Hazardous Materials Code Enforcement

HMCE-Student Manual

1st Edition, 1st Printing-December 2013

FEMA

FEMA/USFA/NFA
HMCE-SM
December 2013
1st Edition, 1st Printing

Hazardous Materials Code Enforcement

FEMA

Hazardous Materials Code Enforcement

HMCE-Student Manual

1st Edition, 1st Printing-December 2013

FEMA

This Student Manual may contain material that is copyright protected. USFA has been granted a license to use this material only for NFA-sponsored course deliveries as part of the course materials, and it shall not be duplicated without consent of the copyright holder. States wishing to use these materials as part of state-sponsorship and/or third parties wishing to use these materials must obtain permission to use the copyright material(s) from the copyright holder prior to teaching the course.

This page intentionally left blank.

U.S. DEPARTMENT OF HOMELAND SECURITY

U.S. FIRE ADMINISTRATION

NATIONAL FIRE ACADEMY

FOREWORD

The U.S. Fire Administration (USFA), an important component of the Department of Homeland Security (DHS), serves the leadership of this nation as the DHS's fire protection and emergency response expert. The USFA is located at the National Emergency Training Center (NETC) in Emmitsburg, Maryland, and includes the National Fire Academy (NFA), National Fire Data Center (NFDC), and the National Fire Programs (NFP). The USFA also provides oversight and management of the Noble Training Center in Anniston, Alabama. The mission of the USFA is to save lives and reduce economic losses due to fire and related emergencies through training, research, data collection and analysis, public education, and coordination with other federal agencies and fire protection and emergency service personnel.

The USFA's NFA offers a diverse course delivery system, combining resident courses, off-campus deliveries in cooperation with state training organizations, weekend instruction, and online courses. The USFA maintains a blended learning approach to its course selections and course development. Resident courses are delivered at both the Emmitsburg campus and the Noble facility. Off-campus courses are delivered in cooperation with state and local fire training organizations to ensure this nation's firefighters are prepared for the hazards they face.

This page intentionally left blank.

TABLE OF CONTENTS

PAGE

Foreword iii
Table of Contents v
Acknowledgments vii
Schedule ix
Firefighter Code of Ethics xi
A Student Guide to End-of-course Evaluations xiii

UNIT 1: INTRODUCTION ..... SM 1-1

UNIT 2: HAZARDOUS MATERIALS REGULATIONS ..... SM 2-1

UNIT 3: IDENTIFY AND CLASSIFY ..... SM 3-1

UNIT 4: MAXIMUM ALLOWABLE QUANTITIES AND CONTROL AREAS ..... SM 4-1

UNIT 5: APPLICATION OF THE CODE AND CONTROL METHODS ..... SM 5-1

UNIT 6: INFORMATION SHARING ..... SM 6-1

Glossary/Acronyms

This page intentionally left blank.

ACKNOWLEDGMENTS

The development of any NFA course is a complex process aimed at providing students the best possible learning opportunity we can deliver.

There are many players in course development, each of whom plays an equally important part in its success. We want to acknowledge their participation and contribution to this effort, and extend our heartfelt thanks for making this quality product.

The following people participated in the creation of this course:

Woody Stratton, Training Specialist
Technical Prevention Curriculum, U.S. Fire Administration, National Fire Academy
Emmitsburg, Maryland

Wayne Yoder, Training Specialist
Hazardous Materials Curriculum, U.S. Fire Administration, National Fire Academy
Emmitsburg, Maryland

Stacey Harmon, Instructional Systems Specialist/Contracting Officer's Representative
Leadership and Fire Risk Reduction Branch, U.S. Fire Administration, National Fire Academy
Emmitsburg, Maryland

Susan Hernandez, Instructional Systems Specialist
Response Section, U.S. Fire Administration, National Fire Academy
Emmitsburg, Maryland

Karen Kent, Instructional Designer
Advanced Technical and Educational Consultants, Inc.
Emmitsburg, Maryland

Shelly Kent, Instructional Designer
Advanced Technical and Educational Consultants, Inc.
Emmitsburg, Maryland

Michael Weller, Instructional Designer
Advanced Technical and Educational Consultants, Inc.
Emmitsburg, Maryland

Mark Bird
Subject-matter Expert

Jim Jaracz
Subject-matter Expert

Jack McCartt
Subject-matter Expert

Ed Prendergast
Subject-matter Expert

Robert Stahl
Subject-matter Expert

Sam Vanover
Subject-matter Expert

This page intentionally left blank.

SCHEDULE

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Morning	Unit 1: Introduction Unit 2: Hazardous Materials Regulations	Unit 3: Identify and Classify (cont'd)	Unit 4: Maximum Allowable Quantities and Control Areas (cont'd)	Unit 5: Application of the Code and Control Methods (cont'd)	Unit 5: Application of the Code and Control Methods (cont'd)	Exam Final Group Project
Afternoon	Unit 2: Hazardous Materials Regulations (cont'd) Unit 3: Identify and Classify	Unit 4: Maximum Allowable Quantities and Control Areas	Unit 5: Application of the Code and Control Methods	Unit 5: Application of the Code and Control Methods (cont'd)	Unit 6: Information Sharing Final Group Project	Presentations Graduation
Evening	Read Units 1-4	Read Unit 5	Read Unit 5	Read Unit 5	Study for Exam	

This page intentionally left blank.

Firefighter Code of Ethics

Background

The Fire Service is a noble calling, one which is founded on mutual respect and trust between firefighters and the citizens they serve. To ensure the continuing integrity of the Fire Service, the highest standards of ethical conduct must be maintained at all times.

Developed in response to the publication of the Fire Service Reputation Management White Paper, the purpose of this National Firefighter Code of Ethics is to establish criteria that encourages fire service personnel to promote a culture of ethical integrity and high standards of professionalism in our field. The broad scope of this recommended Code of Ethics is intended to mitigate and negate situations that may result in embarrassment and waning of public support for what has historically been a highly respected profession.

Ethics comes from the Greek word ethos, meaning character. Character is not necessarily defined by how a person behaves when conditions are optimal and life is good. It is easy to take the high road when the path is paved and obstacles are few or non-existent. Character is also defined by decisions made under pressure, when no one is looking, when the road contains land mines, and the way is obscured. As members of the Fire Service, we share a responsibility to project an ethical character of professionalism, integrity, compassion, loyalty and honesty in all that we do, all of the time.

We need to accept this ethics challenge and be truly willing to maintain a culture that is consistent with the expectations outlined in this document. By doing so, we can create a legacy that validates and sustains the distinguished Fire Service institution, and at the same time ensure that we leave the Fire Service in better condition than when we arrived.

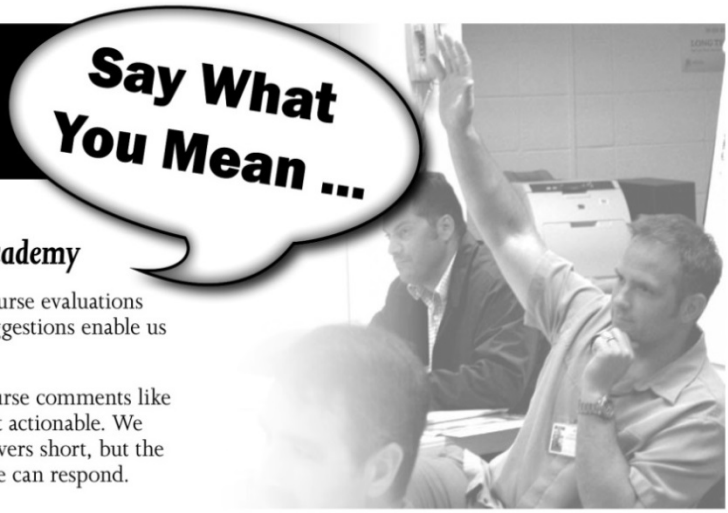
Firefighter Code of Ethics

I understand that I have the responsibility to conduct myself in a manner that reflects proper ethical behavior and integrity. In so doing, I will help foster a continuing positive public perception of the fire service. Therefore, I pledge the following…

- Always conduct myself, on and off duty, in a manner that reflects positively on myself, my department and the fire service in general.
- Accept responsibility for my actions and for the consequences of my actions.
- Support the concept of fairness and the value of diverse thoughts and opinions.
- Avoid situations that would adversely affect the credibility or public perception of the fire service profession.
- Be truthful and honest at all times and report instances of cheating or other dishonest acts that compromise the integrity of the fire service.
- Conduct my personal affairs in a manner that does not improperly influence the performance of my duties, or bring discredit to my organization.
- Be respectful and conscious of each member's safety and welfare.
- Recognize that I serve in a position of public trust that requires stewardship in the honest and efficient use of publicly owned resources, including uniforms, facilities, vehicles and equipment and that these are protected from misuse and theft.
- Exercise professionalism, competence, respect and loyalty in the performance of my duties and use information, confidential or otherwise, gained by virtue of my position, only to benefit those I am entrusted to serve.
- Avoid financial investments, outside employment, outside business interests or activities that conflict with or are enhanced by my official position or have the potential to create the perception of impropriety.
- Never propose or accept personal rewards, special privileges, benefits, advancement, honors or gifts that may create a conflict of interest, or the appearance thereof.
- Never engage in activities involving alcohol or other substance use or abuse that can impair my mental state or the performance of my duties and compromise safety.
- Never discriminate on the basis of race, religion, color, creed, age, marital status, national origin, ancestry, gender, sexual preference, medical condition or handicap.
- Never harass, intimidate or threaten fellow members of the service or the public and stop or report the actions of other firefighters who engage in such behaviors.
- Responsibly use social networking, electronic communications, or other media technology opportunities in a manner that does not discredit, dishonor or embarrass my organization, the fire service and the public. I also understand that failure to resolve or report inappropriate use of this media equates to condoning this behavior.

Developed by the National Society of Executive Fire Officers

A Student Guide to End-of-course Evaluations



Ten Things You Can Do to Improve the National Fire Academy

The National Fire Academy takes its course evaluations very seriously. Your comments and suggestions enable us to improve your learning experience.

Unfortunately, we often get end-of-course comments like these that are vague and, therefore, not actionable. We know you are trying to keep your answers short, but the more specific you can be, the better we can respond.

Actual quotes from student evaluations:	Examples of specific, actionable comments that would help us improve the course:
1 "Update the materials."	• The (ABC) fire video is out-of-date because of the dangerous tactics it demonstrates. The available (XYZ) video shows current practices. • The student manual references building codes that are 12 years old.
2 "We want an advanced class in (fill in the blank)."	• We would like a class that enables us to calculate energy transfer rates resulting from exposure fires. • We would like a class that provides one-on-one workplace harassment counseling practice exercises.
3 "More activities."	• An activity where students can physically measure the area of sprinkler coverage would improve understanding of the concept. • Not all students were able to fill all ICS positions in the exercises. Add more exercises so all students can participate.
4 "A longer course."	• The class should be increased by one hour per day to enable all students to participate in exercises. • The class should be increased by two days so that all group presentations can be peer evaluated and have written abstracts.
5 "Readable plans."	• The plans should be enlarged to 11 by 17 and provided with an accurate scale. • My plan set was blurry, which caused the dotted lines to be interpreted as solid lines.
6 "Better student guide organization," "manual did not coincide with slides."	• The slide sequence in Unit 4 did not align with the content in the student manual from slides 4-16 through 4-21. • The instructor added slides in Unit 4 that were not in my student manual.
7 "Dry in spots."	• The instructor/activity should have used student group activities rather than lecture to explain Maslow's Hierarchy. • Create a pre-course reading on symbiotic personal relationships rather than trying to lecture on them in class.
8 "More visual aids."	• The text description of V-patterns did not provide three-dimensional views. More photographs or drawings would help me imagine the pattern. • There was a video clip on NBC News (date) that summarized the topic very well.
9 "Re-evaluate pre-course assignments."	• The pre-course assignments were not discussed or referenced in class. Either connect them to the course content or delete them. • The pre-course assignments on ICS could be reduced to a one-page job aid rather than a 25-page reading.
10 "A better understanding of NIMS."	• The instructor did not explain the connection between NIMS and ICS. • The student manual needs an illustrated guide to NIMS.

This page intentionally left blank.

UNIT 1: INTRODUCTION

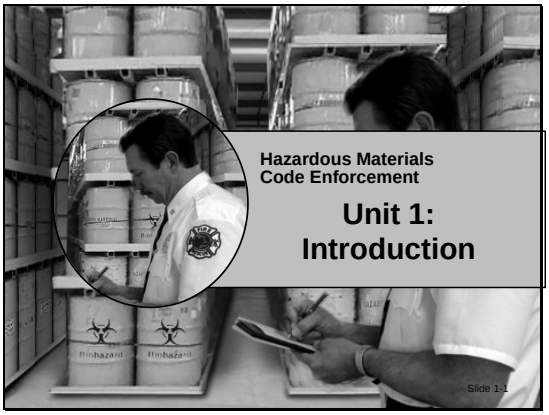
This page intentionally left blank.

NOTE-TAKING GUIDE AND ACTIVITY

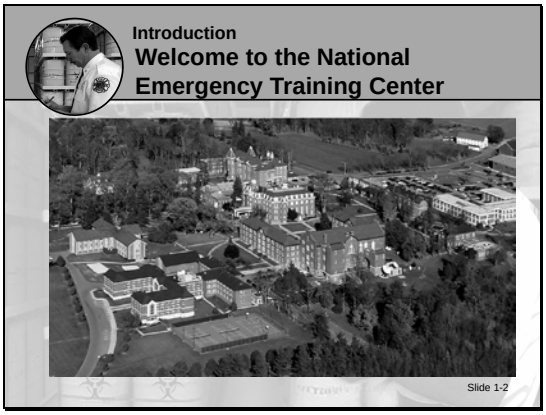
This page intentionally left blank.

NOTE-TAKING GUIDE

Slide 1-1

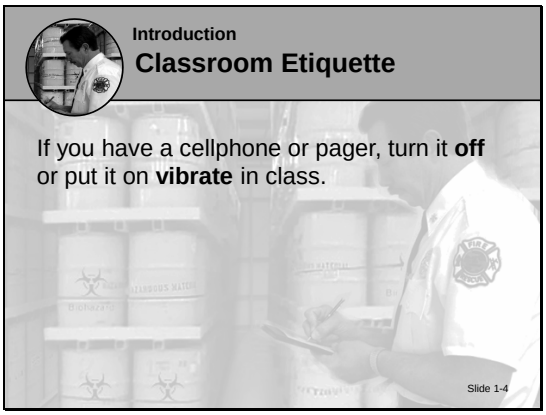


Slide 1-2

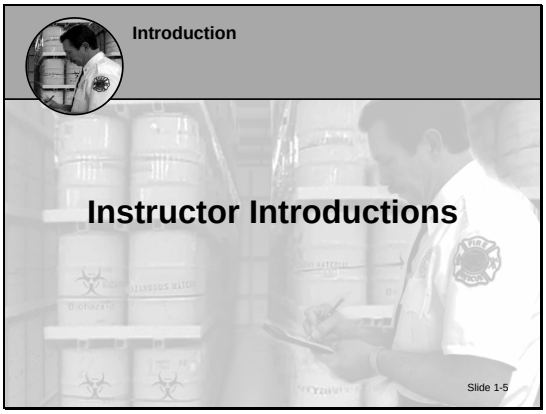


Slide 1-3

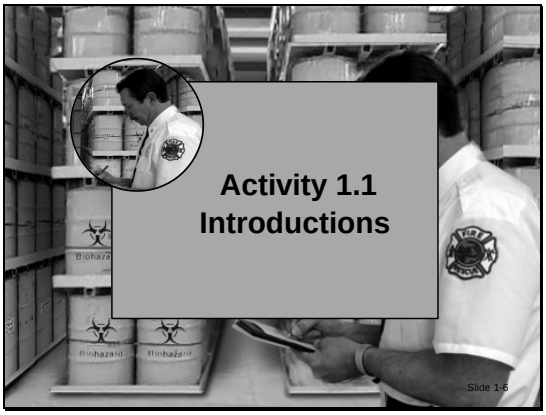
Slide 1-4



Slide 1-5



Slide 1-6



Activity 1.1

Introductions

Purpose

To introduce yourselves to each other at your tables and to the class as a whole.

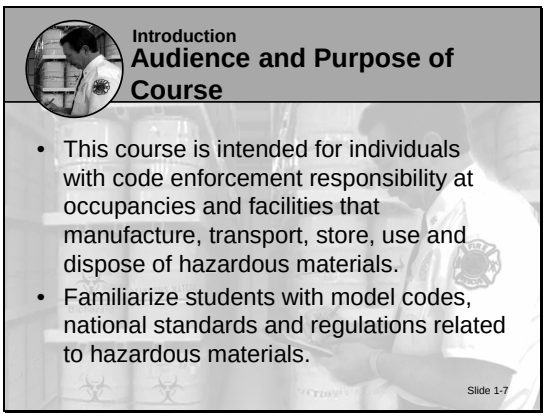
Directions

1. You should get to know the members of your table by sharing the following information:
    a. Name and department.
    b. Hazmat background.
    c. Inspection and code background.
2. Individually, be prepared to answer the following questions:
    a. Why are you here?
    b. What do you expect from this course?

