HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE – AWARENESS

STUDENT MANUAL

AWARENESS CLASS SCHEDULE

Opening

Introductions
Housekeeping issues
Class schedule – lunch/breaks
Review class materials – a walk through of binder
20 minutes

Presentation

SLIDES: Objectives - Definitions
VIDEO: Awareness Video (~ 15 minutes)
Exercise: Short explanation of DOT book – look up placard # in video
40 minutes

Break: 10 minutes

Slides: Chemical Hazards-Physical Hazards-Factors of Toxicity-Fire.

Exercise: Toxicology Fill –in –the –blank
60 minutes

Break: 5 minutes

Slides: Hazard Identification - - Other documentation up to MSDS

45 minutes

LUNCH: 45 minutes

Slides: MSDS

Exercise: Complete MSDS exercise/review answers
30 minutes

Slides: Container Shape
Slides: Dot Book/Practice.

Exercise: Case Study in groups/class discussion
80 minutes

Break

Slides: ERP
Slides: Communications

25 minutes

(Review exercise)/ Game if time permits

Hazardous Waste Operations and Emergency Response Awareness

Follow up Activities:

- Conducted a pre-planning session at my worksite and identified:
  -Potential release points
  -Chemicals that could be released
  -Hazards created when chemicals are released
- Conducted an MSDS inventory for my work area.
- Wrote, reviewed, revised or updated my company's emergency action/response plan.
- Determined who in the company will be in charge of security during a spill.
- Contacted our local emergency responders to educate them on the hazards at our workplace.

Activity Plan

	Activity	Other people involved	Target Deadline
❑			
❑			
❑			
❑			
❑			
❑			
❑			
❑			

Resources Available from the Division of Safety & Hygiene (DSH) Libraries

(800) 644-6292 (614) 466-7388
library@bwc.state.oh.us
www.ohiobwc.com

Safety training:

- Safety talks, outlines and scripts - DSH Safety leader's discussion guide, Training Center's One-hour safety presentations, reference books, web resources
- Videos – hundreds of safety and health topics
- Books and articles on training techniques

Machine and equipment safety:

- Safety standards (ANSI, NFPA, CGA)
- Books and articles on power presses, material handling equipment, lockout/tagout, etc.

Sample written programs:

- DSH program profiles and sample written programs
- Reference books
- Internet resources

Illness and injury statistics:

- Statistics from the U.S. Bureau of Labor Statistics
- National Safety Council's *Injury Facts*
- National Institute of Occupational Safety & Health (NIOSH) studies

Hazard communication and chemical safety:

- Chemical safety information
- Material safety data sheets (MSDSs)
- Sample written programs
- Videos
- Internet resources

Safety standards

- American National Standards Institute (ANSI) standards (including standards for construction, machinery and equipment, personal protective equipment)
- National Fire Protection Association (NFPA) fire codes (including the Life Safety Code and the National Electrical Code)
- Compressed Gas Association (CGA) standards

Other topics of interest (books, articles, magazines, videos and standards):

- Confined spaces
- Electrical safety
- Job safety analysis
- New employee orientation
- Powered industrial trucks
- Respiratory protection
- Safety culture
- Scaffolds

Directories and lists of vendors of safety equipment

Occupational Safety & Health Administration (OSHA) regulations

Manual of Uniform Traffic Control Devices (MUTCD)

Recommendations of useful Internet sites

BWC publications

Saving You Time and Research

Requests for copies of OSHA standards, information on starting a safety committee, a video on accident investigation techniques -- these are some of the thousands of inquiries BWC's Division of Safety & Hygiene (DSH) libraries receive each year.

DSH has two libraries to serve you:

- The central library in the William Green Building in downtown Columbus;
- The resource center and video library located at the Ohio Center for Occupational Safety and Health (OCOSH) in Pickerington.

Both libraries are open 8 a.m. to 4:45 p.m., Monday through Friday. Your need for information does not require a visit to the library. You can phone, fax, or e-mail your requests and receive a quick response.

The central library provides free information services on the topics of occupational safety and health, workers' compensation and rehabilitation.

The OCOSH resource center provides similar services for those who visit OCOSH for meetings and training center classes.

The video library offers an extensive collection of videotapes to supplement your organization's safety and health training program. It is a convenient and popular source for Ohio employers to borrow quality occupational safety- and health-related training aids.

Visit our Web site at **www.ohiobwc.com.**

Central library
30 W. Spring St., Third Floor
Columbus OH 43215-2256
1-800-OHIOBWC
(614) 466-7388
(614) 644-9634 (fax)
library@bwc.state.oh.us

OCOSH resource center
13430 Yarmouth Drive
Pickerington OH 43147
1-800-OHIOBWC
Resource center (614) 728-6464
Video library (614) 644-0018

1910.120 (q) (6) (i)

FIRST RESPONDERS AWARENESS LEVEL.

First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities of the release. First responders at the awareness level shall have sufficient training to objectively demonstrate competency in the following areas:

(a) An understanding of what hazardous materials are, and the risks associated with them in an incident.

(b) An understanding of the potential outcomes associated with an emergency created when hazardous materials are present.

(c) The ability to recognize the presence of hazardous materials in an emergency.

(d) The ability to identify the hazardous material if possible.

(e) An understanding of the role of first responder awareness individual in the employer's emergency response plan including the site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.

(f) The ability to realize the need for additional resources, and to make the appropriate notifications to the communication center.

How Prepared is Your Company for a Disaster?

In 1991, Edwin Zebroski did a study of four major disasters: Three-Mile Island, Bhopal, Chernobyl, and the Challenger Shuttle. All four have been investigated thoroughly and impartially, and each was well documented. As a result of the study, Zebroski identified 11 negative attributes that were common to all four disasters.

Do you see your organization defined in the following criteria? If your answer for an item is "Yes! Absolutely," write a score of 0. If your answer is "No. Definitely not," write a score of 10. If your answer falls somewhere is the middle, write a score between 1 and 9 to indicate how closely the item fits your organization.

1. There is a fuzziness as to whom is responsible for what throughout the organization.
   Score _____

2. Mindset that success is routine, everything is "A-OK," "We are good."
   Score_____

3. Belief that rule compliance is enough to ensure safety. ("If we're in compliance, we're safe.")
   Score_____

4. Team-player concept with dissent not allowed; no whistle-blowers
   Score_____

5. Experience from other facilities not processed systemically for application of lessons learned. ("We didn't learn from similar experiences at other facilities.")
   Score_____

6. Lessons that are learned are disregarded, rather than built into the system.
   Score_____

7. Safety is subordinate to other performance goals in production, schedule, quality, etc.
   Score_____

8. Emergency procedures, plans, training, and regular drills for severe events are lacking.
   Score_____

9. Design and operating features are allowed even though recognized elsewhere as hazardous.
   Score_____

10. Project and risk management techniques are available but not used.
    Score_____

11. Organization has undefined responsibility, authority, and accountability for recognizing and integrating safety.
    Score_____

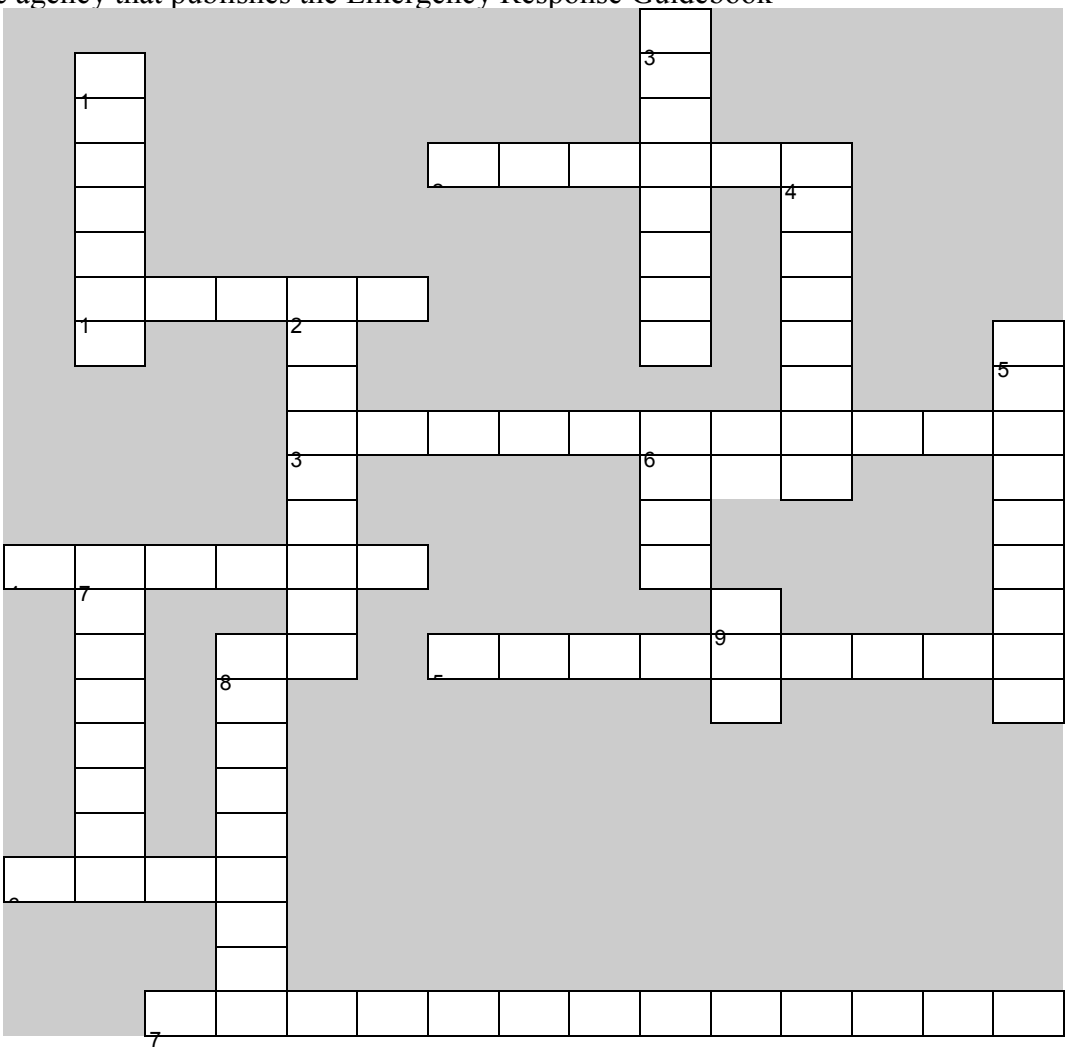
Total Score _____

To calculate your average score, divide your total score by the number of items (11). If you scores are low (0-5) for several items, your organization needs to change the way it approaches safety - and change quickly.

[1] Source: "Safety Accountability with Dan Petersen," a new video series from Core Media Training Solutions; (800537-8352. Reprinted from Industrial Safety & Hygiene News, September 1999.

ACROSS
1. Warning sign placed on a container
2. Contaminants enter the body through four _____ of entry.
3. At the awareness level, training includes _____ of hazards and site control.
4. Approach a spill from uphill & _____
5. Acids and bases are _____
6. Document providing comprehensive information about a substance.
7. UN stands for _____ _____.

DOWN
1. An environmental clue of a spill are dead _____.
2. What the seventh letter of HAZWOPER stands for.
3. Trained only at the awareness level, an employee must stay a safe _____ from the spill.
4. Site _____ & Control
5. The type of _____, such as a box or drum, can give a clue to the substance.
6. The fire diamond is a symbol from what agency
7. Warning signs placed on a truck
8. A reactive chemical can cause an _____.
9. The agency that publishes the Emergency Response Guidebook



HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE - AWARENESS

29 CFR 1910.120

Revised July 2000

Objectives

- Define your role at the Awareness level?
- "Clues" to be gathered upon discovering an incident.
- Be able to read placards and labels.
- Able to read and interpret the DOT book.
- Able to implement site security and control.
- Understand the basics of an Emergency Response Plan

Role of First Responder - Awareness

29 CFR 1910.120(q)

- **Likely to witness or discover release.**
- **Trained to initiate emergency response.**
- **Take no further action .**

FIRST RESPONDER AWARENESS LEVEL

- Understand what hazardous materials are and their risks in an incident.
- Understand the potential outcome of an emergency created when hazardous materials are present.
- Ability to recognize the presence of hazardous materials in an emergency.

- Ability to identify hazardous materials if possible
- Role of the First Responder in the Emergency Response Plan including site security & control and DOT's **Emergency Response Guidebook.**
- Ability to realize the need for additional resources and to make appropriate notification to communication center.

HISTORY

- Superfund Amendments and Reauthorization Act of 1986 (SARA)
  - allocated funds to develop health and safety training for workers involved in transportation, storage, or disposal of hazardous waste.

Hazard Recognition

Definitions

Hazardous substance: “OSHA”

Hazardous waste: “EPA”

Hazardous material: “DOT”

Hazardous Substance - OSHA

- A substance which may result in adverse affects on the health and safety of employees
- A substance included as a hazardous material by DOT and as a hazardous waste by EPA

Hazardous Waste - EPA

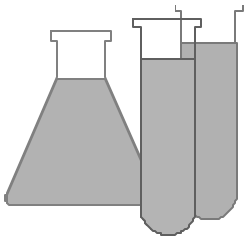
Poses unreasonable risk to health, safety or property when transported in commerce for the purposes of treatment, storage, or disposal as waste

Hazardous Material - DOT

Any substance or material in any form or quantity which poses an unreasonable risk to safety and health and property when transported in commerce

Chemical Hazards

- Flammable
- Corrosive
- Reactive
- Toxic
- Sudden Release of Pressure (explosion)
  - detonation and deflagration



Physical Hazards to Employees

- Radiation
- Electricity
- Stress
- Heat/Cold
- Slips, trips, falls
- Steam & Chemical clouds

Biological Hazards

- Infectious Hospital Waste
- Research Materials
- Raw sewage (hepatitis A, E-coli)
- Bites from vectors (ticks, rats, wild dogs)

Modes and Routes of Entry

Mode	**Route**
Inhalation	Respiratory System
Ingestion	Gastrointestinal Sys.
Injection	Skin
Absorption	Skin

Health Effects

- Acute
  - body response at time of exposure, typically a high concentration, or a few days after exposure.
- Chronic
  - body response takes a long time after repeated or prolonged exposures.

Definitions

- PPM
- TLV
- PEL
- REL
- TWA
- C
- STEL
- IDLH
- OSHA
- ACGIH
- NIOSH

Inhalation Hazard?

Handy rules of thumb

- vapor pressure
  - » <10 mmHg slow
  - » 10-50 mmHg medium
  - » >50 mmHg fast
- evaporation rate
  - » <0.8 slow
  - » 0.8 - 3 medium
  - » > 3 fast

Target Organs

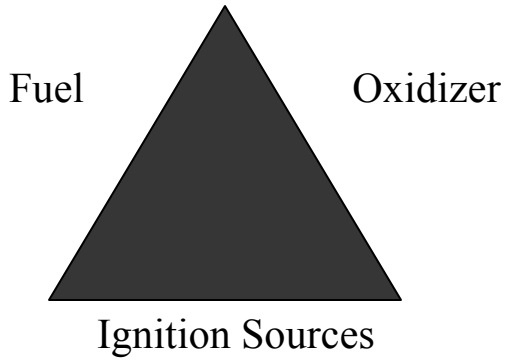
- Nephrotoxin - kidneys
- Hepatotoxin - liver
- Neurotoxin - CNS
- Hemotoxin - blood
- Mutagenic - genetic material
- Teratogenic - fetal deformities
- Carcinogenic - cancer causing

Factors of Toxicity

- Time & Frequency (TWA, STEL)
- Route by which exposure occurs
- Physical & chemical form of the substance
- Dose delivered

Fire & Explosion Characteristics

- **<u>Components of Combustion</u>**



Fire & Explosive Characteristics

Sources of Ignition

Cigarettes

Welding

Grinding / Cutting

Unprotected electrical equipment

Open flames

Hot surfaces

Static electricity

Oxidizing chemicals

Classes Of Fires

- Class A
- Class B
- Class C
- Class D

- Class A/Ordinary Combustible -Extinguish with water
- Class B/Flammable Liquids. Use a Dry Chemical Extinguisher
- Class C/Electrical Equipment. Use a CO_2 Extinguisher
- Class D/Combustible Metals. Use a Dry Powder Extinguisher

Terminology: Flammable

- Flash Point
- Ignition
- Auto Ignition
- Lower Flammability Limit
- Upper Flammability Limit
- Combustible
- Flammability Range
- Oxidizers

Flammable vs. Combustible

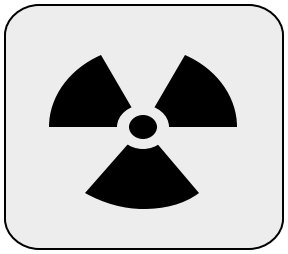
- Flammable
  - A liquid with a flash point below 100°F (Source: 29 CFR 1910.106)
  - A liquid with a flash point below 141°F (Source: DOT)

Combustible

- A liquid with a flash point at or above 100°F but below 200°F (Source: 29 CFR 1910.106)
- A liquid with a flash point at or above 141°F but below 200°F (Source: DOT)

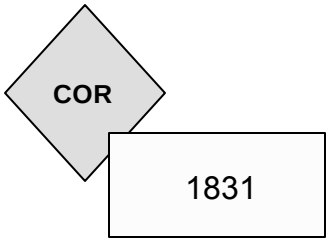
Hazard Identification

- Labels and Placards
- Other Documentation (MSDS)
- Container Shape



Labels and Placards

- DOT System
- NFPA System
- HMIS System



DOT System

- Shipping papers
- Markings
- Labeling
- Placarding

Shipping Papers

- Proper shipping name
- Hazard class (9 classes)
- Identification number
- Packing group
- Container type
- Quantity
- Shipper data
- Emergency phone number

Markings

- Proper shipping name
- Identification number
- Address of the shipper

Labels & Placards

- Graphic representation of the hazard
- Labels on packaging/containers
- Placards on the outside - ends & sides of trucks, rail cars, freight containers


FLAMMABLE
3

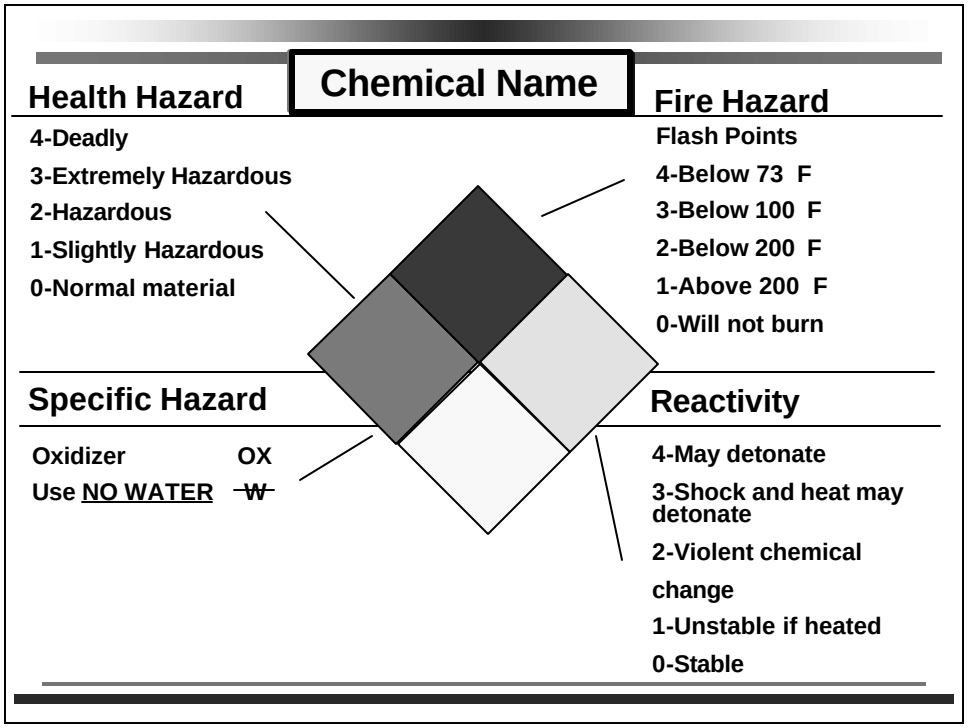

CORROSIVE
8

NFPA SYSTEM

- **Diamond-shaped**
- **Color-coded in 4 small diamonds**

Blue	**Health risk**
Red	**Flammability**
Yellow	**Reactivity**
White	**Special information**

- **Number-coded in the red, blue, and yellow diamonds**



HMIS

Hazard Materials Identification System

- **Rectangular**
- **Color-coded**

Blue	**Health risk**
Red	**Flammability**
Yellow	**Reactivity**
White	**Special information/PPE**

Hazard Materials Information Sheet

Health
Flammability
Reactivity
PPE

NFPA vs. HMIS

- NFPA is geared for fire emergencies
- HMIS is geared for everyday use
- NFPA and HMIS numbers are often in conflict (especially health and reactivity)
- HMIS includes necessary PPE
- NFPA includes special hazards

Other Documentation

- MSDS
- Shipping Containers
- Shipping Papers (Bill of Lading)

How hazardous is it??

- Percent by weight
- How volatile it is (vapor pressure)
- Lowest exposure limit
- Physical form
- Route of entry
- Chronic vs. acute
- Where is it? (out in open, confined area)

Material Safety Data Sheet

Identify (As Used on Label and List)

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Manufacturer's Name	**Emergency Telephone Number**
Address (Number, Street, City, and ZIP Code)	
Telephone Number for Information	
Date Prepared	
Signature of Preparer (optional)	

Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s)	OSHA PEL	ACGIH TLV	Other Limits Recommended	%Optional

Physical/Chemical Characteristics

Boiling Point		**Specific Gravity** (H2O = 1)	
Vapor Pressure (mm Hg.)		**Melting Point**	
Vapor Density (AIR 1)		**Evaporation Rate** (Butyl Acetate 1)	
Solubility in Water			
Appearance and Odor			

Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
Extinguishing Media			
Special Fire Fighting Procedures			
Unusual Fire and Explosion Hazards			

Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable		

Incompatibility (Materials to Avoid)

Hazardous Decomposition or Byproducts

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur		

Health Hazard Data

Route(s) of Entry:	Inhalation? Skin? Ingestion?
Health Hazards (Acute and Chronic)	
Carcinogenicity:	NTP? IARC Monographs? OSHA Regulated?
Signs and Symptoms of Exposure	
Medical Conditions Generally Aggravated by Exposure	
Emergency and First Aid Procedures	

Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled
Waste Disposal Method
Precautions to Be Taken in Handling and Storing
Other Precautions

Control Measures

Respiratory Protection (Specify Type)		
Ventilation	Local Exhaust	Special
	Mechanical **(General)**	Other
Protective Gloves	Eye Protection	
Other Protective Clothing or Equipment		
Work/Hygienic Practices		

Containers

Types of Containers

- Drums and Totes
- Above ground tanks
- Underground tanks
- Tanker trailers
- Ponds or lagoons
- Compressed gas cylinders


CAUTI
WARNING
CAUT
74
77

Container Inspection

- Symbols, words or markings identifying the content
- Signs of deterioration - corrosion, rust, leaks, crystallization around opening (peroxides)
- Signs of container under pressure - bulges & swelling
- Drum type
- Drumhead configuration

North American Emergency Response Guidebook

EMERGENCY RESPONSE GUIDEBOOK

Yellow Section

- **ID # - United Nations # (Numerical Order)**
- **Guide # - Orange Pages**
- **Material Name**

Blue Section

- **Material Name (Alphabetically)**
- **Guide Number (Orange Section)**
- **ID #**

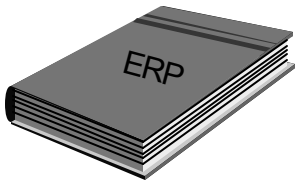
Orange Section

- **Potential Hazards - (Fire/Explosion, Health)**
- **Public Safety - (Notification, PPE, Evacuation)**
- **Emergency Response -(Fire, Spill/Leak, First Aid)**

Green Section

- **Table of Initial Isolation and Protective Action Distances**
- **Small And Large Releases**
- **Day And Night**

Emergency Response Plan



EMERGENCY RESPONSE PLANS

Elements:

- **Emergency escape procedures & route designations**
- **Procedures for employees who stay to operate critical operations before they evacuate.**
- **Accountability procedures for all on-site personnel.**

EMERGENCY RESPONSE PLANS

Elements continued:

- **Rescue and medical responsibilities**
- **Fire and emergency reporting**
- **Emergency call list for notification and assistance**
- **PPE & emergency equipment**

RISK ASSESSMENT

- **Probability of an unwanted event.**
- **Hazards associated with event.**
- **Control measures.**

Hierarchy of Controls:

A. Engineering

B. Administrative work practices

C. Respirators and PPE

Engineering Controls

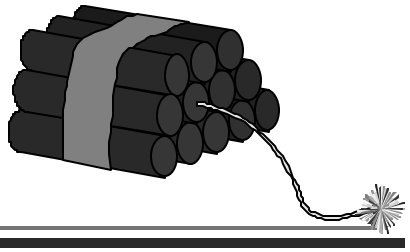
- Pressurized cabs on heavy machinery
- Control booths
- Remotely operated material handling equipment

Work Practices

- Remove all non-essential personnel
- Wetting down dusty operations
- Locating employees upwind of possible hazards

The potential risk from the many hazardous properties of any particular material will vary depending on the conditions during the emergency.

In addition to being able to recognize what has already happened in an emergency, it is necessary to recognize the potential for other problems i.e. a small fire could develop into an explosion.

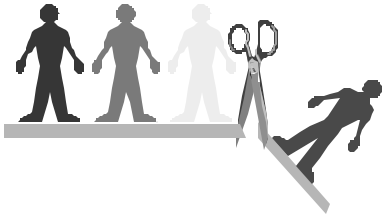


For an Emergency Response Plan to be effective, it requires

- pre-planning
- Training or exercise (Table Top)
- critique/follow-up.

Additional Resources

A first responder must become familiar with the capabilities and limitations of the emergency response team in order to determine the need for additional help or resources.



SITE SECURITY AND CONTROL

- **Safe distances**
- **Evacuation & isolation**
- **Places of refuge**

Site Security & Control cont.

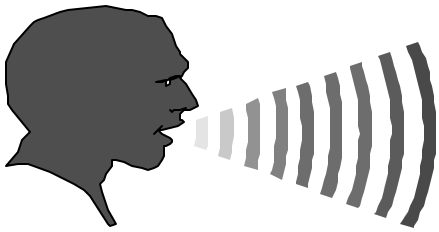
- point of entry
- site maps
- area entry logs
- boundaries

Site Security and Control cont.

- **Accessibility of potential routes**
- **Multiple evacuation routes**
- **Mark evacuation routes**
- **Make escape routes known to all**

COMMUNICATIONS

----First Responder - Awareness has the ability to make appropriate notifications to the communications center.



Communications

Internal

bells

whistles

telephones

sirens

pagers

megaphones

bullhorns

compressed air horns

site alarms

PLUS . . .

colored flags

flares

hand signals

lights

signal boards

External Forms of Communication

Telephone hookups

Cell phones

Radio

Hazardous Waste
Operations and
Emergency Response
1910.120(e)(1)(i) and (ii);
(2)(i) through (vii);
(3)(i) through (iv) and
(4) through (9)

(2) ***Elements to be covered.*** The training shall thoroughly cover the following:

(i) Names of personnel and alternates responsible for site safety and health;

(ii) Safety, health and other hazards present on the site;

(iii) Use of personal protective equipment;

(iv) Work practices by which the employee can minimize risks from hazards;

(v) Safe use of engineering controls and equipment on the site;

(vi) Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards; and

(vii) The contents of paragraphs **(G)** through **(J)** of the site safety and health plan set forth in paragraph **(b)(4)(ii)** of this section.

(3) ***Initial training.***

(i) General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor.

(ii) Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geophysical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iii) Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iv) Workers with 24 hours of training who are covered by paragraphs **(e)(3)(ii)** and **(e)(3)(iii)** of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and two days of training necessary to total the training specified in paragraph **(e)(3)(i)(4).**

(4) ***Management and supervisor training.*** Onsite management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive 40 hours initial training, and three days of supervised field experience the training may be reduced to 24 hours and one day if the only area of their responsibility is employees covered by

paragraphs **(e)(3)(ii)** and **(e)(3)(iii)** and at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

(5) ***Qualifications for trainers.*** Trainers shall be qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they shall have the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instructional skills and knowledge of the applicable subject matter.

(6) ***Training certification.*** Employees and supervisors that have received and successfully completed the training and field experience specified in paragraphs **(e)(1)** through **(e)(4)** of this section shall be certified by their instructor or the head instructor and trained supervisor as having successfully completed the necessary training. A written certificate shall be given to each person so certified. Any person who has not been so certified or who does not meet the requirements of paragraph **(e)(9)** of this section shall be prohibited from engaging in hazardous waste operations.

(7) ***Emergency response.*** Employees who are engaged in responding to hazardous emergency situations at hazardous waste cleanup sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.

(8) ***Refresher training.*** Employees specified in paragraph **(e)(1)** of this section, and managers and supervisors specified in paragraph **(e)(4)** of this section, shall receive eight hours of refresher training annually on the items specified in paragraph **(e)(2)** and/or **(e)(4)** of this section, critiques of incidents that have occurred in the past year that can serve as training examples of any related work, and other relevant topics.

(9) ***Equivalent training.*** Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to that training required in paragraphs **(e)(1**) through **(e)(4)** of this section shall not be required to provide the initial training requirements of those paragraphs to such employees. However, certified employees or employees with equivalent training new to a site shall receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience. However, certified employees or employees with equivalent training new to a site shall receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience.

2. ***Training***. The training program for employees subject to the requirements of paragraph **(e)** of this standard should address: the safety and health hazards employees should expect to find on hazardous waste clean up sites; what control measures or techniques are effective for those hazards; what monitoring procedures are effective in characterizing exposure levels; what makes an effective employer safety and health program; what a site safety and health plan should include; hands-on training with personal protective equipment and clothing they may be expected to use; the contents of the OSHA standards relevant to the employee's duties and functions; and, employee's responsibilities under OSHA and other regulations.

(i) The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean up operations, and the same shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.
(iii) ***Training.*** **(A)** Training for emergency response employees shall be completed before they are called upon to perform in real emergencies. Such training shall include the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn and procedures for handling emergency incidents.
Note: ***Exception #1***: An employer need not train all employees to the degree specified if the employer divided the work force in a manner such that a sufficient number of employees who have responsibility to control emergencies have the training specified, and all other employees, who may first respond to an emergency incident, have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt control activities for which they are not trained.
Note: ***Exception #2***: An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside fully trained emergency response team to respond in a reasonable period and all employees, who may come to the incident first, have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside, fully trained emergency response team for assistance.
(B) Employee members of TSD facility emergency response organizations shall be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This would include training in the methods used to minimize the risk from safety and health hazards; in the safe use of control equipment; in the selection and use of appropriate personal protective equipment; in the safe operating procedures to be used at the incident scene; in the techniques of coordination with other employees to minimize risks; in the appropriate response to overexposure from health hazards or injury to themselves and other employees; and in the recognition of subsequent symptoms which may result from overexposures.
(C) The employer shall certify that each covered employee has attended and successfully completed the training required in paragraph **(p)(8)(iii)** of this section, or shall certify the employee's competency at least yearly. The method used to demonstrate competency for certification of training shall be recorded and maintained by the employer.

> **(i)** ***New employees.*** The employer shall develop and implement a training pro-gram, which is part of the employer's safety and health program, for employees exposed to health hazards or hazardous substances at TSD operations to enable the employees to perform their assigned duties and functions in a safe and healthful manner so as not to endanger themselves or other employees. The initial training shall be for 24 hours and refresher training shall be for eight hours annually. Employees who have received the

initial training required by this paragraph shall be given a written certificate attesting that they have successfully completed the necessary training.

1910.120(p)(7)(i) through (iii) Hazardous Waste Operations—Emer-gency Responders
1910.120(p)(8)(iii)(A) through (C) New Technology Programs
1910.120(o)(i)

(ii) ***Current employees.*** Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this paragraph, shall be considered as meeting the initial training requirements of this paragraph as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees shall receive eight hours of refresher training annually.
(iii) ***Trainers.*** Trainers who teach initial training shall have satisfactorily completed a training course for teaching the subjects they are expected to teach or they shall have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.
(iii) ***Training.*** **(A)** Training for emergency response employees shall be completed before they are called upon to perform in real emergencies. Such training shall include the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn, and procedures for handling emergency incidents.
(4) ***Skilled support personnel.*** Personnel, not necessarily an employer's own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employer's regular employees. However, these personnel shall be given an initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these personnel.
(5) ***Specialist employees.*** Employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances, and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge, shall receive training or demonstrate competency in the area of their specialization annually.

(6) ***Training.*** Training shall be based on the duties and function to be per-formed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate in emergency response, shall be given training in accordance with the following paragraphs:

(i) ***First responder awareness level.*** First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. First responders at the awareness

General Industry Training Requirements
1910.120(q)(4)
1910.120(p)(8)(iii)(A)
1910.120(q)(5)
1910.120(q)(6)(i)(A)
through (F); (iii)(A)
Through I; (iv)(A)
through (I); (v)(A)
through (F)

Training Requirements in OSHA Standards and Training Guidelines

level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

(A) An understanding of what hazardous substances are, and the risks associated with them in an incident.

(B) An understanding of the potential outcomes associated with an emergency created when hazardous substances are present.

(C) The ability to recognize the presence of hazardous substances in an emergency.

(D) The ability to identify the hazardous substances, if possible.

(E) An understanding of the role of the first responder awareness individual in the employer's emergency response plan including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.

(F) The ability to realize the need for additional resources, and to make appropriate notifications to the communications center.

(ii) ***First responder operations level.*** First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

(A) Knowledge of the basic hazard and risk assessment techniques.

(B) Know how to select and use proper personal protective equipment provided to the first responder operational level

(C) An understanding of basic hazardous materials terms.

(D) Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit.

(E) Know how to implement basic decontamination procedures.

(F) An understanding of the relevant standard operating procedures and termination procedures.

(iii) ***Hazardous materials technician.*** Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the employer's emergency response plan.

(C) Be able to function within an assigned role in the Incident Command System

(D) Know how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.

(E) Understand hazard and risk assessment techniques.

(F) Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.

(G) Understand and implement decontamination.

(H) Understand termination procedures.

(I) Understand basic chemical and toxicological terminology and behavior

(iv) ***Hazardous materials specialist.*** Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician, however, those duties require a more directed or specific knowledge of the various sub-stances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with Federal, state, local and other government authorities in regards to site activities. Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the local emergency response plan.

(B) Understand classification, identification and verification of known and unknown materials by using advanced survey instruments and equipment.

(C) Know of the state emergency response plan.

(D) Be able to select and use proper specialized chemical personal protective equipment provided to the hazardous materials specialist.

(E) Understand in-depth hazard and risk techniques.

(F) Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.

(G) Be able to determine and implement decontamination procedures.

(H) Have the ability to develop a site safety and control plan.

(I) Understand chemical, radiological and toxicological terminology and behavior.

(v) ***On scene incident commander.*** Incident commanders, who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know and be able to implement the employer's incident command system.

(B) Know how to implement the employer's emergency response plan.

(C) Know and understand the hazards and risks associated with employees working in chemical protective clothing.

(D) Know how to implement the local emergency response plan.

(E) Know of the state emergency response plan and of the Federal Regional Response Team.

(F) Know and understand the importance of decontamination procedures.

(7) ***Trainers.*** Trainers who teach any of the above training subjects shall have satisfactorily completed a training course for teaching the subjects they are expected to teach, such as the courses offered by the U.S. National Fire Academy, or they shall have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to teach.

(f) ***Training***. **(1)** The employer shall provide training to each employee who is required by this section to use PPE. Each such employee shall be trained to know at least the following:

(i) When PPE is necessary;

(ii) What PPE is necessary;

(iii) How to properly don, doff, adjust and wear PPE;

(iv) The limitations of the PPE; and,

(v) The proper care, maintenance, useful life, and disposal of the PPE.

(2) Each affected employee shall demonstrate an understanding of the training specified in paragraph **(f)(1)** of this section and the ability to use PPE properly before being allowed to perform work requiring the use of PPE.

(3) When the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required by paragraph **(f)(2)** of this section, the employer shall retrain each such employee. Circumstances where retraining is required include, but are not limited to, situations where:

(i) Changes in the workplace render previous training obsolete, or

(ii) Changes in the types of PPE to be used render previous training obsolete; or

(iii) Inadequacies in an affected employee's knowledge or use of assigned PPE indicate that the employee has not retained the requisite understanding or skill.

(4) The employer shall verify that each affected employee has received and understood the required training through a written certification that contains the name of each employee trained, the date(s) of training, and that identifies the subject of the certification.

(k) ***Training and information.*** **(1)** The employer shall ensure that each employee can demonstrate knowledge of at least the following:

(i) Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

(ii) What the limitations and capabilities of the respirator are;

(iii) How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;

(iv) How to inspect, put on and remove, use, and check the seals of the respirator;

(v) What the procedures are for maintenance and storage of the respirator;

1910.120(q)(7)3

Regulations (Standards - 29 CFR) - Table of Contents

• Part Number:	1910
• Part Title:	Occupational Safety and Health Standards
• Subpart:	H
• Subpart Title:	Hazardous Materials
• Standard Number:	1910.120
• Title:	Hazardous waste operations and emergency response.
• Appendix:	A , B , C , D , E

1910.120(a)

Scope, application, and definitions. --

1910.120(a)(1)

Scope. This section covers the following operations, unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards:

1910.120(a)(1)(i)

Clean-up operations required by a governmental body, whether Federal, state local or other involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority Site List (NPL), state priority site lists, sites recommended for the EPA NPL, and initial investigations of government identified sites which are conducted before the presence or absence of hazardous substances has been ascertained);

1910.120(a)(1)(ii)

Corrective actions involving clean-up operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 U.S.C. 6901 ***et seq***);

..1910.120(a)(1)(iii)

1910.120(a)(1)(iii)

Voluntary clean-up operations at sites recognized by Federal, state, local or other governmental bodies as uncontrolled hazardous waste sites;

1910.120(a)(1)(iv)

Operations involving hazardous waste that are conducted at treatment, storage, disposal (TSD) facilities regulated by 40 CFR Parts 264 and 265 pursuant to RCRA; or by agencies under agreement with U.S.E.P.A. to implement RCRA regulations; and

1910.120(a)(1)(v)

Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.

1910.120(a)(2)

Application.

1910.120(a)(2)(i)
All requirements of Part 1910 and Part 1926 of Title 29 of the Code of Federal Regulations apply pursuant to their terms to hazardous waste and emergency response operations whether covered by this section or not. If there is a conflict or overlap, the provision more protective of employee safety and health shall apply without regard to 29 CFR 1910.5(c)(1).
1910.120(a)(2)(ii)
Hazardous substance clean-up operations within the scope of paragraphs (a)(1)(i) through (a)(1)(iii) of this section must comply with all paragraphs of this section except paragraphs (p) and (q).
1910.120(a)(2)(iii)
Operations within the scope of paragraph (a)(1)(iv) of this section must comply only with the requirements of paragraph (p) of this section.

Notes and Exceptions:
1910.120(a)(2)(iii)(A)
All provisions of paragraph (p) of this section cover any treatment, storage or disposal (TSD) operation regulated by 40 CFR parts 264 and 265 or by state law authorized under RCRA, and required to have a permit or interim status from EPA pursuant to 40 CFR 270.1 or from a state agency pursuant to RCRA.
1910.120(a)(2)(iii)(B)
Employers who are not required to have a permit or interim status because they are conditionally exempt small quantity generators under 40 CFR 261.5 or are generators who qualify under 40 CFR 262.34 for exemptions from regulation under 40 CFR parts 264, 265 and 270 ("excepted employers") are not covered by paragraphs (p)(1) through (p)(7) of this section. Excepted employers who are required by the EPA or state agency to have their employees engage in emergency response or who direct their employees to engage in emergency response are covered by paragraph (p)(8) of this section, and cannot be exempted by (p)(8)(i) of this section.
..1910.120(a)(2)(iii)(C)

1910.120(a)(2)(iii)(C)
If an area is used primarily for treatment, storage or disposal, any emergency response operations in that area shall comply with paragraph (p) (8) of this section. In other areas not used primarily for treatment, storage, or disposal, any emergency response operations shall comply with paragraph (q) of this section. Compliance with the requirements of paragraph (q) of this section shall be deemed to be in compliance with the requirements of paragraph (p)(8) of this section.
1910.120(a)(2)(iv)
Emergency response operations for releases of, or substantial threats of releases of, hazardous substances which are not covered by paragraphs (a)(1)(i) through (a)(1)(iv) of this section must only comply with the requirements of paragraph (q) of this section.
1910.120(a)(3)
Definitions --

Buddy system means a system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other

employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

Clean-up operation means an operation where hazardous substances are removed, contained, incinerated, neutralized,d stabilized, cleared-up, or in any other manner processed or handled with the ultimate goal of making the site safer for people or the environment.

Decontamination means the removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of foreseeable adverse health effects.

Emergency response or ***responding to emergencies*** means a response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel are not considered to be emergency responses within the scope of this standard. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

Facility means (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any water-borne vessel.

Hazardous materials response (HAZMAT) team means an organized group of employees, designated by the employer, who are expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members perform responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident. A HAZMAT team is not a fire brigade nor is a typical fire brigade a HAZMAT team. A HAZMAT team, however, may be a separate component of a fire brigade or fire department.

Hazardous substance means any substance designated or listed under (A) through (D) of this definition, exposure to which results or may result in adverse effects on the health or safety of employees:

[A] Any substance defined under section 101(14) of CERCLA;

[B] Any biologic agent and other disease causing agent which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any person, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic

mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations in such persons or their offspring.

[C] Any substance listed by the U.S. Department of Transportation as hazardous materials under 49 CFR 172.101 and appendices; and

[D] Hazardous waste as herein defined.

Hazardous waste means --

[A] A waste or combination of wastes as defined in 40 CFR 261.3, or

[B] Those substances defined as hazardous wastes in 49 CFR 171.8.

Hazardous waste operation means any operation conducted within the scope of this standard.

Hazardous waste site or ***Site*** means any facility or location within the scope of this standard at which hazardous waste operations take place.

Health hazard means a chemical, mixture of chemicals or a pathogen for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. It also includes stress due to temperature extremes. Further definition of the terms used above can be found in Appendix A to 29 CFR 1910.1200.

IDLH or ***Immediately dangerous to life or health*** means an atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would interfere with an individual's ability to escape from a dangerous atmosphere.

Oxygen deficiency means that concentration of oxygen by volume below which atmosphere supplying respiratory protection must be provided. It exists in atmospheres where the percentage of oxygen by volume is less than 19.5 percent oxygen.

Permissible exposure limit means the exposure, inhalation or dermal permissible exposure limit specified in 29 CFR Part 1910, Subparts G and Z.

Published exposure level means the exposure limits published in "NIOSH Recommendations for Occupational Health Standards" dated 1986, which is incorporated by reference as specified in § 1910.6, or if none is specified, the exposure limits published in the standards specified by the American Conference of Governmental Industrial Hygienists in their publication "Threshold Limit Values and Biological Exposure Indices for 1987-88" dated

1987, which is incorporated by reference as specified in § 1910.6.

Post emergency response means that portion of an emergency response performed after the immediate threat of a release has been stabilized or eliminated and clean-up of the site has begun. If post emergency response is performed by an employer's own employees who were part of the initial emergency response, it is considered to be part of the initial response and not post emergency response. However, if a group of an employer's own employees, separate from the group providing initial response, performs the clean-up operation, then the separate group of employees would be considered to be performing post-emergency response and subject to paragraph (q)(11) of this section.

Qualified person means a person with specific training, knowledge and experience in the area for which the person has the responsibility and the authority to control.

Site safety and health supervisor (or official) means the individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

Small quantity generator means a generator of hazardous wastes who in any calendar month generates no more than 1,000 kilograms (2,205) pounds of hazardous waste in that month.

Uncontrolled hazardous waste site means an area identified as an uncontrolled hazardous waste site by a governmental body, whether Federal, state, local or other where an accumulation of hazardous substances creates a threat to the health and safety of individuals or the environment or both. Some sites are found on public lands such as those created by former municipal, county or state landfills where illegal or poorly managed waste disposal has taken place. Other sites are found on private property, often belonging to generators or former generators of hazardous substance wastes. Examples of such sites include, but are not limited to, surface impoundments, landfills, dumps, and tank or drum farms. Normal operations at TSD sites are not covered by this definition.

1910.120(b)

Safety and health program.

NOTE TO (b): Safety and health programs developed and implemented to meet other federal, state, or local regulations are considered acceptable in meeting this requirement if they cover or are modified to cover the topics required in this paragraph. An additional or separate safety and health program is not required by this paragraph.

1910.120(b)(1)

General.

1910.120(b)(1)(i)

Employers shall develop and implement a written safety and health program for their employees involved in hazardous waste operations. The program shall be designed to identify, evaluate, and control safety and health hazards, and provide for emergency response for hazardous waste operations.

1910.120(b)(1)(ii)

The written safety and health program shall incorporate the following:
1910.120(b)(1)(ii)(A)
An organizational structure;
1910.120(b)(1)(ii)(B)
A comprehensive workplan;
..1910.120(b)(1)(ii)(C)

1910.120(b)(1)(ii)(C)
A site-specific safety and health plan which need not repeat the employer's standard operating procedures required in paragraph (b)(1)(ii)(F) of this section;
1910.120(b)(1)(ii)(D)
The safety and health training program;
1910.120(b)(1)(ii)(E)
The medical surveillance program;
1910.120(b)(1)(ii)(F)
The employer's standard operating procedures for safety and health; and
1910.120(b)(1)(ii)(G)
Any necessary interface between general program and site specific activities.
1910.120(b)(1)(iii)
Site excavation. Site excavations created during initial site preparation or during hazardous waste operations shall be shored or sloped as appropriate to prevent accidental collapse in accordance with Subpart P of 29 CFR Part 1926.
1910.120(b)(1)(iv)
Contractors and sub-contractors. An employer who retains contractor or sub-contractor services for work in hazardous waste operations shall inform those contractors, sub-contractors, or their representatives of the site emergency response procedures and any potential fire, explosion, health, safety or other hazards of the hazardous waste operation that have been identified by the employer's information program.
1910.120(b)(1)(v)
Program availability. The written safety and health program shall be made available to any contractor or subcontractor or their representative who will be involved with the hazardous waste operation; to employees; to employee designated representatives; to OSHA personnel, and to personnel of other Federal, state, or local agencies with regulatory authority over the site.
1910.120(b)(2)
Organizational structure part of the site program. --
1910.120(b)(2)(i)
The organizational structure part of the program shall establish the specific chain of command and specify the overall responsibilities of supervisors and employees. It shall include, at a minimum, the following elements:
1910.120(b)(2)(i)(A)
A general supervisor who has the responsibility and authority to direct all hazardous waste operations.
1910.120(b)(2)(i)(B)
A site safety and health supervisor who has the responsibility and authority to develop and implement the site safety and health plan and verify compliance.

1910.120(b)(2)(i)(C)
All other personnel needed for hazardous waste site operations and emergency response and their general functions and responsibilities.
1910.120(b)(2)(i)(D)
The lines of authority, responsibility, and communication.
1910.120(b)(2)(ii)
The organizational structure shall be reviewed and updated as necessary to reflect the current status of waste site operations.
..1910.120(b)(3)

1910.120(b)(3)
Comprehensive workplan part of the site program. The comprehensive workplan part of the program shall address the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives.
1910.120(b)(3)(i)
The comprehensive workplan shall address anticipated clean-up activities as well as normal operating procedures which need not repeat the employer's procedures available elsewhere.
1910.120(b)(3)(ii)
The comprehensive workplan shall define work tasks and objectives and identify the methods for accomplishing those tasks and objectives.
1910.120(b)(3)(iii)
The comprehensive workplan shall establish personnel requirements for implementing the plan.
1910.120(b)(3)(iv)
The comprehensive workplan shall provide for the implementation of the training required in paragraph (e) of this section.
1910.120(b)(3)(v)
The comprehensive workplan shall provide for the implementation of the required informational programs required in paragraph (i) of this section.
1910.120(b)(3)(vi)
The comprehensive workplan shall provide for the implementation of the medical surveillance program described in paragraph (f) if this section.
1910.120(b)(4)
Site-specific safety and health plan part of the program. **--**
1910.120(b)(4)(i)
General. The site safety and health plan, which must be kept on site, shall address the safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection.
1910.120(b)(4)(ii)
Elements. The site safety and health plan, as a minimum, shall address the following:
1910.120(b)(4)(ii)(A)
A safety and health risk or hazard analysis for each site task and operation found in the workplan.
1910.120(b)(4)(ii)(B)
Employee training assignments to assure compliance with paragraph (e) of this section.
1910.120(b)(4)(ii)(C)

Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment program in paragraph (g)(5) of this section.

1910.120(b)(4)(ii)(D)

Medical surveillance requirements in accordance with the program in paragraph (f) of this section.

1910.120(b)(4)(ii)(E)

Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

..1910.120(b)(4)(ii)(F)

1910.120(b)(4)(ii)(F)

Site control measures in accordance with the site control program required in paragraph (d) of this section.

1910.120(b)(4)(ii)(G)

Decontamination procedures in accordance with paragraph (k) of this section.

1910.120(b)(4)(ii)(H)

An emergency response plan meeting the requirements of paragraph (l) of this section for safe and effective responses to emergencies, including the necessary PPE and other equipment.

1910.120(b)(4)(ii)(I)

Confined space entry procedures.

1910.120(b)(4)(ii)(J)

A spill containment program meeting the requirements of paragraph (j) of this section.

1910.120(b)(4)(iii)

Pre-entry briefing. The site specific safety and health plan shall provide for pre-entry briefings to be held prior to initiating any site activity, and at such other times as necessary to ensure that employees are apprised of the site safety and health plan and that this plan is being followed. The information and data obtained from site characterization and analysis work required in paragraph (c) of this section shall be used to prepare and update the site safety and health plan.

1910.120(b)(4)(iv)

Effectiveness of site safety and health plan. Inspections shall be conducted by the site safety and health supervisor or, in the absence of that individual, another individual who is knowledgeable in occupational safety and health, acting on behalf of the employer as necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site safety and health plan shall be corrected by the employer.

1910.120(c)

Site characterization and analysis --

1910.120(c)(1)

General. Hazardous waste sites shall be evaluated in accordance with this paragraph to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

1910.120(c)(2)

Preliminary evaluation. A preliminary evaluation of a site's characteristics shall be

performed prior to site entry by a qualified person in order to aid in the selection of appropriate employee protection methods prior to site entry. Immediately after initial site entry, a more detailed evaluation of the site's specific characteristics shall be performed by a qualified person in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.

1910.120(c)(3)

Hazard identification. All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH) or other conditions that may cause death or serious harm shall be identified during the preliminary survey and evaluated during the detailed survey. Examples of such hazards include, but are not limited to, confined space entry, potentially explosive or flammable situations, visible vapor clouds, or areas where biological indicators such as dead animals or vegetation are located.

1910.120(c)(4)

Required information. The following information to the extent available shall be obtained by the employer prior to allowing employees to enter a site:

1910.120(c)(4)(i)

Location and approximate size of the site.

1910.120(c)(4)(ii)

Description of the response activity and/or the job task to be performed.

1910.120(c)(4)(iii)

Duration of the planned employee activity.

1910.120(c)(4)(iv)

Site topography and accessibility by air and roads.

1910.120(c)(4)(v)

Safety and health hazards expected at the site.

1910.120(c)(4)(vi)

Pathways for hazardous substance dispersion.

1910.120(c)(4)(vii)

Present status and capabilities of emergency response teams that would provide assistance to on-site employees at the time of an emergency.

1910.120(c)(4)(viii)

Hazardous substances and health hazards involved or expected at the site and their chemical and physical properties.

..1910.120(c)(5)

1910.120(c)(5)

Personal protective equipment. Personal protective equipment (PPE) shall be provided and used during initial site entry in accordance with the following requirements:

1910.120(c)(5)(i)

Based upon the results of the preliminary site evaluation, an ensemble of PPE shall be selected and used during initial site entry which will provide protection to a level of exposure below permissible exposure limits and published exposure levels for known or suspected hazardous substances and health hazards and which will provide protection against other known and suspected hazards identified during the preliminary site evaluation. If there is no permissible exposure limit or published exposure level, the employer may use other

published studies and information as a guide to appropriate personal protective equipment.

1910.120(c)(5)(ii)

If positive-pressure self-contained breathing apparatus is not used as part of the entry ensemble, and if respiratory protection is warranted by the potential hazards identified during the preliminary site evaluation, an escape self-contained breathing apparatus of at least five minute's duration shall be carried by employees during initial site entry.

1910.120(c)(5)(iii)

If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site an ensemble providing equivalent to Level B PPE shall be provided as minimum protection, and direct reading instruments shall be used as appropriate for identifying IDLH conditions. (See Appendix B for guidelines on Level B protective equipment.)

1910.120(c)(5)(iv)

Once the hazards of the site have been identified, the appropriate PPE shall be selected and used in accordance with paragraph (g) of this section.

1910.120(c)(6)

Monitoring. The following monitoring shall be conducted during initial site entry when the site evaluation produces information which shows the potential for ionizing radiation or IDLH conditions, or when the site information is not sufficient reasonably to eliminate these possible conditions:

1910.120(c)(6)(i)

Monitoring with direct reading instruments for hazardous levels of ionizing radiation.

1910.120(c)(6)(ii)

Monitoring the air with appropriate direct reading test equipment for (i.e., combustible gas meters, detector tubes) for IDLH and other conditions that may cause death or serious harm (combustible or explosive atmospheres, oxygen deficiency, toxic substances.)

1910.120(c)(6)(iii)

Visually observing for signs of actual or potential IDLH or other dangerous conditions.

1910.120(c)(6)(iv)

An ongoing air monitoring program in accordance with paragraph (h) of this section shall be implemented after site characterization has determined the site is safe for the start-up of operations.

1910.120(c)(7)

Risk identification. Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances shall be identified. Employees who will be working on the site shall be informed of any risks that have been identified. In situations covered by the Hazard Communication Standard, 29 CFR 1910.1200, training required by that standard need not be duplicated.

NOTE TO PARAGRAPH (c)(7). - Risks to consider include, but are not limited to:

[a] Exposures exceeding the permissible exposure limits and published exposure levels.
[b] IDLH Concentrations.
[c] Potential Skin Absorption and Irritation Sources.
[d] Potential Eye Irritation Sources.
[e] Explosion Sensitivity and Flammability Ranges.

[f] Oxygen deficiency.
1910.120(c)(8)
Employee notification. Any information concerning the chemical, physical, and toxicologic properties of each substance known or expected to be present on site that is available to the employer and relevant to the duties an employee is expected to perform shall be made available to the affected employees prior to the commencement of their work activities. The employer may utilize information developed for the hazard communication standard for this purpose.
1910.120(d)
Site control. --
1910.120(d)(1)
General. Appropriate site control procedures shall be implemented to control employee exposure to hazardous substances before clean-up work begins.
..1910.120(d)(2)

1910.120(d)(2)
Site control program. A site control program for protecting employees which is part of the employer's site safety and health program required in paragraph (b) of this section shall be developed during the planning stages of a hazardous waste clean-up operation and modified as necessary as new information becomes available.
1910.120(d)(3)
Elements of the site control program. The site control program shall, as a minimum, include: A site map; site work zones; the use of a "buddy system"; site communications including alerting means for emergencies; the standard operating procedures or safe work practices; and, identification of the nearest medical assistance. Where these requirements are covered elsewhere they need not be repeated.
1910.120(e)
Training. --
1910.120(e)(1)
General.
1910.120(e)(1)(i)
All employees working on site (such as but not limited to equipment operators, general laborers and others) exposed to hazardous substances, health hazards, or safety hazards and their supervisors and management responsible for the site shall receive training meeting the requirements of this paragraph before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety, or health hazards, and they shall receive review training as specified in this paragraph.
1910.120(e)(1)(ii)
Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.
1910.120(e)(2)
Elements to be covered. The training shall thoroughly cover the following:
1910.120(e)(2)(i)
Names of personnel and alternates responsible for site safety and health;
1910.120(e)(2)(ii)
Safety, health and other hazards present on the site;

1910.120(e)(2)(iii)
Use of personal protective equipment;
1910.120(e)(2)(iv)
Work practices by which the employee can minimize risks from hazards;
1910.120(e)(2)(v)
Safe use of engineering controls and equipment on the site;
1910.120(e)(2)(vi)
Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards; and
1910.120(e)(2)(vii)
The contents of paragraphs (G) through (J) of the site safety and health plan set forth in paragraph (b)(4)(ii) of this section.
..1910.120(e)(3)

1910.120(e)(3)
Initial training.
1910.120(e)(3)(i)
General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained experienced supervisor.
1910.120(e)(3)(ii)
Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geophysical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.
1910.120(e)(3)(iii)
Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.
1910.120(e)(3)(iv)
Workers with 24 hours of training who are covered by paragraphs (e)(3)(ii) and (e)(3)(iii) of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and two days of training necessary to total the training specified in paragraph (e)(3)(i).
1910.120(e)(4)
Management and supervisor training. On-site management and supervisors directly responsible for or who supervise employees engaged in hazardous waste operations shall receive 40 hours initial and three days of supervised field experience (the training may be reduced to 24 hours and one day if the only area of their responsibility is employees covered by paragraphs (e)(3)(ii) and (e)(3)(iii) and at least eight additional hours of specialized

training at the time of job assignment on such topics as, but no limited to, the employer's safety and health program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

1910.120(e)(5)

Qualifications for trainers. Trainers shall be qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they shall have the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instructional skills and knowledge of the applicable subject matter.

1910.120(e)(6)

Training certification. Employees and supervisors that have received and successfully completed the training and field experience specified in paragraphs (e)(1) through (e)(4) of this section shall be certified by their instructor or the head instructor and trained supervisor as having completed the necessary training. A written certificate shall be given to each person so certified. Any person who has not been so certified or who does not meet the requirements of paragraph (e)(9) of this section shall be prohibited from engaging in hazardous waste operations.

1910.120(e)(7)

Emergency response. Employees who are engaged in responding to hazardous emergency situations at hazardous waste clean-up sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.

1910.120(e)(8)

Refresher training. Employees specified in paragraph (e)(1) of this section, and managers and supervisors specified in paragraph (e)(4) of this section, shall receive eight hours of refresher training annually on the items specified in paragraph (e)(2) and/or (e)(4) of this section, any critique of incidents that have occurred in the past year that can serve as training examples of related work, and other relevant topics.

1910.120(e)(9)

Equivalent training. Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to that training required in paragraphs (e)(1) through (e)(4) of this section shall not be required to provide the initial training requirements of those paragraphs to such employees and shall provide a copy of the certification or documentation to the employee upon request. However, certified employees or employees with equivalent training new to a site shall receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste site experience.

1910.120(f)

Medical surveillance --

1910.120(f)(1)

General. Employees engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section and not covered by (a)(2)(iii) exceptions and employers of employees specified in paragraph (q)(9) shall institute a medical surveillance program in accordance with this paragraph.

1910.120(f)(2)

Employees covered. The medical surveillance program shall be instituted by the employer for the following employees:

1910.120(f)(2)(i)

All employees who are or may be exposed to hazardous substances or health hazards at or above the established permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;

1910.120(f)(2)(ii)

All employees who wear a respirator for 30 days or more a year or as required by 1910.134;

1910.120(f)(2)(iii)

All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and

1910.120(f)(2)(iv)

Members of HAZMAT teams.

1910.120(f)(3)

Frequency of medical examinations and consultations. Medical examinations and consultations shall be made available by the employer to each employee covered under paragraph (f)(2) of this section on the following schedules:

1910.120(f)(3)(i)

For employees covered under paragraphs (f)(2)(i), (f)(2)(ii), and (f)(2)(iv);

1910.120(f)(3)(i)(A)

Prior to assignment;

1910.120(f)(3)(i)(B)

At least once every twelve months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate;

..1910.120(f)(3)(i)(C)

1910.120(f)(3)(i)(C)

At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months.

1910.120(f)(3)(i)(D)

As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation;

1910.120(f)(3)(i)(E)

At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

1910.120(f)(3)(ii)

For employees covered under paragraph (f)(2)(iii) and for all employees including of employers covered by paragraph (a)(1)(iv) who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or exposed during an emergency incident to hazardous substances at concentrations above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used:

1910.120(f)(3)(ii)(A)
As soon as possible following the emergency incident or development of signs or symptoms;
1910.120(f)(3)(ii)(B)
At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.
1910.120(f)(4)
Content of medical examinations and consultations.
1910.120(f)(4)(i)
Medical examinations required by paragraph (f)(3) of this section shall include a medical and work history (or updated history if one is in the employee's file) with special emphasis on symptoms related to the handling of hazardous substances and health hazards, and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the work site.
1910.120(f)(4)(ii)
The content of medical examinations or consultations made available to employees pursuant to paragraph (f) shall be determined by the attending physician. The guidelines in the ***Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*** (See Appendix D, reference # 10) should be consulted.
1910.120(f)(5)
Examination by a physician and costs. All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine, and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.
1910.120(f)(6)
Information provided to the physician. The employer shall provide one copy of this standard and its appendices to the attending physician and in addition the following for each employee:
1910.120(f)(6)(i)
A description of the employee's duties as they relate to the employee's exposures,
1910.120(f)(6)(ii)
The employee's exposure levels or anticipated exposure levels.
1910.120(f)(6)(iii)
A description of any personal protective equipment used or to be used.
1910.120(f)(6)(iv)
Information from previous medical examinations of the employee which is not readily available to the examining physician.
1910.120(f)(6)(v)
Information required by §1910.134.
1910.120(f)(7)
Physician's written opinion.
1910.120(f)(7)(i)
The employer shall obtain and furnish the employee with a copy of a written opinion from the examining physician containing the following:
1910.120(f)(7)(i)(A)
The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's

health from work in hazardous waste operations or emergency response, or from respirator use.
..1910.120(f)(7)(i)(B)

1910.120(f)(7)(i)(B)
The physician's recommended limitations upon the employees assigned work.
1910.120(f)(7)(i)(C)
The results of the medical examination and tests if requested by the employee.
1910.120(f)(7)(i)(D)
A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.
1910.120(f)(7)(ii)
The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposure.
1910.120(f)(8)
Recordkeeping.
1910.120(f)(8)(i)
An accurate record of the medical surveillance required by paragraph (f) of this section shall be retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1910.20.
1910.120(f)(8)(ii)
The record required in paragraph (f)(8)(i) of this section shall include at least the following information:
1910.120(f)(8)(ii)(A)
The name and social security number of the employee;
1910.120(f)(8)(ii)(B)
Physicians' written opinions, recommended limitations and results of examinations and tests;
1910.120(f)(8)(ii)(C)
Any employee medical complaints related to exposure to hazardous substances;
1910.120(f)(8)(ii)(D)
A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.
1910.120(g)
Engineering controls, work practices, and personal protective equipment for employee protection. Engineering controls, work practices and PPE for substances regulated in Subpart Z. (i) Engineering controls, work practices, personal protective equipment, or a combination of these shall be implemented in accordance with this paragraph to protect employees from exposure to hazardous substances and safety and health hazards.
1910.120(g)(1)
Engineering controls, work practices and PPE for substances regulated in Subparts G and Z.
1910.120(g)(1)(i)
Engineering controls and work practices shall be instituted to reduce and maintain employee exposure to or below the permissible exposure limits for substances regulated by 29 CFR Part 1910, to the extent required by Subpart Z, except to the extent that such controls and

practices are not feasible.

