the rule, although there are specific information requirements. OSHA has developed a non-mandatory format, OSHA Form 174, which may be used by chemical manufacturers and importers to comply with the rule. The MSDS must be in English. You are entitled to receive from your supplier a data sheet which includes all of the information required under the rule. If you do not receive one automatically, you should request one. If you receive one that is obviously inadequate, with, for example, blank spaces that are not completed, you should request an appropriately completed one. If your request for a data sheet or for a corrected data sheet does not produce the information needed, you should contact your local OSHA Area Office for assistance in obtaining the MSDS.

The role of MSDSs under the rule is to provide detailed information on each hazardous chemical, including its potential hazardous effects, its physical and chemical characteristics, and recommendations for appropriate protective measures. This information should be useful to you as the employer responsible for designing protective programs, as well as to the workers. If you are not familiar with material safety data sheets and with chemical terminology, you may need to learn to use them yourself. A glossary of MSDS terms may be helpful in this regard. Generally speaking, most employers using hazardous chemicals will primarily be concerned with MSDS information regarding hazardous effects and recommended protective measures. Focus on the sections of the MSDS that are applicable to your situation.

MSDSs must be readily accessible to employees when they are in their work areas during their workshifts. This may be accomplished in many different ways. You must decide what is appropriate for your particular workplace. Some employers keep the MSDSs in a binder in a central location (e.g., in the pick-up truck on a construction site). Others, particularly in workplaces with large numbers of chemicals, computerize the information and provide access through terminals. As long as employees can get the information when they need it, any approach may be used. The employees must have access to the MSDSs themselves - simply having a system where the information can be read to them over the phone is only permitted under the mobile worksite provision, paragraph (g)(9) of this section, when employees must travel between workplaces during the shift. In this situation, they have access to the MSDSs prior to leaving the primary worksite, and when they return, so the telephone system is simply an emergency arrangement.

In order to ensure that you have a current MSDS for each chemical in the plant as required, and that employee access is provided, the compliance officers will be looking for the following types of information in your written program:

1. Designation of person(s) responsible for obtaining and maintaining the MSDSs;

2. How such sheets are to be maintained in the workplace (e.g., in notebooks in the work area(s) or in a computer with terminal access), and how employees can obtain access to them when they are in their work area during the work shift;

3. Procedures to follow when the MSDS is not received at the time of the first shipment;

4. For producers, procedures to update the MSDS when new and significant health information is found; and,

5. Description of alternatives to actual data sheets in the workplace, if used.

For employers using hazardous chemicals, the most important aspect of the written program in terms of MSDSs is to ensure that someone is responsible for obtaining and maintaining the MSDSs for every hazardous chemical in the workplace. The list of hazardous chemicals required to be maintained as part of the written program will serve as an inventory. As new chemicals are purchased, the list should be updated. Many companies have found it convenient to include on their purchase orders the name and address of the person designated in their company to receive MSDSs.

C. "Employee Information and Training"

Each employee who may be "exposed" to hazardous chemicals when working must be provided information and trained prior to initial assignment to work with a hazardous chemical, and whenever the hazard changes. "Exposure" or "exposed" under the rule means that "an employee is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.) and includes potential (e.g., accidental or possible) exposure." See paragraph (h) of this section for specific requirements. Information and training may be done either by individual

chemical, or by categories of hazards (such as flammability or carcinogenicity). If there are only a few chemicals in the workplace, then you may want to discuss each one individually. Where there are large numbers of chemicals, or the chemicals change frequently, you will probably want to train generally based on the hazard categories (e.g., flammable liquids, corrosive materials, carcinogens). Employees will have access to the substance-specific information on the labels and MSDSs.

Information and training is a critical part of the hazard communication program. Information regarding hazards and protective measures are provided to workers through written labels and material safety data sheets. However, through effective information and training, workers will learn to read and understand such information, determine how it can be obtained and used in their own workplaces, and understand the risks of exposure to the chemicals in their workplaces as well as the ways to protect themselves. A properly conducted training program will ensure comprehension and understanding. It is not sufficient to either just read material to the workers, or simply hand them material to read. You want to create a climate where workers feel free to ask questions. This will help you to ensure that the information is understood. You must always remember that the underlying purpose of the HCS is to reduce the incidence of chemical source illnesses and injuries. This will be accomplished by modifying behavior through the provision of hazard information and information about protective measures. If your program works, you and your workers will better understand the chemical hazards within the workplace. The procedures you establish regarding, for example, purchasing, storage, and handling of these chemicals will improve, and thereby reduce the risks posed to employees exposed to the chemical hazards involved. Furthermore, your workers' comprehension will also be increased, and proper work practices will be followed in your workplace.

If you are going to do the training yourself, you will have to understand the material and be prepared to motivate the workers to learn. This is not always an easy task, but the benefits are worth the effort. More information regarding appropriate training can be found in OSHA Publication No. 2254 which contains voluntary training guidelines prepared by OSHA's Training Institute. A copy of this document is available from OSHA's Publications Office at (202) 219-4667. In reviewing your written program with regard to information and training, the following items need to be considered:

1. Designation of person(s) responsible for conducting training;
2. Format of the program to be used (audiovisuals, classroom instruction, etc.);
3. Elements of the training program (should be consistent with the elements in paragraph (h) of this section); and,
4. Procedure to train new employees at the time of their initial assignment to work with a hazardous chemical, and to train employees when a new hazard is introduced into the workplace.

The written program should provide enough details about the employer's plans in this area to assess whether or not a good faith effort is being made to train employees. OSHA does not expect that every worker will be able to recite all of the information about each chemical in the workplace. In general, the most important aspects of training under the HCS are to ensure that employees are aware that they are exposed to hazardous chemicals, that they know how to read and use labels and material safety data sheets, and that, as a consequence of learning this information, they are following the appropriate protective measures established by the employer. OSHA compliance officers will be talking to employees to determine if they have received training, if they know they are exposed to hazardous chemicals, and if they know where to obtain substance-specific information on labels and MSDSs.

The rule does not require employers to maintain records of employee training, but many employers choose to do so. This may help you monitor your own program to ensure that all employees are appropriately trained. If you already have a training program, you may simply have to supplement it with whatever additional information is required under the HCS. For example, construction employers that are already in compliance with the construction training standard (29 CFR 1926.21) will have little extra training to do.

An employer can provide employees information and training through whatever means are found appropriate and protective. Although there would always have to be some training on-site (such as informing employees of the location and availability of the written program and MSDSs), employee training may be satisfied in part by general training about the requirements of the HCS and about chemical hazards on the job which is provided by, for example, trade associations, unions, colleges, and professional schools. In addition, previous training, education and experience of a worker may relieve the

employer of some of the burdens of informing and training that worker. Regardless of the method relied upon, however, the employer is always ultimately responsible for ensuring that employees are adequately trained. If the compliance officer finds that the training is deficient, the employer will be cited for the deficiency regardless of who actually provided the training on behalf of the employer.

D. "Other Requirements"

In addition to these specific items, compliance officers will also be asking the following questions in assessing the adequacy of the program:

Does a list of the hazardous chemicals exist in each work area or at a central location?

Are methods the employer will use to inform employees of the hazards of non-routine tasks outlined?

Are employees informed of the hazards associated with chemicals contained in unlabeled pipes in their work areas?

On multi-employer worksites, has the employer provided other employers with information about labeling systems and precautionary measures where the other employers have employees exposed to the initial employer's chemicals?

Is the written program made available to employees and their designated representatives?

If your program adequately addresses the means of communicating information to employees in your workplace, and provides answers to the basic questions outlined above, it will be found to be in compliance with the rule.

5. "Checklist for Compliance"

The following checklist will help to ensure you are in compliance with the rule:

Obtained a copy of the rule.	_____
Read and understood the requirements.	_____
Assigned responsibility for tasks.	_____
Prepared an inventory of chemicals.	_____
Ensured containers are labeled.	_____
Obtained MSDS for each chemical.	_____
Prepared written program.	_____
Made MSDSs available to workers.	_____
Conducted training of workers.	_____
Established procedures to maintain current program.	_____
Established procedures to evaluate effectiveness.	_____

6. "Further Assistance"

If you have a question regarding compliance with the HCS, you should contact your local OSHA Area Office for assistance. In addition, each OSHA Regional Office has a Hazard Communication Coordinator who can answer your questions. Free consultation services are also available to assist employers, and information regarding these services can be obtained through the Area and Regional offices as well.

The telephone number for the OSHA office closest to you should be listed in your local telephone directory. If you are not able to obtain this information, you may contact OSHA's Office of Information and Consumer Affairs at (202) 219-8151 for further assistance in identifying the appropriate contacts.

[52 FR 31877, Aug. 24, 1987; 52 FR 46080, Dec. 4, 1987; 53 FR 15035, Apr. 27, 1988; 54 FR 6888, Feb. 15, 1989; 54 FR 24334, June 7, 1989; 59 FR 6170, Feb. 9, 1994; 59 FR 17479, April 13, 1994; 59 FR 65947, Dec. 22, 1994; 61 FR 5507, Feb. 13, 1996; 61 FR 9227, March 7, 1996]

Notes

Appendix H. Manager's In-Depth HazCom Information

H.1 Hazardous Chemical Terms and Concepts

Under the HCS, manufacturers, importers, or distributors of chemicals are required to assess the physical and health hazards of their products and the information must be recorded on the product label and included in the Material Safety Data Sheet.

To be classified as ***hazardous***, a substance must be capable of producing adverse effects on humans or the environment. Before using any chemical, even if it is something that you have worked with at home or in other situations, it is important to understand what the exposure hazards may be and how to work with it safely. In order to assess the hazards of a particular chemical, both the physical and health hazards of the chemical must be considered. Generally, more accurate information is available about a chemical's physical hazards than about its health hazards. What follows is a brief overview of basic toxicology and physical hazards.

H.1.a Physical Hazards of Chemicals

The physical hazards of a chemical are those hazards that are due to a chemical's physical characteristics. Some types of physical hazards are:

- flammable liquids or solids
- combustible liquids
- compressed gases
- explosives
- organic peroxide
- oxidizers
- pyrophoric materials
- unstable materials
- water reactive materials

Flammability is the tendency of a chemical to burn. The ***flash point***, ***autoignition temperature*** and ***flammable limits*** of the material may be found in the MSDS, and are helpful in assessing the potential for a fire hazard under specified conditions. ***Reactivity*** is the potential of the material to explode or react violently with air, water or other substances upon contact.

The MSDS provides all of this information and we will define each of these hazard categories when we discuss Material Safety Data Sheets in Section H.2, below as well as in the glossary (Appendix F). Before using any chemical, review the MSDS or other appropriate source to determine which conditions of use may pose a hazard. Accidents with hazardous chemicals can happen quickly and may be quite severe. The key to prevention of these accidents is awareness.