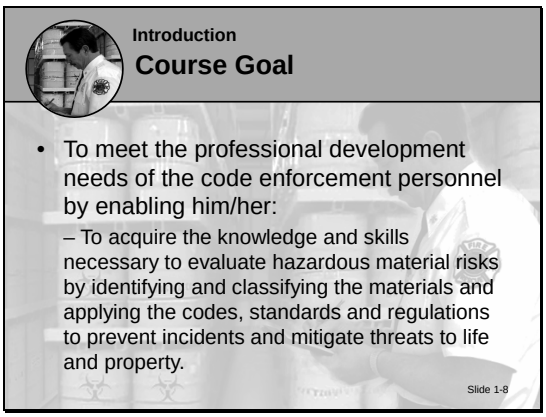
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

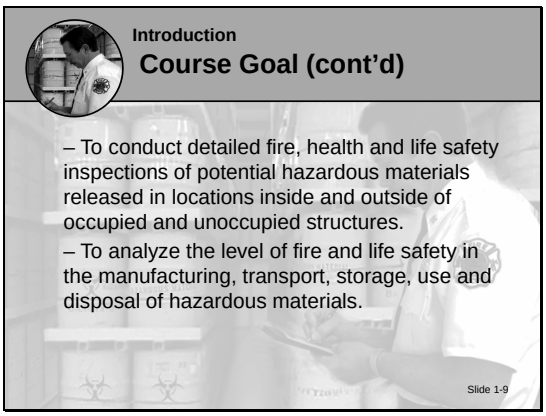
Slide 1-7



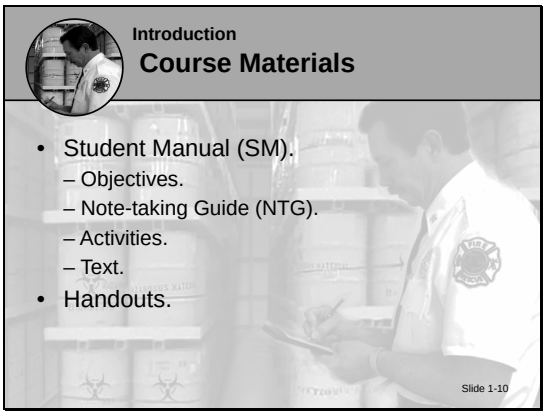
Slide 1-8



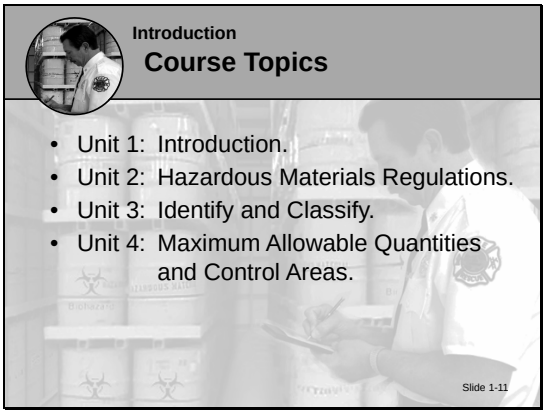
Slide 1-9



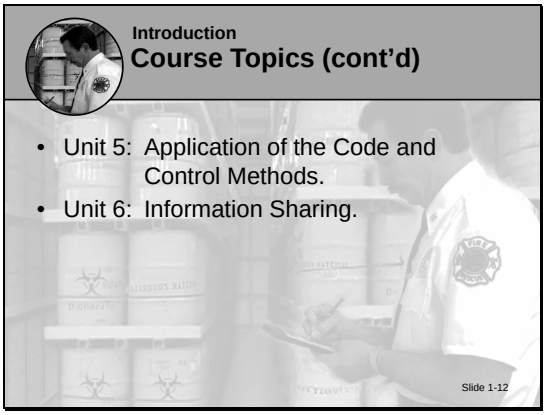
Slide 1-10



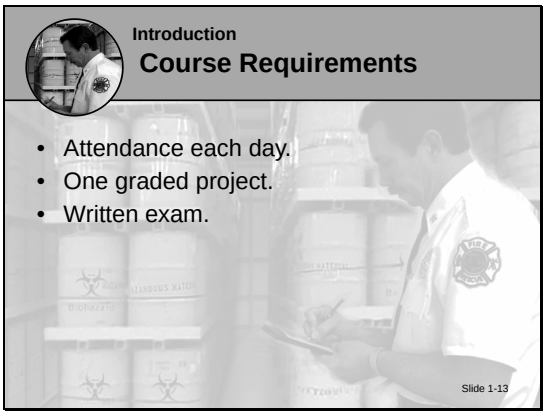
Slide 1-11



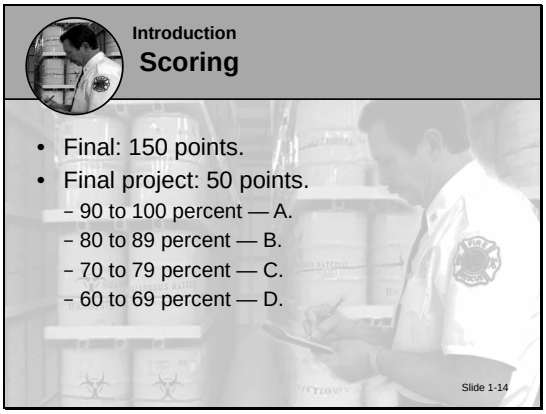
Slide 1-12



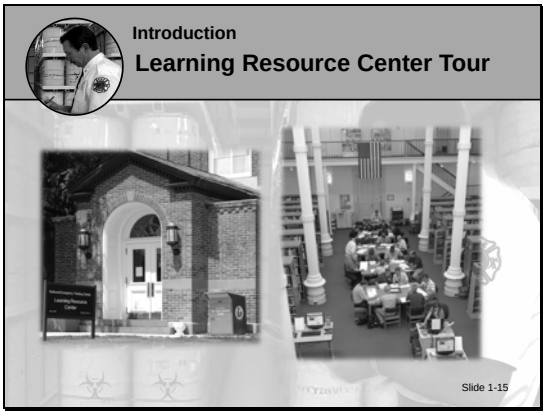
Slide 1-13



Slide 1-14



Slide 1-15



This page intentionally left blank.

UNIT 2: HAZARDOUS MATERIALS REGULATIONS

TERMINAL OBJECTIVE

The students will be able to identify the need for hazardous materials regulations.

ENABLING OBJECTIVES

The students will:

1. *Explain the history of regulations and need for change.*
2. *Describe current regulations.*
3. *Access existing information needed for compliance with regulations.*
4. *Determine what is needed in a Hazardous Materials Management Plan (HMMP).*

This page intentionally left blank.

NOTE-TAKING GUIDE AND ACTIVITIES

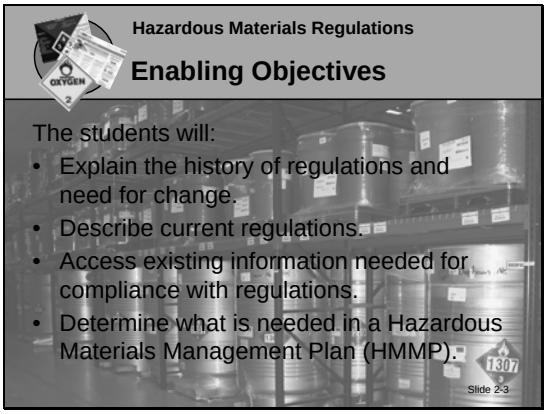
This page intentionally left blank.

NOTE-TAKING GUIDE

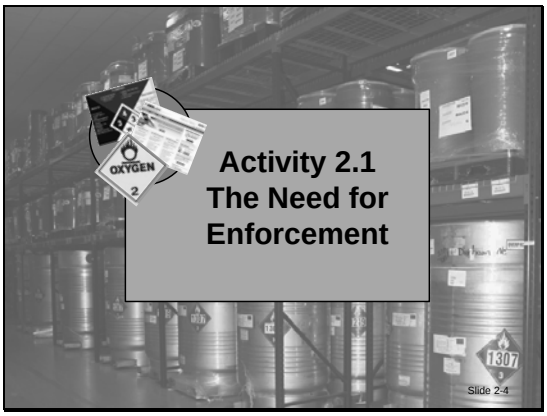
Slide 2-1

Slide 2-2

Slide 2-3



Slide 2-4



Activity 2.1

The Need for Enforcement

Purpose

To address what happens when hazardous materials are not identified.

Directions

1. You will have 25 minutes for group work and 15 minutes to review answers.

2. Individually read the article provided in your Student Manual (SM).

3. Each table group should discuss and answer the following questions and be prepared to discuss the case with the remainder of the class.

   a. What types of hazards exist in “big box stores”?

   _____

   _____

   _____

   b. What was the outcome of this incident in terms of loss of life, injuries, property damage and disruption to the community?

   _____

   _____

   _____

   c. What concerns should be considered if you were doing the inspection of this occupancy?

   _____

   _____

   _____

d. Could code enforcement have changed the outcome? How?

_____

_____

_____

4. Each group will report on a single question.

Activity 2.1 (cont'd)

The Need for Enforcement

Hot Fires in Big Boxes

By: Alisa Wolf (from Interfire.org — "Interfire Online," National Fire Protection Association (NFPA) Journal, 1998, author wrote for NFPA from 1994-1999).

Over the past 10 years, a new type of occupancy has taken hold in the United States, and it's catching on in Europe, too. It's bigger than a hardware store and has more traffic than a warehouse. It carries large quantities of lumber, plumbing supplies, electrical supplies, tools, fixtures, paints, housewares, garden supplies, appliances, and even food in some cases — you name it, and these stores have it.

In addition to products that present ordinary fire hazards, these stores often carry products that present severe fire hazards, such as those made of Group A plastics. Patio furniture, toys, kiddie pools, wastebaskets, and other housewares fall into this category. Such stores may also carry paints, cleaners, aerosol products, flammable and combustible liquids, pool chemicals, and pesticides. And since these so-called bulk warehouse hyper-markets, or "big box" stores (such as Builders Square, HQ, HomeBase, Home Depot, and Lowes) don't fit exactly into any of the occupancy classifications developed by the fire code community, protection schemes draw from standards as diverse as NFPA 231, General Storage; NFPA 231C, Rack Storage of Materials; NFPA 430, Liquid and Solid Oxidizers; NFPA 30, Flammable and Combustible Liquids Code; NFPA 30B, Aerosol Products; NFPA 43D, Storage of Pesticides; and the mercantile occupancies section of NFPA 101®, Life Safety Code®.

"Because of the broad range of products stored," says Rick Mulhaupt, president of the NFPA's National Fire Protection Research Foundation, "most of these big box stores have been considered to be NFPA 231C occupancies, involving high-rack storage of commodity. Because there are small quantities of specialty chemicals, like pool chemicals, in some of these occupancies, there's been some uncertainty as to whether NFPA 430 should also be used for protection, either of the entire occupancy or at least the part that might have this kind of commodity."

In the past, some in the industry didn't accept NFPA 430's requirements for in-rack sprinklers for large quantities of oxidizers. In-rack systems inconvenience retailers who want flexible shelving to accommodate seasonable items. In addition, stock must be treated carefully when in-rack sprinklers are installed so that delicate sprinkler heads aren't damaged.

However, two big box store fires raised some questions about the real-world effectiveness of ceiling-mounted sprinklers alone for certain storage arrangements of specific types of products. NFPA investigated both of these fires, one in 1996 in Albany, Georgia, and one in 1995 in Quincy, Massachusetts. In both incidents, the fire grew more rapidly than anyone had predicted, even though the rack storage systems were protected by ceiling-only sprinkler systems. And in both fires, investigators found oxidizing pool and spa chemicals in the area of fire origin.

Albany, Georgia

The latest of these two fires occurred on Tuesday, April 16, 1996, at approximately 11:21 a.m. in an Albany, Georgia, store. Though the fire was traced to the area where oxidizing pool and spa chemicals were stored, the cause of the blaze was never determined. Once ignited, however, the fire spread through the rack of pool chemicals, producing large amounts of irritating smoke. The building's estimated 100 employees and 85 patrons safely evacuated the store before firefighters arrived minutes later.

First-responding firefighters reported that the building's structural integrity was already failing when they pulled up. They also saw smoke venting through the roof. Rapid fire growth had apparently overwhelmed the building's sprinkler systems, and flames had spread through the entire building, making an interior attack impossible. Eventually, fire destroyed the entire store and all the merchandise inside for an estimated loss of $9 million.

According to NFPA's fire investigation report, merchandise stored in the aisle of fire origin near the oxidizing pool chemicals included cedar, iron, and plastic furniture. Grill accessories, charcoal and lighter fluid, and charcoal and gas grills were also stored on the same double-row rack system as the pool chemicals; no vertical barriers separated the chemicals from these other products, as recommended by NFPA documents. The pool chemicals included sanitizers, algaecides, and chlorinators such as trichloroisocyanuric acid (trichlor) and calcium hypochlorite (cal hypo) which, according to the manufacturers' instructions, shouldn't have been stored near some of the other products without being separated by inert materials.

NFPA's investigators reported that, in addition to the lack of noncombustible vertical barriers, the store had deviated from NFPA 430's requirements by storing oxidizers on racks that were higher and deeper than the retail storage limits allowed. The store also deviated from NFPA 430 requirements by not protecting the stored oxidizers with in-rack sprinklers. And, finally, the sprinkler systems were designed to discharge densities and areas of operation below those required by NFPA 430 for oxidizer storage.

Quincy, Massachusetts

Less than a year earlier, a similar fire occurred in a big box store in Quincy, Massachusetts. This fire began at 8:23 p.m. on Tuesday, May 23, 1995, when 60 employees and 100 customers were in the store, which used a metal double-rack system throughout. As was the case in the Albany fire, investigators traced the fire's origin to the area containing oxidizing pool chemicals.

An investigation conducted by the Quincy Fire Department and the Massachusetts State Fire Marshal's Office traced the area of fire origin to the lower storage rack of stored pool and spa chemicals. Investigators determined that the fire was probably caused by a chemical reaction involving the pool chemicals and leaking motor oil packaged with lawn mowers that were stored nearby. The fire also involved Group A plastics and other combustibles that gave off heavy smoke.

According to Chief Thomas Gorman of the Quincy Fire Department, several factors kept this fire from destroying the building. Perhaps most importantly, the fire department was involved during the store's planning stages. Before construction even began, the fire department had made sure that an adequate water supply was available for the store's sprinkler system by insisting on a 12-inch looped sprinkler main rather than the 6-inch main originally planned.

"The fire probably would've overwhelmed the sprinkler system," Gorman says, "if we hadn't demanded some of these things."

The Quincy fire spread much like the fire in the Albany store, rapidly spreading through the rack of origin and into a rack across the aisle. Smoke developed so quickly that responding Quincy firefighters reported seeing heavy smoke as they approached the scene within two minutes of dispatch. Upon arrival, they reported that smoke was heavy throughout the building down to 5 feet off the ground. Noxious smoke that gathered thickly, not just inside the building but in its parking lot, caused breathing problems for firefighters, 58 of whom were treated for minor smoke inhalation. Twenty-two sprinklers activated and, with the help of firefighter hose lines, the blaze was contained.

Fire damage was limited to the rack of origin, two adjacent racks, and the roof. Direct fire damage was limited to approximately 1,000 square feet, but smoke damage was extensive throughout the store, and most of the stock was sold for salvage. No structural damage was noted, but the trusses and roof deck were heat damaged, and the store had to be closed for nine days due to smoke and chemical contamination. Damage was estimated at $4 million, and the fire alarm system was completely replaced following the fire.

Among the significant factors NFPA's fire investigators found contributing to the blaze were incompatible materials stored too close to the oxidizers. Lack of in-rack sprinklers also played a role in fire growth, as did rack shelving of solid material and wooden slats that were placed too close to each other. Commodities stacked on pallets and wrapped tightly in plastic are also a consideration in any big box fire protection scheme since the plastic on all four sides and the top can resist water penetration. Such encapsulated products were stored higher in this store than NFPA 231C allows without in-rack sprinklers. And stock items were stored in the aisles, which allowed the fire to spread across the aisle to adjacent racks.

Big box store hazards

Because of the volume of product sold in big box stores, the hazards normally associated with mercantile occupancies are intensified. According to Chief Gorman, high-piled storage constitutes one of the biggest potential fire hazards since stacks of boxes can block sprinkler water spray.

"They use every inch of their space for selling," Gorman points out. "They're stocking constantly, all day."

Traditional hardware stores house products bought in larger quantities in a warehouse and bring them out as needed. In big box stores, however, the general public has access to the entire product. Unfortunately, storage arrangements that make materials accessible to the public can also clog aisles, as can shoppers and carts. Free aisle space is not assured, as it is in a more controlled warehouse arrangement, where only employees have access to stock. Stocking operations can also block flue spaces between racks, which are critical to effective sprinkler operation.

In addition to pool chemicals, big box stores also sell large quantities of combustible and flammable liquids, including paint and paint thinners. Gorman notes that incompatible products can be mixed when shoppers pick up an item in one aisle and, deciding against buying it later, lay it down on a product in another aisle. All of these factors can create a cumbersome situation for firefighters notes Gorman.

“You need a lot of resources to fight a fire in these types of stores,” he says. High staff turnover at these occupancies can also be a headache for fire departments trying to instill fire safety awareness and make sure personnel understand evacuation routes.

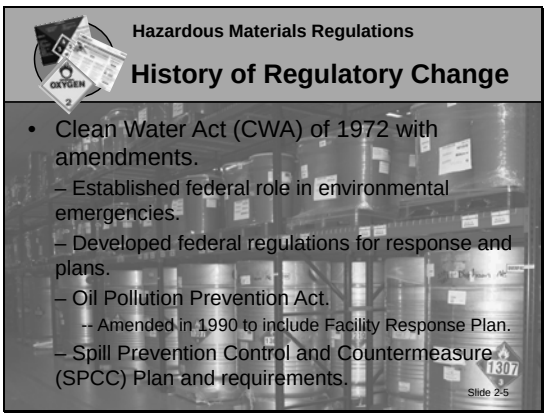
Most of these hazards were identified before the fires in Albany and Quincy. However, attention in the industry began to focus on pool and spa chemicals and the particular hazards of dealing with them in large quantities after state and local fire investigators identified them as a major factor in the intensity with which both these fires burned.

Although most oxidizers don’t themselves burn, they can increase the burning rate of ordinary combustible materials and increase the fire’s temperature. Some oxidizers support spontaneous ignition when they come into contact with incompatible materials, and explosions can result when chlorine from oxidizing pool chemicals reacts with nitrogen from certain algaecides and multipurpose A:B:C dry chemicals found in fire extinguishers. And although a severe fire can occur when pool chemicals come into contact with any incompatible material, the most severe fires occur when they interact with hydrocarbon liquids. In both big box store fires, certain organic liquids were stored near the pool chemicals, and in each facility, the fire grew rapidly, filling the building with smoke within minutes.

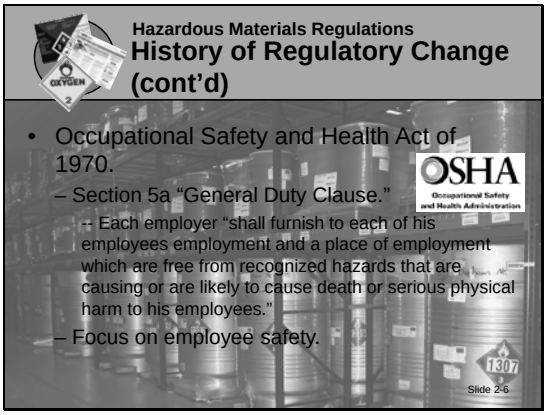
Because both fires burned more quickly and hotter than anyone had anticipated, it was in the best interest of these stores, as well as insurers and manufacturers, to test these chemicals and see what they were up against.