NOTE TO PARAGRAPH (g)(1)(i): Engineering controls which may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices which may be feasible are removing all non-essential employees from potential exposure during opening of drums, wetting down dusty operations and locating employees upwind of possible hazards.

1910.120(g)(1)(ii)

Whenever engineering controls and work practices are not feasible, or not required, any reasonable combination of engineering controls, work practices and PPE shall be used to reduce and maintain to or below the permissible exposure limits or dose limits for substances regulated by 29 CFR Part 1910, Subpart Z.

1910.120(g)(1)(iii)

The employer shall not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

1910.120(g)(1)(iv)

The provisions of 29 CFR, subpart G, shall be followed.

1910.120(g)(2)

Engineering controls, work practices, and PPE for substances not regulated in Subparts G and Z. An appropriate combination of engineering controls, work practices, and personal protective equipment shall be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Z. The employer may use the published literature and MSDS as a guide in making the employer's determination as to what level of protection the employer believes is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

1910.120(g)(3)

Personal protective equipment selection.

1910.120(g)(3)(i)

Personal protective equipment (PPE) shall be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

..1910.120(g)(3)(ii)

1910.120(g)(3)(ii)

Personal protective equipment selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site.

1910.120(g)(3)(iii)

Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply shall be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

1910.120(g)(3)(iv)

Totally-encapsulating chemical protective suits (protection equivalent to Level A protection

as recommended in Appendix B) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

1910.120(g)(3)(v)

The level of protection provided by PPE selection shall be increased when additional informationor site conditions show that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards. (See Appendix B for guidance on selecting PPE ensembles.)

NOTE TO PARAGRAPH (g)(3): The level of employee protection provided may be decreased when additional information or site conditions show that decreased protection will not result in hazardous exposures to employees.

1910.120(g)(3)(vi)

Personal protective equipment shall be selected and used to meet the requirements of 29 CFR Part 1910, Subpart I, and additional requirements specified in this section.

1910.120(g)(4)

Totally-encapsulating chemical protective suits.

1910.120(g)(4)(i)

Totally-encapsulating suits shall protect employees from the particular hazards which are identified during site characterization and analysis.

1910.120(g)(4)(ii)

Totally-encapsulating suits shall be capable of maintaining positive air pressure. (See Appendix A for a test method which may be used to evaluate this requirement.)

1910.120(g)(4)(iii)

Totally-encapsulating suits shall be capable of preventing inward test gas leakage of more than 0.5 percent. (See Appendix A for a test method which may be used to evaluate this requirement.)

1910.120(g)(5)

Personal protective equipment (PPE) program. A personal protective equipment program, which is part of the employer's safety and health program required in paragraph (b) of this section or required in paragraph (p)(1) of this section and which isalso a part of the site-specific safety and health plan shall be established. The PPE program shall address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attached to the plan, they need not be rewritten into the plan as long as they adequately address the procedure or element.

1910.120(g)(5)(i)

PPE selection based upon site hazards,

1910.120(g)(5)(ii)

PPE use and limitations of the equipment,

..1910.120(g)(5)(iii)

1910.120(g)(5)(iii)

Work mission duration,

1910.120(g)(5)(iv)

PPE maintenance and storage,

1910.120(g)(5)(v)

PPE decontamination and disposal,
1910.120(g)(5)(vi)
PPE training and proper fitting,
1910.120(g)(5)(vii)
PPE donning and doffing procedures,
1910.120(g)(5)(viii)
PPE inspection procedures prior to, during, and after use,
1910.120(g)(5)(ix)
Evaluation of the effectiveness of the PPE program, and
1910.120(g)(5)(x)
Limitations during temperature extremes, heat stress, and other appropriate medical considerations.
1910.120(h)
Monitoring. --
1910.120(h)(1)
General.
1910.120(h)(1)(i)
Monitoring shall be performed in accordance with this paragraph where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits, or published exposure levels if there are no permissible exposure limits, for hazardous substances.
1910.120(h)(1)(ii)
Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site.
1910.120(h)(2)
Initial entry. Upon initial entry, representative air monitoring shall be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits or other dangerous condition such as the presence of flammable atmospheres, oxygen-deficient environments.
1910.120(h)(3)
Periodic monitoring. Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:
1910.120(h)(3)(i)
When work begins on a different portion of the site.
1910.120(h)(3)(ii)
When contaminants other than those previously identified are being handled.
..1910.120(h)(3)(iii)

1910.120(h)(3)(iii)
When a different type of operation is initiated (e.g., drum opening as opposed to exploratory

well drilling.)

1910.120(h)(3)(iv)

When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon.)

1910.120(h)(4)

Monitoring of high-risk employees. After the actual clean-up phase of any hazardous waste operation commences; for example, when soil, surface water or containers are moved or disturbed; the employer shall monitor those employees likely to have the highest exposures to those hazardous substances and health hazards likely to be present above permissible exposure limits or published exposure levels by using personal sampling frequently enough to characterize employee exposures. The employer may utilize a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria stated in the first sentence of this paragraph. If the employees likely to have the highest exposure are over permissible exposure limits or published exposure limits, then monitoring shall continue to determine all employees likely to be above those limits. The employer may utilize a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria stated above.

NOTE TO PARAGRAPH (h): It is not required to monitor employees engaged in site characterization operations covered by paragraph (c) of this section.

1910.120(i)

Informational programs. Employers shall develop and implement a program which is part of the employer's safety and health program required in paragraph (b) of this section to inform employees, contractors, and subcontractors (or their representative) actually engaged in hazardous waste operations of the nature, level and degree of exposure likely as a result of participation in such hazardous waste operations. Employees, contractors and subcontractors working outside of the operations part of a site are not covered by this standard.

1910.120(j)

Handling drums and containers --

1910.120(j)(1)

General.

1910.120(j)(1)(i)

Hazardous substances and contaminated, liquids and other residues shall be handled, transported, labeled, and disposed of in accordance with this paragraph.

1910.120(j)(1)(ii)

Drums and containers used during the clean-up shall meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.

1910.120(j)(1)(iii)

When practical, drums and containers shall be inspected and their integrity shall be assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions (i.e., buried beneath the earth, stacked behind other drums, stacked several tiers high in a pile, etc.) shall be moved to an accessible location and inspected prior to further handling.

1910.120(j)(1)(iv)

Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

1910.120(j)(1)(v)
Site operations shall be organized to minimize the amount of drum or container movement.
1910.120(j)(1)(vi)
Prior to movement of drums or containers, all employees exposed to the transfer operation shall be warned of the potential hazards associated with the contents of the drums or containers.
1910.120(j)(1)(vii)
U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent shall be kept available and used in areas where spills, leaks, or ruptures may occur.
1910.120(j)(1)(viii)
Where major spills may occur, a spill containment program, which is part of the employer's safety and health program required in paragraph (b) of this section, shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.
1910.120(j)(1)(ix)
Drums and containers that cannot be moved without rupture, leakage, or spillage shall be emptied into a sound container using a device classified for the material being transferred.
1910.120(j)(1)(x)
A ground-penetrating system or other type of detection system or device shall be used to estimate the location and depth of buried drums or containers.
1910.120(j)(1)(xi)
Soil or covering material shall be removed with caution to prevent drum or container rupture.
1910.120(j)(1)(xii)
Fire extinguishing equipment meeting the requirements of 29 CFR Part 1910, Subpart L, shall be on hand and ready for use to control incipient fires.
1910.120(j)(2)
Opening drums and containers. The following procedures shall be followed in areas where drums or containers are being opened:
1910.120(j)(2)(i)
Where an airline respirator system is used, connections to the source of air supply shall be protected from contamination and the entire system shall be protected from physical damage.
1910.120(j)(2)(ii)
Employees not actually involved in opening drums or containers shall be kept a safe distance from the drums or containers being opened.
1910.120(j)(2)(iii)
If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation shall be placed between the employee and the drums or containers being opened to protect the employee in case of accidental explosion.
1910.120(j)(2)(iv)
Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment shall be located behind the explosion-resistant barrier.
..1910.120(j)(2)(v)

1910.120(j)(2)(v)
When there is a reasonable possibility of flammable atmospheres being present, material

handling equipment and hand tools shall be of the type to prevent sources of ignition.

1910.120(j)(2)(vi)

Drums and containers shall be opened in such a manner that excess interior pressure will be safely relieved. If pressure cannot be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums or containers to reduce the risk of employee injury.

1910.120(j)(2)(vii)

Employees shall not stand upon or work from drums or containers.

1910.120(j)(3)

Material handling equipment. Material handling equipment used to transfer drums and containers shall be selected, positioned and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers.

1910.120(j)(4)

Radioactive wastes. Drums and containers containing radioactive wastes shall not be handled until such time as their hazard to employees is properly assessed.

1910.120(j)(5)

Shock sensitive wastes. As a minimum, the following special precautions shall be taken when drums and containers containing or suspected of containing shock-sensitive wastes are handled:

1910.120(j)(5)(i)

All non-essential employees shall be evacuated from the area of transfer.

1910.120(j)(5)(ii)

Material handling equipment shall be provided with explosive containment devices or protective shields to protect equipment operators from exploding containers.

1910.120(j)(5)(iii)

An employee alarm system capable of being perceived above surrounding light and noise conditions shall be used to signal the commencement and completion of explosive waste handling activities.

1910.120(j)(5)(iv)

Continuous communications (i.e., portable radios, hand signals, telephones, as appropriate) shall be maintained between the employee-in-charge of the immediate handling area and both the site safety and health supervisor and the command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock sensitive materials to explode shall not be used.

1910.120(j)(5)(v)

Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

1910.120(j)(5)(vi)

Drums and containers containing packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials until they have been characterized.

Caution: Shipping of shock sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Employers and their shippers should refer to 49 CFR 173.21 and 173.50.

1910.120(j)(6)
Laboratory waste packs. In addition to the requirements of paragraph (j)(5) of this section, the following precautions shall be taken, as a minimum, in handling laboratory waste packs (lab packs):
1910.120(j)(6)(i)
Lab packs shall be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according to the hazards of the wastes.
1910.120(j)(6)(ii)
If crystalline material is noted on any container, the contents shall be handled as a shock-sensitive waste until the contents are identified.
1910.120(j)(7)
Sampling of drum and container contents. Sampling of containers and drums shall be done in accordance with a sampling procedure which is part of the site safety and health plan developed for and available to employees and others at the specific worksite.
1910.120(j)(8)
Shipping and transport.
1910.120(j)(8)(i)
Drums and containers shall be identified and classified prior to packaging for shipment.
1910.120(j)(8)(ii)
Drum or container staging areas shall be kept to the minimum number necessary to safely identify and classify materials and prepare them for transport.
1910.120(j)(8)(iii)
Staging areas shall be provided with adequate access and egress routes.
1910.120(j)(8)(iv)
Bulking of hazardous wastes shall be permitted only after a thorough characterization of the materials has been completed.
1910.120(j)(9)
Tank and vault procedures.
1910.120(j)(9)(i)
Tanks and vaults containing hazardous substances shall be handled in a manner similar to that for drums and containers, taking into consideration the size of the tank or vault.
1910.120(j)(9)(ii)
Appropriate tank or vault entry procedures as described in the employer's safety and health plan shall be followed whenever employees must enter a tank or vault.
1910.120(k)
Decontamination --
1910.120(k)(1)
General. Procedures for all phases of decontamination shall be developed and implemented in accordance with this paragraph.
..1910.120(k)(2)

1910.120(k)(2)
Decontamination procedures.
1910.120(k)(2)(i)
A decontamination procedure shall be developed, communicated to employees and

implemented before any employees or equipment may enter areas on site where potential for exposure to hazardous substances exists.

1910.120(k)(2)(ii)

Standard operating procedures shall be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

1910.120(k)(2)(iii)

All employees leaving a contaminated area shall be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated.

1910.120(k)(2)(iv)

Decontamination procedures shall be monitored by the site safety and health supervisor to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

1910.120(k)(3)

Location. Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

1910.120(k)(4)

Equipment and solvents. All equipment and solvents used for decontamination shall be decontaminated or disposed of properly.

1910.120(k)(5)

Personal protective clothing and equipment.

1910.120(k)(5)(i)

Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

1910.120(k)(5)(ii)

Employees whose non-impermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

1910.120(k)(6)

Unauthorized employees. Unauthorized employees shall not remove protective clothing or equipment from change rooms.

1910.120(k)(7)

Commercial laundries or cleaning establishments. Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposures to hazardous substances.

1910.120(k)(8)

Showers and change rooms. Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they shall be provided and meet the requirements of 29 CFR 1910.141. If temperature conditions prevent the effective use of water, then other effective means for cleansing shall be provided and used.

1910.120(l)

Emergency response by employees at uncontrolled hazardous waste sites --

1910.120(l)(1)

Emergency response plan.

1910.120(l)(1)(i)

An emergency response plan shall be developed and implemented by all employers within the scope of paragraphs (a)(1)(i) through (ii) of this section to handle anticipated emergencies prior to the commencement of hazardous waste operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHA personnel and other governmental agencies with relevant responsibilities.

1910.120(l)(1)(ii)

Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan complying with 29 CFR 1910.38.

1910.120(l)(2)

Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following:

1910.120(l)(2)(i)

Pre-emergency planning.

1910.120(l)(2)(ii)

Personnel roles, lines of authority, training, and communication.

1910.120(l)(2)(iii)

Emergency recognition and prevention.

1910.120(l)(2)(iv)

Safe distances and places of refuge.

1910.120(l)(2)(v)

Site security and control.

1910.120(l)(2)(vi)

Evacuation routes and procedures.

..1910.120(l)(2)(vii)

1910.120(l)(2)(vii)

Decontamination procedures which are not covered by the site safety and health plan.

1910.120(l)(2)(viii)

Emergency medical treatment and first aid.

1910.120(l)(2)(ix)

Emergency alerting and response procedures.

1910.120(l)(2)(x)

Critique of response and follow-up.

1910.120(l)(2)(xi)

PPE and emergency equipment.

1910.120(l)(3)

Procedures for handling emergency incidents.

1910.120(l)(3)(i)

In addition to the elements for the emergency response plan required in paragraph (l)(2) of this section, the following elements shall be included for emergency response plans:

1910.120(l)(3)(i)(A)

Site topography, layout, and prevailing weather conditions.

1910.120(l)(3)(i)(B)

Procedures for reporting incidents to local, state, and federal governmental agencies.

1910.120(l)(3)(ii)
The emergency response plan shall be a separate section of the Site Safety and Health Plan.
1910.120(l)(3)(iii)
The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.
1910.120(l)(3)(iv)
The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.
1910.120(l)(3)(v)
The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.
1910.120(l)(3)(vi)
An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation, to stop work activities if necessary, to lower background noise in order to speed communication, and to begin emergency procedures.
1910.120(l)(3)(vii)
Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.
1910.120(m)
Illumination. Areas accessible to employees shall be lighted to not less than the minimum illumination intensities listed in the following Table H-120.1 while any work is in progress:

TABLE H-120.1. -- MINIMUM ILLUMINATION INTENSITIES IN FOOT-CANDLES

Foot-candles	Area or operations
5	General site areas.
3	Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas.
5	Indoors: warehouses, corridors, hallways, and exitways.
5	Tunnels, shafts, and general underground work areas; (Exception: minimum of 10 foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Mine Safety and Health Administration approved cap lights shall be acceptable for use in the tunnel heading.
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.
30	First aid stations, infirmaries, and offices.

1910.120(n)
Sanitation at temporary workplaces --
1910.120(n)(1)
Potable water.
1910.120(n)(1)(i)

An adequate supply of potable water shall be provided on the site.

1910.120(n)(1)(ii)

Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

1910.120(n)(1)(iii)

Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

1910.120(n)(1)(iv)

Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

1910.120(n)(2)

Nonpotable water.

1910.120(n)(2)(i)

Outlets for nonpotable water, such as water for firefighting purposes shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

1910.120(n)(2)(ii)

There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing nonpotable water.

..1910.120(n)(3)

1910.120(n)(3)

Toilet facilities.

1910.120(n)(3)(i)

Toilets shall be provided for employees according to Table H-120.2.

TABLE H-120.2. -- TOILET FACILITIES

Number of employees	Minimum number of facilities
20 or fewer	One.
More than 20, fewer than 200	One toilet seat and 1 urinal per 40 employees.
More than 200	One toilet seat and 1 urinal per 50 employees.

1910.120(n)(3)(ii)

Under temporary field conditions, provisions shall be made to assure not less than one toilet facility is available.

1910.120(n)(3)(iii)

Hazardous waste sites, not provided with a sanitary sewer, shall be provided with the following toilet facilities unless prohibited by local codes:

1910.120(n)(3)(iii)(A)

Chemical toilets;

1910.120(n)(3)(iii)(B)

Recirculating toilets;

1910.120(n)(3)(iii)(C)

Combustion toilets; or

1910.120(n)(3)(iii)(D)

Flush toilets.

1910.120(n)(3)(iv)

The requirements of this paragraph for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.

1910.120(n)(3)(v)

Doors entering toilet facilities shall be provided with entrance locks controlled from inside the facility.

..1910.120(n)(4)

1910.120(n)(4)

Food handling. All food service facilities and operations for employees shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

1910.120(n)(5)

Temporary sleeping quarters. When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

1910.120(n)(6)

Washing facilities. The employer shall provide adequate washing facilities for employees engaged in operations where hazardous substances may be harmful to employees. Such facilities shall be in near proximity to the worksite; in areas where exposures are below permissible exposure limits and which are under the controls of the employer; and shall be so equipped as to enable employees to remove hazardous substances from themselves.

1910.120(n)(7)

Showers and change rooms. When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require six months or greater time to complete, the employer shall provide showers and change rooms for all employees exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations.

1910.120(n)(7)(i)

Showers shall be provided and shall meet the requirements of 29 CFR 1910.141(d)(3).

1910.120(n)(7)(ii)

Change rooms shall be provided and shall meet the requirements of 29 CFR 1910.141(e). Change rooms shall consist of two separate change areas separated by the shower area required in paragraph (n)(7)(i) of this section. One change area, with an exit leading off the worksite, shall provide employees with an area where they can put on, remove and store work clothing and personal protective equipment.

1910.120(n)(7)(iii)

Showers and change rooms shall be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system shall be provided that will supply air that is below the permissible exposure limits and published exposure levels.

1910.120(n)(7)(iv)

Employers shall assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

1910.120(o)

New technology programs.

1910.120(o)(1)

The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations, and the same shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.

1910.120(o)(2)

New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, absorbents, neutralizers, or other means to suppress the level of air contaminants while excavating the site or for spill control, shall be evaluated by employers or their representatives. Such an evaluation shall be done to determine the effectiveness of the new methods, materials, or equipment before implementing their use on a large scale for enhancing employee protection. Information and data from manufacturers or suppliers may be used as part of the employer's evaluation effort. Such evaluations shall be made available to OSHA upon request.

1910.120(p)

Certain Operations Conducted Under the Resource Conservation and Recovery Act of 1976 (RCRA). Employers conducting operations at treatment, storage and disposal (TSD) facilities specified in paragraph (a)(1)(iv) of this section shall provide and implement the programs specified in this paragraph. See the "Notes and Exceptions" to paragraph (a)(2)(iii) of this section for employers not covered.

1910.120(p)(1)

Safety and health program. The employer shall develop and implement a written safety and health program for employees involved in hazardous waste operations that shall be available for inspection by employees, their representatives and OSHA personnel. The program shall be designed to identify, evaluate and control safety and health hazards in their facilities for the purpose of employee protection, to provide for emergency response meeting the requirements of paragraph (p)(8) of this section and to address as appropriate site analysis, engineering controls, maximum exposure limits, hazardous waste handling procedures and uses of new technologies.

1910.120(p)(2)

Hazard communication program. The employer shall implement a hazard communication program meeting the requirements of 29 CFR 1910.1200 as part of the employer's safety and program.

NOTE TO §1910.120 - The exemption for hazardous waste provided in 1910.1200 is applicable to this section.

..1910.120(p)(3)

1910.120(p)(3)

Medical surveillance program. The employer shall develop and implement a medical surveillance program meeting the requirements of paragraph (f) of this section.

1910.120(p)(4)

Decontamination program. The employer shall develop and implement a decontamination procedure meeting the requirements of paragraph (k) of this section.

1910.120(p)(5)

New technology program. The employer shall develop and implement procedures meeting the requirements of paragraph (o) of this section for introducing new and innovative

equipment into the workplace.

1910.120(p)(6)

Material handling program. Where employees will be handling drums or containers, the employer shall develop and implement procedures meeting the requirements of paragraphs (j)(1)(ii) through (viii) and (xi) of this section, as well as (j)(3) and (j)(8) of this section prior to starting such work.

1910.120(p)(7)

Training program --

1910.120(p)(7)(i)

New employees. The employer shall develop and implement a training program which is part of the employer's safety and health program, for employees exposed to health hazards or hazardous substances at TSD operations to enable the employees to perform their assigned duties and functions in a safe and healthful manner so as not to endanger themselves or other employees. The initial training shall be for 24 hours and refresher training shall be for eight hours annually. Employees who have received the initial training required by this paragraph shall be given a written certificate attesting that they have successfully completed the necessary training.

1910.120(p)(7)(ii)

Current employees. Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this paragraph, shall be considered as meeting the initial training requirements of this paragraph as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees shall receive eight hours of refresher training annually.

1910.120(p)(7)(iii)

Trainers. Trainers who teach initial training shall have satisfactorily completed a training course for teaching the subjects they are expected to teach or they shall have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.

1910.120(p)(8)

Emergency response program --

1910.120(p)(8)(i)

Emergency response plan. An emergency response plan shall be developed and implemented by all employers. Such plans need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the U.S. Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan. The emergency response plan shall be a written portion of the employer's safety and health program required in paragraph (p)(1) of this section. Employers who will evacuate their employees from the worksite location when an emergency occurs and who do not permit any of their employees to assist in handling the emergency are exempt from the requirements of paragraph (p)(8) if they provide an emergency action plan complying with 29 CFR 1910.38.

1910.120(p)(8)(ii)

Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

1910.120(p)(8)(ii)(A)
Pre-emergency planning and coordination with outside parties.
1910.120(p)(8)(ii)(B)
Personnel roles, lines of authority, training, and communication.
1910.120(p)(8)(ii)(C)
Emergency recognition and prevention.
1910.120(p)(8)(ii)(D)
Safe distances and places of refuge.
1910.120(p)(8)(ii)(E)
Site security and control.
1910.120(p)(8)(ii)(F)
Evacuation routes and procedures.
1910.120(p)(8)(ii)(G)
Decontamination procedures.
1910.120(p)(8)(ii)(H)
Emergency medical treatment and first aid.
1910.120(p)(8)(ii)(I)
Emergency alerting and response procedures.
..1910.120(p)(8)(ii)(J)

1910.120(p)(8)(ii)(J)
Critique of response and follow-up.
1910.120(p)(8)(ii)(K)
PPE and emergency equipment.
1910.120(p)(8)(iii)
Training.
1910.120(p)(8)(iii)(A)
Training for emergency response employees shall be completed before they are called upon to perform in real emergencies. Such training shall include the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn and procedures for handling emergency incidents.

Exception #1: an employer need not train all employees to the degree specified if the employer divides the work force in a manner such that a sufficient number of employees who have responsibility to control emergencies have the training specified, and all other employees, who may first respond to an emergency incident, have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt control activities for which they are not trained.

Exception #2: An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside fully-trained emergency response team to respond in a reasonable period and all employees, who may come to the incident first, have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside fully-trained emergency response team for assistance.

1910.120(p)(8)(iii)(B)
Employee members of TSD facility emergency response organizations shall be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This would include training in the methods used to minimize the risk from safety and health hazards; in the safe use of control equipment; in the selection and use of appropriate personal protective equipment; in the safe operating procedures to be used at the incident scene; in the techniques of coordination with other employees to minimize risks; in the appropriate response to over exposure from health hazards or injury to themselves and other employees; and in the recognition of subsequent symptoms which may result from over exposures.
1910.120(p)(8)(iii)(C)
The employer shall certify that each covered employee has attended and successfully completed the training required in paragraph (p)(8)(iii) of this section, or shall certify the employee's competency for certification of training shall be recorded and maintained by the employer.
1910.120(p)(8)(iv)
Procedures for handling emergency incidents.
1910.120(p)(8)(iv)(A)
In addition to the elements for the emergency response plan required in paragraph (p)(8)(ii) of this section, the following elements shall be included for emergency response plans to the extent that they do not repeat any information already contained in the emergency response plan:
1910.120(p)(8)(iv)(A)(1)
Site topography, layout, and prevailing weather conditions.
1910.120(p)(8)(iv)(A)(2)
Procedures for reporting incidents to local, state, and federal governmental agencies.
1910.120(p)(8)(iv)(B)
The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.
1910.120(p)(8)(iv)(C)
The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.
1910.120(p)(8)(iv)(D)
The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.
..1910.120(p)(8)(iv)(E)

1910.120(p)(8)(iv)(E)
An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation, to stop work activities if necessary, to lower background noise in order to speed communication; and to begin emergency procedures.
1910.120(p)(8)(iv)(F)
Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.
1910.120(q)

Emergency response program to hazardous substance releases. This paragraph covers employers whose employees are engaged in emergency response no matter where it occurs except that it does not cover employees engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section. Those emergency response organizations who have developed and implemented programs equivalent to this paragraph for handling releases of hazardous substances pursuant to section 303 of the Superfund Amendments and Reauthorization Act of 1986 (Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11003) shall be deemed to have met the requirements of this paragraph.

1910.120(q)(1)

Emergency response plan. An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to the commencement of emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives and OSHA personnel. Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan in accordance with 29 CFR 1910.38.

1910.120(q)(2)

Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

1910.120(q)(2)(i)

Pre-emergency planning and coordination with outside parties..

1910.120(q)(2)(ii)

Personnel roles, lines of authority, training, and communication.

1910.120(q)(2)(iii)

Emergency recognition and prevention.

1910.120(q)(2)(iv)

Safe distances and places of refuge.

1910.120(q)(2)(v)

Site security and control.

1910.120(q)(2)(vi)

Evacuation routes and procedures.

1910.120(q)(2)(vii)

Decontamination.

1910.120(q)(2)(viii)

Emergency medical treatment and first aid.

1910.120(q)(2)(ix)

Emergency alerting and response procedures.

..1910.120(q)(2)(x)

1910.120(q)(2)(x)

Critique of response and follow-up.

1910.120(q)(2)(xi)

PPE and emergency equipment.

1910.120(q)(2)(xii)

Emergency response organizations may use the local emergency response plan or the state

emergency response plan or both, as part of their emergency response plan to avoid duplication. Those items of the emergency response plan that are being properly addressed by the SARA Title III plans may be substituted into their emergency plan or otherwise kept together for the employer and employee's use.

1910.120(q)(3)

Procedures for handling emergency response.

1910.120(q)(3)(i)

The senior emergency response official responding to an emergency shall become the individual in charge of a site-specific Incident Command System (ICS). All emergency responders and their communications shall be coordinated and controlled through the individual in charge of the ICS assisted by the senior official present for each employer.

NOTE TO PARAGRAPH (q)(3)(i). - The "senior official" at an emergency response is the most senior official on the site who has the responsibility for controlling the operations at the site. Initially it is the senior officer on the first-due piece of responding emergency apparatus to arrive on the incident scene. As more senior officers arrive (i.e. , battalion chief, fire chief, state law enforcement official, site coordinator, etc.) the position is passed up the line of authority which has been previously established.

1910.120(q)(3)(ii)

The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies.

..1910.120(q)(3)(iii)

1910.120(q)(3)(iii)

Based on the hazardous substances and/or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations, and assure that the personal protective equipment worn is appropriate for the hazards to be encountered. However, personal protective equipment shall meet, at a minimum, the criteria contained in 29 CFR 1910.156(e) when worn while performing fire fighting operations beyond the incipient stage for any incident.

1910.120(q)(3)(iv)

Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear positive pressure self-contained breathing apparatus while engaged in emergency response, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees.

1910.120(q)(3)(v)

The individual in charge of the ICS shall limit the number of emergency response personnel at the emergency site, in those areas of potential or actual exposure to incident or site hazards, to those who are actively performing emergency operations. However, operations in hazardous areas shall be performed using the buddy system in groups of two or more.

1910.120(q)(3)(vi)

Back-up personnel shall be standing by with equipment ready to provide assistance or rescue. Qualified basic life support personnel, as a minimum, shall also be standing by with medical

equipment and transportation capability.

1910.120(q)(3)(vii)

The individual in charge of the ICS shall designate a safety officer, who is knowledgeable in the operations being implemented at the emergency response site, with specific responsibility to identify and evaluate hazards and to provide direction with respect to the safety of operations for the emergency at hand.

1910.120(q)(3)(viii)

When activities are judged by the safety officer to be an IDLH and/or to involve an imminent danger condition, the safety officer shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene.

1910.120(q)(3)(ix)

After emergency operations have terminated, the individual in charge of the ICS shall implement appropriate decontamination procedures.

1910.120(q)(3)(x)

When deemed necessary for meeting the tasks at hand, approved self-contained compressed air breathing apparatus may be used with approved cylinders from other approved self-contained compressed air breathing apparatus provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatus shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.

1910.120(q)(4)

Skilled support personnel. Personnel, not necessarily an employer's own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employer's regular employees. However, these personnel shall be given an initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these personnel.

1910.120(q)(5)

Specialist employees. Employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances, and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge, shall receive training or demonstrate competency in the area of their specialization annually.

1910.120(q)(6)

Training. Training shall be based on the duties and function to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate, in

emergency response, shall be given training in accordance with the following paragraphs:
1910.120(q)(6)(i)
First responder awareness level. First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities of the release. First responders at the awareness level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:
..1910.120(q)(6)(i)(A)

1910.120(q)(6)(i)(A)
An understanding of what hazardous substances are, and the risks associated with them in an incident.
1910.120(q)(6)(i)(B)
An understanding of the potential outcomes associated with an emergency created when hazardous substances are present.
1910.120(q)(6)(i)(C)
The ability to recognize the presence of hazardous substances in an emergency.
1910.120(q)(6)(i)(D)
The ability to identify the hazardous substances, if possible.
1910.120(q)(6)(i)(E)
An understanding of the role of the first responder awareness individual in the employer's emergency response plan including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.
1910.120(q)(6)(i)(F)
The ability to realize the need for additional resources, and to make appropriate notifications to the communication center.
1910.120(q)(6)(ii)
First responder operations level. First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:
1910.120(q)(6)(ii)(A)
Knowledge of the basic hazard and risk assessment techniques.
1910.120(q)(6)(ii)(B)
Know how to select and use proper personal protective equipment provided to the first responder operational level.
1910.120(q)(6)(ii)(C)
An understanding of basic hazardous materials terms.
1910.120(q)(6)(ii)(D)
Know how to perform basic control, containment and/or confinement operations within the

capabilities of the resources and personal protective equipment available with their unit.
1910.120(q)(6)(ii)(E)
Know how to implement basic decontamination procedures.
1910.120(q)(6)(ii)(F)
An understanding of the relevant standard operating procedures and termination procedures.
..1910.120(q)(6)(iii)

1910.120(q)(6)(iii)
Hazardous materials technician. Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:
1910.120(q)(6)(iii)(A)
Know how to implement the employer's emergency response plan.
1910.120(q)(6)(iii)(B)
Know the classification, identification and verification of known and unknown materials by using field survey instruments and equipment.
1910.120(q)(6)(iii)(C)
Be able to function within an assigned role in the Incident Command System.
1910.120(q)(6)(iii)(D)
Know how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.
1910.120(q)(6)(iii)(E)
Understand hazard and risk assessment techniques.
1910.120(q)(6)(iii)(F)
Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.
1910.120(q)(6)(iii)(G)
Understand and implement decontamination procedures.
1910.120(q)(6)(iii)(H)
Understand termination procedures.
1910.120(q)(6)(iii)(I)
Understand basic chemical and toxicological terminology and behavior.
1910.120(q)(6)(iv)
Hazardous materials specialist. Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician, however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with Federal, state, local and other government authorities in regards to site activities. Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:
1910.120(q)(6)(iv)(A)

Know how to implement the local emergency response plan.

1910.120(q)(6)(iv)(B)

Understand classification, identification and verification of known and unknown materials by using advanced survey instruments and equipment.

1910.120(q)(6)(iv)(C)

Know the state emergency response plan.

1910.120(q)(6)(iv)(D)

Be able to select and use proper specialized chemical personal protective equipment provided to the hazardous materials specialist.

1910.120(q)(6)(iv)(E)

Understand in-depth hazard and risk techniques.

1910.120(q)(6)(iv)(F)

Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.

1910.120(q)(6)(iv)(G)

Be able to determine and implement decontamination procedures.

1910.120(q)(6)(iv)(H)

Have the ability to develop a site safety and control plan.

1910.120(q)(6)(iv)(I)

Understand chemical, radiological and toxicological terminology and behavior.

1910.120(q)(6)(v)

On scene incident commander. Incident commanders, who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

1910.120(q)(6)(v)(A)

Know and be able to implement the employer's incident command system.

1910.120(q)(6)(v)(B)

Know how to implement the employer's emergency response plan.

1910.120(q)(6)(v)(C)

Know and understand the hazards and risks associated with employees working in chemical protective clothing.

1910.120(q)(6)(v)(D)

Know how to implement the local emergency response plan.

..1910.120(q)(6)(v)(E)

1910.120(q)(6)(v)(E)

Know of the state emergency response plan and of the Federal Regional Response Team.

1910.120(q)(6)(v)(F)

Know and understand the importance of decontamination procedures.

1910.120(q)(7)

Trainers. Trainers who teach any of the above training subjects shall have satisfactorily completed a training course for teaching the subjects they are expected to teach, such as the courses offered by the U.S. National Fire Academy, or they shall have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to

teach.

1910.120(q)(8)

Refresher training.

1910.120(q)(8)(i)

Those employees who are trained in accordance with paragraph (q)(6) of this section shall receive annual refresher training of sufficient content and duration to maintain their competencies, or shall demonstrate competency in those areas at least yearly.

1910.120(q)(8)(ii)

A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

1910.120(q)(9)

Medical surveillance and consultation.

1910.120(q)(9)(i)

Members of an organized and designated HAZMAT team and hazardous materials specialist shall receive a baseline physical examination and be provided with medical surveillance as required in paragraph (f) of this section.

1910.120(q)(9)(ii)

Any emergency response employees who exhibit signs or symptoms which may have resulted from exposure to hazardous substances during the course of an emergency incident either immediately or subsequently, shall be provided with medical consultation as required in paragraph (f)(3)(ii) of this section.

1910.120(q)(10)

Chemical protective clothing. Chemical protective clothing and equipment to be used by organized and designated HAZMAT team members, or to be used by hazardous materials specialists, shall meet the requirements of paragraphs (g)(3) through (5) of this section.

1910.120(q)(11)

Post-emergency response operations. Upon completion of the emergency response, if it is determined that it is necessary to remove hazardous substances, health hazards and materials contaminated with them (such as contaminated soil or other elements of the natural environment) from the site of the incident, the employer conducting the clean-up shall comply with one of the following:

1910.120(q)(11)(i)

Meet all the requirements of paragraphs (b) through (o) of this section; or

..1910.120(q)(11)(ii)

1910.120(q)(11)(ii)

Where the clean-up is done on plant property using plant or workplace employees, such employees shall have completed the training requirements of the following: 29 CFR 1910.38, 1910.134, 1910.1200, and other appropriate safety and health training made necessary by the tasks they are expected to perform such as personal protective equipment and decontamination procedures.

APPENDICES TO §1910.120 - HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE

NOTE: The following appendices serve as non-mandatory guidelines to assist employees and

employers in complying with the appropriate requirements of this section. However paragraph 1910.120(g) makes mandatory in certain circumstances the use of Level A and Level B PPE protection.
[61 FR 9227, March 7, 1996; 67 FR 67964, Nov. 7, 2002]

In order to recognize the potential for an emergency, pre-planning should be done ahead of time to identify the following:

- Potential release points
- Chemicals that could be released
- Hazards created when chemicals are released

The following section will help identify some potential release points at your facility.

POTENTIAL RELEASE POINTS – EQUIPMENT & EQUIPMENT PROCESSES

- Electroplating – tank leaks or failures
  - Acids
  - Caustics
  - Cyanide solutions

- Parts cleaning – tank leaks or failures
  - Trichorethylene
  - Perchlorethylene
  - Freon

- Painting
  - Dip tank leaks
  - Spray system failure
  - Cleaning solvents container spills

- Electrical equipment
  - Oil spills from transformers, regulators, switch gear, capacitors; any of the above may contain PCB material

- Batch process vessels
  - Mixers, blenders, reactors, vessel failure – overfilling, run away reaction

- Waste water treatment
  - Spill or release of chemicals
  - Overflow of process tanks
  - Spill or release elsewhere causing system malfunction

- Piping systems
  - Failure to move material caused by corrosion
  - Valve and fitting failure
  - Struck by forklifts, trucks

- Continuous process (oil refining, chemicals)
  - Potential for large releases due to high volumes
  - Inability to shut down quickly and simply
  - Large amount of piping & process equipment
  - Covers large area, harder to monitor, fewer workers

Information in this section concerns the basic hazards which may exist and general methods of determining the nature of the hazard.

Health and safety hazards can be grouped into three main types:

CHEMICAL	Flammable liquids Toxic gases Carcinogens Poisons
BIOLOGICAL	Infectious hospital wastes Research materials
PHYSICAL	Radiation Electricity Stress Heat and cold Slips, trips and falls Steam and chemical clouds

HEALTH EFFECTS

The health effects due to a hazardous substance can be acute or chronic.

ACUTE EFFECTS

An acute health effect means the body's response occurs at the time of exposure or within a few days. Acute effects may result from exposure to high concentrations of a substance.

- Choking
- Coughing
- Dizziness
- Nausea
- Burning in eyes, throat or skin

CHRONIC EFFECTS

A chronic health effect means that the body's response takes a long time to show up. Chronic effects involve repeated or prolonged exposure to a chemical. Examples:

- Cancer
- Liver disease
- Mental deterioration
- Lead poisoning
- Impotence

Chemical reactions can cause harm to people and the environment by:

- Releasing toxic gases
- Putting out large amounts of heat
- Causing a fire or explosion

Chemical terms used to describe the chemical and physical properties of substances help the first responder to anticipate the hazards that may be present during an incident.

- Flash point
- Vapor pressure
- Boiling point
- Vapor density
- Flammability
- Solubility

Knowing the upper and lower explosive limits help the first responder determine if the atmosphere is potentially explosive. If the concentration of a flammable vapor or gas is greater that 10% of the LEL, the area should be evacuated.

There are three main ways that chemicals and other harmful substances can enter the body:

1. Mouth
2. Lungs
3. Skin

Once chemicals enter the body, they can affect organs like the liver, the blood, and bone marrow, kidneys and bladder, and the nervous system.

Proper use of Personal Protective Equipment and safe work practices can protect workers from many chemical hazards. Signs of chemical exposure can be immediate or delayed.

CHEMICAL EFFECTS

Toxicology is the capacity of a substance to produce injury. Toxicity is the quality, relative or specific degree of being toxic or poisonous.

Central element of toxicology is the depiction of the safe use of chemicals. As establishing the probability that injury will result from the chemical under certain conditions and the establishment of limits of safety. Safety is the practical certainty that injury will not result from use of a substance under specified conditions of quantity and manner of use.

The measurement of toxicity has many factors:

- Time and frequency
- Route by which exposure occurs
- Physical and chemical form of substance
- Dose delivered

Types

- Site of first contact, e.g., local: lungs or skin
- Systemic: site distant from contact point to which toxicant is absorbed and distributed

Major routes of entry:

- Respiratory
- Skin
- Gastrointestinal
- Injection

Major routes of excretion:

- Lungs
- Urine/Feces
- Skin
- Hair/Nails

Chemical & Physical Characteristics

Understanding the way chemicals behave can help the first responder anticipate the hazards a substance might present in an emergency. Scientists have developed many terms to describe the chemical and physical properties of substances. A general understanding of these terms' meanings would be helpful.

PHYSICAL STATES

The physical characteristics of a substance at a given temperature, pressure, and volume. Substances can exist as solids, liquids, or gases --- water – ice; water; steam. The importance of its physical state can determine the type of response activity that will be most appropriate.

BOILING POINT

The temperature at which a liquid changes into gas. Water boils at 212˚F. The air's temperature will determine whether it will be a liquid or gas during an emergency response.

Corrosive

A compound which can damage or destroy skin, metal, or other solids. Corrosives need to be kept in appropriate containers such as glass or special plastics. Corrosives can harm your skin, lungs, mouth and stomach.

FLAMMABILITY

It is the potential for a liquid or gas to catch on fire; gasoline and kerosene are liquids; propane a gas.

The flammability of a substance is important to know to determine the probability of a fire.

FLASH POINT

It is the lowest temperature at which a material will give off enough vapor to start burning. The flash point is used to classify the relative fire hazards of liquids. A low flash point means it is considered flammable.

OXIDIZER

A chemical with the capability of giving off large amounts of oxygen such as perchloric acid and sodium peroxide.

Fires or explosions are more likely to occur if oxidizers are stored near flammables.

VAPOR PRESSURE

A measurement of how much vapor is given off by a chemical at a specific temperature. It is measured in millimeters of mercury, like atmospheric pressure. Materials with high vapor pressures overcome a first responder who is not protected.

pH

Is a measurement scale to determine whether a substance is an acid or a base. A range of 1 to 6 is considered an acid and a range of 8 to 14 a base. A pH of 7 is considered neutral. pH is important because mixing a strong acid with a strong base could result in a violent and harmful reaction. In addition, acids and bases by themselves can cause skin burns or corrode certain metals. pH can be measured by a pH meter or litmus paper.

SOLUBILITY

Is the measurement of how readily a chemical dissolves in a liquid. Alcohol mixes with water and oil floats on water. If liquid spills into a waterway and is not soluble, it will either float or sink. **SPECIFIC GRAVITY** is the relative weight of a liquid compared with an equal volume of water. Oil with a specific gravity of less than (<) 1 floats on water. Lead has a specific gravity of more than (>) 1 and sinks in water.

CHEMICAL REACTIONS

Various types of chemical reactions can occur when two or more compounds combine.

- Toxic gases
- Heat
- Fire or explosion

Incompatible chemicals can be dangerous such as ammonia and chlorine which can produce a toxic gas when combined.

SPONTANEOUS COMBUSTION

Some chemicals can catch on fire without a flame. When white phosphorus is exposed to air a fire and a dense fog of toxic materials results.

VAPOR DENSITY

Relative weight of a gas as compared to an equal volume of air. Helium is < than 1 and rises. Phosgene is > than 1 is heavier than air and will sink.

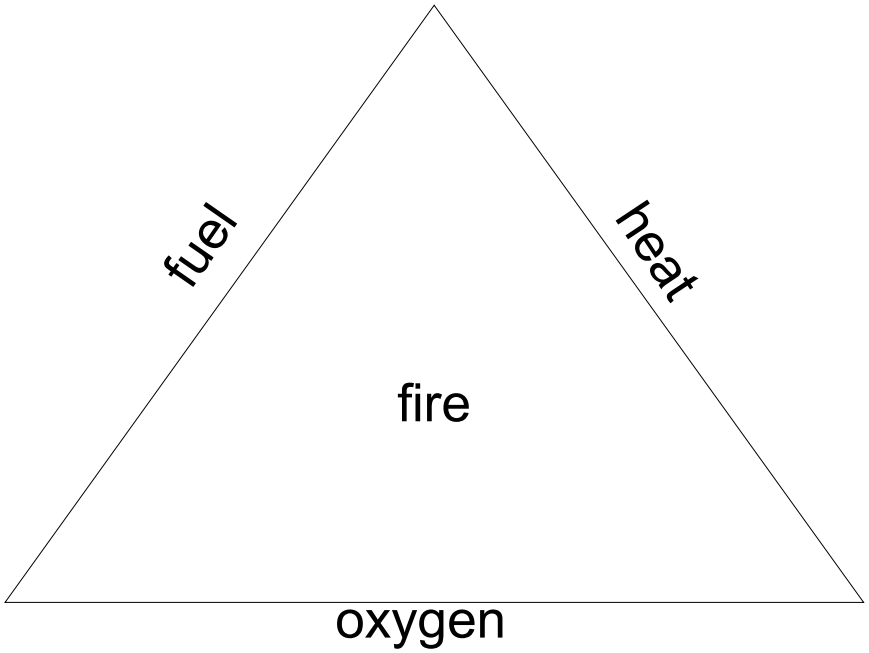
If a vapor is denser it may accumulate in low areas such as a trench or hole and could lead to an oxygen decrease in the air, a fire, explosion and other dangers to a first responder.

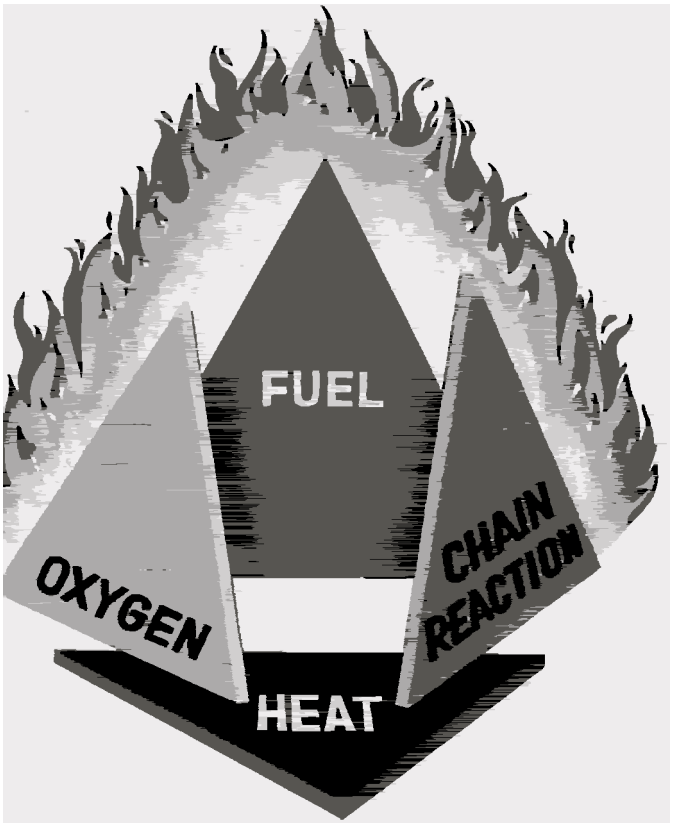
FIRE TRIANGLE AND FIRE TETRAHEDRON

Fire is considered a chemical reaction. This chemical reaction is known as combustion. The fire triangle and fire tetrahedron are useful in explaining what is necessary for combustion to occur and how combustion can be extinguished.

Fire triangle

For a fire to burn, there must be at least three things: fuel, oxygen and heat (flame or spark). These three things make up the fire triangle. Fuel, oxygen, and heat in the proper proportions will allow for a fire to occur. Removing any one of the three will cause the fire to be extinguished.




FUEL
OXYGEN
CHAIN REACTION
HEAT

RECOGNIZING CHEMICAL HAZARDS – CONTAINER SHAPES

Containers are used to store and ship materials. Although the identity of materials in containers may be generally known at a facility, in an emergency, the labels and placards may be damaged or blocked from view. It is important to recognize specific types of containers.

Some of the types of containers and their common contents are identified here. There are, also, special types of containers that may be used at the plant that require review as part of preplanning.

Compressed gas cylinders

May contain flammable gases, corrosive gases, toxic gases, or a wide variety of gas and liquids. Gas is normally released through a valve on top of the cylinder. Failure of the cylinder valve, rupture disk, or wall may release liquid and gas and propel the cylinder like a rocket.

Tote tanks

Tote tanks are used when the required quantity is more than a drum and less than a tank truck. Empty tanks are normally returned to the supplier for refilling and reuse. They could be made of steel, aluminum, plastic. Normally, they drain through a bottom valve and have no remote shut-off.

Some common materials stored are:

- paints
- solvents
- resins
- corrosives

RECOGNIZING CHEMICAL HAZARDS FROM CONTAINER SHAPES

Infectious Materials

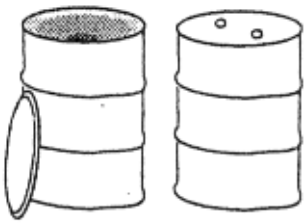
This type of waste should be in boxes, plastic containers or **red** plastic bags. Examples include used needles and syringes, soiled bandages, test tubes, etc.

Infectious materials symbol
Fluorescent orange

CONTAINER SHAPES

Drums

- Closed-top metal – noncorrosive liquids
- Closed-top plastic or composite – corrosive liquids
- Open-top metal – solids or sludges
- Open-top plastic – corrosive solids or sludges
- Stainless steel, nickel, MONEL – chemicals that require special containers for safe confinement



Open-top (left) and closed-top drums (right)

Drum Type	Hazards
Polyethylene or PVC-lined Drums	Often contain strong acids or bases. If the lining is punctured, the substances usually quickly corrode the steel, resulting in a significant leak or spill.
Exotic Metal Drums (i.e. aluminum, nickel or other unusual metal)	Very expensive drums that usually contain an extremely dangerous material.
Single-walled drums used as a pressure vessel	These drums have fittings for both product filling and placement of an inert gas, such as nitrogen. May contain reactive, flammable, or explosive substances.
Laboratory Packs	Used for disposal of expired chemicals and process samples from university laboratories, hospitals, and similar institutions. Individual containers within the lab pack are often packed in absorbent material. They may contain incompatible materials, radioisotopes, shock-sensitive, highly volatile, highly corrosive, or very toxic exotic chemicals. Laboratory packs can be an ignition source for fires at hazardous waste sites.

Drumhead Configuration	Information
Whole lid removable	Designed to contain a solid material
Has a bung	Designed to contain a liquid
Contains a liner	May contain a highly corrosive or otherwise hazardous material.

SPHERE TANKS

These tanks may be round or elliptical and have large relief devices at the very top of the tank. They store pressurized materials such as methane, propane, LPG, heptane, ethane, and other light gasses

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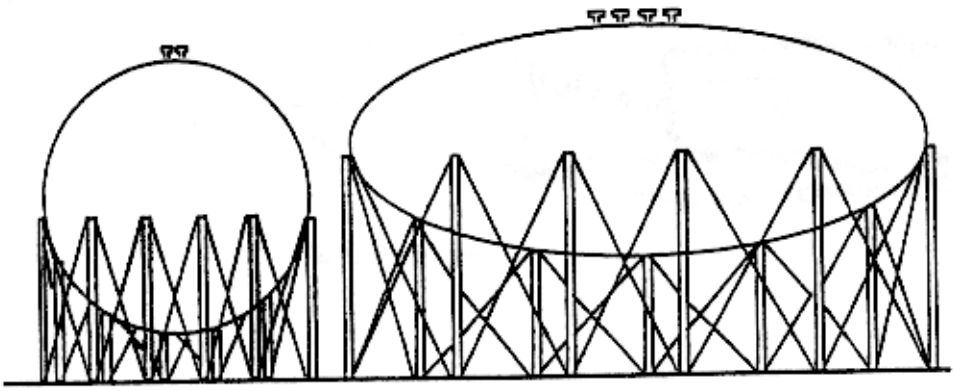
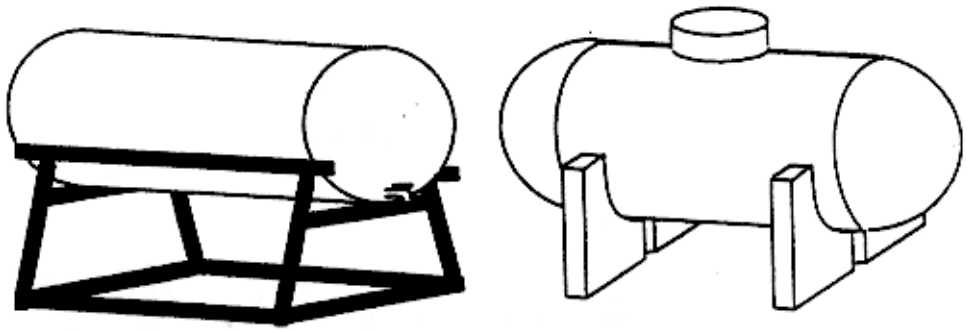


Sphere Tanks

HORIZONTAL TANKS

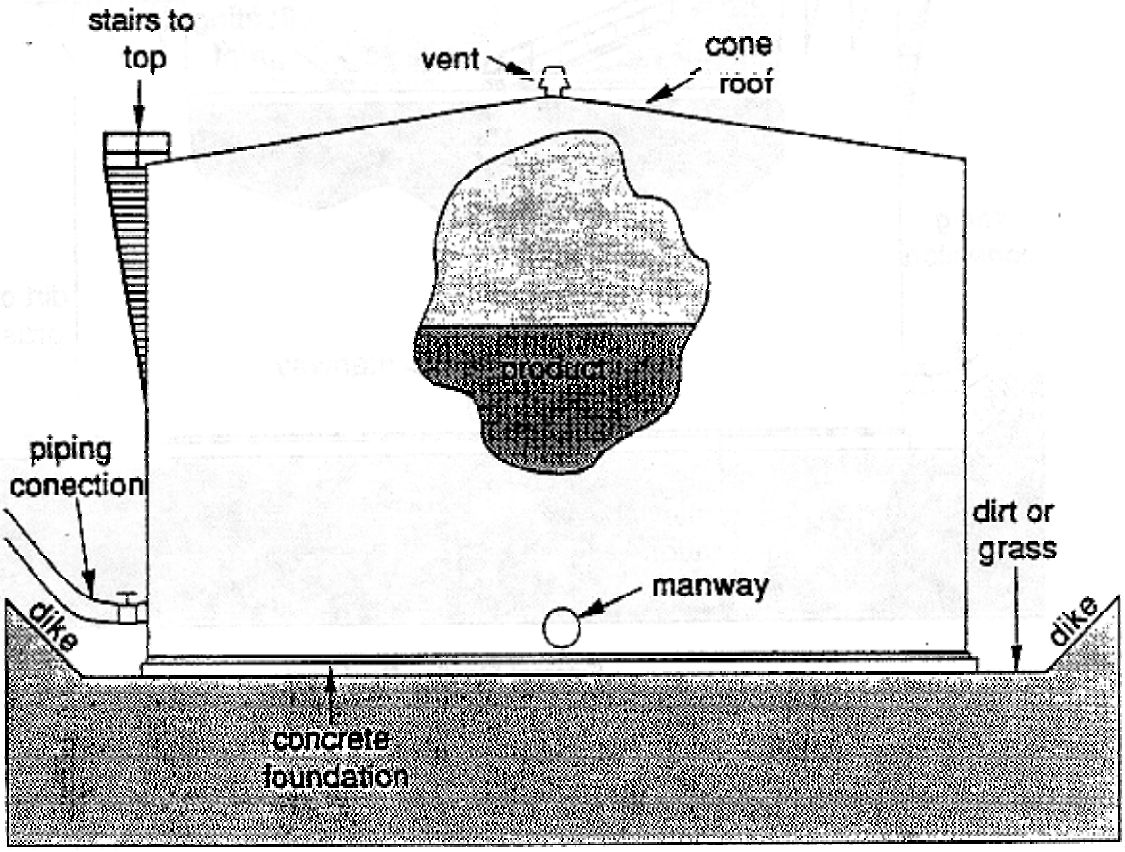
Horizontal tanks are horizontal cylinders which sit on the ground or on legs. These tanks usually store flammable liquids, corrosives, and poisons, but may contain anything.



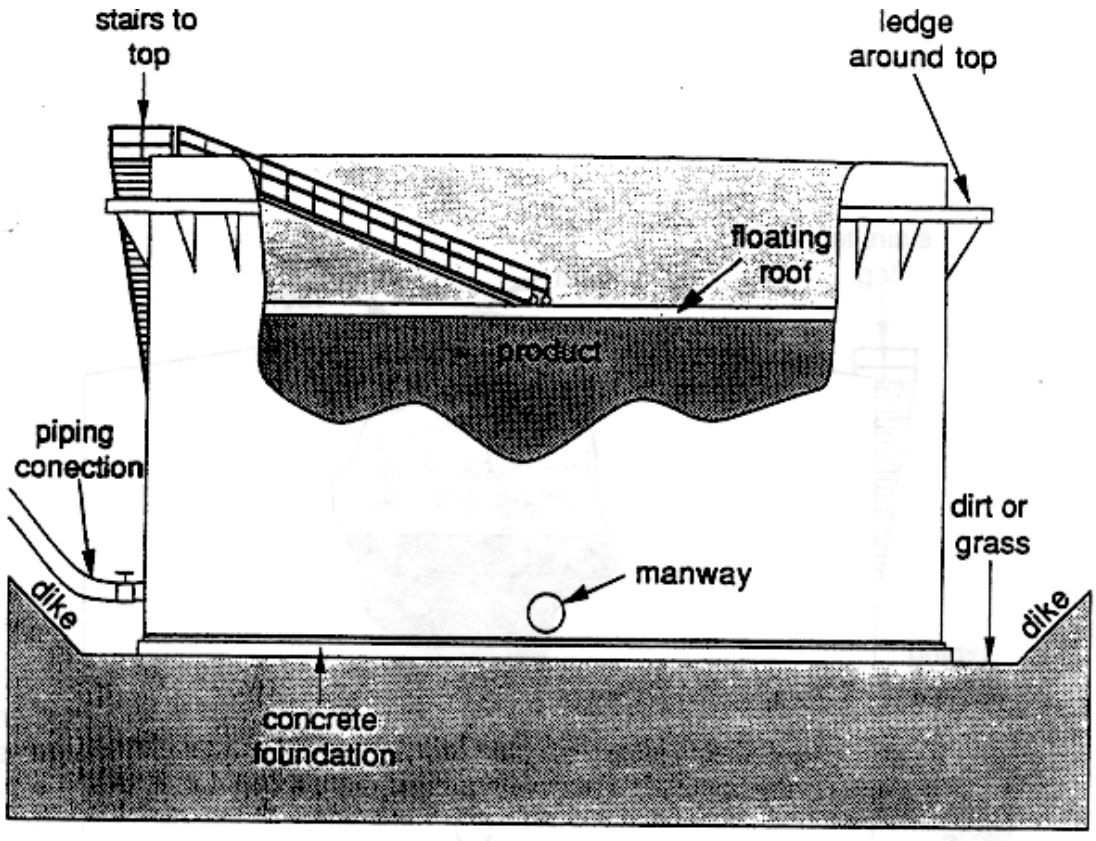
Horizontal Tanks

CONE ROOF TANKS

Cone roof tanks have a distinctive roof design. These tanks store liquids that will burn or explode.



FLOATING ROOF TANKS

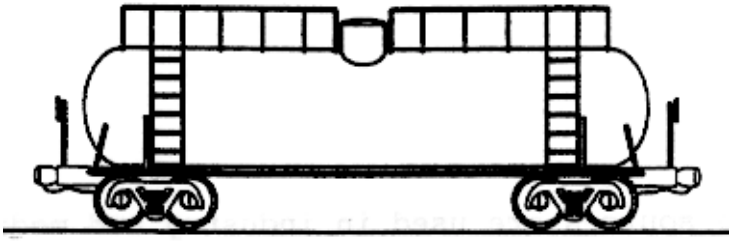


External Floating Roof Tanks

- Roof appears flat actually floats up and down.
- Normally store flammable liquid.
- Common use in petroleum bulk storage facilities.

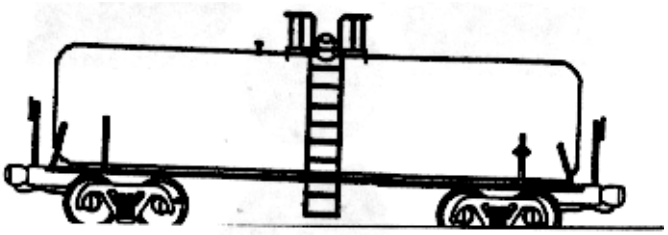
PRESSURIZED TANK CARS

Horizontal tanks with rounded ends. Usually carry flammable and non-flammable gases and poisons.



NON-PRESSURIZED RAIL TANK CARS

Horizontal tank with flat ends and a manway with valves and fittings. Carry flammable and combustible liquids, solids, oxidizers, organic peroxides, and corrosives.

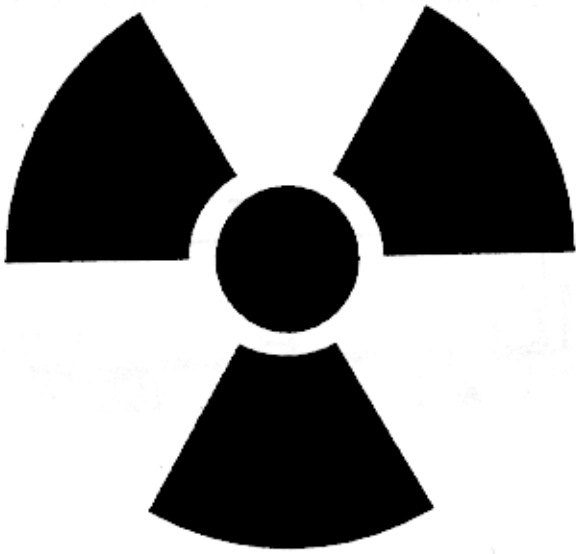


RECOGNIZING PHYSICAL HAZARDS

Physical hazards include a wide range of potential exposures. These include radiation, electricity, and slips, trips, and falls. The potential for injury from these hazards may increase during an emergency due to poor visibility and tendency to rush.

Radiation

Radioactive sources are used in industry and medicine. Radioactive wastes result from energy and weapons production. As a first responder you should keep as far away as possible from anything bearing the radiation symbol.