H.1.b Health Hazards of Chemicals

A health hazard is one which can occur from either an acute or chronic chemical exposure. Because of individual susceptibility and other factors, the health effects of a hazardous chemical are often less clearly understood than the physical hazards of the chemical. Data on the health effects of chemical exposure, especially from chronic exposure, are often incomplete.

When discussing the health effects of chemicals, two terms are often used interchangeably - *toxicity* and *hazard*. However, the actual meanings of these words are quite different. ***Toxicity*** is the ability of a chemical substance to cause harm. ***Hazard*** is the likelihood that a material will cause harm *under the conditions of use*. Thus, with proper handling, even highly toxic chemicals can be used safely. Conversely, ***less toxic chemicals can be extremely hazardous if handled improperly***.

H.1.c Routes of Entry

The actual health risk of a chemical depends on its toxicity and its exposure route. No matter how toxic a material may be, there is little risk involved unless it enters the body. An assessment

of the toxicity of the chemicals and the possible routes of entry will help determine what protective measures should be taken by workers.

Inhalation

The most common route of entry for chemical substances into the body is through inhalation (i.e., breathing). Breathed in, gases, vapors and particles can pass into the bloodstream along with oxygen or they may also harm the tissues of the respiratory system (e.g., asbestos, silica, etc.).

Most chemicals have an odor which can be smelled at a certain concentration, called the ***odor threshold***. Olfactory fatigue, which may occur when a worker has been exposed to high concentrations or after prolonged lower level exposure to some substances, may make an odor seem to diminish or disappear, while the danger of overexposure remains.

Overexposure symptoms may include headache, increased mucus production, and eye, nose and throat irritation. Narcotic effects, including confusion, dizziness, drowsiness, or collapse, may result from exposure to some substances, including many common hydrocarbon solvents (e.g., toluene). In the event of overexposure, close containers, open windows or otherwise increase ventilation, and move to fresh air. If symptoms persist, seek medical attention.

Chemicals that produce vapors should only be used in a well ventilated area or in a fume hood. Ventilation can be increased by local exhausts or fans but, occasionally, ventilation may not be adequate and a fume hood not practical, making it necessary to use a ***respirator***. OSHA has strict requirements for respirator use which include a medical examination and a respirator fit test. The medical exam is necessary because wearing respirators increases the work of breathing which may cause health problems for some people. Also, the work environment must be evaluated to identify the concentration of the hazard and help select the appropriate mask and filter system.

Skin and Eye Contact

Many solids, liquids, vapors, and gases can be absorbed through the skin and eyes. This route is the second most common route of entry. Skin contact with a chemical may produce a local reaction (e.g., burn or rash) but can result in absorption into the bloodstream with no skin reaction. Absorption into the blood may then allow the chemical to cause toxic effects on other parts of the body.

The absorption of a chemical through intact skin is influenced by the health of the skin and the properties of the chemical. Skin that is dry or cracked or has small cuts or lacerations offers less resistance. Wear gloves and other protective clothing to minimize skin exposure. Symptoms of skin exposure include dry, whitened skin, redness and swelling, rashes or blisters, and itching. In the event of chemical contact on skin, rinse the affected area with water for at least 15 minutes, removing clothing while rinsing, if necessary. Seek medical attention if symptoms persist.

Chemical contact with eyes can be particularly dangerous, producing a painful injury or even blindness. Wearing safety goggles or a face shield can reduce the risk of eye contact. Eyes which have been in contact with chemicals should be rinsed immediately with water continuously for at least 15 minutes (see Section 5.1). Contact lenses should be removed while rinsing. Do not delay rinsing to remove the lenses, seconds count. Medical attention is necessary if symptoms persist.

Ingestion

The third most common route of entry for chemicals into the body is ingestion (i.e., swallowing). People do not intentionally swallow chemicals, but it can occur by failing to wash hands before

eating or drinking; eating or drinking contaminated food or beverages in the work area; or touching the mouth with contaminated hands. Workers can easily reduce the risk of ingestion by not eating, drinking, smoking, or storing food in the areas where chemicals are used or stored and by washing hands thoroughly after working with chemicals, even when gloves are worn.

In the event of accidental ingestion, immediately go to the emergency room or contact the UW 3E Company Poison Center at 1-800-451-8346 for instructions. You will need to know the exact chemical involved (the MSDS is useful in this event). Do not induce vomiting unless directed to do so by a health care professional or by instructions in the MSDS.

Injection

Another possible route of exposure to chemicals is by accidental injection which can occur by needle sticks or through accidents with broken glassware or other sharp objects that have been contaminated with chemicals. If accidental injection has occurred, wash the area with soap and water and seek medical attention, if necessary (refer to the MSDS). Always use caution when handling sharp objects to reduce this risk.

H.1.d Health Hazards of Chemical Exposure

While the daily use of chemicals can be perfectly safe, the body will react to exposure to harmful chemicals. In the past, workers were exposed to hazardous chemicals which made them sick or even eventually killed them (e.g., mercury poisoning) because they were not aware of what could happen. A goal of the Hazard Communication Program is to allow workers to be made aware of health hazards.

Exactly how a chemical exposure affects a person depends on many factors. Some of these factors are the amount of the chemical involved, whether the exposure was acute or chronic, and the specific toxicity of the chemical.

Toxic Effects of Chemicals

The toxic effects of a chemical may be local or systemic. ***Local*** injuries only involve the area of the body in contact with the chemical. For example, if you spill an acid on your arm, the effect will be on your arm. ***Systemic*** injuries involve tissues or organs other than the contact site where toxins have been transported through the bloodstream. For example, methanol that has been swallowed may cause blindness. Certain chemicals may only affect a ***target organ***. For example, lead primarily affects the brain, kidney and red blood cells; some organic solvents may harm the liver and kidneys.

It is also important to distinguish between acute and chronic exposure and toxicity. ***Acute toxicity*** results from a single, short intense exposure to a chemical and the acute effects usually appear quickly and are often reversible. ***Chronic toxicity*** results from repeated exposure to lower levels over a long period of time. The effects are usually delayed and gradual, and may even be irreversible. For example, the acute effect of drinking alcohol is to become drunk, while one of the chronic effects from drinking alcohol over a long period of time is cirrhosis of the liver.

Individual Susceptibility

People react differently in their sensitivity to chemical exposure. This variability in sensitivity to chemicals depends on many factors such as eating habits, physical condition, obesity, medical conditions, drinking and smoking, and pregnancy.

Over a period of time, regular exposure to some substances can lead to the development of an allergic rash, breathing difficulty, or other reactions. This phenomenon is referred to as

sensitization. Over time, these effects may occur with exposure to smaller and smaller amounts of the chemical, but will disappear soon after the exposure stops. For reasons not fully understood, not everyone exposed to a sensitizer will experience this reaction. Examples of sensitizers include epoxy resins, nickel salts, isocyanates and formaldehyde. Some workers even become sensitized to the rubber used in protective gloves, their hands may begin to itch and some workers have even experienced life-threatening shock reaction from gloves made from natural latex. However, natural latex gloves are rarely useful for protection against chemicals.

Particularly Hazardous Substances

Carcinogens -- Many chemicals have been evaluated for their ability to cause cancer. The ***latent period*** (the length of time from exposure to cancer formation) for many cancers ranges from twenty to forty or more years. The risk of developing cancer from exposure to a chemical increases with the length of exposure and with the chemical's exposure concentration.

It is important to understand the distinction between human carcinogens and suspected human carcinogens. The term ***human carcinogen*** is used when there is clear evidence of a chemical's ability to cause cancer in humans. ***Suspected human carcinogen*** refers to chemicals that have been shown to cause cancer in two or more animal species and are therefore suspect in humans.

Anyone who works with, or plans to work with carcinogens or suspected carcinogens must follow strict guidelines to minimize exposure. For a particular substance, the *Toxicity Data* section of the MSDS will state whether or not the substance is considered a carcinogen by OSHA, the National Toxicology Program (NTP), or the International Agency for Research on Cancer (IARC). Appendix 10 of the *Model Chemical Hygiene Plan* provides a more detailed discussion of Particularly Hazardous Substances.

Reproductive Toxins -- Reproductive toxins are chemicals which affect the reproductive system. These include ***mutagens*** (those which cause chromosomal damage), ***teratogens*** and embryotoxins. ***Embryotoxins*** may be lethal to the fertilized egg, embryo or fetus, may be teratogenic (able to cause fetal malformations), may retard growth or may cause postnatal functional deficits. Other reproductive toxins may cause sterility or may affect sperm motility.

Some chemicals can cross the placenta, affecting the fetus. A developing fetus may be more sensitive to some chemicals than its pregnant mother, particularly during the first twelve weeks of pregnancy when the mother may not even know she is pregnant. Proper handling of chemicals and use of protective equipment is especially important to reduce fetal exposure to chemicals.

Known human teratogens include organic mercury compounds, lead compounds, ionizing radiation, some drugs, alcohol ingestion, and cigarette smoking. Some substances which may cause adverse reproductive effects in males include 1,2-dibromo-3-chloropropane, cadmium, mercury, boron, lead, some pesticides, and some drugs. More than 800 chemicals have been shown to be teratogenic in animal models; many of these are suspected human teratogens.

People who work with teratogens and those who are contemplating pregnancy or are already pregnant should review the toxicity of the chemicals in their workplace and, if concerned, should consult with the Safety Department to determine whether any of the materials pose additional risk during pregnancy and possible means to reduce those risks.

H.2 Material Safety Data Sheets

The OSHA Hazard Communication Standard requires each work unit obtain Material Safety Data Sheets (MSDSs) from the supplier and maintain them in such a way that they are readily accessible to personnel in any work areas and during any shift.

Suppliers are required by OSHA to supply you with an MSDS for all chemicals or chemical products purchased. With pesticides, the MSDS information is often incorporated into the container label or label information that is usually an attached booklet. Additionally, state purchasing rules require vendors to include an MSDS inside the package of all incoming chemicals and to also send a copy of A& M Accounts Receivable, who then forwards them to the EH & S Office. Make sure that all packages of incoming chemicals are accompanied by an MSDS. If you have not received an MSDS with your product, contact the supplier and remind them of the requirement. Several chemical vendors have MSDSs available on the Internet. The EH&S Office web page (http:www.aamu.edu/oehs/limks.html) has links to some of these sites.

You should have a system in place to catalogue MSDSs when received. One easy solution is to keep a copy of each MSDS with your HazCom Plan. If an MSDS is not received with a shipment, it may have been sent to Purchasing and then forwarded to EH&S. Call EH&S if you are missing any MSDS. In the unlikely event that a supplier is uncooperative or if you have repeated problems obtaining MSDS, contact the EH&S Office and we will work with Purchasing to enforce this rule.