NOTE-TAKING GUIDE (cont'd)

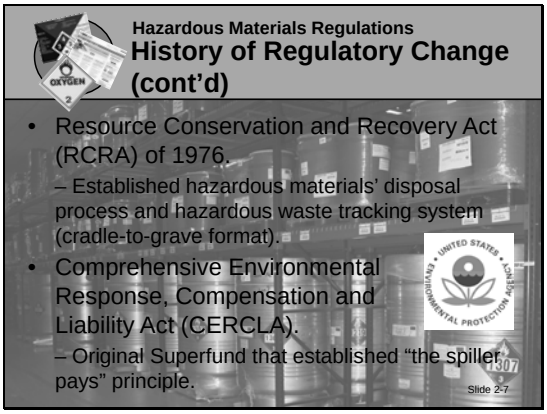
Slide 2-5



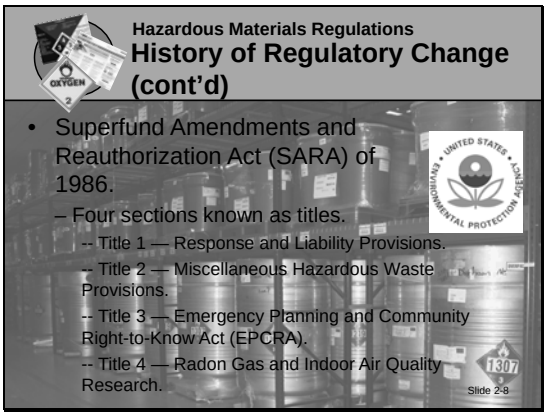
Slide 2-6



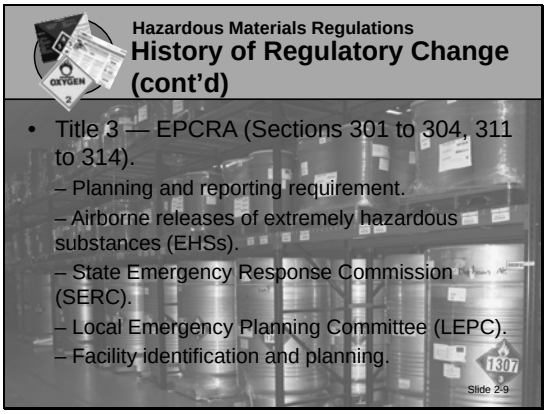
Slide 2-7



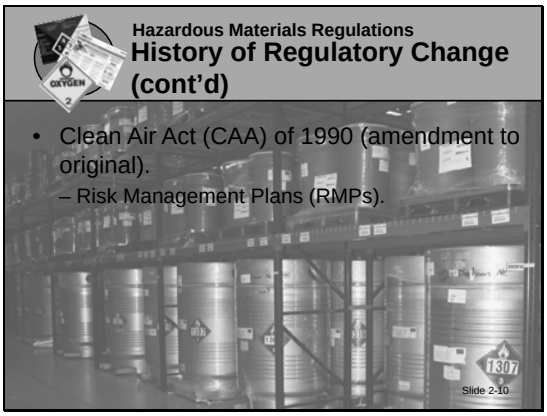
Slide 2-8



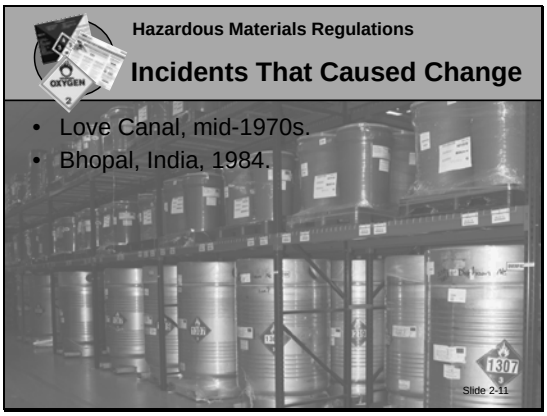
Slide 2-9



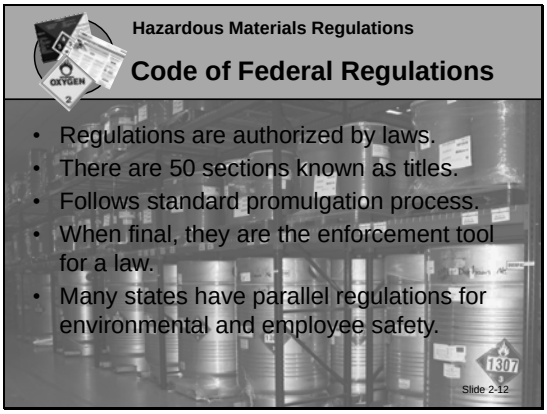
Slide 2-10



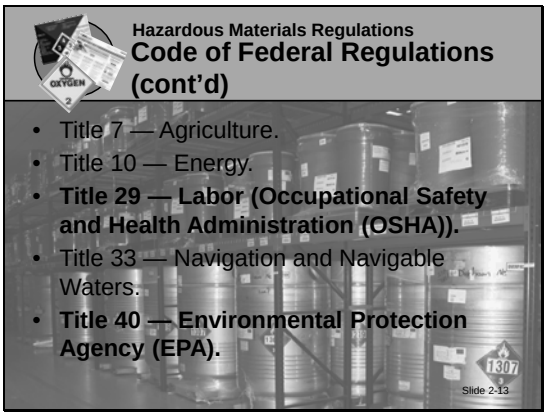
Slide 2-11



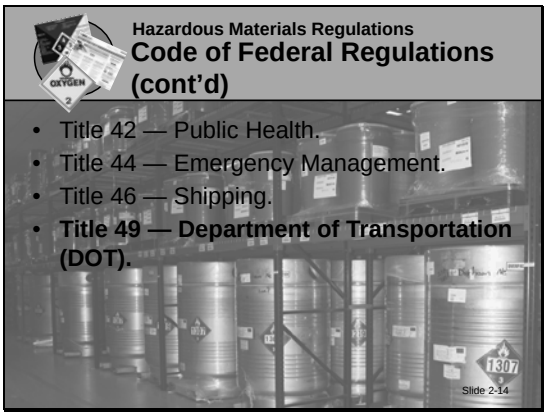
Slide 2-12



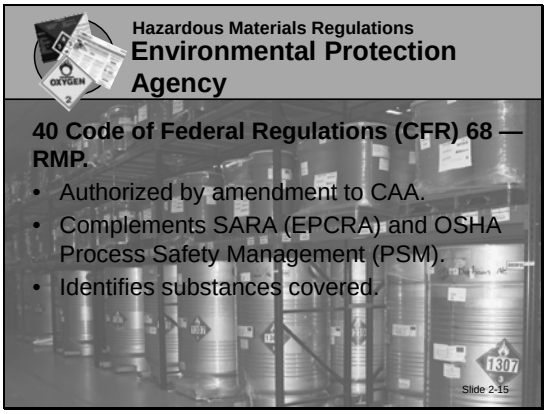
Slide 2-13



Slide 2-14

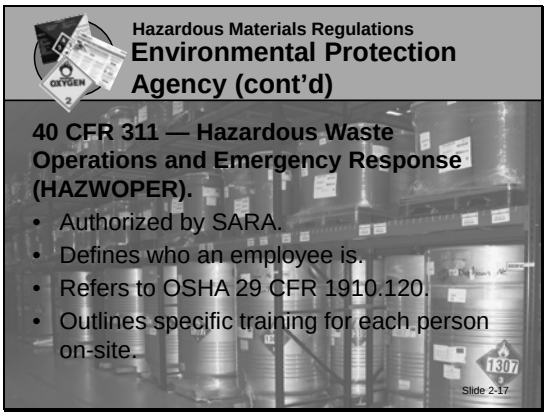


Slide 2-15



Slide 2-16

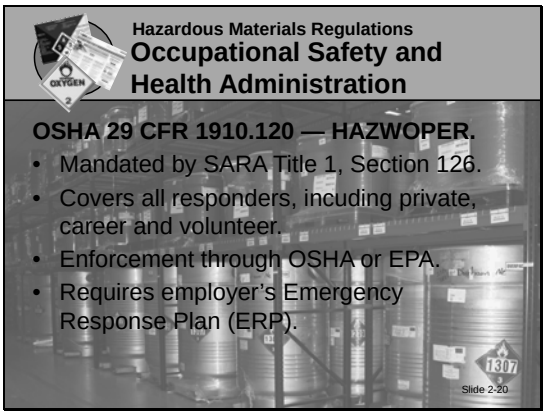
Slide 2-17



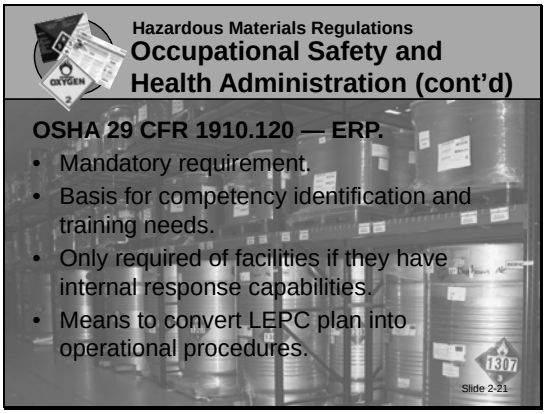
Slide 2-18

Slide 2-19

Slide 2-20



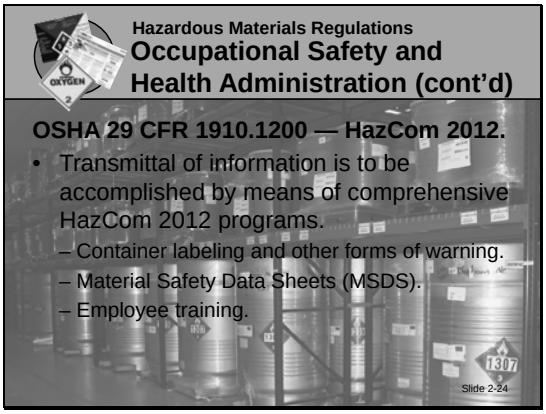
Slide 2-21



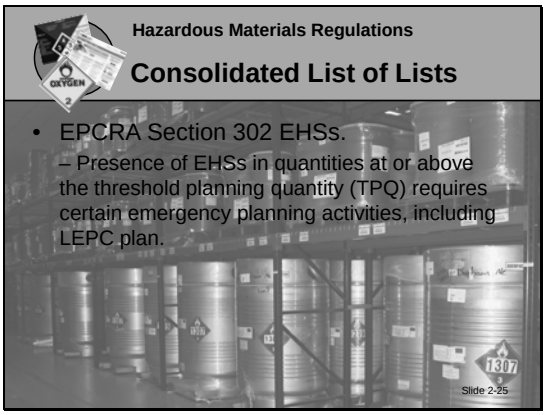
Slide 2-22

Slide 2-23

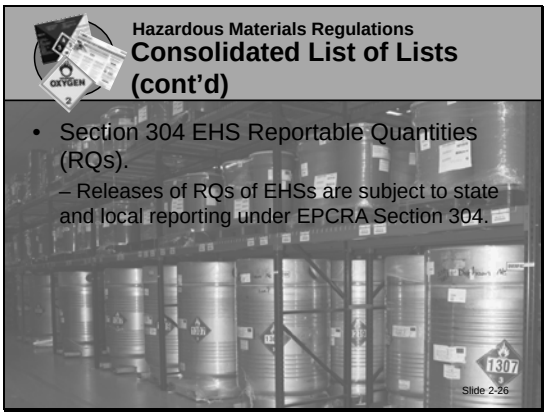
Slide 2-24



Slide 2-25



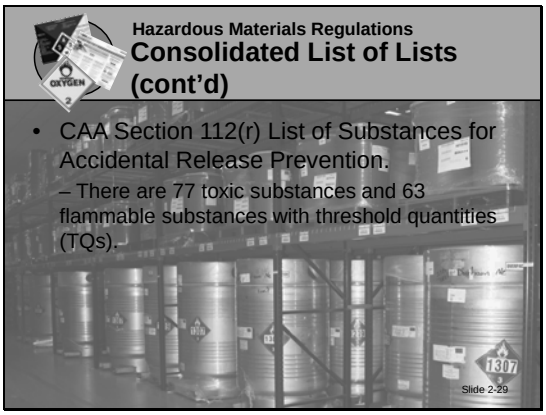
Slide 2-26



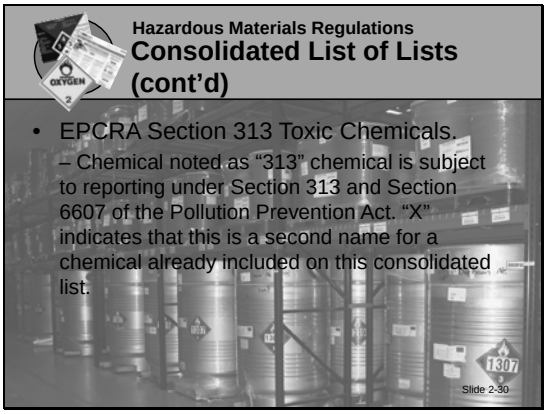
Slide 2-27

Slide 2-28

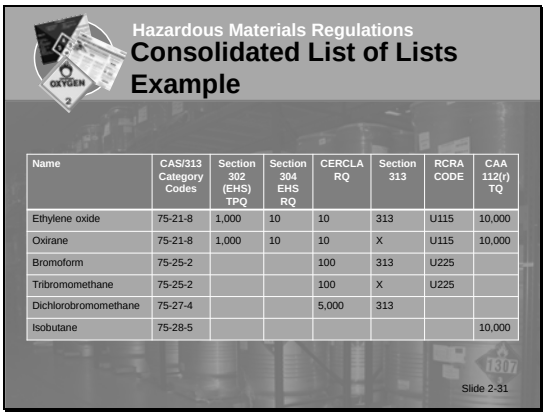
Slide 2-29



Slide 2-30

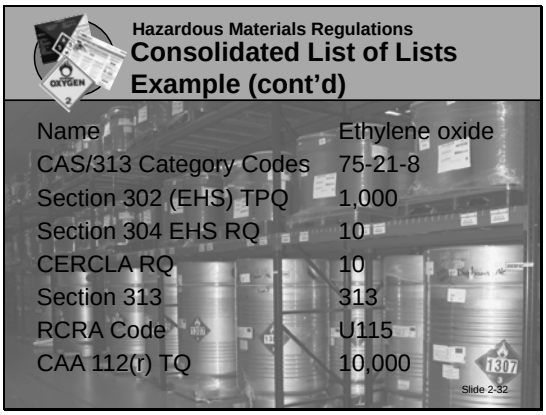


Slide 2-31

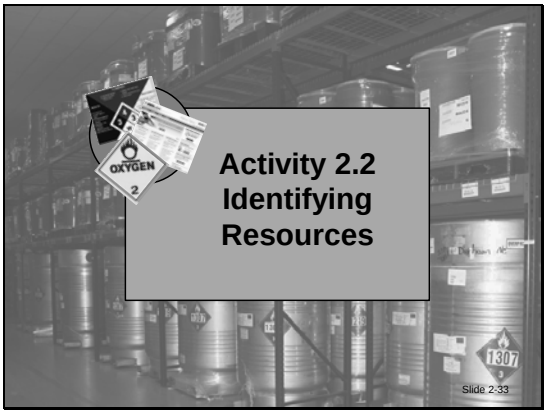


Name	CAS/313 Category Codes	Section 302 (EHS) TPQ	Section 304 EHS RQ	CERCLA RQ	Section 313	RCRA CODE	CAA 112(r) TQ
Ethylene oxide	75-21-8	1,000	10	10	313	U115	10,000
Oxirane	75-21-8	1,000	10	10	X	U115	10,000
Bromoform	75-25-2			100	313	U225	
Tribromomethane	75-25-2			100	X	U225	
Dichlorobromomethane	75-27-4			5,000	313		
Isobutane	75-28-5						10,000

Slide 2-32



Slide 2-33



Activity 2.2

Identifying Resources

Purpose

To develop research skills to identify resources used to assist in hazardous materials compliance.

Directions

1. The following activity is split into three parts.

2. Your group will be provided with scenarios pertaining to hazardous materials compliance.

3. You are to answer the questions using smartphone applications, search engines and written reference documents.

4. Be prepared to share your results with the class upon completion.

This page intentionally left blank.

Activity 2.2 (cont'd)

Identifying Resources

Scenario 1

A warehouse distribution center is shipping and receiving retail products. You are conducting an inspection and discover that consumer fireworks (1.4 grams) are being stored next to automotive products, specifically vehicle batteries.

1. Identify and list smartphone applications that would provide information on storage concerns.

_____

_____

_____

2. How would this application be useful to you in the field?

_____

_____

_____

3. Do the applications vary between brands of smartphones? How?

_____

_____

_____

Scenario 2

A new business that manufactures lithium ion and lithium polymer batteries has been proposed in your jurisdiction. The local plan commission has asked that you provide information to them on the potential hazards and concerns of the fire department at the meeting tomorrow evening.

1. Identify, list and compare search engines (Google, Bing, Yahoo, etc.) that you used to conduct research on these products.

_____

_____

_____

2. How did the information vary between search engines?

_____

_____

_____

3. Which search engines provided the most concise information?

_____

_____

_____

Scenario 3

A fuel transportation company is expanding in your jurisdiction and has plans to install six aboveground storage tanks (ASTs) on a 5-acre site. They are asking for guidance on specific requirements for tank spacing.

1. List which written documents you will use to reference this.

_____

_____

_____

2. What information is provided through the Internet?

_____

_____

_____

3. Are there applications available that specialize in fuel tanks?

_____

_____

_____

4. What information were you able to obtain from search engines?

_____

_____

_____

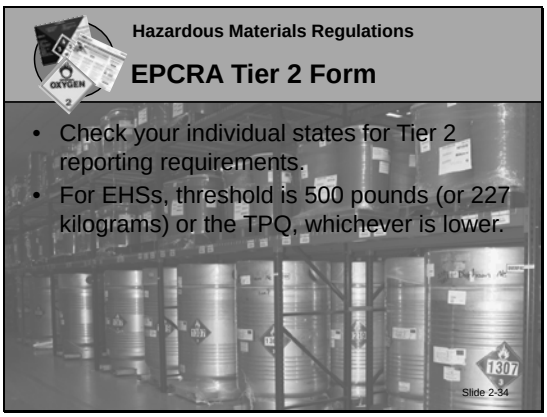
Personal Perspective

Individually, identify features that you would like to see if you were to create a smartphone application dealing with hazardous materials for inspectors. Share your responses with your group and be prepared to offer responses to the class.