Radiation Symbol

PHYSICAL HAZARDS

Electricity

Power lines or sources may be damaged in accident or incidents. They represent a major risk of electrocution. Other risks of electrical and hazardous material exposure may be present at transformers and circuit boxes.

HEAT AND COLD

Extreme temperatures put extra physical stress on the body.

SLIPS, TRIPS, AND FALLS

Injured backs and broken limbs may result. To the first responder an incident might result in a delayed response or exposure to hazardous materials.

STEAM

May cause severe burns or, the steam and the heat from it, may react with other materials to compound the problem at a hazardous materials incident scene. It is possible that what appears to be steam is actually toxic clouds or gases escaping from a pressurized container.

CONFINED SPACES

Emergency responders must be aware of the dangers of entering into areas such as ditches, stream beds, trailers, tanks, rail cars, basements, and storage closets. Accumulations of chemical vapors can occur quickly in confined spaces.

GENERAL CHARACTERISTICS AND EXAMPLES OF HAZARDOUS MATERIALS

GENERAL CATEGORY DOT CLASSIFICATIONS	EXAMPLES	GENERAL HAZARDOUS PROPERTIES
Explosives and Blasting Agents		
Class A Explosive	Dynamite, Dry TNT, Black Powder	Sensitive to heat and shock
Class B Explosive	Propellant Explosives, Rocket Motors, Special Fireworks	Contamination could cause explosion Thermal and mechanical impact potential
Class C Explosive	Common Fireworks, Small Arms Ammunition Ammonium Nitrate - Fuel Oil Mixtures	
Blasting Agent		
Gases (Compressed, Liquefied or Dissolved under Pressure)		
Flammable Gas	Liquefied Petroleum Gas, Acetylene, Hydrogen	Explosion potential BLEVE Vapor-air
Nonflammable Gas	Carbon Dioxide, Sulfur Dioxide, Anhydrous Ammonia	Flammability hazard
Cryogenic	Ethylene, Nitrogen	Liquefied gases - cold temperatures - frostbite-high expansion ratio
Flammable and Combustible Liquids		
Flammable Liquid	Acetone, Gasoline, Methyl Alcohol	Flammability hazard
Pyroforic Liquid	Aluminum Alkyls, Alkyl Boranes	Explosion potential BLEVE Vapor-air
Combustible Liquid	Fuel Oils, Ethylene Glycols	Potentially corrosive, toxic, thermally unstable
Flammable Solids		
Flammable Solid	Pyroxylin Plastics, Magnesium-Aluminum Powder	Readily ignite and burn explosively, some spontaneously
Water Reactive	Sodium and Potassium Metals, Calcium Carbide	Water reactive potential Toxic and corrosive potentials
Spontaneously Combustible	Phosphorus	
Oxidizers and Organic Peroxides		
Oxidizer	Ammonium Nitrate Fertilizer, Hydrogen Peroxide Solution	Supply oxygen to support combustion of normally nonflammable materials
Organic Peroxide	Benzoyl Peroxide, Peracetic Acid Solution	Explosively sensitive to heat, shock, friction. Potentially toxic
Poisonous and Infectious Substances		
Poison A	Arsine, Hydrocyanic Acid, Phosgene	Harm from inhalation, ingestion, absorption
Poison B	Aniline, Arsenic, Methyl Bromide	
Irritant	Tear Gas, Xylyl Bromide	Flammability potential
Etiologic Agent	Anthrax, Botulism, Rabies, Tetanus	
Radioactive Substances		
Radioactive Material	Plutonium, Cobalt, Uranium, Uranium Hexafluoride	Harm: Particulate - alpha and beta particles Radiation - gamma rays Internal and external
Corrosives		
Corrosive Material	Acids - Hydrochloric Acid, Oleum, Sulfuric Acid Bases - Caustic Soda, Caustic Potash	Harm: Disintegration of tissues, external Fuming potential Oxidizing effect Splatter potential
Other Regulated Materials		
ORM A	Dry Ice, Carbon Tetrachloride	Toxic
ORM 6	Quicklime, Metallic Mercury	Corrosive
ORM C	Oakum, Bleaching Powder	
ORM D	Consumer Commodity	
ORM E	Hazardous Substances - Pentachloro-phenol, Adipic Acid - and Hazardous Wastes	

Refer to Appendix A for definitions

MSDS Practice Exercise

Instructions: Using the MSDS the instructor provides, answer the following questions:

1. If more information is needed on the hazards of this product, what other name might a person look under?

2. Is this substance a mixture? If so, what?

3. What is the NFPA numerical ratings for this product?

4. A small spill of the product has caught fire. What can be used to extinguish it? Are there any special fire fighting procedures to be taken?

5. What could happen to a person if they were exposed to this product?

6. What is the recommended first aid procedures?

7. What is the minimum protective clothing necessary while handling this product?

8. A small spill has occurred. What is the procedure for clean-up?

CLOROX -- CLOROX GERMICIDAL BLEACH
MATERIAL SAFETY DATA SHEET
NSN: 793000F046054
Manufacturer's CAGE: 93098
Part No. Indicator: A
Part Number/Trade Name: CLOROX GERMICIDAL BLEACH

==========

General Information

==========

Company's Name: CLOROX CO (HEADQUARTERS)
Company's Street: 1221 BROADWAY
Company's P. O. Box: 24305
Company's City: OAKLAND
Company's State: CA
Company's Country: US
Company's Zip Code: 94623
Company's Emerg Ph #: 510-847-6100
Company's Info Ph #: 510-847-6796
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SE
Date MSDS Prepared: 01NOV92
Safety Data Review Date: 18JAN96
Preparer's Company: CLOROX CO (HEADQUARTERS)
Preparer's St Or P. O. Box: 1221 BROADWAY
Preparer's City: OAKLAND
Preparer's State: CA
Preparer's Zip Code: 94623
MSDS Serial Number: BYMMQ

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: SODIUM HYPOCHLORITE, HYPOCHLOROUS ACID SODIUM SALT
Ingredient Sequence Number: 01
Percent: 5.25
NIOSH (RTECS) Number: NH3486300
CAS Number: 7681-52-9

==========

Physical/Chemical Characteristics

==========

Appearance And Odor: CLEAR, LIGHT YELLOW LIQUID W/CHLORINE ODOR
Boiling Point: 212F
Specific Gravity: 1.085
Solubility In Water: COMPLETE
pH: 11.4

==========

Fire and Explosion Hazard Data

==========

Special Fire Fighting Proc: IN A FIRE, COOL CONTAINERS TO PREVENT RUPTURE & RELEASE OF SODIUM CHLORATE.
Unusual Fire And Expl Hazrds: NON-FLAMMABLE/EXPLOSIVE.

==========

Reactivity Data

==========

Stability: YES
Materials To Avoid: STRONG OXIDIZING AGENT, ACIDS, AMMONIA.
Hazardous Decomp Products: HAZARDOUS GASES, CHLORINE & OTHER CHLORINATED SPECIES.
Hazardous Poly Occur: NO

Health Hazard Data

Route Of Entry - Inhalation: YES
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: EYES: CORNEAL INJURY. SKIN: IRRITATION. INHALATION: EXPOSURE TO VAPOR/MIST MAY IRRITATE NOSE, THROAT & LUNGS. PROLONGED CONTACT W/METAL MAY CAUSE PITTING/DISCOLORATION.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NONE
Signs/Symptoms Of Overexp: IRRITATION, NAUSEA, VOMITING.
Med Cond Aggravated By Exp: HEART CONDITIONS/CHRONIC RESPIRATORY PROBLEMS, ASTHMA, CHRONIC BRONCHITIS/OBSTRUCTIVE LUNG DISEASE.
WASH AREA W/WATER. INGESTION: DRINK A GLASSFUL OF WATER. INHALATION: REMOVE TO FRESH AIR. OBTAIN MEDICAL ATTENTION IN ALL CASES.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: SMALL(<5 GALLONS)/LARGE(5 GALLONS): ABSORB, CONTAINERIZE & LANDFILL IN ACCORDANCE W/LOCAL REGULATIONS. WASH DOWN RESIDUAL TO SANITARY SEWER. PUMP MATERIAL TO WASTE DRUMS & DISPOSE.
Waste Disposal Method: CONTACT THE SANITARY TREATMENT FACILITY IN ADVANCE TO ASSURE ABILITY TO PROCESS WASHED-DOWN MATERIAL. DISPOSE OF IAW/FEDERAL, STATE & LOCAL REGULATIONS.
Precautions-Handling/Storing: USE GENERAL VENTILATION TO MINIMIZE EXPOSURE TO VAPOR/MIST.
Other Precautions: AVOID CONTACT W/EYE, SKIN & INHALATION OF VAPOR/MIST. KEEP OUT OF REACH OF CHILDREN.

Control Measures

Ventilation: GENERAL
Protective Gloves: REQUIRED
Eye Protection: SAFETY GLASSES
Work Hygienic Practices: REMOVE/LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.

Transportation Data

Disposal Data

Label Data

Label Required: YES
Label Status: G
Common Name: CLOROX GERMICIDAL BLEACH
Special Hazard Precautions: EYES: CORNEAL INJURY. SKIN: IRRITATION. INHALATION: EXPOSURE TO VAPOR/MIST MAY IRRITATE NOSE, THROAT & LUNGS. PROLONGED CONTACT W/METAL MAY CAUSE PITTING/DISCOLORATION. IRRITATION, NAUSEA, VOMITING.
Label Name: CLOROX CO (HEADQUARTERS)
Label Street: 1221 BROADWAY
Label P.O. Box: 24305
Label City: OAKLAND
Label State: CA
Label Zip Code: 94623

Label Country: US
Label Emergency Number: 510-847-6100

GABELS COSMETICS -- AFTER SHAVE LOTION, BAY RUM
MATERIAL SAFETY DATA SHEET
NSN: 852000N084704
Manufacturer's CAGE: GABEL
Part No. Indicator: A
Part Number/Trade Name: AFTER SHAVE LOTION, BAY RUM
==========
General Information
==========
Company's Name: GABELS COSMETICS INC
Company's Street: 126 SOUTH AVENUE 18
Company's City: LOS ANGELES
Company's State: CA
Company's Country: US
Company's Zip Code: 90031-1777
Company's Emerg Ph #: 800-424-9300 (CHEMTREC)
Company's Info Ph #: 213-221-2430
Safety Data Action Code: A
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 17DEC93
Safety Data Review Date: 03APR98
MSDS Serial Number: CGTSR
==========
Ingredients/Identity Information
==========
Proprietary: NO
Ingredient: ETHYL ALCOHOL
Ingredient Sequence Number: 01
Percent: 50
Ingredient Action Code: A
NIOSH (RTECS) Number: KQ6300000
CAS Number: 64-17-5
OSHA PEL: 1000 PPM
ACGIH TLV: 1000 PPM; 9495

Proprietary: NO
Ingredient: BRUCINE SULFATE
Ingredient Sequence Number: 02
Percent: <0.1
Ingredient Action Code: A
NIOSH (RTECS) Number: 1006998BS
CAS Number: 4845-99-2
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

Proprietary: NO
Ingredient: TERT-BUTYL ALCOHOL (SARA 313)
Ingredient Sequence Number: 03
Percent: <0.1
Ingredient Action Code: A
NIOSH (RTECS) Number: EO1925000
CAS Number: 75-65-0
OSHA PEL: 100 PPM
ACGIH TLV: 100 PPM; 9495

Proprietary: NO
Ingredient: SUPDAT:EYES SHOULD BE FLUSHED FOR AT LEAST 15 MINUTES. REMOVE AND WASH CONTAMINATED CLOTHING BEFORE REUSE. (ING 5)

Ingredient Sequence Number: 04
Ingredient Action Code: A
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: ING 4: GET MEDICAL ATTENTION IMMEDIATELY.
Ingredient Sequence Number: 05
Ingredient Action Code: A
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: OTHER PREC: PROTECTIVE MEASURES DURING MAINTENANCE OF
CONTAMINATED EQUIPMENT: EMPTIED CONTAINERS SHOULD BE (ING 7)
Ingredient Sequence Number: 06
Ingredient Action Code: A
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: ING 6:FLUSHED THOROUGHLY SINCE RESIDUAL VAPOR MAY REMAIN
BEHIND. KEEP AWAY FROM HEAT, SPARKS, FLAME AND ALL (ING 8)
Ingredient Sequence Number: 07
Ingredient Action Code: A
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: ING 7:OTHER IGNITION SOURCES. VAPORS MAY BE FLAMMABLE. MAY BE
HARMFUL IF SWALLOWED.
Ingredient Sequence Number: 08
Ingredient Action Code: A
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: PROT GLOVES: (WORN WHEN MANUFACTURING ONLY)
Ingredient Sequence Number: 09
Ingredient Action Code: A
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE
==========
Physical/Chemical Characteristics
==========
Appearance And Odor: CLEAR SOLN: AMBER, GREEN, PURPLE, WHITE; BAY RUM;
LILAC, LIME, SPICE, MENTHOL.
Boiling Point: 173F,78C
Melting Point: N/A
Vapor Pressure (MM Hg/70 F): 45 @ 20C
Vapor Density (Air=1): 1.6
Specific Gravity: 0.8
Evaporation Rate And Ref: NOT APPLICABLE
Solubility In Water: COMPLETE

==========
Fire and Explosion Hazard Data
==========
Flash Point: 78.0F,25.6C
Flash Point Method: TCC
Lower Explosive Limit: 4.3%
Upper Explosive Limit: 19%
Extinguishing Media: USE WATER SPRAY, FOAM, CARBON DIOXIDE, DRY CHEM. H*2O MAY BE INEFFECTIVE, BUT H*2O SHOULD BE USED TO KEEP (SUPDAT)
Special Fire Fighting Proc: USE NIOSH APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N).
Unusual Fire And Expl Hazrds: NOT APPLICABLE.
==========
Reactivity Data
==========
Stability: YES
Cond To Avoid (Stability): AVOID GENERATION OF AIRBORNE DUST.
Materials To Avoid: STRONG OXIDIZING AGENTS, ACETYL CHLORIDE.
Hazardous Decomp Products: (INCLUDING COMBUSTION PRODUCTS): CARBON MONOXIDE.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT.
==========
Health Hazard Data
==========
LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: INHALATION: MAY CAUSE HEADACHE, DROWSINESS, LIQUID OR VAPOR MAY CAUSE IRRITATION. ABSORBED THROUGH SKIN: SLIGHT ABSORPTION. INGESTION: CAN CAUSE DEPRESSION OF CENTRAL NERVOUS SYSTEM, NAUSEA, VOMITING AND DIARRHEA. NOTE: (EFTS OF OVEREXP)
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT.
Signs/Symptoms Of Overexp: HLTH HAZ: CONDITIONS DO NOT APPLY TO NORMAL USE.
Med Cond Aggravated By Exp: ASTHMA AND OTHER RESPIRATORY CONDITIONS.
Emergency/First Aid Proc: INGEST:IF VICTIM IS CONSCIOUS & ABLE TO SWALLOW, HAVE VICTIM DRINK H*2O/MILK TO DILUTE. NEVER GIVE ANYTHING BY MOUTH IF VICTIM IS UNCON/HAVING CONVL. CALL A MD OR POIS CTL CTR IMMED. INDUCE VOMIT ONLY IF ADVISED BY MD. INHAL:IMMED REMOVE VICTIM TO FRESH AIR. IF VICTIM HAS STOPPED BRTHG GIVE ARTF RESP, PREFERABLY MOUTH-TO-MOUTH. GET MED ATTN IMMED. CNTCT W/EYE/SKIN:IMMED FLUSH AFFECTED (SUPDAT)
==========
Precautions for Safe Handling and Use
==========
Steps If Matl Released/Spill: FLUSH WITH WATER. AVOID INHALATION OF VAPOR.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DISPOSE OF ALL WASTES IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATION.
Precautions-Handling/Storing: PROTECT CONTAINER AGAINST PHYSICAL DAMAGE. SMOKING SHOULD BE PROHIBITED IN STORAGE AREAS. WHEN IN USE REPLACE CLOSURE SECURELY AFTER EACH OPENING.
Other Precautions: KEEP PACKAGED MATL OUT OF SUN & AWAY FROM HEAT. KEEP CLOSURE UP TO PVNT LEAKAGE. CNTNRS ARE HAZ WHEN EMPTY. SINCE EMPTY CNTNRS RETAIN RESIDUAL PROD (VAP/LIQ), ALL PREC DESCRIBED ON THIS MSDS MUST BE OBSERVED. (ING 6)

==========
Control Measures
==========
Respiratory Protection: USE NIOSH APPROVED RESPIRATOR (NOT FOR NORMAL USE).
Ventilation: NECESSARY IF VAPOR CONCENTRATIONS ARE LIKELY TO EXCEED PERMISSIBLE LIMITS.
Protective Gloves: RUBBER GLOVES (ING 9)
Eye Protection: ANSI APPROVED CHEM WORKERS GOGGS (FP N).
Other Protective Equipment: EYE WASH FOUNTAIN & DELUGE SHOWER WHICH MEET ANSI DESIGN CRITERIA (FP N). RUBBER APRON (WORN WHEN MFR ONLY).
Work Hygienic Practices: AVOID INHALATION OF VAPORS AND SKIN CONTACT.
Suppl. Safety & Health Data: EXTING MEDIA: FIRE-EXPOSED CNTNRS COOL. IF A LEAK/SPILL HAS NOT IGNITED, USE WATER SPRAY TO DISPERSE VAPS & TO PROTECT MEN ATTEMPTING TO STOP A LEAK. WATER SPRAY MAY BE USED TO FLUSH SPILL AWAY FROM EXPOS & TO DILUTE SPILLS TO NONFLAMMABLE MIX. FIRST AID PROC: AREA W/ PLENTY OF COOL WATER. (ING 4)
==========
Transportation Data
==========
==========
Disposal Data
==========
==========
Label Data
==========
Label Required: YES
Technical Review Date: 03APR98
Label Date: 03APR98
Label Status: M
Common Name: AFTER SHAVE LOTION, BAY RUM
Chronic Hazard: NO
Signal Word: DANGER!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-Severe: X
Reactivity Hazard-None: X
Special Hazard Precautions: FLAMMABLE. ACUTE: INHALATION: MAY CAUSE HEADACHE, DROWSINESS, INABILITY TO CONCENTRATE, IRRITATION OF THROAT. CONTACT WITH SKIN OR EYES: LIQUID OR VAPOR MAY CAUSE IRRITATION. ABSORBED THROUGH SKIN: SLIGHT ABSORPTION. INGESTION: CAN CAUSE DEPRESSION OF CENTRAL NERVOUS SYSTEM, NAUSEA, VOMITING AND DIARRHEA. CONDITIONS DO NOT APPLY TO NORMAL USE. CHRONIC: NONE SPECIFIED BY MANUFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: GABELS COSMETICS INC
Label Street: 126 SOUTH AVENUE 18
Label City: LOS ANGELES
Label State: CA
Label Zip Code: 90031-1777
Label Country: US
Label Emergency Number: 800-424-9300 (CHEMTREC)

CLOROX -- PRO FORMULA 409 DEGREASER AND MULTI-PURPOSE CLEANER
MATERIAL SAFETY DATA SHEET
NSN: 793000N062618
Manufacturer's CAGE: CLORO
Part No. Indicator: A
Part Number/Trade Name: PRO FORMULA 409 DEGREASER AND MULTI-PURPOSE CLEANER
==========
General Information
==========
Company's Name: CLOROX CO
Company's Street: 7200 JOHNSON DR
Company's City: PLEASANTON
Company's State: CA
Company's Country: US
Company's Zip Code: 94588
Company's Emerg Ph #: 800-424-9300(CHEMTREC)
Company's Info Ph #: 510-847-6100
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 01DEC93
Safety Data Review Date: 18AUG95
MSDS Serial Number: BYGVK
==========
Ingredients/Identity Information
==========
Proprietary: NO
Ingredient: ETHANOL, 2-BUTOXY-; (2-BUTOXYETHANOL)
Ingredient Sequence Number: 01
Percent: 5-10
NIOSH (RTECS) Number: KJ8575000
CAS Number: 111-76-2
OSHA PEL: S, 50 PPM
ACGIH TLV: S, 25 PPM

Proprietary: NO
Ingredient: SODIUM HYDROXIDE (CERCLA)
Ingredient Sequence Number: 02
Percent: 0.1-0.5
NIOSH (RTECS) Number: WB4900000
CAS Number: 1310-73-2
OSHA PEL: 2 MG/M3
ACGIH TLV: C 2 MG/M3
==========
Physical/Chemical Characteristics
==========
Appearance And Odor: NONE SPECIFIED BY MANUFACTURER.
Specific Gravity: 1.0 (H*20=1)
Solubility In Water: COMPLETE
pH: 12.5
==========
Fire and Explosion Hazard Data
==========
Flash Point: 105F,41C
Flash Point Method: SCC
Extinguishing Media: MEDIA SUITABLE FOR SURROUNDING FIRE (FP N).
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA & FULL
PROTECTIVE EQUIPMENT (FP N).
Unusual Fire And Expl Hazrds: NONE SPECIFIED BY MANUFACTURER.
==========

Reactivity Data

Stability: YES
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.
Materials To Avoid: NONE SPECIFIED BY MANUFACTURER.
Hazardous Decomp Products: NONE SPECIFIED BY MANUFACTURER.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT

Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: WARNING:SKIN & EYE IRRIT. DIRECT EYE CONT/ PRLNGD & RPTD SKIN CONT W/LIQ IS EXPECTED TO CAUSE SIGNIFICANT, BUT REVERSIBLE, IRRIT. HARMFUL IF SWALLOWED. OVEREXP TO PROD MAY CAUSE WORKER EXPOS LIM OF ING 1 TO BE EXCEEDED. RPTS HAVE ASSOC BLOOD & BONE MARROW DMG W/EXPOS TO ING 1. UNDER NORMAL CONSUMER (EFTS OF OVEREXP)
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: HLTH HAZS:CNDTNS, LIKELIHOOD OF ANY ADVERSE HLTH EFTS ARE LOW. ANIMAL STUDIES CLEARLY DEMONSTRATED DOSE-RELATED ADVERSE EFFECTS ON CNS, HEMATOPOIETIC TISS, BLOOD, KIDNEYS & LIVER, ASSOC W/ADMIN OF ETHYLENE GLYCOL MONBUTYL ETHER (EGBE). (EXTRACTED FROM DHHS (NIOSH) PUBLICATION NO. 90-118 (FP N).
Med Cond Aggravated By Exp: NO MEDICAL CONDITIONS ARE KNOWN TO BE AGGRAVATED BY EXPOSURE TO THIS PRODUCT.
Emergency/First Aid Proc: EYES:IMMEDIATELY RINSE WITH WATER FOR AT LEAST 15 MINUTES. CALL A PHYSICIAN. SKIN:WASH THOROUGHLY WITH SOAP AND WATER. INGESTION:DRINK A GLASSFUL OF WATER. CALL A PHYSICIAN. INHALATION:IF BREATHING PROBLEMS DEVELOP REMOVE TO FRESH AIR.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: ABSORB AND CONTAINERIZE. WASH RESIDUAL DOWN TO SANITARY SEWER. CONTACT THE SANITARY TREATMENT FACILITY IN ADVANCE TO ASSURE ABILITY TO PROCESS WASHED-DOWN MATERIAL.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DISPOSE OF IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.
Precautions-Handling/Storing: AVOID BREATHING VAPORS. AVOID EYE AND SKIN CONTACT AND INHALATION OF VAPOR OR MIST. KEEP OUT OF REACH OF CHILDREN.
Other Precautions: NOT RECOMMENDED FOR USE ON SOFT VINYL, VARNISHES OR ALUMINUM. IF SPRAYED ON THESE SURFACES, RINSE AND WIPE DRY IMMEDIATELY.

Control Measures

Respiratory Protection: USE NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN (FP N).
Ventilation: USE GENERAL VENTILATION TO MINIMIZE EXPOSURE TO VAPOR OR MIST.
Protective Gloves: NITRILE, NEOPRENE/NATURAL RUBBER GLOVES.
Eye Protection: ANSI APPROVED CHEM WORKERS GOGGS (FP N).
Other Protective Equipment: IN MANUFACTURING SETTINGS, ALSO WEAR A CHEMICAL APRON.
Work Hygienic Practices: WASH AFTER CONTACT WITH PRODUCT. AVOID BREATHING

VAPORS.
Suppl. Safety & Health Data: NONE SPECIFIED BY MANUFACTURER.
==========
Transportation Data
==========
==========
Disposal Data
==========
==========
Label Data
==========
Label Required: YES
Technical Review Date: 18AUG95
Label Status: G
Common Name: PRO FORMULA 409 DEGREASER AND MULTI-PURPOSE CLEANER
Chronic Hazard: YES
Signal Word: WARNING!
Acute Health Hazard-Moderate: X
Contact Hazard-Slight: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: ACUTE:SKIN AND EYE IRRITANT. DIRECT EYE CONTACT OR PROLONGED AND REPEATED SKIN CONTACT WITH LIQUID IS EXPECTED TO CAUSE SIGNIFICANT, BUT REVERSIBLE, IRRITATION. HARMFUL IF SWALLOWED. CHRONIC:ANIMAL STUDIES CLEARLY DEMONSTRATED DOSE-RELATED ADVERSE EFFECTS ON CNS, BLOOD FORMING TISSUES, BLOOD, KIDNEYS AND LIVER ASSOCIATED WITH THE ADMINISTRATION OF ETHYLENE GLYCOL MONOBUTYL ETHER (EGBE) (FP N).
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: CLOROX CO
Label Street: 7200 JOHNSON DR
Label City: PLEASANTON
Label State: CA
Label Zip Code: 94588
Label Country: US
Label Emergency Number: 800-424-9300(CHEMTREC)

Material Safety Data Sheet

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 9A
OLEUM
(Revision A)

Issued: October 1983
Revised: February 1986

SECTION 1. MATERIAL IDENTIFICATION

19

MATERIAL NAME: OLEUM

DESCRIPTION: "Solution" of sulfur trioxide in anhydrous sulfuric acid (H_2SO_4). Commercial material: 10-70% SO_3.

OTHER DESIGNATIONS: Fuming Sulfuric Acid, CAS #8014-95-7; Pyrosulfuric Acid, or Disulfuric Acid, $H_2S_2O_7$, CAS #7783-05-3

HMIS
H: 4
F: 0
R: 3
PPE: *
* See Sect. 8

Not Found

R 1
I 2
S 4
K 0

MANUFACTURER: Available from several suppliers, including, 20%, 25%, and 30% oleum, from Monsanto Chemical Intermediates Co., 800 N. Lindberg Blvd., St. Louis, MO 63167; Telephone: (314) 694-1000

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Sulfuric Acid (H_2SO_4)	>30**	8-hr TWA: 1 mg/m^3
Sulfur Trioxide (SO_3)	<70**	No TLV established

Material can contain low impurity levels of iron (75 ppm max) and nitrate (50 ppm max).		Rat, Oral, LD_{50}: 80 mg/kg
		---
* Current OSHA PEL and ACGIH (1985-86) TLV for sulfuric acid. (Because SO_3 forms H_2SO_4 with moisture, a limit of 0.8 mg/m^3 may be inferred for SO_3).		Rabbit, Dermal, LD_{50}: >2.0 g/kg
		---
** Concentration also expressed as % equivalent H_2SO_4 or as total SO_3 content (see sect. 2).		Rat, Inhalation, LC_{50}: 347 ppm/ 1 hr.

SECTION 3. PHYSICAL DATA

Oleum (approx "free SO_3"%)	10%	20%	25%	30%	45%*	65%
% Equivalent H_2SO_4	102.2	104.5	105.9	106.8	110.1	114.6
Total SO_3, %	83.4	85.3	86.2	87.1	89.9	93.1
Specific Gravity @ 100/60°)(approx)	1.88	1.88	--	1.92	--	1.98
(Freezing Point, deg F (approx)	32	20	48	67	95.0	34

*At 1:1 molar ratio crystalline solid compound, $H_2S_2O_7$, pyrosulfuric acid.

Appearance and odor: Viscous, fuming opaque liquid. Sharp penetrating odor (SO_3) with good warning properties; however, workers exposed to low concentrations of vapor can gradually experience olfactory fatigue.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None - Noncombustible	NA	NA	NA	NA

Oleum itself is not combustible; however it is a strong oxidizing agent and may cause ignition by contact with combustible materials. Cool fire-exposed containers with water to prevent rupture. Remove containers from fire area if safe to do so. Small fires may be smothered with suitable dry chemical. DO NOT add water or other liquid to the acid!

On dilution with water below 60° Baume, material can react with most metals to liberate flammable hydrogen gas. H_2SO_4 mists and vapors from a fire area are corrosive (see sect. 5).

Fire fighters should wear self-contained breathing apparatus and fully protective clothing.

SECTION 5. REACTIVITY DATA

Oleum is stable in a suitable closed container under normal conditions of handling and storage. It does not undergo hazardous polymerization.

It is a strongly acidic mixture of sulfuric acid (see Genium MSDS #9) and sulfuric acid anhydride. It reacts with alkaline materials and with metals (if moisture is present) to produce hydrogen gas. It is incompatible with reducing agents. It is extremely hygroscopic, readily picking up moisture from the air or extracting it from other materials.

It reacts exothermically with water. (Acid should always be added slowly to water. Water added to acid can cause uncontrolled boiling and splashing.) The water-diluted material is sulfuric acid.

Sulfur oxides can be evolved by volatilization from decomposition and from the oxidizing reactions of oleum.

SECTION 6. HEALTH HAZARD INFORMATION | TLV

Oleum is highly corrosive and damaging to all human tissue with which it comes in contact, producing severe burns at the site of exposure. Ingestion may cause severe injury or death. Eye contact may cause severe or permanent injury. Inhalation of fumes can damage both the upper respiratory tract and the lungs. Individual sensitivity to mist vapors is variable; 0.125 to 0.50 ppm can be mildly annoying; 2.5 ppm quite unpleasant.

FIRST AID: EYE CONTACT: Immediately flush eyes with plenty of running water for at least 15 minutes (including under eyelids). Speed in diluting and rinsing with water is extremely important if permanent eye damage is to be avoided. Contact physician! SKIN CONTACT: Immediately flush affected areas with water, removing contaminated clothing under the safety shower. Continue washing with water and get medical attention. INHALATION: Remove victim to fresh air. Restore and/or support breathing. Contact physician! INGESTION: Dilute acid immediately with large amounts of milk or water, then give victim milk of magnesia to neutralize. Never give anything by mouth to an unconscious person. Contact physician! Do not induce vomiting; if it occurs spontaneously, give victim more fluid. Observe for possible delayed onset of pulmonary edema.

Oleum is not listed as a carcinogen by the NTP, IARC, or OSHA.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Handle major spills by a predetermined plan. Contact supplier for assistance in this planning, in meeting local regulations, and for disposing of large amounts.

Notify safety personnel. Provide optimum ventilation (corrosive fumes). Fumes can affect neighboring materials. Cleanup personnel need protection against inhalation or contact. Shut off leak if there is no risk involved. Keep upwind. Contain spill. Oleum spills are best controlled by using a nonreactive absorbent (diatomaceous earth). Minor leaks or spills can be diluted with much water and neutralized with soda ash or lime. If water is not available, cover contaminated area with sand, ashes, or gravel and neutralize cautiously with soda ash or lime.

DISPOSAL: Follow Federal, state, and local regulations. Do not flush to sewers. Hydrogen gas evolution may create a fire or explosion hazard. EPA (CWA) RQ 1000 lbs (40 CFR 117). AQUATIC TOXICITY TLm 96: 100-10 ppm
EPA Hazardous Waste No. D002 (40 CFR 261.22)

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust or hood ventilation to meet TLV requirements in the workplace. For nonroutine or emergency conditions use a self-contained breathing apparatus with full facepiece operated in pressure-demand mode.

Avoid eye contact by use of chemical safety goggles or face shield where splashing may occur. Acid-resistant protective clothing such as rubber gloves, aprons, boots, hats, and suits should be used to avoid body contact as conditions may warrant.

Eyewash fountain and safety showers with a deluge type of head should be immediately available where this material is handled or stored. Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

Comprehensive preplacement and annual medical examinations with emphasis on dental erosion, cardiopulmonary system, and mucous membrane irritation and cough are indicated.

Provide proper safety education and training to workers handling oleum.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store oleum in suitable, tightly closed steel containers in a well-ventilated area having acid-resistant floors with controlled drainage. Certain grades may tend to freeze in storage. Protect containers against physical damage. Storage facilities to be separate from metallic powders, organic materials, chromates, chlorates, nitrates, fluorides, carbides, reducing agents, oxidizables, etc. Sand and soda ash or lime should be kept in general storage or work areas for emergency use.

A hygroscopic material, oleum is highly corrosive to most metals as it combines with moisture in the air.

Avoid breathing fumes. Do not get in eyes, on skin, or on clothing. Do not ingest. Practice good personal hygiene. Never add water to acid. Do not smoke. Use nonsparking tools free of oil, dirt, and grit and vapor-proof type of electrical fixtures.

DOT Classification: CORROSIVE MATERIAL, ID No.: NA1831; Label: CORROSIVE
UN1831; Label: CORROSIVE, POISON

Data Source(s) Code: 1, 4-11, 34, 42, 82, 84, (Genium MSDS #9). CK

Approvals	
Indust. Hygiene/Safety	6/86
Medical Review	6/86

May 1996

REFERENCE DATA SHEET ON MATERIAL SAFETY DATA SHEETS

By: Richard Gullickson, CIH

REQUIRED AND POTENTIAL USES

- OSHA Hazard Communication Standard[1]
  - General Industry
  - Shipyard Employment
  - Marine Terminals
  - Construction
  - Agriculture
  - Federal Employees
- EPA Regulations
  - Air Programs [2]
  - Superfund, Emergency Planning, and Community Right-To-Know Programs [3-5]
  - Toxic Substance Control Act [6]
  - Solid Wastes [7, 8]
- DOT - Emergency Response Information [9]
- Employee Training

The purpose of a Material Safety Data Sheet (MSDS) is to inform industrial purchasers and users of hazardous chemicals of the reasonably foreseeable physical and chemical hazards that may arise from the use of those chemicals. Most materials packaged for consumer use are exempt from the requirements of the Hazard Communication Standard (HCS). The MSDS should include precautions for normal use, handling, storage, disposal, and spill cleanup. It should not include recommendations for protective measures that are more strict than needed. OSHA states, in the inspection procedures for the HCS, [10] "Some MSDSs include recommendations for protective measures that are for 'worst case scenarios,' e.g., recommending supplied air suits for products of relatively low toxicity. The HCS requires that accurate information be provided on the MSDSs. This applies as much to 'overwarning' on the MSDS and label as well as the absence of information ('underwarning')."

HISTORY

In the 1940s the Manufacturing Chemists' Association, now known as the Chemical Manufacturers Association (CMA), began producing "Chemical Safety Data Sheets" containing "Properties and Essential Information for Safe Handling and Use" of some of the more important hazardous chemicals used in commerce. Ultimately about 100 of these Data Sheets were produced. They were very detailed in their coverage of each chemical, to the point of being almost a stand-alone book on the product. The longest Data Sheet was 46 pages. Later, some chemical companies began to produce data sheets for some of their high volume or hazardous chemicals. CMA no longer produces or supports the "Chemical Safety Data Sheets."

On November 25, 1983 OSHA published the Hazard Communication Standard as 29 CFR Part 1910, adding § 1910.1200. This initial standard applied only to Standard Industrial Classification (SIC) Codes 20 through 39. The requirement that manufacturers and distributors provide MSDSs to their customers became effective on November 25, 1985. The standard does not require a particular format for the MSDS, but does specify what information must be included. Effective September 23, 1987, the requirements of the standard were extended to include "... all employers with employees exposed to hazardous chemicals in their workplaces."

In 1986 the U.S. Environmental Protection Agency (EPA) published the "Emergency Planning and Community Right-To-Know Act of 1986," and in 1988 "Toxic Chemical Release Reporting: Community Right-To-Know." The use and distribution of MSDSs is an important part of these regulations. The "Toxic Chemical Release Reporting" regulation requires that MSDSs for chemicals requiring reporting by these regulations contain specific language notifying users that these chemicals are subject to these regulations. These and other EPA regulations have been promulgated under Title III C Emergency Planning and Community Right-To-Know Act of the Superfund Amendments and Reauthorization Act of 1986 (EPCRA).

OSHAs definition of a hazardous chemical is broad, and includes many materials that might otherwise be considered innocuous. Because of the potential for product liability suits, and the demands of customers for MSDSs for almost all materials they purchase, manufacturers usually prepare MSDSs for even relatively harmless materials.

IMPLICATIONS:

OSHA requires manufacturers and importers of hazardous chemicals to distribute Material Safety Data Sheets with information concerning reasonably foreseeable health and toxicity concerns arising from their use. Users of these chemicals are required to ensure that these MSDSs are received with chemicals they purchase, and that they are used and available in the workplace.

CONTENT OF A MATERIAL SAFETY DATA SHEET

Paragraph (g) of the OSHA Hazard Communication Standard specifies what must be contained in MSDSs. OSHA publishes a form that can be used for the MSDS, but does not require its use, as long as all of the required information is included. A condensed version of the language in the standard follows. Chemical manufacturers and importers shall obtain or develop a Material Safety Data Sheet for each hazardous chemical they produce or import. Employers shall have a Material Safety Data Sheet in the workplace for each hazardous chemical they use.

A. Each Material Safety Data Sheet shall be in English, and shall contain at least the following information:

    1. The identity (product name) used on the label, and chemical and common name(s) of ingredients which have been determined to be health hazards, and which comprise 1% or greater of the composition, except carcinogens shall be listed if the concentrations are 0.1% or greater; and,

    2. The chemical and common name(s) of all ingredients which have been determined to present a physical hazard when present in the mixture;

    3. Relevant physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point);

    4. Relevant physical hazards, including the potential for fire, explosion, and reactivity;

    5. Relevant health hazards, including signs and symptoms of exposure, and any medical conditions generally recognized as being aggravated by exposure to the chemical;

    6. The primary route(s) of entry into the body;

    7. The OSHA permissible exposure limit and ACGIH Threshold Limit Value. Additional applicable exposure limits may be listed;

    8. Whether the hazardous chemical is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens (latest edition) or has been found to be a potential

carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions), or by OSHA;

9. Precautions for safe handling and use, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks;

10. Appropriate control measures, such as engineering controls, work practices, or personal protective equipment;

11. Emergency and first aid procedures;

12. The date of preparation of the Material Safety Data Sheet or the last change to it; and,

13. The name, address and telephone number of the chemical manufacturer, importer, employer or other responsible party preparing or distributing the Material Safety Data Sheet, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

B. If no relevant information is found for any given category, it should be marked to indicate that no applicable information was found.

C. If significant new information becomes available regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the Material Safety Data Sheet within three months.

D. A Material Safety Data Sheet must be provided with the initial shipment of a hazardous chemical, and with the first shipment after a Material Safety Data Sheet is updated.

E. Material Safety Data Sheets shall also be made readily available, upon request, to designated employee representatives and to OSHA representatives.

IMPLICATIONS:

OSHA requires an extensive amount of specific information to be included, but the MSDS should not be a complete scientific work on the hazardous chemical. Employers may accept the content of an MSDS from a supplier unless they know it is incorrect. However, the employer must ensure that an MSDS is available for each hazardous chemical, and that it contains all of the required information. If an MSDS is not received, the employer must contact the supplier to request one. If the information is still not received, OSHA should be contacted for assistance.

The quality and accuracy of MSDSs varies widely. One recent study showed that of 150 randomly selected MSDSs, information was accurately identified in Health Effects in 37%, in First Aid Procedures in 76%, in Personal Protective Clothing in 47%, and in Occupational Exposure Limits in 47%.[11] *A Material Safety Data Sheet is for the benefit of people who work with hazardous chemicals. If it is not in a reasonably accurate, useful, and understandable format, it will not achieve its purpose.*

STANDARDIZATION OF MATERIAL SAFETY DATA SHEETS

Since the OSHA Hazard Communication Standard does not impose a format on MSDSs, there is a wide variation in the order in which the information is presented, and in the number of pages. The length of an MSDS can range from two pages to eight pages or even more. Some companies, in order to make the MSDS more uniform for their training programs, have transferred the information on vendor MSDSs into their own uniform format. The hazard of handling the information in this way is that the company then becomes the "responsible party" for the content of the MSDS.

In an effort to improve the completeness, accuracy, and consistency of MSDSs, the Chemical Manufacturers Association (CMA) has developed a voluntary standard for their preparation. The standard was published in 1993 as ANSI Z400.1-1993, "American National Standard for Hazardous Industrial Chemicals -- Material Safety Data Sheets -- Preparation." [12] The Standard is 179 pages long. It establishes an MSDS format containing sixteen sections. A very brief description of the purpose and scope of each section follows.

Section 1: Chemical Product and Company Identification Names the material and relates the MSDS with the label and shipping documents. Must also have a mailing address and telephone number for the manufacturer or distributor.

Section 2: Composition, Information on Ingredients Identifies the hazardous components of the material. If non-hazardous ingredients are listed, they should be listed separately. Chemical Abstract Service (CAS) numbers should be included, as well as OSHA Permissible Exposure Limits and American Conference of Government Industrial Hygienists (ACGIH) TLVs. If the identity of any ingredient is claimed to be a trade secret, it should be so indicated in this section.

Section 3: Hazards Identification Describes the material's appearance, odor, and health, physical, and environmental hazards that may be of concern for emergency response personnel.

Section 4: First Aid Measures This section should include emergency and first aid procedures. It should be in layman's language, easy to understand, and procedures for each potential route of exposure should be included. A "Notes to Physicians" subsection should be included if such information is available.

Section 5: Fire Fighting Measures This section should describe fire and explosive properties of the material, extinguishing media to be used, and fire-fighting instructions. It applies to anyone who may be in the area of the fire.

Section 6: Accidental Release Measures This section should have information needed to prevent or minimize adverse effects on employees, neighbors, property, and the environment, including waterways. It is intended for emergency response personnel.

Section 7: Handling and Storage This section provides guidelines for minimizing any potential hazards from storing the material. It should include information to minimize handling when appropriate, and conditions such as temperature, inert atmosphere, and conditions to avoid.

Section 8: Exposure Controls, Personal Protection Discusses the degree of engineering control that may be needed when handling the material, and the personal protective equipment that should be used if there is a potential for exposure above the regulatory or suggested limits. Exposure guidelines, such as OSHA PELs and ACGIH TLVs should be included in this section.

Section 9: Physical and Chemical Properties These properties should be included to assist users to determine proper handling and storage. Appearance, odor, physical state (liquid, solid, gas), pH, vapor pressure and density, melting and freezing point, solubility, and specific gravity should be included. Additional properties may be included if they are useful.

Section 10: Stability and Reactivity This section should describe conditions that may result in a potentially hazardous reaction, such as evolution of hazardous gases, production of heat, or other hazardous conditions.

Section 11: Toxicological Information This section should include any known information resulting from animal testing or human experience on the toxicity of the material. Also included would be information on its potential for causing cancer. Data should be included for acute, subchronic, and chronic exposures, if available.

Section 12: Ecological Information This section should list impacts to the environment that may occur if the material is released to the environment, or in evaluating waste treatment practices.

Section 13: Disposal Considerations This section is intended to provide guidance to environmental and other technical people responsible for waste management for the product.

Section 14: Transport Information This section should provide information concerning classification for shipping the material. It should include U.S. Department of Transportation (DOT) classifications, or an indication that it is not regulated. It may include information for shipment into other countries.

Section 15: Regulatory Information This section should contain information regarding the regulatory status of the material. It should include OSHA AND EPA regulations. It may also include other regulatory agencies, and state agencies, if appropriate.

Section 16: Other Information This section is intended for other material the preparer feels is pertinent, and that should not be included in the other fifteen sections. For example, it may include label information, hazard ratings, revision dates, and references to other related information.

IMPLICATIONS:

Although the OSHA Hazard Communication does not require the use of a specific format for the preparation of MSDSs, many suppliers may request them in the ANSI format in the interest of having a more uniform placement of information. This may aid them in training their people to use these chemicals and materials safely.

REFERENCES

1. "Hazard Communication," *29 CFR 1910.1200*. Washington, Occupational Safety and Health Administration 52 FR 31877, August 24, 1987.

2. "National Emission Standards for Hazardous Air Pollutants for Source Categories," *40 CFR Part 63*. Washington, Environmental Protection Agency, 58 FR 61970, Dec. 29, 1993.

3. "Emergency Planning and Notification," *40 CFR Part 355*. Washington, Environmental Protection Agency, 52 FR 13395, Apr. 22, 1987.

4. "Hazardous Chemical Reporting: Community Right-To-Know," *40 CFR Part 370.* Washington, Environmental Protection Agency, 52 FR 38364, Oct. 15, 1987.

5. "Toxic Chemical Release Reporting: Community Right-To-Know," *40 CFR Part 372*. Washington, Environmental Protection Agency, 53 FR 4525, Feb. 16, 1988.

6. "Significant New Uses of Chemical Substances." *40 CFR Part 371*. Washington, Environmental Protection Agency, 53 FR 28358, July 27, 1988.

7. "Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities," *40 CFR Part 266*. Washington, Environmental Protection Agency, 50 FR 666, Jan. 4, 1985.

8. "Land Disposal Restrictions," *40 CFR Part 266*. Washington, Environmental Protection Agency, 51 FR 40638, Nov. 7, 1986.

9. "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications Requirements and Emergency Response Information Requirements," *49 CFR Part 172*. Washington, Department of Transportation, 41 FR 15996, Apr. 15, 1976.

10. "Inspection Procedures for the Hazard Communication Standard, 29 CFR 1910.1200, 1915.99, 1917.28, 1918.90, 1926.59, and 1928.21," *OSHA Instruction CPL 2-2.38C*, Appendix A (g)(1). Washington, Occupational Safety and Health Administration, October 22, 1990.

11. Kolp, P., P. Williams and R. Burtan, "Assessment of the Accuracy of Material Safety Data Sheets," *American Industrial Hygiene Association Journal* 56 (2):178-183 (1995).

12. *American National Standard for Hazardous Industrial Chemicals -- Material Safety Data Sheets -- Preparation*, ANSI Z400.1-1993. New York, American National Standards Institute, 1993.

LABEL FORMAT AND CONTENT

I. INTRODUCTION

Good container labels are necessary to prevent injuries to persons who otherwise do not know what is in a container. But who is it that requires the use of labels in the American workplace, what are the reasons, what specific information should be on each label, and where does the information come from?

The following section provides this information plus it describes in detail the specific information that is placed in each label in this publication and the reasons why Genium has selected this information as being the most appropriate and most accurate available. Using the same reasoning presented here, and your on-hand material safety data sheets, you should be able to follow this logical approach and produce your own labels for additional materials.

A. OSHA LABELING REQUIREMENTS

1. Situations Where OSHA Requires a Label

OSHA's Hazard Communication standard 29CFR 1910.1200, requires that all in-plant containers of hazardous chemicals be labeled, tagged, or marked with the identity of the material and appropriate hazard warnings. Organizations that manufacture, import, or distribute chemicals are required to make sure every container of hazardous chemical shows a label with the same information, plus the name and address of the producer of the chemical or "other responsible party."

OSHA allows employers who purchase chemicals from outside suppliers to rely on the labels provided by those suppliers as long as two conditions exist: 1) The chemical remains stored in its original container or 2) The chemical is transferred into an in-plant container that will only be used by the employee making the transfer. If the in-plant container will be used by other employees, the employer must label the in-plant container.

2. Information OSHA Required on a Label *

Since the Hazard Communication standard is performance oriented, the more information that can be included on a chemical label, the less chance of a problem with OSHA. The agency does however, have some minimum label content requirements.

* Definitions of words, phrases, and acronyms that you do not understand may be found in the "Glossary of Terms and Abbreviations" section of this book.

Every chemical container label must include at least:

- The identity of the chemical – any name that appears on the label, on the MSDS, and on the hazardous materials inventory, and links these three sources of information together.
- Appropriate hazard warning – OSHA describes this warning as "a brief statement of the hazardous effects (both physical and health hazards) of the chemical."

OSHA recognizes that labels frequently contain additional information, but the agency emphasizes that additional information is provided on a voluntary basis and is not required by the Hazard Communication standard. OSHA modified the definition of hazard warning in 1994 to make such warnings more uniformly adequate. OSHA mentioned that these warnings should include the "specific or health hazard(s), including target organ effects, of the chemical(s) in the container(s)."

The only other label requirement set forth by OSHA is that container labels must be legible and prominently displayed.

3. The Meaning of "Appropriate Hazard Warning"

OSHA requires that hazardous material container labels warn employees of the physical and health hazards associated with exposure to the material. OSHA has made it clear, on several occasions, that this warning needs to include the material's target organs. Most chemicals that produce systemic toxicity do not cause a similar degree of toxicity in all organs but usually produce the major toxicity to one or two organs. These are referred to as target organs of toxicity for that chemical.

OSHA defines a chemical as a physical hazard when there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

OSHA defines a chemical as a health hazard when "there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic effects may occur in exposed employees." OSHA defines the term "health hazard" as "includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes."

OSHA points out that phrases such as "danger" and "caution" are caution statements and not hazard warnings. Remember, OSHA's definition of "hazard warning" states that the warning must convey the hazards of the chemical and is intended to include target organ effects, e.g. "Prolonged or repeated inhalation may cause lung damage."

4. The Difference Between Labels for "Shipped" and "In-Plant" Containers

OSHA recognizes that the amount of information on labels can vary, based on the label's application. For example, labels used on in-plant containers in a workplace generally do not need to be as detailed as labels used on shipping containers. This is because additional hazard information, like the MSDS for the material, is readily available in the workplace to support in-plant container labels. The labels on shipped containers, on the other hand, may, in certain situations, have to stand alone as the only hazard information available for the material.

As a result of this difference, OSHA's requirements for labeling in-plant containers is generally less stringent. This is particularly true with regard to the use of labeling systems that use letters, numbers, and pictographic symbols to designate and rate the hazard effects of a chemical. Examples of such systems recognized by OSHA are the HMIS® (Hazardous Materials Information System) developed by the National Paint and Coatings Association, and the well-known fire diamond hazard rating system developed by the National Fire Protection Association. These systems do not contain specific target organ information.

The training provisions of the Hazard Communication standard require that employees be trained on the physical and health hazards of the chemicals they are exposed to in the workplace. OSHA includes making the employee aware of each chemical's target organ effect, as part of the training requirements. OSHA will allow employers to use the HMIS® or NFPA systems on labels for in-plant containers without including specific target organ effect information. In order to do so, though, employers must prove the hazard communication training program in-place for that workplace explicitly instructs employees on how to use and understand the labeling system. The training program must ensure that employees are aware of the effects (including target organ effects) of the hazardous chemicals to which they are exposed.

OSHA allows no such flexibility with labels for shipped containers. A label incorporating a rating system is not permitted for shipped containers unless additional information is affixed to the container.

B. ANSI STANDARD FOR HAZARDOUS INDUSTRIAL CHEMICALS

1. Background

Since OSHA's Hazard Communication standard is performance oriented, it does not require or establish a process or formula that must be followed when preparing labels for chemical containers. Affected employees are free to prepare labels using any method they choose, provided the end result of their efforts is a label meeting OSHA's minimum information requirements.

Instead of reinventing wheels, many employers prefer the following procedures that have been developed and tested by experts in a given field. Doing so saves time, helps ensure quality, and enhances acceptance by others. The American National Standards Institute (ANSI) is in place to foster and attain technical consensus, i.e., a consensus that considers all views and objections and takes into account all government regulations that impact the activity. Unlike OSHA standards, those published by ANSI do not have the force of law, and their use is entirely voluntary.

ANSI Z129.1-1994 was sponsored by the Chemical Manufacturers Association. The intent of the standard is to provide guidance for developing precautionary information on chemical container labels in accordance with the labeling requirements set forth in OSHA's Hazard Communication standard. ANSI, like OSHA, recognizes that chemical labels should only be used as warning instruments. In order to fulfill this function effectively, ANSI recommends that the language on the label address hazardous exposures to be avoided under normal workplace use, misuse, handling, and storage circumstances.

2. Methodology – Steps for Making an ANSI Label

The label development methodology presented in the standard includes the following general steps:

- Conduct a health hazard evaluation of the subject chemical:
  ANSI recommends that a qualified hazard communication professional conduct this evaluation in accordance with all government-required tests for determining if a material is considered hazardous.

- Identify documents that must be created or revised to provide necessary safety and health information:
  These would consist of MSDSs, container labels, technical fact sheets and bulletins, and supplier product brochures available for the chemical.

- Determine what information is most important:
  Keep in mind that MSDSs and other vendor-supplied literature contain large amounts of detailed data while both ANSI and OSHA recommend that the information put on container labels be limited to the most important hazard warning data. A section of ANSI's standard is devoted to explaining what types of information should be included on a label. Here is the standard's "general example" of the type of information that should be included on a chemical label:

Product Name or Identification (Identity of Hazardous Component(s), Where Appropriate)
Signal Word Statement of immediate hazard(s) Delayed Hazard(s) label statement
Precautionary Measures
Instructions in Case of Contact or Exposure (First aid statements and antidotes where appropriate)
Fire Instructions
Spill or Leak Instructions
Container Handling and Storage Requirements
References
Additional Useful Statements
Name and address of company
Telephone Number

- Create the specific label text:
  The standard emphasizes that label text should convey the necessary warning information in as simple and clear a style as possible. To help users realize this objective, the standard included tables of concise glossarized statements for many common hazards, first aid response actions, and fire extinguishing measures. By using these statements as appropriate and modeling other text after them, the labels prepared maintain an easy-to-understand consistency that will enhance the effectiveness of their warning value.

- Position the label text on the label:
  The standard addresses how to determine where on the label each piece of data should be positioned. It prioritizes the data, based on what type of hazard is involved, to help determine in what order the information should be presented. This data is especially useful in situations where container and label size require a label to be edited by eliminating the least important information.

II. CREATING A LABEL FROM AN MSDS

The following methodology for extracting and formatting appropriate chemical container label data from a material safety data sheet (MSDS) was developed by Genium Publishing Corporation. It is designed to assist qualified hazard communication professionals with an logical method for creating container labels using data provided by the supplier of the chemical.

In creating this methodology, Genium has attempted to incorporate the required label elements set forth by OSHA, using ANSI's guidelines for preparing precautionary labels. At the same time, Genium has also incorporated additional data elements for its model label format that go beyond strict OSHA mandates and ANSI suggestions to a label that will fully satisfy the performance orientation of the OSHA HazMat regulations."

Users need to be advised that, although Genium Publishing Corporation has made every effort to ensure the accuracy and completeness of the information presented in this methodology, the company extends to warranties, makes no representations, and assumes no responsibility as to the accurate or suitability of this information for application to the user's intended purpose or for consequences of its use.

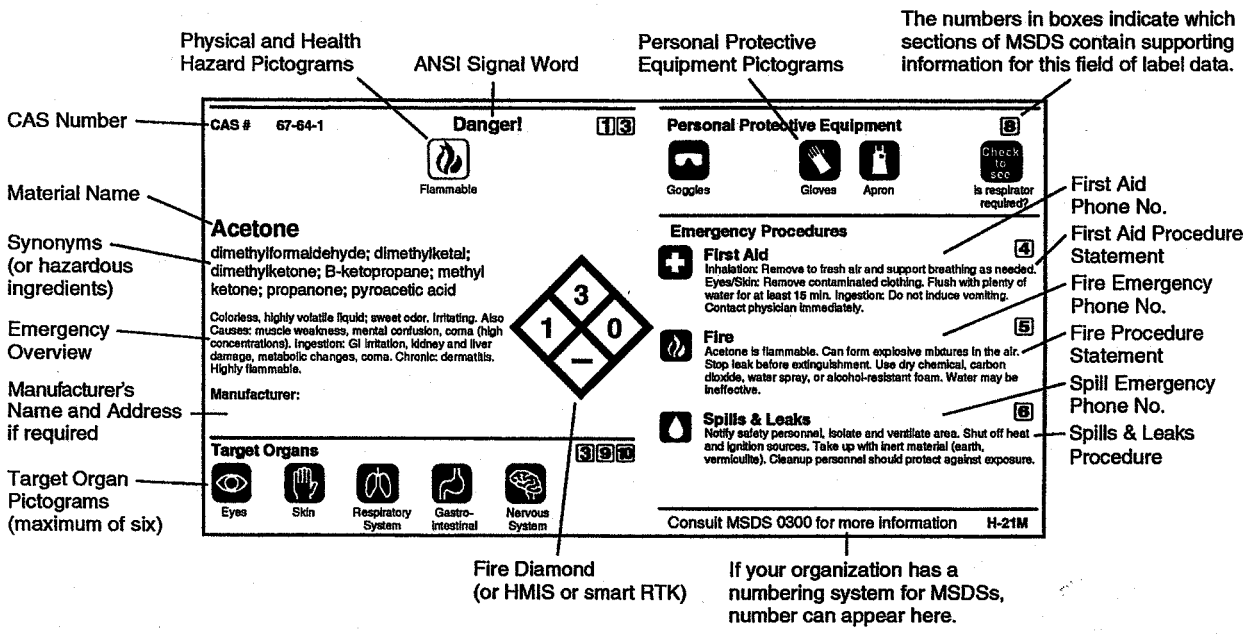
Always keep in mind that a chemical label can only be as accurate as the information sources used to create it. If you're attempting to use the following methodology to create a label using only a poorly written, incomplete, vendor supplied MSDS as your reference, chances are good that the resulting label will also be poorly written and incomplete.

A. GENIUM'S MODEL LABEL FORMAT – BACKGROUND

Genium Publishing Corporation takes the position that chemical labels should provide chemical users with the most complete "appropriate hazard warning" possible. Instead of trying to limit the amount of information placed on a label, Genium looked for ways to increase it.

The best way to present the maximum amount of material safety and health information on a label, with it's very limited space, is to establish guidelines, criteria, and concise wording that can be

applied in all situations. Genium-developed label information is a reflection of that precision from the way the label is laid out, to the use of pictograms, to the wording that is used throughout. Genium worked closely with Electromark, a major chemical label and safety sign manufacturer in Wolcott, NY, to develop a label design that would accommodate Genium's label data gathering methodology. The pictograms used in this methodology were developed by Electromark. Following is the general label format developed by Genium:



The SmartRTK label design does not rely solely upon a series of letter or number codes. Relying solely on the number/letter schemes may make it difficult to extract crucial information quickly. Many workers, often untrained, illiterate or infrequent users of these materials, may thus be neither well informed nor adequately protected.

The SmartRTK design provides a complete, clear, and easy-to-read label that ties closely to the MSDS. Familiarity and redundancy are great aids in the transmission of hazard information to the average worker. As a result, symbols and text are used together to clearly identify hazards. In addition, the introduction of the human silhouette on larger labels provides a visual reference to strengthen the user's identification with the specific hazard to his or his organs.

NOTE:

1. Throughout this discussion when mention is made of an MSDS section where information can be found, it refers to the 16-section MSDS format, ANSI Standard ANSI Z400.1. For those unfamiliar with this format, Appendix A describes the 16-section MSDS format.

2. The MSDS section reference indicates only where the information is generally found. Some manufacturers may put this information in other sections, and there may be additional relevant information throughout the MSDS. Therefore, use the section citation as a guideline; read the entire MSDS to make sure that all needed information is at hand.

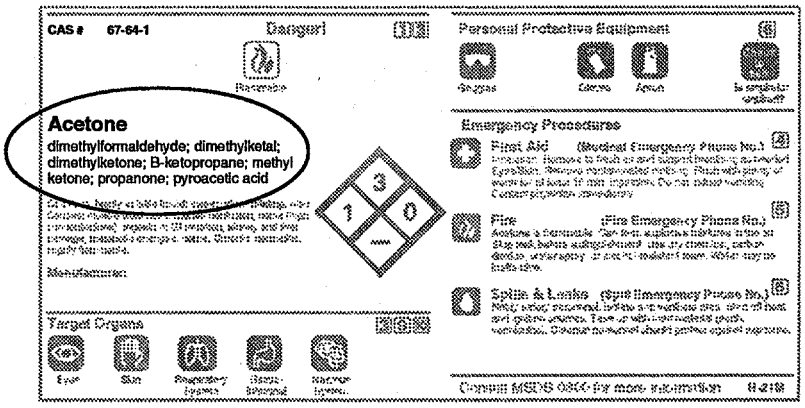
B. LABEL INFORMATION FIELDS AND DATA CONTENT

Genium's model label format contains a number of fields of information. They are as follows:

1. Material Identification

a. CAS Number (*67-64-1)*

The CAS number is a concise, unique means of material identification. The number is assigned by Chemical Abstracts Service, an organization within the American Chemical Society. It can be found in Section 1 of the MSDS.



b. Name ("Acetone")

Go to section number 1 (Chemical Product and Company Identification) of the MSDS and obtain the name of the material. The name of the material used for its label must be spelled exactly as it is on the MSDS.

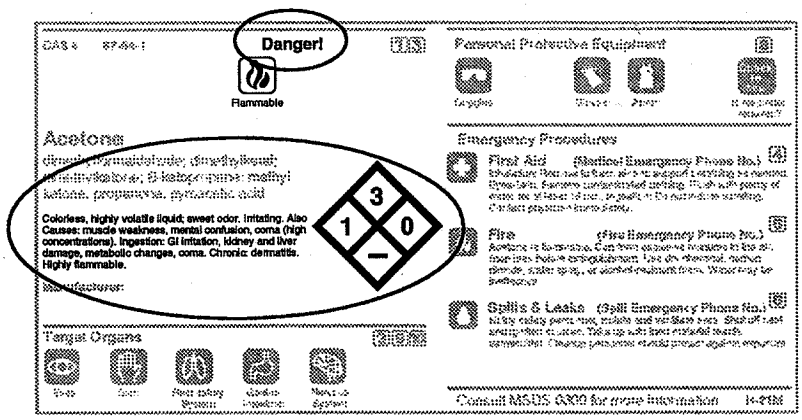
c. Synonyms (*"dimethylformaldehyde…"*)

If space permits, Genium recommends the label include all common synonyms and trade names for the materials as listed in Section 1 of the MSDS. If there is not sufficient space to list all synonyms and trade names, make sure you include any that are used by employees who may come in contact with this material. You can also include any unique nicknames your employees commonly use for workplace materials. For example, suppose employees in your organization commonly refer to a hazardous cleaning solution as "blanket cleaner." You should make sure that the name "blanket cleaner" is included as a synonym on the label for this solution.

d. A Note on "Ingredients"

All of the materials in Genium's collection of MSDSs are raw organic and inorganic chemicals. When using Genium's label data gathering methodology for chemical mixtures, users must remember to include all hazardous ingredients listed on the MSDS. These ingredients should be listed prior to including any synonym designations.