H.2.a Content of Material Safety Data Sheets

There is no reason to think that MSDSs are confusing. True, they contain a lot of chemical, medical and legal information. But remember, they are written to be useful to a wide variety of individuals (e.g., workers, emergency responders, physicians, etc.), for any quantity of that chemical product. Therefore, there is some key information on an MSDS that every employee should review and understand for the chemicals they use. Managers should review MSDSs with their employees to check their ability to identify and comprehend key information. The EH&S Office can answer questions or set up training sessions to review MSDS's for the chemical products in your workplace. Training videos are also available for loan.

The MSDS is the centerpiece of the HazCom Standard and while OSHA does not prescribe a specific format it does require that MSDSs have certain items of information such as:

- Health hazards
- Physical hazards
- Safety precautions for using the material
- Personal Protective Equipment (PPE)
- What to do in an emergency
- How to clean up a spill
- Symptoms of exposure
- How to dispose of the material

H.2.b Explanation of Material Safety Data Sheet Information

Although OSHA does not mandate a specific format for MSDSs, the use of the 16-section American National Standards Institute (ANSI) MSDS has increased because of its ease-of-use and the ANSI form helps companies meet international requirements. The Chemical Manufacturers Association worked with OSHA and ANSI to develop the format. Additionally, the ANSI format encourages standardization enabling supervisors and employees as well as emergency responders to find detailed, consistent information about workplace chemicals. Lets look at the type of information found in each of the sections of an ANSI-format MSDS.

Section 1. Chemical, Product and Company Identification

This section tells the name of the chemical as it appears on the container label. The name on the MSDS will always be the same as the name on the container label, providing a direct link of the chemical to the MSDS. This section also gives the name and address of the manufacturer and an emergency phone number where questions about toxicity and chemical hazards can be directed.

A common emergency number found is for CHEMTREC, a center established by the Chemical Manufacturers Association. The 24-hour, toll-free number is 1-800-424-9300.

If one generic MSDS is used to cover various grades of a material, all grades must be listed as well as known synonyms. If an optional number or code is used by the manufacturer to help identify the MSDS, it should appear in this section, and on every page of the MSDS. Remember, thousands of materials with many similar names are found in workplaces. A mistake on the supplier's part in sending you the wrong MSDS needs to be caught immediately before you put your trust in the wrong information.

Section 2. Composition, Information on Ingredients

This section tells just what is hazardous in the chemical. It identifies the chemical by both its common and scientific name. If it is a chemical compound, this section describes the percent composition of the substance, listing chemicals present in the mixture which contribute to its hazardous nature. Otherwise, it lists all carcinogens and ingredients making up more than 1%.

This section may also include the chemical family or group of chemicals with related physical and chemical properties, the chemical formula, and the ***Chemical Abstract Services*** (***CAS***) Registry number.

The chemical's exposure limits are also found in this section. There may be several values and types of limits listed. The most common are: Permissible Exposure Limit (PEL), Time Weighted Average (TWA), Threshold Limit Value (TLV), Short Term Exposure Limit (STEL) and Ceiling Limit (CL).

OSHA, along with other organizations, sets exposure limits. OSHA sets the ***permissible exposure limit*** (***PEL***). The ***threshold limit value*** (***TLV***) is set by the American Conference of Governmental Industrial Hygienists (ACGIH). Both the PEL and TLV specify the maximum amount of exposure a worker can have to a substance averaged over an 8-hour workday. These limits are usually expressed in parts per million parts of air (ppm) or milligrams of dust or vapor per cubic meter of air (mg/m^3). The OSHA PEL is the enforceable standard while the others are recommendations and may be different than the OSHA levels. When comparing hazards, the lower the ppm number, the more hazardous the chemical. For example, a chemical with a PEL or TLV of 2 ppm is far more hazardous than one listed as 200 ppm.

The PEL is often expressed as a ***time weighted average*** (***TWA***). TWA is a technique for averaging individual variant measurements over an 8-hour workday. The ***short term exposure limit*** (***STEL***) is a term used by the ACGIH. It is the maximum concentration most workers can tolerate for a 15-minute exposure period (with a maximum of four periods a day with at least 60 minutes between exposure periods) without adverse effects. The ACGIH also establishes a ***ceiling limit*** (***CL***). This is the exposure limit never to be exceeded, even instantaneously.

If established, the chemical's exposure limits are listed. Some compounds may not have an established exposure limit and this would be blank. Thus, if the MSDS shows "8-hr TWA: 100 ppm or 300 mg/m^3" it is a guideline establishing an exposure limit which should not be exceeded when averaged over an 8-hour workday. If the MSDS shows "STEL: 100 ppm" it is a guideline for an exposure level not to be exceeded over a 15-minute continuous exposure. A "skin" notation means that skin exposure is significant in contributing to the overall exposure.

These exposure levels are set for healthy adult workers, based on the average 150 lb male, age 25 - 44. Lower exposure levels may be necessary for people at higher risk (e.g., those who are young or elderly, pregnant, smokers, etc.) or workers who have already been exposed to other materials for which exposure limits have been set. Exertion increases the effects of exposure.

Exposure to more than one hazardous substance at a time may be especially harmful because the combined effects of more than one material may be more damaging than the additive effects of each material. Thus, both smoking and asbestos can cause lung cancer; however, if a smoker is also exposed to asbestos, the danger of lung cancer is far greater (e.g., by a factor of 10) than just adding the separate risks from the two exposures.

Section 3. Hazards Identification

This section is divided into two parts. The first part describes the material's appearance and provides the most significant immediate concerns for emergency personnel. Examples include:

Chlorine is a greenish-yellow gas with a pungent, suffocating odor. It is a highly toxic and corrosive gas which is irritating to the eyes and mucous membranes. Although noncombustible, it is a strong oxidizer and supports the combustion of other organic materials. It is an extremely reactive and explosive gas. Chlorine reacts with many common substances such as acetylene, ammonia, hydrogen, ether, fuel gas, hydrocarbons, turpentine, and finely divided metals.

Sweet smelling clear liquid. Evaporates quickly at normal temperatures. High concentrations in immediate area can reduce oxygen and result in dizziness, unconsciousness, and even death with longer exposures. Keep people without self-contained breathing apparatus out of area. Not a fire hazard in open areas. Water fog can be used on fires. Contain large spills and keep liquid out of water sources.

This information is important to both workers and emergency responders since it describes a chemical's normal appearance and odor and describes how the chemical will behave when it is released. Workers are expected to be trained in recognizing a chemical's hazard.

The second part of this section provides information on the potential adverse health effects and symptoms associated with exposure to the material. Section 3 must list all the routes of entry (i.e., eye contact, skin contact, inhalation, ingestion) pertinent to this material. It also lists the actual health hazard of the chemical, both acute (effects that show up immediately after exposure) and chronic (effects that develop over time, usually following prolonged exposure).

If the material is *Particularly Hazardous* and considered a confirmed or suspected carcinogen by IARC, NTP, or OSHA, a teratogen (causes physical defects in a developing embryo or fetus), a mutagen (causes genetic mutations), toxic to aquatic life or a danger to the environment, this may be included here or in other sections of the MSDS.

Signs and symptoms of exposure are noted here. They can range from minor skin irritation to chronic lung disease. Some chemicals may harm a "***target organ***" such as the heart, liver, lungs, etc. Chronic effects are particularly dangerous because workers may not experience discomfort in the presence of the material but may develop severe health problems later in life as a result of the exposure. There is a possibility that exposure to some chemicals will aggravate preexisting medical conditions such as heart or respiratory problems.

Remember, sickness and even death from improper exposure can be prevented if workers are aware of the potential hazards before they use a chemical.

Section 4. First Aid Measures

This section describes medical and first aid treatment for accidental exposure by route of exposure (i.e., inhalation, skin, eye, ingestion). Clear instructions including known antidotes that

may be administered by a lay person or specially trained health care professional will be indicated. In accidents, give a copy of the MSDS to attending physicians. A subsection entitled **Note to Physicians** may also be found here. This will provide specific medical information on treatment and diagnostic procedures which trained medical personnel can apply.

Section 5. Fire Fighting Measures

This section describes the fire and explosive properties of the material, the proper extinguishing materials, and the precautions and procedures to safely and effectively fight the fire. If a chemical has a high fire or explosion potential, the work area should be inspected carefully before it is used and all ignition sources should be removed.

The flammable properties combined with the physical and chemical properties give a good indication of how hazardous a material is in a fire situation. The ***flash point*** of a chemical is the lowest temperature at which the chemical's vapors are concentrated enough to ignite if an ignition source is present. The lower the flash point, the more dangerous the material. Gasoline's flash point is - 45 °F. The ***autoignition temperature*** is the lowest temperature at which a liquid will give off enough flammable vapors or heat energy to ignite and burn by itself. Thus, it tells how hot a material must be before it will set itself on fire without a flame or spark. Other properties include the upper and lower ***flammable limits***, the concentration in the air between which the substance is likely to ignite, and the upper and lower ***explosion limits*** (***UEL*** and ***LEL***), the minimum and maximum concentration of the chemical's vapor in the air where an explosion could occur.

With most fires, often the greatest danger to human life comes not from the heat of the fire, but from the toxic smoke that can quickly fill a work area. Known or anticipated hazardous products of combustion would be listed here. Thus, carbon disulfide, when burned, produces toxic gases and irritants, including carbon monoxide and sulfur oxides.

This section also discusses the best way to safely and quickly extinguish fires. Some burning materials may react with water and are best smothered with foam, carbon dioxide gas, or a dry chemical. Certain chemicals may also present unusual fire hazards (e.g., strong oxidizer, explosive potential), these would be discussed here.

Section 6. Accidental Release Measures

This section provides spill, leak, and response procedures for emergency responders and environmental professional. It describes evacuation procedures, containment and cleanup techniques, and other emergency advice to protect the health and safety of the responders as well as the environment.

Section 7. Handling and Storage

This section provides information for employees, health and safety professionals, and employers on safe handling practices and storage procedures for the substance.

Under the safe handling, the precautions listed are for the unique properties of the material. There may be general warnings such as, "*Do not breathe dust*" and general practices to prevent continued exposure such as, "*Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.*" Handling practices, such as how to prevent vapor release, the need for a totally enclosed system, and recommendations to prevent injury would also be found here. Information like, "*To avoid sudden release of pressure, loosen closure cautiously before opening*" and "*To reduce potential*

for static discharge, bond and ground containers when transferring materials" are warnings about the specific material which must be followed.

Information about appropriate storage practices, including explanations of necessary storage conditions to avoid damage to containers, contact with incompatible materials and subsequent dangerous reactions, evaporation or decomposition of stored material, or flammable and explosive atmospheres in the storage area. Examples of specific storage procedures to avoid dangerous conditions include, "*Keep away from oxidizing materials*," "*Keep containers closed, store in the dark at temperatures less than 20 °C (68 °F)*," and "*Protect these containers from physical damage, shield them from direct sunlight, and maintain their temperature at less than 38 °C (100 °F).*"

Section 8. Exposure Controls / Personal Protection

This section discussed methods that safety professionals and employers can employ for reducing worker exposure to hazardous materials. Control measures are often divided into engineering and administrative controls.