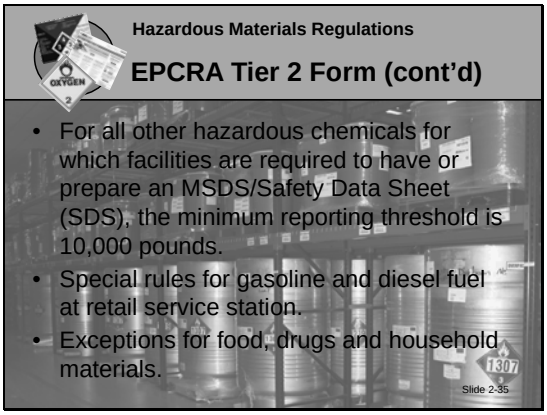
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

Slide 2-34



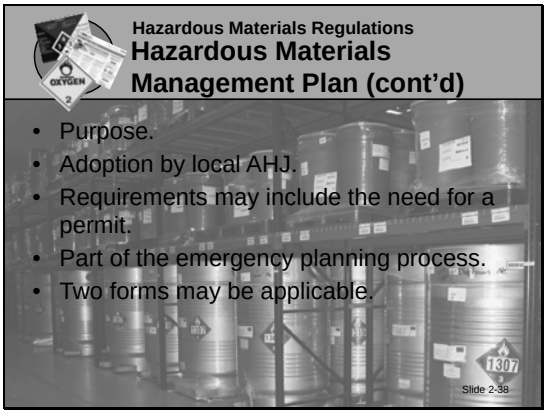
Slide 2-35



Slide 2-36

Slide 2-37

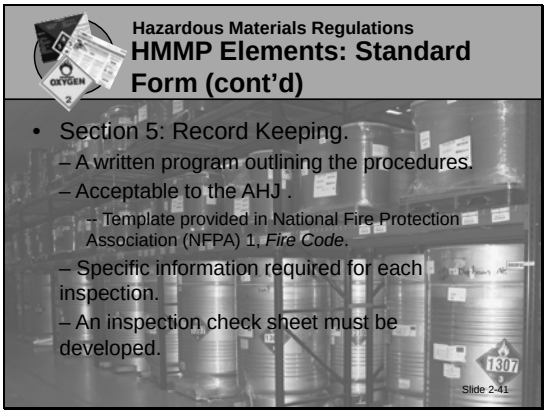
Slide 2-38



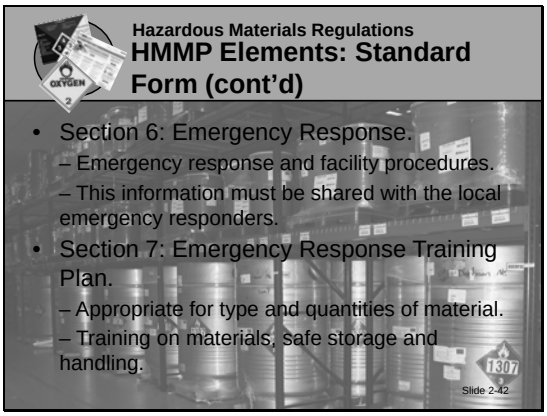
Slide 2-39

Slide 2-40

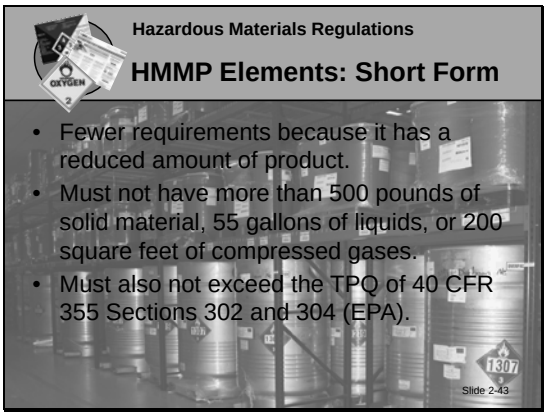
Slide 2-41



Slide 2-42



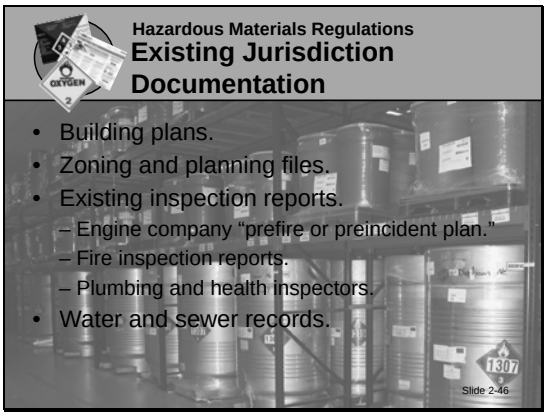
Slide 2-43



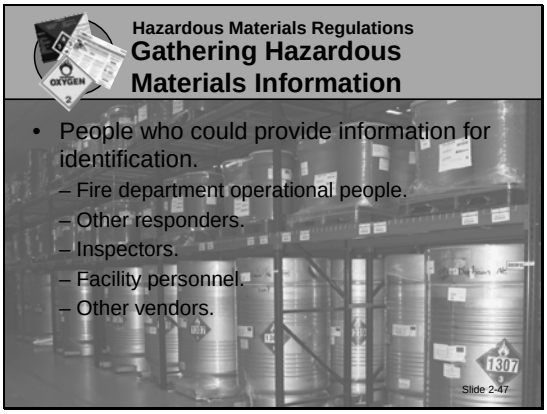
Slide 2-44

Slide 2-45

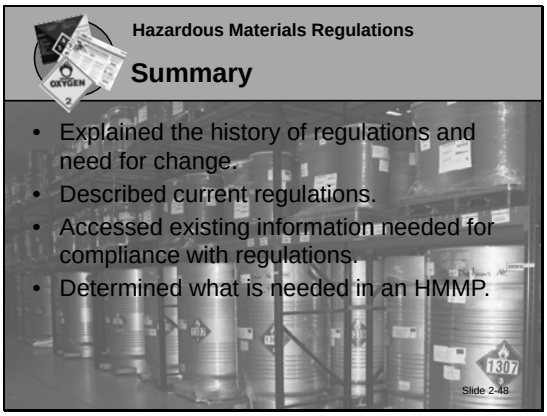
Slide 2-46



Slide 2-47



Slide 2-48



This page intentionally left blank.

BACKGROUND TEXT

This page intentionally left blank.

HISTORY OF REGULATORY CHANGE

The Clean Water Act of 1972 (CWA)

This established a federal role in environmental emergencies and led to federal regulations addressing such responses and plans. It led to the Oil Pollution Prevention Act. It was amended in 1990 to include the Facility Response Plan. It specifies the Spill Prevention Control and Countermeasure (SPCC) Plan and requirements.

Occupational Safety and Health Act of 1970

The Occupational Safety and Health Act of 1970, in Section 5a "General Duty Clause," states that each employer "shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees." The focus is on employee safety.

Resource Conservation and Recovery Act of 1976 (RCRA)

Established hazardous materials disposal process and hazardous waste tracking system (cradle-to-grave format).

Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA)

Original Superfund that established "the spiller pays" principle. It established safety regulations for response and cleanup and Community Right-to-Know.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

By 1980, public awareness and governmental interest were growing, but even after 10 years, both the CWA and CERCLA dealt only with the federal role in environmental mishaps. Six more years would elapse before Congress would legislate standard requirements at state and local government levels. Those six years culminated in the passage of the SARA, which has the following provisions:

- **Title 1** — Response and Liability Provisions. Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) training and safety regulations.

- **Title 2** — Miscellaneous Hazardous Waste Provisions.

- **Title 3** — Emergency Planning and Community Right-to-Know Act (EPCRA). There is a planning and reporting requirement, airborne releases of extremely hazardous substances (EHSs), and State Emergency Response Commission (SERC). It established the Local Emergency Planning Committee (LEPC) and facility identification and planning.

  - This means that facilities annually must submit an Emergency and Hazardous Chemical Inventory Form to the authority having jurisdiction (AHJ).

  - Facilities provide either a Tier 1 or Tier 2 form. Most states require the Tier 2 form. Some states have specific requirements in addition to the federal Tier 2 requirements. Many accept Tier 2 submissions in an electronic format.

- **Title 4** — Radon Gas and Indoor Air Quality Research.

Clean Air Act (CAA)

CAA was amended in 1990. This amendment established the requirement for sites and facilities to have a Risk Management Plan (RMP).

Incidents That Caused Regulatory Change

Love Canal, Niagara Falls, New York, Mid-1970s

Unregulated chemical disposal went on for decades. Two schools were built on the land with little regard for the risk, even though the previous owner provided a disclaimer for the land.

Children attending the schools suffered chronic and fatal illnesses. Public outcry eventually caused the site to be cleaned.

This incident, along with another incident in Times Beach, Missouri, led to the development of CERCLA, more commonly known as **Superfund.** This fund is established to cover costs of cleanup work at known chemical sites where the public may be at risk. This incident also had a hand in the "Community Right-to-Know Act," which allowed information regarding hazardous chemicals and processes to be provided to the public. Both of these legislative acts provided for a safer community and more transparency when dealing with hazardous sites. It is important for the inspector to recognize when these situations appear in the community and verify that the facility meets **Tier 2** and other permitting requirements.

Bhopal, India, 1984

Union Carbide facility chemical release, including methyl isocyanate, resulted in thousands of deaths.

1985 — Similar incident in Institute, West Virginia, without the same loss. Six workers were injured and hundreds of citizens were sent to the hospital when a leak of chemicals used to make pesticides occurred.

SARA of 1986.

HAZARDOUS MATERIALS REGULATIONS

The Code of Federal Regulations (CFR) is authorized by law. The CFR is composed of 50 sections known as titles. When final, they are the enforcement tool for a law. Many states have parallel regulations for environmental and employee safety.

While there are many titles that can involve hazardous materials, there are nine different CFR titles of specific importance. They are as follows:

1. Title 7 — Agriculture.
2. Title 10 — Energy.
3. **Title 29 — Labor.**
4. Title 33 — Navigation and Navigable Waters.
5. **Title 40 — EPA.**
6. Title 42 — Public Health.
7. Title 44 — Emergency Management.
8. Title 46 — Shipping.
9. **Title 49 — Department of Transportation (DOT).**

During this course, we will concentrate on certain sections of the EPA, OSHA and DOT regulations.

EPA Laws and Regulations

40 CFR 68 — RMP was authorized by amendment to CAA. It complements SARA (EPCRA) and OSHA Process Safety Management (PSM). It identifies the substances covered, provides for analysis of off-site consequence scenarios, develops a prevention and emergency response program, and identifies overall management for implementation.

40 CFR 311 — Hazardous Waste Operations and Emergency Response (HAZWOPER) was authorized by SARA. It defines who an employee is. Refers to 29 CFR 1910.120. It outlines specific training for each person on-site.

40 CFR 355 — Emergency Planning and Notification places SARA Title 3 facility planning requirements in the form of regulations. It stems from EPCRA.

40 CFR 112 — Spill Prevention Control and Countermeasure (SPCC) Plan is required of facilities that have "oil." Oil is very loosely defined (petroleum, animal fats, etc.). Generally applies to facilities with 1,320 gallons or greater in aboveground "containers" larger than 55 gallons or one 660-gallon container. Completely buried tanks that are 42,000 gallons or greater also apply. Specific secondary containment requirements are often adopted by states. A Facility Response Plan is possibly required.

OSHA

OSHA 29 CFR 1910.120 — HAZWOPER was mandated by SARA Title 1, Section 126. This covers all responders, including private, career and volunteer. The enforcement is through OSHA or EPA. It requires an Employer's Emergency Response Plan (ERP). This is an important component and a mandatory requirement. It forms the basis for competency identification and training needs. It is only required of facilities if they have internal response capabilities. It is a means to convert the LEPC plan into operational procedures.

It includes response procedures, roles, authorities and communications. It specifies personal protective equipment (PPE), decontamination, evacuation to safe refuge areas and emergency procedures. It defines minimum response competency categories: Awareness, Operations, Technician, etc.

OSHA 29 CFR 1910.1200 — Hazardous Communication Standard (HazCom 2012): Hazards of all chemicals produced or imported are evaluated. Information concerning their hazards is transmitted to employers and employees. Transmission of information is to be accomplished by means of comprehensive HazCom 2012 programs, including container labeling and other forms of warning, Material Safety Data Sheets (MSDS), and employee training.

Consolidated List of Lists

- EPCRA Section 302 EHSs: The presence of EHSs in quantities at or above the threshold planning quantity (TPQ) requires certain emergency planning activities, including an LEPC plan.
- Section 304 EHS Reportable Quantity (RQ): Releases of RQs of EHSs are subject to state and local reporting under EPCRA Section 304.
- CERCLA Hazardous Substances: Releases of CERCLA hazardous substances, in quantities equal to or greater than their RQs, are subject to reporting.

- RCRA Code: This is for specific chemicals from the RCRA P and U lists (commercial chemicals that are hazardous wastes). Other RCRA hazardous wastes (F and K lists and wastes exhibiting the characteristics of ignitability, corrosiveness, reactivity and toxicity) go on a separate list.

- CAA Section 112(r) List of Substances for Accidental Release Prevention: There are 77 toxic substances and 63 flammable substances with threshold quantities (TQs).

- EPCRA Section 313 Toxic Chemicals: Chemical noted as "313" chemical is subject to reporting under Section 313 and Section 6607 of the Pollution Prevention Act. "X" indicates that this is a second name for a chemical already included on this consolidated list.

Name	CAS/313 Category Codes	Section 302 (EHS) TPQ	Section 304 EHS RQ	CERCLA RQ	Section 313	RCRA CODE	CAA 112(r) TQ
Ethylene oxide	75-21-8	1,000	10	10	313	U115	10,000
Oxirane	75-21-8	1,000	10	10	X	U115	10,000
Bromoform	75-25-2			100	313	U225	
Tribromomethane	75-25-2			100	X	U225	
Dichlorobromomethane	75-27-4			5,000	313		
Isobutane	75-28-5						10,000

Name	Ethylene oxide
CAS/313 Category Codes	75-21-8
Section 302 (EHS) TPQ	1,000 pounds
Section 304 EHS RQ	10
CERCLA RQ	10
Section 313	313
RCRA Code	U115
CAA 112(r) TQ	10,000

ACCESSING HAZARDOUS MATERIALS INFORMATION THROUGH EXISTING DOCUMENTATION

EPCRA Tier 2 Form Required

Check with individual states for Tier 2 reporting requirements. For EHSs designated under EPCRA Section 302, the reporting threshold is 500 pounds (or 227 kilograms) or the TPQ, whichever is lower. For all other hazardous chemicals for which facilities are required to have or prepare an MSDS/Safety Data Sheet (SDS), the minimum reporting threshold is 10,000 pounds.

There are special rules for gasoline and diesel fuel at retail service stations. There are exceptions for food, drugs and household materials.

The EPCRA Tier 2 form includes facility identification, owner/operator information and emergency contact information as well as chemical descriptions; physical and health hazards; and an inventory of storage codes, locations and possibly a site plan.

☐ Check if information below is identical to the information submitted last year. **Reporting Period:** January 1 to December 31, 20____

Tier Two **Emergency and Hazardous Chemical Inventory** *Specific Information by Chemical*	*For Official Use Only* *State ID#:* *Date Received*

Facility Identification

Name	*Maximum No. of Occupants:* ☐ N/A	☐ Manned	☐Unmanned
Street	*County*	*City*	*State* *Zip*
Latitude	*Longitude*	*NAICS Code*	*Phone Number (optional)* ( )
Dun & Bradstreet Number	*TRI Facility ID:* ☐ N/A	*RMP Facility ID:* ☐ N/A	

Subject to Emergency Planning under Section 302 of EPCRA (40 CFR part 355)? ☐ Yes ☐ No

Subject to Chemical Accident Prevention under Section 112(r) of CAA (40 CFR part 68, Risk Management Program)? ☐ Yes ☐ No

Owner or Operator Information		**Parent Company Information (optional)**	
Name		*Name*	*Dun & Bradstreet Number:*
Address		*Address*	
Phone Number ( )	*Email*	*Phone Number* ( )	*Email*
Facility Emergency Coordinator (if applicable)		**Tier II Information Contact**	
Name	*Title*	*Name*	*Title*
Email Address		*Email Address*	
Phone Number ( )	*24-hour Phone* ( )	*Phone Number* ( )	
Emergency Contacts			
Name		*Name*	
Title		*Title*	
Phone Number ( )	*24-hour Phone* ( )	*Phone Number* ( )	*24-hour Phone* ( )
Email Address		*Email Address*	

Certification *(Read and sign after completing all sections)*

I certify under penalty of law that I have personally examined and am familiar with the information submitted in pages one through , and that based on my inquiry of those individuals responsible for obtaining the information, I believe that the submitted information is true, accurate and complete.

Name and official title of owner/operator OR owner/operator's authorized representative

Signature Date Signed

Reporting Ranges
Weight Range in pounds

Range Code	From	To
01	0	99
02	100	499
03	500	999
04	1,000	4,999
05	5,000	9,999
06	10,000	24,999
07	25,000	49,999
08	50,000	74,999
09	75,000	99,999
10	100,000	499,999
11	500,000	999,999
12	1,000,000	9,999,999
13	10,000,000	Greater than 10 million

The public reporting and recordkeeping burden for this collection of information is estimated to range from 6 to 120 hours per response. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed form to this address.

EPA Form No. 8700-30 **OMB Control No. 2050-0072** **Page 1 of ___**

EPA Form No. 8700-30 OMB Control No. 2050-0072 Page __ of ___

Chemical Description	Physical and Health Hazards	Inventory	Type of Storage	Storage Conditions (Pressure, Temperature)	Storage Locations	Additional Reporting Information (Optional)
☐ Check if information below is identical to the information submitted last year. **Chemical Name:** CAS No. EHS: Yes ☐ No ☐ ☐ Solid ☐ Liquid ☐ Gas ☐ Trade Secret	☐ Fire ☐ Sudden Release of Pressure ☐ Reactive ☐ Immediate (Acute) ☐ Delayed (Chronic)	Maximum Amount **Range Code:** Average Daily Amount **Range Code:** No. of days on site:			Confidential: ☐ Yes ☐ No	☐ Below Reporting Thresholds (optional) ☐ State or Local Requirements
☐ Check if information below is identical to the information submitted last year. **Mixture or Product Name:** **CAS No.** ☐ **Not Available** ☐ Solid ☐ Liquid ☐ Gas ☐ Trade Secret EHS: Yes ☐ No ☐ EHS(s) Name (if applicable): CAS No. Non-EHS(s) Name (optional):	☐ Fire ☐ Sudden Release of Pressure ☐ Reactive ☐ Immediate (Acute) ☐ Delayed (Chronic)	Maximum Amount (Total Mixture) **Range Code:** Average Daily Amount (Total Mixture) **Range Code:** No. of days on site: Maximum Amount of each EHS in the Mixture **Range Code:**			Confidential: ☐ Yes ☐ No	☐ Below Reporting Thresholds (optional) ☐ State or Local Requirements

Optional Attachments: ☐ I have attached a site plan ☐ I have attached a list of site coordinate abbreviations
☐ I have attached a description of dikes and other safeguard measures

Hazardous Materials Management Plan (HMMP)

Having a business create an HMMP can be as easy as simply handing them the premade form. New or existing facilities that store, use or handle hazardous materials covered by this code in amounts greater than those listed in the maximum allowable quantity (MAQ) tables must submit HMMPs to the AHJ.