2. Physical and Health Hazards



OSHA defines a physical hazard as a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, on organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive.

OSHA defines the term "health hazard" as "includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes."

Genium's model label format uses a series of up to six hazard pictograms, the popular fire diamond rating system, and signal word, and an Emergency Overview statement to convey an appropriate hazard warning. Remember that both ANSI and OSHA agree that not every potential hazard can be covered in a label, without severely impairing the effectiveness of the warning message.

Genium's label methodology is based on the premise that the hazard warnings that receive the most attention on a label should be those that users of the chemical are most likely to experience under normal use conditions. Have your employees depend on the MSDS and Hazard Communication training for information on all possible physical and health hazards and let the label focus on those hazards most likely to occur in your workplace.

The following chart shows you what element of Genium's label format is used to indicate the status of each OSHA recognized health and physical hazard. The third column of this table shows you in what section of a typical 16-section MSDS, information regarding each hazard is generally located.

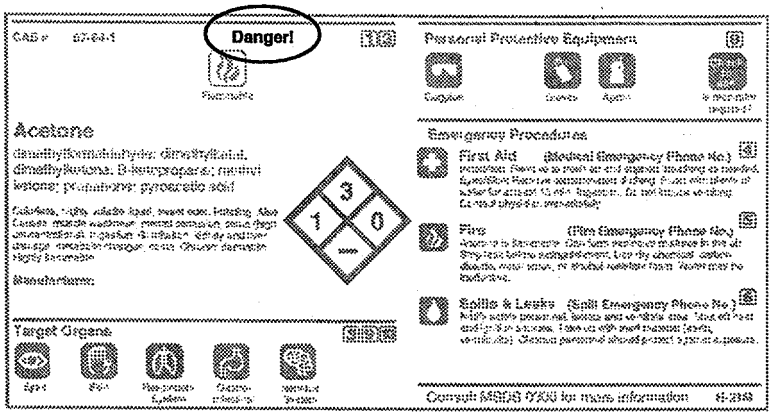
Hazard Type	Where Indicated on Label	Where Found on MSDS
Physical Hazards		
Combustible	Hazards: Emergency Overview	Section 5
Compressed Gas	Hazards: Pictogram	Section 3 Section 9
Explosive	Hazards: Pictogram	Section 9
	Hazards: Emergency Overview	Section 5

Hazard Type	Where Indicated on Label	Where Found on MSDS
Physical Hazards		
		Section 10
Flammable	Hazards: Pictogram Hazards: Emergency Overview	Section 3 Section 5 Section 10
Organic Peroxide	Hazards: Emergency Overview	Section 5 Section 10 Section 3
Oxidizer	Hazards: Fire Diamond Hazards: Emergency Overview	Section 5
Pyrophoric	Hazards: Emergency Overview	Section 5
Unstable (Reactive)	Hazards: Emergency Overview	Section 10
Water Reactive	Hazards: Fire Diamond Hazards: Emergency Overview	Section 5 Section 10

Hazard Type	Where Indicated on Label	Where Found on MSDS
Health Hazards		
Carcinogen	Hazards: Emergency Overview	Section 3
Toxic	Hazards: Emergency Overview	Section 11 Section 3
Highly Toxic	Hazards: Pictogram (Poison) Hazards: Emergency Overview	Section 11 Section 3
Irritant	Hazards: Emergency Overview	Section 3
Corrosive	Hazards: Pictogram Hazards: Emergency Overview	Section 3
Sensitizer	Hazards: Emergency Overview	Section 3
Reproductive Toxin	Hazards: Emergency Overview	Section 3 Section 11
Hepatotoxin	Hazards: Emergency Overview	Section 3
Nephrotoxin	Hazards: Emergency Overview	Section 3
Neurotoxin	Hazards: Emergency Overview	Section 3

Several organizations have developed hazard rating systems that are intended to give the user a quick view of the hazards for a particular chemical. The essential element of such hazard rating systems is the 0 to 4 number scale for the severity of the various possible hazards (health, flammability, reactivity, or oxidizer). To further organize this information for quick recognition, the numbers are generally presented in a visually recognizable block or shape. This manual describes three such hazard rating systems in Appendix C from three organizations: the National Fire Prevention Association (diamond shape), the Hazardous Materials Identification System (HMIS)® from the National Paint and Coatings Association (vertical stack), and the SmartRTK Hazard Rating Index (sliding horizontal scales).

3. ANSI Signal Word (*Danger!*)



The ANSI standard requires the use of a signal word to indicate the relative degree of severity of an immediate hazard. The three possible signal words are:

DANGER! Most severe immediate hazards. According to the ANSI standard, the word DANGER! is assigned to the following hazards:

- Extremely flammable liquid
- Pyrophoric solid
- Corrosive to living tissue
- Highly toxic by absorption
- Sensitizer to lungs
- Flammable gas
- Oxidizer
- Highly toxic by inhalation
- Highly toxic by ingestion

WARNING! According to the ANSI standard, the word WARNING! is assigned to the following hazards:

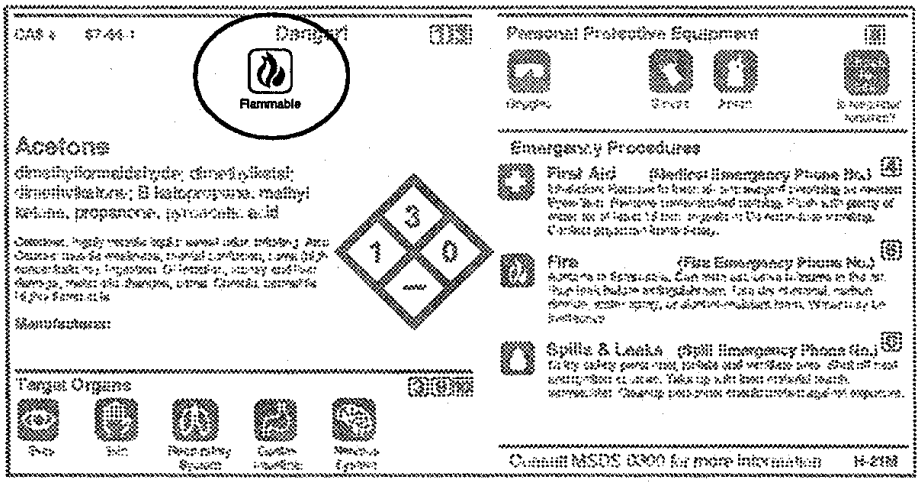
- Flammable liquid
- Irritant, severe respiratory
- Irritant, severe eye
- Toxic by absorption
- Sensitizer, skin
- Flammable solid
- Irritant, severe skin
- Toxic by inhalation
- Toxic by ingestion

CAUTION! Least severe immediate hazards. According to the ANSI standard, the word CAUTION! is assigned to the following hazards:

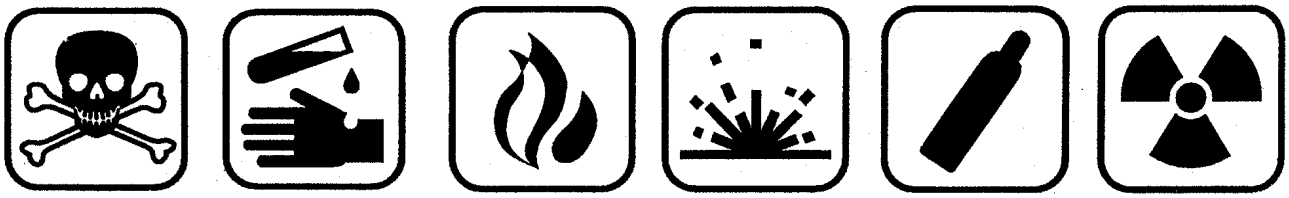
- Combustible liquid
- Irritant, moderate skin
- Irritant, moderate eye
- Harmful by absorption
- Irritant, moderate respiratory
- Irritant, defatting skin
- Potential suffocation
- Harmful by ingestion

Note: It is easier to determine the appropriate signal word after you have completed Label Fields 6 and 7 (Respiratory Protection, Target Organ Pictograms) of the chemical container label format. This is because the assignment of the appropriate signal word requires that you first determine the most severe immediate hazards. In order to make this determination, you must go through all of the steps required to complete Label Fields 6 and 7.

4. Physical and Health Hazard Pictograms



Genium's label data information uses six hazard pictograms to quickly and visually alert the reader to the material's dangers. In Genium's model label format, the hazard pictogram(s) always appears in the same sequence position on any given label. Hazard pictograms used by Genium and their order of appearance on the label are as follows:



a. Poison (Highly Toxic)

If the material is a poison, the skull-and-crossbones pictogram and word "poison" appear. A material is classified as a poison if it is a highly toxic material. According to the ANSI standard there are four categories of highly toxic chemicals:

1. A chemical that has a median lethal dose (LD_{50}) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose (LD_{50}) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less, if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration (LC_{50}) of gas or vapor in air of 200 parts per million (ppm) or less by volume, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less, if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each, provided such concentration or condition, or both, are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

4. A chemical that is a liquid having a saturated vapor concentration (ppm) at 68 degrees F (20 degrees C) equal or greater to its LC_{50} (vapor) value (ppm), if the LC_{50} is 3000 parts per million (ppm) or less when administered by continuous inhalation for 1 hour (or less, if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each, provided such concentration or condition, or both, are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

The information needed to apply the "poison" criteria listed above is generally found in MSDS section 11, Toxicological Information. You should also review the Emergency Overview statement in MSDS section 3, Hazards Identification. This statement should contain an overview of the most significant immediate concerns upon exposure including if a material is "toxic" or "highly toxic."

If the MSDS indicates that the material is "highly toxic," the poison hazard pictogram is used in Genium's model label format. If the MSDS indicates that the material is "toxic," this information would be included in the model label format's "Emergency Overview" statement described below.

b. Corrosive 

If the MSDS indicates that the material is "corrosive," the corrosive hazard pictogram is used. The corrosive hazard pictogram is a hand and test tube with the word "Corrosive" underneath. According to the ANSI standard, a material is classified as a corrosive if it causes visible destruction of or—irreversible alterations in—living tissue by chemical action at the site of contact.

There are generally three locations on a typical 16-section MSDS that will indicate if a chemical is corrosive. The first place you should look is the Emergency Overview statement in the Hazards Identification section, section 3. If nothing regarding the material's corrosivity is found in this statement, review the "acute effects" statement, also located in the MSDS section 3. Examine both the "eye" and "skin" acute effects to see if the MSDS indicates that the chemical "is corrosive" or "causes burns." If the NFPA Fire Diamond rating is on the MSDS, and the health rating has a value of "3" or "4," you will know that the material is probably corrosive.

c. Explosive 

If the MSDS indicates that the material is "explosive," the explosive hazard pictogram is used. The explosive hazard pictogram is a starburst with the word "explosive underneath. A material is classified as explosive if it exhibits any of the following characteristics:

- Explosive when heated
- Explosive when shocked
- Explosive by friction, by concussion, by percussion, by detonation
- Forms potentially explosive mixtures with water
- May polymerize explosively
- May form explosive dust-air mixtures
- Material that in itself is capable of detonation, explosive decomposition, or explosive reaction at normal temperature and pressure or does not require a strong initiating source or heating under confinement

There are generally three locations on a typical 16-section MSDS that will indicate if a chemical is explosive. The first place you should look is the Emergency Overview statement in the Hazards Identification, MSDS section 3. If you can not find information on the material's explosivity, then review section 5 of the MSDS, Fire Fighting Measures. Look for any statements describing any of the seven characteristics of explosivity listed above. The Stability and Reactivity Section, MSDS section 10, should also be reviewed for the same indications of explosivity.

d. Flammable 

If the MSDS indicates that the material is "flammable," the flammable hazard pictogram is used. The flammable hazard pictogram is a picture of a flame with the word "Flammable" underneath. A material is classified as flammable if it is a liquid with a flash point less than or equal to 141 degrees Fahrenheit; a gas that at atmospheric pressure/temperature has a Lower Flammability Limit (LFL) or 13% or less or the difference between the LFL and the Upper Flammability Limit (UFL) is wider than 12%, or projects a flame more than 18 inches beyond the ignition source; or is a solid that ignites readily or is liable to cause fire. See the ANSI labeling standard for a more detailed description of these classifications.

To determine if the material is flammable, first look in the Emergency Overview statement in the MSDS section 3, Hazards Identification. If nothing regarding the material's flammability is found in this statement, compare the flammability characteristics described in the preceding paragraph to the material's flammability related physical properties. The flash point, LFL, and UFL for a material will generally be located in MSDS section 5, Fire Fighting Measures. While reviewing Fire Fighting Measures you should also be on the look-out for any statements that would indicate a high degree of flammability (i.e. "readily ignitable" or "burns vigorously and persistently"). Also review section 10, Stability and Reactivity, for any data that refer to the material's flammability.

e. Compressed Gas 

If the MSDS indicates that the material is a "compressed gas," the compressed gas hazard pictogram is used. The compressed gas hazard pictogram is a picture of a gas cylinder with the words "Compressed Gas" underneath. A material is classified as a compressed gas by the DOT in 49CFR 173.115 as any material or mixture having in the container either an absolute pressure greater then 276 kPa (40 lbf/in^2) at 21 degrees C (70 degrees F), or an absolute pressure greater than 717 kPa (104 lb/in^2) at 54 degrees C (129 degrees F) or both, or any liquid flammable material having a Reid vapor pressure greater than 276 kPa (40 lbf/in^2) at 38 degrees C (100 degrees F).

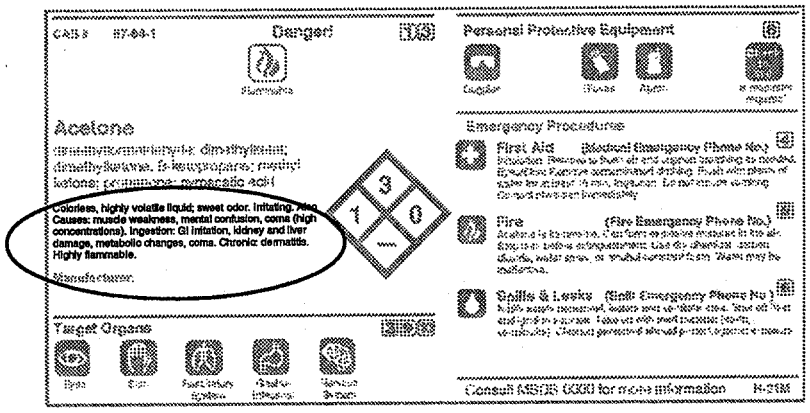
To determine if the material is classified as a compressed gas, look first in the Emergency Overview statement in MSDS section 3, Hazards Identification. If this statement is missing or does not indicate the material is a compressed gas, review MSDS section 9, Physical and Chemical Properties. Compare the absolute pressure and/or Reid vapor pressure reported for the material with the criteria included in the preceding paragraph, or see if the material is defined as a compressed gas.

e. Radioactive

If the MSDS indicates that the material is "radioactive," the radioactive hazard pictogram is used. The radioactive hazard pictogram is the standard radiation tri-foil symbol with the word "Radioactive" underneath. A material is classified as radioactive if it emits ionizing radiation.

To see if a material is radioactive look first in the Emergency Overview statement in the Hazards Identification section, MSDS section 3. If nothing regarding the material's radioactivity is found in this statement, review other portions of MSDS section 3 to see if radiation is listed as a hazard. Also review MSDS section, Stability and Reactivity, for statements that the material is radioactive.

5. Emergency Overview (*Colorless, highly volatile…"*)



The Emergency Overview statement is one area of the label that summarizes the essential and MOST IMPORTANT hazards for that chemical. Unlike other sections of the Right-to-Know label that rely on number codes and pictograms, this Emergency Overview statement expresses, in simple and easy-to-understand terms, the essential characteristics and hazards of the chemical. As a distillation of the MSDS, this section must be crafted carefully. It has to be not only very concise but also highly structured so that essential information is not missed. Use the following steps as a road map to make sure your own Emergency Overview statement is as effective as possible.

ANSI also recommends that chemical manufacturers include a similar, but slightly longer and more detailed Emergency Overview statement in MSDS section 3, Hazard Identification, of the 165-section MSDS format. The purpose of this statement is to describe the material's appearance and most significant immediate concerns for emergency response personnel. ANSI recognized that users of hazardous chemicals were having difficulty extracting appropriate label data from the vendor MSDS. In response to this concern, ANSI recommended that chemical manufacturers include the Emergency Overview statement on each MSDS.

If you're fortunate to be working with MSDSs from vendors who comply with ANSI's 16-section MSDS guidelines, you should have easy access to these Emergency Overview statements. As a result, your label writing tasks should prove to be much simpler.

a. Step 1: What is the Material's Color, Physical Form, and Odor?

The first sentence of the chemical container label's Overview is used to describe the material's color, physical form, and odor (in that order). This information is important as a means of identification. If the label tells you the liquid is *green* but the chemical inside the container is *orange*, you have a warning that the chemical *named* on the container may not be the same chemical in the container. The same chemical in different physical forms can present dramatically different levels of hazards. For example, a solid piece of aluminum is virtually non-hazardous, while aluminum powder is not only an irritant, but when dispersed in air, can be an explosion hazard.

Hopefully, your MSDS contains its own Emergency Overview, located in section 3, Hazards Identification. The first sentence of the MSDS's Overview should address color, physical form, and odor. If it does not, go to section 9, Physical and Chemical Properties, and look for the Physical State and Appearance and Odor information there. The first sentence for a label's Emergency Overview section could be, for example, as follows: "Light pink or red crystals with vinegar odor."

b. Step 2: Is the Material Corrosive or an Irritant?

The next statement describes if the material is a corrosive or irritant. The most dangerous materials are corrosive, and the label will show the signal word DANGER and the "corrosive" pictogram. The Emergency Overview should go further and explain the corrosive properties, especially the material's effect on the eyes, skin, and respiratory tract.

Less hazardous materials are described as "severely irritating," "irritating," or "mildly irritating." Again, the Emergency Overview statement should specify whether your eyes, skin, or respiratory tract are potentially affected.

The first place you should look for corrosive/irritant characteristics in the Emergency Overview statement in the Hazards Identification section, MSDS section 3. If you can find nothing in the statement regarding the material's corrosivity or irritation aspects, review the "acute effects" statement, also located in MSDS section 3, for relevant information.

c. Step 3: Is the Material Toxic?

If the material is a poison (highly toxic chemical), as classified by ANSI, then the hazard pictogram shows that danger, and it is reinforced with the word "poison" in the emergency overview. Materials that are "toxic," as classified by ANSI, a characteristic that is not quite as hazardous as "poison," have the word "toxic" at this point in the emergency overview.

ANSI defines a material as toxic if it falls within any of the following four categories:

1. Has a median lethal dose (LD_{50}) or more than 50 milligrams per kilogram, but no more than 500 milligrams per kilogram of body weight, when administered orally to albino rats weighing between 200 and 300 grams each;

2. Has a median lethal dose (LD_{50}) of more than 200 milligrams per kilogram, but no more than 1000 milligrams per kilogram of body weight, when administered by continuous contact for 24 hours (or less, if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each;

3. Has a median lethal concentration (LC_{50}) in air or more than 200 parts per million (ppm), but no more than 2000 parts per million (ppm) of gas or vapor by volume, or more than 2 milligrams per liter, but no more than 20 milligrams per liter, of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less, if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each, provided such concentration or condition, or both, are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

4. Is a liquid having saturated vapor concentration (ppm) at 68 degrees F (20 degrees C) of more than one-fifth its LC_{50} (vapor) value (ppm), if the LC_{50} is not more than 5000 ml/m3 (ppm) when administered by continuous inhalation for 1 hour (or less, if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each, and the criteria for "highly toxic chemical" is not met, provided such concentration, or condition, or both, are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

The information needed to apply the poison/toxic criteria is generally found in MSDS section 11, Toxicological Information. You should also review the Emergency Overview statement in MSDS section 3, Hazards Identification. This statement should contain an overview of your most significant and immediate concerns if you were to be exposed to the toxic material. If needed the statement should define the material as "toxic" or "highly toxic" (poison).

d. Step 4: Are There Additional Major Acute Effects?

The sentence beginning "Also causes…" lists additional major acute effects (other than the corrosive/irritant effects) caused by exposure to the material. (*Note:* If there are no corrosive/irritant effects, then this prompt may become "Causes"). The small size of the label (especially when compared to an MSDS) means that you must use concise language. Review the entire MSDS with a watchful eye for specific acute effects. Generally this information needs to be reduced to the symptom and then, if space permits, the target organ effects and route of entry.

This information is usually found on MSDS section 3, Hazards Identification, "acute effects" and/or "target organs." You should also review the Emergency Overview statement in MSDS section 3, Hazards Identification to make certain that the acute effected mentioned in the MSDS statement are also included in your Emergency Overview statement on your label.

e. Step 5: Is the Material Toxic?

Any known chronic effects are then listed in the Emergency Overview statement. OSHA has a specific list of health concerns: cancer hazard, reproductive hazard, sensitizer, and materials hazardous to the liver, kidney, and nervous system. In writing the Emergency Overview statement for your label make sure you review the MSDS for these chronic effects.

Information on chronic effects is generally found in MSDS section 3, Hazards Identification, "chronic effects" and/or "target organs." Additional information may be found in MSDS section 11, Toxicological Information. You should also review the Emergency Overview statement in MSDS section 3, Hazards Identification, to make certain that chronic effects mentioned in you MSDS statement are also part of your label statement. Statements on carcinogenicity found on the Genium label data information are based on IARC classifications. Classifications include "known cancer hazard," "suspect (probable) cancer hazard," and "possible cancer hazard."

f. Step 3: Is the Material Flammable or Combustible?

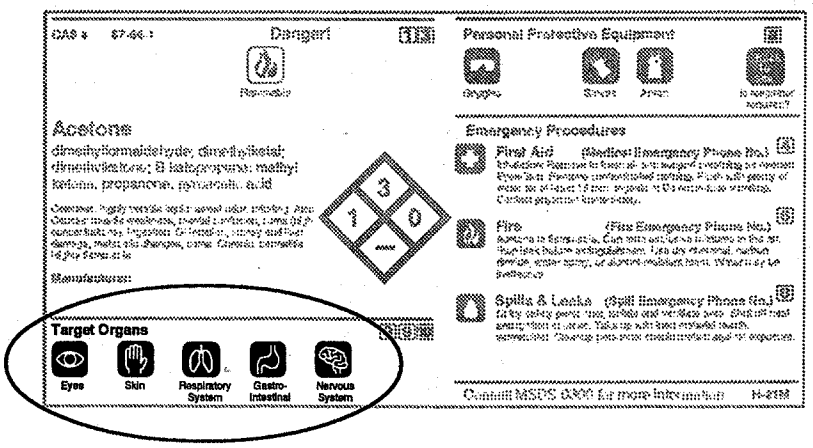
The next part of the label Emergency Overview statement covers the material's flammability/ combustibility. A material is flammable if it has a flash point less than—or equal to—141 degrees Fahrenheit. This characteristic has already been presented on the label by the "flammable" hazard pictogram, but it is reinforced in the label's Emergency Overview by the word "flammable." Similarly, the word "combustible" appears in the Emergency Overview if the flash point is greater that 141 degrees Fahrenheit, but less than 200 degrees Fahrenheit. (Note that these classifications for "flammable" and "combustible" are adapted from DOT criteria). The Emergency Overview statement may not actually include the words "flammable" or "combustible." Be careful though! The material may still be flammable or combustible. For example, many materials burn when exposed to temperatures greater that 200 degrees Fahrenheit.

To determine if the material is flammable or combustible, first turn to the Emergency Overview statement in MSDS section 3, Hazards Identification. If nothing regarding the material's flammability is found in this statement, you need to compare the flammability characteristics described earlier (i.e., flash points) to the material's flammability related physical properties. The flash point, LFL and UFL for a material will generally be located in MSDS section 5, Fire Fighting Measures. While reviewing Fire Fighting Measures you should also be on the look-out for statements indicating a high degree of flammability (i.e. "readily ignitable" or "burns vigorously and persistently). Also review MSDS section 10, Stability and Reactivity, for any data that refer to the material's flammability.

g. Step 3: Is There Special Hazards?

Finally, if space permits, the label's Emergency Overview should reinforce and emphasize other special hazards shown on the fire diamond, the hazards shown in the hazard pictograms, and any other material-specific hazards that has not already been addressed in this Emergency Overview. Compare the Emergency Overview statement in MSDS section 3, Hazards Identification, and see if the label's Overview is missing special hazards. Examples of special hazards are: 1) Explosivity; 2) If the material is an oxidizer; and 3) Whether it reacts with water.

6. Target Organ Pictograms (*Eyes, Skin,…*)

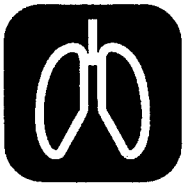


Fifteen different target organ pictograms quickly show the user what parts of the body are most affected by the material. A maximum of six target organ pictograms can be listed on Genium's

model label format. If more than six target organs were found to exist for a material in Genium's model label collection, the six most important were chosen based on the frequency and severity of the effects. Target organ pictograms are just guidelines; the MSDS should always be consulted for complete information on organs that may be affected by the material. Target organ pictograms are shown as follows:

Eyes

Skin



Respiratory System

Mucous Membranes

Gastrointestinal System

Nervous System

Liver

Kidneys

Cardiovascular System

Blood

Bone

Teeth

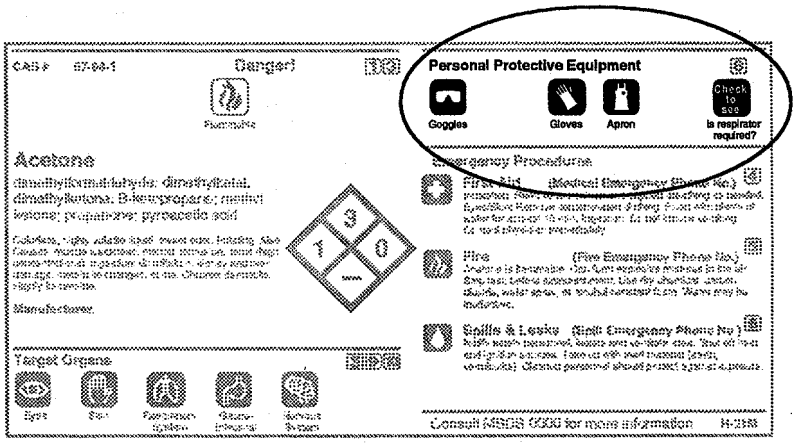
Lymphatic System

Reproductive System

Glandular System

Consult the following MSDS sections for information about target organs:
Section 3, Hazards Identification – target organs, acute effects, chronic effects, emergency overview
Section 11, Toxicological Information

7. PPE (*Goggles, Gloves,…)*



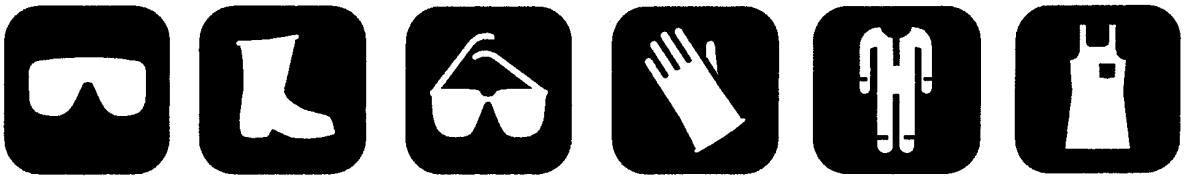
a. PPE Recommendation Criteria Used for Genium's Label Data Information

PPE recommendations in Genium's collection of model chemical container labels are given for worst case exposures. There may be many situations when only very small quantities are being used and PPE requirements will naturally be less stringent. It must be the responsibility of the safety officer or other qualified person in charge of printing the labels to decide what the PPE needs are for a particular situation.

For the purposes of Genium's labels, worst case will refer to exposures well above OSHA, ACGIH, or NIOSH recommended levels. In general, a competent safety officer, industrial hygienist, or occupational physician would deem these exposure levels dangerous to the health of their workers.

PPE information is generally found in section 8 of the MSDS, Exposure Controls/Personal Protection, but you should also review the Emergency Overview statement in MSDS section 3, Hazards Identification; MSDS section 7, Handling and Storage; MSDS section 8, Physical and Chemical Properties; and MSDS section 10, Stability and Reactivity, for specific material characteristics that will help determine the appropriate PPE.

b. PPE Pictograms



Full-Face Respirator | **Full-Face Air Line Respirator** | **Dust Mask** | **Face Shield** | **Cartridge Respirator** | **Air Line Respirator**

Genium presents the suggested Personal Protective Equipment (PPE) as pictograms. Six types of PPE pictograms can be presented. PPE pictograms used by Genium and their position on the label are as follows:

1) **Eye Protection** – Choices: Safety Glasses, Goggles
   Safety Glasses PPE pictogram – Safety glasses are recommended for nuisance dusts and for materials that are "mildly irritating" to the eyes
   Goggles PPE pictogram – Goggles are recommended for materials that are liquids and materials that are "irritating," "severely irritating," or "corrosive" to the eyes and for compressed gases that may cause frostbite.

2) **Face Protection** – Choices: Faceshield
   Faceshield PPE pictogram – A faceshield is recommended is the material is "corrosive."

3) **Hand Protection** – Choices: Gloves
   Gloves PPE pictogram – Genium always recommends that gloves be worn. However, because gloves are made from many different materials, permeation rates will vary and/or the glove material may be incompatible with the material being handled. The MSDS should be consulted to make certain that the most appropriate gloves are used. Many gases (**cryogenic gas/liquids**) are contained in a pressurized cylinder. These gases become liquids under pressure or when at extremely low temperatures (e.g., liquid nitrogen). As a result, release of these low temperature, compressed gases can cause frostbite. Gloves are therefore recommended for protection.

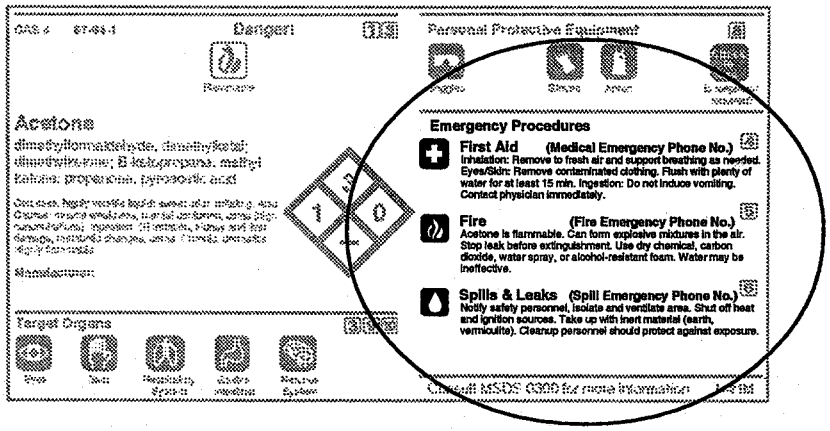
4) **Body Protection** – Choices: Apron, Full Suit
   Apron PPE pictogram – If a full suit is not recommended, generally an apron should be substituted. Gases that are only simple asphyxiant hazards (and not frostbite hazards) are the only materials for which Genium does not suggest a body protection PPE.
   Full Suit PPE pictogram – A full suit is always recommended if a material is "corrosive" to the skin. A full suit is also recommended for materials that are absorbed through the skin and are "highly toxic" or "toxic" to organs within the body. For some materials, the exposure potential (amount of material being used, possibility of skin contact) dictates if a full suit should be worn. Our own approach is conservative, we recommend a full suit, even though there are particular situation involving the material when use of a full suit is not warranted.

5) **Foot Protection** – Choices: Boots
   Boots PPE pictogram – The criteria for recommending boots and a full suit are the same. If the full suit PPE pictogram appears on the label, then the boots PPE pictogram will also appear, and vice versa.

6) **Respiratory Protection** – Choices: "check to see if respirator is needed," Dust Mask, Cartridge Respirator, Airline Respirator, Full Face or Airline Respirator, Full Face Respirator
Respirator PPE pictogram – Genium has included no respirator recommendations on its label data information. It is because it is EXTREMELY IMPORTANT that the user find out which respirator, if any, should be used. Genium has placed a warning pictogram "check to see if respirator is needed" on the label data information. For most materials there are many possible respirator recommendations; the choice depends on the potential exposure levels. In that there are so many possible situations, Genium is not able to provide a *single* PPE respirator recommendation for each material. The MSDS should be consulted before selecting the appropriate respirator.

8. Emergency Procedures (*First Aid Inhalation: Remove to fresh air…*)

Next is a series of three highly structured Emergency Procedures. Information is presented in a specific order and, as much as possible, the same wording is always used for recommended actions.



a. First Aid

1) First Aid Statement

This statement describes the basic first aid steps to take should someone become exposed to the material. Standard first aid procedures should always prevail and will be followed. For example, you should never give anything by mouth to an unconscious or convulsing person. The label information, then, includes only material-specific first aid information. Consult the MSDS for additional first aid procedures. It is always a good idea to have the person evaluated by qualified medical personnel even after first aid steps have been taken.

The first aid statement is structured as follows:

Inhalation The first item in this statement is the prompt "Inhalation:" This is followed by information about the first aid steps to take if a person inhales this material. Generally, this includes the statement "Remove to fresh air and support breathing as needed." Since space is limited to the first aid statement area, this statement may be edited to "Remove to fresh air." There may also be other information specific to the material. Information for this part of the statement can be found in MSDS section 4, First Aid Measures.

Eyes/Skin The next item in this statement is the prompt "Eyes/Skin:" This is followed by a description of the first aid steps to take if the material contacts a person's eyes or skin. Information for this part of the statement can be found in MSDS section 4, First Aid Measures, but as noted after some of the statements listed below, other sections of the MSDS should be consulted for material specific information. Common statements found in this area are:

- "Remove contaminated clothing" (This should be done almost all cases of contact exposure. As a result, if the space was needed for other first aid information, this statement does not appear. It is assumed that this first aid step will be taken.)

- "Flush with flooding amounts of water for at least 15 minutes," "flush with plenty of water," "this should prevent any adverse reaction" are first aid instructions that apply to many materials. If a material is water soluble it is important that the flushing with water process continue for 15 minutes. If the material is at all water reactive it is important that plenty of water be used so that adverse reactions are minimized. Consult MSDS section 9, Physical and Chemical Properties; section 3, Hazard Identification; and section 10, Stability and Reactivity.)

- "Flush eyes with tepid (104 degree F) water," "Immerse affected skin in tepid (104 degree F) water until completely rewarmed" are first aid instructions that apply to situations where the material is a compressed gas that causes frostbite upon contact with the eyes or skin. (Consult MSDS section 3, Hazard Identification; and MSDS section 9, Physical and Chemical Properties.)

- "Thoroughly wash skin with soap and water" are first aid instructions that apply to water insoluble materials, and many other materials that dissolve slowly in water or are not water reactive. (Consult MSDS section 3, Hazard Identification; and MSDS section 9, Physical and Chemical Properties.)

There may also be other information specific to the material.

Ingestion Following the prompt "Ingestion" should be information about which first aid steps to take should someone ingest the material. Information for this part of the statement can be found in section 4, First Aid Measures, but as noted after some of the statements listed below, other sections of the MSDS should be consulted for material specific information. Common statements found in this area are:

- "Do not induce vomiting," followed by either "Consult physician," or "Contact physician immediately." "Consult physician applies to less hazardous materials, especially those materials where vomiting is not necessary. "Contact physician immediately" applies to the more hazardous materials, especially materials that may be hazardous but vomiting might cause more injury to the gastrointestinal tract, or be a choking hazard. (Consult MSDS section 3, Hazard Identification; and the fire diamond health rating.)

- "Consult physician before inducing vomiting" is a statement that is used when vomiting may be a recommended first aid step and the material is not particularly hazardous. (Consult MSDS section 3, Hazard Identification; and the fire diamond health rating.)

- "Induce vomiting as directed by physician" is a statement that is used when vomiting may be a recommended first aid step and the material is hazardous. (Consult MSDS section 3, Hazard Identification; and the fire diamond health rating.)

- "Unlikely" is used only if the material is a gas or a material with a characteristic that you make it impossible to ingest, e.g., "immediately burns upon exposure to air." (Consult MSDS section 3, Hazard Identification; and MSDS section 9, Physical and Chemical Properties.)

There may also be other first aid information specific to the material.

2) First Aid Phone Number

If there is space on the label and there is a specific first aid number that should be called, Genium suggests that it be inserted at this point on the label. Life-saving minutes could be saved.

b. Fire 

1) Fire Procedure Statement

The statement describes basic fire procedure information for this material. It is assumed that fire fighters will follow standard operations procedures for fire fighting, such as wearing a SCBA. As a result, the information here shows only material-specific fire fighting information. Information for this fire procedure statement can generally be found in MSDS section 5, Fire-Fighting Measures, but as noted after some of the statement listed below, other sections of the MSDS should be consulted for material-specific information.

The fire statement is structured as follows:

The first piece of information pertains to the material's burning characteristic. One of three words may appear in the first statement:

"noncombustible"	- the material does not burn. (Consult the fire diamond fire rating, should be a zero if the material is noncombustible)
"flammable"	- material has a flash point less than or equal to 141 degrees Fahrenheit. (Note: In developing the physical hazard pictograms and emergency overview for the label for this material you have already determined this characteristic.)
"combustible"	- material has a flash point greater than 141 degrees Fahrenheit, but less than 200 degrees Fahrenheit. (Note: In developing the physical hazard pictograms and emergency overview for the label for this material you have already determined this characteristic.)

If none of these three words appear, it generally means that the material will burn, but not in accordance with the criteria that would classify the material as noncombustible, flammable, or combustible. (Consult the fire diamond fire rating.)

- "However, it is a strong oxidizer capable of igniting combustibles" appears next for some materials. This statement applies only if the material is noncombustible and the fire diamond special field contains the symbol OX.

- If a material is explosive and/or pyrophoric, that is stated next. (Consult section 3, Hazard Identification, Emergency Overview; and the fire diamond special rating.)

- One of the following phrases may appear next:
  "Stop flow of gas" will appear if the material is a compressed gas. (Note: The physical hazard pictograms for this material which were developed earlier will provide this information.)

- "Use agent suitable for surrounding fire" will appear if the material is noncombustible.

- Next is the fire fighting information (unless the material is noncombustible). This information will consist of agents that should be used to fight fires and other material specific fire fighting information. Because of the limited space on the label, the MSDS should always be consulted for fire fighting information.

- Finally, if space permits, any of the following phrases, or similar phrases, may appear in this section if they apply to fires involving this material:

  "Do not use water to extinguish fire" applies to materials where the fire diamond special field contains the *no water* symbol.

  "Fight fire from maximum distance" generally applies to materials with a fire diamond fire rating of 3 or 4.

  "Remove cylinder from fire to prevent rupture due to heat" applied to compressed gases.

  "Let fire burn if leak can't be stopped" applies to some compressed gases.

  "Water may be used, but will generate excess heat"

  "Material will float and may re-ignite on water surface"

  "Fire may be difficult to extinguish and may re-ignite"

  "Do not scatter with a high pressure water stream"

  "Material can burn in oxygen deficient atmospheres"

(Consult MSDS section 3, Hazard Identification, Emergency Overview; MSDS section 6, Accidental Release Measures; MSDS section 10, Stability and Reactivity; and MSDS section 13, Disposal Considerations.)

b. Spills & Leaks 

1) Spills & Leaks Statement

This statement outlines the basic precautions and procedures to follow in case of a spill or leak. Information for this spills & leaks statements can generally be found in MSDS section 6, Accidental Release Measures, but as noted after some of the statements listed below, other sections of the MSDS should be consulted for material specific information.

The spills & leaks statement is structured as follows:

- "Notify safety personnel, isolate and ventilate area, deny entry, stay upwind" is the first statement. Genium believes that a statement like this should appear on every label. This quickly reminds people of standard safety precautions that should be taken in all spill/leak incidents.

- Next will be the phrase "Shut off ignition sources" if the material is flammable, combustible, or explosive. (Note: The fire procedure statement for this material, which was developed earlier, will provide this information.)

- Next will be the phrase "Remove combustibles" if the material is an oxidizer, which means that the symbol OX appears in the fire diamond special field.

- Next will be the phrase "Shut off water sources" if the material is water reactive, which means that the *no water* symbol appears in the fire diamond special field.

- "Shut off gas" or a similar statement will be the next phrase if the material is a compressed gas. (Note: The physical hazard pictograms for this material, which were developed earlier, will provide this information.)

- Next will be the neutralizing information as contained in the MSDS, section 6, Accidental Release Measures. Because space is limited, this information may need to be condensed. Users of the material should always be instructed to consult the MSDS for more detailed neutralizing information.)

- For most solids the statement "DO NOT SWEEP! Carefully scoop up or vacuum (with a HEPA filter). Damp mop residue" will appear next. If the solid is not water soluble, then the "Damp mop residue" portion of the statement may have been removed. (Consult MSDS section 9, Physical and Chemical Properties.)

- For most liquids the statement "Take up with inert material such as sand or vermiculite" will appear next. (MSDS section 9, Physical and Chemical Properties.)

- Next, if space permits, will be other information specific to the material.

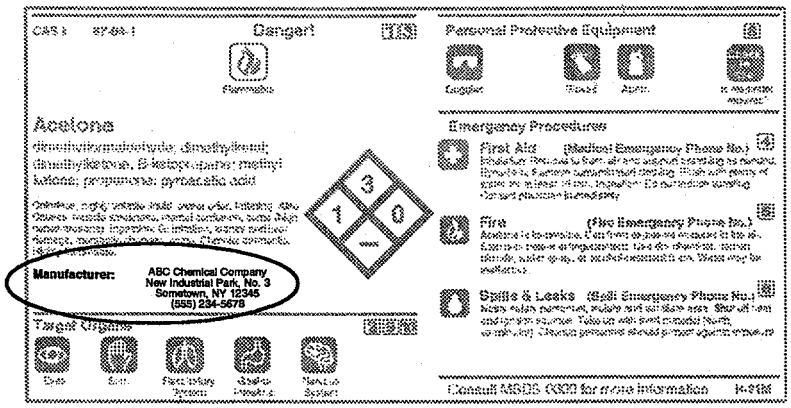
Genium suggests that the last statement always be "Cleanup crew should protect against exposure" (or "Protect against exposure" if space is limited. While this precaution is much more important for some hazardous materials, it is an appropriate step to take when dealing with spills and leaks of any hazardous chemical.

2) Spills & Leaks Phone Number

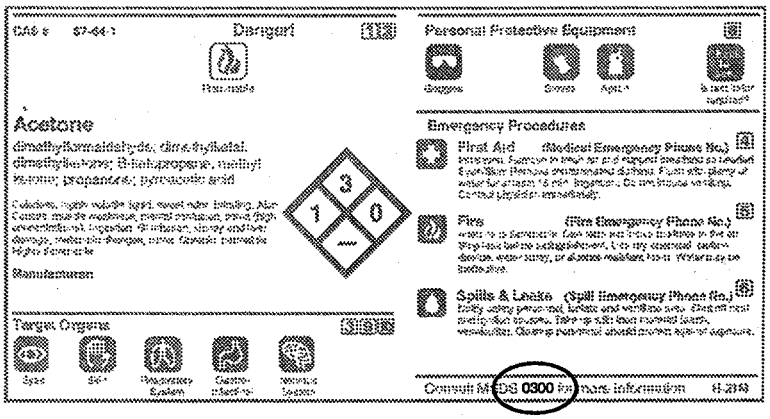
If there is space on the label and there is a specific number that should be called in the case of a spill or leak, Genium suggests that it be inserted at this point on the label.

9. Manufacturer Information

The label should also list the name, address and phone number of the manufacturer of the chemical to use in case of emergency.



10. Label Number



It is a good idea to assign a unique number to each material for record keeping purposes. For example, Genium assigns the same number to a given material in both its label data collection and its MSDS collection.

III. THE MSDS, SOURCE OF ALL LABEL INFORMATION

MSDSs were initially written for health and safety professionals and trained workers in the chemical industry. The information was usually very technical, and the type of information and formats varied from supplier to supplier. As Federal and state right-to-know regulations expanded, a wider audience with diverse backgrounds needed MSDSs. Reading and understanding the various MSDSs became a difficult task for many.

A few years ago the Chemical Manufacturers Association (CMA) began working on a standard to develop consistent and understandable MSDSs that would be easily recognized in the U.S., Canada, and Europe. This standard, also accepted by ANSI (American National Standards Institute), does not fulfill every country's legal requirements, but it does proved consistent and useful information to a variety of audiences, from the worker on the shop floor to the physician treating an exposure victim.

Specific legal requirement for an MSDS in the U.S. are addressed in OSHA's Hazard Communication standard, and are covered in the first 10 of 16 total sections of the ANSI standard. It's not yet known whether OSHA will adopt the ANSI standard and revise the HCS requirements to reflect this new MSDS format. Remember, ANSI standards, although well-respected and followed by most industries, are *recommendations*. OSHA standards are *law*.

Currently, according to OSHA's Hazard Communication standard, MSDSs must include:

- The material's identity, including its chemical and common names (example, brand name: *Clorox* ™; chemical name: *sodium hypochlorite*; common name: *bleach*).
- Hazardous ingredients (even in parts as small as 1%).
- Cancer-causing ingredients (even in parts as small as 0.1%).
- List of physical and chemical hazards (stability, reactivity) and characteristics (flammable, explosive, corrosive, etc.).
- List of health hazards, including:
  - Acute effects such as burns or unconsciousness, which occur immediately.
  - Chronic effects such as allergic sensitization, skin problems, or respiratory disease, which build up over a period of time.
- If the material is listed as a carcinogen by OSHA, IARC, or NTP.
- Limits to which a worker can be exposed, the primary routes of entry of into the body, specific target organs likely to sustain damage, and medical problems that can be aggravated by exposure.
- Precautions and safety equipment.
- Emergency and first aid procedures.
- Specific fire fighting information.
- Procedures for cleanup of spills and leaks.
- Precautions for safe handling and use, including personal hygiene.
- Identity of the organization responsible for creating the MSDS, date of issue, and emergency phone number.

The last six sections of the ANSI standard include toxicological (animal data), ecological, disposal, transport, and regulatory information, as well as a section for other information. Because these last sections are not required by OSHA, manufacturers may choose not to include this information on their MSDSs. However, this information may be required internationally. For consistency, the ANSI standard recommends that the headings be listed even in the absence of data, and that the company print either *data not given* or *data not available*. Alternatively, some manufacturers may

choose to provide this information in different ways, such as by listing a telephone number or issuing bulletins. The ANSI standard also allows some flexibility in placing the information within the 16 sections. For example, exposure guidelines, such as OSHA PELs or ACGIH TLVs, may be placed in Section 2-Composition/Information on Ingredients, or in Section 8-Exposure Controls/Personal Protection.

The law states very clearly that the manufacturer/supplier must include complete data on the MSDS. If you feel that an MSDS is incomplete, or you don't fully understand it, the sheet may be returned to the manufacturer/supplier with a request for a better sheet. If you encounter a material with which you're unfamiliar, immediately read its MSDS for precautions, and then scan the sheet for health and physical hazards. But remember, to be completely informed about the material, you must read and understand the whole sheet.

In the Appendix are descriptions of the sixteen sections of an MSDS according to the ANSI standard and notes that will help you find and interpret the information on a typical good-quality MSDS.

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Material Safety Data Sheet Collection

Potassium Cyanide **MSDS No. 13**

Date of Preparation: 9/77 Revision: E, 3/97

Section 1 - Chemical Product and Company Identification 49

Product/Chemical Name: Potassium Cyanide **Chemical Formula:** KCN **CAS Number:** 151-50-8
Synonyms: AI3-28749; Caswell No. 688A; cyanide of potassium; hydrocyanic acid, potassium salt; M-44 capsules
Derivation: By absorption of hydrogen cyanide in potassium hydroxide.
General Use: In the extraction of gold and silver from ores; metal cleaning; heat treatment of metals; electroplating; as a reagent in analytical chemistry; raw material in the manufacture of dyes, pigments, nylon, and chelating agents; an insecticide; and a fumigant.
Vendors: Consult the latest *Chemical Week Buyers' Guide.* (73)

Section 2 - Composition / Information on Ingredients

Potassium Cyanide, ca 95 % wt (commercial); other grades include pure, solution, and reagent.
Trace Impurities: potassium carbonate, formate, and hydroxide.

OSHA PEL
8-hr TWA: 5 mg/m^3

IDLH Level
25 mg/m^3 (as CN)

ACGIH TLV
Ceiling: 5 mg/m^3, *skin*

DFG (Germany) MAK
TWA: 5 mg/m^3, total dust, danger of cutaneous absorption
Category II: Substances with systemic effects, onset of effect ≤2 hr, half-life <2 hr

NIOSH REL
10-min TWA Ceiling: 4.7 ppm (5 mg/m^3)

Peak Exposure Limit:
10 mg/m^3, 30 min, average value, 4 per shift

Section 3 - Hazards Identification

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Potassium cyanide occurs as white, amorphous, deliquescent lumps or a crystalline mass with a faint odor of bitter almonds. It is poisonous and corrosive (causes severe skin and eye burns). Potassium cyanide reacts with water or any acid-releasing flammable and highly toxic hydrogen cyanide gas.

Wilson Risk Scale
R 1
I 3
S 3*
K 1
* Skin absorption

HMIS
H 3*
F 0
R 0
PPE†
*Chronic Effects
†Sec. 8

Potential Health Effects

Primary Entry Routes: Inhalation; skin absorption; skin and/or eye contact; ingestion.
Target Organs: Eyes; skin; upper respiratory, cardiovascular, and central nervous systems; thyroid; blood.
Acute Effects
Inhalation: Irritation of the nose and throat and systemic symptoms like those seen via ingestion may also be caused by absorption through the mucous membranes. Nose irritation leading to obstruction, bleeding, sloughs, and in some cases septum perforation has been reported in workers in the electroplating industry.
Eye: Irritation and possible burns. Dilated pupils are common in severe poisoning. Corneal edema (swelling) may occur. Human poisoning cases due to eye exposure only have not been reported.
Skin: Itching, irritation, discoloration (bright pink color), dermatitis, rash, or corrosion (burns) may occur. Systemic symptoms like those seen via ingestion may also be caused by skin absorption. Mild systemic symptoms such as headache and dizziness have been caused by solutions as dilute as 0.5% potassium cyanide.
Ingestion: Chemical asphyxia and death may occur without warning from severe exposure. Initial symptoms of lesser exposure include burning, acrid, bitter taste upon ingestion, weakness, headache, flushing, dizziness, confusion, salivation, nausea and vomiting, hyperventilation, bradycardia (slowed heart beat), hypertension (high blood pressure), and anxiety. These may progress to increased rate and depth of respiration, slow and gasping respiration, pulmonary edema (fluid in lungs), lactic acidosis (abnormal accumulation of lactic acid in the blood resulting in a metabolic derangement), stupor, seizures, coma, apnea (absence of breathing), tachycardia (rapid heart beat), hypotension (low blood pressure), and death.
Carcinogenicity: IARC, NTP, and OSHA *do not* list potassium cyanide as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: Disorders of the skin, thyroid, and cardiovascular, upper respiratory, and central nervous systems.
Chronic Effects: Dermatitis, scarlet rash and papules, and itching have been reported in workers in the electroplating industry. Other symptoms may include headache, weakness, nausea, dizziness, loss of appetite, insomnia, memory loss, tremors, functional changes in hearing, enlarged thyroid gland, folate abnormalities, palpitations, chest discomfort, upper respiratory tract irritation, nose bleeds, and eye irritation.

Section 4 - First Aid Measures

Note! In all cases of exposure where absorption may occur (i.e., inhalation, skin contact, and ingestion), administer 100% oxygen immediately and obtain and prepare the cyanide antidote kit for use in symptomatic patients.

Inhalation: *Note!* The odor of bitter almonds may be noted on the breath or vomitus. Remove exposed person to fresh air and immediately begin therapy with 100% oxygen.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist immediately if irritation or pain develop.

Skin Contact: *Quickly* remove contaminated clothing. Speed is extremely important. Rinse with flooding amounts of water for at least 15 min. Wash exposed area extremely thoroughly with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, *do not* induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Determine hemoglobin, arterial blood gases, venous pO_2 or measured versus $\%O_2$ saturation, serum lactate, electrolytes, and whole blood cyanide levels. If the victim is unconscious, bradycardia and absence of cyanosis may be key diagnostic signs. For cases of ingestion, perform gastric lavage with a large bore tube after endotracheal intubation.

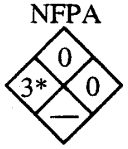
Special Precautions/Procedures: To prevent self-poisoning, avoid mouth-to-mouth resuscitation during CPR. To avoid becoming secondary victims, do not enter areas with high potential airborne concentrations without donning a self-contained breathing apparatus (SCBA). Give specific and detailed instructions on the use of cyanide antidote kits to all persons working with and around potassium cyanide.

Section 5 - Fire-Fighting Measures

Flash Point: Noncombustible **Autoignition Temperature:** None reported.

LEL: None reported. **UEL:** None reported.

NFPA



Extinguishing Media: Use extinguishing media suitable for surrounding fire. Do not use carbon dioxide extinguisher; this can liberate hydrogen cyanide by the action of the dissolved carbon dioxide. Water may be used on surrounding fires *not* involving potassium cyanide. Use alkali dry chemical. Keep fire-exposed containers cool with water spray.

Unusual Fire or Explosion Hazards: Potassium cyanide reacts with water or any acid-releasing flammable hydrogen cyanide.

Hazardous Combustion Products: Nitrogen oxides and cyanide.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.

Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing is *not* effective for potassium cyanide.

*According to NFPA criteria, Genium would rate the health hazard a 4 based on the Rat, oral, LD_{50} of 5 mg/kg.

Section 6 - Accidental Release Measures

Spill /Leak Procedures: Notify safety personnel immediately, evacuate all unnecessary personnel, and isolate and ventilate area. Cleanup personnel should wear fully-encapsulating protective clothing to protect against inhalation, skin and eye contact.

Small Spills: Carefully scoop up the spilled potassium cyanide and place in dry containers for disposal or reclamation. For potassium cyanide solution spills, take up with a noncombustible, absorbent material such as sand or vermiculite and place in containers for later disposal. Neutralize with a strong alkali solution of calcium hypochlorite.

Cleanup: Prompt cleanup and removal are necessary. To avoid generating dust, *do not* sweep! Remove residue by vacuuming (with an appropriate HEPA filter) or mopping with a liberal quantity of water.

Large Spills Containment: For large dry spills, cover with a plastic sheet to avoid dust dispersion until later disposal. For large solution spills, dike far ahead for later disposal. Do not release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all contact with potassium cyanide. Use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Wear appropriate personal protective equipment to protect against skin and eye contact. Make cyanide antidote kits readily available in all areas where potassium cyanide is used. Replace ingredients of kits every 1-2 yr to ensure freshness. Practice good personal hygiene procedures to avoid inadvertently ingesting potassium cyanide.

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from light, acids, water, carbon dioxide, and other incompatibles (Sec. 10). Outside or detached storage is preferred. Protect from physical damage. Keep containers covered or in an exhausted hood when not in use.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose all operations to avoid dust dispersion into the workplace.
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.
Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the cardiovascular, upper respiratory, and nervous systems, skin, and thyroid. Maintain pertinent medical records for 5 years following the last exposure. Educate workers about the hazards of potassium cyanide and train in emergency first aid procedures for cyanide poisoning.
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations ≤ 25 mg/m^3, wear a supplied-air respirator or any SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program.
Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl chloride, Neoprene, butyl rubber, fluoronitrile carbon rubber, nitrile rubber, and chlorinated polyethylene are recommended materials for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove potassium cyanide from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using potassium cyanide, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance and Odor: White lumps or colorless crystals; faint odor of bitter almonds.
Vapor Pressure: about 0 mm Hg at 68 °F (20 °C)
Formula Weight: 65.11
Specific Gravity (H_2O=1, at 4 °C): 1.55
pH (0.1N aqueous solution): 11.0
Water Solubility: Soluble
Other Solubilities: Soluble in 100 parts alcohol, soluble in 25 parts methanol, and soluble in 2 parts glycerol.
Boiling Point: 2957 °F (1625 °C)
Melting Point: 1173 °F (634 °C)
Refractive Index: 1.410

Section 10 - Stability and Reactivity

Stability: Potassium cyanide is stable at room temperature in closed containers under normal storage and handling conditions. It absorbs moisture and carbon dioxide from the air and slowly decomposes.
Polymerization: Hazardous polymerization cannot occur.
Chemical Incompatibilities: Potassium cyanide is incompatible with acids (releases highly toxic hydrogen cyanide gas), metallic salts, permanganates, peroxides, perchloryl fluoride, chlorates (potassium cyanide and sodium chlorate explode when heated), nitrites, oxidizing agents, nitrogen trichloride, iodine, alkaloids, ammoniacal silver, mercury (II) nitrate, and chromium tetraoxide. Hydrogen cyanide gas is also released when sodium cyanide is dissolved in and reacts with water. However, unless this occurs in a closed space, the amount is too small to be hazardous. Potassium cyanide also reacts with carbon dioxide in the air to release hydrogen cyanide gas.
Conditions to Avoid: Avoid contact with acids, water, and other incompatibles.
Hazardous Decomposition Products: Thermal oxidative decomposition of potassium cyanide can produce nitrogen oxides and cyanide gas.

Section 11- Toxicological Information

Toxicity Data:*

Acute Oral Effects:
Human, oral, LD_{Lo}: 2857 µg/kg
Man, oral, TD_{Lo}: 13699 µg/kg caused convulsions or effect on seizure threshold, coma, and metabolic acidosis.

Reproductive Effects:
Rat, oral: 65 g/kg administered to a female 14 days prior to mating and during the 1-22 day of pregnancy caused toxic effects on fertility.

Acute Oral Effects: ***continued***

Woman, oral, TD_{Lo}: 100 mg/kg caused convulsions or effect on seizure threshold, increased pulse rate without fall in blood pressure, and blood pressure lowering not characterized in autonomic section.

Rat, oral, LD_{50}: 5 mg/kg

Other Multiple Dose Toxicity:

Rat, oral: 31500 mg/kg/50 weeks/continuous caused changes in urine composition and thyroid weight and weight loss or decreased weight gain.

Genetic Effects:

Mouse, lymphocyte: 1 mmol/L caused DNA inhibition.

* See NIOSH, *RTECS* (TS8750000), for additional toxicity data.

Section 12 - Ecological Information

AquaticToxicity: TLm (fresh water Bluegill): 0.16 ppm for 48 hr; TLm (salt water adult Zebrafish): 0.49 ppm for 48 hr

Environmental Fate: Potassium cyanide will readily dissociate in water and may then form hydrogen cyanide or react with various metals present in natural water. Complex metallocyanides may form if the cyanide ion is present in excess, but if metals are prevalent, simple metal cyanides may form. Bioconcentration: 0.3 (calculated from water solubility by regression equations).

Soil Absorption/Mobility: 3.0 (calculated from water solubility by regression equations).

Section 13 - Disposal Considerations

Disposal: Add potassium cyanide with stirring to a strong alkaline solution of calcium hypochlorite. Let stand 24 hr and route to sewage plant (only with approval from local municipality). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Container Cleaning and Disposal: Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Potassium cyanide
Shipping Symbols: —
Hazard Class: 6.1
ID No.: UN1680
Packing Group: I
Label: Poison
Special Provisions (172.102): B69, B77, N74, N75, T18, T26

Packaging Authorizations
a) Exceptions: None
b) Non-bulk Packaging: 173.211
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger, Aircraft, or Railcar: 5 kg
b) Cargo Aircraft Only: 50 kg

Vessel Stowage Requirements
a) Vessel Stowage: B
b) Other: 52

Section 15 - Regulatory Information

EPA Regulations:

Listed as a RCRA Hazardous Waste (40 CFR 261.33)
RCRA Hazardous Waste Number: P098
Listed as a CERCLA Hazardous Substance (40 CFR 302.4) per RCRA, Sec. 3001 and CWA, Sec. 311 (b)(4)
CERCLA Reportable Quantity (RQ), 10 lb (4.54 kg)
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a SARA EHS (Extremely Hazardous Substance) (40 CFR 355), Threshold Planning Quantity (TPQ): 100 lb

OSHA Regulations:

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1)

Section 16 - Other Information

References: 73, 103, 124, 136, 149, 167, 176, 197, 200, 209, 210, 212

Prepared By: MJ Wurth, BS
Industrial Hygiene Review: PA Roy, MPH, CIH
Medical Review: R Teichman, MD

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CAS # 7664-41-7 **Danger!** [1][3]

Corrosive | Compressed Gas

Anhydrous Ammonia

ammonia; ammonia anhydrous

Colorless gas with a strong, suffocating odor. Causes skin, eye, and respiratory tract burns. May cause blindness. Exposure to high levels may be fatal. Potential explosion hazard in confined space. Use sufficient ventilation to prevent vapor build-up.

Manufacturer:

Target Organs [3][9][10]

Eyes | Skin | Respiratory System

Personal Protective Equipment [8]

Goggles | Face Shield | Gloves | Full Suit | Boots | Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air. Eyes/Skin: Flush with flooding amounts of water for at least 15 min. Ingestion: Ingestion of gas is unlikely. For aqueous solutions, do not induce vomiting. Consult physician immediately.

Fire [5]
Stop flow of gas. Use CO_2 or dry chemical to extinguish flame at gas valve. Use water spray to protect personnel shutting off gas. Remove cylinders from fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry. Shut off gas and ignition sources. Cleanup crew must protect against inhalation, skin and eye contact. Use water spray to reduce vapor.

Consult MSDS 0001 for more information **H-21M**

CAS # 1336-21-6 **Danger!** [1][3]

Corrosive

Ammonium Hydroxide

ammonia aqua; ammonium hydrate; ammonia water; Spirits-of-Hartshorn

Colorless liquid with a strong, suffocating odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Toxic! May cause blindness. Exposure to high levels may be fatal.

Manufacturer:

Target Organs [3][9][10]

Eyes | Skin | Respiratory System | Mucous Membranes | Gastro-intestinal

Personal Protective Equipment [8]

Goggles | Face Shield | Gloves | Full Suit | Boots | Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air. Eyes/Skin: Flush immediately with flooding quantities of water for at least 15 min. Ingestion: Do not induce vomiting. Consult a physician immediately!

Fire [5]
Vapor may burn. Extinguish with dry chemical, water spray, carbon dioxide, or regular foam.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Take up with absorbent, inert material (earth, sand, vermiculite). Neutralize large spills with sodium bicarbonate. Cleanup crew should protect against exposure.