Engineering controls include things like ventilation, process controls (e.g., isolation, enclosure, etc.), sampling devices and concentration monitoring. These are critical because they do not require any action by the workers to be protected. Administrative controls include training, labeling, warning devices, operating procedures, etc. Administrative controls require the workers to take an active part in their safety. Guidance for appropriate ***personal protective equipment*** (***PPE***) is also found here. PPE is discussed in great detail in Section 2.5.

Remember protection of the workers is the employer's responsibility. To accomplish this, employers must provide engineering and administrative controls and PPE. The workers must be trained to use the right PPE correctly. Employees are responsible for handling chemicals as instructed and using the PPE. Both managers and workers are responsible for insuring protection systems are inspected and properly maintained to provide the proper amount of protection.

Section 9. Physical and Chemical Properties

This section lists the physical and chemical properties that characterize the material. The physical data such as evaporation rate, vapor density, etc. is important because it tells what circumstances (e.g., temperature) could change a chemical's normal state. It can also be used to determine conditions for exposure and allow workers to judge how a chemical will react to changes in condition and how it will disperse into the atmosphere. For example, certain kinds of jobs could raise the work area temperature greatly and that could change the chemical and its hazards. Some of the common characteristics listed for a chemical are:

- **Appearance/Odor** - color, physical state at room temperature, size of particles, consistency, odor, etc. Odor threshold refers to the concentration required in the air before vapors are detected or recognized.
- **Melting Point** - the temperature at which a solid begins to change to a liquid
- **Boiling Point** - the temperature at which liquid changes to a gas or to its vapor state
- **Evaporation Rate** - how fast the chemical turns into a vapor, usually expressed as a time ratio with ethyl ether = 1 (or butyl acetate), unless otherwise specified. A chemical with a higher number evaporates faster; one with a lower number evaporates slower.
- **Solubility in Water** - the percentage of material that will dissolve in water, usually at ambient temperature. Since much of the human body is made of water, water soluble substances are more readily absorbed and distributed.

- **Specific Gravity** - the ratio of volume weight of material to equal volume weight of water (water = 1).
- **Vapor Density** - the weight of a gas or vapor compared to the weight of an equal volume of air (air = 1). A vapor density greater than 1 indicates it is heavier than air, less than 1 indicates it is lighter than air (i.e., it will rise in air). Vapors heavier than air can flow just above ground, where they may pose a fire or explosion hazard or may displace breathable air.
- **Vapor Pressure** - a measure of how volatile a substance is and how quickly it evaporates. For comparison, the VP of water (at 20 °C) is 17.5 mm Hg, Vaseline (nonvolatile) is close to 0 mm Hg, and diethyl ether (very volatile) is 440 mm Hg. The higher the number the faster it evaporates.
- **Viscosity** - internal resistance to flow exhibited by a fluid, normally measured in centiStoke time or Saybolt Universal Secs.

Section 10. Stability and Reactivity

There are many different ways that materials may react with one another. Some substances are unstable and can react with other substances or under specific kinds of situations and/or changes in conditions (e.g., temperature, humidity, light, etc.). The MSDS would list materials and circumstances that could be hazardous when combined with the material covered by the MSDS.

The MSDS will warn about the possibility of reactions and the conditions that create them. Some unstable chemicals will react when the temperature changes, or when they are exposed to sunlight, air, or water. Many chemicals will react violently when exposed to water. If the chemical is incompatible with another chemical, the MSDS lists the materials so they are not stored in close proximity and they are kept far apart on the job. For example, if the material reacts with metal, it should be stored on nonmetal shelves. If the material reacts with natural rubber, you wouldn't wear a respirator or gloves made of natural rubber or use a rubber stopper to close the bottle.

Decomposition products or hazardous byproducts, such as toxic gases that the chemical could generate, along with their hazards, are listed here. It is common knowledge that mixing bleach (sodium hypochlorite) with ammonia gives off toxic and irritating chlorine gas. Polymerization is also a reactivity hazard. In this instance the material changes form usually releasing a lot of heat.

Knowledge of the physical and chemical properties and a chemical's stability and reactivity potential can be used in selecting proper personal protective equipment, storage or shelving, and choice of containers.

Section 11. Toxicological Information

This section contains information on toxicity testing of the material and / or its components. Normally the information reflects animal testing, although some human data will be available if accidental human poisonings have occurred and the exposure amounts are known, or if epidemiological studies have been conducted. The information is intended for medical and health and safety professionals.

Data includes acute, sub-chronic, and chronic studies through various routes of exposure (inhalation, ingestion, skin, etc.). A typical example of data might be "*Rat, Oral, LD_{50}: 200 mg/kg*" which means that 200 milligrams of the chemical per each kilogram of body weight is the lethal dose that killed 50% of a group of test rats following oral administration. These data are then used to help estimate the degree of hazard to humans.

Section 12. Ecological Information
This section assists in evaluating the effect a chemical may have if it is released to the environment. Ecotoxicity data may include information on acute and long-term toxicity to fish and invertebrates, or plant and microorganism toxicity. Chemical behavior in the air, soil, or water is also important data when evaluating environmental contamination. Other information may include persistence and degradation, soil mobility, bioaccumulation, and photolytic (i.e., decomposition by light) stability.

Section 13. Disposal Considerations
This section provides proper disposal information for environmental professionals or persons responsible for waste management activities. The information may include special disposal methods or limitations per Federal, state, or local regulations, and waste management options (e.g., recycling, reclamation) and may include RCRA waste classification and / or EPA waste identification numbers and descriptions.

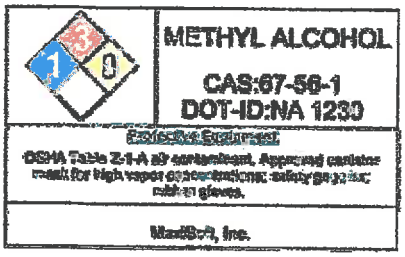
Section 14. Transportation Information
This section provides shipping classification information. If regulated, shipping information includes DOT hazardous materials description / proper shipping name, hazard class, and identification numbers. This information helps shippers properly prepare materials for shipment.

Section 15. Regulatory Information
This section gives regulatory information for employers and compliance personnel. Includes reportable quantities (RQ) for spills or discharges and threshold planning quantities (TPQ). All of this helps management to comply with various regulatory requirements.

Section 16. Other Information
This section provides a location for additional information, such as a list of references, keys / legends, or preparation and revision indicators. Hazard ratings defining the acute health, flammability, and reactivity hazards of a material may also be included.

H.3 Labeling Systems

There are several standardized and uniform labeling systems. The most commonly encountered in the workplace are the Department of Transportation (DOT), the National Fire Protection Association (NFPA), and the Hazardous Materials Information Systems (HMIS)



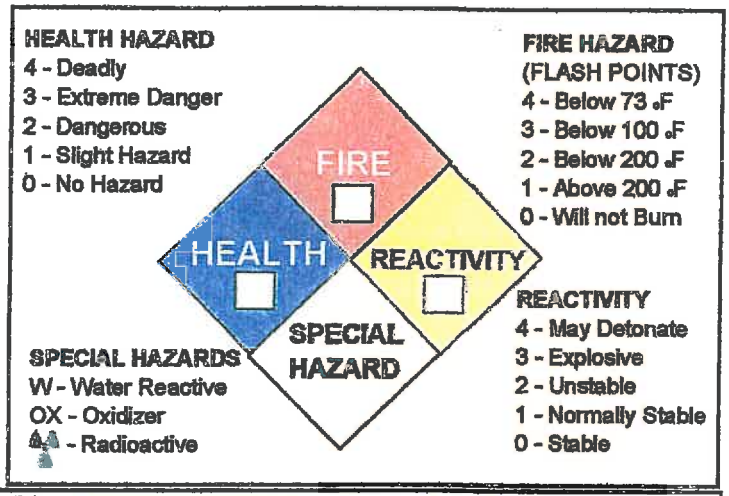
H.3.a DOT Labels

When chemicals are shipped and moved about in transport, there must be labels to satisfy DOT. Many containers are individually labeled with the standard DOT diamond-shaped labels that are designed to identify DOT classes of hazardous materials. These DOT labels are diamond-shaped and color-coded by hazard. The hazard class or division number appears in the lower corner. Usually these are found on large (5 gallon) containers of chemicals or cases containing several unit containers. If you are involved in the shipment or receipt of hazardous materials, you must be trained to assess the hazard and be capable of responding in an emergency.

The EH&S Office conducts training classes which will allow you to comply with DOT requirements, call 372-4091 and schedule a training session.

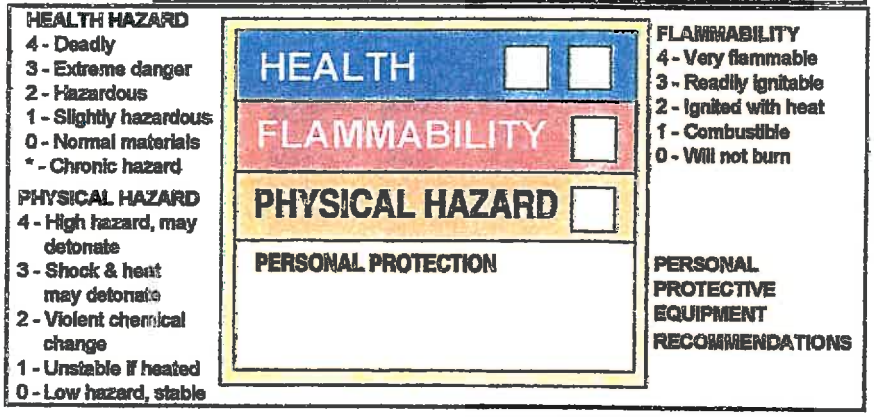
H.3.b NFPA Labels

The popular NFPA diamond was originally developed by the ***National Fire Protection Association***. It contains 4 colored diamond shapes associated with different hazards. This system refers to the hazards associated with the material under fire-type conditions.



H.3.c HMIS Labels

Another popular system was developed by the ***National Paint and Coatings Association***. It contains 4 different colored rectangular shapes related to different hazards. As opposed to the NFPA label, the Hazard Materials Information System (HMIS) rates the material as it is under normal conditions.