The purpose for this form is to ensure that a facility has a plan to manage and deal with the potential for spills pertaining to hazardous materials when they use, store or handle hazardous materials greater than the MAQs as specified in NFPA 400, *Hazardous Materials Code*. This plan must be adopted by the local jurisdiction and is not an enforceable part of NFPA 400.

Part of the emergency planning process as listed in Chapter 1 of NFPA 400. There are two forms that may be applicable depending on the amount of product in question (a short form and the normal form in the appendix).

Section 1: Facility Description

Part A: General Information includes business name and address; emergency contact; business activity; business owner or operator; Standard Industrial Classification (SIC) code; number of employees and hours; Dunn and Bradstreet number; and signature of owner, operator or designated representative.

Part B: General Site Plan includes location of buildings, exterior storage facilities, permanent access ways, evacuation routes, parking lots, internal roads, chemical loading areas, equipment cleaning area, storm and sanitary sewer accesses, emergency equipment, and adjacent property uses.

Part C: Building Floor Plan (Facility Map) includes hazardous materials storage areas within the building and shall indicate rooms, doorways, corridors, means of egress and evacuation routes. Each hazardous materials storage facility shall be identified by a map key that lists the individual hazardous materials, their hazard class, and the quantity present for each area. The building floor plan must also be provided and show all areas of the building. It may be something to consider including as a requirement during the permit application process.

Section 2: Hazardous Materials Inventory Statement (HMIS)

Incorporated into the HMMP but will be discussed as a separate form.

Section 3: Separation, Secondary Containment and Monitoring

This section is organized into aboveground and underground storage. For each, material storage, handling, compatibility and monitoring are covered.

Hazardous materials handling is the information showing that activities involving the handling of hazardous materials between the storage areas and manufacturing processes on-site are conducted in a manner to prevent the accidental release of such materials. Hazardous materials handling shows that the activities involving hazardous materials on-site are conducted in a manner to prevent an accidental release.

Chemical compatibility and separation is the information showing procedures, controls, signs and other methods to ensure that products are protected from one another.

Monitoring program is the information including, but not limited to, the location; type; manufacturer's specifications, if applicable; and suitability of monitoring methods for each storage facility when required. A monitoring program discusses the methods used to monitor the product while it is at the facility or being used in a specific process.

As an inspector, you should ask what types of monitoring equipment are being used. Is this compatible with the chemicals that are being used?

Section 4: Waste Disposal

Section 5: Record Keeping

One of the most important fields in this plan is inspections and record keeping. A written program outlining the procedures for inspections to verify safety, monitoring and emergency equipment must be in place. The process must be acceptable to the AHJ, and most likely, the template provided in NFPA 1, *Fire Code* will be used.

Inspections must be conducted frequently enough to detect problems and have specific information required for each inspection. An inspection check sheet must be developed to be used in conjunction with routine inspections.

Section 6: Emergency Response

Finally, emergency response and facility procedures must be addressed.

There are many documents and standards available, depending on the type of industry that a company can utilize when considering emergency response procedure development. And OSHA has specific requirements for response procedures for specific industries.

Regardless of their chosen level of in-house response, it is paramount that this information be shared with the fire department and local emergency responders so that an effective resolution can be attained.

Section 7: Emergency Response Training Plan

A training program appropriate for the types and quantities of materials stored or used must be conducted to prepare employees to safely handle the materials on a daily basis. Employee training that provides information on the types and quantities of materials on-site must be prepared and include instruction on safe storage and handling, monitoring and maintenance records, emergency procedures for leaks and spills, and record keeping procedures.

Short Form Minimal Storage Site

The short form has fewer requirements because it has a reduced amount of product. To qualify for the short form, a facility must not have more than 500 pounds of solid material, 55 gallons of liquids, or 200 square feet of compressed gases. The facility must also not exceed the TPQ as specified in 40 CFR 355 Sections 302 and 304 (EPA requirements for emergency planning and emergency release notification).

General facility information can include a simple drawing showing the locations of storage facilities, physical state, hazard classes and specific materials being stored, including handling procedures. Training and security assurances must be in place and signage must be maintained. A disposal policy is also included in the short form, along with maintenance of records. Records

must be made available to the AHJ upon request. This is important for you when working with AHJs and other regulatory agencies.

HMIS

Each building on the grounds of the facility must have an HMIS, regardless of occupancy. The document must present the hazards or hazardous materials found in that specific building, and the HMIS has specific requirements that must be provided to the local AHJ.

Requirements for an HMIS: Obviously, we want to know the hazard class of a product to better understand how to deal with it. While they may have specific production names, first responders may recognize products more accurately by their common or trade names or the chemical name, components and concentration.

And if the product is a waste, it may fall under a specific waste category as required by other regulatory agencies, such as the EPA. The Chemical Abstracts Service (CAS) number will provide more in-depth information on the product as a whole and allow the facility users to categorize the product properly.

Physical state: The product's mixture or purity will be beneficial to know in the event of a fire or other type of release when considering reactivity.

Maximum quantity: Obviously, we want to know how much of a product is being stored in a specific location, along with the storage conditions.

MSDS

MSDS will now be called SDS. There are 16 sections, similar to what was previously recommended. While all 16 sections can contain important information to an inspector, the underlined items will be the most important to determine the hazardous materials. The other sections could be a part of the planning process.

1. Product and company identification.
2. Hazardous materials identification.
3. Composition/Information on ingredients.
4. First-aid measures.
5. Firefighting measures.
6. Accidental release measures.
7. Handling and storage.
8. Exposure controls/Personal protection.

9. Physical and chemical properties.

10. Stability and reactivity.

11. Toxicological information.

12. Ecological information.

13. Disposal considerations.

14. Transport information.

15. Regulatory information.

16. Other information.

Existing Jurisdiction Documentation

Building plans include storage areas, special ventilation and process areas. They include zoning and planning files and existing inspection reports. These reports include the engine company "prefire or preincident plan," fire inspection reports, and plumbing and health inspectors' reports. Plans also need water and sewer records.

GATHERING HAZARDOUS MATERIALS INFORMATION

People are also a source of information for identification of hazardous materials: fire department operational people, hazardous materials personnel, and the engine company. Other possibilities are responders, such as law enforcement or Emergency Medical Services (EMS) personnel; inspectors for fire, building, plumbing and health; as well as facility personnel, other vendors and inspectors.

It is wise to develop a relationship with people such as water meter readers, electric meter readers, etc.

SUMMARY

- Explained the history of regulations and need for change.
- Described current regulations.
- Accessed existing information needed for compliance with regulations.
- Determined what is needed in an HMMP.

APPENDIX: HAZARDOUS MATERIALS MANAGEMENT PLAN

This page intentionally left blank.

SAMPLE FORMAT
HAZARDOUS MATERIALS MANAGEMENT PLAN (HMMP) INSTRUCTIONS

SECTION I — FACILITY DESCRIPTION

1.1 Part A

1. Fill out Items 1 through 11 and sign the declaration.
2. Only Part A of this section is required to be updated and submitted annually, or within 30 days of a change.

1.2 Part B—General Facility Description (Site Plan)

1. Provide a site plan on 8½ in. by 11 in. (215 mm by 279 mm) paper, using letters on the top and bottom margins and numbers on the right and left side margins, showing the location of all buildings, structures, chemical loading areas, parking lots, internal roads, storm and sanitary sewers, wells, and adjacent property uses. Indicate the approximate scale, northern direction and date the drawing was completed.
2. List all special land uses within 1 mile (1.609 km).

1.3 Part C—Facility Storage Map (Confidential Information)

1. Provide a floor plan of each building on 8½ in. by 11 in. (215 mm by 279 mm) paper, using letters on the top and bottom margins and numbers on the right and left side margins, with approximate scale and northern direction, showing the location of each storage area. Mark map clearly "Confidential—Do Not Disclose" for trade-secret information as specified by federal, state, and local laws.
2. Identify each storage area with an identification number, letter, name, or symbol.
3. Show the following:
   (a) Accesses to each storage area.
   (b) Location of emergency equipment.
   (c) The general purpose of other areas within the facility.
   (d) Location of all aboveground and underground tanks to include sumps, vaults, belowgrade treatment systems, piping, etc.
4. **Map key.** Provide the following on the map or in a map key or legend for each storage area:
   (a) A list of hazardous materials, including wastes.
   (b) Hazard class of each hazardous waste.
   (c) The maximum quantity for hazardous materials.
   (d) Include the contents and capacity limit of all tanks at each area and indicate whether they are above or below ground.
   (e) List separately any radioactives, cryogens, and compressed gases for each facility.
   (f) Trade-secret information shall be listed as specified by federal, state, and local laws.

SECTION II—HAZARDOUS MATERIALS INVENTORY STATEMENT (HMIS)

2.1 Part A—Declaration

Fill out all appropriate information.

2.2 Part B—Inventory Statement

1. You must complete a separate inventory statement for all waste and nonwaste hazardous materials. List all hazardous materials in alphabetical order by hazard class.
2. Inventory Statement Instructions.

Column	Information Required
1	Provide hazard class for each material.
2	**Nonwaste.** Provide the common or trade name of the regulated material. **Waste.** In lieu of trade names, you may provide the waste category.
3	Provide the chemical name and major constituents and concentrations, if a mixture.
4	Enter the chemical abstract service number (CAS number) found in 29 CFR. For mixtures, enter the CAS number of the mixture as a whole if it has been assigned a number distinct from its constituents. For a mixture that has no CAS number, leave this item blank or report the CAS numbers of as many constituent chemicals as possible.
5	Enter the following descriptive codes as they apply to each material. You may list more than one code, if applicable. P = Pure M = Mixture S = Solid L = Liquid G = Gas
6	Provide the maximum aggregate quantity of each material handled at any one time by the business. For underground tanks, list the maximum volume [in gallons (liters)] of the tank. Enter the estimated average daily amount on site during the past year.
7	Enter the units used in Column 6 as: Lb = Pounds Ga = Gallons Cf = Cubic Feet
8	Enter the number of days that the material was present on site (during the last year).

© 2012 National Fire Protection Association NFPA 1 (p. 1 of 8)

FIGURE D.3.1 Sample Format of Hazardous Materials Management Plan (HMMP) Instructions.

Column	Information Required
9	Enter the storage codes below for type, temperature, and pressure:

Type

A = Aboveground Tank
B = Belowground Tank
C = Tank Inside Building
D = Steel Drum
E = Plastic or Nonmetallic Drum
F = Can
G = Carboy
H = Silo
I = Fiber Drum
J = Bag
K = Box
L = Cylinder
M = Glass Bottle or Jug
N = Plastic Bottles or Jugs
O = Tote Bin
P = Tank Wagon
Q = Rail Car
R = Other

Temperature

4 = Ambient
5 = Greater than Ambient
6 = Less than Ambient, but not Cryogenic [less than –150°F (–101.1°C)]
7 = Cryogenic conditions [less than –150°F (–101.1°C)]

Pressure

1 = Ambient (Atmospheric)
2 = Greater than Ambient (Atmospheric)
3 = Less than Ambient (Atmospheric)

10 For each material listed, provide the SARA Title III hazard class as listed below. You may list more than one class. These categories are defined in 40 CFR 370.3.

Physical Hazard

F = Fire
P = Sudden Release of Pressure
R = Reactivity

Health Hazard

I = Immediate (Acute)
D = Delayed (Chronic)

11 **Waste Only.** For each waste, provide the total estimated amount of hazardous waste handled throughout the course of the year.

SECTION III—SEPARATION AND MONITORING

3.1 Part A—Aboveground

Fill out Items 1 through 6, or provide similar information for each storage area shown on the facility map. Use additional sheets as necessary.

3.2 Part B—Underground

1. Complete a separate page for each underground tank, sump, vault, belowgrade treatment system, etc.
2. Check the type of tank and method(s) that applies to your tank(s) and piping, and answer the appropriate questions. Provide any additional information in the space provided or on a separate sheet.

SECTION IV—WASTE DISPOSAL

Check all that apply and list the associated wastes for each method checked.

SECTION V—RECORD KEEPING

Include a brief description of your inspection procedures. You are also required to keep an inspection log and recordable discharge log, which are designed to be used in conjunction with routine inspections for all storage facilities or areas. Place a check in each box that describes your forms. If you do not use the sample forms, provide copies of your forms for review and approval.

SECTION VI—EMERGENCY RESPONSE PLAN

1. This plan should describe the personnel, procedures, and equipment available for responding to a release or threatened release of hazardous materials that are stored, handled, or used on site.
2. A check or a response under each item indicates that a specific procedure is followed at the facility, or that the equipment specified is maintained on site.
3. If the facility maintains a more detailed emergency response plan on site, indicate this in Item 5. This plan shall be made available for review by the inspecting jurisdiction.

SECTION VII—EMERGENCY RESPONSE TRAINING PLAN

1. This plan should describe the basic training plan used at the facility.
2. A check in the appropriate box indicates the training is provided or the records are maintained.
3. If the facility maintains a more detailed emergency response training plan, indicate this in Item 4. This plan shall be made available for review by the inspecting jurisdiction.

© 2012 National Fire Protection Association NFPA 1 (p. 2 of 8)

FIGURE D.3.1 *Continued*

HAZARDOUS MATERIALS MANAGEMENT PLAN
SECTION I: FACILITY DESCRIPTION

Part A — General Information

1. Business Name: _____ Phone: _____
   Address: _____
2. Person Responsible for the Business:

Name	Title	Phone

3. Emergency Contacts:

Name	Title	Home Number	Work Number

4. Person Responsible for the Application/Principal Contact:

Name	Title	Phone

5. Property Owner:

Name	Address	Phone

6. Principal Business Activity: _____
7. Number of Employees: _____
8. Number of Shifts: _____
9. Hours of Operation: _____
10. SIC Code: _____
11. Dunn and Bradstreet Number: _____
12. Declaration:
    I certify that the information above and on the following parts is true and correct to the best of my knowledge.

    Signature: _____ Date: _____
    Print Name: _____ Title: _____
    (Must be signed by owner/operator or designated representative)

Part B — General Facility Description/Site Plan

(Use grid format in Part C)

Special land uses within 1 mile (1.609 km): _____

© 2012 National Fire Protection Association NFPA 1 (p. 3 of 8)

FIGURE D.3.1 *Continued*

SECTION I: FACILITY DESCRIPTION (Continued)

Part C — Facility Map

(Use grid format below)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1															1
2															2
3															3
4															4
5															5
6															6
7															7
8															8
9															9
10															10
11															11
12															12
13															13
14															14
15															15
16															16
17															17
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	

BUSINESS NAME	DATE
ADDRESS CITY	PAGE _____ OF _____

SECTION II: HAZARDOUS MATERIALS INVENTORY STATEMENT

Part A — Declaration

1. Business Name: _____
2. Address: _____
3. Declaration:
   Under penalty of perjury, I declare the above and subsequent information, provided as part of the hazardous materials inventory statement, is true and correct.

Signature: _____ Date: _____

Print Name: _____ Title: _____

(Must be signed by owner/operator or designated representative)

© 2012 National Fire Protection Association NFPA 1 (p. 4 of 8)

FIGURE D.3.1 *Continued*

SECTION II: HAZARDOUS MATERIALS INVENTORY STATEMENT (Continued)

Part B—Hazardous Materials Inventory Statement

(1) Hazard Class	(2) Common/ Trade Name	(3) Chemical Name, Components, and Concentration	(4) Chemical Abstract Service No.	(5) Physical State

(6) Maximum Quantity on Hand at Any Time	(7) Units	(8) Days on Site	(9) Storage Code (Type, Pressure, Temperature)	(10) SARA Class	(11) Annual Waste Throughput

SECTION III: SEPARATION, SECONDARY CONTAINMENT, AND MONITORING

Part A—Aboveground Storage Areas

Storage Area Identification (as shown on facility map): _____

1. Storage Type:
   - _____ Original Containers
   - _____ Inside Machinery
   - _____ 55 gal (208.2 L) Drums or Storage Shed
   - _____ Pressurized Vessel
   - _____ Safety Cans
   - _____ Bulk Tanks
   - _____ Outside Barrels
   - _____ Other: _____
2. Storage Location:
   - _____ Inside Building
   - _____ Secured
   - _____ Outside Building
3. Separation:
   - _____ All Materials
   - _____ Compatible
   - _____ Separation by 20 ft (6.1 m)
   - _____ One-Hour Separation Wall/Partition
   - _____ Approved Cabinets
   - _____ Other: _____

© 2012 National Fire Protection Association NFPA 1 (p. 5 of 8)

FIGURE D.3.1 *Continued*

SECTION III: SEPARATION, SECONDARY CONTAINMENT, AND MONITORING *(Continued)*

4. Secondary Containment:
   - _____ Approved Cabinet
   - _____ Tray
   - _____ Vaulted Tank
   - _____ Double-Wall Tank
   - _____ Secondary Drums
   - _____ Bermed, Coated Floor
   - _____ Other: _____

5. Monitoring:
   - _____ Visual
   - _____ Continuous
   - _____ Other: _____

   Attach specifications if necessary

6. Monitoring Frequency:
   - _____ Daily
   - _____ Weekly
   - _____ Other: _____

   Attach additional sheets as necessary

Part B—Underground

Single-Wall Tanks and Piping

Tank Area Identification (as shown on facility map): _____

1. _____ Backfill Vapor Wells
   Model and Manufacturer: _____
   Continuous or Monthly Testing: _____
2. _____ Groundwater Monitoring Wells
3. _____ Monthly Precision Tank Test
4. _____ Piping
   Monitoring Method: _____
   Frequency: _____
5. _____ Other: _____

Double-Wall Tanks and Piping

Tank Area Identification (as shown on facility map): _____

1. Method of monitoring the annular space: _____
2. Frequency: ❑ Continuous ❑ Daily ❑ Weekly ❑ Other: _____
3. List the type of secondary containment for piping: _____
4. List method of monitoring the secondary containment for piping: _____
5. Are there incompatible materials within the same vault? ❑ Yes ❑ No
   If yes, how is separate secondary containment provided? _____

Note: If you have continuous monitoring equipment, you shall maintain copies of all service and maintenance work. Such reports shall be made available for review on site, and shall be submitted to the fire prevention bureau upon request.