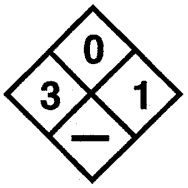
Consult MSDS 0001A for more information **H-21M**

CAS # 1310-58-3 **Danger!** [1][3]

Corrosive

Potassium Hydroxide

caustic potash; lye; potassium hydrate



White or slightly yellow deliquescent pellets, rods, or lumps. Corrosive, causes severe burns to eyes/skin/respiratory tract. Toxic! May cause serious lung damage. Repeated skin contact can cause dermatitis. Reacts with water producing excessive heat.

Manufacturer:

Target Organs [3][9][10]

Eyes | Skin | Respiratory System | Mucous Membranes | Gastro-intestinal

Personal Protective Equipment [8]

Goggles | Face Shield | Gloves | Full Suit | Boots | Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Flush with flooding amounts of water for at least 15 minutes. Make sure slippery feeling is gone. Ingestion: Do not induce vomiting. Consult physician immediately.

Fire [5]
Use agents suitable for surrounding fire. However, avoid water: reaction of water + potassium hydroxide can produce enough heat to ignite combustibles.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Carefully scoop up or vacuum (with appropriate filter). Do not sweep! Damp mop residue with dilute acetic acid solution. Cleanup crew should protect against exposure.

Consult MSDS 0002 for more information **H-21M**

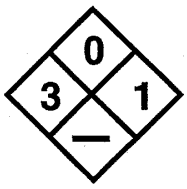
CAS # 1310-73-2 **Danger!** [1][3]


Corrosive

Sodium Hydroxide

caustic soda; soda lye; sodium hydrate

White, odorless, hydroscopic flakes, lumps, or pellets. Highly corrosive! Causes severe eye, skin, and respiratory tract burns. Repeated skin contact can cause dermatitis. Reacts with water producing excessive heat.



Manufacturer:

Target Organs [3][9][10]


Eyes, Skin, Respiratory System, Mucous Membranes, Gastro-intestinal

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Flush with flooding amounts of water for at least 15 minutes. Make sure slippery feeling is gone. Ingestion: Do not induce vomiting. Consult physician immediately.

Fire [5]
Use agents suitable for surrounding fire. However, avoid water: reaction of water + sodium hydroxide can produce enough heat to ignite combustibles.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Carefully scoop up or vacuum (with appropriate filter). Do not sweep! Cleanup crew should protect against exposure.

Consult MSDS 0003 for more information **H-21M**

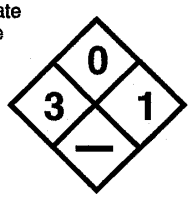
CAS # 1310-73-2 **Danger!** [1][3]


Corrosive

Sodium Hydroxide, 50% Liquid

soda lye; soda, lye solution; sodium hydrate solution; sodium hydroxide solution; white caustic solution

Clear liquid; odorless. Corrosive causes serious burns to eyes/skin/respiratory tract. Also Causes: temporary hair loss (nasal passages), pulmonary edema, permanent scarring, permanent corneal opacification. Chronic: dermatitis.



Manufacturer:

Target Organs [3][9][10]


Eyes, Skin, Respiratory System

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing. Eyes/Skin: Flush with flooding amounts of cold water for at least 15 minutes. Can become very hot when in contact with water. Ingestion: Do not induce vomiting. Contact physician immediately.

Fire [5]
Noncombustible. Water may be used, but will generate excessive heat. Use dry chemical, carbon dioxide, or regular foam.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Shut off water sources. Absorb small liquid spills with fly ash or cement powder. Neutralize spill with vinegar or dilute acid. Cleanup crew should protect against exposure.

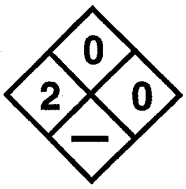
Consult MSDS 0003A for more information **H-21M**

CAS # 10043-35-3 **Caution** [1][3]

Boric Acid

boracic acid; hydrogen borate; orthoboric acid

Odorless, colorless crystals or white powder. Irritating to eyes/skin/respiratory tract. Can cause varying degrees of CNS, gastrointestinal and kidney toxicity. Chronic exposure can cause dry skin, eruptions, and GI disturbances.



Manufacturer:

Target Organs [3][9][10]


Eyes, Skin, Respiratory System, Gastro-intestinal, Nervous System, Kidneys

Personal Protective Equipment [8]

Goggles, Gloves, Apron, is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air. Eyes/Skin: Flush with flooding amounts of water for at least 15 minutes. This should prevent any adverse reaction. Ingestion: Contact physician immediately. Induce vomiting as directed by physician.

Fire [5]
Noncombustible. Use agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against dust inhalation. DO NOT SWEEP! Carefully scoop up or vacuum (with a HEPA filter).

Consult MSDS 0004 for more information **H-21M**

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CAS # 1333-82-0 **Danger!** [1][3]

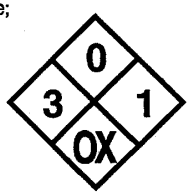
Corrosive

Chromic Acid

chromium anhydride; chromium (VI) oxide; chromium trioxide

Dark, purplish-red prisms deliquescent crystals or powder. Corrosive, causes severe burns to eyes/skin/respiratory tract. Toxic! Chronic: dermatitis, tooth erosion, nasal septum perforation. Strong oxidizer capable of igniting combustibles.

Manufacturer:



Target Organs [3][9][10]

Eyes Skin Respiratory System Liver Kidneys Teeth

Personal Protective Equipment [8]

Goggles Face Shield Gloves Full Suit Boots Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Flush with flooding amounts of water for at least 15 min. Ingestion: Do not induce vomiting. Do not neutralize. Contact physician immediately.

Fire [5]
Noncombustible. Use extinguishing media suitable for surrounding area.

Spills & Leaks [6]
Notify safety personnel. Isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should protect against exposure. Remove combustibles. Do not sweep! Damp mop spill or vacuum (appropriate filter).

Consult MSDS 0005 for more information **H-21M**

CAS # 7664-39-3 **Danger!** [1][3]

Corrosive

Hydrogen Fluoride

anhydrous hydrofluoric acid; hydrofluoric acid gas

Colorless gas; strong, irritating odor. Toxic. Corrosive. Also Causes: difficulty breathing, fever, cyanosis, pulmonary edema, nosebleeds, hypomagnesemia, cardiac arrhythmias, liver/kidney effects. Chronic: nasal congestion, bronchitis, fluorosis.

Manufacturer:

Target Organs [3][9][10]

Eyes Skin Respiratory System Cardio-vascular Bone

Personal Protective Equipment [8]

Goggles Face Shield Gloves Full Suit Boots Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Observe for pulmonary edema for 24 to 48 hr. Eyes/Skin: Flush with flooding amounts of water for at least 15 minutes. Apply topical fluoride-neutralizing agents. Ingestion: Unlikely.

Fire [5]
Noncombustible. Use agent suitable for surrounding fire. Keep water out of inside of containers because it evolves heat when in contact with water. Produces flammable hydrogen gas in contact with metals.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off gas. Otherwise, remove leaking cylinder to fume hood to empty. Tag as defective and return to supplier. Cleanup crew should protect against exposure.

Consult MSDS 0006 for more information **H-21M**

CAS # 7664-39-3 **Danger!** [1][3]

Corrosive

Hydrofluoric Acid, aqueous

fluohydric acid; fluoric acid; hydrogen fluoride, aqueous

Clear, colorless liquid. Corrosive, causes severe burns to eyes/skin/respiratory tract. Toxic! Pain may not be immediate, but begins as hydrogen fluoride penetrates deep to the bone. Chronic exposure can cause irreversible bone damage.

Manufacturer:

Target Organs [3][9][10]

Eyes Skin Respiratory System Mucous Membranes Bone

Personal Protective Equipment [8]

Goggles Face Shield Gloves Full Suit Boots Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air, support breathing. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Apply calcium gluconate (2.5%) to skin. Ingestion: Do not induce vomiting. Consult physician immediately!

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding area.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Neutralize spill with sodium carbonate/slaked lime mixture. Thoroughly wash all porous surfaces with ammonia. Cleanup crew should protect against exposure.

Consult MSDS 0006A for more information **H-21M**

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CAS # 7697-37-2 **Danger!** [1][3]

Corrosive

Nitric Acid

aqua fortis; azotic acid; hydrogen nitrate

Clear to yellow fuming liquid; acrid, suffocating odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Also Causes: heavy exposures: lung damage. Chronic: tooth erosion, bronchitis. Strong oxidizer capable of igniting combustibles.

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Mucous Membranes, Gastro-intestinal, Teeth

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air. Eyes/Skin: Flush with plenty of water for at least 15 min. Ingestion: Do not induce vomiting, give a cupful of water. Consult physician immediately.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Remove combustibles. Neutralize with sodium bicarbonate or lime. Take up with inert material such as sand or vermiculite. Cleanup crew should protect against exposure.

Consult MSDS 0007 for more information **H-21M**

CAS # 7664-38-2 **Danger!** [1][3]

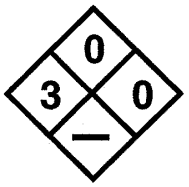
Corrosive

Phosphoric Acid

orthophosphoric acid

Viscous, water-white, odorless liquid. Corrosive, causes severe burns to eyes/skin/respiratory tract. Pain may not be immediate. Chronic: may cause upper respiratory disease.

Manufacturer:



Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Mucous Membranes, Gastro-intestinal

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Flush with plenty of water for at least 15 min. Ingestion: Do not induce vomiting. Give a cupful of water or milk. Consult physician immediately!

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding area.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Neutralize with soda ash or lime. Take up with inert material such as sand or vermiculite. Cleanup crew should protect against exposure.

Consult MSDS 0008 for more information **H-21M**

CAS # 7664-93-9 **Danger!** [1][3]

Corrosive

Sulfuric Acid

battery acid; hydrogen sulfate; sulphuric acid

Colorless to dark-brown, oil, odorless liquid. Corrosive, causes severe burns to eyes/skin/respiratory tract. May cause blindness. Chronic: tooth erosion, GI disturbances, and dermatitis. Reaction with water produces excessive heat.

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Mucous Membranes, Gastro-intestinal, Teeth

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Do not induce vomiting. Consult physician immediately.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding area. However, avoid water: contact with sulfuric acid can generate sufficient heat to ignite combustibles.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Neutralize with soduim bicarbonate. Take up with inert material such as sand or vermiculite. Cleanup crew should protect against exposure.

Consult MSDS 0009 for more information **H-21M**

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CAS # 8014-95-7 **Danger!** [1][3]

Corrosive

Oleum

disulphuric acid; dithionic acid; fuming sulfuric acid; pyrosulfuric acid

Oily, light yellow-brown liquid with sharp odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Toxic! May cause blindness! Chronic: tooth enamel erosion, bronchitis, gastritis. Contact with water causes a violent reaction.

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Mucous Membranes, Gastro-intestinal, Teeth

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Do not induce vomiting. Consult physician immediately.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding area. However, avoid water: contact with sulfuric acid can generate sufficient heat to ignite combustibles.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Neutralize with soduim bicarbonate.Take up with inert material such as sand or vermiculite. Cleanup crew should protect against exposure.

Consult MSDS 0009A for more information **H-21M**

CAS # 13775-80-9 **Caution** [1][3]

Hydrazine Hydrobromide

hydrazine monohydrobromide

White flakes with an ammonia odor. Irritating to eyes/skin/respiratory tract. Strong dermal sensitizer! Also Causes: can cause temporary blindness, nausea, dizziness and damage to the central nervous system, liver, kidneys, and blood.

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Nervous System, Liver, Kidneys

Personal Protective Equipment [8]

Goggles, Gloves, Apron, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Give a cupful of water. Do not induce vomiting! Consult physician.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Neutralize with dilute hydrochloric acid solution. Take up with inert material such as sand or vermiculite. Cleanup personnel should protect against exposure.

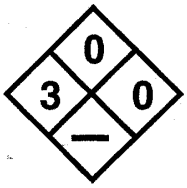
Consult MSDS 0010 for more information **H-21M**

CAS # 7784-30-7 **Danger!** [1][3]

Corrosive

Aluminum Phosphate

aluminophosphoric acid; aluminum acid phosphate; aluminum monophosphate; aluminum salt of phosphoric acid



Clear colorless liquid; odorless. Corrosive, causes severe burns to eyes/skin/respiratory tract. Avoid contact with metals - can release flammable hydrogen gas.

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Give a cupful of water. Do not induce vomiting! Consult physician.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Neutralize with dilute caustic solution. Take up with inert material such as sand or vermiculite. Cleanup personnel should protect against exposure.

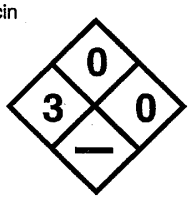
Consult MSDS 0011 for more information **H-21M**

CAS # 0544-92-3 **Danger!** [1][3]

Corrosive

Cuprous Cyanide

copper cyanide; copper (I) cyanide; cupricin



Varying forms: white powder, green orthorhombic crystals, red monoclinic crystals; slight, bitter almond odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Toxic! Causes chemical asphyxiation (lack of oxygen to tissues).

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Nervous System

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush eyes with plenty of water for at least 15 min. Wash skin thoroughly with soap and water. Ingestion: Do not induce vomiting! Consult physician.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Treat with strong sodium or calcium hypochlorite solution. Take up with inert material such as sand or vermiculite. Cleanup personnel should protect against exposure.

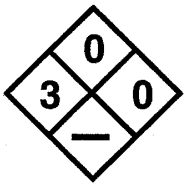
Consult MSDS 0012 for more information **H-21M**

CAS # 0151-50-8 **Danger!** [1][3]

Poison, Corrosive

Potassium Cyanide

cyanide of potassium; potassium salt of hydrocyanic acid



White, crystalline powder with a bitter almond odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Poison! Inhalation can cause anoxia, quickly leading to severe central nervous system effects. Use only with adequate ventilation.

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Nervous System, Liver, Kidneys

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Flush with flooding amounts of water for at least 15 min. Ingestion: Do not induce vomiting. Prepare cyanide antidote kit. Consult a physician immediately!

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire. However, do not use CO_2 because of liberation of toxic hydrogen cyanide gas.

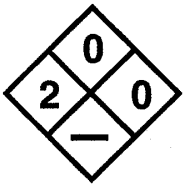
Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Carefully scoop up or vacuum (with appropriate filter). Mop any traces with strong sodium hypochlorite solution. Cleanup crew should protect against exposure.

Consult MSDS 0013 for more information **H-21M**

CAS # 7488-55-3 **Caution** [1][3]

Stannous Sulfate

tin sulfate



White to yellow, odorless crystals. Irritating to the eyes/skin/respiratory tract. Also Causes: ingestion of large amounts can cause nausea, vomiting, abdominal pain, headache, and fatigue.

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System

Personal Protective Equipment [8]

Goggles, Gloves, Apron, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Give a cupful of water. Induce vomiting only on physician's advice.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Carefully scoop into suitable container or vacuum (with HEPA filter). Do not sweep! Cleanup crew should protect against exposure.

Consult MSDS 0014 for more information **H-21M**

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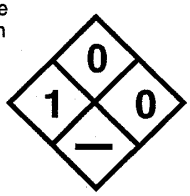
CAS # 1332-21-4 [1][3]

Asbestos

amosite; brown asbestos; chrysotile; white asbestos; crocidolite; blue asbestos; earth flax; mountain cork; stone flax



White or greenish (chrysotile), blue (crocidolite), or grey-green (amosite) fibrous, odorless fibers. Some eye, nose and throat irritation may occur at high levels. Dangerous chronic hazard: can cause lung cancer, asbestosis, and mesothelioma.

Manufacturer:

Target Organs [3][9][10]

Eyes | Skin | Respiratory System | Gastro-intestinal

Personal Protective Equipment [8]

Safety Glasses | Gloves | Full Suit | Boots | Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air. Clean any fibers from nose and mouth. Encourage cough or blow nose to remove fibers. Eyes/Skin: Wet clothing before removal. Rinse exposed area well with water. Ingestion: Induce vomiting as directed by physician.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel. Cleanup crew should protect against inhalation and eye/skin contact. Do not sweep! Use HEPA filter vacuum or wet-cleaning methods. Place in dust-proof containers for disposal.

Consult MSDS 0015 for more information H-21M

CAS # 11135-81-2 **Danger!** [1][3]

Corrosive | Explosive | Flammable

Sodium-Potassium Alloy

Nack; NaK alloy

Silvery soft metal or liquid; odorless. Corrosive, causes severe burns to eyes/skin/respiratory tract. Explosive in dry or moist air! Flammable. Forms flammable hydrogen gas and produces caustic hydroxides on contact with water.

Manufacturer:

Target Organs [3][9][10]

Eyes | Skin | Respiratory System

Personal Protective Equipment [8]

Goggles | Face Shield | Gloves | Full Suit | Boots | Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing. Eyes/Skin: Remove contaminated clothing. Flush eyes with plenty of mineral oil. Flood skin with 1% solution of stearic acid in mineral oil. Follow with 2% acetic acid solution. Ingestion: Unlikely.

Fire [5]
Explosive. Flammable. Do not use water to extinguish fire. For small fires, use approved Class D extinguishers, G-1 powder, dry sodium chloride, dry sodium carbonate, sand, resin coated sodium chloride, or dry soda ash. Withdraw and let large fires burn.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition and water sources. Do not sweep! Carefully scoop up and cover with an approved dry powder extinguishing agent. Protect against exposure.

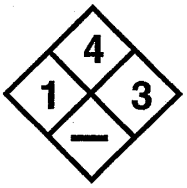
Consult MSDS 0016 for more information H-21M

CAS # 7440-67-7 **Danger!** [1][3]

Explosive | Flammable

Zirconium Powder

Zircat; zirconium shavings



Bluish-black powder or grayish-white, lustrous metal. Irritating to the eyes/repiratory tract. Chronic: dermatitis. Highly flammable! Can explode in air! Use extreme caution when handling.

Manufacturer:

Target Organs [3][9][10]

Eyes | Skin | Respiratory System

Personal Protective Equipment [8]

Safety Glasses | Gloves | Apron | Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush eyes with plenty of water. Thoroughly wash skin with soap and water. Ingestion: Induce vomiting as directed by physician.

Fire [5]
Highly flammable and can explode on exposure to air. Use dry chemical, soda ash, lime, or pulverized mineral carbonate such as dolamite or sand. Water can be used but may cause re-ignition.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Shut off ignition sources. Wet with plenty of water and place in drum of water for disposal. Cleanup crew should protect against exposure.

Consult MSDS 0017 for more information H-21M

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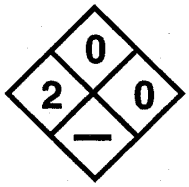
CAS # 71-48-7 **Warning!** [1][3]

Cobalt Acetate

acetic acid, cobalt (2+) salt; acetic acid, cobalt (II) salt; cobaltous acetate

Light pink or red crystals with vinegar odor. Irritating to the eye/skin/respiratory tract. Also Causes: may cause allergic dermatitis. Ingestion can cause facial flushing, ringing in ears, and heart disorders.

Manufacturer:



Target Organs [3][9][10]

Eyes | Skin | Respiratory System | Gastro-intestinal | Nervous System | Cardio-vascular

Personal Protective Equipment [8]

Goggles | Gloves | Apron | Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Give a cupful of water and induce vomiting.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Carefully scoop up, vacuum (with HEPA filter) or damp mop. Do not sweep! Cleanup crew should protect against exposure.

Consult MSDS 0018 for more information H-21M

CAS # 7705-08-0 **Danger!** [1][3]

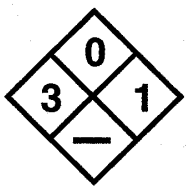
Corrosive

Ferric Chloride Solution

flores martis; iron (III) chloride; iron perchloride; iron sesquichloride; iron trichloride

Greenish-black liquid; slight hydrochloric acid odor. Corrosive! Also Causes: local brown discoloration of conjunctiva; upon ingestion: abdominal pain, vomiting, diarrhea, rapid/weak pulse, low blood pressure, cyanosis, secondary shock, coma.

Manufacturer:



Target Organs [3][9][10]

Eyes | Skin | Respiratory System

Personal Protective Equipment [8]

Goggles | Face Shield | Gloves | Full Suit | Boots | Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with flooding amounts of water for at least 15 minutes. Ingestion: Do not induce vomiting. Consult physician immediately.

Fire [5]
Noncombustible. Use agent suitable for surrounding fire. Reacts with water to produce toxic and corrosive fumes.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Shut off water sources. Take up with inert material such as sand or vermiculite. Rinse spill area with sodium bicarbonate or soda ash solution. Protect against exposure.

Consult MSDS 0019 for more information H-21M

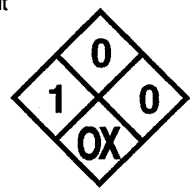
CAS # 13138-45-9 **Danger!** [1][3]

Nickel (II) Nitrate

nickelous nitrate; nitric acid, nickel (II) salt

Green, deliquescent crystals; odorless. Irritating to eyes/skin/respiratory tract. Also Causes: ingestion may cause nausea, vomiting, diarrhea and possible liver and kidney damage. Chronic: dermatitis; possible carcinogen. Strong oxidizer!

Manufacturer:



Target Organs [3][9][10]

Eyes | Skin | Respiratory System | Gastro-intestinal

Personal Protective Equipment [8]

Goggles | Gloves | Apron | Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Give a cupful of water and induce vomiting.

Fire [5]
Noncombustible. However, it is a strong oxidizer capable of igniting combustible materials. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Remove combustibles from spill area. Carefully scoop up or vacuum (with HEPA filter). Do not sweep! Cleanup crew should protect against exposure.

Consult MSDS 0020 for more information H-21M

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CAS # 12125-02-9 [1][3]

Ammonium Chloride

ammonium chloratum; ammonium chloridion; ammonium muriate; sal ammonia; salmiac

Colorless to white crystals or powder; odorless. Irritating to eyes/skin/respiratory tract. Also Causes: ingestion can cause headache, hyperventilation, drowsiness, nausea, vomiting, diuresis, and possibly coma.

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Mucous Membranes, Gastro-intestinal, Nervous System

Personal Protective Equipment [8]

Safety Glasses, Gloves, Apron, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Induce vomiting as directed by physician.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire. Firefighters should protect against hydrogen chloride and ammonia gas produced in fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Carefully scoop up, vacuum (with HEPA filter), or damp mop. Cleanup personnel should protect against exposure.

Consult MSDS 0021 for more information H-21M

CAS # 1305-78-8 **Danger!** [1][3]

Corrosive

Calcium Oxide

burnt lime; calcia; Calx; lime; pebble lime; quicklime; unslaked lime

White-gray crystals or powder; odorless. Corrosive, causes severe burns to eyes/skin/respiratory tract due to formation of calcium hydroxide in contact with moisture. Chronic: dermatitis, perforation of nasal septum. Water reactive!

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Mucous Membranes, Gastro-intestinal

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with flooding (to counteract heat) amounts of water for at least 15 min. Ingestion: Do not induce vomiting! Consult physician.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire. Do not use water unless enough can be used to absorb the significant amounts of heat generated by the calcium oxide + water reaction.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Shut off all water sources. Carefully scoop up or vaccum (with HEPA filter). Do not sweep! Cleanup crew should protect against exposure.

Consult MSDS 0022 for more information H-21M

CAS # 7440-43-9 **Danger!** [1][3]

Explosive, Flammable

Cadmium Powder

colloidal cadmium

Silver, blue tinged, metal powder; odorless. Irritating to eyes/skin/respiratory tract. Toxic! Also Causes: nausea, headache, weakness, pulmonary edema. Chronic: emphysema, kidney damage, bone demineralization; possible respiratory cancer. Flammable!

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Liver, Kidneys, Bone

Personal Protective Equipment [8]

Safety Glasses, Gloves, Apron, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush eyes with plenty of water for at least 15 min. Thoroughly wash skin with soap and water. Ingestion: Do not induce vomiting! Consult physician.

Fire [5]
Can be flammable as a fine powder. The more finely divided the greater the fire/explosion potential. Use carbon dioxide, dry chemical or sand.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Carefully scoop up, vacuum (with HEPA filter) or damp mop. Cleanup personnel should protect against exposure.

Consult MSDS 0023 for more information H-21M

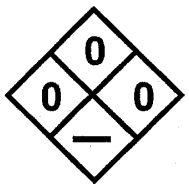
CAS # 12001-26-2 [1][3]

Mica

biotite; lepidolite; muscovite; paragonite; pegmatite; vermiculite

White-silver, shiny plates; odorless. May cause mechanical irritation of the eyes/respiratory tract. Chronic: pneumoconiosis characterized by cough, shortness of breath, weakness, weight loss.

Manufacturer:



Target Organs [3][9][10]

Eyes, Respiratory System

Personal Protective Equipment [8]

Safety Glasses, Gloves, Apron, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush eyes and skin with plenty of water. Ingestion: Unlikely.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Carefully scoop up or vacuum (with HEPA filter). Damp mop residue. Cleanup crew should protect against exposure.

Consult MSDS 0024 for more information H-21M

CAS # 7723-14-0 **Danger!** [1][3]

Poison, Corrosive, Explosive, Flammable

Phosphorus

white phosphorus; yellow phosphorus

White to pale yellow, waxy solid; pungent odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Poison! Ingestion: nausea, abdominal pain, liver damage. Chronic: poisoning hazard. Explosive! Ignites spontaneously in air.

Manufacturer:

Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Liver, Kidneys, Teeth

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush eyes with plenty of water for at least 15 min. Gently wash skin with 3% copper sulfate. Ingestion: Do not induce vomiting! Consult physician.

Fire [5]
Pyrophoric and can ignite spontaneously in air. Use water or fog to extinguish fire. After the phosphorus fire is extinguished, cover the involved materials with wet sand or earth.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Shut off ignition sources. Carefully scoop up or vacuum (with HEPA filter). Mix with wet sand for disposal. Cleanup personnel should protect against exposure.

Consult MSDS 0025 for more information H-21M

CAS # 7439-97-6 **Danger!** [1][3]

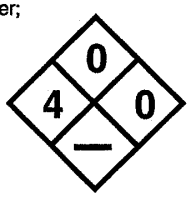
Corrosive

Mercury

colloidal mercury; hydrargyrum; liquid silver; Quicksilver

Odorless, heavy, silvery liquid. Corrosive! Toxic! Inhalation causes respiratory and CNS effects including bronchitis, headache, and ringing in ears. Causes severe delayed neurotoxicity and kidney damage. Possible reproductive hazard.

Manufacturer:



Target Organs [3][9][10]

Eyes, Skin, Respiratory System, Nervous System, Liver, Kidneys

Personal Protective Equipment [8]

Goggles, Face Shield, Gloves, Full Suit, Boots, Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Thoroughly rinse eyes. Wash skin with soap and water. Ingestion: Do not induce vomiting! Should generally pass through GI tract uneventfully.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Keep a mercury spill kit on hand. If spill can't be cleaned promptly, dust with calcium polysulfide to prevent vapor dispersion. Clean spill THOROUGHLY!

Consult MSDS 0026 for more information H-21M

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CAS # 2551-62-4 **Caution** [1][3]

Compressed Gas

Sulfur Hexafluoride

sulfur fluoride

Colorless, odorless gas. A simple ashyxiant which can displace available oxygen needed for breathing. Stored as a compressed gas which can cause frostbite if in contact with eyes or skin.

Manufacturer:

Target Organs [3][9][10]

Eyes Skin Nervous System

Personal Protective Equipment [8]

Gloves — Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Frostbite: Flush eyes with tepid (104 degree F) water for at least 15 min. Immerse affected skin in tepid water until completely rewarmed.

Fire [5]
Nonflammable. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Shut off leaking cylinder if possible; otherwise remove to safe, outdoor location or fume hood and allow to empty. Tag cylinder as defective, close valve, and return to supplier.

Consult MSDS 0027 for more information H-21M

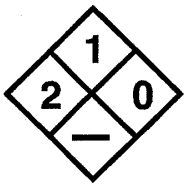
CAS # 1309-64-4 **Caution** [1][3]

Antimony Trioxide

antimonious oxide; antimony peroxide; antimony sequioxide; diantimony trioxide; flowers of antimony; antimony white

White, crystalline powder; odorless. Irritating to eyes/skin/respiratory tract. Also Causes: headache, chest pain, shortness of breath, diarrhea, weight loss. Chronic: pneumoconiosis, heart disorders, possible lung cancer.

Manufacturer:



Target Organs [3][9][10]

Eyes Skin Respiratory System Gastro-Intestinal Cardio-vascular

Personal Protective Equipment [8]

Goggles Gloves Apron — Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush eyes with plenty of water. Thoroughly wash skin with soap and water. Ingestion: Consult physician before inducing vomiting.

Fire [5]
Will burn. Use dry chemical, carbon dioxide, water spray, or regular foam.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Shut off all ignition sources. Carefully scoop up or vacuum (with HEPA filter). Cleanup personnel should protect against exposure.

Consult MSDS 0028 for more information H-21M

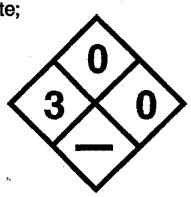
CAS # 7758-98-7 **Warning!** [1][3]

Copper Sulfate

blue vitriol; blue stone; copper monosulfate; copper sulfate (1:1); cupric sulfate

Grayish-white to greenish-white crystals or powder. Highly irritating to the eyes/skin/respiratory tract. Toxic! Heavy exposures may cause nausea, vomiting, and serious blood, liver, and kidney damage. Use with adequate ventilation.

Manufacturer:



Target Organs [3][9][10]

Eyes Skin Respiratory System Liver Kidneys Blood

Personal Protective Equipment [8]

Goggles Gloves Apron — Check to see is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Give a cupful of water. Spontaneous vomiting may occur. Consult a physician.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Cleanup personnel should protect against inhalation and eye/skin contact. Scoop up or vacuum (with appropriate filter). Do not sweep!

Consult MSDS 0029 for more information H-21M

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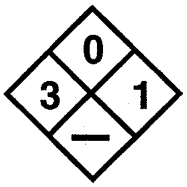
CAS # 7647-01-0 **Danger!** [1][3]

Corrosive | Compressed Gas

Hydrogen Chloride

anhydrous hydrochloric acid



Colorless gas; characteristic suffocating, pungent odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Stored as compressed gas which may cause frostbite. Chronic: Repeated or prolonged exposure may cause erosion of teeth.

Manufacturer:

Target Organs [3][9][10]

Eyes | Skin | Respiratory System | Teeth

Personal Protective Equipment [8]

Goggles | Face Shield | Gloves | Full Suit | Boots | Check to see: is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing. Eyes/Skin: Flush with flooding amounts of water for at least 15 minutes. Thoroughly wash skin with soap and water. Ingestion: Unlikely. Contact physician immediately.

Fire [5]
Noncombustible. Use agent suitable for surrounding fire. In presence of water, hydrogen chloride can react with certain metals such as iron to produce highly flammable and explosive hydrogen gas.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Shut off ignition sources. Shut off gas. Otherwise, remove leaking cylinder to fume hood to empty. Tag as defective and return to supplier. Protect against exposure.

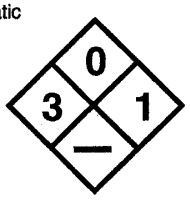
Consult MSDS 0030 for more information **H-21M**

CAS # 7647-01-0 **Danger!** [1][3]

Corrosive

Hydrochloric Acid

Caswell No. 486; chlorohydric acid; muriatic acid; spirits of salt



Colorless, or yellow from impurities, fuming liquid with a strong, pungent odor. Corrosive, causes severe burns to eyes/skin/respiratory tract. Toxic! Chronic: dermatitis, tooth erosion, conjunctivitis, gastritis, nose and gum bleeds.

Manufacturer:

Target Organs [3][9][10]

Eyes | Skin | Respiratory System | Mucous Membranes | Gastro-intestinal | Teeth

Personal Protective Equipment [8]

Goggles | Face Shield | Gloves | Full Suit | Boots | Check to see: is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Rinse with plenty of water for at least 15 min. Ingestion: Do not induce vomiting! Consult physician immediately.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

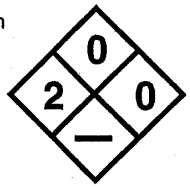
Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area, deny entry, stay upwind. Neutralize spills with sodium bicarbonate. Take up with inert material such as sand or vermiculite. Cleanup personnel should protect against inhalation and eye/skin contact.

Consult MSDS 0030A for more information **H-21M**

CAS # 16893-85-9 **Warning!** [1][3]

Sodium Hexafluorosilicate

disodium hexafluorosilicate; sodium silicofluoride; sodium fluorosilicate; silicon sodium fluoride



White, crystalline powder; odorless. Irritating to eyes/skin/respiratory tract. Toxic! Also Causes: nausea, vomiting, muscle weakness, tremors, weak pulse. Chronic: kidney damage, mottling of teeth, bone densification.

Manufacturer:

Target Organs [3][9][10]

Eyes | Skin | Respiratory System | Gastro-intestinal | Kidneys | Teeth

Personal Protective Equipment [8]

Goggles | Gloves | Apron | Check to see: is respirator required?

Emergency Procedures

First Aid [4]
Inhalation: Remove to fresh air and support breathing as needed. Eyes/Skin: Remove contaminated clothing. Flush with plenty of water for at least 15 min. Ingestion: Give a cupful of milk. Do not induce vomiting! Consult physician.

Fire [5]
Noncombustible. Use extinguishing agents suitable for surrounding fire.

Spills & Leaks [6]
Notify safety personnel, isolate and ventilate area. Carefully scoop up or vacuum (with HEPA filter). Damp mop residue. Cleanup personnel should protect against exposure.

Consult MSDS 0031 for more information **H-21M**

GENIUM PUBLISHING

Part of preplanning is understanding the systems *which are* used to identify hazardous materials. Identification information is included on labels fixed to small containers (drums, packages, boxes) and placards fixed to large containers (trailers, rail cars, tanks). There are several different systems; one or more may be used at the plant by contract personnel or companies which supply raw materials. Some of these systems are described below.

The DOT (Department of Transportation)
System of Placards and Labels

What does the DOT system look like?

- Diamond-shaped

- Color-coded

Color	**Hazard**
orange	explosive
red	flammable
green	nonflammable
yellow	reactive
white	poisonous
white/red vertical stripes	flammable solid
white top with black bottom	corrosive
two colors	two major hazards

- Word-coded (hazard class name)

For Example:

EXPLOSIVES
BLASTING AGENTS
DANGEROUS - (may be used with mixed loads)

Symbol-coded

Symbol	**Hazard**
bursting ball	explosive
flame	flammable
W with slash	dangerous when wet
skull and crossbones	poisonous
Symbol circle with flame	oxidizing material
cylinder	non-flammable gas
propeller	radioactive
test tube/hand/metal	corrosive
special symbol	infectious (discussed later)

A four-digit number in **center identifies** a specific compound. These numbers are identified in the DOT Emergency Response Guidebook. For example, 1223 is kerosene.

A one-digit number at **bottom** is the UN (United Nations) Hazard Class

#	**UN Hazard Class**
1	Explosives
2	Gases (compressed, liquified, or dissolved under pressure)
3	Flammable liquids
4	Flammable solids or substances
5	Oxidizing substances
6	Poison and infectious substances
7	Radioactive substances
8	Corrosives
9	Miscellaneous dangerous substances

The placard displayed below is red with white symbols except for the black 4-digit number. This placard tells you that the substance is **Flammable** (the flame and the red background), a **Flammable Liquid** (the UN Class Number 3), and **Acetone** (the 4-digit number 1090).

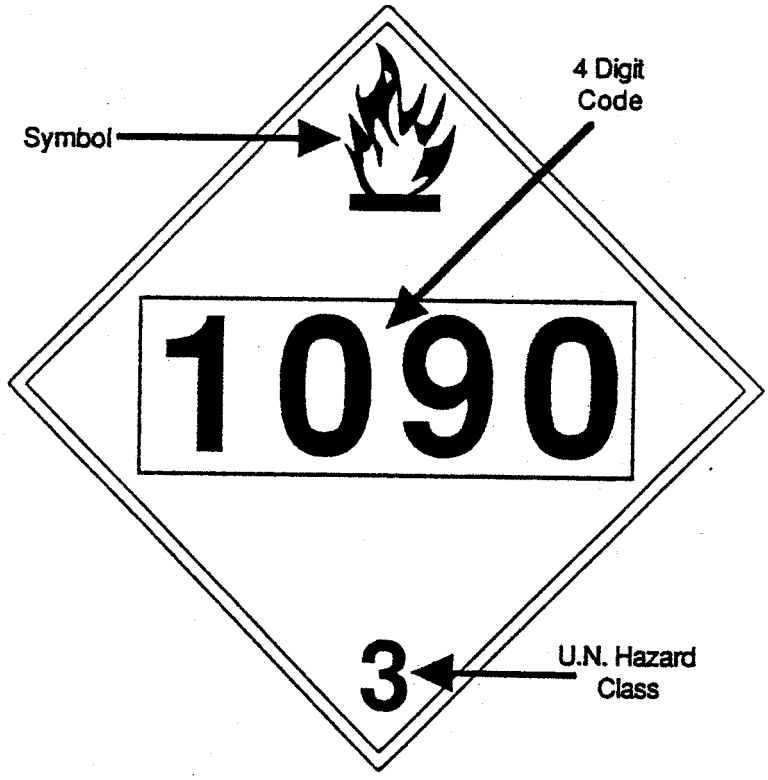


Figure 1: DOT Placard for Acetone

The Acetone placard is called a "number placard" which means that the number at the center of the placard specifies the exact contents of the container. "Word placards" are so named because a word designating a type of hazard (e.g. "flammable") will be printed in the middle of the placard. Number placards must be displayed on large portable tanks, tank trucks, and rail cars. A word placard means that drums or smaller containers are present.

You can find more information on what these numbers and symbols mean in the DOT Chart and the DOT Book. Both are handouts with this training manual.

To use the DOT Book you need to know either the chemical name or the identification number.

- If you know the name, look in the blue pages to find the Guide Number. The Guide in the white pages with orange tops contains more-detailed information on the chemical.

- If you know the number, look in the yellow pages to find the Guide Number. The Guide in the white pages with orange tops contains more-detailed information on the chemical.

The NFPA-704M System

The National Fire Protection Association (NFPA) system is used on storage vessels and containers.

What does the NFPA system look like?

- Diamond-shaped

- Color-coded in 4 small diamonds

Color	Hazard
red	flammability
blue	health
yellow	reactivity
white	special information (such as radioactive)

-- Number-coded in the red. blue, and yellow diamonds

ranks the potential health, flammability, and reactivity hazard. Ranges from 0 (least hazard) to 4 (worst hazard).

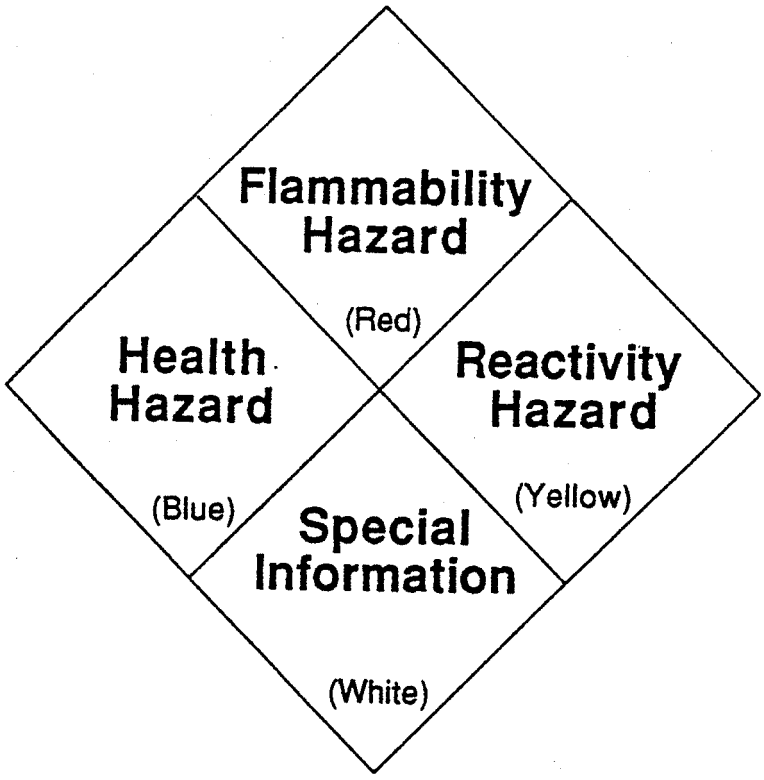
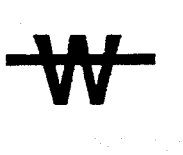


Figure 2: The NFPA-704M system

The Special Information (white) section of the NFPA-704M label may contain symbols that give more information about the chemical. The following are examples of some symbols and their meanings that might be found in the Special Information (white) section of the NFPA-704M label.



Do not use water.

Biological Hazard

Oxidizer

Radiation Hazard

The HMIS (Hazardous Material Information System)

Labels like the one shown in Figure 3, are used on storage vessels and containers.

What does the HMIS system look like?

- Rectangular

- Color-coded

Color	Hazard
blue	health risk
red	flammability
yellow	reactivity
white	personal protective equipment needed

- Number-coded

  ranks the potential health, flammability, and reactivity hazard. Ranges from 0 (minimal) to 4 (serious).

- Letter-coded

  tells you what personal protective equipment you should use to protect yourself when working with the material. Ranges from A (safety glasses) to K (full protective suit with gloves, boots, a hood or mask and an air line or Self-Contained Breathing Apparatus). If the personal protection is coded X, specialized handling procedures are needed.

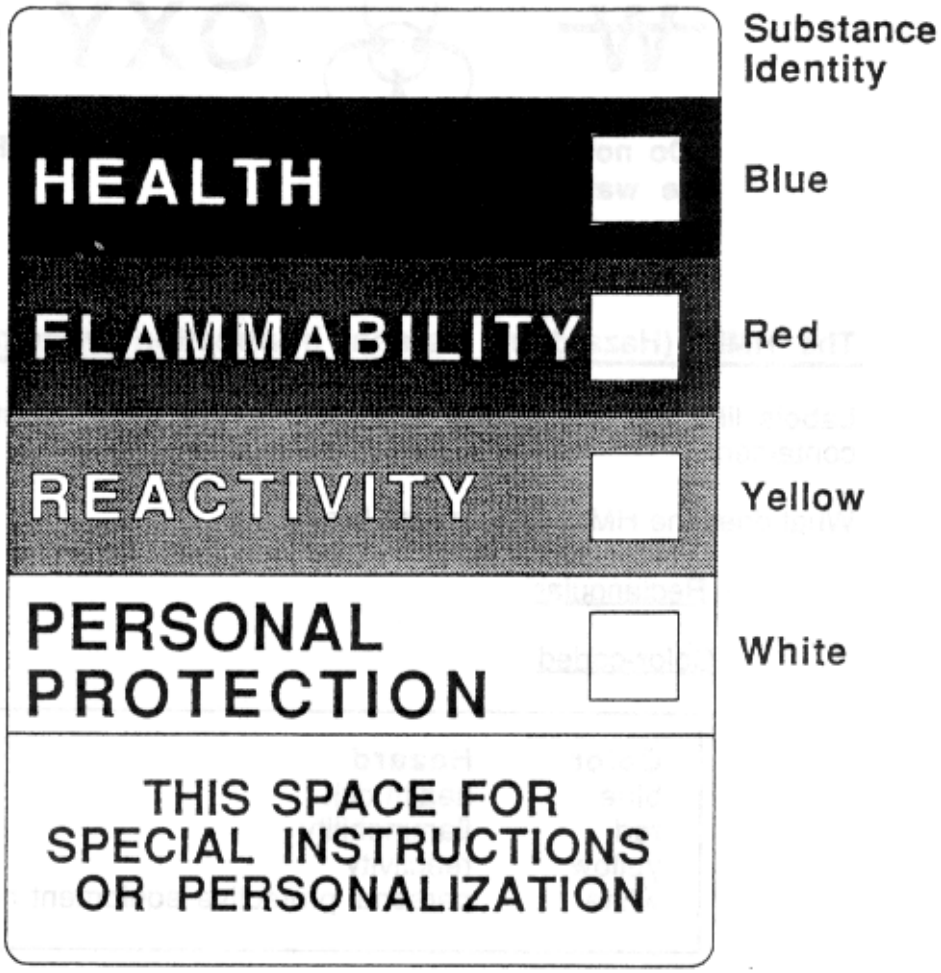


Figure 3: The HMIS label

Occupational Training NFPA Health Category

4	Materials which upon very limited exposure could cause death or major residual injury even though prompt medical treatment is given, including those which are too dangerous to be approached without specialized protective equipment. This degree should include: • Materials which can penetrate ordinary rubber protective clothing; • Materials which under normal conditions or under fire conditions give off gases which are extremely hazardous (i.e., toxic or corrosive) through inhalation or through contact with or absorption through the skin.
3	Materials which upon short-term exposure could cause serious temporary or residual injury even though prompt medical treatment is given, including those requiring protection from all bodily contact. This degree should include: • Materials giving off highly toxic combustion products; • Materials corrosive to living tissue or toxic by skin absorption.
2	Materials which on intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical treatment is given, including those requiring use of respiratory protective equipment with independent air supply. This degree should include: • Materials giving off toxic combustion products; • Materials giving off highly irritating combustion products; • Materials which either under normal conditions or under fire conditions give off toxic vapors lacking warning properties.
1	Materials which on exposure would cause irritation but only minor residual injury even if no treatment is given, including those which require use of an approved canister type gas mask. This degree should include: • Materials which under fire conditions would give off irritating combustion products • Materials which on the skin could cause irritation without destruction of tissue.
0	Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material.

NFPA Descriptions

NFPA Label, Flammability, Reactivity, Special

NFPA Tables

A-B, C-D, E-L, M-O, P-S, T-Z

4	Materials which will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or which are readily dispersed in air, and which will burn readily. This degree should include: • Gases; • Cryogenic materials; • Any liquid or gaseous material which is a liquid while under pressure and have a flash point below 73°F (22.8°C) and having a boiling point below 100°F(37.8°C). (Class IA flammable liquids.) • Materials which on account of their physical form or environmental conditions can form explosive mixtures with air and which are readily dispersed in air, such as dusts of combustible solids and mists of flammable or combustible liquid droplets.
3	Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. This degree should include: • Liquids having a flash point below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C) and those liquids having a flash point at or above 73°F (22.8°C) and below 100°F (37.8°C). (Class IB and Class IC flammable liquids); • Solid materials in the form of coarse dusts which may burn rapidly but which are generally do not form explosive atmospheres with air; • Solid materials in a fibrous or shredded form which may burn rapidly and create flash fire hazards, such as cotton, sisal and hemp; • Materials which burn with extreme rapidity, usually by reason of self-contained oxygen (e.g., dry nitrocellulose and *many organic peroxides*); • Materials which ignite spontaneously when exposed to air.
2	Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres with air. This degree should include: • Liquids having a flash point above 100°F (37.8°C), but not exceeding 200°F (93.4°F); • Solids and semisolids which readily give off flammable vapors.
1	Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature condition, before ignition and combustion can occur. This degree should include: • Materials which will burn in air when exposed to a temperature of 1500°F (815.5°C) for a period of 5 minutes or less; • Liquids, solids, and semisolids having a flash point above 200°F (93.4°C); • This degree includes most ordinary combustible materials.
0	Materials that will not burn. This degree should include any material which will not burn in air when exposed to a temperature of 1500°F (815.5°C) for a period of 5

	minutes.

NFPA Descriptions

Health, NFPA Label, Reactivity, Special

NFPA Tables

A-B, C-D, E-L, M-O, P-S, T-Z

Occupational Training NFPA Reactivity Category

4	Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. This degree should include materials which are sensitive to mechanical or localized thermal shock at normal temperatures and pressures.
3	Materials which in themselves are capable of detonation or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. This degree should include materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat or confinement.
2	Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. This degree should include materials which can undergo chemical change with rapid release of energy at normal temperatures and pressures or which can undergo violent chemical change at elevated temperatures and pressures. It should also include those materials which may react violently with water or which may form potentially explosive mixtures with water.
1	Materials which in themselves are normally stable, but which can become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.
0	Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.

NFPA Descriptions

Health, Flammability, NFPA Label,Special

NFPA Tables

A-B, C-D, E-L, M-O, P-S, T-Z

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Occupational Training NFPA Special Category

OX	Denotes material that are oxidizing agents. These compounds give up oxygen easily, remove hydrogen from other compounds, or attract negative electrons.
W	Denotes materials that are water-reactive. These compounds undergo rapid energy releases on contact with water.

NFPA Descriptions

Health, Flammability, Reactivity, NFPA Label

NFPA Tables

A-B, C-D, E-L, M-O, P-S, T-Z

Occupational Training NFPA Table A-B

NFPA Label Description

Chemical Name	CAS #	H	F	R	Special
ACETALDEHYDE	75070	2	4	2	
ACETIC ACID, [GLACIAL]	64197	2	2	0	
ACETIC ANHYDRIDE	108247	2	2	1	
ACETONE	67641	1	3	0	
ACETONE CYANOHYDRIN	75865	3	2	2	
ACETONITRILE	75058	3	3	0	
ACETOPHENONE	98862	1	2	0	
ACETYL CHLORIDE	75365	3	3	2	**No water**
ACETYLENE	74862	1	4	3	
ACETYLENE TETRABROMIDE	79276	3	1	0	
ACETYL PEROXIDE SOLUTION,[<=25% PEROXIDE]	110225	1	2	4	
ACROLEIN DIMER, [STABILIZED]	100732	1	2	1	
ACROLEIN, [INHIBITED]	107028	3	3	3	
ACRYLAMIDE	79061	3	2	2	
ACRYLIC ACID	79107	3	2	2	
ACRYLONITRILE	107131	4	3	2	
ADIPIC ACID	124049		1	0	
ADIPONITRILE	111693	4	2	1	
ALKYL ALUMINUM HALIDES		3	4	3	**No water**
ALLYL ALCOHOL	107186	3	3	1	
ALLYLAMINE	107119	3	3	1	
ALLYL BROMIDE	106956	3	3	1	
ALLYL CHLORIDE	107051	3	3	1	
ALLYL CHLOROCARBONATE	2937500	3	3	1	
ALUMINUM ALKYL CHLORIDE		3	4	3	**No water**
ALUMINUM CHLORIDE, [ANHYDROUS]	7446700	3	0	2	**No water**
ALUMINUM PHOSPHIDE	20859738	3	4	2	**No water**
ALUMINUM POWDER, [METALLIC]	7429905	0	1	1	
ALUMINUM TRIETHYL	97938	3	4	3	**No water**
AMMONIA, [ANHYDROUS]	7664417	3	1	0	
AMMONIUM BICHROMATE	7789095	2	1	1	**Oxidizer**
AMMONIUM FLUORIDE	12125018	3	0	0	
AMMONIUM NITRATE, [NO ORGANIC COATING]	6484522	1	0	3	**Oxidizer**
AMMONIUM NITRATE, [ORGANIC COATING]	6484522	1	0	3	**Oxidizer**

AMMONIUM PERCHLORATE, [OXIDIZER]	7790989	1	0	4	**Oxidizer**
AMMONIUM PERMANGANATE	13446101	1	0	3	**Oxidizer**
AMYL ACETATE	628637	1	3	0	
AMYL ALCOHOL	71410	1	3	0	
N-SEC-AMYL ALCOHOL		0	2	0	
TERT-AMYL ALCOHOL	75854	1	3	0	
AMYLAMINE	110587	2	3	0	
AMYL MERCAPTAN	110667	2	3	0	
AMYL NITRATE	1002160	2	2	0	**Oxidizer**
ANILINE	62533	3	2	0	
ANTIMONY PENTACHLORIDE	7647189	3	0	1	
ANTIMONY PENTAFLUORIDE	7783702	3	0	1	
ANTIMONY SULFIDE, [SOLID]	12627520	2	1	1	
ARSENIC PENTOXIDE, [SOLID]	1303282	2	0	0	
ARSENIC TRICHLORIDE, [LIQUID]	7784341	3	0	0	
ARSENIC TRIOXIDE, [SOLID]	1327533	2	0	0	
ARSENIC TRISULFIDE	1303339	2	0	0	
ARSINE	7784421	4	4	2	
ASPHALT	8052424	0	1	0	
BARIUM CHLORATE	13477004	2	0	1	**Oxidizer**
BENZALDEHYDE	100527	2	2	0	
BENZENE	71432	2	3	0	
BENZOTRICHLORIDE	98077	3	3	1	
BENZOYL CHLORIDE	98884	3	2	2	**No Water**
BENZYL CHLORIDE	100447	2	2	1	
BERYLLIUM, [POWDER]	7440417	3	1	0	
BIS(CHLOROMETHYL) ETHER	542881	3	3	1	
BORON TRIBROMIDE	10294334	4	0	2	**No water**
BORON TRIFLUORIDE	7637072	4	0	1	
BROMINE	7726956	3	0	0	**Oxidizer**
BROMINE PENTAFLUORIDE	7789302	4	0	3	**No Water; Oxidizer**
BROMINE TRIFLUORIDE	7787715	4	0	3	**No Water; Oxidizer**
BROMOPENTANE	29756385	1	3	0	
BROMOPROPYNE	106967	4	3	4	
1,3-BUTADIENE, [INHIBITED]	106990	2	4	2	
BUTANE	106978	1	4	0	
BUTENE	25167673	1	4	0	
BUTYL ACETATE	123864	1	3	0	
BUTYL ACRYLATE	141322	2	2	2	

BUTYL ALCOHOL	35296721	1	3	0	
N-BUTYL ALCOHOL	71363	1	3	0	
SEC-BUTYL ALCOHOL	78922	1	3	0	
TERT-BUTYL ALCOHOL	75650	1	3	0	
BUTYLAMINE	109739	3	3	0	
1,2-BUTYLENE OXIDE	106887	2	3	2	
BUTYL ETHER	142961	2	3	1	
TERT-BUTYL HYDROPEROXIDE	75912	1	4	4	**Oxidizer**
BUTYL LITHIUM	109728	3	4	2	**No water**
TERT-BUTYL PEROXYACETATE, [<= 76% IN SOLUTION]	107711	2	3	4	**Oxidizer**
TERT-BUTYL PEROXYACETATE	107711	2	3	4	**Oxidizer**
TERT-BUTYL PEROXYBENZOATE, [TECHNICALLY PURE]	614459	1	3	4	**Oxidizer**
TERT-BUTYL PEROXYPIVALATE, [<= 77% IN SOLUTION]	927071	0	3	4	**Oxidizer**
N-BUTYL PHTHALATE	84742	0	1	0	
BUTYRALDEHYDE	123728	2	3	2	
BUTYRIC ACID	107926	3	2	0	

Exported from CAMEO Codebreaker 4.5 for Macintosh

NFPA Tables

NFPA Label Description

Top, **C-D**, **E-L**, **M-O**, **P-S**, **T-Z**

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GLOSSARY OF TERMS AND ABBREVIATIONS

The language used on the typical material safety data sheet can be daunting to the lay person. Chemical names and descriptive adjectives, medical conditions in Latin, abbreviations and acronyms substituting for long technical descriptions. All these need explanation. On the following pages you will find a comprehensive list of such terms and their definitions to help you understand the safety message on each MSDS you read. This glossary is based on the 1996 printing of Genium's MSDS *Pocket Dictionary,* one of a family of over a dozen different pocket-sized publications for materials safety. If you are interested in additional information call 1-800-243-6486 for titles and descriptions.

Absolute. A chemical substance relatively free of impurities, e.g., absolute alcohol.

Absolute Pressure. The total pressure within a vessel, pipe, etc., not offset by external atmospheric pressure. See psia, psig.

Absorb. To soak up. The incorporation of a liquid into a solid substance, as by capillary, osmotic, solvent, or chemical action. See Adsorb.

ACGIH. American Conference of Governmental Industrial Hygienists. An organization of professionals in governmental agencies or educational institutions engaged in occupational safety and health programs. ACGIH develops and publishes recommended occupational exposure limits for chemical substances and physical agents (see TLV and BEI). (1330 Kemper Meadow, Cincinnati, OH 45240; [513] 742-2020.)

Acid. An inorganic or organic compound that:
1) is usually corrosive to human tissue and must be handled with care;
2) has a pH of less than 7.0;
3) neutralizes bases (alkalis) to form salts;
4) dissociates in water yielding hydrogen or hydronium ions;
5) may react with metals to yield hydrogen; and
6) turns litmus paper red.

Acidosis. A condition of decreased alkalinity of the blood and tissues. Symptoms may include sickly sweet breath, headache, nausea, vomiting, visual disturbances; usually the result of excessive acid production. Tissues and CNS functions are disturbed.

Acrid. Irritating and bitter (usually referring to smell).

ACS. American Chemical Society. Professional society that establishes standards of purity for a number of reagents, e.g., the ACS Reagent Grade. They publish *Chemical Abstracts* and a host of professional journals and magazines dealing with various areas of chemistry, chemical engineering, and allied sciences. (1155 Sixteenth St., N.W., Washington, DC 20036; [202] 872-4567.)

Action Level. The exposure level (concentration in air) at which OSHA regulations to protect employees take effect (29 CFR 1910.1001-1047); e.g., workplace air analysis, employee training, medical monitoring, and record keeping. Exposure at or above action level is termed occupational exposure. Exposure below this level can also be harmful. This level is *generally* half the PEL.

Acute Exposure. Exposure of short duration, usually to relatively high concentrations or amounts of material.

Acute Health Effect. An adverse effect on a human or animal body, with symptoms developing rapidly. See Chronic Health Effect.

Active Ingredient. The ingredient of a product that actually does what the product is designed to do.

Acute Lethality. The death of animals immediately or within 14 days after a single dose of or exposure to a toxic substance.

Acute Toxicity. Adverse health effects resulting from brief exposure to a chemical (e.g. seconds, minutes, hours).

Administrative Controls. A number of measures used to reduce worker exposure, including work practices, labeling and warning devices, training, environmental monitoring, assignment scheduling, housekeeping, maintenance, and management.

Adsorb. To attract and retain gas or liquid molecules on the surface of another material. See Absorb.

Aerosol. A fine suspension in air or other gas of liquid (mist, fog) or solid (dust, fume, smoke) particles small enough to stay suspended. See Smoke; Fog; Mist.

Agent. Any substance, force, radiation, organism, or influence affecting the body. The effects may be beneficial or injurious.

AICS. Abbreviation for the Australian Inventory of Chemical Substances. This list contains chemical substances which can be used commercially in Australia. It is similar to TSCA Chemical Substances Inventory in the U.S.

ALARA. Acronym for "as low as reasonably achievable."

Alkali. An inorganic or organic chemical that: 1) is usually corrosive to human tissue and must be handled with care; 2) has a pH of more than 7.0; 3) neutralizes acids to form salts; 4) dissociates in water yielding hydroxide ions; 5) turns litmus paper blue; and 6) may also be called a base or caustic. Examples are oxides and hydroxides of certain metals belonging to group IA of the periodic table (Li, Na, K, Rb, Cs, Fr). Ammonia and amines may also be alkaline. Common commercial alkalis are sodium carbonate (soda ash), caustic soda and caustic potash, lime, lye, waterglass, regular mortar, Portland cement, and bicarbonate of soda. See Acid; Base; pH.

Allergen. A substance that causes an allergic reaction.

Allergy. A condition in which an initial symptomless exposure to a specific allergen later gives rise to a sensitivity to further exposure. Symptoms may be exhibited in a variety of ways, usually by respiratory distress or skin eruptions.

Alopecia. Loss of hair.

Ambient. Usual or surrounding conditions of temperature, humidity, etc.

Analgesia. Reduced sensitivity to pain.

Anesthesia. Loss of sensation, including loss of touch, pain, vibration sense, and/or temperature sense.

Anhydride. A compound derived from another compound (e.g., an acid) by removing the elements that compose water, i.e., hydrogen and oxygen.

Anhydrous. "Without water." Describes a substance in which no water molecules are present in the form of a hydrate or as water of crystallization.5-

Anorexia. Loss of appetite.

Anosmia. Loss of the sense of smell.

Anoxia. A lack of oxygen in blood or tissues (literally, "without oxygen"). See Hypoxia.

ANSI. American National Standards Institute. A privately funded organization that identifies industrial/ public national consensus standards and coordinates their development. Many ANSI standards relate to safe design/performance of equipment and safe practices or procedures. (1430 Broadway, New York, NY 10018; [212- 642-4900.)

Antagonism. When the effect of one chemical or material counteracts (works against) the effect of another.

Antidote. A remedy to counteract a poison's toxic effects; it may act to eliminate, absorb, or neutralize the poison.

Anuria. Absence or defective excretion of urine.

Apnea. Temporary stoppage of breathing.

Appearance. A material's physical state (solid, gas, or liquid), its color, and other visual attributes. If there is a difference between a material's appearance and that listed on the MSDS, contact your supervisor.

AQTX, Aquatic Toxicity. The adverse effects on fresh or salt water life forms that result from exposure to a toxic substance. See TLm.

Aqueous, aq. Describes a water-based solution or suspension. Frequently describes a gaseous compound dissolved in water.

Argyria. Local or generalized gray-blue colored impregnation of body (skin) tissue with silver.

Article. A manufactured item that is specifically shaped or formed with its function dependent on its shape or design. Hazard laws exclude articles unless they give off harmful dust or fumes during their use.

Asbestosis. Chronic lung disease caused by inhaling airborne asbestos fibers.

Asphyxia. Lack of oxygen or inability of cells to use oxygen; simple asphyxia is suffocation caused by a lack of oxygen in the inhaled air (e.g. displacement by nitrogen); chemical asphyxia poisons the blood's ability to carry oxygen (carbon monoxide) or the cell's ability to use oxygen (cyanide).

Asphyxiant. A vapor or gas that can cause unconsciousness or death by suffocation (lack of oxygen). Most *simple asphyxiants* are harmful to the body only when they become so concentrated that they reduce (displace) the available oxygen in the air (normally about 21 %) to dangerous levels (18% or lower). Examples of simple asphyxiants are carbon dioxide, nitrogen, hydrogen, and helium. *Chemical asphyxiants* like carbon monoxide (CO) reduce the blood's ability to carry oxygen, or like cyanide, interfere with the body's utilization of oxygen.

Asphyxiation. A condition that causes asphyxia or suffocation. Asphyxiation is one of the principal potential hazards of working in confined spaces.

Aspiration Hazard. The danger of drawing material into the lungs, leading to an inflammatory response that can be fatal.

Asthma. A medical disorder which causes attacks of wheezing, chest tightness, shortness of breath, and/or coughing due to spasmodic contraction of the air passages.

ASTM. American Society for Testing and Materials. An organization that devises consensus standards for materials characterization and use. (100 Barr Harbor Drive, West Conshohocken, PA 19428; [6101832-9500.)

Asymptomatic. Not exhibiting symptoms.