H.3.d NFPA and HMIS Labeling Systems

Workers will probably see both types of labels used on containers. At first glance, these labeling systmes appear quite similar. On both the NFPA and HMIS label, each color represents a specific type of hazard:

- ✓ **Blue** stands for health hazard
- ✓ **Red** means flammability hazard
- ✓ **Yellow** is reactivity hazard (NFPA) or **Orange** is physical hazard (HMIS)
- ✓ **White** stands for special hazard information or special notice

The blue, red, and yellow/orange sections also contain a number from 0 to 4 that tells about the degree of hazard. The number 4 means the most serious hazard, 0 the least serious. The table in Appendix E explains each rating more thoroughly. The white section of the label uses no numbers. If a material presents a special hazard, then a symbol or phrase may be placed in the white section giving special attention. The HMIS label will sometimes note personal protective equipment using specially designated icons.

However, there are significant differences. The HMIS system attempts to convey full health warning information to all employees while the NFPA diamond is meant primarily for fire fighters and other emergency responders. HMIS is not intended for emergency circumstances.

This version of the HMIS, called HMIS® III replaced a similar system in April, 2002. The change was to replace the yellow Reactivity section with the orange Physical Hazard section. While both types of labels may be seen, the label with the yellow Reactivity will ultimately vanish.

The HMIS label attempts to convey full health warning information as is listed on an MSDS. Lets look at what the specific sections of the label present.

Health

This section conveys the health hazards of the material. In the latest version, the blue Health bar has two spaces, one for an asterisk and one for a numeric hazard rating. If present, the asterisk signifies a ***chronic health hazard***, meaning that long-term exposure to the material could cause a health problem such as emphysema or kidney damage. The NFPA diamond lacks this important information because NFPA is meant only for emergency or acute (short-term) exposures. The numbering system uses a 0 to 4 scale where 0 indicates minimal hazard and 4 indicates an extreme hazard.

Flammability

Initially the NFPA and HMIS used the same criteria to assign numeric values (0 = low hazard to 4 = high hazard). In HMIS III, the flammability criteria are defined according to OSHA standards (see Appendix G). OSHA defines a flammable liquid as "any liquid having a flash point below 100 °F (37.8 °C), except any mixture having components with flash points of 100 °F (37.8 °C) or higher, the total of which make up 99 percent or more of the total volume of the mixture. Flammable liquids shall be known as Class I liquids."

Physical Hazard

HMIS III replaced the Reactivity (yellow) rating with an orange section using the OSHA criterion of physical hazard. Seven such hazard classes are recognized:

- water reactives
- explosives
- pyrophoric materials
- unstable reactives
- organic peroxides
- compressed gases
- oxidizers

The numerical rating values of 0 = low hazard / stable to 4 = high hazard / may detonate, are still used to describe the magnitude of hazard from the substance.

Personal Protection

This is by far the largest area of difference between the NFPA and HMIS systems. As described in Appendix E and section H.3.b, the white diamond in the NFPA system is used to convey special hazards (e.g., water reactive, oxidizer, radioactive, etc.). The white section in the HMIS label uses the white section to indicate what personal protective equipment should be used when working with the material. One drawback of the HMIS Personal Protection coding system is that they use a letter coding system to prescribe the required protective equipment. The reason this is a drawback is that some of the letters / symbols used are used by other hazard communication systems and have completely different meanings and applicctions. Listed here, for your reference are the HMIS Personal Protection codes and corresponding equipment needs:

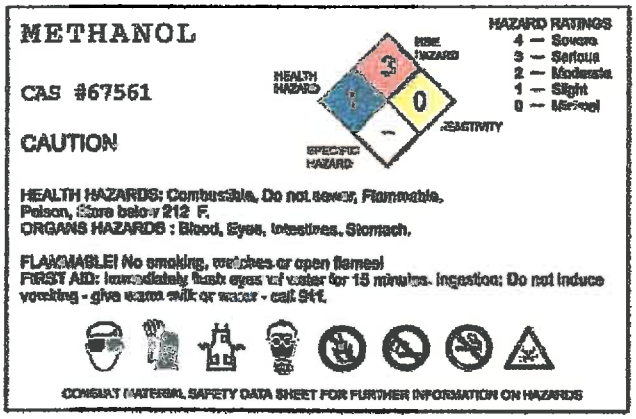
A Safety Glasses
B Safety Glasses, Gloves
C Safety Glasses, Gloves, Apron

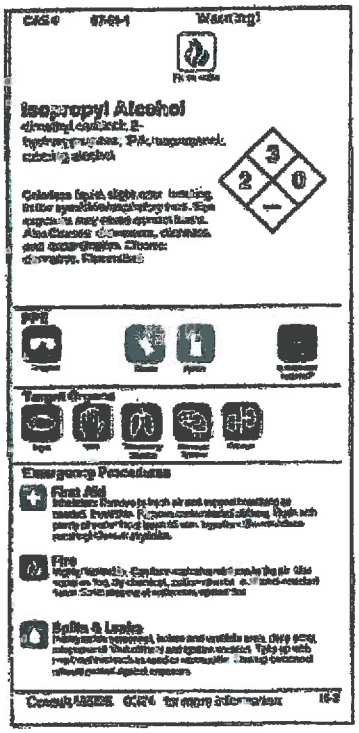
D Face Shield, Gloves, Apron
E Safety Glasses, Gloves, Dust Respirator
F Safety Glasses, Gloves, Apron, Dust Respirator
G Safety Glasses, Gloves, Vapor Respirator
H Splash Goggles, Gloves, Apron, Vapor Respirator
I Safety Glasses, Gloves, Dust and Vapor Respirator
J Splash Goggles, Gloves, Apron, Dust and Vapor Respirator
K Air Line Hood or Mask, Gloves, Full Suit, Boots
X Ask supervisor or safety specialist for handling instructions.

For example, consider the NFPA labeling for a container of methanol. A hazard degree rating of 1 has been assigned to the health hazard which means the material is a slight hazard. The flammability rating is 3 which means it has a flash point below 100 °F and will readily ignite at normal temperatures. The reactivity rating of 0 means that the material is stable. Personal protective equipment includes safety goggles, rubber gloves and apron. Other symbols which might be used include: no smoking, no open flames, no matches. Since it is poisonous, the "skull & crossbones" symbol or the word "poison" would appear on the NFPA label. The target organs affected from a hazardous exposure are: blood, eyes, intestines, and stomach.

H.3.e Other Labeling Systems

While the NFPA and HMIS systems are relatively common, some vendors have created their own "Right-to-Know" label system which incorporates one or both these labels. When looking at containers, look for the common elements rather than the differences.





H.3.f Labeling Secondary Containers

Sometimes workers need only a small amount of material for a specific task and may transfer the amount of chemical they need from the original container to a smaller, more portable, ***secondary container***. If all of the material is to be used immediately by the employee who transferred the material, the secondary container need not have a label. However, the chemical can **only** be used by the worker who transferred it and it must be only used on that shift. It is better to label any secondary container with all the necessary information.

H.3.g Tradename Chemical Hazards

Many of the tradename products used on the job are really hazardous materials. Most workers strive to work safely when using pure solvents like benzene and acetone, but may overlook proper safety when these same solvents are an ingredient in a product.

Once a chemical is no longer 100% pure and becomes an ingredient in another product, it is no longer labeled as that chemical. For example, when you pick up a bottle of "Mr. Clean-n-Bright" toilet bowl cleaner, the fact that it might contain a hazardous ingredient doesn't leap out at you. In one instance, a building custodian was using a heavy-duty disinfectant cleaning solution to scrub down the bathroom. The label directions warned users not to overuse the cleaner and provided specific dilutions for mixing with water. The custodian poured too much into each toilet bowl and when he headed back to the first bowl to scrub it, the toxic fumes had taken over the bathroom. The custodian was lucky to get only ten stitches in his head when he passed out and banged his head on the floor.

Many products you work with at home contain hazardous ingredients: bleach is sodium hypochlorite and water; window cleaner is often isopropanol or glycol ether or even ammonia; and nail polish remover is often acetone or ethyl acetate.

The key to working safely is to read the label. Trade name products usually have an ingredient list and necessary precautions printed on the container label. Products you use every day may contain one or more hazardous materials; you should handle them just as carefully as you would a bottle or can of a pure chemical.

Consider a wood glue that contains 80% polyvinyl acetate base and 0.1% formalin. Formalin is a solution of formaldehyde, a toxic chemical. While the small percentage of a hazardous material suggest there is less chance it has to pose a health risk, it does not mean it poses no threat. Formaldehyde (formalin) is highly toxic and can cause severe burns upon inhalation, ingestion, or skin contact. Some people are extremely sensitive to formalin. It is also a suspected human carcinogen.

According to OSHA's HazCom Standard, any material considered hazardous must be listed on the MSDS and its hazard information listed on the product label if it is present at 1% or greater. If it is a carcinogen, that percentage is reduced to 0.1% or greater. Follow these guidelines when working with tradename products:

- ✓ Read the label.
- ✓ Look for hazardous ingredients (they may be printed in bold type or have asterisks (*) after their names.
- ✓ Follow all required precautions.
- ✓ Consult the MSDS.
- ✓ Open tradename product containers correctly to prevent the possibility of a spill or spray.
- ✓ Close container when finished.
- ✓ Never mix a tradename product with any other material.

H.3.h Post Rooms and Areas for Chemical Hazards

You should post all areas or rooms where chemical hazards are present. While the NFPA diamond provides useful information to firefighters, it is not always the best system to warn employees of chemical hazards. However, if a single chemical is present in very large quantities, the container and room door should be posted with either the DOT label or an NFPA diamond.

Work situations involving stationary process containers or any process that might create a health hazard during the normal completion of a given task (e.g., welding), a readily visible label or sign or placard must be posted to indicate the identity and nature of the hazard. Situations for which separate hazard warning labels or signs must also be posted include:

- ✓ Welding areas where workers are exposed to various air emissions and fumes
- ✓ Areas where workers may be exposed to carbon monoxide (e.g., vehicles idling, forklifts in use, etc.).

The EH&S Office can assist you in the determination of the "Emergency Safety Information" card to post outside your door. This will notify emergency responders and others of the chemical hazards. Call the EH&S for advice on labeling containers or posting rooms.

Appendix I. Emergency Response

Chemical emergencies require prompt, appropriate action. Appropriate emergency action is given in Material Safety Data Sheet. There are also Alabama A & M's procedure for chemical emergencies that you need to know. See Chapter 11 of the *Model Chemical Hygiene Plan* for a fuller discussion of emergency response. Appendix I discusses Emergency Response. This appendix can easily be copied and kept in each work area so personnel will know the appropriate response to the various issues. A key concept in response is: **the situation dictates the response**. Thus, injuries require first removal of the injuring substance (e.g., emergency shower, removal from the area, etc.,), fires should include call (5555), spills require containment, evaluation, and clean-up.

First Aid

Accidental chemical exposure can be hazardous. In an accident situation, proper action depends on rapid treatment applied to the route of exposure.