Attach additional sheets as necessary

SECTION IV: WASTE DISPOSAL

- _____ Discharge to the Sanitary Sewer—
  Wastes: _____
- _____ Pretreatment—
  Wastes: _____
- _____ Licensed Waste Hauler—
  Wastes: _____
- _____ Recycle—
  Wastes: _____

© 2012 National Fire Protection Association NFPA 1 (p. 6 of 8)

FIGURE D.3.1 *Continued*

SECTION IV: WASTE DISPOSAL *(Continued)*

_____ Other —
Describe Method: _____
Wastes: _____

_____ No Waste

SECTION V: RECORD KEEPING

Description of our inspection program: _____

_____ We will use the attached sample forms in our inspection program.
_____ We will not use the sample forms. We have attached a copy of our own forms.

SECTION VI: EMERGENCY RESPONSE PLAN

1. In the event of an emergency, the following shall be notified:
   A. On-Site Responders:

Name	Title	Phone

   B. Method of Notification to Responder:
      _____ Automatic Alarm
      _____ Manual Alarm
      _____ Phone
      _____ Verbal
      _____ Other: _____
   C. Agency and Phone Number: _____
      Fire Department: _____
      State Office of Emergency: _____
      Services: _____
      Other: _____
2. Designated Local Emergency Medical Facility:

Name	Address	Phone (24 hours)

3. Mitigation Equipment:
   A. Monitoring Devices:
      _____ Toxic or Flammable Gas Detection
      _____ Fluid Detection
      _____ Other: _____
   B. Spill Containment:
      _____ Absorbents
      _____ Other: _____
   C. Spill Control and Treatment
      _____ Vapor Scrubber
      _____ Pumps/Vacuums
      _____ Neutralizer
      _____ Mechanical Ventilation
      _____ Secondary Containment
      _____ Other: _____

© 2012 National Fire Protection Association NFPA 1 (p. 7 of 8)

FIGURE D.3.1 *Continued*

SECTION VI: EMERGENCY RESPONSE PLAN *(Continued)*

4. Evacuation:
   - _____ Immediate area evacuation routes posted
   - _____ Entire building evacuation procedures developed
   - _____ Assembly areas preplanned
   - _____ Evacuation maps posted
   - _____ Other: _____

5. Supplemental hazardous materials emergency response plan on site.
   Location: _____
   Responsible Person: _____
   Phone: _____

SECTION VII: EMERGENCY RESPONSE TRAINING PLAN

1. Person responsible for the emergency response training plan:

Name	Title	Phone

2. Training Requirements:
   A. All employees trained in the following as indicated:
      - _____ Procedures for internal alarm/notification
      - _____ Procedures for notification of external emergency response organizations
      - _____ Location and content of the emergency response plan

   B. Chemical handlers are trained in the following as indicated:
      - _____ Safe methods for handling and storage of hazardous materials
      - _____ Proper use of personal protective equipment
      - _____ Locations and proper use of fire- and spill-control equipment
      - _____ Specific hazards of each chemical to which they may be exposed

   C. Emergency response team members are trained in the following:
      - _____ Procedures for shutdown of operations
      - _____ Procedures for using, maintaining, and replacing facility emergency and monitoring equipment

3. The following records are maintained for all employees:
   - _____ Verification that training was completed by the employee
   - _____ Description of the type and amount of introductory and continuing training
   - _____ Documentation on and description of emergency response drills conducted at the facility

4. A more comprehensive and detailed emergency response training plan is maintained on site.
   Location: _____
   Responsible Person: _____
   Phone: _____

© 2012 National Fire Protection Association NFPA 1 (p. 8 of 8)

FIGURE D.3.1 *Continued*

UNIT 3:
IDENTIFY AND CLASSIFY

TERMINAL OBJECTIVE

The students will be able to classify chemicals and identify hazards when used or stored within an occupancy.

ENABLING OBJECTIVES

The students will:

1. *Identify hazardous materials.*
2. *Given a case study and photos, identify the presence of hazardous materials.*
3. *Recognize the difference between a physical hazard and a health hazard.*
4. *Using the appropriate resources, place materials into the appropriate hazard classes.*
5. *Classify materials found in a given scenario.*

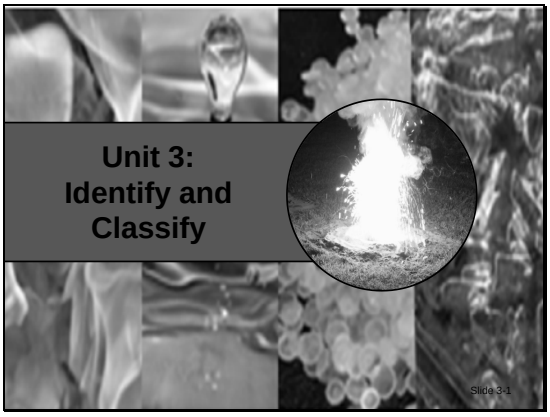
This page intentionally left blank.

NOTE-TAKING GUIDE AND ACTIVITIES

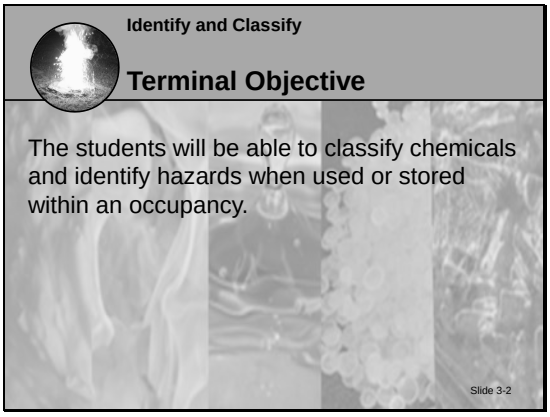
This page intentionally left blank.

NOTE-TAKING GUIDE

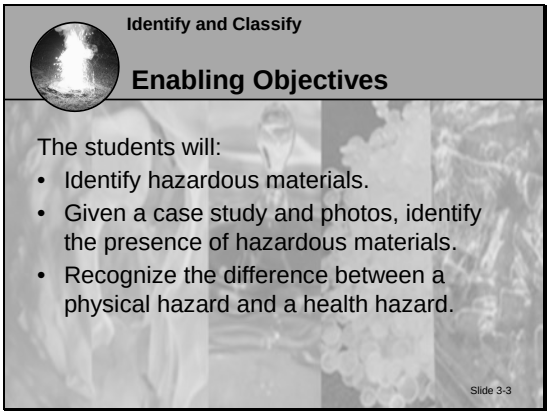
Slide 3-1



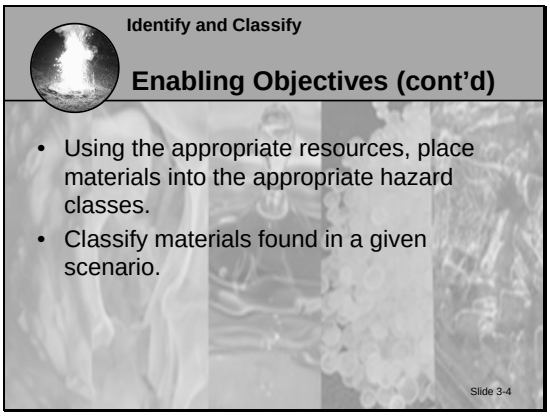
Slide 3-2



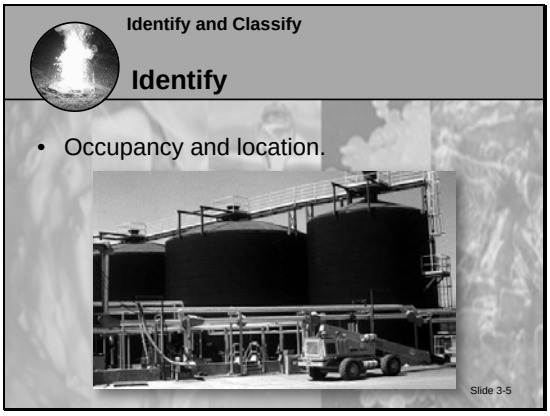
Slide 3-3



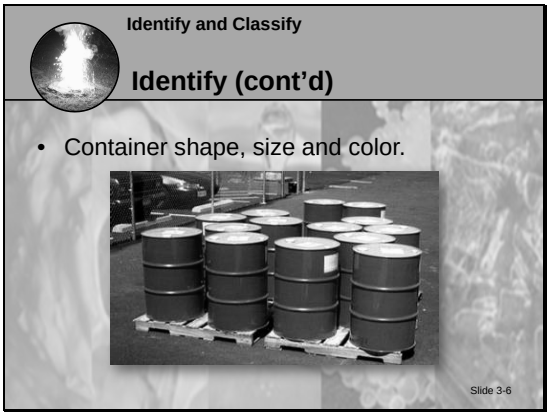
Slide 3-4



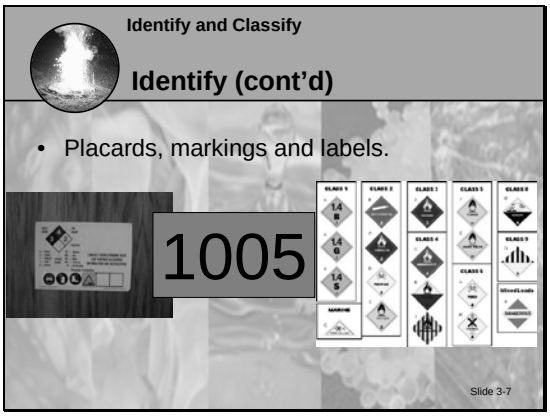
Slide 3-5



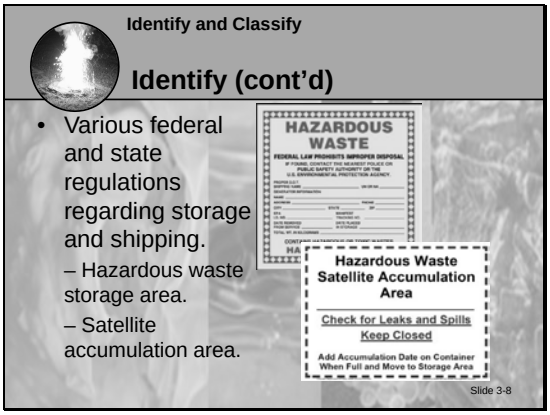
Slide 3-6



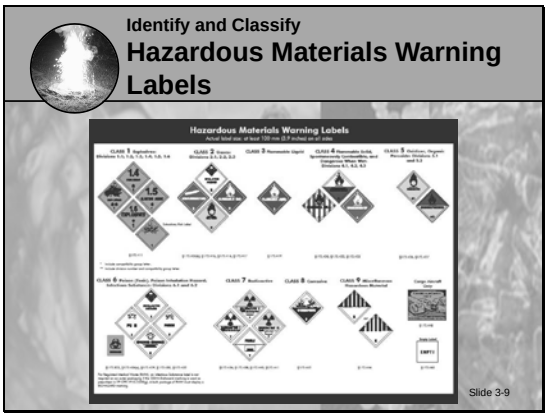
Slide 3-7



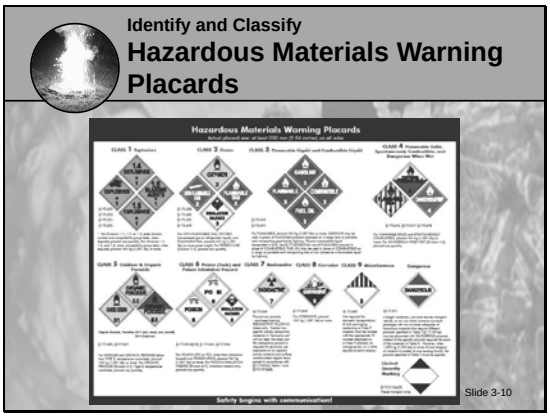
Slide 3-8



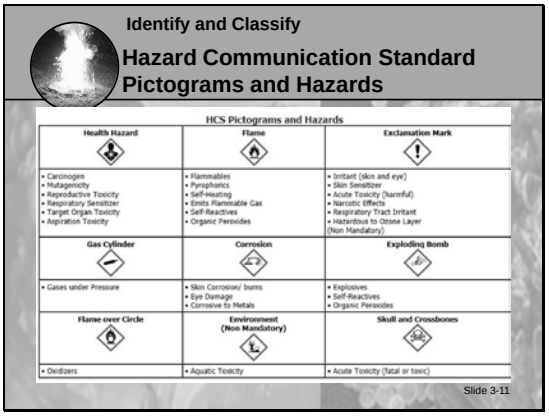
Slide 3-9



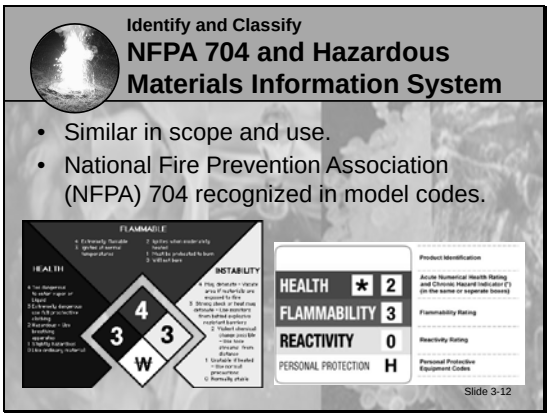
Slide 3-10



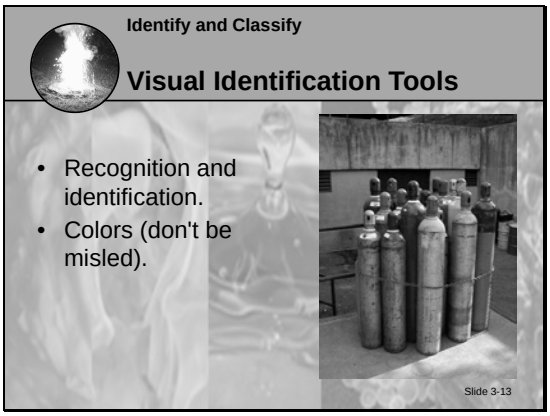
Slide 3-11



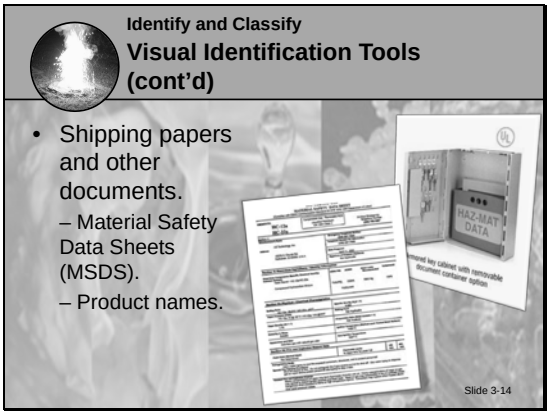
Slide 3-12



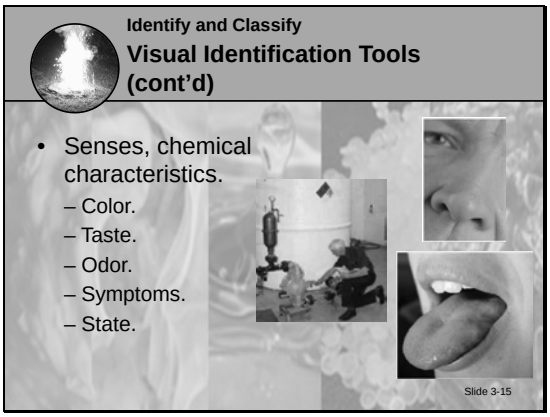
Slide 3-13



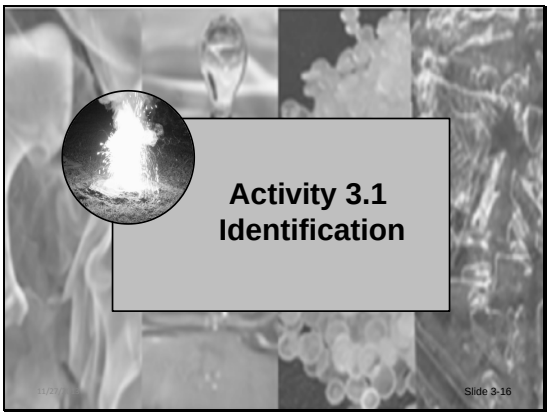
Slide 3-14



Slide 3-15



Slide 3-16



Activity 3.1

Identification

Purpose

Given a case study and photos, identify the presence of hazardous materials.

Directions

1. The instructor will show a series of slides to the entire class.

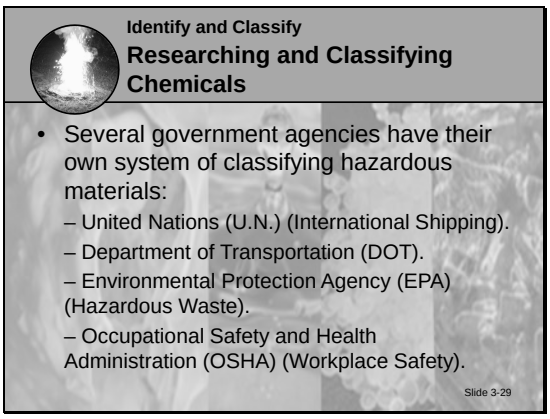
2. After each photo, you will have the opportunity to volunteer and identify the presence of hazardous materials.