Ataxia. A loss of muscular coordination of gait or movement.

atm. Atmosphere. A unit of pressure equal to the average pressure that air exerts at sea level. 1 atm = 1.013 x 105 N/m2, or 14.7 lb/in2, or 760 mm Hg or 101 kPa. Generally used in connection with high pressures.

Atrophy. Reduction in size or function of tissue, organs, or the entire body caused by lack of use.

Autoignition Temperature. The minimum temperature at which a substance ignites without application of a flame or spark. Do not heat materials to greater than 80% of this temperature.

BAL. British Anti-Lewisite. A name for the drug dimercaprol, a treatment for inhalation or ingestion of specific toxic metal compounds.

Base. An alkali. See Alkali.

Baumé, Bé. A scale of specific gravities devised by the French chemist Antoine Baumé (c. 1800; pronounced bo-may) that indicates concentration of materials in a solution. Baumé degree increases as specific gravity decreases.

BEI, Biological Exposure Indexes. Numerical values based on procedures to determine the amount of a material the human body absorbs by measuring the material or its metabolic products in tissue, fluid, or exhaled air. See the ACGIH publication *Documentation of the Threshold Limit Values and Biological Exposure Indices.*

Bioconcentration. The process by which a chemical is passed through the food chain from soil to plants and animals where it accumulates and is ultimately passed to humans.

Biodegradable. An organic material's capacity for decomposition as a result of attack by microorganisms. Sewage-treatment routines are based on this property. Biodegradable materials do not persist in nature.

Biological Monitoring. Analysis of body substances, such as blood or urine, to determine the extent of hazardous material absorption or accumulation.

BLEVE, Boiling Liquid Expanding Vapor Explosion. Used when describing fires involving compressed gases in cylinders which rupture due to extreme pressures and proceed to burn rapidly.

BOD, Biochemical Oxygen Demand. Amount of oxygen needed by bacteria to stabilize organic matter under aerobic conditions. Used to estimate degree of contamination in water supplies.

Body Burden. The total toxic material a person has ingested or inhaled from all sources over time and retained in the body. For example, lead can be ingested from drinking water channeled through lead-soldered pipes, lead glazes on dishes, or flakes from painted surfaces, as well as from many industrial operations.

Boiling Point, BP. The temperature at which a liquid's vapor pressure equals the surrounding atmospheric pressure so that the liquid rapidly vaporizes. Flammable materials with low BPs generally present special fire hazards [e.g., butane, BP = -0.5 ºC (31 ºF); gasoline, BP = 38 ºC (100 ºF)]. For mixtures, a range of temperature is given.

Bonding. A safety practice where two objects (tanks, cylinders, etc.) are interconnected with clamps and wire. This equalizes the electrical potential between the objects and helps prevent static sparks that can ignite flammable materials transferred between tanks. See Grounding.

BP. See Boiling Point.

Bradycardia. Slowed heartbeat (less than 60 beats per minute).

British Anti-Lewisite. See BAL.

Bronchitis. An inflammatory condition of the airways (bronchial tubes) resulting in coughing up of sputum.

Btu. British thermal unit. The quantity of heat required to raise the temperature of 1 lb of water from 17 ºC (63 ºF) to 18 ºC (64 ºF). Compare to Calorie.

Buffer. A substance that reduces the change in hydrogen ion concentration (pH) otherwise produced by adding acids or bases to a solution. A pH stabilizer.

Bulk Density. The mass (weight) per unit volume of a solid particulate material as it is normally packed, with voids between particulates containing air. Usually expressed as lb/ft^3 or g/cm^3.

Burning Rate. The time it takes a specified sized sample of solid material (e.g., I in by I in) to bum a designated distance. The rate is given in units of distance/time.

c, ca. Circa, about, approximately,

C. Indicates continuous exposure when used with toxicological data; e.g., "LC_{50} > 5 mg/m^3, 24 h-C" means continuous exposure for 24 hr. OSHA also uses C to designate ceiling exposure Emit. See Ceiling Limit; TLV.

ºC. Degrees Celsius (centigrade). Metric temperature scale on which 0 = water's freezing point and 100 = its boiling point. ºF = (ºC x 9/5) + 32. ºC (ºF - 32) x 5/9. See ºF.

CAA. Clean Air Act. Public Law PL 9 1 604, 40 CFR 50-80. EPA has jurisdiction. Effective December 31, 1970, and significantly amended several times, most recently in 1990. The regulatory vehicle that sets limitations and monitors airborne pollution hazardous to public health or natural resources. The EPA sets national ambient air-quality standards. Enforcement and issuance of discharge permits are carried out by the states and are called state implementation plans. The CAA is directed toward by-products discharged into the air from stationary sources (i.e., factories) and mobile sources (i.e., automobiles) rather than use and assessment of specific chemicals.

Calorie. Unit of heat. The amount of heat required to raise I g of water I *C. See Btu.

Cancer. An abnormal multiplication of cells that tends to infiltrate other tissues and metastasize (spread). Each cancer is believed to originate from a single "transformed" cell that grows (splits) at a fast, abnormally regulated pace, no matter where it occurs in the body.

Carcinogen. A material that either causes cancer in humans, or, because it causes cancer in animals, is considered capable of causing cancer in humans. A material is considered a carcinogen if 1) the International Agency for Research on Cancer (IARC) has evaluated and found it a carcinogen or potential carcinogen; 2) the National Toxicology Program's (NTP) *Annual Report on Carcinogens* lists it as a carcinogen or potential carcinogen; or 3) OSHA regulates it as a carcinogen.

Cardiovascular. System of the human body involving the heart and blood vessels.

CAS Number (CAS Registration Number). An assigned number used to identify a chemical. CAS stands for Chemical Abstracts Service, an organization that indexes information published in *Chemical Abstracts* by the American Chemical Society and that provides index guides by which information about particular substances may be located in the abstracts. Sequentially assigned CAS numbers identify *specific* chemicals, except when followed by an asterisk (*) which signifies a compound (often naturally occurring) of variable composition. The numbers have no chemical significance. The CAS number is a concise, unique means of material identification. (Chemical Abstracts Service, Division of American Chemical, Society, Box 3012, Columbus, OH 43210; [614] 447-3600.)

Catalyst. A substance that modifies (slows, or more often quickens) a chemical reaction without being consumed in the reaction.

Cataract. A loss of transparency in the eye ls crystalline lens or its capsule.

Caustic. See Alkali.

CC. Closed cup. Identifies one of the methods used to measure flash points of flammable liquids.

cc, cm^3. Cubic centimeter.

Ceiling Limit, C. The concentration not to exceed at any time. "An employee's exposure [to a hazardous material] shall at no time exceed the ceiling value" (OSHA).

Celsius. See ºC.

Centigrade. See ºC. Celsius is now this temperature scale's preferred name.

Centimeter, cm. 1/100 meter. A cm approximately 0.4 in.

Centipoise, cP. A metric (cgs) unit of viscosity equal to 1/100 poise. The viscosity of water at 20 ºC (68 ºF) is almost 1 centipoise.

Central Nervous System (CNS). The brain and spinal cord.

Central Nervous System (CNS) Depression. Drowsiness, dizziness, and headache caused by a chemical acting on the brain; higher doses can cause unconsciousness, coma, or death.

CEPA, (Canada) Environmental Protection Act. Federal legislation, administered by Environment Canada, designed to protect the environment.

CERCLA. The Comprehensive Environmental Response, Compensation, and Liability Act. The Superfund Law, Public Law PL 96-5 10, found at 40 CFR 300. The EPA has jurisdiction. Enacted Dec. 11, 1980, and amended thereafter, CERCLA provides for identification and cleanup of hazardous materials released on the land and into the air, waterways, and groundwater. It covers areas affected by newly released materials and older leaking or abandoned dump sites. Report releases of hazardous materials to the National Response Center, (800) 424-8802. CERCLA established the superfund, a trust fund to help pay for cleanup of hazardous materials sites. The EPA has authority to collect cleanup costs from those who release the waste material. Cleanup funds come from fines and penalties, from taxes on chemical/ petrochemical feed stocks, and the U.S. Treasury Dept. A separate fund collects taxes on active disposal sites to finance monitoring after they close. CERCLA is a result of the problems that arose from the release of hazardous materials in the Love Canal area near Niagara Falls, New York, August 1978.

CFC. Chlorofluorocarbon. Associated with damage to the Earth's ozone layer.

CFR. *Code of Federal Regulations.* A collection of the regulations established by law. Contact the agency that issued the regulation for details, interpretations, etc. Copies are sold by the Superintendent of Documents, Government Printing Office, Washington, DC 20402; (202) 512-1800.

cgs. Metric units of measure based upon centimeter, gram, and second.

Chelating Agent. A substance (e.g. EDTA) which can remove heavy metal toxins (such as lead, mercury, or arsenic) from the blood by complexing them and allowing their excretion in urine.

Chemical Cartridge Respirator. A respirator using various chemical substances to purify inhaled air of certain contaminative gases and vapors. Approved for concentrations no more than 10 times the TLV for a half facepiece and 100 times the TLV for a full facepiece, provided the contaminant has warning properties (odor or irritation) near the TLV.

Chemical Family. A group of single elements or compounds of a common general type. For example, acetone, methyl ethyl ketone (MEK), and methyl. isobutyl ketone (MIBK) are of the ketone family; acrolein, furfural, and acetaldehyde are of the aldehyde family.

Chemical Formula. The number and kind of atoms comprising a molecule of a material. Water's chemical formula is H20 water molecule consists of 2 atoms of hydrogen and 1 atom of oxygen.

Chemical Hygiene Officer. Per 29 CFR 1910.1450; OSHA regulation, "Occupational Exposures to Hazardous Chemicals in Laboratories." The designated, qualified employee who assists in the development and implementation of the CHP. See CHP.

Chemical Name. A chemical's scientific name. Complex chemicals may have more than one name, corresponding to different naming systems.

Chemical Pneumonitis. Inflammation of the lungs caused by inhaling a chemical that is irritating or otherwise toxic to the lungs.

Chemical Reactivity. A chemical's tendency to react with other materials. Undesirable and dangerous effects such as heat, explosions, or production of noxious substances can result.

Chemiluminescence. Emission of light during a chemical reaction other than burning.

CHEMTREC. Chemical Transportation Emergency Center. Established in Washington, DC, by the Chemical Manufacturers Association

(CMA) to provide emergency information on materials involved in transportation accidents. 24-hour number: (800) 424-9300.

Chloracne. A severe form of skin acne caused by exposure to certain chlorinated chemical compounds.

CHP, Chemical Hygiene Plan. Per 29 CFR 1910.1450, OSHA standard; "Occupational Exposures to Hazardous Chemicals in Laboratories." Effective May 1 1990. A written plan that includes specific work practices, standard operating procedures, equipment, engineering controls, and policies to ensure that employees are protected from hazardous exposure levels to all potentially hazardous chemicals in use in their work area. This OSHA standard provides for training, employee access to information, medical consultations, examinations, hazard identification procedures, respirator use, and record keeping practices. See paragraph E of the Standard.

Chronic Exposure. Continuous or intermittent exposure extending over a long time period, usually applies to relatively low material amounts or concentrations.

Chronic Health Effect. An adverse effect on a human or animal body with symptoms that develop slowly over a long time period and persist or that recur frequently. See Acute Health Effect.

Chronic Toxicity. Adverse health effects resulting from long-term exposure to a chemical (e.g. months, years, decades).

Clastogenic. An agent that causes damage to genetic material (i.e., breakage or disruption of chromosomes).

Closed Cup. See CC.

Closed System. Equipment designed and used so that there is no release of the chemical into the surrounding environment.

CNS. See Central Nervous System.

CNS Depression. See Central Nervous System Depression.

CO, Carbon Monoxide. A colorless, odorless, flammable, and very toxic gas produced by incomplete combustion of carbon compounds and as a by-product of many chemical processes. A chemical asphyxiant, it reduces the blood's ability to carry oxygen. Hemoglobin absorbs CO 200 times more readily than it does oxygen.

$C0_2$, Carbon Dioxide. A dense, colorless gas produced by combustion and decomposition of organic substances and as a by-product of many chemical processes. C02 does not bum and is relatively nontoxic and unreactive. High concentrations, especially in confined places, can create hazardous oxygen-deficient environments that can cause asphyxiation. CO_2 is 1.5 times as dense as air, making it useful as a fire-extinguishing agent to block oxygen and smother a fire.

COD, Chemical Oxygen Demand. The amount of oxygen required under designated test conditions to oxidate waterborne organic and inorganic material. Used in measuring the degree of pollution in domestic and industrial waters.

Code of Federal Regulations See CFR.

Coefficient of Water/Oil Distribution. Also called the partition coefficient, it is the ratio of the solubility of a chemical in water to its solubility in oil. Used to indicate how easily human or other organisms can absorb or store a material. Sometimes abbreviated Ko/w; may also be expressed as its logarithm, log Ko/w.

Coma. Extended loss of consciousness due to an injury, illness, or poison.

Combustible. A materials that will bum under most conditions and may ignite easily depending on its flash point. The DOT defines *combustible liquids* as a liquid with a flash point above 141 ºF (60.5 ºC) and below 200 ºF (93 ºC). Both NFPA and OSHA generally define *combustible liquid* as a liquid with a flash point at or above 100 ºF (38 ºC but below 200 ºF (93.3 ºC).

Common Name. A designation for a material other than its chemical name, such as code name or code number or trade, brand, or generic name. May be used as the "product identifier" in Canadian law [Workplace Hazardous Materials Information System (WHMIS) regulations].

Compressed Gas. Any material which is a gas at normal temperature and pressure, and contained under pressure as a dissolved gas or liquefied by compression or refrigeration.

conc. Concentration.

Conjunctivitis. Irritation and inflammation of the lining of the eye and eyelids.

Consumer Products Safety Commission. See CPSC.

Convulsions. Violent body spasms; fits or seizures.

Cornea. Transparent structure of the eyeball's external layer.

Corrosion Rate. Expressed in inches or millimeters of steel (or other defined material) per year, at a stated temperature.

Corrosive. A chemical that causes visible destruction of or irreversible alterations in living tissue by chemical action at the site of contact, or which causes a severe corrosion rate in steel or aluminum. A waste that exhibits a "characteristic of corrosivity (40 CFR 261.22)," as defined by RCRA, and may be regulated by EPA as a hazardous waste.

cP. See Centipoise.

CPSC. Consumer Products Safety Commission. A Federal agency responsible for regulating hazardous materials when they are used in consumer goods per the Hazardous Substances Act and Poison Prevention Packaging Act of 1970.

Critical Pressure/Critical Temperature. A temperature above which a gas cannot be liquefied by pressure. The critical pressure is that pressure required to liquefy a gas at its critical temperature.

Cryogenic. Relating to extremely low temperature. For example, refrigerated gases are cryogenic materials that can cause frostbite on contact.

cu ft, ft^3. Cubic foot. Cu ft is more usual.

cu m, m^3. Cubic meter. m^3 is preferred.

Cutaneous. Pertaining to the skin (dermal).

CVS. Cardiovascular system (heart and blood vessels).

CWA. Clean Water Act. Public Law PL 92500. Found at 40 CFR 100-140 and 400-470. Effective November 18, 1972, and amended significantly since then. EPA and Army Corps of Engineers have jurisdiction. CWA regulates the discharge of nontoxic and toxic pollutants into surface waters. Its ultimate goal is to eliminate all discharges into surface waters. Its interim goal is to make surface waters usable for fishing, swimming, etc. EPA sets guidelines, and states issue permits (NPDES, Natural Pollutant Discharge Elimination System permit) specifying types of control equipment and discharges for facilities.

Cyanosis. A dark blue to purplish coloration of the skin and the mucous membrane caused by lack of oxygen utilization by the body.

Dangerously Reactive Material. A material that can react by itself (e.g., polymerize) or with air or water to produce a hazardous condition. Preventive measures can be taken if you know what conditions may cause the dangerous reaction.

Dec, Decomp. Decompose, Decomposition. Breakdown of a material (by heat, chemical reaction, electrolysis, decay, or other processes) into parts, elements, or simpler compounds.

Deliquescent. A term used to characterize water-soluble salts (usually powdered) that tend to absorb moisture from the air and to soften or dissolve as a result. See Hygroscopic; Hydrophilic.

Demulcent. A material capable of soothing or protecting inflamed, irritated mucous membranes.

Density. Ratio of weight (mass) to volume of a material, usually in grams per cubic centimeter or pounds per gallon. See Specific Gravity and Bulk Density.

Dermal. Pertaining to the skin (cutaneous).

Dermal Toxicity. Adverse effects resulting from a material's absorption through skin. Ordinarily used to denote effects on experimental animals.

Dermatitis. Skin rash; inflammation of the skin.

Designated Area. An area of (or device within) a lab to be used for work with select carcinogens, reproductive toxins, and other materials which have a high degree of acute toxicity. An administrative control intended to minimize the potential for employee exposure to hazardous chemicals.

Diaphoresis. Perspiration, especially profuse.

Dilution Ventilation. See General Ventilation.

DOT. U.S. Dept. of Transportation. Regulates transportation of materials to protect the public as well as fire, law enforcement, and other emergency-response personnel. DOT classifications specify the use of appropriate warnings, such as Oxidizing Agent or Flammable Liquid. (400 7th St., SW, Washington, DC 20590.)

DOT Identification Numbers. Four-digit numbers used to identify particular materials for regulation of their transportation. See DOT publications that describe the regulations (49 CFR 172. 10 1). These numbers are called product identification numbers (PINs) under the Canadian Transportation of Dangerous Goods Regulations. Those numbers used internationally may carry a UN prefix (e.g., UN 1170, ethyl alcohol), but those used only in North America have an NA prefix (e.g., NA 9163, zirconium sulfate).

Dust. Solid particles suspended in air, often produced by some mechanical process such as crushing, grinding, abrading, or blasting. Dusts may be inhalation, fire, or dust explosion hazards.

Dysplasia. Abnormal growth or development of organs or cells.

Dyspnea. A sense of difficulty in breathing; shortness of breath.

Dysuria. Difficult or painful urination.

EC_{50}. (Median) effective concentration. The concentration of a material expressed in ppm or ppb in the environment (usually water), a single dose of which is expected to cause a biological effect on 50% of a group of test animals.

Eczema. A skin rash characterized by redness, itching, sometimes blistering; may become scaly or crusty.

ED_{50}. (Median) effective dose, usually expressed in mg/kg, that produced a specified effect in 50% of the test population.

Edema. Swelling due to accumulation of fluid in tissues.

EEC. European Economic Community.

EINECS. The European Inventory of Existing Chemical Substances. A list of chemical substances identified by CAS and EINECS numbers that were marketed in the European Community between January 1 1971 and September 18, 1981.

ELINICS. A list of approximately 400 chemicals identified by EINECS numbers, established with the European Community from September 18, 1981 to June 30, 1990. The list was published on May 29, 1991 and is a supplement to EINECS. Additional supplements will be added as necessary.

Electrolyte. A substance (as an acid, base, salt) that dissociates into ions when in aqueous solution and that provides ionic conductivity. Electrolytes are lost from the body through perspiration as salts, causing impairment of CNS functions if not adequately replaced.

Embolism. Obstruction of a blood vessel by a transported clot, a mass of bacteria, etc.

Embryo. An organism in the early stages of development before birth. In humans, the developing child is considered an embryo from conception to the end of the second month of pregnancy.

Embryotoxin. A material harmful to a developing embryo at a concentration that has no adverse effect on the pregnant female.

Emetic. An agent, such as syrup of ipecac, which induces vomiting. *Never* use emetics if victim is not alert or after ingestion of solvents; always seek medical advice before giving an emetic.

Emphysema. An irreversible lung condition in which the alveolar walls lose resiliency, resulting in excessively reduced lung capacity.

Endothermic. A chemical reaction that absorbs heat.

Engineering Controls. Engineering control systems reduce potential hazards by isolating the worker from the hazard or by removing the hazard from the work environment. Methods include substitution, ventilation, isolation, and enclosure. This is preferred over administrative controls and personal protective equipment.

EP. Extreme pressure.

EPA, (U.S.) Environmental Protection Agency. A Federal agency with environmental protection regulatory and enforcement authority. Administers the CAA, CWA, RCRA, TSCA, and other Federal environmental laws. (400 M Street, SW, Washington, DC 20460; [202] 382-2090.)

Epidemiology. The study of the relationships between diseases and the various factors that could determine their frequency and distribution in populations.

Epiphora. Excessive flow of tears.

Epistaxis. Nosebleed.

Ergonomics. The study of human characteristics for appropriate design of living and work environments.

Erythema. Redness of the skin; usually due to a local increase in blood flow.

Etiology. All factors that contribute to the cause of a disease or an abnormal condition.

Evaporation Rate. The rate at which a material vaporizes (volatilizes, evaporates) from the liquid or solid state when compared to a known material's vaporization rate. Evaporation rate can be useful in evaluating a material's health and fire hazards. The known reference material is usually normal butyl acetate (N-BuAc or n-BuAc), with a vaporization rate designated as 1.0. Vaporization rates of other solvents or materials are then classified as 1) Fast evaporating if greater than 3.0, e.g., methyl. ethyl ketone (MEK), 3.8; acetone, 5.6; hexane, 8.3; 2) *Medium* evaporating if 0.8 to 3.0, e.g., 190-proof (95%) ethyl alcohol, 1.4; VM&P naphtha, 1.4; MIBK, 1.6; 3) Slow evaporating if less than 0.8, e.g., xylene, 0.6; isobutyl alcohol, 0.6; normal butyl alcohol, 0.4; water, 0.3; mineral spirits, 0.1.

Explosive. A material that produces a sudden, almost instantaneous release of pressure, gas, and heat when subjected to abrupt shock, high temperature, or an ignition source.

Explosive Limits. See Flammable Limits.

Exposure Limits. The concentration in workplace air of a chemical deemed the maximum acceptable. Meaning that most workers can be exposed at given levels or lower without harmful effects. Exposure limits in common use are; 1) TLV-TWA (threshold limit value - time-weighted average); 2) STEL (short-term exposure limit); and 3) C (ceiling value).

Exothermic. A chemical reaction that gives off heat.

Extinguishing Media, Agents. The type of fire extinguisher or extinguishing method appropriate for a specific material. Some chemicals react violently in the presence of water, so other methods, such as the use of foam or C02, should be followed.

ºF or F. Degrees Fahrenheit. See ºC.

f/cc. Fibers per cubic centimeter of air.

Fasciculation. Muscular twitching.

Federal Register (U.S.). See FR.

Fiber. A basic form of matter, usually crystalline, with a high ratio of length to diameter. Examples: animal (wool); vegetable (cotton); mineral (asbestos, steel); and synthetic (rayon, carbon, high polymers).

Fibrosis. Scarring; scarring in the lungs may affect oxygenation of blood.

FIFRA. The Federal Insecticide, Fungicide, and Rodenticide Act. Enacted on October 2 1, 1972, this act provides the regulatory authority for registration and use of pesticides and similar products intended to kill or control insects, rodents, and weeds.

Fines. Finely crushed or powdered material or fibers; especially those smaller than the average in a mix of various sizes.

Fire Diamond (NFPA Hazard Rating). The National Fire Protection Agency (NFPA) visual rating system that addresses the health, flammability, reactivity, and related hazards of a material that may exist due to a short-term, acute exposure caused by a fire, spill, or similar emergency. Per "NFPA 704" publication.

Position A - Health Hazard *(Blue).* Degree of hazard; level of short-term protection
0 = Ordinary Combustible Hazards in a Fire
I = Slightly Hazardous
2 = Hazardous
3 = Extreme Danger
4 = Deadly

Position B - Flammability *(Red).*
Susceptibility to burning
0 = Will Not Burn
I = Will Ignite if Preheated
2 = Will Ignite if Moderately Heated
3 = Will Ignite at Most Ambient Conditions
4 = Bums Readily at Ambient Conditions

Position C - Reactivity, Instability *(Yellow).*
Energy released if burned, decomposed, or mixed
0 = Stable and Not Reactive with Water
1 = Unstable if Heated
2 = Violent Chemical Change
3 = Shock and Heat May Detonate
4 = May Detonate

Position D - Special Hazard *(White).*
OX = Oxidizer
~~W~~ = Use No Water, reacts!

Fire Point. The lowest temperature at which a liquid produces sufficient vapor to flash near its surface and continues to burn.--usually 10 to 30 ºC higher than the flash point.

First Aid. Immediate measures that can be taken by the victim or others in order to reduce or eliminate the potential effects of a chemical exposure or other injury.

Flammable. Describes any solid, liquid, vapor, or gas that ignites easily and burns rapidly. See Combustible and Inflammable.

Flammable Aerosol. A material is considered a flammable aerosol if it is packaged in an aerosol container and can release a flammable material.

Flammable Gas. A gas that at normal atmospheric pressure forms a flammable mixture with air at a concentration of 13% by volume or less; or over a concentration range greater than 12% by volume, regardless of lower limit.

Flammable Limits (Flammability Limits, Explosive Limits). Minimum and maximum concentrations of a flammable gas or vapor between which ignition can occur. Concentrations below the lower flammable limit (LFL) are too lean to bum, while concentrations above the upper flammable limit (UFL) are too rich. All concentrations between LFL and UFL are in the flammable range, and special precautions are needed to prevent ignition or explosion.

Flammable Liquid. A liquid that gives off vapors readily ignitable at room temperature. The DOT defines a flammable liquid as a liquid with a flash point of not more than 141 'F (60.5 'Q. The NFPA and OSHA generally define a flammable liquid as a liquid with a flash point below 100 ºF (37.8 ºC).

Flammable Solid. A solid, other than an explosive or blasting agent, that ignites readily and continues to burn so vigorously and persistently that it creates a serious hazard. Flammable solids are liable to cause fires under ordinary conditions or during transportation, through friction, as a result of spontaneous chemical change, or from retained heat from manufacturing or processing, or moisture absorption.

Flash Back. Occurs when a distant spark or ignition source ignites a trail of flammable material (e.g., gasoline vapor). The flame then travels along the trail of the material back to its source.

Flash Point, FP. Lowest temperature at which a flammable liquid gives off sufficient vapor to form an ignitable mixture with air near its surface or within a vessel. Combustion does not continue. FP is determined by laboratory tests in cups. See Fire Point.

Foam. Fire-fighting material consisting of water and foaming agents into which air is blown, producing a voluminous, stable blanket of bubbles. The foam clings to vertical and horizontal surfaces and flows freely over burning materials. Foam puts out a fire by blanketing it, excluding air, and blocking escape of volatile vapor. Its flowing properties resist mechanical interruption and reseal the burning material.

Fog. A visible suspension of fine droplets of liquid in a gas; e.g., water in air.

Formula Mass. The sum of atomic weights of the atoms in a molecule. For example, water (H2O) has a formula mass of 18.0, the atomic weights being [hydrogen: 2(1.0) + oxygen: 16] = 18.0.

FP. See Flash Point.

FR. *Federal Register.* A daily publication that lists and discusses Federal regulations. Available from the Government Printing Office.

Freezing Point. The temperature at which a material changes from a liquid to a solid state upon cooling. This information is important because a frozen material may burst its container or the hazards could change.

Fugitive Emission. Gas, liquid, solid, vapor, fume, mist, fog, or dust that escapes from process equipment or a product.

Full Protective Clothing. Fully protective gear that prevents skin contact with, inhalation of, or ingestion of gases, vapor, liquids, and solids (dusts, etc.). Includes SCBA (self-contained breathing apparatus).

Fumes. Tiny solid particles formed by the vaporization of a solid which then condenses in air; particles are usually of a size which readily reach the air sacs (alveoli) of the lungs.

g. Grain. Metric unit of weight. See kg.

Gangrene. Death of tissue leading to its rotting.

Gas. A formless fluid which disperses in air; often found in tanks or cylinders and may be created by a chemical reaction. It can be changed to its liquid or solid state only by increased pressure and/or decreased temperature.

Gastric Lavage. Washing out the stomach with a tube and fluids. Pumping the stomach.

Gastroenteritis. Stomach and intestine inflammation.

Gastrointestinal Tract (GI tract). The stomach and intestine as a functional unit.

Gavage. Feeding by means of a stomach tube.

General Ventilation. Also known as dilution ventilation. The removal of contaminated air and its replacement with clean air from the general workplace area as opposed to local ventilation, which is specific air changing in the immediate area of a contamination source. An example of local ventilation is a laboratory fume hood.

Generic Name. A common, possibly chemical, name applied generally to a substance. For example, bleach is the generic name for the chemical sodium hypochlorite. Chlorox ™ is a tradename for bleach. A chemical name may be used as a generic name, but tradenames are not generic names.

Gestation. The development of the fetus in the womb from conception to birth (i.e., pregnancy).

GI, GIT. See Gastrointestinal Tract.

Gingivitis. Inflammation of the gums.

GRAS. Generally recognized as safe. A phrase applied to food additives approved by the Food and Drug Administration (FDA).

Grounding. A safety practice to conduct any electrical charge to the ground, preventing sparks that could ignite a flammable material. See Bonding.

h, hr(s). Hour(s).

Hazard Communication Rule. Requires chemical manufacturers and importers to assess the hazards associated with the materials in their workplace (29 CFR 1910.1200). Material safety data sheets, labeling, and training are all results of this law. You are urged to acquire and become familiar with these regulations. Contact your local OSHA office. See OSH Act.

Hazardous Chemical, Material. In a broad sense, any substance or mixture of substances having properties capable of producing adverse effects on the health or safety of a human. In 1971 OSHA adopted the following definition in regulations affecting employers in operations subject to the Federal Longshoremen's and Harbor Worker's Compensation Act. "The term *Hazardous Material* means a material which has one or more of these characteristics:

1) Has a flash point below 140 ºF (60 ºC), closed cup, or is subject to spontaneous heating;
2) Has a threshold limit value below 400 ppm for gases and vapors, below 15 mg/m3 for fumes, and below 25 mppcf (million particles per cubic foot) for dusts;
3) Has a single dose oral LD_{50} below 500 mg/kg;
4) Is subject to polymerization with the release of large amounts of energy;
5) Is a strong oxidizing or reducing agent;
6) Causes first-degree burns to skin [from a] short time exposure, or is systemically toxic by skin contact; or
7) In the course of normal operations, may produce dusts, gases, fumes, vapors, mists, or smokes which have one or more of the above characteristics." Included are substances that are carcinogens, toxic, irritants, corrosives, sensitizers, and agents which damage the lungs, skin, eyes, mucous membranes, etc.

Hazardous Decomposition. A breaking down or separation of a substance into its constituent parts, elements, or into simpler compounds accompanied by the release of heat, gas, or hazardous materials.

Hazardous Decomposition Products. Hazardous products resulting from decomposition of a material. For example, vinyl chloride, a compound used to make plastics, releases poisonous hydrogen chloride, carbon monoxide, and phosgene gases when burned.

Hazard Warning. Defined by OSHA as "any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which convey the hazard(s) of the chemical(s) in the container(s)".

Hazardous Waste Number. An identification number assigned by the EPA, per the RCRA law (40 CFR 261.33, 40 CFR 302.4), to identify and track wastes.

Health Surveillance. The continuing scrutiny of specific individuals for the purpose of identifying disorders or health states, especially those which may relate to exposure to hazardous materials.

Hematopoietic System. Blood production system of the body.

Hematuria. Blood in the urine.

Hemolysis. Destruction of red blood cells leading to release of hemoglobin.

HEPA. High-efficiency particulate air filter. Also called absolute. Has a 99.97% removal efficiency for 0.3-micron particles.

Hepatic. Pertaining to the liver.

Hepatotoxins. Substances poisonous to the liver.

HMIS. The hazardous materials identification system developed by the National Paint and Coatings Association (NPCA) to provide information on the acute health, reactivity, and flammability hazards encountered in the workplace. This system also includes temperatures under fire conditions (especially for flammability and reactivity). A number is assigned to a material indicating degree of hazard, from 0 for the least up to 4 for the most severe. Letters designate personal protective equipment. (Details from Labelmaster, 5724 N Pulaski Rd, Chicago, IL 60646; [312] 478-0900.) See NPCA.

Hydrolysis. Process by which chemical compounds are decomposed by reaction with water.

Hydrophilic. Describing materials having large molecules that tend to absorb and retain water, causing them to swell and frequently to gel. See Deliquescent.

Hygroscopic. Readily adsorbing available moisture in any form. See Deliquescent.

Hyperemia. Congestion of blood in a body part.

Hypergolic. Self-igniting upon contact of its components without a spark or external aid; especially rocket fuel or a propellant that consists of combinations of fuels and oxidizers.

Hypocalcemia. Calcium deficiency of the blood.

Hypoxia. Insufficient oxygen reaching the tissues of the body. See Anoxia.

I. Intermittent.

IARC. International Agency for Research on Cancer. One of the three sources that OSHA refers to for data on a material's carcinogenicity. (World Health Organization, Geneva, Switzerland; distributed in the USA from 49 Sheridan Avenue, Albany, NY 12210 [5181436-9686.)

IDLH. Immediately dangerous to life and health. The maximum concentration from which one could escape within 30 min without any escape-impairing symptoms or irreversible health effects. Used to determine respirator selection. (Note: Carcinogenic effects were not considered in setting these values.)

Ignition Temperature. The lowest temperature at which a combustible material ignites in air and continues to bum independently of the heat source.

Impervious Describes a material that does not allow another substance to penetrate or pass through it; impermeable.

Incompatible. Describes materials that could cause dangerous reactions and the release of energy from direct contact with one another.

Inert Ingredients. Anything other than the active ingredient in a product;,, not having active properties. Inert ingredients may be hazardous. For example, the propellant gas in aerosol spray, such as hair spray, may be flammable.

Inflammable. Capable of being easily set on fire and continue burning, especially violently. *Do not confuse with nonflammable.* See Combustible and Flammable.

Inflammation. A local response to cellular injury due to trauma, infection, or chemical irritation; symptoms include swelling, redness, pain, tenderness, and loss of function.

Ingestion. Swallowing a chemical substance; may inadvertently result from eating, drinking, or smoking in the workplace or with contaminated hands.

Inhalation. Entry of a chemical substance to the lungs by breathing.

Inhibitor. A material added to another to prevent an unwanted reaction; e.g., polymerization.

Inorganic Materials. Compounds derived from other than vegetable or animal sources that do not generally contain carbon atoms. Some simple carbon compounds are considered inorganic (e.g., C02, carbonates, cyanides).

Insol. Insoluble.

Interstitial Fibrosis. Scarring of the lungs.

Intraperitoneal. A route of administration for toxicological studies. A material is injected into the peritoneal (abdominal/pelvic) cavity.

Iodism. An abnormal condition resulting from prolonged (chronic) exposure to iodine or its compounds - characterized by emaciation, skin eruptions, headache, excess salivation, runny nose, and sneezing.

Iridocyclitis. Inflammation of both the eye's iris and its ciliary body.

Irritant. A substance capable of causing a reversible or irreversible inflammatory effect on living tissue by chemical action at the site of contact as a function of concentration or duration of exposure.

Isomers. Chemical compounds with the same molecular weight and atomic composition but differing molecular structure; e.g., n-pentane and 2-methylbutane.

I.V. Intravenous. Injection of a substance into a vein.

Jaundice. Yellowish discoloration of tissue (skin), whites of eyes (sclera), and bodily fluids with bile pigment (bilirubin) caused by Ever damage, gall bladder disease, or hemolysis.

Ketosis. The condition marked by excessive production or accumulation of ketone bodies in the body caused by disturbed carbohydrate metabolism.

kg, kilogram. 1000 gram.

L, l. Liter. Basic metric unit of volume. One liter of water weighs I kg and is equal to 1.057 quarts.

Label. Any written, printed, or graphic sign or symbol displayed on or affixed to containers of hazardous chemicals. A label should identify the hazardous material, appropriate hazard warnings, and name and address of the chemical manufacturer, importer, or other responsible party.

Laboratory. Per 29 CFR 1910.1450, a facility where laboratory use of hazardous chemicals occurs; where relatively small quantities of hazardous chemicals are used on a non-production basis.

Laboratory Scale (Activity). The work involves containers of substances used for reactions and transfers that are designed for easy and safe handling by one person. Workplaces that produce commercial quantities of materials are excluded from the definition of "Laboratory."

Laboratory-type Hood. An enclosed laboratory cabinet with a moveable sash or fixed access port on the front, connected to a ventilating system which may incorporate air scrubbing or filtering facilities. In operation it draws in and then exhausts air from the lab to prevent or minimize the escape of air contaminants. It enables employees to manipulate materials in the hood using only their hands and arms. Walk-in hoods are permitted if airflow and exhaust remove contaminants and the employee is not within the enclosure when contaminants are released.

Laboratory Use. Of hazardous chemicals is when all of these conditions are met: a) Chemical manipulations are carried out on a "laboratory scale." b) Multiple chemical procedures or chemicals are used. c) The procedures are neither part of nor simulate a production process. d) Protective lab practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

Lacrimation. Secretion and discharge of tears.

Lacrimator. A material that upon exposure to it causes tears.

Landfill. Disposal of trash and waste products at a controlled location that is then sealed and buried under earth. Increasingly seen as a less than satisfactory disposal method because of the long-term environmental impact of waste materials in the ground.5-

Latency Period. Time that elapses between exposure and first manifestations of disease or illness. Latency periods can range from minutes to decades, depending on hazardous material and disease produced.

Lavage. Rinse with water.

Lay Language. Language that is easily understood by the general public without specialized training.

LC_{50}. Lethal concentration 50, median lethal concentration. The concentration of a material in air that on the basis of laboratory tests (respiratory route) is expected to kill 50% of a group of test animals when administered as a single exposure in a specific time period, usually I hr. LC_{50} is expressed as parts of material per million parts of air, by volume (ppm) for gases and vapors, as micrograms of material per liter of air (µg/l), or milligrams of material per cubic meter of air (mg/m^3) for dusts and mists, as well as for gases and vapors.

LC_{Lo}. Lethal concentration low. Lowest concentration of a substance in air reported to have caused death in humans or animals. The reported concentrations may be entered for periods of exposure less than 24 hr (acute) or greater than 24 hr (subacute and chronic).

LD_{50}. Lethal dose 50. The single dose of a substance that causes the death of 50% of an animal population from exposure to the substance by any route other than inhalation. LD_{50} is usually expressed as milligrams or grains of material per kilogram of animal weight (mg/kg or g/kg). The animal species and means of administering the dose (oral, intravenous, etc.) should also be stated.

LD_{Lo}. Lethal dose low. The lowest dose of a substance introduced by any route, other than inhalation, reported to have caused death in humans or animals.

Leaching. The movement of a substance down through or out of soil as a result of its mixing and moving with water. Important when assessing a material's ability to contaminate groundwater.

LEL. See Lower Explosive Limit, Lower Flammable Limit.

Lesion. An abnormal change, injury, or damage to tissue or to an organ.

Lethargy. A sense of fatigue, drowsiness, and laziness.

Leukemia. A progressive, malignant disease of the blood-forming organs.

LFL. See Lower Flammable Limit, Lower Explosive Limit.

LFM or **lfm.** Linear feet per minute.

Limits of Flammability. See Flammable Limits.

Lipid Granuloma. A mass of chronically inflamed tissue that is usually infective.

Lipid Pneumonia. A chronic condition caused by aspiration of oily substances into the lungs.

Local Ventilation. The drawing off of contaminated air directly from its source. This type of ventilation is recommended for hazardous airborne materials. Treatment of exhausted air to remove contaminants may be required.

Lower Explosive Limit, Lower Flammable Limit. Refers to the lowest concentration of gas or vapor (% by volume in air) that bums or explodes if an ignition source is present at ambient temperatures. See Flammable Limits.

m. Meter. The basic metric measure of length equivalent to 39.371 in.

m^3 or **cu m.** Cubic meter; m^3 is preferred.

Malaise. A vague, generalized, ill feeling.

Material Safety Data Sheet. See MSDS.

Maximum Safe Storage Temperature (MSST). See SADT (Self-Accelerating Decomposition Temperature).

Melting Point. The temperature above which a solid changes to a liquid upon heating.

Mercaptans. A group of organic compounds resembling alcohols, but with sulfur replacing the oxygen of the hydroxyl group. For example, ethanethiol [C_2H_5SH].

Metabolism. The process of change some chemicals go through after absorption by the body.

Metastasis. The transmission of a disease from one part of the body to another.

Meter (m). The basic metric measure of length; equivalent to 39.371 in.

Methemoglobinemia. The presence of methemoglobin in the bloodstream caused by the reaction of materials with the hemoglobin in red blood cells that reduces their oxygen-carrying capacity. Methemoglobin is a soluble, brown, crystalline blood pigment that differs from hemoglobin in that it contains the iron (III) ion instead of iron (II) and is unable to combine reversibly with molecular oxygen.

mg. Milligram (1/1000, 10^{-3}, of a gram).

mg/kg. Milligram per kilogram. Dosage used in toxicology testing to indicate a dose administered per kg of body weight.

mg/m^3. Milligram per cubic meter of air. mg/m^3 = ppm x MW/24.45 at 25 ºC.

Microgram (µg). One-millionth (10^{-6}) of a gram.

Micrometer (µm). One-millionth (10^{-6}) of a meter; often referred to as a micron.

Micron (µ). See micrometer.

Millimeter (mm). 1/1000 (10^{-3}) of a meter.

min. Minute.

Mine Safety and Health Administration. See MSHA.

Miscible. When two liquids or two gases are completely soluble in each other in all proportions. While gases mix with one another in all proportions, the miscibility of liquids depends on their chemical natures.

Mist. Suspended liquid droplets in the air generated by condensation from the gaseous to the liquid state or by mechanically breaking up a liquid by splashing or atomizing.

MITI. Japanese Ministry of International Trade and Industry.

Mixture. A heterogeneous association of materials that cannot be represented by a chemical formula and that does not undergo chemical change due to interaction among the mixed materials. The constituent materials may or may not be uniformly dispersed and can usually be separated by mechanical means (as opposed to a chemical reaction). Uniform liquid mixtures are called solutions. "If a hazardous chemical is present in the mixture m, reportable quantities (i.e., 0.1% for carcinogens and 1.0% for other health hazards), it must be reported unless the mixture has been tested as a Whole" (OSHA CPL 23-02.38A).

ml. Milliliter. One thousandth of a liter. A metric unit of capacity, for all practical purposes equal to 1 cubic centimeter. One cubic inch is about 16 ml.

MLD. Mild irritation effects.

mm Hg. A measure of pressure in millimeters of a mercury column above a reservoir, or difference of level in a U-tube. See atm.

MOD. Moderate irritation effects.

Mole or mol. The quantity of a chemical substance that has a mass in grams numerically equal to the formula mass. For example, table salt (NaCl) has a formula mass of 58.5 (Na, 23, and Cl, 35.5). Thus, one mole of NaCl is 58.5 g.

Molecular Weight. See Formula Mass.

Molecule. Smallest representative particle of a covalently bonded chemical compound.

mppcf. Millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques (OSHA).

MSDS. Material safety data sheet. A fact sheet summarizing information about material identification; hazardous ingredients; health, physical, and fire hazards; first aid; chemical reactivities and incompatibilities; spill, I leak, and disposal procedures; and protective measures required for safe handling and storage. OSHA has established

guidelines for descriptive data that should be concisely provided on a data sheet to serve as the basis for written hazard communication programs. The thrust of the law is to have those who make, distribute, and use hazardous materials responsible for effective communication. See Hazard Communication Rule, 29 CFR, Part 1910.1200, as amended, Sec. g. See also Schedule 1, Sec. 12, of the Canadian Hazardous Products Act. The CMA has recently drawn up a set of guidelines for developing a consistent MSDS format. This standard format has been accepted by ANSI.

MSHA. Mine Safety and Health Administration. A Federal agency within the U.S. Dept. of Labor that devises and promulgates mandatory safety and health rules for mines.

MSST (Maximum Safe Storage Temperature). See SADT (Self-Accelerating Decomposition Temperature).

Mucous Membrane. The mucous-secreting membrane lining the hollow organs of the body, i.e., nose, mouth, stomach, intestine, bronchial tubes, and urinary tract.

Mutagen. A material that induces genetic changes (mutations) in the DNA of chromosomes. Chromosomes are the "blueprints" of life within individual cells. Mutagens may affect future generations if sperm or egg cells are affected.

MW. See Molecular Weight.

N (Newton). The metric unit of force, approximately equal to the weight of a 102.5 g mass.

***n*-.** Normal. A chemical name prefix signifying a straight-chain structure; i.e., no branches.

NA, ND. Not applicable, not available; not determined.

NA Number. See DOT Identification Numbers.

Narcosis. Sleepiness or a state of unconsciousness caused by a chemical.

National Fire Protection Association. See NFPA.

National Toxicology Program. See NTP.

Nausea. A tendency to vomit; a feeling of sickness in the stomach.

NCI. National Cancer Institute. A part of the National Institutes of Health that studies cancer.

Necrosis. Localized death of tissue.

Neoplasm. A new or abnormal tissue growth that is uncontrollable and progressive.

Nephrotoxic. Poisonous to the kidney.

Nephrotoxins. Substances poisonous to the kidneys

Neuritis. Inflammation of the nerves.

Neurotoxins. Substances poisonous to the nervous system.

Neutralize. To render less chemically reactive; to change the pH to about 7 (neutral) by adding acid to a basic compound or base to an acidic compound.

NFPA. National Fire Protection Association. An international voluntary membership organization formed to promote and improve fire protection and prevention and establish safeguards against loss of life and property by fire. Best known for the *National Fire Codes,* 16 volumes of standards, recommended practices, and manuals developed (and periodically updated) by NFPA committees. NFPA 704M publication is the code for showing hazards of materials using the familiar diamond-shaped label with appropriate numbers or symbols (NFPA hazard rating). See Fire Diamond. (Batterymarch Park, Quincy, MA 02269; [800] 344-3555, [617] 770-3000.)

NFPA Hazard Rating. See Fire Diamond.

ng. Nanogram. One billionth, 10^{-9}, of a grain.

NIOSH. National Institute of Occupational Safety and Health. The agency of the Public Health Service that tests and certifies respiratory and air-sampling devices. It recommends exposure limits to OSHA for substances, investigates incidents, and researches occupational safety. (NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226; [513] 533-8328.)

NLM. National Library of Medicine. A government library in Bethesda, Maryland, containing medical documents.

NOC. Not otherwise classified.

NOEL. No observable effect level.

Nonflammable. Incapable of easy ignition. Does not bum, or bums very slowly. Also, a DOT hazard class for any compressed gas other than a flammable one.

NOR. Not otherwise regulated.

NOS. Not otherwise specified.

NO_x. A general formula for oxides of nitrogen (NO, NO_2). They react with moisture in the respiratory tract to produce acids that corrode and irritate tissue, causing congestion and pulmonary edema. Symptoms of acute exposure can develop over 6 to 24 hr. Chronic exposure to low levels can cause irritation, cough, headache, and tooth corrosion. Exposure to 5 to 50 ppm of NO_2 can cause slowly evolving pulmonary edema. Commonly produced by combustion processes, including motor vehicle engines.

NPCA. National Paint and Coatings Association. The trade association of manufacturers that developed the HMIS labeling system. (1500 Rhode Island Avenue, NW, Washington, DC 20005; [202] 462-6272.) See HMIS.

NRC. National Response Center. A notification center that must be called if a RQ (reportable quantity) is released, or an oil or chemical spill or other environmental accident occurs. (1-800-424-8802).

NTP. National Toxicology Program. Federal activity overseen by the Department of Health and Human Services with resources from the National Institutes of Health, the Food and Drug Administration, and the Centers for Disease Control. Its goals are to develop tests useful for public health regulations of toxic chemicals, to develop toxicological profiles of materials, to foster testing of materials, and to communicate the results for use by others. (NTP Information Office, MD B2-04, Box 12233, Research Triangle Park, NC 27709.)

Nuisance Particulates. Dusts that do not produce significant organic disease or toxic effect from "reasonable" concentrations and exposures. Otherwise known as "Particulates not otherwise classified" (PNOC). The 1992-93 ACGIH TLV is 10 mg/m^3. The value is for total dust containing no asbestos and <1% crystalline silica.

Nystagmus. Rapid, rhythmic, involuntary horizontal movements of the eyes.

Occupational Exposure. See Action Level.

Occupational Safety and Health Act. See OSH Act.

Occupational Safety and Health Administration. See OSHA.

Odor Threshold. The lowest concentration detectable by odor; note that published values vary greatly, as does an individual's ability to detect chemical odors; air monitoring is a much more reliable way to detect chemical hazards for many substances.

OEL. Occupational Exposure Limit. See Exposure Limits.

Oliguria. Scanty or low volume of urine.

Opaque. Impervious to light rays.

Open Transfer. Any transfer that at any time involves contact of a moving fluid with atmosphere, air, or oxygen. Open transfer of flammable liquids, especially Class IA liquids, is dangerous due to the release of flammable vapors into the work area. Since there is a risk of fire or explosion if an ignition source is present, do these transfers only in a hood.

Oral. An exposure route “through the mouth.”

Organic Materials. Compounds composed of carbon, hydrogen, and other elements with chain or ring structures. Almost all chemical constituents of living matter are of this type, but many compounds of this type are manufactured and do not occur naturally.

Organic Peroxide. A compound containing the bivalent – O – O – structure and which is a

structural derivative of hydrogen peroxide (H_2O_2) where one or both hydrogen atoms are replaced by an organic radical. These compounds tend to be reactive and unstable.

ORM. Other regulated material. DOT hazard classification of a particular hazardous material to label it in transport. **ORM-D:** materials such as consumer commodities that present limited hazards during transportation due to their form, quantity, and packaging.

OSHA. The Occupational Safety and Health Administration. Part of the U.S. Dept of Labor. The regulatory and enforcement agency for safety and health in most U.S. industrial sectors. (Documents are available from the OSHA Technical Data Center Docket Office, Rm N-3670, 200 Constitution Ave, NW, Washington, DC 20210; [2021 219-7500.)

OSH Act. The Occupational Safety and Health Act of 1970. Effective April 28, 1971. Public Law 91-596. Found at 29 CFR 19 10, 1915, 1918, 1926. OSHA jurisdiction. The regulatory vehicle to ensure the safety and health of workers in firms larger than 10 employees. Its goal is to set standards of safety that prevent injury and illness among the workers. Regulating employee exposure and informing employees of the dangers of materials are key factors. This act established the Hazard Communication Rule (29 CFR 1910.1200). See Hazard Communication Rule for details.

OSHA Flammable/Combustible Liquid Classification. (29 CFR 1910.106). Flammable/combustible liquid is a standard classification used to identify the risks of fire or explosion associated with a liquid. Flammable, or Class I, liquids (flash point below 38 ºC [100 ºF]) are divided into: Class IA -- flash point below 22.8 ºC (73 ºF), boiling point below 38 ºC (100 ºF); Class IB -- flash point below 22.8 ºC (73 ºF), boiling point at or above 38 ºC (100 ºF); and Class IC -- flash point at or above 22.8 ºC (73 ºF), boiling point below 38 ºC (100 ºF). Combustible liquids (flash point at or above 38 ºC [100 ºF]) are divided into two classes: Class II, flash point at or above 38 ºC (100 ºF) and below 60 ºC (140 ºF), except any mixture having components with flash points of 93.3 ºC (200 ºF) or higher, the volume of which makes up 99% or more of the mixture's total volume; and Class III, flash point at or above 140 ºF (60 ºC. Class III liquids are divided into two subclasses: Class IIIA, flash point at or above 60 ºC (140 ºF) and below 93.3 ºC (200 ºF), except any mixture having components with flash points of 93.3 ºC (200 ºF) or higher, the volume of which makes up 99% or more of the mixture's total volume; and Class IIIB, flash point at or above 93.3 ºC (200 ºF).

Oxidation. A reaction in which a substance combines with oxygen or another oxidizer.

Oxide Pox. Dermatitis caused by contact with metal oxides under poor personal hygienic conditions.

Oxidizer. The DOT defines an oxidizer or oxidizing material as a substance that yields oxygen readily to cause or enhance the combustion (oxidation) of other materials. Many oxidizers, such as chlorate (ClO_3), permanganate (MnO_4), and nitrate (NO_3) compounds contain large amounts of oxygen (O). Others, such as chlorine, do not.

Oxidizing Agent. A chemical or substance that brings about an oxidation reaction. The agent may; 1) provide the oxygen to the substance being oxidized (in which case the agent has to be oxygen or contain oxygen), or 2) receive electrons being transferred from the substance undergoing oxidation. (Chlorine is a good oxidizing agent for electron-transfer purposes, even though it contains no oxygen.) See Reducing Agent.

PAH. See Polycyclic Aromatic Hydrocarbons.

Palpitation. Irregular, rapid heartbeat.

Paresthesias. Altered sensations of the skin, often numbness and tingling, or "pins and needles" sensation.

Particulates. Solid or liquid particles suspended in air; aerosol.

Partition Coefficient. See Coefficient of Water/Oil Distribution.

PCB. Polychlorinated biphenyl. A family of compounds used as a heat-transfer medium. PCBs accumulate in tissue, are environmentally hazardous, and are believed harmful to human health. Their handling is regulated by law (40 CFR Part 761).

PEL. Permissible exposure limit. Established by OSHA. This may be expressed as a time-weighted average (TWA) limit, a short-term exposure limit (STEL), or as a ceiling exposure limit. A ceiling limit must never be exceeded instantaneously even if the TWA exposure limit is not violated. OSHA PELs have the force of law. Note that ACGIH TLVs and NIOSH RELs are recommended exposure limits that OSHA may or may not enact into law.

Pensky-Martens Closed Cup or **Closed Tester.** See PMCC.

Percent Volatile. Percent volatile by volume. The percentage of a liquid or solid (by volume) that evaporates at an ambient temperature of 70 ºF (20 ºC) unless another temperature is stated. E.g., gasoline and paint thinner (mineral spirits) are 100% volatile; their individual evaporation rates vary, but over a period of time each evaporates completely. This physical characteristic reflects the potential for releasing harmful vapor into the air.

Percutaneous. Through the skin; often referring to absorption of a chemical.

Peripheral Nervous System (PNS). Nerves outside of the brain and spinal cord, including motor nerves to control the function of muscles, sensory nerves to carry sensations to the brain, and autonomic nerves to control a variety of organ functions.

Peripheral Neuropathy. An abnormal or degenerative state involving the nerves of the extremities (hands, feet, arms, legs).

Permissible Exposure Limit. See PEL.

Personal Hygiene. Precautionary measures taken to maintain good health when exposed to potentially harmful materials. This includes keeping hands, and other parts of the body, work clothing, and equipment free of a material's residue, as well as not eating, drinking, applying makeup, or using toilet facilities where a material is in use.

Personal Protective Equipment. See PPE.

pH. Hydrogen ion exponent, a measure of hydrogen ion concentration of a solution. A scale (0 to 14) representing an aqueous solution's acidity or alkalinity. Low pH values indicate acidity and high values, alkalinity. The scale's mid-point, 7, is neutral. Some substances in aqueous solution ionize to various extents giving different concentrations of H and OH ions. Strong acids have excess H ions and a pH of 1 to 3 (HCl, pH = 1). Strong bases have excess OH ions and a pH of 11 to 13 (NaOH, pH = 12).

Phlegm. Thick mucous from respiratory passage.

Photophobia. Intolerance to light.

Physical Hazard. A substance for which there is valid evidence that it is a combustible liquid, compressed gas, explosive, flammable, organic peroxide, oxidizer, pyrophoric, unstable (reactive), or water reactive. In the general safety sense, a hazard of physical origin, such as a fall, heat bum, etc, and not a chemical or infective disease hazard.

Physical State. Condition of a material; i.e., solid, liquid, or gas, at room temperature.

PIN. Product identification number. A four-digit number, prefaced by UN or NA, used in Canada under the Transportation of Dangerous Goods Regulation for use by emergency personnel to identify a material in the event of an accident. See DOT identification number, the same numbering system used in the U.S.

PMCC. Pensky-Martens closed cup. One of several types of apparatus for determining flash points. The Pensky-Martens closed tester (ASTM D93-79) is used for liquids that: have a viscosity of 45 SUS (Saybolt universal seconds) or more at 38 ºC (100 ºF), have flash points of 93.6 ºC (200 ºF) or higher, contain suspended solids, or form surface films.

Pneumoconiosis. A respiratory tract and lung condition caused by inhalation and retention of irritant mineral or metallic particles. An X-ray can detect changes, which include fibrosis, emphysema.

Pneumonia. Inflammatory lung disease caused by microorganisms, virus, and chemical or physical irritants.

PNOC. An ACGIH term for "particulates not otherwise classified." See Nuisance Particulates.

PNOR. An OSHA term for "particulates not otherwise regulated." (TWA: 15 mg/m^3, total dust; 5 mg/m^3, respirable fraction).

Poison Control Center. Provides medical information on a 24-hr basis for accidents involving ingestion of potentially poisonous materials. Call your area's largest hospital to find the one nearest you.

Poisonous Material. A material, other than a gas, which is known (on the basis of animal tests) to be so toxic to humans or causes such extreme irritation as to afford a hazard to health during transportation.

Polycyclic Aromatic Hydrocarbons (PAH). A family of chemical compounds containing only carbon and hydrogen, in which molecules consist of three or more carbon ring structures fused so that some carbon atoms are common to two or three rings. A large number of this chemical family's members are carcinogens, or are converted to carcinogens when metabolized by animals or humans. PAHs are formed during incomplete combustion of hydrocarbons. They are common in smoke, such as that of vehicle exhaust or tobacco, and are also important industrial contaminants in coal gas or coke manufacture and other processes involving heating of coal tar and pitch.

Polymerization. A chemical reaction in which one or more small molecules combine to form larger molecules. Hazardous *polymerization* takes place at a rate that releases large amounts of energy that can cause fires or explosions or burst containers. Materials that can polymerize usually contain inhibitors that can delay reactions.

Pour Point. The temperature at which a liquid either congeals or ceases to flow.

PO_x. A general term for the several oxides of phosphorus.

ppb. Parts per billion.

PPE. Personal protective equipment. Devices or clothing worn to help isolate a worker from direct exposure to hazardous materials. Examples include gloves, respirators, safety glasses, or ear plugs.

ppm. Parts per million. "Parts of vapor or gas per million parts of air by volume at 25 ºC and 1 atm pressure" (ACGIH). At 25 ºC, ppm = (mg/m^3 x 24.45) divided by molecular weight.

ppt. Parts per trillion.

Precordial. In front of the heart, stomach.

Product Identification Number. See PIN.

Prostration. A state of total mental or physical exhaustion.

Protective Laboratory Practices & Equipment. As defined by OSHA 29CFR 1910.1450 Lab Standard, those laboratory procedures, practices, and equipment that laboratory health and safety experts accept as effective, or that the employer can show are effective, in minimizing the potential for employee exposure to hazardous chemicals.

Proteinuria. Presence of protein in the urine.

psia. Pounds per square inch absolute.

psig. Pounds per square inch gauge (i.e., above atmospheric pressure).

Psychotropic, PSY. Acting on the mind.

Pulmonary Edema. Fluid in the lungs.

Purge. To clean, clear, or empty of material; a bleed of air or inert gas into a vessel to remove or exclude contaminants.

Pyrolysis. Chemical decomposition or breaking apart of molecules produced by heating.

Pyrophoric. Describes materials that ignite spontaneously in air below 54 'C (130 'F).

RCRA. Resource Conservation and Recovery Act, PL 94-580. Found at 40 CFR 240-27 1. EPA has jurisdiction. Enacted November 21, 1976, and amended since. RCRA's major emphasis is the control of hazardous waste disposal. It controls all solid-waste disposal and encourages recycling and alternative energy sources.

RCRA Hazardous Waste. A material designated by RCRA as a hazardous waste and assigned a number to be used in record keeping and reporting compliance (e.g., D003, F001, U169).

Reactive Flammable Material. A material which is a fire hazard because it reacts readily with air or water. Included are materials which:
1) spontaneously ignite in air or water;
2) react vigorously with air; and
3) give off flammable gas on reaction with water.
Keep these materials dry and away from oxidizers. They are often stored in an all-nitrogen or argon environment

Reactive Material. A chemical substance or mixture that vigorously polymerizes, decomposes, condenses, or becomes self-reactive due to shock, pressure, or temperature. Includes materials or mixtures within any of these categories: **1) explosive material** - a substance or mixture that causes sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden adverse conditions; **2) organic peroxide** - an organic compound that contains the bivalent -O-O- structure, which can be considered a structural derivative of hydrogen peroxide, in which one or both of the hydrogen atoms has been replaced by an organic radical; **3) pressure-generating material** - a substance or mixture that spontaneously polymerizes with an increase in pressure unless protected by the addition of an inhibitor or by refrigeration or other thermal control; decomposes to release gas in its container, or comprises the contents of a self-pressurized container; **4) water-reactive material** – a substance or mixture that reacts with water releasing heat or flammable, toxic gas.

Reactivity. A substance's tendency to undergo chemical reaction either by itself or with other materials with the release of energy. Undesirable effects such as pressure buildup; temperature increase; or formation of noxious, toxic, or corrosive by-products may occur because of the substance's reactivity to heating, burning, direct contact with other materials, or other conditions in use or in storage. A solid waste that exhibits a "characteristic of reactivity," as defined by RCRA, may be regulated (by the EPA) as a hazardous waste and assigned the number D003.

Reagent. Substance used in a chemical reaction to aid in qualitative or quantitative analysis of another substance.

Recommended Exposure Limit. See REL.

Reducing Agent In a reduction reaction (which always occur-, simultaneously with an oxidation reaction), the reducing agent is the chemical or substance that 1) combines with oxygen or 2) loses electrons to the reaction. See Oxidation; Oxidizing Agent.

REL. The NIOSH REL (Recommended Exposure Limit) is the highest allowable airborne concentration that is not expected to injure a worker. It may be expressed as a ceiling limit or as a time-weighted average (TWA), usually for 10-hr work shifts.

Reportable Quantity. See RQ.

Reproductive Health Hazard/Toxin. Any agent with a harmful effect on the adult male or female reproductive systems or on the developing fetus or child. Such hazards affect people in many ways, including loss of sexual drive, impotence, infertility, sterility, mutagenic effects on germ cells, teratogenic effects on the fetus, and transplacental carcinogenesis.

Resource Conservation and Recovery Act. See RCRA.

Respirator. A variety of devices that limit inhalation of toxic materials. They range from disposable dust masks to self-contained

breathing apparatus (SCBA). All have specific uses and limitations. Their use is covered by OSHA, 29 CFR 1910.134. See SCBA, Chemical Cartridge Respirator.

Respiratory System. The breathing system, including the lungs and air passages (trachea or windpipe, larynx, mouth, and nose).

Route of Entry or Route of Exposure. The way a chemical enters the body; inhalation, skin contact, eye contact, and ingestion.