- **Chemical splash on the body:** Immediately rinse the affected area in the nearest emergency shower or other water source for at least 15 minutes. While showering, remove all contaminated clothing, including undergarments and jewelry. Removing saturated clothing from the victim promptly can greatly reduce the severity of a chemical burn.
- **Chemical splash in the eye:** Immediately flush the opened eyes for 15 minutes in an emergency eyewash. If contact lenses are present, remove contacts while flushing the eye. Remember, time is crucial.
- **Smoke or other gaseous inhalation:** Move the victim to an area of fresh air, resuscitate with rescue breathing if necessary, and give shock prevention treatment (victim lying down, lightly covered to preserve body heat and comforted to reduce anxiety.)
- **Poison:** Call 3E Company (1-800-451-8346) for advice about poisoning and chemical toxicity. The MSDS and chemical label will be necessary for definitive treatment
- **Thermal Burn:** Immerse the burned area in cold water or hold under cold running water until the pain stops. Cover with a sterile dressing.
- **Injured and Bleeding:** Hold a clean pad directly on the wound and apply hand pressure. If necessary, elevate the bleeding extremity and apply pressure to a pressure point to reduce blood flow.
- **Clothing Fires:** Put out burning clothing or hair by dousing the victim in a safety shower or other water source, or by smothering the fire with a cotton lab coat or fire blanket. If these resources are not available, make the victim roll on the ground to put out the flames.

Always get medical attention for the victim after administering first aid.

Fires

Be prepared for fires. Participate in the annual building evacuation drills. Know where your emergency exits and nearest alarms are. Call EH&S (4091) to sign up for fire extinguisher training. Your ability to respond quickly and competently with the appropriate fire extinguisher can keep a minor flame from turning into a major conflagration.

In the event of a fire, pull the fire alarm first. Then, if you have been trained and the fire is very small, attempt to extinguish the fire with an appropriate fire extinguisher. If you manage to completely, extinguish the fire, inform A&M's Police.

If you doubt your ability to quickly extinguish the fire with an extinguisher, get out of the building , and call Campus Police (5555) to summon the Fire Department. When you evacuate, move well away from the building to allow firefighters room to work. Move upwind of the building. Do not reenter the building until permission is given by the Fire Department.

Spills

Persons spilling chemicals or discovering chemical spills are responsible for assessing the spill and notifying A&M Police or the EH&S Office. Campus chemical users are responsible for cleanup of small-to medium-sized spills, while the Huntsville Fire Department's Hazardous Incident Team responds to more serious spills. In general, the EH&S Office does not clean up chemical spills on campus, but they are always available for on-site advice and can occasionally, loan spill cleanup supplies. For Mercury spills, call the EH&S Office.

Persons causing small spills are responsible for cleanup to the extent of their abilities. Assessment and response depends upon whether the spill is small or large and whether the chemical is an inhalation hazard. The table below may be used to help assess spills.

Category	Size	Response	Treatment Materials
Small	up to 300 cc (about 10 oz)	chemical treatment or absorption	neutralization or absorption spill kit
Medium	300 cc - 5 liters	absorption	absorption spill kit
Large	more than 5 liters	call A&M's Police (5555), contain if possible	outside help
Inhalation Hazard	Small and/or low toxicity†	Absorption	Absorption spill kit
	Large†	Evacuate, call A&M's Police (5555)	outside help

The EH&S Office can help you define and prepare for situations that might occur in your work area.
When in doubt, get out!

The Huntsville Fire Department's Hazardous Incident Team handles large chemical spills and other major emergencies. Call the University Police to summon the fire department. They have self-contained breathing apparatus and other protective equipment that will allow them safe entry into the hazardous area. Two points to remember when making your assessment.

- ✓ Even a small amount of spilled flammable liquid or reactive substance presents a significant fire hazard. There are many spark sources in our work areas. If you are unsure of the spill's fire potential, do not hesitate to pull the fire alarm, evacuate and notify University Police.
- ✓ Any uncontained chemical that can disperse fumes, gases or dusts may be hazardous to your health and the health of those around you. If you suspect that the spilled or released chemical is toxic, evacuate the area. If others in the area could be exposed to the chemical, evacuate the area or building and follow the high hazard emergency procedures.

Small- to Medium-Sized Spill

A small spill is defined as one that does not spread rapidly, does not endanger people or property except by direct contact (i.e., is not an inhalation hazard), and does not endanger the environment

outside the building. For most situations, a small spill would usually contain less than 5 liters and could be neutralized, absorbed, or otherwise managed by the user(s) of the chemical.

No notification of emergency responders is necessary for small spills. However, you must notify the EH&S Office because some small spills of certain compounds must be reported to state agencies. The EH&S Office is always available for advice.

Cleanup of these small spills is relatively easy. Each work site should have appropriate amounts of absorber (e.g., Floor-dry, sand, vermiculite, etc.) and spill pillows to rapidly clean a spill as well as containers (e.g., 5-gallon pails) in which to place the material. Always wear appropriate protective clothing and clean up a small spill as follows:

1. Sprinkle spill control materials over the entire spill area. Circle the spill working the absorber from the outside to the inside of the spill. This reduces the chance of splash or spreading the spilled material.
2. Use care if your spill is acidic. Many spill pillows do not work with hydrofluoric acid. Many neutralizers for acids or bases have a color change indicator to show when neutralization is complete. Read the instructions first.
3. When spilled materials have been absorbed, use a brush and scoop to place the materials in an appropriate container (e.g., polyethylene bag, 5-gallon pail, etc.).
4. Decontaminate the surface where the spill occurred with mild detergent and water
5. Call the EH&S Office to notify them of the spill and to remove your waste.

When you are finished, don't forget to replenish your spill supplies and discuss with your fellow workers the basic cause of the spill. Such discussions can lead to correcting poorly engineered work places and provide a training tool to reduce the occurrence of similar incidents.

Large Spills / Major Emergencies

Large spills and major emergencies are those incidents that pose an immediate threat to health, property or the environment. Major emergencies, such as large spills and releases of hazardous materials to the environment, require the assistance of University Police and the Huntsville Fire Department or their Hazardous Incident (Response) Team. Emergencies that require the evacuation of a building (or a floor or a wing of a building) are major emergencies. If you do not know the nature or magnitude of the emergency or are in any way uncertain as to how to handle the emergency, proceed as if it were a major emergency. Emergency responses include:

1. For routine spills, notify your supervisor and call the University police (5555):
   - Identify yourself and the reason you are calling.
   - Identify the exact location of the emergency.
   - Identify the nature of the emergency, any injuries or symptoms involved, and the identity of any hazardous materials involved if you know them.
2. For situations that threaten fire or explosion, and spills in which hazardous vapors are present:
   - Pull the fire alarm.
   - Evacuate the area and tell others to evacuate.
   - Close, but do not lock doors behind you to isolate the area.
   - If you have time to do so safely, close fume hood sashes and post a sign to warn others not to enter the area.
   - Call University Police, tell them you pulled the fire alarm, include items in #1, above.
3. If fire, smoke, gases or vapors are spreading to other areas:

- Pull the fire alarm to evacuate the building.
- Call University Police from a remote location and inform them of the spill.
- Be available to advise emergency response personnel by identifying yourself when they arrive. Someone responsible for that room or building should be present to provide details of the incident to emergency responders. This individual should be able to identify the types and quantities of chemicals stored there and their locations within the rooms.

Preparing for Spills

Everyone who handles chemicals should be aware of the hazards associated with the materials they work with and how to manage any spills of these materials. This information can be found in the Material Safety Data Sheets (MSDS) which accompany the chemicals purchased. If you are unsure of the safety hazards of a particular chemical be sure to read the MSDS before starting any procedures. These sheets should be kept in a central location in your work area so you can access them quickly. If you need an MSDS, you can call the 3E Company (1-800-451-8346).

Supervisors are responsible for training employees and students on the procedures for safely working with chemicals, including chemical spill response. Training aids such as handouts and videotapes are available from the EH&S Office. EH&S Office personnel are also available for training and consultation regarding safety practices and engineering controls to prevent spills and releases and they can visit your work area to recommend spill control materials that are applicable for your specific situation.

Be prepared for the worst case scenario. Plan for a spill of your largest container of acid, base, solvent, or dry chemical. At a minimum, have a few bags of Oil-Dry (or other spill absorbent), spill control pillows, heavy-duty disposal bags, plastic pails, a broom and a dustpan or shovel. Always wear appropriate protective equipment:

- ✓ **Eye Protection:** Always wear safety glasses when working or cleaning up spills of hazardous materials; for corrosive or reactive materials, goggles or a face shield are also necessary.
- ✓ **Skin Protection:** All personnel should at least be wearing suitable work clothes (see Appendix C, PPE Assessment for further guidance). If splashing is a possibility, an apron should be worn as well. Gloves are very important to protect your hands. A pair of heavy nitrile, butyl, or neoprene gloves and one box of disposable polyethylene gloves are recommended for each person involved in a cleanup. Plan on at least two people per cleanup. Since some chemicals may go through even heavy nitrile, butyl, or neoprene gloves, you should refer to the glove selection in section Appendix: M Glove Chemical Resistance Guide to choose the best glove for your work. The EH&S Office is available for consultation on glove selection. Boots or shoe covers may be necessary for large liquid spills.

Preventing and Containing Spills

Good housekeeping practices and well-organized work areas help to prevent spills due to accidents.

Store and use hazardous liquid containers in a pan large enough to contain the contents whenever possible. The pan is a secondary container if the original container leaks or breaks. Secondary containment can prevent leaks from damaging other materials and may make the difference between a minor annoyance and a major emergency.

Appendix J. Employee HazCom Training

A building custodian was using an "industrial strength" disinfectant cleaning solution to scrub down the bathroom. The label directions warned users not to overuse the cleaner and provided specific dilutions for mixing with water. The custodian poured too much into each toilet bowl and when he headed back to the first bowl to scrub it, the toxic fumes had taken over the bathroom. In this instance, the custodian was lucky to get only ten stitches in his head where it banged the floor.

Are Your Chemicals Hazardous?