3. The instructor will discuss the correct answers.

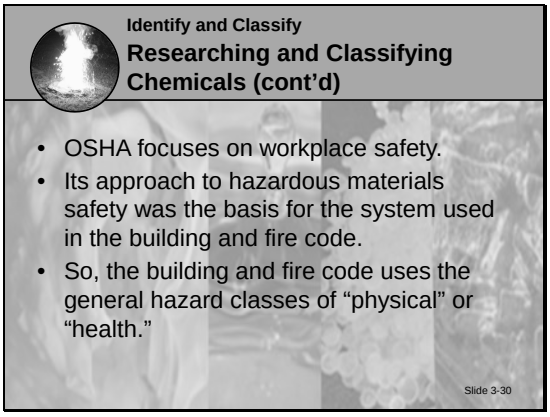
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

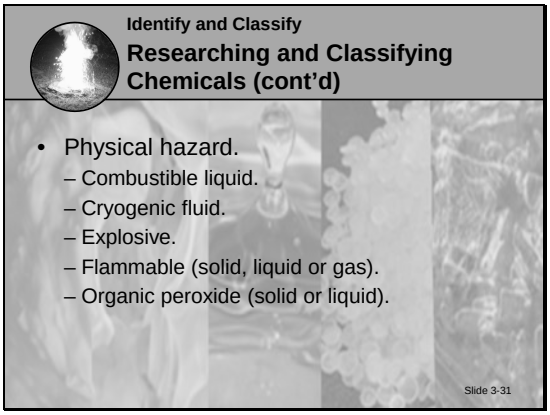
Slide 3-29



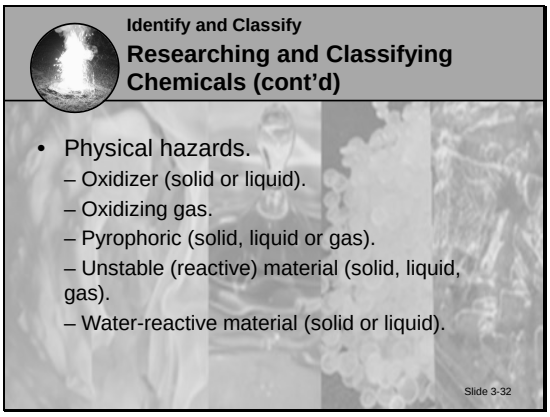
Slide 3-30



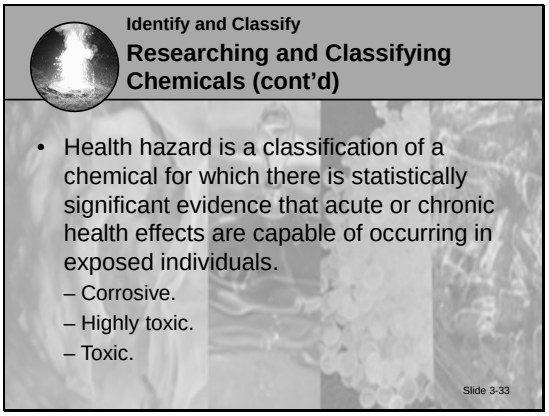
Slide 3-31



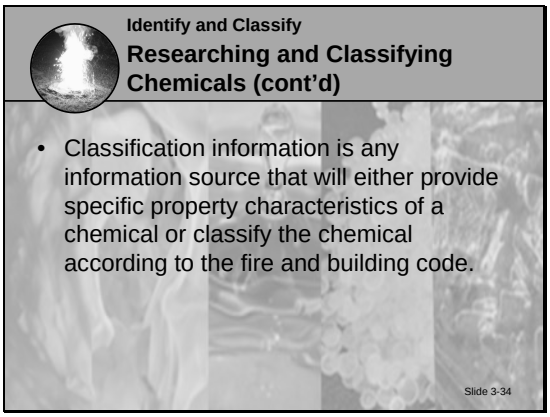
Slide 3-32



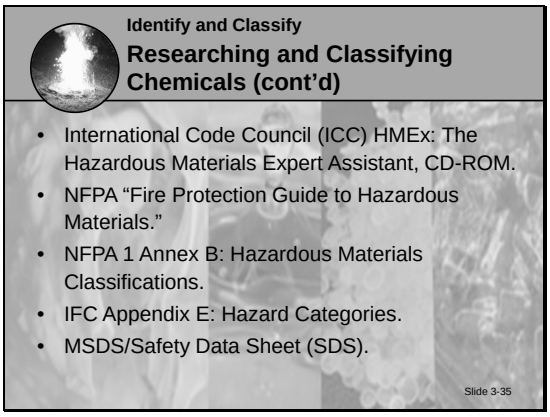
Slide 3-33



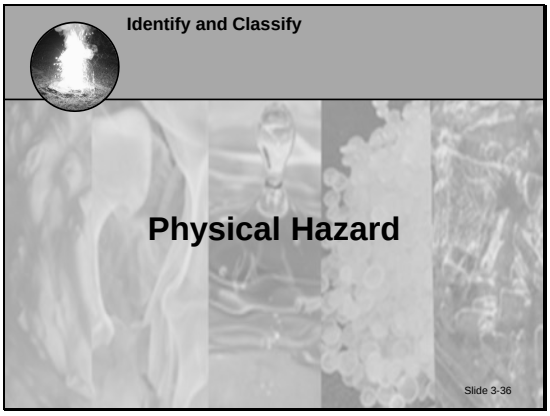
Slide 3-34



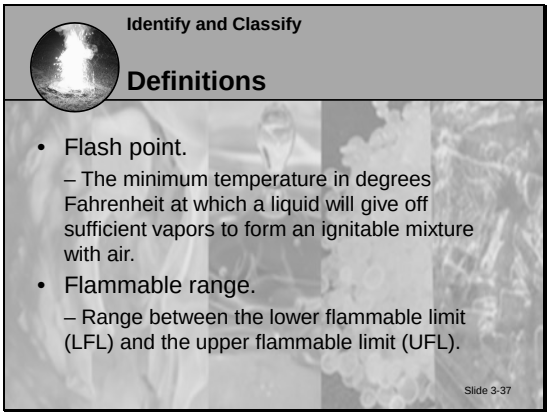
Slide 3-35



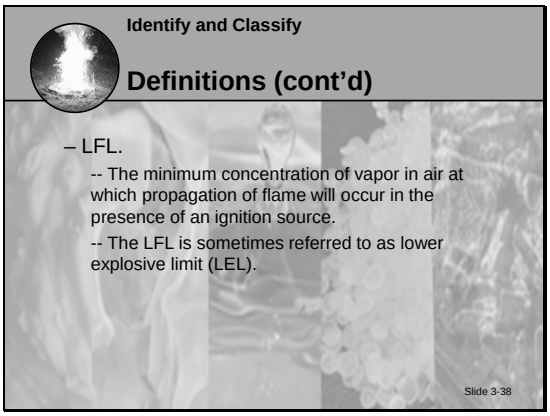
Slide 3-36



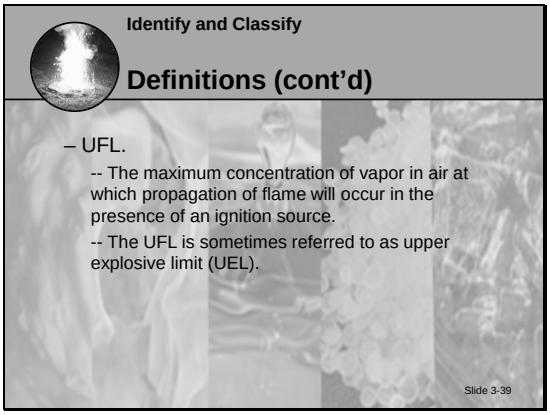
Slide 3-37



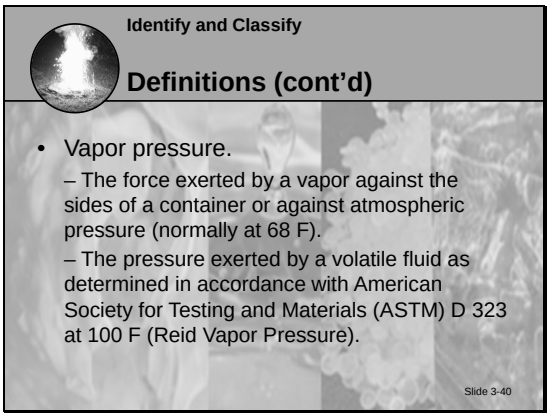
Slide 3-38



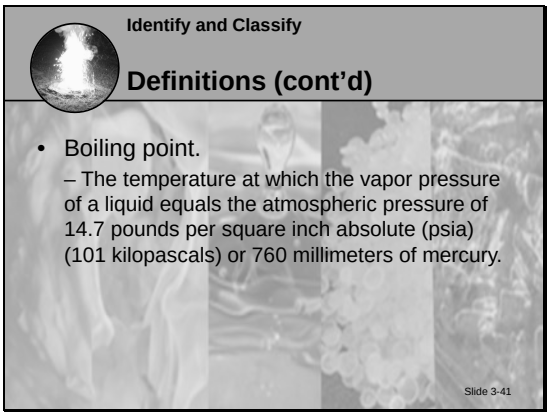
Slide 3-39



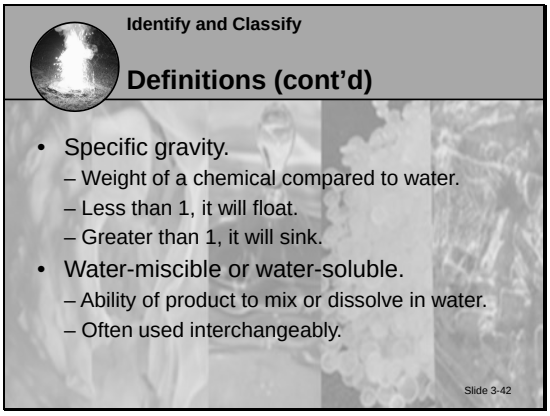
Slide 3-40



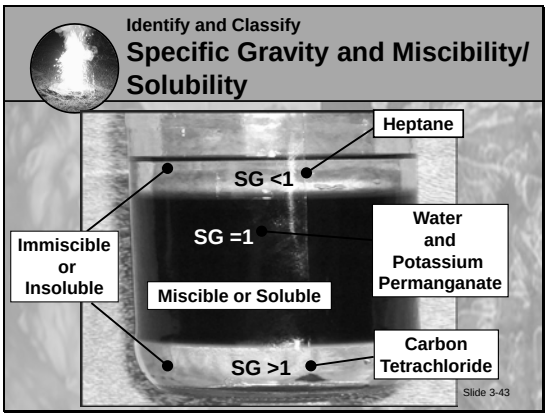
Slide 3-41



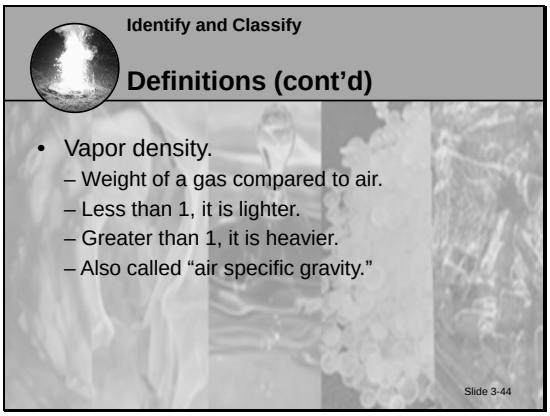
Slide 3-42



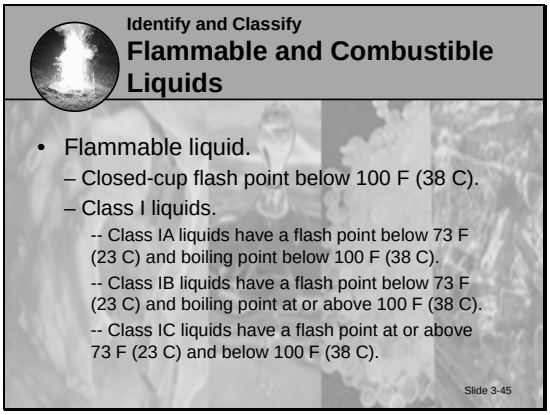
Slide 3-43



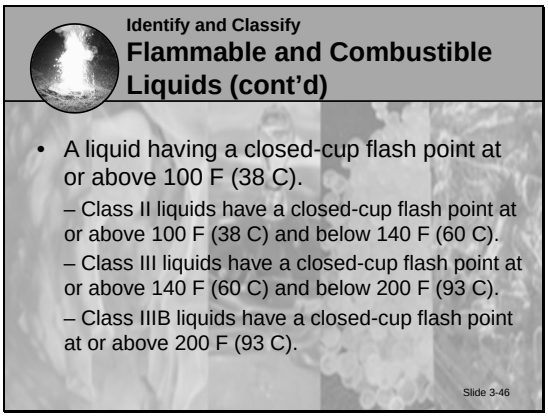
Slide 3-44



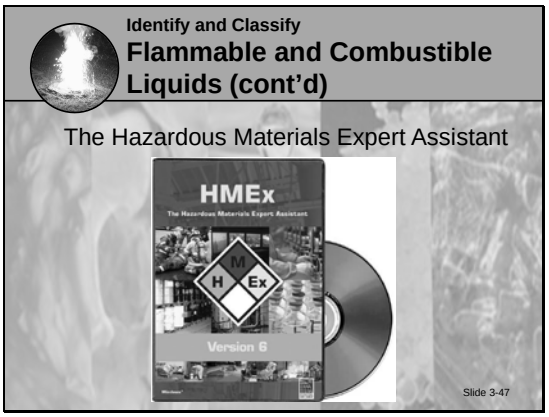
Slide 3-45



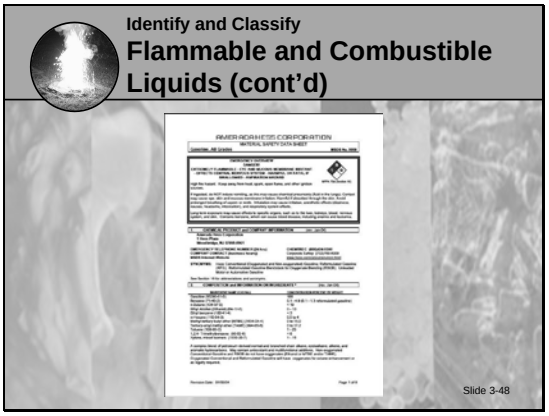
Slide 3-46



Slide 3-47



Slide 3-48



This page intentionally left blank.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

EMERGENCY OVERVIEW
DANGER!
EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD

NFPA 704 (Section 16)

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Contains benzene, which can cause blood disease, including anemia and leukemia.

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-04)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs): **CHEMTREC (800)424-9300**
COMPANY CONTACT (business hours): Corporate Safety (732)750-6000
MSDS Internet Website www.hess.com/about/environ.html

SYNONYMS: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS * (rev. Jan-04)

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Gasoline (86290-81-5)	100
Benzene (71-43-2)	0.1 - 4.9 (0.1 - 1.3 reformulated gasoline)
n-Butane (106-97-8)	< 10
Ethyl Alcohol (Ethanol) (64-17-5)	0 - 10
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Tertiary-amyl methyl ether (TAME) (994-05-8)	0 to 17.2
Toluene (108-88-3)	1 - 25
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 - 15

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol or MTBE and/or TAME). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

3. HAZARDS IDENTIFICATION (rev. Dec-97)

EYES
Moderate irritant. Contact with liquid or vapor may cause irritation.

SKIN
Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION
The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY
Contains benzene, a regulated human carcinogen. Benzene has the potential to cause anemia and other blood diseases, including leukemia, after repeated and prolonged exposure. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with systemic toxicity. See also Section 11 - Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Dec-97)

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

5. FIRE FIGHTING MEASURES (rev. Dec-97)

FLAMMABLE PROPERTIES:

FLASH POINT:	-45 °F (-43°C)
AUTOIGNITION TEMPERATURE:	highly variable; > 530 °F (>280 °C)
OSHA/NFPA FLAMMABILITY CLASS:	1A (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.4%
UPPER EXPLOSIVE LIMIT (%):	7.6%

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

During certain times of the year and/or in certain geographical locations, gasoline may contain MTBE and/or TAME. Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration - refer to NFPA 11 "Low Expansion Foam - 1994 Edition."

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Dec-97)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Dec-97)

HANDLING PRECAUTIONS

******USE ONLY AS A MOTOR FUEL******
******DO NOT SIPHON BY MOUTH******

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Jan-04)

EXPOSURE LIMITS

Component (CAS No.)	Source	TWA (ppm)	STEL (ppm)	Note
Gasoline (86290-81-5)	ACGIH	300	500	A3
Benzene (71-43-2)	OSHA	1	5	Carcinogen
	ACGIH	0.5	2.5	A1, skin
	USCG	1	5	
n-Butane (106-97-8)	ACGIH	800	–	2003 NOIC: 1000 ppm (TWA) Aliphatic Hydrocarbon Gases Alkane (C1-C4)
Ethyl Alcohol (ethanol) (64-17-5)	OSHA	1000	–	
	ACGIH	1000	–	A4
Ethyl benzene (100-41-4)	OSHA	100	–	
	ACGIH	100	125	A3

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

Component (CAS No.)	Source	TWA (ppm)	STEL (ppm)	Note
		Exposure Limits		
n-Hexane (110-54-3)	OSHA	500	–	
	ACGIH	50	–	skin
Methyl-tertiary butyl ether [MTBE] (1634-04-4)	ACGIH	50		A3
Tertiary-amyl methyl ether [TAME] (994-05-8)				None established
Toluene (108-88-3)	OSHA	200		Ceiling: 300 ppm; Peak: 500 ppm (10 min.)
	ACGIH	50	–	A4 (skin)
1,2,4- Trimethylbenzene (95-63-6)	ACGIH	25	–	
Xylene, mixed isomers (1330-20-7)	OSHA	100	–	
	ACGIH	100	150	A4

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as that made of of E.I. DuPont Tychem ®, products or equivalent is recommended based on degree of exposure.

Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Jan-04)

APPEARANCE

A translucent, straw-colored or light yellow liquid

ODOR

A strong, characteristic aromatic hydrocarbon odor. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odor and is detectable at a lower concentration than non-oxygenated gasoline.

ODOR THRESHOLD

	Odor Detection	Odor Recognition
Non-oxygenated gasoline:	0.5 - 0.6 ppm	0.8 - 1.1 ppm
Gasoline with 15% MTBE:	0.2 - 0.3 ppm	0.4 - 0.7 ppm
Gasoline with 15% TAME:	0.1 ppm	0.2 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	85 to 437 °F (39 to 200 °C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)
VAPOR DENSITY (air = 1):	AP 3 to 4
SPECIFIC GRAVITY (H_2O = 1):	0.70 – 0.78
EVAPORATION RATE:	10-11 (n-butyl acetate = 1)
PERCENT VOLATILES:	100 %

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

SOLUBILITY (H_2O): Non-oxygenated gasoline - negligible (< 0.1% @ 77 °F). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 °F); ethanol is readily soluble in water

10. STABILITY and REACTIVITY (rev. Dec-94)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Dec-97)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 5 ml/kg
Acute Oral LD50 (rat): 18.75 ml/kg
Primary dermal irritation (rabbits): slightly irritating
Draize eye irritation (rabbits): non-irritating
Guinea pig sensitization: negative

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: OSHA: NO IARC: YES - 2B NTP: NO ACGIH: YES (A3)

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

This product may contain methyl tertiary butyl ether (MTBE): animal and human health effects studies indicate that MTBE may cause eye, skin, and respiratory tract irritation, central nervous system depression and neurotoxicity. MTBE is classified as an animal carcinogen (A3) by the ACGIH.