RQ. Reportable Quantity. The amount of a material that, when spilled, must be reported to the DOT (Section 311 of the Clean Water Act).

RTECS. *Registry of Toxic Effects of Chemical Substances,* published by NIOSH. Presents basic toxicity data on thousands of materials. Its objective is to identify all known toxic substances and to reference the original studies.

SADT, Self-Accelerating Decomposition Temperature. A test that determines an organic peroxide's minimum unsafe storage temperature. This test describes an organic peroxide's tendency to decompose as it warms. Since organic peroxides are oxygen-containing organic compounds, they are both a fuel and an oxidizer. Decomposition can be violent. A related term is MSST, the Maximum Safe Storage Temperature.

Saint Andrew's Cross. X. Used in packaging for transport; means harmful stow away from foodstuffs. (IMO, Material Class 6. 1, Group III).

SARA. Superfund Amendments and Reauthorization Act. Signed into law October 17, 1986. Title III of SARA is known as the Emergency Planning and Community Right-to-Know Act of 1986. A revision and extension of CERCLA, SARA is intended to encourage and support local and state emergency planning efforts. It provides citizens and local governments with information about potential chemical hazards in their communities. SARA calls for facilities that store hazardous materials to provide officials and citizens with data on the types (flammables, corrosives, etc.); amounts on hand (daily, yearly); and their specific locations. Facilities are to prepare and submit inventory lists, MSDSs, and tier 1 and 2 inventory forms. The 1987 disaster in Bhopal, India, added impetus to this law's passage.

SCBA. See Self-Contained Breathing Apparatus.

SCC. See SETA, SETAFLASH Closed Tester.

Sclera. The tough, white, fibrous covering of the eyeball.

Select Carcinogen. See Carcinogen.

Self-Accelerating Decomposition Temperature. See SADT.

Self-Contained Breathing Apparatus (SCBA). A respirator which contains its own air supply that the user carries, usually in a tank on his or her back (very similar to scuba gear).

Sensitization. A state of immune-response reaction in which exposure to a material elicits an immune or allergic response.

Sensitizer. A material that on first exposure causes little or no reaction in humans or test animals, but upon repeated exposure may cause a marked response not necessarily limited to the contact site. Skin sensitization is the most common form. Respiratory sensitization to a few chemicals also occurs.

SETA, SETAFLASH Closed Tester. Apparatus used to measure flash points in liquids in the 0 ºC to 110 ºC (32 ºF to 230 ºF) range (ASTM D 3278-82).

Siderosis. Pneumoconiosis caused by inhalation of iron particles. Also, tissue pigmentation caused by contact with iron.

Silicosis. A condition of massive fibrosis of the lungs causing shortness of breath because of prolonged inhalation of silica dusts.

Skin. A notation to exposure limits (TLVs) indicating possible significant contribution to overall exposure to a material by way of absorption through the skin, mucous membranes, and eyes by direct or airborne contact.

Slurry. A pourable mixture of solid and liquid.

Smoke. Dry particles and droplets (usually carbon or soot) generated by incomplete combustion of an organic material combined with and suspended in gases from combustion.

Solubility in Water. A term expressing the percentage of a material (by weight) that dissolves in water at ambient temperature. Solubility information is useful in determining cleanup methods for spills and fire-extinguishing methods for a material. Solubility may be expressed as *negligible,* less than 0. 1%; *slight,* 0. 1 to 1.0%; *moderate,* 1 to 10%; *appreciable,* more than 10%; *complete,* soluble in all proportions. Alternatively, and more usually, it may be expressed as a percentage by weight in a solution, as grams of solute per liter of solution, or as grams of solute dissolved in 100 g of water.

Solution, Soln. A uniformly dispersed single-phase mixture of a solvent (water or other fluid) and a dissolved substance, called the solute.

Solvent. A material that can dissolve other materials to form a uniform single-phase mixture. Water is the most common solvent.

Soot. Fine particles, usually black, formed by combustion (complete or incomplete) and consisting chiefly of carbon. Soot gives smoke its color.

SO_x. Oxides of sulfur where x equals the number of oxygen atoms.

Spasm. An involuntary, convulsive muscular contraction.

SPCC. Spill Prevention, Control, and Counter-measure plan.

Specific Gravity. The ratio of the density of a substance to the density of a reference substance, at a specified temperature. Specific gravity is a dimensionless number. Water (density 1 kg/l, or 1 g/mL, or 1 g/cm^3 at 4 ºC) is the reference for solids and liquids, while air (density 1.29 g/l at 0 ºC and 760 mm Hg pressure) is the reference for gases. If a volume of a material weighs 8 g, and an equal volume of water weighs 10 g, the material has a specific gravity of 0.8 (8 ÷ 10 = 0.8). Insoluble materials with specific gravity greater than 1.0 will sink (or go to the bottom) in water. Specific gravity is an important fire suppression and spill cleanup consideration since most (but not all) flammable liquids have a specific gravity less than 1.0 and, if insoluble, float on water.

Spontaneously Combustible Material. A material which undergoes self-heating to the point of ignition without requiring heat from another source.

Stability. The ability of a material to remain unchanged. For MSDS purposes a material is stable if it remains in the same form under expected and reasonable conditions of storage or use. Conditions such as temperatures above 66 ºC (150 ºF) or shock from being dropped that may cause instability (dangerous change) are stated on the MSDS. See Unstable.

STEL. Short-term exposure limit; ACGIH terminology. See TLV-STEL.

Stomatitis. Inflammation of the mucous membrane of the mouth.

Stupor. Partial or near complete unconsciousness.

Subcutaneous. Beneath the skin.

Sublime. To change from the solid to the vapor phase without passing through the liquid phase. Dry ice exhibits sublimation.

Subpart Z. See Z List.

Superfund Amendments and Reauthorization Act. See SARA, CERCLA.

SUS. Saybolt Universal Seconds. A unit measure of viscosity determined by the number of seconds required for an oil heated to 54 ºC (130 ºF) (lighter oils) and 99 ºC (210 ºF) (heavier oils) to flow through a standard orifice and fill a 60-ml flask.

Synergism. A combined action of two or more toxic substances to give an effect greater than the sum of their activity when each toxic substance is alone. For example, both smoking and exposure to asbestos can

cause lung cancer; however, if a smoker is also exposed to asbestos, the danger of lung cancer is far greater than just adding together the separate risks from the two exposures.

Synonyms. Alternative names by which a material may be known.

Systemic Toxicity. Adverse effects induced by a substance which affects the body in a general manner rather than locally. For example, a substance absorbed through the skin of the hands may result in kidney damage.

Tachycardia. Excessively rapid heartbeat, usually with a pulse rate above 100 beats per minute.

Tachypnea. Increased rate of respiration.

Tag Closed Cup. See TCC or TCT.

Tag Open Cup. See TOC.

Tag Open Tester. Open-tank tester for liquids with low flash points. See TCC or TCT.

Target Organ Effects. Chemically caused effects from exposure to a material on specific listed organs and systems, i.e. liver, kidneys, nervous system, lungs, skin, and eyes.

TCC or **TCT.** Tag (Tagliabue) closed cup or Tag closed tester. One of several types of apparatus for determining flash points. The Tag closed tester, per ASTM D56-79, is intended for testing liquids with a viscosity of less than 45 SUS at 38 ºC (100 ºF) and a flash point below 93.4 ºC (200 ºF). Liquids should not have suspended solids or form surface films.

TC_{Lo}. Toxic concentration low. The lowest concentration of a substance in air to which humans or animals have been exposed for any given period of time that has produced any toxic effect in humans or produced a tumorigenic or reproductive effect in animals or humans.

TD_{Lo}. The lowest dose of a substance introduced by any route other than inhalation over any given period of time and reported to produce any toxic effect in humans or to produce tumorigenic or reproductive effects in animals or humans.

Temp. Temperature.

Teratogen. An agent or material causing physical defects in a developing embryo or fetus.

Threshold Limit Value. See TLV.

Threshold Planning Quantity (TPQ). Per 40 CFR 302. The amount of material at a facility that requires emergency planning and notification per CERCLA.

Time-Weighted Average. See TLV.

Tinnitus. A ringing sound in the ears.

TLm. Median tolerance limit. Designates a toxic material's concentration at which 50% of the test organisms, usually aquatic, survive. For example, a conservation authority may limit pollution to TL_{90} (at which 90% survival is required), to protect fish.

TLV. Threshold limit value. A term ACGIH uses to express the maximum airborne concentration of a material to which most workers can be exposed during a normal daily and weekly work schedule without adverse effects. "Workers" means healthy individuals; "healthy" is defined as a 150 lb. male, age 25 to 44. The young, old, ill, or naturally susceptible have lower tolerances and need to take additional precautions. ACGIH expresses TLVs in three ways: **TLV-TWA,** allowable time-weighted average concentration for a normal 8-hour workday or 40-hour week; **TLV-STEL,** short-term exposure limit or maximum concentration for a continuous exposure period of 15 minutes (with a maximum of four such periods per day, with at least 60 minutes between exposure periods, and provided that the daily TLV-TWA is not exceeded); and **Ceiling (C),** concentration not to exceed at any time.

TLV-Ceiling Limit. TLV-C. The ceiling exposure limit or concentration not to exceed at any time, even for very brief times. The ACGIH publishes a book annually that explains and lists TLVs called: *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.* Copies are available from ACGIH *(q.v.).*

TLV-Skin. See Skin.

TOC. Tag open-cup test method.

torr. A unit of pressure, equal to 1 mm Hg. See atm (atmosphere).

Toxic. Poisonous; having properties of causing adverse health effects when the body is exposed. Having;

1) an LD_{50} of 50 to 500 mg/kg when administered orally to albino rats weighing 200 to 300 g each;
2) an LD_{50} of 200 to 1000 mg/kg when administered by continuous contact for 24 hr to the bare skin of albino rabbits weighing 2 to 3 kg each; or
3) an LC_{50} of 200 to 2000 ppm (gas or vapor) or 2 to 20 mg/l (mist, fume, or dust) when administered by continuous inhalation for 1 hour to albino rats weighing 200 to 300 g each. See Acute Toxicity.

Toxicology. The study of the nature, effects, and detection of poisons in living organisms. Also, substances that are otherwise harmless but prove toxic under particular conditions. The basic assumption of toxicology is that there is a relationship among the dose (amount), the concentration at the affected site, and the resulting effects.

Toxic Substance. Any chemical or material that 1) has evidence of an acute or chronic health hazard and 2) is listed in the NIOSH *Registry of Toxic Effects of Chemical Substances (RTECS),* provided that the substance causes harm at any dose level; causes cancer or reproductive effects in animals at any dose level; has a median lethal dose (LD_{50}) of less than 500 mg/kg of body weight when administered orally to rats; has a median LD_{50} of less than 1000 mg/kg of body weight when administered by continuous contact to the bare skin of albino rabbits; or has a median lethal concentration (LC_{50}) in air of less than 2000 ppm by volume of gas or vapor, or less than 20 mg/L of mist, fume, or dust when administered to albino rats.

Toxic Substances Control Act. See TSCA.

TPQ. See Threshold Planning Quantity.

Tradename. A name, usually not the chemical name, given to a product by the manufacturer or supplier and usually protected as a Registered Trademark. The same or similar products can be marketed under different tradenames by different companies.

Trade Secret. Confidential information (formula, process, device, etc.) that gives the owner an advantage over competitors. Manufacturers may choose to withhold proprietary data from an MSDS. Typically these would be ingredients of a formulated product. OSHA permits this provided 1) the trade secret claim can be substantiated; 2) the MSDS indicates that data is being withheld, and 3) the properties and health effects are included. State laws vary on this practice; some states require a trade secret registration number to be assigned to a material. There are procedures to obtain necessary trade secret information in emergency situations.

TSCA. Toxic Substances Control Act. Public Law PL 94-469. Found in 40 CFR 700-799. EPA has jurisdiction. Effective January 1, 1977. Controls the exposure to and use of raw industrial chemicals not subject to other laws. Chemicals are to be evaluated prior to use and can be controlled based on risk. The act provides for a listing of all chemicals that are to be evaluated prior to manufacture or use in the U.S. (EPA, Industry Assistance Office,
[202] 554-1404.)

Tumor. A growth of tissue without physiological function. May be benign (noninvasive) or cancerous. See Cancer, Neoplasm.

TWA. Time-weighted average. See TLV-TWA.

UEL. See Upper Explosive Limit, Upper Flammable Limit.

UFL. See Upper Flammable Limit, Upper Explosive Limit.

Ulcer. Loss or death of tissue resulting in an open sore on the skin or on a surface of an internal organ, such as the stomach.

UN Number. See DOT Identification Numbers; PIN.

Unstable. Tending toward decomposition or other unwanted chemical change during normal handling or storage. An unstable chemical in its pure state, or as commonly produced or transported, polymerizes vigorously, decomposes, condenses, or becomes self-reactive under conditions of shock, pressure, or temperature. See Stability, Reactive Material.

Upper Explosive Limit, Upper Flammable Limit. UEL, UFL. The highest concentration of a material in air that produces an explosion or fire or that ignites when it contacts an ignition source (high heat, electric arc, spark, or flame). Any concentration above the UEL in air is too rich to be ignited. See Flammable Limits.

Urticaria. Hives caused by a systemic allergic reaction.

UV. Ultraviolet (light).

Vapor. The gaseous state of a material normally encountered as liquid or solid.

Vapor Density. The ratio of the formula mass (FM) of the compound to the average formula mass of the gases in air (29 grams per mole). This formula mass ratio is correct for a pure gas at room temperature. However, this ratio does not accurately express the vapor density of a liquid solvent. A liquid cannot liberate vapors more concentrated than its saturated vapor concentration. The saturated vapor concentration of a liquid is the ratio of its vapor pressure at a given temperature to the atmospheric pressure. Using this ratio, the % of the compound in air and the remaining % of air at saturation (for example, 19.7% hexane and 80.3% air) can be calculated. The saturated vapor density is then determined by multiplying the % of the compound in air by its FM and the % of air by its FM; adding this air/liquid vapor mixture at saturation; and dividing the sum by 29 and multiplying by the density of pure air (1.2 kg/m^3, 0.075 lbs/ft^3). Saturated air/liquid vapor mixtures may be heavier than air, but not as heavy as formula mass ratios indicate. Temperature differences and turbulence create density differences between volumes of air and often have a greater influence on the movement of contaminated air than the actual saturated vapor density of the chemical.

Vapor Pressure. The pressure a saturated vapor exerts above its own liquid in a closed container. Vapor pressures reported on MSDSs are usually stated in millimeters of mercury (mm Hg) at 20 ºC (68 ºF). The lower a substance's boiling point, the higher its vapor pressure; and the higher the vapor pressure, the greater the material's tendency to evaporate into the atmosphere. Vapor pressures are useful (with evaporation rates) in learning how quickly a material becomes airborne within the workplace and thus how quickly a worker is exposed to it.

Vertigo. A feeling of revolving in space; dizziness, giddiness.

Viscosity. Measurement of a fluid's thickness or resistance to flow. Unit of measurement, usually centipoise (cP), and temperature are included.

VOC. Volatile organic compounds. Used in coatings and paint because they evaporate very rapidly. Regulated by the EPA per the Clean Water Act.

Volatility. Measure of a material's tendency to vaporize or evaporate at ambient routine conditions.

VP. See Vapor Pressure.

WHMIS. Workplace Hazardous Materials Information System. A nationwide Canadian system providing information to workers on hazardous materials in the workplace. This is accomplished through labels, MSDSs, and worker education. It is similar to the United States' OSHA Hazard Communication Standard.

Water Reactive. Describes a material that reacts with water to release a flammable gas or to present a health hazard.

Wilson RISK Scale. An acute hazard rating scale unique to Genium's MSDS Collection. This scale was developed by a certified industrial hygienist for compliance with the OSHA Labeling Standard (29 CFR 1910. 1200). This numbering system (of 0-4) & four hazard categories -reactivity (R), inhalation (1), skin contact (S), and kindling (K) - represents a material's degree of hazard based on documented values and/or the best judgments of certified industrial hygienists. The higher numbers indicate an increased hazard.

Working Alone. Performance of any work by an individual out of audio or visual range of another individual for more than a few minutes. No other person is aware of the individual working alone, the nature of the work being done, or the time period the individual expects to work. A worker alone in a lab should no undertake experiments known to be hazardous. Always work under conditions where the availability of emergency aid is compatible with the nature and the degree of the exposure.

Zinc Fume Fever. Caused by inhalation of zinc oxide fume and characterized by flu-like symptoms: metallic taste in mouth, coughing, weakness, fatigue, muscular pain, and nausea, followed by fever and chills. Symptoms occur 4 to 12 hr after exposure.

Z List. OSHA's Toxic and Hazardous Substances Tables Z-1, Z-2, and Z-3 of air contaminants, (29 CFR 1910.1000). These tables record TWAs, STELs, and ceiling concentrations for the materials listed. Any material on these tables is considered hazardous.

EMERGENCY ACTION / RESPONSE PLANS

- **Purpose:** To develop a plan to deal with emergencies in the workplace(such as chemical spills, tornadoes, fires, etc.).

- **OSHA Standards:**
- 29 CFR 1910.38 (Emergency Action Plan)
- 29 CFR 1910.120 (Emergency Response Plan)

- **Requirement**: Plan required if facility/operations has potential for hazardous material spill

- **Emergency Action Plan:** Can only be used if you evacuate the facility AND INDIVIDUALS DO NOT RE-ENTER, but wait for a outside contractor to respond to incident

- **Plan Elements**
- If 10 or less employees, plan can be oral
- Employees know contents of plan
- Emergency escape procedures
- Critical operations that can not be shut down
- Employee accountability
- Rescue and medical duties
- Method of reporting emergencies
- Plan should include responsibilities (i.e., who to brief fire department upon arrival), maps of piping and drainage system, MSDSs, etc.

- **Training:**
- Designated employees trained to assist in evacuation
- Fire hazards present in facility
- Periodic practice evacuations

EMERGENCY ACTION / RESPONSE PLANS
(Continued)

- **Emergency Response Plan: Company MUST** have a formal response plan if anyone re-enters the facility or if the company's employees contain/clean-up the spill.

- **Written plan**
- Pre-emergency planning & coordination with outside parties
- Personnel roles, lines of authority, combination
- Safe distances/places of refuge
- Site security
- Evacuation routes
- First aid
- Emergency reporting
- PPE/ equipment
- Use of state/local resources

- **Training**
- First Responder Awareness Level (Notification only)
- First Responder Operations Level (Defensive containment)
- Hazardous Materials Technician/Specialist (Stops spills, clean-up, decontamination)
- On Scene Incident Commander

Related OCOSH Courses
- IHY 212: "Hazard Communication"
- IHY 317: "Hazardous Waste - Awareness"
- IHY 335: "Hazardous Waste - Operations"
- IHY 318: "Hazardous Waste - Technician"
- IHY 319: "Hazardous Waste - Refresher"

HOW TO SET UP AN EMERGENCY ACTION PLAN

(Items to consider when developing a plan)

- Employee input
- Plan comprehensive enough to deal with all expected situations
- MSDSs available on all material. Will they be available in an emergency?
- Emergency escape procedures and routes assignments
- Employee assembly area and accountability procedures
- Sufficient employees trained to assist in evacuation
- Handicapped employees considered. Who will assist them
- Who will remain to shut down critical operations
- Clear chain of command established
- Who assigned to meet emergency response forces (fire department)
- MSDSs available for fire department
- Diagrams of Piping systems, Locations of chemical hazards, and Sewer drains
- Emergency phone numbers valid and available
- Procedures if phones are inoperative
- Who needs to be notified
- Company officials
- Local officials
- EPA/OSHA
- Outside contractor to clean-up spill
- Who is designated to speak to news media
- Site security
- Alarm systems
- Employees trained
- Evacuation plans regularly practiced
- Rescue procedures

- **Note: All the above actions need to be considered if everyone just evacuates and does not re-enter, contain or clean-up the spill. ANY response by company employees in working with the spill requires an emergency response plan, training, equipment, and so forth. Many companies have found that unless they have over 100 employees, they do not have the resources (staffing or financial) to deal with a spill themselves.**

Example Spill Response Guidelines

General Response Guidelines
For simple spills, emergency responders do not need to be notified. However, you should contact the environmental health and safety office or other responsible person within your facility. Most importantly, before cleaning up a simple spill, be sure that you can do so safely. You must have the right personal protective equipment, including, at a minimum, appropriate eye protection, protective gloves, and an elastomeric apron. Additional protective equipment may be required for spills that present special hazards (such as corrosive or reactive spills or spills that have a splash potential).

As a rule of thumb, if you feel you need a respirator, you should request outside assistance because you do not have a simple spill.

THE FOLLOWING STEPS SHOULD BE TAKEN DURING SPILL CLEANUP.

Prevent the spread of dusts and vapors.
If the substance is volatile or can produce airborne dusts, close the area door and increase ventilation (through ventilation fans, for example) to prevent the spread of dusts and vapors to other areas.

Neutralize acids and bases, if possible.
Spills of most liquid acids or bases, once neutralized, can be mopped up and rinsed down the drain (to the sanitary sewer). However, be careful because the neutralization process is often vigorous, causing splashes and yielding large amounts of heat. Neutralize acids with soda ash or sodium bicarbonate. Bases can be neutralized with citric acid or ascorbic acid. Use pH paper to determine when acid or base spills have been neutralized.

Control the spread of the liquid.
Contain the spill. Make a dike around the outside edges of the spill. Use absorbent materials such as vermiculite, cat litter, or spill pillows.

Absorb the liquid.
Add absorbents to the spill, working from the spill's outer edges toward the center. Absorbent materials, such as cat litter or vermiculite, are relatively inexpensive and work well, although they are messy. Spill pillows are not as messy as other absorbents, but they are more expensive. Note that special absorbents are required for chemicals such as hydrofluoric and concentrated sulfuric acids.

Collect and contain the cleanup residues.
The neutralized spill residue or the absorbent should be scooped, swept, or otherwise placed into a plastic bucket or other container. For dry powders or liquids absorbed to dryness, double bag the residue using plastic bags. Additional packaging may be required before the wastes can be transported from your facility. For spills of powders or solid materials, you may need to add a dust suppressant. Be sure to place descriptive labels on each container.

Dispose of the wastes.
Keep cleanup materials separate from normal trash. Contact your environmental health and safety officer for guidance in packaging and labeling cleanup residues. Promptly place cleanup wastes in an appropriate hazardous waste receptacle.

Decontaminate the area and affected equipment.
Ventilating the spill area may be necessary. Open windows or use a fan unless the area is under negative pressure. In some instances, your environmental health and safety officer can test the air to ensure that hazardous vapors are gone. For most spills, conventional cleaning products, applied with a mop or sponge, will provide adequate decontamination. If you have any question about the suitability of a decontaminating agent, seek expert advice.

SPECIAL PRECAUTIONS
The following precautions apply to chemicals that have hazardous characteristics. Note that some chemicals may exhibit more than one characteristic.

Flammable Liquids
Remove all potential sources of ignition**.** Vapors are what actually burn, and they tend to accumulate near the ground.

Flammable liquids are best removed through the use of spill pillows or pads. Spill pads backed with a vapor barrier are available from most safety supply companies. Because flammable liquids will probably be incinerated, avoid using inert absorbents such as cat litter. All used absorbent materials should be placed in heavy-duty poly bags, which are then sealed, labeled, and disposed through your facility's hazardous waste management program. Before resuming work, make sure the spill area has been adequately ventilated to remove flammable vapors.

Volatile Toxic Compounds
Use appropriate absorbent material to control the extent of the spill. Spill pillows or similar absorbent material usually work best because they do not have the dust associated with cat litter, vermiculite, or corn cobs. Place all used absorbent materials in heavy-duty poly bags. Seal the bags, label them, and hand them over to your facility's hazardous waste management program. Again, make sure the spill area has been adequately ventilated before resuming work.

Direct Contact Hazards
Carefully select suitable personal protective equipment. Make sure all skin surfaces are covered and that the gloves you use protect against the hazards posed by the spilled chemical. Often it is a good idea to wear two sets of gloves: one as the primary barrier, the second as a thin inner liner in the event the primary barrier fails. When the cleanup is completed, be sure to wash hands and other potentially affected skin surfaces.

Mercury Spills

Mercury spills rarely present an imminent hazard unless the spill occurs in an area with extremely poor ventilation. The main exposure route of mercury is via vapor inhalation. Consequently, if metallic mercury is not cleaned up adequately, the tiny droplets remaining in surface cracks and crevices may yield toxic vapors for years.

When a mercury spill occurs, first barricade off the spill area to prevent people from inadvertently tracking the contamination over a much larger area. Generally, a special mercury vacuum cleaner provides the best method of mercury spill cleanup. DO NOT use a regular vacuum cleaner, because you will only disperse toxic vapors into the air and contaminate your vacuum cleaner. If a special mercury vacuum is not available, first use an appropriate suction device to collect the big droplets, then use a special absorbent (available from most chemical supply vendors) to amalgamate smaller mercury droplets.

Ideally, mercury spills should be prevented in the first place. Examine all uses of mercury to see if substitutes are available. If substitutes are not available, use trays or other equipment to provide spill containment. Spilled mercury often accumulates in sink traps. Be prepared to contain the mercury when servicing such facilities.

Documentation

After cleaning up a spill, a simple write-up should be prepared to document what happened, why, what was done, and what was learned. Such documentation can be used to avoid similar instances in the future. Major incidents are almost always preceded by numerous near misses.

Facilities seeking to minimize and prevent spills should consider the possible results of their choices and procedures. Such consideration should focus on reducing the likelihood of spills, as well as minimizing spill damage. Production should only involve chemicals that are actually needed for the desired results. Ideally, facilities should only store chemicals that will be used within a reasonable period of time. Additionally, correct chemical and equipment choices must be made.

APPENDIX A. REGULATORY OVERVIEW

This appendix is intended to briefly describe regulations that may apply to chemical spills. Do not rely on this information for regulatory compliance purposes. Rather, consult the appropriate regulations directly.

Federal regulations that may be applicable to chemical spills address the following issues: releases to the environment (typically to water or air), worker safety and training, planning with public emergency response agencies for major chemical emergencies, and disposal of spill cleanup materials.

Releases to the Environment

Any chemical that presents a threat to the environment is defined by the Environmental Protection Agency (EPA) as a hazardous substance. The Agency assigns each hazardous substance a reportable quantity (RQ), which is based on a chemical's inherent risk properties. Virtually all common industrial chemicals are on this hazardous substance list. Some hazardous substances have RQs as low as one pound. All chemical hazardous wastes have an RQ of one pound. A list of reportable quantities can be found in 40 CFR 302.4 (Code of Federal Regulations, Protection of Environment, Designation of Hazardous Substances).

Federal law requires reporting any hazardous substance spill or release that exceeds its RQ to the National Response Center (800-424-8802). State and local governments often have their own spill-reporting requirements, necessitating calls to state and local emergency response agencies as well.

Worker Safety and Training

All workers must be trained (or be accompanied by a trained person) about the facility's chemical risks and the actions to be taken in an emergency.

Workers who clean up their own spills must be trained. This plan includes a written certification that all participants are trained on how to use their personal protective equipment. Workers who go into other work areas to assist with spills must be documented as having had additional, special training. Such training covers how to handle the specific material spilled, as well as how to approach hazardous material accidents in unfamiliar locations.

Planning with Local Emergency Responders

Preplanning with local emergency responders is required if a facility has environmentally hazardous substances exceeding threshold planning quantities. As with reportable quantities, threshold planning quantities vary according to each chemical's inherent hazards. Although many facilities do not have sufficient quantities of hazardous chemicals to be subjected to these requirements, preplanning can help avoid miscommunication with local emergency responders. A list of threshold planning quantities is found in 40 CFR 355 (Emergency Planning and Notification) Appendices A and B.

Some spills require outside help from emergency responders because of the following:
a confined space,
the need for emergency medical attention,
a fire,
a natural gas leak,
the need to shut off electricity,
the need for evacuation,
the need for traffic control, and
the need for building security.

Due to a third-party notification, or the miscommunication of a legal spill notification, emergency responders may arrive when their services are not necessary. Maintaining a good working relationship with your local emergency responders will help foster the mutual respect necessary to optimize spill response activities.

Disposal of Spill Cleanup Materials

Cleanup materials from hazardous substance spills are regulated as hazardous waste. Follow your facility's guidelines for packaging, labeling, and disposing of these materials.

APPENDIX B. SPILL PREVENTION METHODS

Spills can occur during a chemical's storage, transportation, or transfer, as well as production. A spill prevention program for storage areas should include the following: sturdy shelves and properly designed storage areas to minimize breakage and tipping; containers stored by hazard class; larger containers stored closer to the floor; containers stored on shelves sufficiently away from the shelf edge to minimize the danger of falling; storage shelves with lips to reduce the danger of falling; regular inspection of the integrity of containers; and seismic security in earthquake-prone areas.

To minimize spills during transport, a facility should integrate the following:
carts, where appropriate,
safety containers,
rubberized buckets,
straps to secure containers, and
properly trained and thoughtful workers.

For the transfer of liquids from one container to another, the risk of spills can be reduced by paying careful attention to the size of containers to avoid overfilling. Using pumps or other mechanical devices rather than simply pouring directly into a container, providing spill containment to capture any leaks, and bonding and grounding containers when flammable liquids are involved is required.

In addition to chemical spills, loose connections or breaks in lines to water condensers or cooling systems can cause water spills. Such spills can cause damage and inconvenience, even if they do not present environmental or health risks. Appropriate planning, including use of security clamps or other devices to prevent loosening of connections or automatic shut-off devices, can reduce the likelihood of flood damage. Occasionally, a facility may be affected by a leaking roof or a flood elsewhere in a building.

Planning to prevent damage from incidents should include the protection of equipment that might be harmed by water. Similarly, storing chemicals and supplies so that they will not be touched by leaking water will minimize damage and inconvenience.

While considerable attention is given to potential spills or leaks of liquids, facilities using gases should also develop spill prevention plans for these materials. Such plans should consider safety concerns related to securing tanks and other gas containers. Additionally, frequent checks of valves and tubing can be useful in spill and leak prevention. A facility should take care to prevent gas from escaping down a drain or out a ventilation hood.

Finally, pay attention to physical details in the facility, such as reducing clutter and unnecessary materials, eliminating tripping hazards and other obstructions, and having all needed equipment readily available before starting work.

POTENTIAL CAUSE OF SPILL PREVENTION TECHNIQUE

Container, such as a secondary container, tips over
Secure containers and equipment to minimize the possibility of tipping.

Container dropping
Keep containers and equipment as low as possible.

Breaking a container
Protect containers from breakage by keeping other items from falling on them.

A runaway reaction
Plan reactions in production to anticipate and to provide controls for undesired outcomes such as overheating.

Releases during transfer of materials from one container to another
Pay attention to what you are doing. Provide secondary containment in the event of spills.

Holes and other leaks in transfer equipment such as pipes, hose, or valves
Check for holes or leaks before use.

Placing material in an incompatible container
Check for compatible uses of chemicals, particularly solvents or aggressive solutions. Check the material and construction of containers and equipment with a goal of maintaining structural integrity.

Breakage of thermometers or similar equipment
Select equipment that has reduced potential for breakage, e.g., replace mercury thermometers and electronic temperature devices

APPENDIX C: RECOMMENDED COMPONENTS OF A FACILITY CHEMICAL SPILL KIT

BASIC KIT

Kit Container
Accessible
Visible
Securable

Residue Management
Whisk broom or hand-held brush
Plastic dust pan
Metal dust pan
Large, sealable (e.g., Zip Loc) plastic bags
5-gallon plastic drum liners
5-gallon waste disposal container with lid

Absorbents
Paper towels (one roll)
Pillows and brooms
Sheets and pads
Loose bulk (e.g., cat litter)
Mercury Spill Kit (unless it is known that there is no mercury in the facility)

Personal Protective Equipment (PPE)
Chemical splash goggles
Face shields
Gloves (proper elastomer for the material in the facility)

Appropriate body protection, such as
Lab coat
Elastomeric aprons
Tyvek suits
Shoe/foot coverings
Saranex suits
Booties

Basic Emergency Equipment (should be close at hand)
Respirators
Neutralizers (citric acid, sodium bicarbonate, etc.)
Special reactants (chelating agents, etc.)
Decontaminants and biostats (e.g., for blood-borne pathogen cleanup)
Specialized PPE

Appendix D: Decontamination

Decontamination is the process of physically removing or neutralizing contaminants that have accumulated on personnel and equipment; the last step of spill cleanup.

Evaluate the following;

Are they contaminated?:

All cleanup supplies and equipment (brooms, dustpans, shovels, containers, suction tubes, sponges, vacuum cleaners, monitoring equipment, etc.)

Personal protective equipment (chemical suits, respirators, gloves, boots, aprons, etc.)

Any additional equipment in the area may have been contaminated during the spill or release, but may not be obvious. Examples might include analytical and/or computer equipment (particularly for releases of dusts), work benches, etc.
NOTE: The need for decontamination may be avoided by wrapping or bagging monitoring and sampling equipment, wearing disposable outer garments during cleanup, minimizing contact by not walking through areas of obvious contamination.

Decontamination Processes

The probability and extent of permeation is directly linked to the length of contact. The longer the contact, the more effort that will be required to accomplish decontamination.

Scrubbing, washing, and rinsing may remove loose contaminants such as dust or vapors.

Adhering contaminants such as resins and muds may require physical removal by brushing and wiping. The effectiveness of this removal may be improved by solidifying, freezing, adsorption and absorption procedures.

Volatile substances may be removed by evaporation together with washing and rinsing.

Be aware of worker exposure during this process!

EMERGENCY RESPONSE WRITTEN PLAN
CRITICAL ELEMENTS CHECKLIST

1. Statement of policy/purpose.	**Yes**	**No**
Comment: _____		
2. Pre-emergency planning (details).	**Yes**	**No**
Comment: _____		
3. Personnel roles & assignments.	**Yes**	**No**
Comment: _____		
4. Lines of authority determined.	**Yes**	**No**
Comment: _____		
5. Employee training specified.	**Yes**	**No**
Comment: _____		
6. Emergency communications set up.	**Yes**	**No**
Comment: _____		
7. Emergency recognition and/or prevention training and person(s) responsible.	**Yes**	**No**
Comment: _____		
8. Detailed evacuation plan and its execution.	**Yes**	**No**
Comment: _____		
9. Site security and control procedures and person(s) responsible.	**Yes**	**No**
Comment: _____		
10. Determine safe distances and place of refuge.	**Yes**	**No**
Comment: _____		

Emergency Spill Response Policy
(Sample)

It is the policy of this company to train all employees in emergency spill response to an awareness level during Hazard Communication training. In the event of a spill, the first employee to discover the spill will immediately determine the extent of the spill and nature of the spill. If the spill is dangerous to the employee through the nature of the spilled material or the extent of the spill, the employee will immediately leave the area and sound the alarm. If there is any question as to the danger of the spill, the employee will err of the side of safety and evacuate the area and sound the alarm. At that point, our spill response contractor, _____ , will be contacted for spill clean up. If there is a hazard to the environment or surrounding buildings, the local fire department will be contacted along with any law enforcement agencies affected. Under no circumstances is any employee to attempt to clean up a spilled material he/she is not equipped or trained to clean up. MSDS's will be consulted prior to any attempt to clean up any spilled material and all Personal Protective Equipment and disposal equipment required by the MSDS will be obtained and used during the process. This will only be done on small, non-hazardous spills not requiring the spill response contractor. Again, if there is any doubt to the extent of the hazard, employees are directed to evacuate the area and notify management.

(Example)
XYZ Components Company
Emergency Response Plan

Purpose

In accordance with 29 CFR 1910.120 (q) the following plan is designed to minimize or prevent damage to human health and the environment in the event of an unplanned sudden or non-sudden release of hazardous material within the plant perimeter. It is understood that provisions of this plan must be carried out immediately when such an event or occasion would necessitate an immediate response.

Pre-Emergency Planning And Coordination

The following procedures describe the actions facility personnel must take in order to ensure compliance with 29 CFR 1910.120 (q) in response to an emergency. Arrangements have been made to coordinate the emergency plan and emergency services with the local police department, fire department, hospitals and Local Emergency Preparedness Committee (LEPC) which developed the Local Emergency Response Plan (LERP).

Community telephone contacts include.

Police	911
Fire Department	911
Hospital	222-2222
LEPC Coordinator	444-4444

Meetings will be held annually with personnel from these groups. Minutes will be kept by the Plant Manager, who will insure that these meetings are conducted.

A copy of the emergency plan and all revisions will be maintained at the facility in the main office area and will be submitted to the local agencies mentioned above. The plan will be reviewed and immediately amended whenever:

(a) Applicable regulations are revised.

(b) The plan fails in the event of an emergency.

(c) The facility changes in design, construction, operation, maintenance, or other circumstances that may increase the potential for fires, explosions, or

releases of hazardous materials, or changes in the response necessary in an emergency.

(d) The list of emergency coordinators changes.

(e) The list of emergency equipment changes.

Personnel

The facility has personnel on site 24 hours a day, 7 days a week. The head person in the guard shack will be aware of the primary and alternate emergency coordinators in the emergency plan, as well as, all emergency procedures. The primary and alternate emergency coordinators are thoroughly familiar with all aspects of the facility emergency plan, all operations and activities at the facility, the location and characteristics of hazardous material, the location of all records within the facility and the facility layout.

The Emergency Response Team For The Facility Consists Of:

ER Coordinator (1) Alternates (2)
ER Technician level (12)
ER Operations level (24)

The Emergency Coordinator And Alternates shall have been trained at the On-Scene Incident Commander Level. Responsibilities of the Emergency Coordinator include:

1. Identification of material involved in the emergency.
2. Activate internal facility alarms or communication systems to notify all personnel.
3. Notify, if needed, police/fire departments, and state and national organizations.
4. Assume overall authority for managing the Emergency (unless higher command arrives), performing termination procedures and conducting critique and follow-up.

The ER Technician level personnel shall perform all duties assigned by the Coordinator, consistent with his/her training at the technician level. These may include:

1. Implement the ER Plan.
2. Use monitoring equipment.
3. Function within the ICS system.
4. Select and use specialized PPE.
5. Perform advance control, containment and/or confinement operations.
6. Implement the decon procedures.
7. Participate in hazard and risk assessment and termination procedures.

The ER Operations level personnel (Operations-Level First Responder) shall perform all duties assigned by the Coordinator consistent with training at the Operations level. These may include:

1. Use provided PPE.
2. Basic control, containment and/or confinement measures.
3. Implement basic decon procedures.
4. Participate in the ER procedures, termination process, and basic hazards and risks assessment techniques.

The owner or operator must note in the operating record the time, date, and details of any incident that requires implementing the emergency plan. The report must include:

1. Name, address and telephone number of the owner operator.
2. Name, address and telephone number of the facility.
3. Date, time and type of incident.
4. Name and quantity of material(s) involved.
5. Extent of injuries (if any).
6. Extent of damages to facility or materials.
7. Assessment of actual or potential hazards to human health or the environment.
8. Estimated quantity and disposition of recovered material(s).

Communication

The Emergency Coordinator is in charge of all communication while the incident is under the sole control of plant personnel. When outside help is sought, the Emergency Coordinator assumes a role of direct responsibility to the Incident Commander of the outside group.

Internal Communication

The specifics of the internal communication systems (radios, who has them, frequency band, consequences of jamming the system) are included in the appended SOP.

Following are the primary and alternate emergency coordinators for this facility, their names, titles, business numbers and home phone numbers:

Joe Smith X - 515
Supervisor Response
(111)222-3333

Jane Doe X - 616
Maintenance Supervisor
(111)444-5555

John Who X - 717
Safety Manager
(111)666-7777

External Communication

The Emergency Coordinator is in charge of all communication until additional personnel are called. Communication with outside personnel is the sole responsibility of the Coordinator (or his/her designee).

The Following May Be Called:

Fire Department	911
Police Department	911
Hospital	222-2222

(Add others, as appropriate)

When making a call, include the following information:

Identify yourself
State the exact location
Describe the emergency
Give names of persons involved
Give areas potentially affected

Lines Of Authority

If the incident response is limited to plant personnel, the Emergency Coordinator has overall responsibility for all actions. Personnel should check with the Emergency Coordinator before undertaking any actions not directly ordered by him/her.

If additional personnel are involved, the Emergency Coordinator will defer to the Incident Commander, who gives all instructions.

Training

Individual member of the ER team will receive training as specified in 1910.120 (q). In addition, all plant employees will receive four hours of training annually to update Hazard Communication Training (1910.1200).

Personnel who may be expected to wear SCBAs receive monthly training drills in donning, doffing, and maneuverability as described in the written respirator program required under 1910.134.

EMERGENCY RECOGNITION AND PREVENTION

A. Fire

Whenever the fire alarm sounds (continuous ringing), all non-supervisory personnel must evacuate the facility immediately. After exiting the building, proceed quickly to the consolidation area (flagpole). Do not re-enter the building until and “all clear” condition has been established, and the Emergency Coordinator has verified conditions are suitable for re-entry.

Supervisory personnel will shut down the line and immediately evacuate.

In the event that alarms sounds on the weekends, at nights, or on holidays, it is important that the gate operator be notified so that the front gate is open when fire equipment arrives. The phone number for contacting the gate operator is X-111.

B. False Alarms

False alarms do occur, fortunately far more frequently than legitimate occurrences. Very often, they are the result of power failures. However, should the alarm be triggered accidentally, the person responsible should present

him/herself to the Fire Department upon their arrival and explain. No charges will be filed unless the act was malicious or intentional.

C. Fire Prevention

In order to minimize the potential for fire, the following SOPs have been developed:

1. Maintenance of degreasers.
2. Fire suppression system maintenance and testing.
3. No Smoking policy facility wide.
4. All employees will receive annual training on the no smoking policy and the fire alarm system.

SAFE DISTANCES AND PLACES OF REFUGE

A. Evacuation

If the evacuation horn is sounded, all non-supervisory personnel must report immediately to the flagpole area. Supervisors should secure their area per previous training and then report to the flagpole.

B. Non-Evacuation

All personnel will follow the direction of the Emergency Coordinator. Unless you have a direct role or are requested to assist, leave the area.

C. Site Security and Control

Site security and control is the responsibility of the Emergency Coordinator. The SOP will be followed.

EVACUATION ROUTES AND PROCEDURES

Whenever a need arises to evacuate any area of the facility, all employees in that area shall proceed to the nearest exit after hearing the fire alarm. It shall be each employee's responsibility to be completely aware of the exit plan for those areas in the facility in which he or she works. The Emergency Coordinator or his/her designee shall then take count of all employees present once assembled at the flagpole. Only when the "all-clear" signal is given and verified by the Emergency Coordinator shall employees be allowed to re-enter the facility.

The following alarms are used:
FIRE Notice -- continuous blast
ALL Clear -- short 1 second blasts

An exit plan is posted at each supervisor's station, at each stairwell, and near each time clock. In case of fire DO NOT use the freight elevators, use only stairwells shown on the exit plan.

DECONTAMINATION

All emergency apparatus (broom, shovels, temporary dikes, etc.) will be rinsed on-site and washed in a tub (20 - 30 gallons) several times with detergent water and or any of several varieties of commercial decon solutions with brushes and sponges; then placed on a bench or rack for drying. Fire extinguishers will be sent out for refilling and SCBA respirators will be sponged with isopropyl alcohol. All personnel glovers (inner and outer), hats, boots, coveralls, and coats will be placed in sealed plastic bags to be sent out for proper disposal.

EMERGENCY MEDICAL TREATMENT AND FIRST AID

A. First Aid

At least one person on each shift will be trained in first aid. A nurse is typically only on duty during the first shift.

B. Medical Treatment

In the event that first aid is not sufficient care, personnel will be taken to the hospital by security personnel or it conditions warrant an emergency squad will be called.

C. Emergency Alerting and Response

Emergency situations may arise at any time and in any location within the facility. In an emergency or disaster, all employees present must handle the situation as calmly and promptly as possible. Emergencies will generally be in the nature of spills, fires, or explosions, which could result in the spread of hazardous materials. Since it is not possible to devise a set of rules or procedures to govern all possible emergencies, the following considerations are presented only as a guide to aid the user in establishing more specific emergency procedures applicable to his/her working conditions.

Emergency Description	**Contact For Assistance**	**Telephone #**
• Injury or severe sudden illness	Life Squad	911
• Fire or explosion	Fire Department	911
• Chemical Spill or Release	Main Office / Security	222
• Bomb or Hostage Situation	**Police**	911

Then:

1. **Identify Yourself** to the person who answers.
2. **State the exact location** of the emergency, either in the facility itself or on the grounds, or address.
3. **Describe** briefly and calmly the nature of the emergency.
4. **Give the Name(s)** of person(s) involved.

D. Fire Emergency

The fire alarm system is an automatic/manual network consisting of automatic sprinkler / hose flow sensors, manual pull boxes, alarm bells, a notifier connected to the Fire Department and a system control box.

The alarm system may be triggered in any of the following ways:

- ♦ Any flow in the sprinkler / hose system automatically trips the alarm. Hence, fire hose should not be used for anything other than firefighting.
- ♦ The alarm may be activated manually by use of any pull box.
- ♦ Through the notifier box, located on the loading dock, the Fire department is alerted any time the alarm system is activated. They are required to respond and will do so shortly after the alarm is sounded.

CRITIQUE OF RESPONSE AND FOLLOW-UP

A thorough investigation is required to ensure the adequacy of procedures and to identify needed changes in the Response Plan. Immediately upon completion of the termination procedures, a debriefing will be conducted with all department personnel and any outside agencies. A meeting will be called by the Emergency Coordinator who will make a full report to the plant manager.

Sections of the report will include;

- Description of the Emergency
- Diagram
- Personnel responding and roles
- Material released - identity and quantity
- Environmental measurements
- Zones
- Site Security operations
- Reported health effects
- Actions / events contributing to the emergency
- Needed follow-up action

EMERGENCY RESPONSE AND PERSONNEL PROTECTION

Personnel protection and emergency response procedures have been established at the Facility for response to emergency situations. A general listing of the safety equipment available at the facility include;

- Safety Showers
- Eye Wash
- SCBA's (Four)
- Spill control cart (Protective gear, absorbents, etc.)
- Respirators
- Gloves
- Boots
- Safety glasses / goggles / shields
- First aid supplies
- Fire Extinguishers
- Fire hoses
- Garden hose
- Patching material for stopping leaks

SMALL SPILLS

For small spills, a mobile cart has been assembled which will contain (2) 55 gallon drums with accompanying shovels, tools, and absorbents. Persons using the spill cart will be properly attired with gear according to the materials involved.

Personnel using this equipment will have been trained in this procedure.

LARGE SPILLS

For large spills such as the rupturing of a holding tank, an outside emergency response team will be contacted. Both the outside response team and the local fire department will be notified. This notice must include;

- Name and phone number of reporter
- Name and address of carrier
- Date, time and location of incident
- Extent of injuries
- Hazard class, name and quantity of hazardous material involved
- Type of incident and nature of materials involved

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The Emergency Response Plan: Key to Compliance with the Emergency Response Provisions of the Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120)

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The emergency response plan, as required by the hazardous waste operations and emergency response standard (29 CFR 1910.120) paragraph (q)(1) is a comprehensive document through which compliance with all of the emergency requirements can be identified and met. The required components of an emergency response plan are identified in Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) paragraph (q)(2). Strategies for addressing each component of the emergency response plan are presented. Development of an emergency response plan requires a systematic review of the hazards on site, assumptions of worst case scenarios, development of evacuation procedures, standard operating procedures for response activities, coordination with outside response agencies, and other preplanning activities. Case studies of four facilities and their respective emergency response plans are presented. The case studies demonstrate the range of appropriate emergency response plans that will meet compliance with the performance-oriented requirements. The guidance offered in HAZWOPER for planning for emergencies. if followed, offers facilities preplanned procedures, trained employees, and the availability of needed equipment at critical moments during emergencies. This type of responsibility & preparation can only benefit the facility, the employees, and the community at large. FITZGERALD, M.E.: THE EMERGENCY RESPONSE PLAN: KEY TO COMPLIANCE WITH THE EMERGENCY RESPONSE PROVISIONS OF THE HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE STANDARD (29 CFR 1910-1201. APPL. OCCUP. ENVIRON. HYG. 11(9):1154-1162; 1996.

The Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) addresses the emergency response to the uncontrolled release of hazardous substance in three separate paragraphs, at hazardous waste sites and clean-up operations, paragraph (1);[(1)] at hazardous waste treatment storage and disposal facilities, paragraph (p)(8);[(1)] and at responses to releases or substantial threats of releases of hazardous substance without regard to the location of the hazard (i.e., any other type of operation), paragraph (q). Although the requirements vary slightly depending on the applicable paragraph of HAZWOPER, the requirements with the broadest application and most detailed specifications are found in paragraph (q), which applies to all work sites with the potential for an emergency caused by

the uncontrolled release of hazardous substance except hazardous waste clean-up operations and hazardous waste treatment and storage and disposal facilities which, as mentioned, are covered by the other paragraphs. These requirements apply to emergency response operations without regard to the location of the hazard. This article will discuss compliance with the emergency response provisions of paragraph (q) of the HAZWOPER standard for industrial facilities where emergency response is incidental to the main business of the organization. Strategies for compliance with the emergency response requirements through the development of a facility-specific emergency response plan will be presented.

Background

Due in part to the catastrophe in Bhopal, India, and near tragedy in Institute, West Virginia, Congress passed the Superfund Amendments and reauthorization Act of 1986. In title I section 126 of that legislation, [2] Congress mandated that the Secretary of Labor promulgate a standard to protect the safety and health of workers involved in hazardous waste operations. In a unique mandate for an occupational safety and health regulation, Congress also instructed the Environmental Protection Agency (EPA) to promulgate an identical standard [3] to protect the safety and health of workers who do not fall under the scope of the Occupational Safety and Health Organization (OSHA) act, including state and local government employees and volunteers.

The resulting regulation, the HAZWOPER standard, was published as an interim rule on August 8, 1986 and as a final rule on March 6, 1989 with an effective date of March 6, 1990, and is found in the code of federal regulations at 29 CFR 1910.120. [4] The EPA adopted Worker Protection Standards for Hazardous Waste Operations and Emergency Response, codified as 40 CFR 311, with a regulatory scope including state and local government employees and a definition of "employee" that includes "compensated or noncompensated workers" (i.e., volunteers).[3]

The final OSHA and EPA rules discuss 5 groups of employers covered by the scope of the standard in 1910.120 (a)(l)(i)-(v). [1,3,4] These 5 groups can be broken into 3 categories of activity: (1) hazardous waste site remediation and cleanup operations, (2) hazardous waste treatment storage and disposal facilities (TSDFs), and (3) emergency response operations to releases of or the potential for releases of hazardous substances regardless of the location of the release.

This last category, emergency response operations, is the activity discussed in this article. The pertinent section of HAZWOPER's scope (29 CFR 1910.120(a)(1)(v)) includes any employer with significant quantities of hazardous substance, which if released in an uncontrolled fashion would present an emergency situation. [1, 4] The actual language of the standard reads:

> *(a) Scope, applications and definitions-(1) Scope--(v) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.* [1,4]

Hazardous substance is a broadly defined term. Thus, perhaps most if not all industrial facilities across the United States have a responsibility to comply with this standard. If industrial hygienists find themselves asking the question "Does this standard apply?" the answer is most probably, yes. But, more important than regulatory compliance, is the excellent guidance this standard offers to facilities preparing for potential emergencies.

The key to compliance with the emergency response provisions found in 1910.120(q) is development of a comprehensive emergency response plan as required in 1910.120 paragraph (q)(1) and further defined in (q)(2). [5] It is only through the emergency response plan that the other provisions described in paragraph (q) can be appropriately addressed. Below we will discuss procedures for

development of such a plan and how the other provisions and requirements of paragraph (q) are clarified through the planning process.

Emphasis on Training

Since the promulgation of HAZWOPER, there has been a significant effort on the part of employers to come into compliance with the standard's training requirements. This is particularly true of the training requirements for emergency responders found in paragraph (q). There are 5 different levels of competency to which an emergency responder may be trained.[1,4] The hazardous materials technician level, requiring a minimum of 24 hours of training, has become a benchmark, to which employers seeking to be in compliance have trained their employees. Training organizations across the country have developed and marketed HAZWOPER training programs while at the same time reminding prospective clients of the necessity of compliance with OSHA regulations.

This focus on training has been beneficial, however an equally important requirement has been neglected: the emergency response plan. Indeed, in the absence of an emergency response plan, compliance with the training requirements is meaningless. Training program content is based on the duties and functions of the emergency responder as defined in the emergency response plan.[1,4] Hence without the definition of the roles and responsibilities found in the emergency response plan it is impossible to design an appropriate training program. The question of which comes first: training for emergency responders or the emergency response plan? clearly must be answered in favor of the emergency response plan.

The emergency response plan is the key to compliance with 1910.120(q) and the framework from which other provisions of the standard, like the training requirements, can most effectively be interpreted and met. Training, personal protective equipment, medical surveillance requirements, and the role emergency responders are expected to play must all be defined in the emergency response plan. [1,4]

The Emergency Response Plan and Compliance Strategies

In an effort to accommodate the range of facilities covered by this performance-oriented standard, OSHA offers the following 2 strategies for compliance with the provisions of 1910.120(q).[1,4]

The Evacuation Strategy

The first strategy entails development of an evacuation plan that meets compliance with 1910.38(a). [6] The evacuation plan is referred to as an emergency action plan (EAP) in the standard. The employer is also required *not to allow any of their employees to play any role in the emergency response.*[5]

This compliance strategy may be appropriate for smaller facilities that lack adequate resources to respond. However; larger facilities will probably find it beneficial to plan at least limited response procedures to emergency situations. Ultimately a driving force behind decisions in the preplanning stage must be an analysis of what a facility may lose in the event of an emergency if it has no in-house emergency response capabilities.

The evacuation/no-response alternative compliance strategy requires an employer to instruct and require all of their employees to take no action and simply evacuate. [1,4] There may not be even the most minor of responses by an employee into the danger area to stem the tide of an unfolding emergency and divert potential disaster with the exception of trained chemical process operators. These individuals may take limited action in the danger area before evacuating to prevent the incident from increasing in severity (i.e., to prevent a catastrophe) if the emergency response team is on the way and their arrival is imminent. [5,7] All employees must evacuate to a safe distance, and inform outside emergency

responders who have the proper training, equipment, and procedures to respond to the incident. The emergency action plan/no-response compliance strategy would not be an appropriate alternative for facilities of any size, since those facilities would most likely want to take immediate action themselves to control the emergency.

The Response Strategy

The second alternative compliance strategy entails full compliance with all of the provisions of paragraph (q).[1] All of the provisions of paragraph (q) must be addressed, however, the response alternative allows for a spectrum of response strategies. The employer may opt to address only limited emergencies and evacuate during larger incidents, or the employer may opt to respond to all incidents. Emergency response plans can be comprehensive or limited depending on the particular requirements of the facility. However, if any response activity is to be taken, the procedures to be used must be anticipated and delineated in the ERP. (1,4)

An emergency action plan (1910.38(a)) designed to evacuate all nonessential personnel is a fundamental component of the larger ERP for facilities that intend to respond to HAZMAT emergencies. Employers are required to evacuate all nonessential personnel. Only personnel who will be actively performing emergency operations, including those serving as backup are to remain in the vicinity of the danger area. (1, 4)

[1] 'Although OSHA requires compliance with all of the provisions of the emergency response paragraph for facilities that respond, there is an allowance for not complying with specific provisions that may not be applicable. The emergency response compliance directive states. "It may be that some of the requirements of air ERP are not applicable to the place of employment in question. While OSHA does not expect the employer to meet requirements that are not applicable, an explanation of how the specific requirement is inappropriate, or is otherwise met, must be addressed in the ERP." (5)

Elements of an ERP

The elements an employer must address in the ERP are presented in paragraph (q)(2) "Elements of an emergency response plan (ERP)." (1, 4) A discussion of each specific element and procedures for developing the individual components of the ERP will be discussed below on an element-by-element basis.

Preemergency Planning and Coordination with Outside Parties

HAZWOPER in paragraph (q)(2)(i) requires "preemergency planning and coordination with outside parties" as an element of the ERP.(1,4) Therefore, an industrial facility with a significant quantity of hazardous substance, which if released in an uncontrolled fashion would pose an emergency, has a responsibility to coordinate their emergency response activities in advance, with local emergency response agencies. (5)

The ERP should address coordination with outside emergency response organizations, such as fire departments, police, and emergency medical services. The plan should be developed in cooperation with the community emergency response agencies expected to respond from outside the facility to ensure that outside responders are cognizant of and have accepted their role in the plan. The ERP should include contact names, telephone numbers, preplanned locations of emergency command posts, and safe staging areas for responders arriving from outside the facility. The response roles of the various agencies should be coordinated in advance. The employer should ascertain that the outside parties are properly equipped and competent to carry out the role they have agreed to play as identified in the ERP. This can be done by reviewing the outside responders procedures, equipment, and the training level competencies of its personnel.

TABLE 1. Roles and Responsibilities to be Addressed in Emergency Response Plan [1,4]

Title	Role
On-scene incident commander	Direct all activities of the emergency response at the incident scene.
Site safety and health officer	Technical support to on-scene incident commander on all safety and health issues.
Security officer	Responsible For security of site and exclusion of danger area from unauthorized entry.
Hazardous material specialist	Responds with, and in support to, HAZMAT technicians. Have specific knowledge or expertise of hazardous substances.
Hazardous material technician	Responds aggressively in the danger area to contain the release.
First responder operations level responder	Responds in a defensive manner (places absorbent, digs dikes) and performs decontamination procedures.
First responder awareness level	Discovers HAZMAT emergency, reports emergency to the incident command structure, and evacuates the danger area.
Specialist employee	Advises the on-scene incident commander on their area of expertise (e.g., specific process areas or hazardous substances).
Skilled support personnel	Provides support to the on-scene incident commander in terms of a technical support (heavy equipment operator, tow truck, etc.).

Personnel Roles, Lines of Authority Training, and Communication

Response roles should be clearly defined by naming individuals and their projected role in emergency response operations. Although specific HAZWOPER titles are not required, there should be parallel positions that are identifiable and trained in accordance with 1910.120. [5] As a minimum response team, there must be an on-scene incident commander and two hazardous material technicians identified. [5] OSHA recommends that backup personnel be available in the event that a rescue is required. [5] Also, trained personnel responsible for decontaminating the responders who enter the danger zone may be required, and these personnel would be required to be trained to the first responder operations level. Facilities with the potential for an emergency caused by the release of hazardous substance would also be required to have individuals likely to discover releases of hazardous substance trained to the first responder awareness level, allowing them to recognize an emergency situation and report it to the proper authorities.

Other roles that the ERP may want to xaddress are presented in Table 1.

Lines of authority must also be clearly spelled out in the ERP. Initial communication channels should move toward the on-scene incident commander expeditiously in the event of an emergency. Although first responder awareness level respondents may be expected to inform their supervisors (as opposed to the on-scene incident commander or HAZMAT response team) in the event of an emergency, *the supervisor, unless properly trained, should do nothing other than inform the emergency response personnel.* ([5])

Once an incident has been determined to require an emergency response by an appropriately trained individual (i.e., first responder awareness level or above) the incident should not be investigated further without the coordinated effort of trained emergency responders. However, if untrained individuals report an incident to their supervisor, and the supervisor is trained to at least the first responder awareness level, the supervisor may investigate the incident limiting their actions to those for which they have been appropriately trained. Untrained personnel who attempt to take direct action in the danger area during an emergency often endanger themselves and others.

Lines of communication need to be clearly delineated in the ERP. Essentially all employees who may encounter the uncontrolled release of hazardous substance

that requires an emergency response should be addressed in the ERP, and must understand to whom they are to report a release. [5] These preordained lines of communication need not be developed for each individual employee but rather for different groups of employees from different areas within a facility who would be required to report to the same individual during an emergency incidental. [5]

Means of communication, which must be addressed in the ERP, might include dedicated radio frequencies, hand signals, and siren blasts. [5] The response plan should also address secondary means of communication, in the event that the primary means has been incapacitated due to the emergency (e.g., phone lines are knocked out). A system to communicate evacuations of all employees who are not designated as emergency responders must be developed.

Provisions for employee training should be incorporated into the ERP. [5] This might entail including the training course outline for each of the various levels of emergency responder included in the ERP. The plan should also address the required refresher training schedule and refresher course content.

Emergency Recognition and Prevention

Emergency recognition is perhaps the most important element of an emergency response plan because it defines when the procedures in the plan are to be followed (i.e., when there is to be an emergency response). [5] ERPs should cover procedures for responding to incidental releases; however, this is not required.

The distinction between an incidental release of hazardous substances and a release that requires an emergency response is fundamental to compliance with 1910.120(q). [5] Standard operating procedures need to be developed that allow workers to identify releases as incidental or as one that requires an emergency response. These facility-specific standard operating procedures should serve as the basis of the first responder awareness level training program. In the absence of such standard operating procedures, there is no guidance to the first responder awareness level personnel as to just what constitutes an emergency.

Releases of hazardous substances in the workplace can be categorized into 3 distinct groups in terms of compliance with 1910.120. These groups are (1) releases that are clearly incidental in nature regardless of the circumstances, (2) releases that may be incidental or may require an emergency response depending on the circumstances, and (3) releases that clearly require an emergency response regardless of the circumstances. [5]

RELEASES THAT ARE CLEARLY INCIDENTAL. The HAZWOPER standard addresses the inevitable release of a hazardous substance that is limited in quantity and/or toxicity arid poses no emergency or threat to the safety and health of workers in the immediate vicinity.[5] These releases are common and ubiquitous, and fall outside the scope of 1910.120. This type of release is referred to as an "incidental release" in paragraph 1910.120(a)(3), where "emergency response" or "responding to emergencies" is defined. [1, 4]

An incidental release is a release of hazardous substance that does not pose a significant safety or health hazard to employees in the immediate vicinity or to the worker cleaning it up, nor does it have the potential to become an emergency. [5] Incidental releases are limited in quantity. exposure potential, toxicity, or some combination of the three that clearly presents no safety or health hazard to workers in the immediate work area or those assigned to clean it up. [5]

If the hazardous substances used in a particular work area are always in limited quantity, as may be the case in a research laboratory, for example, and the hazardous substance's toxicity and exposure potential is limited, then the potential for a release to

cause an emergency is minimal. In this setting incidental releases will be the norm and employees will be trained to know how to protect themselves in handling incidental releases per the training requirements of the hazard communication standard.[5,8]

RELEASES THAT MAY BE INCIDENTAL OR REQUIRE AN EMERGENCY RESPONSE DEPENDING ON THE CIRCUMSTANCES. In the recently published compliance directive for enforcement of the emergency response provisions of the HAZWOPER standard,[5] OSHA has identified the factors that contribute to defining the distinction between an incidental release and a release that requires an emergency response. The compliance directive, which is essentially instructions to the OSHA compliance officer on how to enforce the requirements of the standard, states:

> *The properties of hazardous substances, such as toxicity, volatility, flammability, explosiveness, corrosiveness, etc., as well as the particular circumstances of the release itself, such as quantity, confined space considerations, etc., will have an impact on what employees can handle safely and what procedures should be followed. Additionally, there are other factors which may mitigate the hazard associated with a release and its remediation, such as the knowledge of the employee in the immediate work area, the response and personal protective equipment at hand, and pre-established standard operating procedures for responding to releases of hazardous substances.*[5]

These three considerations, properties of the hazardous substance, the circumstances of the release, and the mitigating factors in the work-area, combine to define the distinction between incidental releases and releases that require an emergency response, for releases that are neither clearly incidental in nature nor clearly require an emergency response.