There are an estimated 575,000 existing chemical products and hundreds of new ones are introduced annually. Almost 32,000,000 workers are potentially exposed to one or more chemical hazards in the workplace. In fact, nearly all chemicals and chemical products are considered hazardous by the Occupational Safety and Health Administration (OSHA). Examples of chemicals and chemical products which are considered hazardous:

acids	coating	insecticides	solder
adhesives	degreasers	muriatic acid	solvents
aerosol cans	deicer	oil	thinner
antifreeze	detergents	paints	varnish
bleach	gasoline	pesticides	weed killer
caustics	glue	propane	compressed gas
cleaners	ink	soap	

According to OSHA a *hazardous chemical* is any chemical which is a health hazard or a physical hazard. A chemical is a *health hazard* if there is evidence that acute or chronic health effects may occur in exposed employees. Health hazards include chemicals that are carcinogens, reproductive toxins, irritants, corrosives, sensitizers or exhibit other types of toxicity, and agents which can damage the lungs, skin, eyes or mucous membranes. A chemical is a *physical hazard* if that chemical could cause physical damage in the work place. Physical hazards include chemicals that are a combustible liquid, a compressed gas, an explosive, a flammable (gas or liquid), an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

The OSHA Hazard Communication Standard

The obvious answer to the question "Are your chemicals hazardous?" is "Yes!" and in 1983 OSHA set out to help control workers' on-the-job chemical exposure by publishing the Hazard Communication Standard (HCS), commonly called HazCom or "Right to Know." The Standard, published in Title 29, Part 1910.1200 of the Code of Federal Regulations (29 CFR 1910.1200) requires all employers to provide information and training on chemical hazards to any employees who have the potential of being exposed to a hazardous chemical "under normal condition of use or in a foreseeable emergency."

The HazCom Standard covers chemicals in all physical forms -- liquids, solids, gases, vapors, fumes and mists -- whether they are contained or not. It requires chemical manufacturers and importers to evaluate their chemicals and determine if they are hazardous. Chemicals determined to be hazardous must have a comprehensive ***Material Safety Data Sheet*** (***MSDS***) and ***warning***

labels on chemical containers. It also requires the employer (e.g., A&M) to develop a written hazard communication program and provide information and training to employees about the hazardous chemicals in their workplace. The HazCom Standard establishes three important informational requirements: labels, Material Safety Data Sheets (MSDSs), and employee training.

- ✓ ***Labels*** provide a brief statement of the hazards associated with the chemical.
- ✓ ***MSDSs*** provide more comprehensive technical information on the hazardous chemical and serve as reference documents for employees, emergency responders, and health professionals.
- ✓ ***Training*** ensures that employees understand the information provided by labels and MSDSs, know where and how to obtain this information, and are aware of the proper protective measures and emergency procedures to follow.

Labels

MSDSs and container labels tell you about the hazards of the material you will work with and how to work safely with it. You must read the label before opening hazardous chemical containers. Labels alert you to the health and physical hazards a material presents during use, handling, and storage. Once you are aware of the potential hazards, you can take the necessary precautions. If a label tells you a material is corrosive, avoid contact with your skin and eyes, and don't breathe the vapors. If a label tells you a material is flammable, keep it away from heat, sparks, and flame. Good labels also include first aid instructions in case of exposure or contact, fire and spill or leak procedures, and handling and storage requirements. If an accident or spill occurs, you can be prepared to deal with it quickly and effectively.

Container labels are an essential information source and one of the key ways in which workers are made aware of the chemical hazards in their work area. Do not remove or deface the manufacturer's original label from any chemical container. The HazCom Standard requires that all containers of hazardous chemicals be marked with:

- ✓ the chemical's identity
- ✓ name and address of the chemical manufacturer or supplier
- ✓ the chemical's hazards

OSHA also requires an appropriate hazard warning which must include "target organ" effects. For example, if the chemical, when inhaled, causes lung damage, then that warning and the health hazard should be spelled out: "***Do not inhale - May cause lung damage.***" All carcinogenic or "cancer causing" information must be on the label. Key points to remember:

- ✓ Always read the container label before the container is opened, moved, or handled. Labels provide an immediate warning of the hazards workers may be exposed to, and through the chemical identification, they provide a direct link to the MSDS.
- ✓ An unlabeled container should never be used and should be reported immediately. You should not handle a container whose contents are unknown.
- ✓ Even a trace of a chemical residue in a supposedly empty container can pose a serious health and safety risk if an incompatible chemical is added to the container. The combination could be deadly.
- ✓ Never remove a label unless you immediately replace it with another one (e.g., the original label has become soiled, torn, or unreadable and must be replaced with one containing the same (required) information).

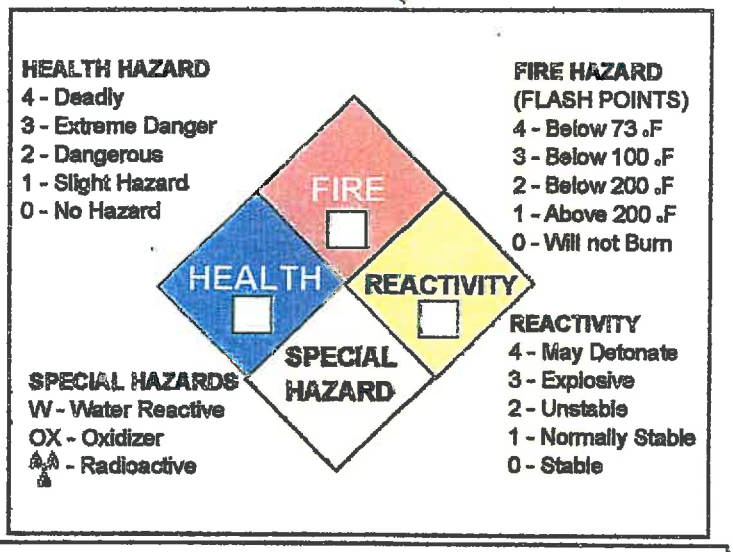
There are several standardized and uniform labeling systems. The most commonly encountered are the Department of Transportation (DOT), the National Fire Protection Association (NFPA), and the Hazardous Materials Information Systems (HMIS)

DOT Labels

Many containers are individually labeled with the standard DOT diamond-shaped label that are designed to identify DOT classes of hazardous materials. These DOT labels are diamond-shaped and color-coded by hazard. The hazard class or division number appears in the lower corner. Usually these are found on large (5 gallon) containers of chemicals or cases containing several unit containers.

NFPA Labels

The popular NFPA diamond was originally developed by the ***National Fire Protection Association***. It contains 4 colored diamond shapes associated with different hazards. This system refers to the hazards associated with the material under fire-type conditions.



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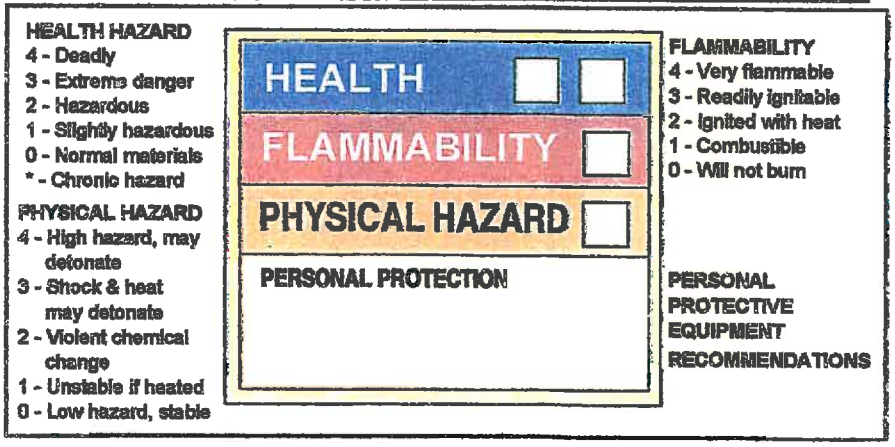

NFPA and HMIS Labeling Systems

On both the NFPA and HMIS label, each color represents a type of hazard:

- ✓ **Blue** stands for health hazard
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- ✓ **Yellow** is reactivity hazard (NFPA) or **Orange** is physical hazard (HMIS)
- ✓ **White** stands for special hazard information or special notice

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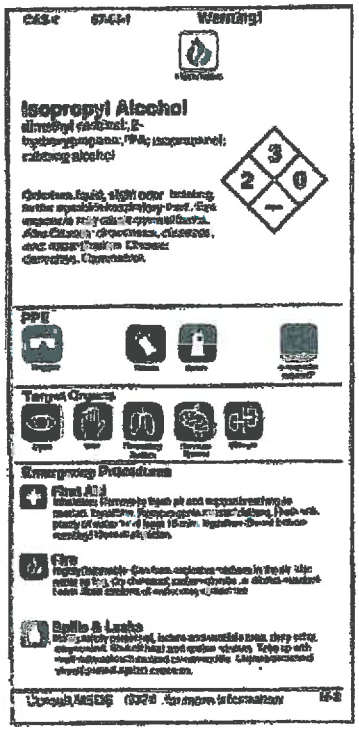
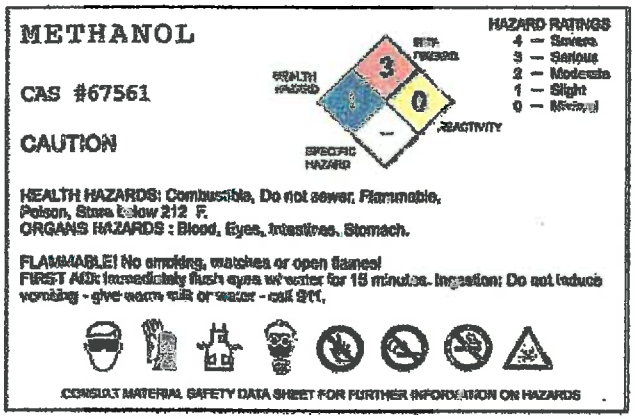
For example, consider the label NFPA label on a container of methanol. A hazard degree of 1 has been assigned to the health hazard which means the material is a slight hazard. The flammability rating is 3 which means it has a flash point below 100° F and will readily ignite at normal temperatures. The reactivity rating of 0 means that the material is stable. Personal protective equipment includes safety goggles, rubber gloves, rubber gloves and apron. Other symbols which might be used include: no smoking, no open flames, no matches. Since it is poisonous, the "skull & crossbones" symbol or the word "poison" would appear on the NFPA label. The target organs affected from a hazardous exposure are: blood, eyes, intestines, and stomach.





While the NFPA and HMIS systems are relatively common, some vendors have created their own "Right-to-Know" label system which incorporates one or both these labels. When looking at containers, look for the common elements rather than the differences.

Material Safety Data Sheets

The OSHA HazCom Standard requires each work unit obtain MSDSs from the manufacturer and maintain them in such a way that they are readily accessible to personnel in any work areas and during any shift. Suppliers are required to include an MSDS for each chemical or chemical

product purchased. Make sure that all packages of incoming chemicals have an MSDS. Your work unit should have a system to catalogue MSDSs and to make them available for your review.

MSDSs contain a lot of chemical, medical and legal information. But that is no reason to think they are confusing. Remember, they are written to be useful to a wide variety of individuals (e.g., workers, emergency responders, physicians, etc.), for any quantity of that chemical product. Therefore, there is some key information on an MSDS that every employee should review and understand for the chemicals they use. Managers should review MSDSs with their employees to check their ability to identify and comprehend key information. For more information on the contents of the MSDS, see Section H.2 in Appendix H.