OSHA clarifies this distinction with the following example:

> *A spill of the solvent toluene in a facility that manufactures toluene may not require an emergency response because the advanced knowledge of the personnel in the immediate vicinity and equipment available to absorb and clean up the spill. However, the same spill inside a furniture refinishing shop with personnel that have had only the basic hazard communication training on toluene, may require an emergency response by more highly trained personnel. The furniture refinishing shop's emergency response plan in this case would call for evacuation for all but the most minor spills, while evacuation and emergency response would be necessary for only much larger spills at the chemical manufacturing facility.* [5]

TABLE 2. Guidance from OSHA: Definition of the Types of Hazardous Substance Releases that Require an Emergency Response [5]

Interpretive Language: Each of the following conditions defines the need for an emergency response.
Response comes from outside the immediate release area.
The release requires evacuation of employees in the area.
The release poses, or has the potential to pose, conditions that are immediately dangerous to life and health (IDLH).
The release poses a serious threat of fire or explosion (exceeds or has the potential to exceed the lower explosive limit or lower flammable limit).
The release requires immediate attention because of imminent danger,
The release may cause high levels of exposure to toxic substances.
There is uncertainty that the employee in the work area can handle the severity of the hazard with the PPE and equipment that has been provided and the exposure limit could easily be exceeded.
The situation is unclear, or data are lacking on important factors.

The distinction between incidental and emergency response, and the procedures through which that distinction can be discerned, must be addressed by the ERP.

RELEASES THAT REQUIRE AN EMERGENCY RESPONSE REGARDLESS OF THE CIRCUMSTANCES. There are releases of hazardous substances which pose a significant enough threat to health and safety that by their very nature require an emergency response, regardless of the circumstances surrounding the release or the mitigating factors. OSHA has offered several interpretations defining this type of release in various letters of interpretation summarized in the Emergency Response Directive and presented in Table 2.

The ERP should also address emergency prevention. Employees not trained as emergency responders may be required to shut down processes, close emergency valves, and otherwise secure operations before evacuating in the event of an emergency. [5] These procedures need to be developed and included in the ERP, and employees must be trained to be able to perform these preevacuation procedures safely.[5] Employees instructed to evacuate during an emergency (i.e., not trained in compliance with 1910.120) *should not be instructed to perform preevacuation procedures in the "danger area."* [5]

Chemical process operators (i.e., highly trained individuals) who have informed the incident command structure of the emergency incident, who have adequate personal protective equipment and training, and who can employ the buddy system may take action in the danger area necessary to stop the incident from increasing in severity before the emergency response team arrives. [5] This kind of response must be addressed and examined in detail in the ERP and emergency responders must act within the capabilities of their training and equipment, have clear guidance and training in this determination, and be clearly told that they may evacuate without employer penalty if they subjectively believe it is beyond their capabilities. [5]

This action assumes that the emergency response team is on its way and that the action taken is immediately necessary to prevent the incident from increasing drastically in severity (i.e., to prevent a catastrophe). It is important that employers make clear to employees that they should evacuate when they lack the capabilities to respond to an emergency in a safe and healthful manner.

Once the distinction between incidental and emergency releases has been established through standard operating procedures written into the ERP, inventories of hazardous substances in each area of the facility need to be reviewed. The quantity of hazardous substance stored with worst-case scenario assumptions about potential releases being made will dictate if the potential for an emergency exists in that particular area. Response procedures can then be developed chat address specific potential release scenarios.

Safe Distances and Places of Refuge

The ERP should contain a site map with safe places of refuge identified for each section of the facility. [5] Ideally the map should contain the location of all buildings, structures, equipment, emergency apparatus, first aid stations, routes of entry and exit, emergency exit routes, staging areas, and safe places of refuge. The safe places of refuge will be the areas in which accounting of all employees is performed. This can be critically important for identifying individuals who did not get out and estimating where they may be in the facility.[5] Allowances should be made to ensure that this information is given to the emergency response organization in a timely fashion.

Site Security and Control

Areas surrounding the danger area need to be controlled during emergencies *by* prohibiting unauthorized personnel from entering the exclusion zone, or hot zone. [5] Personnel expected to effect this exclusion must be trained to the first responder operations level. Methods of excluding areas and defining various zones need to be addressed in the ERP. Emergency responses need to be

coordinated from a command post some safe distance from the exclusion zone.[5] Creation of a command post must be addressed in the plan.

Evacuation Routes and Procedures

All employees not trained in emergency response and who will not serve as specialist employees during the response operation need to be evacuated from the exclusion zone. [5] This aspect of the ERP should be in compliance with 29 CFR 1910.38(a), requirements for an emergency action plan.

Decontamination

The ERP must contain provisions for decontamination of emergency responders leaving the exclusion zone. [5] Individuals who will assist the responders as they leave the exclusion area must be trained in decontamination procedures. These individuals should wear personal protective equipment at the same *level or* one level below the emergency responders they are supporting. [5]

Decontamination of response equipment and the contaminated area may be handled in the post-emergency response and therefore decontamination procedures for these areas do not necessarily need to be part of the ERP.[5] However, if emergency responders are expected to decontaminate their own equipment or the contaminated area, then the procedures to be followed must be included in the ERP (see the discussion of post-emergency response operations).[5]

TABLE 3. Alarm System Criteria [5]

Requirement	Definition
1. Notification	Making the existence of the emergency situation known.
2. Level/type of response	The required response based on the extent and type of emergency.
3. Nature of the emergency	The type of emergency condition (fire, explosion, vapor release, chemical spill, medical).
4. Location	Critically important in large facilities.
5. Ambient conditions	Environmental factors influence evacuation or response procedures (wind speed and direction).

Emergency Medical Treatment and First Aid

This section of the ERP should list all qualified emergency medical technicians on site, their certifications, and how to best contact them during an emergency. Hospitals capable of receiving or responding to accident victims that may arrive contaminated must be listed. [5]

Arrangements must be made for the handling of contaminated victims with first aid responders on site, or community emergency medical technicians and area hospital facilities. If victims must be decontaminated at an area hospital, coordination with the hospital is required prior to the emergency to ensure the hospital has personal protective equipment, methods of containing the hazardous material waste water, and staff' trained to at least the operations level who are capable of performing decontamination.[5]

Emergency Alerting and Response Procedures

This section of the ERP should address how employees will be informed that an emergency exists, and how they should respond. OSHA identifies 3 important questions that need to be addressed by the alarm system: (1) who needs to be made aware of the emergency?, (2) what do they need to be told to do?, and (3) how will they be alerted?[5] The alarm systems must inform all affected personnel that a potential

emergency exists and what their immediate response should be.

Depending on plant size and the magnitude of the potential emergency, "all affected employees" may include all employees, or just employees from a limited area. If the facility intends to evacuate employees from limited areas in response to emergencies, it must have alerting procedures in place that can communicate specifically only to those employees who must evacuate. [5]

Criteria for meeting the second objective of informing the employees of what their immediate response should be were published in OSHA's compliance directive [5] and are presented in Table 3.

Critique of Response and Followup

ERPs must be based on site-specific needs and experience. It is important to consider previous accidents in preparing a facility's ERP. [5] It is just as important to consider new information, experience, and incidents with the goal of enhancing the ERP and keeping it current. [5] The ERP must be a dynamic document that changes in response to changing conditions and increased experience concerning implementation of the plan.

Formalized procedures for the critique of an emergency response incident should be written into the ERP. Appropriate changes should be made in the ERP in accordance with the results of a critique of a specific incident. Time spent by emergency response employees critiqueing incidents can be credited towards their refresher training requirements. [5]

Personal Protective Equipment and Emergency Equipment

This section of the ERP should list the facility's inventory of personal protective equipment (PPE) and emergency response equipment. [5] The ERP should include instructions on how and when the PPE and emergency equipment is to be used. The limitations of PPE must be known and understood and the ERP should address procedures for maintaining the PPE, storage, decontamination, inspection, and in use monitoring of the equipments effectiveness.

HAZWOPER requires emergency responders to be trained in selection of proper PPE, and the incident commander must be aware of the equipment and PPE available during an emergency. [5]

Post-Emergency Response Operations

The on-scene incident commander is responsible for bringing an emergency response operation to a formal close by declaring it over. This is usually considered to be the point at which the uncontrolled nature of the release or threatened release has been stabilized or eliminated and only the cleanup of hazardous substances released remains to be done. [1, 4] This phase of the operation, referred to as a post-emergency response operation, may be handled by either of two strategies identified in 29 CFR 1910.120, paragraph (q)(11) "Post emergency response operations." [1,4] Of course the hazardous substances released may be cleaned up during the emergency response action, in which case a post-emergency response would not be necessary. However, if a post-emergency response is necessary, the employer may opt to clean up the contaminated area meeting all the requirements of HAZWOPER paragraphs (b) through (o) as if the site were an uncontrolled hazardous waste site or a Resource Conservation and Recovery Act (RCRA) corrective action. [1,4] If the cleanup is to be performed on plant property, the employer may use properly trained plant or workplace employees. [1,4] Properly trained workplace employees are defined to include those employees trained in accordance with 29 CFR 1910.38(a), [6] 29 CFR 1910.1200, [8] and 29 CFR 1910.134, [9] and other appropriate safety and health training made necessary by the duties they are expected to perform. [1,4]

In response to experience gained during oil spill response, OSHA published inspection guidelines for post-emergency response

operations under the HAZWOPER standard. OSHA's experience indicated that post-emergency response operations involved hazards that varied widely in severity of potential injury or illness. Therefore, OSHA indicated that for duties with a low magnitude of risk, fewer than 24 hours of training[2] may be appropriate, but, though the number of hours may vary, a minimum of 4 hours would be appropriate in most situations. (10) OSHA states that petroleum spills are unique in that individuals who participate in cleanup – the emergency responder, or hazardous waste remediator—may not engage in similar activities on a recurring basis (i.e., because of the absence of the potential for chronic exposure, a casual post-emergency responder may not require the level of training afforded individuals who partake in cleanup operations repeatedly).(10)

Case Studies

Development of ERP in the real world is a function of the facility's individual characteristics. To illustrate how the principles outlined in this article are applied, the following case studies discuss a range of facilities, their pertinent characteristics that influence design of the ERP, and the appropriate facility ERPs.

Case Study 1: A Furniture Refinishing Shop

A small furniture refinishing shop with 5 employees buys its chemical stripper in 55-gallon drums. The stripper contains toluene, methylene chloride, and acetone. Paint and lacquer thinners are also purchased in 55-gallon drums. The 55-gallon drums are stored in a storage room in the back of the building. Working supplies of 1 gallon or less are pumped from the drums in the storage

The employees have been trained in compliance with the hazard communication standard. The employer's compliance strategy with 1910.120 is to evacuate all employees in the event of an emergency. Releases of working quantities of the stripper or thinners are defined as incidental and are cleaned up by the employee who spilled the substance, following standard operating procedures that all employees are familiar with through their hazard communication training.

Releases associated with failure or puncture of a drum in the storage area are considered beyond the capabilities of the employees to handle safely. Therefore, if a drum is found to be leaking the facility is immediately evacuated and the local fire department is called. The Fire department has visited the shop and has on file an inventory map of the storage area and material safety data sheets for all of the substances on site. The fire department uses HAZMAT technicians trained in the proper techniques to apply patch kits on drums.

Case Study 2: A Small Package Shipping Company

A small package shipping company has major facilities with hundreds of employees, satellite centers with tens of employees, and many trucks with lone drivers. Packages identified by the shipper as containing hazardous substance constitute a fraction of 1 percent of all packages shipped. The weight of any one package shipped is limited to a maximum weight of 70 pounds, and hazardous materials are further limited in weight by Department of Transportation hazardous material packaging requirements.

It may appear From the above scenario that the HAZWOPER standard does not even apply to this type of operation because there are limited quantities of hazardous substances with the potential to be released. However, the factors that mitigate the potential for a spill to

[2] This OSHA directive applies to post-emergency response operations performed off-site, not on plant property, and therefore workers involved in cleanup would be required (per paragraph (q)(11)) to have either 24 hours of emergency response training (to the hazardous materials technician level-paragraph (q)(6)) or, as a minimum. 24 hours of off-site training per paragraph (e).

cause an emergency are totally absent in this company. The knowledge of workers in the immediate release area of the hazards associated with any particular hazardous substance is essentially nil. Immediately following any release, the hazardous substance released will be unknown. The package handlers would have no special knowledge through work experience, training, or education. Therefore they would not know how to safely clean up even incidental releases. Additionally. there are substances that if released in such limited quantities still have the potential to cause an emergency situation as previously discussed. The shear magnitude of the quantity of packages containing hazardous substances shipped through the system each day requires that some preplanning be performed to protect the safety and health of workers potentially exposed to these releases.

The ERP developed to address the specific needs and challenges of this company's work environment is a combination of compliance strategy I and II (see pages 5 and 6 from [11]). In the event of a release requiring an emergency response all employees evacuate in accordance with an emergency action plan (29 CFR 1910.38(a)). However, the decision to evacuate will be made by individuals trained to the first responder operations level. The decision is made by strict adherence to standard operating procedures and a decision tree analysis of incidents contained in the emergency response plan. [11]

If this trained individual decides the release is incidental and can be cleaned up safely, the personnel trained to operations level will ameliorate the situation. These trained individuals know how to clean up incidental releases safely by following procedures spelled out in the ERP. Because of the range of possible substances that may be released, careful planning and training which address broad categories of hazardous substances are required.

Case Study 3: A Chicken Processing Plant

A chicken process plant houses a refrigeration system using ammonia for cooling and ice production. The system is composed of piping that runs throughout the plant, an engine room with 6 compressors, and a storage tank that holds 5000 pounds of liquid ammonia.

The facility's ERP outlines the structure of the smallest possible HAZMAT response team allowed by the HAZWOPER regulation. [1,4] This minimum response team is appropriate to this situation due to the limited spectrum of potential emergency scenarios. Essentially the only hazardous substance emergency that could take place at this facility is a release of ammonia.

Clearly, at this facility there is the potential for a release of hazardous substance that could pose a substantial safety and health hazard. However, the threat is not the result of a process, and workers in the work area may not have any special knowledge of the characteristics or hazards associated with the substance (ammonia). The refrigeration system is closed. Line employees never perform maintenance operations or other procedures that would bring them into direct contact with ammonia. Line employees would need to be made aware of the dangers of ammonia in the event of a release, how to sense a release, how the alarm system works, and how to properly evacuate.

The first step in the development of the plant's ERP is a review of previous release incidents at the facility. This review process allows the safety professional to understand the types of releases that may be expected and also how they are currently being handled. In this particular facility there were several incidents of releases in the compressor room with at least one requiring evacuation of the process area. The piping system was also known to periodically spring leaks throughout the plant. In the recent past a relief valve positioned directly outside a garage door leading into the process area released

ammonia vapor that was immediately swept into the building due to the prevailing air flow patterns.

As part of the process of emergency preplanning it was decided to replace the piping system, several old compressors, isolate the compressor room from the process area, and install emergency ventilation systems in the compressor room, as well as relocate the relief valve away from the garage door, thus eliminating the possibility of escaping ammonia blowing into the process area.

The ERP called for 4 maintenance personnel to be trained to HAZMAT technician level while the plant manager was trained to be the on-scene incident commander. The minimal response allowed by the ERP was 2 HAZMAT technicians and the on-scene incident commander, or a third HAZMAT tech playing the role of the senior official on-site (before the on-scene incident commander arrived). It is preferable to respond with 3 technicians, but where visibility is not an issue the second tech can stay back and serve as a buddy and backup to perform rescue should the other hazardous material technician go down. [5]

This plant also coordinated their ERP with the local fire department and Local Emergency Planning Commission for the potential where a release could not be contained by the personnel on sight. The fire department was aware of the ammonia tank, and although they did not have a HAZMAT response team, they were prepared to apply water on the release from the upwind side (first responder operations level response defensive action remote from the danger area).

Case Study 4: A 500-Acre Multiprocess Chemical Manufacturing Facility

The final case study involves a large multiprocess chemical manufacturing facility with thousands of hazardous substances stored in large quantities, many process areas, many previous release incidents, and high catastrophic potential. Such facilities may also have planning responsibilities under OSHA's process safety management standard (29 CFR 1910.119); [12] however, these facilities must comply with the provisions of 29 CFR 1910.120 (q). [1,4]

The ERP for this facility outlines a tiered response that utilizes the expertise and substance specific knowledge of process operators in the immediate release area (John Clawson, personal communication, August, 1992). At the same time the ERP recognizes the potential for facility-wide emergencies and the necessity of responding to them in a coordinated fashion. The plant is divided into 42 process areas. Each area has 4 emergency responders who operate as an area brigade. Each emergency responder is trained to the hazardous material technician level. Other process operators in the area are trained to the first responder awareness level and instructed to inform the area brigade members in the event of a release of hazardous substance, no matter how minor.

The 4 emergency responders assigned to the area brigade are dedicated to their particular process area. Their training is specific to the hazardous substances and procedures to be followed in their area in the event of an emergency. Their emergency response expertise does not extend beyond those limited duties and therefore they are not called on to respond to emergencies in other process areas. In the event of any release of hazardous substance the area brigade members inform the Emergency Response Center, which is staffed 24 hours a day by an on-scene incident commander. A determination is made if the area brigade can handle the response alone or assistance is called in if required. Although the decision to call in outside assistance can be made immediately, most often it is made while the incident commander is monitoring the situation.

The emergency response center is controlled by the emergency response group

(ERG), which employs 16 full-time emergency responders, each trained to the hazardous material technician and on-scene incident commander level. The control center is linked by radio to all area brigades and electronically to all process and employee alarm systems. The response center also contains sophisticated computer systems, with alternate power supplies, designed to predict, based on prevailing weather conditions and the nature of the release, a contaminant plume's spread in the event of a catastrophic emergency. If an emergency in a the process area is large enough to be beyond the control of the area brigade, the emergency response group will respond. If additional resources are required, the site brigade may be called into action. The site brigade is composed of one HAZMAT tech from each area brigade who receives additional training that allows them to respond to other areas on-site.

The ERP has been coordinated with local area emergency response agencies. These local emergency responders have received training and equipment from this facility through the establishment of "mutual aid" relationships with the four area fire departments surrounding the facility. These agreements assure the local responders are properly equipped and trained to play the support role identified for them in the ERP and by the local emergency planning committee.

Additionally, the ERP addresses the inevitable transportation emergency caused by releases of material being shipped to or from the facility. This potentiality has resulted in the acquisition of a state-of-the-art HAZMAT response truck, emergency response equipment, and the training of emergency responders for transportation accidents. The transportation emergency response group has 16 HAZMAT technicians (8 are members of the ERG), who are able to respond anywhere. The success of this group is evidenced by the team having established formal relationships with local government agencies to respond to transportation accidents involving hazardous materials throughout the region.

The training received by the different groups is indicative of the complexity and hazardous potential of the facility The area brigade members receive 80 hours of initial training and 8 hours of refresher training on a bimonthly basis. The site brigade members, emergency response group, and transportation HAZMAT team receive 120 hours of initial training and 8 hours of refresher training on a monthly basis. The emphasis on refresher training is due to the dynamic nature of the 42 process areas in the facility. The plant is constantly changing and shifting into different phases of operations. These changes impact the ERP and consequently redefine the actions to be taken by responders. Refresher training includes review of all previous release incidents and how the response was handled.

It is important to highlight the tiered nature of this facility's emergency response plan because in a sense it represents the spectrum of response alternatives open to industrial facilities that choose to respond to releases of hazardous substance.

Conclusions

The HAZWOPER standard requires employers whose facilities have the potential for an emergency caused by the uncontrolled release of a hazardous substance to plan in advance for such emergencies. This may entail development of an evacuation plan with all employees being instructed to evacuate, and no one being allowed to respond to the emergency, until outside responders arrive. At the other end of the spectrum, compliance may be reached by development of a comprehensive ERP in accordance with all the provisions of HAZWOPER paragraph (q).

Development of an emergency response plan requires a systematic review of the hazards on site, assumption of worstcase scenarios, defining the distinction between

incidental releases and releases that require an emergency response, development of evacuation procedures, standard operating procedures for response activities, coordination with outside response agencies, and other preplanning activities. The ERP serves as the document that defines the criteria of compliance for other provisions of paragraph (q), most notably; distinctions between incidental releases and releases that require an emergency response and the content of the training program.

The guidance offered in the HAZWOPER standard regarding emergency response operations, if followed, offers facilities preplanned procedures, trained employees, and the availability of needed equipment at critical moments during emergencies. This type of responsible preparation can only benefit the facility, the employees, and the community at large.

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CASE STUDY 1

You are a member of the emergency response team at a plating company. The plating company employs 70 people. On a warm, sunny afternoon at approximately 1:00 pm., you are purchasing lunch from the "roach coach". The lunch truck parks outside the open bay doors of the warehouse. The warehouse is a separate building located approximately 20 feet from the main plant. While making your selection, you hear an awful crash and employees running from the building. Looking through the bay doors and based on the information from employees exiting the building - you gather the following information.

The identity of the spill is unknown. A worker was driving a forklift and backed into a storage rack. The driver had been issued verbal warnings in the past regarding his reckless forklift operation. The rack toppled and the containers stored on that rack crashed to the floor. A number of the containers broke and spilled their contents. Some of the employees began to vomit and had difficulty breathing – like the oxygen was being sucked out of the air. Everyone in the vicinity of the spill immediately ran outside for fresh air. It is believed that a few people are missing but it is unknown if they were in the warehouse area or in the main plant at the time of the accident. It is possible that one employee was between the storage racks conducting an inventory when the accident occurred.

You have been trained to the awareness level and, therefore, you will do your best to identify the spilled material, call for help, and secure the area. You can not see the labeling on the containers from the doorway. Will you enter the area to get a closer look? You do know that in that warehouse, they store cyanide tablets, sulfuric acid, hydrochloric acid, sodium hydroxide, and sodium metabisulfite. From the doorway, you can see that the spilled material is a white powder and you can detect a bad odor. Further observation reveals a number of barrels located near the spilled material. The bung on one or two barrels has been removed – this is a common practice in the warehouse to allow the release of stored pressure in the barrel. There are no other employees in sight.

What is the spilled material?
What might be in the open barrels and is there any need to be concerned about the contents?

You make the 911 call. What information should be given to the dispatcher? The fire trucks have arrived and the firechief approaches you for information. The fire department does not have any information regarding the materials in your warehouse. In addition, the media has heard of the spill and they are sticking a microphone in your face and bombarding you with questions. The media are “hot” for a story because an elementary school is located within a block of your facility and this could be “BIG” news. How will you secure the immediate area and how will you respond to these people's demands? What would you recommend regarding evacuation of the remainder of the plant and the school?

CASE STUDY 2

You are a member of the emergency response team for a construction company. The company you work for is the prime for the construction of a medical office building. There are a number of subcontractors on the job each day.

With so many subcontractors on the job, space is at a premium. Each company has a different area to store supplies and construction materials that are needed to get the job done. For example, at the loading dock of the building, there are pipes and stacks of plywood. Also, in the corner of the dock area, there are a number of 55-gallon drums. The drums are labeled with the number 1203.

In this same vicinity, two of the workers are preparing the area for concrete. One is driving a bulldozer around to smooth the ground and dumping gravel while the other worker spreads the gravel with a shovel. Accidentally, the bulldozer backs up into one of the barrels. The barrel breaks and spills its contents onto the ground. The two workers are not concerned and continue with the job at hand of spreading gravel with the shovels. What is the spilled material? What will you report when you call in the incident? How will you secure the scene? What is the major hazard with this material that you must be concerned about?

TANKER SPILL

Watch the video and collect as many clues as you can –

The D.O.T. number on the tanker is 1831.

The trailer is transporting 55-gallon drums of Methyl Ethyl Ketone. If any of the drums have spilled, what hazard(s) of MEK do we need to be concerned about?

What information will you provide to the fire department regarding the situation?

Will you attempt to save the victim?

How will you secure the area? Do you need to recommend evacuation?

CROSSWORD PUZZLE ANSWERS

ACROSS

1. Label
2. Routes
3. Recognition
4. Upwind
5. Corrosive
6. MSDS
7. United Nations

DOWN

1. Animals
2. Emergency
3. Distance
4. Security
5. Container
6. NFPA
7. Placards
8. Explosion
9. DOT

TOXICOLOGY ANSWERS

TERMS:

OSHA – Occupational Health and Safety Administration

ACGIH – American Conference of Governmental Industrial Hygienists

NIOSH – National Institute for Occupational Safety and Health

DEFINITIONS:

PEL stands for Permissible Exposure Limit. PELs are legal limits set by **OSHA**.

REL stands for Recommended Exposure Limit. RELs are set by **NIOSH**. RELs are not legally enforceable – they are as their name applies, recommendations.

TLV stands for Threshold Limit Value. TLVs are recommended guidelines offered by **ACGIH**.

TWA stands for **Time Weighted Average**. TWAs are based on an **8-hour** hour work shift and a **40** hour work week.

Ceiling Value is an exposure level that shall not be exceeded during any part of the work day.

STEL stands for Short Term Exposure Limit. An STEL is a **15** minute TWA exposure.

IDLH stands for **Immediately Dangerous to Life or Health**.

PPM stands for Parts Per Million which means one part contaminant per one million parts of air. One part per million is equivalent to 1 inch in 16.7 miles or 1 teaspoon in 1,300 gallons.

There are four routes of exposure. Those routes of exposure are:

1. **Inhalation**
2. **Absorption**
3. **Injection**
4. **Ingestion**

The principal route of entry into the body is through **inhalation**.

What is the importance of the notation "skin" in toxicological data? **Absorbed through the skin – need to use appropriate PPE**

Toxicology is a function of dose and time. A chemical's ability to do damage as a result of exposure to a single large dose is known as **acute**. Chemical damage due to low level repeated exposures over a long period of time is known as **chronic**.

When the chemical affects the site of exposure, such as the skin from an acid burn, this is known as a **local** affect.

When the chemical does not affect the its initial site of contact but attacks other organs known as target organs, this is known as **systemic** affect. An example is the affect that lead has on neurons resulting in loss of memory, muscle tremors, loss of muscle coordination and others.

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*                     M S D S                             *
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*** IDENTIFICATION ***

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MSDS RECORD NUMBER        : 2245281
PRODUCT NAME(S)           : SULFURIC ACID FUMING
PRODUCT IDENTIFICATION    : MSDS NUMBER: S8252
                            PRODUCT CODE:  2886
                            C.A.S. NUMBER: 8014-95-7
DATE OF MSDS              : 1998-06-30
CURRENCY NOTE             : This MSDS was provided to CCOHS in
                            electronic form on 2000-03-13
```

*** MANUFACTURER INFORMATION ***

```
MANUFACTURER              : Mallinckrodt Baker, Inc
ADDRESS                   : 222 RED SCHOOL LANE
                            PHILLIPSBURG  NEW JERSEY
                            U.S.A.    08865
                            Telephone:  800-582-2537  (Customer
                            Service)
EMERGENCY TELEPHONE NO. : 908-859-2151
                            800-424-9300  (CHEMTREC, USA)
                            703-527-3887  (Outside USA & CANADA)
                            613-996-6666  (CANUTEC)
```

*** MATERIAL SAFETY DATA ***

```
                                           Effective Date: 06/30/98
                                               Supercedes: 09/24/97

====
MSDS   MATERIAL SAFETY DATA SHEET          CHEMTREC: 800-424-9300 (USA)
====   ----------------------------                  703-527-3887
       From: Mallinckrodt Baker, Inc.                (Outside USA & CANADA)
             222 Red School Lane           CANUTEC:  613-996-6666
             Phillipsburg, NJ 08865
                                           NOTE: Use CHEMTREC and CANUTEC
Emergency Telephone Number: 908-859-2151   phone numbers only in the event
                                           of a chemical emergency.
```

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

M A L L I N C K R O D T

SULFURIC ACID FUMING

1. Product Identification

Synonyms: Oleum; disulfuric acid; pyrosulfuric acid; sulfuric acid mixed with sulfur trioxide
CAS No: 8014-95-7
Molecular Weight: 178.14
Chemical Formula: H2SO4 + 20% SO3
Product Codes: 2886

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sulfuric Acid, mixt. with Sulfur Trioxide	8014-95-7	100%	Yes
Sulfuric Acid	7664-93-9	80%	Yes
Sulfur Trioxide	7446-11-9	> 18%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE.
LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE. WATER REACTIVE. STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE OR EXPLOSION. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

Potential Health Effects

Inhalation:
Corrosive! Fuming sulfuric acid vapors, fumes and mists can burn all surfaces of the respiratory tract chemically as well as by heat of reaction with water. Coughing, choking and breathing difficulty can be immediate symptoms; tissue destruction, lung edema, etc. can follow severe exposure.

Ingestion:
Corrosive! Causes very severe often fatal burns in the mouth and esophagus due to tissue destruction and heat. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death.Gastrointestinal upset and associated secondary symptoms may accompany the ingestion of small amounts.

Skin Contact:
Corrosive! Can destroy skin layers and subsurface tissue on contact. Produces deep, slow healing burns. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow skin contact or ingestion. Circulatory shock is often the immediate cause of death.

Eye Contact:
Corrosive! Vapors, fumes and mists can cause severe irritation. Can destroy eye tissue on contact. A painful burning sensation and tearing will be the immediate symptoms, scarring or loss of sight are expected.

Chronic Exposure:
Damage to tooth enamel and injury to the respiratory tract may follow prolonged exposure to vapors. Chronic exposure to mists containing sulfuric acid is a cancer hazard.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.

Ingestion:
DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Excess acid on skin can be neutralized with a 2% solution of bicarbonate of soda. Call a physician immediately.

Eye Contact:
Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately. Speed in diluting and rinsing with water is extremely important.

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5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition.

Explosion:
Contact with most metals causes formation of flammable and explosive hydrogen gas. A violent exothermic reaction occurs with water. Sufficient heat may be produced to ignite combustible materials.

Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. DO NOT ADD water or other liquid to the acid.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving this material. Stay away from sealed containers. Water spray may be used to extinguish surrounding fire and cool exposed containers. Water spray will also reduce fume and irritant gases.

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6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

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7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

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8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
1 mg/m3 (TWA) for sulfuric acid.
-ACGIH Threshold Limit Value (TLV):
1 mg/m3(TWA), 3 mg/m3 (STEL) for sulfuric acid.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators (NIOSH Approved):
For sulfuric acid:
If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge and dust/mist filter may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance: Colorless, oily, fuming liquid.	Boiling Point: Decomposes.
Odor: Penetrating, sulfur trioxide.	Melting Point: No information found.
Solubility: Miscible with water, liberates much heat.	Vapor Density (Air=1): No information found.
Specific Gravity: 1.92	Vapor Pressure (mm Hg): No information found.
pH: No information found.	Evaporation Rate (BuAc=1): No information found.

% Volatiles by volume @ 21C (70F):
No information found.

==========

10. Stability and Reactivity

Stability:
Stable in tightly closed containers under normal conditions of storage. Extremely hygroscopic. Reacts exothermically with water.

Hazardous Decomposition Products:
Toxic fumes of oxides of sulfur when heated to decomposition. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Water, potassium chlorate, potassium perchlorate, potassium permanganate, sodium, lithium, bases, organic material, halogens, metal acetylides, oxides and hydrides, metals (yields hydrogen gas), strong oxidizing and reducing agents and many other reactive substances.

Conditions to Avoid:
Heat, moisture, air, incompatibles.

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11. Toxicological Information

Toxicological Data:
Inhalation rat LC50: 347 ppm/1-hr.
For sulfuric acid: Oral rat LD50: 2140 mg/kg; inhalation rat LC50: 510 mg/m3/2H; standard Draize, eye rabbit, 250 ug (severe); investigated as a tumorigen, mutagen, reproductive effector.

Carcinogenicity:
Cancer Status: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mists containing sulfuric acid" as a known human carcinogen, (IARC category 1). This classification applies only to mists containing sulfuric acid and not to sulfuric acid or sulfuric acid solutions.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sulfuric Acid, mixt. with Sulfur Trioxide (8014-95-7)	No	No	None
Sulfuric Acid (7664-93-9)	No	No	None
Sulfur Trioxide (7446-11-9)	No	No	None

==========

12. Ecological Information

Environmental Fate:
For Concentrated Sulfuric Acid: When released into the soil, this material may leach into groundwater. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material may be removed from the atmosphere to a moderate extent by dry deposition.

Environmental Toxicity:
For sulfuric acid:
LC50 Flounder 100 to 330 mg/l/48 hr aerated water/Conditions of bioassay not specified; LC50 Shrimp 80 to 90 mg/l/48 hr aerated water /Conditions of bioassay not specified; LC50 Prawn 42.5 ppm/48 hr salt water /Conditions of bioassay not specified.
This material may be toxic to aquatic life.

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13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations.

Dispose of container and unused contents in accordance with federal, state and local requirements.

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14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SULFURIC ACID, FUMING (WITH LESS THAN 30% FREE SULFUR TRIOXIDE)
Hazard Class: 8
UN/NA: UN1831 Packing Group: I
Information reported for product/size: 500G

International (Water, I.M.O.)

Proper Shipping Name: SULPHURIC ACID, FUMING
Hazard Class: 8, 6.1
UN/NA: UN1831 Packing Group: I
Information reported for product/size: 500G

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15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Sulfuric Acid, mixt. with Sulfur Trioxide (8014-95-7)	Exempt	No	Yes	Yes
Sulfuric Acid (7664-93-9)	Yes	Yes	Yes	Yes
Sulfur Trioxide (7446-11-9)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sulfuric Acid, mixt. with Sulfur Trioxide (8014-95-7)	Yes	No	No	Yes
Sulfuric Acid (7664-93-9)	Yes	Yes	No	Yes
Sulfur Trioxide (7446-11-9)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sulfuric Acid, mixt. with Sulfur Trioxide (8014-95-7)	No	No	No	No
Sulfuric Acid (7664-93-9)	1000	1000	Yes	No
Sulfur Trioxide (7446-11-9)	100	100	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sulfuric Acid, mixt. with Sulfur Trioxide (8014-95-7)	1000	No	No
Sulfuric Acid (7664-93-9)	1000	No	No
Sulfur Trioxide (7446-11-9)	1	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: Yes (Mixture / Liquid)
Australian Hazchem Code: 4WE
Australian Poison Schedule: No information found.
WHMIS: This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings:
Health: 3 Flammability: 0 Reactivity: 2 Other: Water reactive

Label Hazard Warning:
POISON! DANGER! CORROSIVE.
LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE. WATER REACTIVE. STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE OR EXPLOSION. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe mist, vapor, or fumes.
Keep container closed.
Keep from contact with clothing and other combustible materials.
Use only with adequate ventilation.
Wash thoroughly after handling.
Do not contact with water.

Label First Aid:
In all cases call a physician immediately. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use. Excess acid on skin can be neutralized with a 2% bicarbonate of soda solution. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person.

Product Use:
Laboratory Reagent.

Revision Information:
MSDS Section(s) changed since last revision of document include: 1, 2, 3.

Disclaimer:
****
Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE
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S8252

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                                IDENTIFICATION

MSDS RECORD NUMBER      : 2245290
PRODUCT NAME(S)         : SODIUM METABISULFITE
PRODUCT IDENTIFICATION  : MSDS NUMBER: S4378
                          PRODUCT CODE:  7776, 7777
                          C.A.S. NUMBER: 7681-57-4Sodium
                          Metabisulfite; 7631-90-5 Sodium Bisulfite.
DATE OF MSDS            : 1999-11-17
CURRENCY NOTE           : This MSDS was provided to CCOHS in
                          electronic form on 2000-03-13

                       *** MANUFACTURER INFORMATION ***

MANUFACTURER            : Mallinckrodt Baker, Inc
ADDRESS                 : 222 RED SCHOOL LANE
                          PHILLIPSBURG  NEW JERSEY
                          U.S.A.    08865
                          Telephone:  800-582-2537  (Customer
                          Service)
EMERGENCY TELEPHONE NO. : 908-859-2151
                          800-424-9300  (CHEMTREC, USA)
                          703-527-3887  (Outside USA & CANADA)
                          613-996-6666  (CANUTEC)

                          *** MATERIAL SAFETY DATA ***



                                                  Effective Date: 11/17/99
                                                      Supercedes: 12/08/96

====
MSDS   MATERIAL SAFETY DATA SHEET            CHEMTREC: 800-424-9300 (USA)
====   --------------------------                      703-527-3887
       From: Mallinckrodt Baker, Inc.                  (Outside USA & CANADA)
             222 Red School Lane             CANUTEC:  613-996-6666
             Phillipsburg, NJ 08865
                                             NOTE: Use CHEMTREC and CANUTEC
Emergency Telephone Number: 908-859-2151     phone numbers only in the event
                                             of a chemical emergency.

All non-emergency questions should be directed to Customer Service
(1-800-582-2537) for assistance.

M A L L I N C K R O D T
```

SODIUM METABISULFITE

1. Product Identification

Synonyms: Sodium pyrosulfite; pyrosulfurous acid, disodium salt
CAS No: 7681-57-4 Sodium Metabisulfite; 7631-90-5 Sodium Bisulfite.
Molecular Weight: 190.13
Chemical Formula: $Na_2S_2O_5$ (sodium metabisulfite) and $NaHSO_3$ (sodium bisulfite)
Product Codes: 7776, 7777

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Metabisulfite	7681-57-4	100%	Yes
Sodium Bisulfite	7631-90-5	< 0.001%	No

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY CAUSE ALLERGIC RESPIRATORY REACTION. REACTS WITH ACIDS AND WATER RELEASING TOXIC SULFUR DIOXIDE GAS.

Potential Health Effects

Inhalation:
Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. May cause allergic reaction in sensitive individuals.

Ingestion:
May cause gastric irritation by the liberation of sulfurous acid. An asthmatic reaction may occur after ingestion. Large doses may result in nausea, vomiting, diarrhea, abdominal pains, circulatory disturbance, and central nervous system depression. Estimated fatal dose is 10 gm.

Skin Contact:
Causes irritation to skin. Symptoms include redness, itching, and pain.

Eye Contact:
Causes irritation, redness, and pain. Contact may cause irreversible eye damage. Symptoms may include stinging, tearing, redness, swelling, corneal damage and blindness.

Chronic Exposure:
No information found.

Aggravation of Pre-existing Conditions:
Some individuals are said to be dangerously sensitive to minute amounts of sulfites in foods. Symptoms may include broncho constriction, shock, gastrointestinal disturbances, angio edema, flushing, and tingling sensations. Once allergy develops, future exposures can cause asthma attacks with shortness of breath, wheezing, and cough.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

Skin Contact:
Wipe off excess material from skin then immediately flush skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

==========

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Do not allow water runoff to enter sewers or waterways.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

==========

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. Cautiously spray residue with plenty of water, providing ventilation to clear sulfur dioxide fumes generated from water contact. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

==========

7. Handling and Storage

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities. Releases toxic sulfur dioxide gas when in contact with water, ice. Keep away from acids, water, ice, and oxidizing agents. Use only with appropriate protective equipment. Do not use in unventilated areas such as holds of fishing boats, walk in coolers or confined spaces. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

==========

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
-ACGIH Threshold Limit Value (TLV):
5mg/m3 (TWA) for sodium bisulfite & for sodium metabisulfite, A4 Not classifiable as a human carcinogen.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face respirator with an acid gas cartridge may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. (neoprene, polyvinyl chloride).

Eye Protection:
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

==========

9. Physical and Chemical Properties

Appearance: White to yellow white crystalline granules.	Boiling Point: Not applicable.
Odor: Slight odor of sulfur dioxide.	Melting Point: 150C (302F)
Solubility: Very soluble in water, insoluble in alcohol.	Vapor Density (Air=1): No information found.
Specific Gravity: 1.48	Vapor Pressure (mm Hg): No information found.
pH: Aqueous solution is acidic.	Evaporation Rate (BuAc=1): No information found.
% Volatiles by volume @ 21C (70F): 0	

==========

10. Stability and Reactivity

Stability:
Strength diminishes somewhat with age. Gradually decomposes in air to sulfate, generating sulfurous acid gas. Contact with moisture (water, wet ice, etc.), will release toxic sulfur dioxide gas.

Hazardous Decomposition Products:
Oxides of sulfur and sodium may form when heated to decomposition.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Water, acids, alkalis, sodium nitrite, oxidizers, aluminum powder.

Conditions to Avoid:
Moisture, heat, flames, ignition sources and incompatibles.

==========

11. Toxicological Information

Sodium Metabisulfite [7681-57-4]: No LD50/LC50 information found relating to normal routes of occupational exposure. Investigated as a tumorigen, mutagen and reproductive effector. Sodium Bisulfite [7631-90-5]: Oral rat LD50: 2000 mg/kg. Investigated as a tumorigen and mutagen.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sodium Metabisulfite (7681-57-4)	No	No	3
Sodium Bisulfite (7631-90-5)	No	No	3

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12. Ecological Information

Environmental Fate:
No information found.

Environmental Toxicity:
No information found.

==========

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations.

Dispose of container and unused contents in accordance with federal, state and local requirements.

==========

14. Transport Information

Not regulated.

==========

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Sodium Metabisulfite (7681-57-4)	Yes	Yes	Yes	Yes
Sodium Bisulfite (7631-90-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------------------------------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Sodium Metabisulfite (7681-57-4)	Yes	Yes	No	Yes
Sodium Bisulfite (7631-90-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\--------------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Sodium Metabisulfite (7681-57-4)	No	No	No	No
Sodium Bisulfite (7631-90-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\---------------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Sodium Metabisulfite (7681-57-4)	No	No	Yes
Sodium Bisulfite (7631-90-5)	5000	No	Yes

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No
Reactivity: Yes (Mixture / Solid)
Australian Hazchem Code: No information found.
Australian Poison Schedule: No information found.
WHMIS: This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

==========

16. Other Information

NFPA Ratings:
Health: 3 Flammability: 0 Reactivity: 1

Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY CAUSE ALLERGIC RESPIRATORY REACTION. REACTS WITH ACIDS AND WATER RELEASING TOXIC SULFUR DIOXIDE GAS.

Label Precautions:
Avoid contact with eyes, skin and clothing.
Avoid breathing dust.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
For Reagent and Technical Grades: Not For Food Use.For TAC Grades: Do not use in meats or in foods recognized as a source of Vitamin B-1, nor in fruits or vegetables to be served or sold raw to consumers or to be presented to consumers as fresh.

Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If

inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, wipe off excess material from skin then immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

Product Use:
Laboratory Reagent.

Revision Information:
No changes.

Disclaimer:
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Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)
S4378

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*                       M S D S                           *
*                                                         *
*  Canadian Centre for Occupational Health and Safety     *
* * * * * * * * * * * * * * *  Issue : 2000-2 (May, 2000) *

                        *** IDENTIFICATION ***

MSDS RECORD NUMBER      : 1988341
PRODUCT NAME(S)         : SULFUR DIOXIDE
PRODUCT IDENTIFICATION  : MSDS NO:  2541
                          CAS NUMBER: 7446-09-5
                          PRODUCT CODE: NA
DATE OF MSDS            : 1998-07-31
CURRENCY NOTE           : This MSDS was provided to CCOHS in
                          electronic form on 1999-05-07

                     *** MANUFACTURER INFORMATION ***

MANUFACTURER            : BP Oil Company
ADDRESS                 : 200 Public Square
                          Cleveland  Ohio
                          U.S.A.    44114-2375
                          Telephone:  216-586-6184  (Technical,
                          General Assistance)    216-586-8023 (MSDS
                          Contact, General Assistance)    (Normal
                          Office Hours, 8:00-4:30 M-F EST)
EMERGENCY TELEPHONE NO. : 800-321-8642  (BP America, 24 Hour
                          Assistance)
                          800-424-9300  (CHEMTREC, 24 Hour
                          Assistance, In U.S.)
                          703-527-3887  (CHEMTREC, 24 hour
                          Assistance, Elsewhere)

                *** SUPPLIER/DISTRIBUTOR INFORMATION ***

SUPPLIER/DISTRIBUTOR    : BP America
ADDRESS                 : 200 Public Square
                          Cleveland  Ohio
                          U.S.A.    44114-2375
EMERGENCY TELEPHONE NO. : 800-321-8642  (24 Hour Emergency
                          Assistance)
                          800-424-9300  (CHEMTREC, 24 Hour Emergency
                          Assistance, In U.S.)
                          703-527-3887  (CHEMTREC, 24 Hour Emergency
                          Assistance, Elsewhere)

                          *** MATERIAL SAFETY DATA ***
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========== CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ==========

TRADE NAME: SULFUR DIOXIDE
CAS NUMBER: 7446-09-5
SYNONYM(S): OHS22290; PROCESS STREAM; SULFUROUS ACID ANHYDRIDE; SULFUROUS ANHYDRIDE; SULFUROUS OXIDE; SULFUR OXIDE; SULPHUR DIOXIDE; SO2
MSDS NUMBER: 2541
PRODUCT CODE: NA
HIERARCHY: NA
MANUFACTURER/SUPPLIER: BP Oil Company

ADDRESS: 200 Public Square, Cleveland, OH 44114-2375
TELEPHONE NUMBERS - 24 HOUR EMERGENCY ASSISTANCE:
BP America: 800-321-8642
CHEMTREC Assistance (In U.S.): 800-424-9300
CHEMTREC Assistance (Elsewhere): 703-527-3887
TELEPHONE NUMBERS - GENERAL ASSISTANCE: (Normal Office Hours): (8:00-4:30 M-F, EST):
Technical: 216-586-6184
MSDS Contact: 216-586-8023

========== COMPOSITION/INFORMATION ON INGREDIENTS ==========

COMPONENT:Sulfur Dioxide
CAS NO.: 7446-09-5
% BY WT.: 100
EXPOSURE LIMITS:
5.2 mg/m3 (2 ppm) TLV ACGIH
13 mg/m3 (5 ppm) STEL ACGIH
5 mg/m3 (2 ppm) PEL OSHA
13 mg/m3 (5 ppm) STEL OSHA
5 mg/m3 (2 ppm) REL NIOSH
13 mg/m3 (5 ppm) STEL NIOSH
100 ppm IDLH NIOSH
5 mg/m3 (2 ppm) TWA MEXICAN
10 mg/m3 (5 ppm) STC MEXICAN

The OSHA Permissible Exposure Limits listed above were promulgated by OSHA in 1989. This standard was vacated by the U.S. Court of Appeals for the Eleventh Circuit. Exposure limits defined in specific chemical standards found in 29 CFR 1910.1000-1048 are not covered by this ruling and are still enforceable.

========== HAZARDS IDENTIFICATION ==========

EMERGENCY OVERVIEW:

Clear Gas or Liquid With a Pungent, Suffocating Odor.
Danger! Harmful or Fatal If Inhaled. Poisonous Gas. Toxic Effects May Be Delayed. May Be Irritating/Corrosive To the Skin, Eyes and Respiratory Tract. Possible Reproductive Hazard (Contains Material Which May Cause Reproductive Effects Based On Animal Data).

POTENTIAL HEALTH EFFECTS:

SKIN:

May cause skin irritation. Contact with moist skin may cause severe irritation and burns. Repeated or prolonged exposure may cause dermatitis. Contact with liquefied material may cause frostbite.

EYE:

May be severely irritating and/or corrosive. Exposure to gas may cause irritation, conjunctivitis and lacrimation. Direct contact with liquid may cause irritation, blurred vision, edema, possible permanent corneal opacity and loss of vision.

INHALATION:

May cause severe irritation to the respiratory tract. May also cause bronchoconstriction, cough, sneezing, wheezing, chest pain, nausea, vomiting, confusion, cyanosis, pulmonary edema and unconsciousness. Toxic lung effects may be delayed. Death may occur from lack of oxygen due to severe edema or obstruction of the upper airway. Repeated or prolonged exposure may cause perforation of the nasal septum. May cause allergic reactions in some individuals.

INGESTION:

Not a normal route of exposure. Ingestion is unlikely.

SPECIAL TOXIC EFFECTS:

May cause adverse reproductive effects, based on tests with laboratory animals. May also be mutagenic in mammalian and non-mammalian test systems. Studies indicate that there may be a relationship between chronic respiratory illness and the frequency of exposure. An epidemiology study noted a statistically significant association for emphysema mortality and increased duration of exposure to sulfur dioxide with peak values exceeding 24 ppm. IARC has determined that there is limited evidence for the carcinogenicity of Sulfur Dioxide in experimental animals and inadequate evidence for the carcinogenicity of Sulfur Dioxide in humans. (IARC Class- 3). IARC has determined that occupational exposures in petroleum

refining are probably carcinogenic to humans.

See Section FIRST AID MEASURES - for Medical Conditions Aggravated By Exposure.

========== FIRST AID MEASURES ==========

SKIN:

Remove contaminated clothing immediately. Wash area of contact thoroughly with soap and water. Get immediate medical attention.

EYE:

Flush immediately with large amounts of room temperature water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Get immediate medical attention.

INHALATION:

Patients should be moved from the toxic environment and administered 100% humidified supplemental oxygen with assisted ventilation as required. If not breathing, institute cardiopulmonary resuscitation (CPR). If breathing is difficult, ensure clear airway and give oxygen. Keep affected person warm and at rest. Get immediate medical attention.

INGESTION:

Ingestion is unlikely. Give 1-3 glasses of water or milk to dilute stomach contents. Get immediate medical attention.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Persons with asthma or pre-existing respiratory tract disorders may be at an increased risk of exposure.

NOTES TO PHYSICIAN:

Support respiratory and cardiovascular function. Administer 100% humidified supplemental oxygen with assisted ventilation as required. Endotracheal intubation or tracheostomy may be needed if upper airway obstruction is present. Rewarming and a variety of topical treatments are useful for frostbite injury. Consult standard references. Any patient with a history of significant inhalation exposure or respiratory tract irritation should be admitted to the hospital for at least 24 hours observation. Baseline chest x-ray and arterial blood gases should be obtained in victims with significant inhalation exposure or symptoms of respiratory tract irritation. If cough or difficulty in breathing develops, evaluate for respiratory tract

irritation, bronchitis, or pneumonitis. Carefully observe patients with inhalation exposure for the development of any systemic signs or symptoms and administer symptomatic treatment as necessary. Respiratory tract irritation, if severe, can progress to pulmonary edema which may be delayed in onset up to 24 to 72 hours after exposure in some cases. Maintain adequate ventilation and oxygenation with close monitoring of arterial blood gases. If pO2 cannot be maintained above 50 mmHg with inspiration of 60 percent oxygen by face mask or mechanical ventilation, then positive-end-expiratory pressure (PEEP) in intubated patients or continuous-positive-airway pressure (CPAP) in non-intubated patients may be necessary. Inhaled sympathomimetic bronchodilators may be useful if bronchospasm is present. Avoid bronchodilators containing sulfite preservatives (i.e., isoetharine). Consider the use of albuterol inhalation (90 mcg aerosol). Exposed skin should be copiously flushed with room temperature water. Exposed eyes should be irrigated with copious amounts of room temperature water for at least 15 minutes. If irritation, pain, swelling, lacrimation, or photophobia persist after

15 minutes of irrigation, an ophthalmologic examination should be performed. Crystalloid solutions must be administered carefully, AVOIDING a net positive fluid balance. Monitor fluid status through a central line or Swan Ganz(R) catheter. Morphine is not recommended since respiratory depression and elevated intracranial pressure may occur. Antibiotics are indicated only when there is evidence of infection. Urticaria or other hypersensitivity rashes may be treated with antihistamines and corticosteroids.

========== FIREFIGHTING MEASURES ==========

FLASH POINT: NA
AUTOIGNITION TEMPERATURE: NA
FLAMMABILITY LIMITS IN AIR (% BY VOL.) LOWER: NA
FLAMMABILITY LIMITS IN AIR (% BY VOL.) UPPER: NA

HAZARDOUS COMBUSTION PRODUCTS:

Combustion may produce toxic gases such as sulfur oxides.

BASIC FIRE FIGHTING PROCEDURES:

Shut off source of flow if possible. Do not extinguish fire if gas source cannot be shut off. Use a water spray to cool fire-exposed containers, structures and to protect personnel. If leak or spill has not ignited, ventilate area and use water spray to disperse gas or vapor and to protect personnel attempting to stop a leak. Exposed firefighters must wear MSHA/NIOSH approved positive pressure self-contained breathing apparatus with full face mask and full protective clothing.

UNUSUAL FIRE & EXPLOSION HAZARDS:

Irritating and/or toxic substances may be emitted upon thermal decomposition.

========== ACCIDENTAL RELEASE MEASURES ==========

If your facility or operation has an "Oil or Hazardous Substance Contingency Plan", activate its procedures. Take immediate steps to stop and contain the spill. Caution should be exercised regarding personnel safety and exposure to the spilled material. For technical advice and assistance related to chemicals, contact CHEMTREC (800/424-9300) and your local fire department. Notify the National Response Center, if required. Also notify appropriate state and local regulatory agencies, the LEPC and the SERC. Contact the local Coast Guard if the release is into a waterway.
Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Do not touch or walk through spilled material. Stop leak if you can do it without risk. If possible, turn leaking containers so that gas escapes rather than liquid. Prevent entry into waterways, sewers, basements, or confined areas. Do not direct water at spill or source of leak. Use water spray to reduce vapors or divert vapor cloud drift. Isolate area until gas has dispersed.

During an accidental release, personal protection equipment may be required (see Section EXPOSURE CONTROLS/PERSONAL PROTECTION). Additional regulatory requirements may apply (see Section REGULATORY INFORMATION).

========== HANDLING AND STORAGE ==========

HANDLING:

Use only with adequate ventilation. Keep containers closed. A sensitized employee should not be exposed to the material which causes the sensitization. Use good personal hygiene practices. Wash hands before eating, drinking, smoking, or using toilet facilities. Remove contaminated clothing and clean before reuse. Wash thoroughly after work using soap and water.

Empty containers may contain toxic, flammable/combustible or explosive residue or vapors. Do not cut, grind, drill, weld, reuse or dispose containers unless adequate precautions are taken against these hazards.

STORAGE:

Store in tightly closed containers in cool, dry area away from heat and incompatibles. Do not store in unlabeled containers.

========== EXPOSURE CONTROLS / PERSONAL PROTECTION ==========

ENGINEERING CONTROLS:

Ventilation and other forms of engineering controls are often the preferred means for controlling chemical exposures.

PERSONAL PROTECTION EQUIPMENT (PPE):

EYE PROTECTION:

Prevent eye contact with this material. Wear chemical tight goggles. Provide an eyewash station immediately accessible to the work area.

SKIN PROTECTION:

Prevent skin contact. Wear gloves found to be impervious under conditions of use. Additional protection may be necessary to prevent skin contact including use of apron, armcovers, face shield, boots, or full body protection. A safety deluge shower should be located in the work area.

RESPIRATORY PROTECTION:

If exposure limits are exceeded or if irritation is experienced, NIOSH approved respiratory protection should be worn. Respiratory protection may be needed for non-routine or emergency situations.

See Section COMPOSITION/INFORMATION ON INGREDIENTS For Exposure Guidelines.

================ PHYSICAL AND CHEMICAL PROPERTIES ======================

BOILING POINT:	-10 C (14 F)
SP. GRAVITY (Water=1):	1.434 @ -10 C (14 F)
MELTING POINT:	-73 C (-99.4 F)
% VOLATILE:	NA
VAPOR PRESSURE:	2538 MM HG @ 21 C (69.8 F)
EVAPORATION RATE:	ND
VAPOR DENSITY (Air=1):	2.26
VISCOSITY:	0.368 MPA @ 0 C (32 F)
% SOLUBILITY IN WATER:	22.8 % @ 0 C (32 F)
OCTANOL/WATER PARTITION COEFFICIENT:	ND
POUR POINT:	NA
pH:	ACIDIC IN SOLUTION
MOLECULAR WEIGHT:	64.06
MOLECULAR FORMULA:	SO2

ODOR/APPEARANCE:
Clear Gas or Liquid With a Pungent, Suffocating Odor.

==================== STABILITY AND REACTIVITY ==========================

STABILITY/INCOMPATIBILITY:

Stable under conditions of normal use. May corrode aluminum surfaces. Liquid may attack some forms of plastic, rubber and coatings.

HAZARDOUS REACTIONS/DECOMPOSITION PRODUCTS:

Irritating or toxic substances may be emitted upon thermal decomposition. Decomposition products include oxides of sulfur. May react with water to form corrosive sulfuric and sulfurous acids. May also react with alkaline materials and some active metals.

==================== DISPOSAL CONSIDERATIONS ==========================

WASTE DISPOSAL (Resource Conservation & Recovery Act - RCRA):

This substance, when discarded or disposed of, is not specifically listed as a hazardous waste in Federal regulations; however it could be characteristically hazardous if it is considered toxic, corrosive, ignitable, or reactive according to Federal definitions (40 CFR 261). Additionally, it could be designated as hazardous according to state regulations. This substance could also become a hazardous waste if it is mixed with or comes in contact with a hazardous waste. Check 40 CFR 261 to determine whether it is a hazardous waste. If it is a hazardous waste, regulations at 40 CFR 262, 263, 264, 268 and 270 apply. The transportation, storage, treatment, and disposal of this waste material must be conducted in compliance with all applicable Federal, state, and local regulations.

There may be specific current regulations at the local, regional, or state level that pertain to this information. Chemical additions, processing, or otherwise altering this material may make the waste management information presented in this MSDS, incomplete, inaccurate, or otherwise inappropriate.

========== TRANSPORT INFORMATION ==========

U.S. DEPARTMENT OF TRANSPORTATION (D.O.T.):

Proper Shipping Name (49 CFR 172.101):	Sulfur Dioxide
Hazard Class (49 CFR 172.101):	2.3
UN/NA Code (49 CFR 172.101):	UN 1079
Packing Group (49 CFR 179.101):	NA
Bill Of Lading Desc. (49 CFR 172.101):	Sulfur Dioxide, 2.3, UN 1079
Labels Required (49 CFR 172.101):	Poison Gas (2.3), Corrosive (8)
Placards Required (49 CFR 172.101):	Poison Gas (2.3), Corrosive (8)

INTERNATIONAL AND DOMESTIC AIR TRANSPORTATION:

IATA Proper Shipping Name:	Sulfur Dioxide
Hazard Class:	Toxic Gas (2.3)
Subsidiary Risk:	Corrosive (8)
UN Code:	UN 1079
Package Specification:	200 (max 25 kg)
Labels Required:	Toxic Gas (2.3), Corrosive (8), Cargo Aircraft Only, Orientation Arrows

INTERNATIONAL WATER TRANSPORTATION:

IMDG Proper Shipping Name:	Sulfur Dioxide
Hazard Class:	2.3
UN Code:	UN 1079
IMDG Page Number:	2179
Labels Required:	Poison Gas (2.3), Corrosive (8)
Placards Required:	Poison Gas (2.3), Corrosive (8)

CANADIAN TRANSPORTATION OF DANGEROUS GOODS (T.D.G.):

Shipping Name:	Sulfur Dioxide
PIN (UN/NA):	UN 1079
Regulated Class:	2.3
Division:	NA
Packaging Group:	NA
Labels Required:	Poison Gas (2.3)
Placards Required:	Poison Gas (2.3)

========== REGULATORY INFORMATION ==========

NOTIFICATION:

The reportable quantity for this material is 500 pound(s). Any spill or other release, or substantial threat of release, of this material to the air, water, or land (unless entirely contained in the workplace) equal to or in excess of the reportable quantity must be reported immediately to the National Response Center (800/ 424-8802) as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies. Contact the Coast Guard if spilled into navigable waterways under their jurisdiction. Failure to report may result in substantial civil and criminal penalties.

US EPA TOXIC SUBSTANCE CONTROL ACT (TSCA):

All components of this product are listed on the TSCA inventory.

US EPA SUPERFUND AMENDMENTS & REAUTHORIZATION ACT (SARA) TITLE III INFORMATION:

Listed below are the hazard catagories for SARA Section 311/312 (40 CFR 370):

Immediate Hazard:	X
Delayed Hazard:	X
Fire Hazard:	-
Pressure Hazard:	X
Reactivity Hazard:	-

OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION (OSHA):

This material is listed on OSHA's List of Highly Hazardous Chemicals. The threshold quantity is 1000 pounds.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA):

All components of this product are listed on the Canadian DSL Inventory.

CANADIAN WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) CATEGORIES:

The following WHMIS categories apply to this product:

Compressed Gas:	X	Other Toxic Effects:	X
Flammable/Combustible:	-	Bio Hazardous:	-
Oxidizer:	-	Corrosive:	X
Acutely Toxic:	X	Dangerously Reactive:	-

========== OTHER INFORMATION ==========

NFPA RATINGS:		HMIS RATINGS:	
Health:	3	Health:	3
Flammability:	0	Flammability:	0
Reactivity:	0	Reactivity:	0
Special Hazards:	-	Personal Protective Equipment:	H

REVISION DATE: 31-jul-1998
REPLACES SHEET DATED: 26-aug-1993
COMPLETED BY: BP OIL HSEQ DEPARTMENT
REVISION SUMMARY: The following section(s) have been revised since
the previous issue of this MSDS:
CHEMICAL PRODUCT AND COMPANY IDENTIFICATION
HAZARDS IDENTIFICATION
FIRST AID MEASURES

FIREFIGHTING MEASURES
ACCIDENTAL RELEASE MEASURES
HANDLING AND STORAGE
EXPOSURE CONTROLS / PERSONAL PROTECTION
PHYSICAL AND CHEMICAL PROPERTIES
STABILITY AND REACTIVITY
TRANSPORT INFORMATION
REGULATORY INFORMATION
OTHER INFORMATION

NOTICE: The information presented herein is based on data considered to be accurate as of the date of preparation of this Material Safety Data Sheet. However, no warranty or representation, express or implied, is made as to the accuracy or completeness of the foregoing data and safety information, nor is any authorization given or implied to practice any patented invention without a license. In addition, no responsibility can be assumed by vendor for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

ND: No Data NA: Not Applicable *See specific note or section