Safe Work Procedures

Many products you work with at home contain hazardous ingredients: bleach is sodium hypochlorite and water; window cleaner is often isopropanol or glycol ether or even ammonia; and nail polish remover is often acetone or ethyl acetate. The key to working safely is to read the label. Commercial products usually have an ingredient list and necessary precautions printed on the container label.

Products you use every day may contain one or more hazardous materials; you should handle them just a carefully as you would a bottle or can of a pure chemical. Consider a wood glue that contains 80% polyvinyl acetate base and 0.1% formalin. Formalin is a solution of formaldehyde, a toxic chemical. While the small percentage of a hazardous material suggest there is less chance it has to pose a health risk, it does not mean it poses no threat. Formaldehyde (formalin) is highly toxic and can cause severe burns upon inhalation, ingestion, or skin contact. Some people are extremely sensitive to formalin. It is also a suspected human carcinogen.

Remember, sickness and even death from improper exposure can be prevented if workers are aware of the potential hazards before they use a chemical. Follow these guidelines when working with any hazardous substance:

- ✓ Read the label.
- ✓ Look for hazardous ingredients (they may be printed in bold type or have asterisks (*) after their names).
- ✓ Follow all required precautions.
- ✓ Read the MSDS if you have <u>any</u> question about the product.
- ✓ Open hazardous chemical containers correctly to prevent the possibility of a spill or spray.
- ✓ Close container when finished.
- ✓ Never mix a commercial product with any other material, some of the constituents may react.

If you have any questions about safety, ask your supervisor. If your supervisor is unable to provide you the information, ask him to can EH&S Office.

Notes

Appendix K. Safe Handling of Waste Light Bulbs

Light bulbs that contain mercury vapor must be treated as a hazardous material and disposed following requirements for hazardous waste disposal established by the US Environmental Protection Agency (EPA) and the Alabama Department of Environmental Management (ADEM)

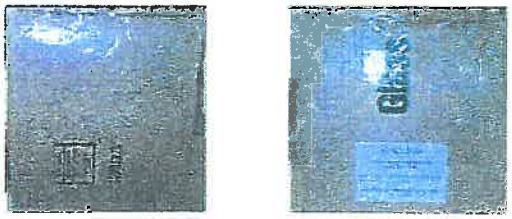
Mercury is a hazardous material that can cause harm to humans exposed to mercury vapor and can harm the environment if disposed improperly.

Light bulbs containing mercury vapor become a hazardous waste when the bulb burns out and is removed from the light fixture. You must handle the bulb carefully to avoid breaking the bulb since the vapor is contained inside the bulb! If the bulb is broken, the mercury vapor will be released to the environment creating a potential exposure hazard for you and others working nearby. Fluorescent bulbs with green ends also contain mercury and must be recycled.

Upon removal from the fixture, the bulb must immediately be placed in a strong box or other container with enough padding material to prevent bulb breakage. The box must be sufficiently strong to prevent damage to the bulbs under normal storage conditions and to protect the bulbs while being transported to the storage facility. Partially filled or completely filled waste bulb storage containers must be kept closed at all times unless a bulb is being placed in the box.

Examples of Improper storage conditions

Bulbs in box, box closed when not in use



Box labeled and dated

Boxes or other containers used to store waste bulbs must be labeled with the words "***Universal Waste***" and "***Lamps for Recycling***" Other cautionary information may be included as well. The EH&S Office has given labels for this to your supervisor, but the words can also be written on the box. The label or information must be placed on the box when the first waste bulb is placed in the box.

Universal Waste

Lamps for Recycling

Lamps contain mercury
Do not break bulbs!

Universal Waste

Lamps
for Recycling

Contact your supervisor to arrange for a pickup of your full box of waste bulbs and delivery to the designated holding facility.

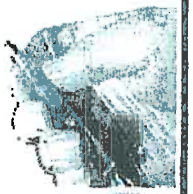
Broken bulbs <u>may</u> require additional action

1. If a bulb breaks inside the storage box, it is safer to leave the broken bulb in the box and the box processed as stated above.
2. If you break a waste light bulb or lamp, all glass and other debris must be cleaned up immediately. Clean the debris by:
   a. Put on disposable gloves
   b. Carefully pick up the broken glass and end pieces and place in a plastic bag. Be careful when handling the broken glass to avoid being cut by broken glass.
   c. Once you have picked up all the broken debris, remove your gloves and place them in the bag.
   d. Seal the bag and place the plastic bag in a paper bag or box to prevent the glass from puncturing the plastic bag.
   e. The bag containing the broken glass and end pieces will be disposed of as hazardous waste. Keep separate from unbroken bulbs, notify your supervisor.

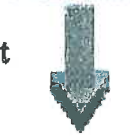
Sharps and Laboratory Glass Disposal

NEEDLES AND OTHER SHARPS

Sharps: Items designed to cut or puncture skin and sharp items contaminated with human blood and body fluids.



- Needles and syringes with needles
- Lancets
- Scalpels and razor blades
- Contaminated broken vials, hematocrit tubes, Pasteur pipettes and laboratory slides



OSHA-Approved Sharps Container: Closable, puncture resistant, leakproof, plastic sharps container.
Obtain from: Laboratory supply/safety catalog.

Disposal Procedure:

- Collect in an OSHA-approved sharps container.
- When full take to a sharps collection area and deposit container in the red plastic collection can. (Ask your building manager for the location)

HAZARDOUS GLASS AND PLASTIC

Hazardous Glass and Plastic: Items that can injure if disposed of in normal trash containers.

- Pasteur pipettes
- Other pipettes and tips
- Uncontaminated slides and cover slips
- Broken or fragile glass

Sturdy, Leakproof Cardboard Boxes:

- Use plastic liner.
- Double box or tape seams to contain waste.
- Use packing tape, not lab tape or masking tape.
- Limit weight to 20 lbs.
- Limit bottom size to 12"x12"
- Use discarded boxes or obtain boxes from a lab supply catalog.

Disposal Procedure:

- If contaminated with infectious agents or human blood, decontaminate first.
- Empty the item of hazardous chemicals and drain liquids.
- Tape box closed.
- Mark box with the words "Hazardous Glass for Disposal" and your room number.
- Place in hallway next to your lab door.

EMPTY BOTTLES, OTHER GLASS AND PLASTIC

Unbroken Glass and Plastic: Items that present no hazard if disposed of as normal trash.

- Petri dishes (decontaminated)
- Sturdy test and centrifuge tubes
- Empty bottles

Regular Lab Wastebasket

Disposal Procedure:

- If contaminated with infectious agents or human blood, decontaminate first.
- Empty the item of hazardous chemicals, rinse and drain liquids.
- Place in wastebasket
- Place large (4 liter) bottles next to wastebasket.

Alabama A & M University
Environmental Health and Safety

Appendix M. Glove Chemical Resistance

Glove Chemical Resistance

Chemical	Nitrile	Natural	Yellow
Acetaldehyde	P	NT	P
Acetone	NR	P	E
Acetonitrile	F	P	P
Amyl Acetate	E	P	NT
Amyl Alcohol	E	F	G
Aniline	NR	F	NR
Aqua Regia	F	G	NT
Benzaldehyde	NR	NT	P
Benzene	P	NR	NR
Butyl Acetate	F	P	P
Butyl Alcohol	E	F	NT
Calcium Hypochlorite	NT	NT	G
Carbon Disulfide	G	NR	NT
Carbon Tetrachloride	G	NR	NR
Cellosolve	G	P	NT
Cellosolve Acetate	F	P	P
Chlorobenzene	NR	NT	NR
Chloroform	NR	NR	NR
Citric Acid	E	E	G
Cyclohexanol	E	G	NT
Dibutyl Phthalate	G	G	F
Diethylamine	F	NT	P
Diesel Fuel	NT	NT	P
Diethyl Ether	E	P	P
Dimethyl Formamide	NR	F	P
Dimethyl Sulfoxide	E	P	P
Dioctyl Phthalate	G	F	F
Dioxane	NR	P	P
Ethanol	E	G	E
Ethyl Acetate	NT	P	F
Ethylene Glycol	E	E	F
Formalin	E	F	E
Furfural	NR	F	NT
Gasoline	E	NT	P
Glycerine	NT	E	G
Hexane	E	NR	P
Hydrazine	E	NT	NT
Hydrogen Peroxide	E	E	NT
Isobutyl alcohol	E	F	NT
Iso Octane	E	NT	P
Isopropanol	E	F	G
Kerosene	E	F	P
Lactic Acid	E	NT	G
Methanol	E	P	G

Chemical	Nitrile	Natural	Yellow
Methylene Chloride	NR	NR	NR
Methylamine	E	NT	P
Methyl Ethyl Ketone	NR	P	F
Methyl Isobutyl Ketone	P	P	P
Methyl Methacrylate	P	P	NT
Mineral Spirits	E	NT	F
Morpholine	NR	NR	NT
Naphthas, VM&P	E	NR	NT
Nitrobenzene	NR	F	P
Octyl Alcohol	E	NT	NT
Oxalic Acid	E	G	G
Perchloroethylene	G	NR	NR
Propyl Alcohol	E	P	G
Sodium Hypochlorite	NT	E	NT
Stoddard Solvent	E	NT	NT
Tetrahydrofuran	NR	NR	NT
Toluene (Toluol)	F	NR	NR
1,1,1-Trichloroethane	F	NR	NR
Trichloroethylene	NR	NR	NR
Tricresyl Phosphate	E	NT	NT
Triethanolamine	E	NT	NT
Turpentine	E	NT	NT
Xylene (Xylol)	G	NR	NR
Common Acids			
Acetic Acid, Glacial	G	F	E
Chromic Acid, 50%	F	F	NT
Formic Acid, 90%	F	F	G
Hydrochloric Acid, Con	E	G	P
Hydrochloric Acid, 10%	E	NT	E
Hydrofluoric Acid, 48%	E	G	NT
Nitric Acid, 10%	E	E	NR
Nitric Acid, 70%	NR	NT	NR
Perchloric Acid	E	NT	NT
Phosphoric Acid	E	E	NT
Sulfuric Acid, 10%	E	E	G
Sulfuric Acid, 95%	NR	NT	NR
Common Bases			
Ammonium Hydroxide	E	P	E
Calcium Hydroxide	NT	E	E
Potassium Hydroxide, 50%	E	G	E
Sodium Hydroxide, 50%	E	E	E

Key: E=Excellent; G = Good; F = Fair; P = Poor; NR = Not Recommended; NT = Not Tested
Nitrile = Ansell Edmont SolVex® nitrile latex
Natural = Marigold Industrial® natural rubber/neoprene unlined latex
Yellow = Best Value Masters® lined natural latex
This glove selection does not protect against all chemicals. For aggressive chlorinated solvents such as chloroform and trichloroethylene, order some Silvershield® or polyvinyl alcohol gloves from a safety equipment vendor.