12. ECOLOGICAL INFORMATION (rev. Jan-04)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, oxygenates such as ethers and alcohols will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. The API (www.api.org) provides a number of useful references addressing petroleum and oxygenate contamination of groundwater.

13. DISPOSAL CONSIDERATIONS (rev. Dec-97)

Consult federal, state and local waste regulations to determine appropriate disposal options.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

14. TRANSPORTATION INFORMATION (rev. Jan-04)

DOT PROPER SHIPPING NAME:	Gasoline
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1203
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

PLACARD:

15. REGULATORY INFORMATION (rev. Jan-04)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a "petroleum exclusion" clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline)
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 to 15

US EPA guidance documents (www.epa.gov/tri) for reporting Persistent Bioaccumulating Toxics (PBTs) indicate this product may contain the following deminimis levels of toxic chemicals subject to Section 313 reporting:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION - Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i) perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

Revision Date: 01/08/04 Page 7 of 8

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)
Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Jan-04)

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
HMIS® HAZARD RATING	HEALTH:	1 *	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
	* CHRONIC		

SUPERSEDES MSDS DATED: 12/30/97

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than
N/A = Not Applicable N/D = Not Determined ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212)642-4900
API	American Petroleum Institute (202)682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Workplace Hazardous Materials Information System (Canada)

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

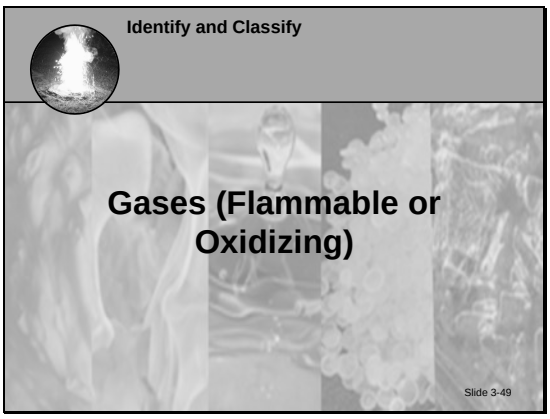
Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

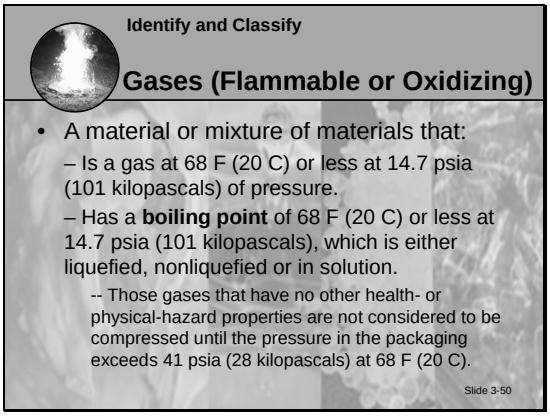
Revision Date: 01/08/04 Page 8 of 8

NOTE-TAKING GUIDE (cont'd)

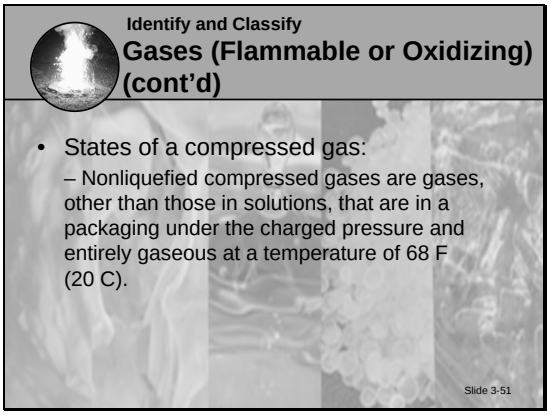
Slide 3-49



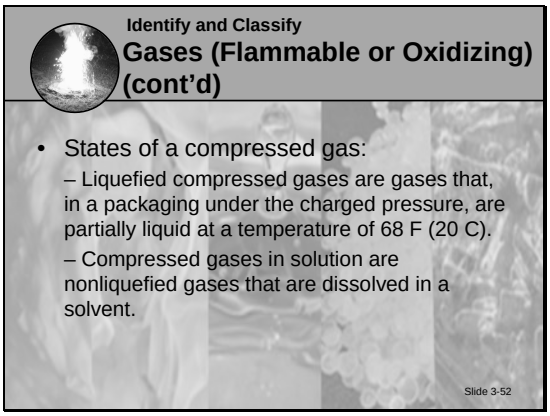
Slide 3-50



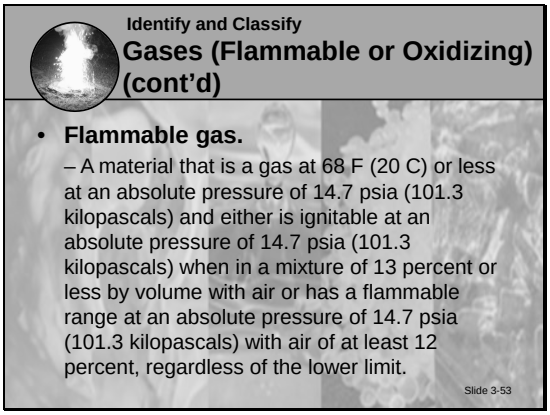
Slide 3-51



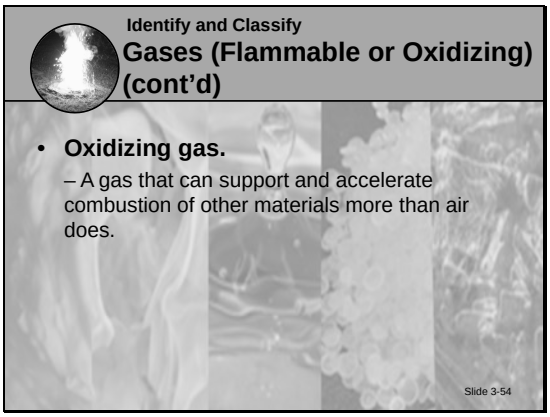
Slide 3-52



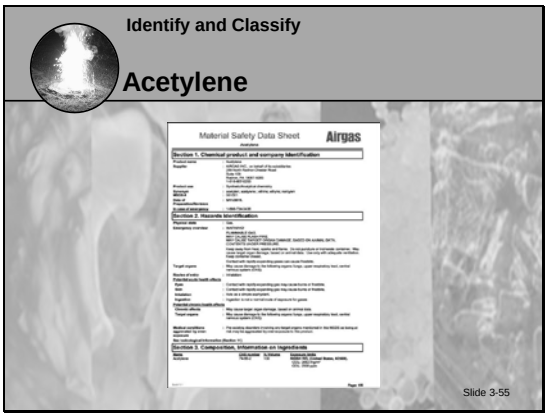
Slide 3-53



Slide 3-54



Slide 3-55


Identify and Classify
Acetylene
Material Safety Data Sheet
Airgas
Section 1. Chemical product and company identification
Section 2. Hazards identification
Section 3. Composition, information on ingredients
Slide 3-55

This page intentionally left blank.

Material Safety Data Sheet

Airgas

Acetylene

Section 1. Chemical product and company identification

Product name : Acetylene

Supplier : AIRGAS INC., on behalf of its subsidiaries
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Product use : Synthetic/Analytical chemistry.

Synonym : acetylen; acetylene ; ethine; ethyne; narcylen

MSDS # : 001001

Date of Preparation/Revision : **5/11/2011.**

In case of emergency : 1-866-734-3438

Section 2. Hazards identification

Physical state : Gas.

Emergency overview : WARNING!

FLAMMABLE GAS.
MAY CAUSE FLASH FIRE.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CONTENTS UNDER PRESSURE.

Keep away from heat, sparks and flame. Do not puncture or incinerate container. May cause target organ damage, based on animal data. Use only with adequate ventilation. Keep container closed.

Contact with rapidly expanding gases can cause frostbite.

Target organs : May cause damage to the following organs: lungs, upper respiratory tract, central nervous system (CNS).

Routes of entry : Inhalation

Potential acute health effects

Eyes : Contact with rapidly expanding gas may cause burns or frostbite.

Skin : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : Acts as a simple asphyxiant.

Ingestion : Ingestion is not a normal route of exposure for gases

Potential chronic health effects

Chronic effects : May cause target organ damage, based on animal data.

Target organs : May cause damage to the following organs: lungs, upper respiratory tract, central nervous system (CNS).

Medical conditions aggravated by over-exposure : Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (Section 11)

Section 3. Composition, Information on Ingredients

Name	CAS number	% Volume	Exposure limits
Acetylene	74-86-2	100	**NIOSH REL (United States, 6/2009).** CEIL: 2662 mg/m³ CEIL: 2500 ppm

Acetylene

Section 4. First aid measures

No action shall be taken involving any personal risk or without suitable training.If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus.It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Eye contact : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention 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. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : As this product is a gas, refer to the inhalation section.

Section 5. Fire-fighting measures

Flammability of the product : Flammable.

Auto-ignition temperature : 305°C (581°F)

Flash point : Closed cup: -18.15°C (-0.7°F).

Flammable limits : Lower: 2.5% Upper: 100%

Products of combustion : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Fire hazards in the presence of various substances : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge, heat and oxidizing materials.

Fire-fighting media and instructions : In case of fire, use water spray (fog), foam or dry chemical.

In case of fire, allow gas to burn if flow cannot be shut off immediately. Apply water from a safe distance to cool container and protect surrounding area. If involved in fire, shut off flow immediately if it can be done without risk.

Contains gas under pressure. Flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions : Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment (section 8). Shut off gas supply if this can be done safely. Isolate area until gas has dispersed.

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Acetylene

Section 7. Handling and storage

Handling : Use only with adequate ventilation. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. High pressure gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Keep container closed. Keep away from heat, sparks and flame. To avoid fire, eliminate ignition sources. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Storage : Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Segregate from oxidizing materials. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Personal protection

Eyes : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

The applicable standards are (US) 29 CFR 1910.134 and (Canada) Z94.4-93

Hands : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Personal protection in case of a large spill : Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product.

Product name

Ethyne	**NIOSH REL (United States, 6/2009).** CEIL: 2662 mg/m³ CEIL: 2500 ppm

Consult local authorities for acceptable exposure limits.

Section 9. Physical and chemical properties

Molecular weight : 26.04 g/mole

Molecular formula : C2-H2

Melting/freezing point : Sublimation temperature: -81.8°C (-115.2 to °F)

Critical temperature : 35.3°C (95.5°F)

Vapor pressure : 635 (psig)

Vapor density : 0.907 (Air = 1)

Specific Volume (ft ^{3}/lb) : 14.7058

Gas Density (lb/ft ^{3}) : 0.0691 (-80°C / -112 to °F)

Acetylene

Section 10. Stability and reactivity

Stability and reactivity : The product is stable.

Incompatibility with various substances : Extremely reactive or incompatible with the following materials: oxidizing materials.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Toxicity data

Chronic effects on humans : May cause damage to the following organs: lungs, upper respiratory tract, central nervous system (CNS).

Other toxic effects on humans : No specific information is available in our database regarding the other toxic effects of this material to humans.

Specific effects

Carcinogenic effects : No known significant effects or critical hazards.

Mutagenic effects : No known significant effects or critical hazards.

Reproduction toxicity : No known significant effects or critical hazards.

Section 12. Ecological information

Aquatic ecotoxicity

Not available.

Products of degradation : Products of degradation: carbon oxides (CO, CO_2) and water.

Environmental fate : Not available.

Environmental hazards : This product shows a low bioaccumulation potential.

Toxicity to the environment : Not available.

Section 13. Disposal considerations

Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, local regulation.Return cylinders with residual product to Airgas, Inc.Do not dispose of locally.

Section 14. Transport information

Regulatory information	UN number	Proper shipping name	Class	Packing group	Label	Additional information
DOT Classification	UN1001	ACETYLENE, DISSOLVED	2.1	Not applicable (gas).		**Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: 15 kg

Acetylene						
TDG Classification	UN1001	ACETYLENE, DISSOLVED	2.1	Not applicable (gas).		**Explosive Limit and Limited Quantity Index** 0 **Passenger Carrying Ship Index** 75 **Passenger Carrying Road or Rail Index** Forbidden **Special provisions** 38, 42
Mexico Classification	UN1001	ACETYLENE, DISSOLVED	2.1	Not applicable (gas).		-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 15. Regulatory information

United States

U.S. Federal regulations : **TSCA 8(a) IUR**: Partial exemption
United States inventory (TSCA 8b): This material is listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: Ethyne
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: Ethyne: Fire hazard, reactive, Sudden release of pressure, Immediate (acute) health hazard

Clean Air Act (CAA) 112 accidental release prevention - Flammable Substances: Acetylene

Clean Air Act (CAA) 112 regulated flammable substances: Ethyne

State regulations : **Connecticut Carcinogen Reporting**: This material is not listed.
Connecticut Hazardous Material Survey: This material is not listed.
Florida substances: This material is not listed.
Illinois Chemical Safety Act: This material is not listed.
Illinois Toxic Substances Disclosure to Employee Act: This material is not listed.
Louisiana Reporting: This material is not listed.
Louisiana Spill: This material is not listed.
Massachusetts Spill: This material is not listed.
Massachusetts Substances: This material is listed.
Michigan Critical Material: This material is not listed.
Minnesota Hazardous Substances: This material is not listed.
New Jersey Hazardous Substances: This material is listed.
New Jersey Spill: This material is not listed.
New Jersey Toxic Catastrophe Prevention Act: This material is not listed.
New York Acutely Hazardous Substances: This material is not listed.
New York Toxic Chemical Release Reporting: This material is not listed.
Pennsylvania RTK Hazardous Substances: This material is listed.

Acetylene

Rhode Island Hazardous Substances: This material is not listed.

Canada

WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.
Class F: Dangerously reactive material.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

United States

Label requirements : FLAMMABLE GAS.
MAY CAUSE FLASH FIRE.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CONTENTS UNDER PRESSURE.

Canada

Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.
Class F: Dangerously reactive material.

Hazardous Material Information System (U.S.A.) :

Health	*	1
Flammability		4
Physical hazards		2

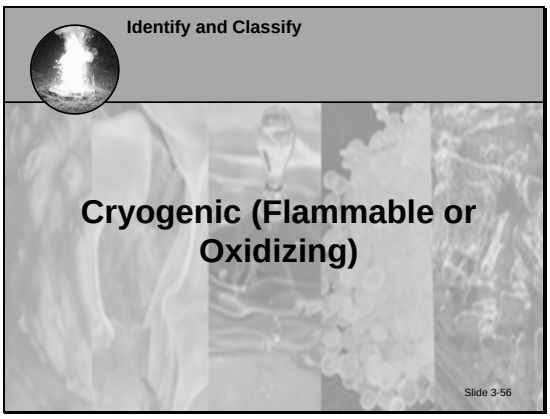
National Fire Protection Association (U.S.A.) :

Notice to reader

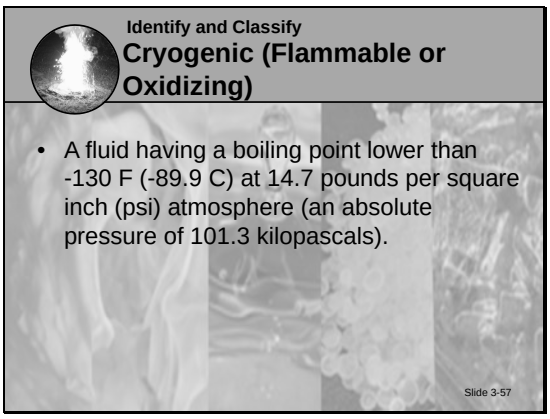
To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

NOTE-TAKING GUIDE (cont'd)

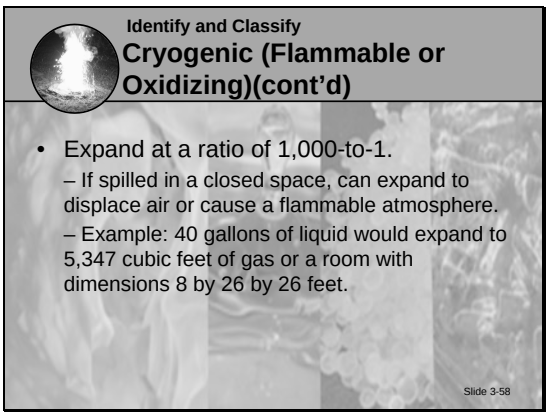
Slide 3-56



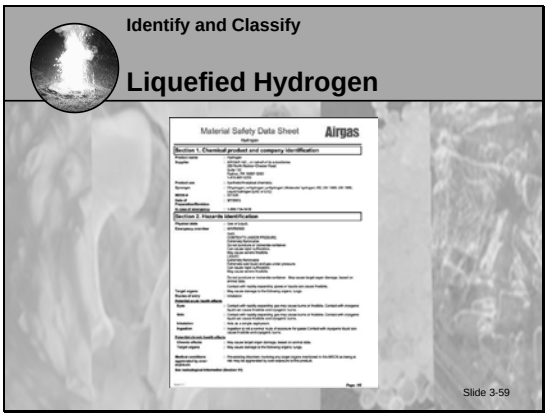
Slide 3-57



Slide 3-58



Slide 3-59


Identify and Classify
Liquefied Hydrogen
Material Safety Data Sheet
Airgas
Slide 3-59

Material Safety Data Sheet

Airgas

Hydrogen

Section 1. Chemical product and company identification

Product name : Hydrogen

Supplier : AIRGAS INC., on behalf of its subsidiaries
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Product use : Synthetic/Analytical chemistry.

Synonym : Dihydrogen; o-Hydrogen; p-Hydrogen; Molecular hydrogen; H2; UN 1049; UN 1966; Liquid hydrogen (LH2 or LH2)

MSDS # : 001026

Date of Preparation/Revision : **3/7/2013.**

In case of emergency : 1-866-734-3438

Section 2. Hazards identification

Physical state : Gas or Liquid.

Emergency overview : WARNING!

GAS:
CONTENTS UNDER PRESURE.
Extremely flammable
Do not puncture or incinerate container.
Can cause rapid suffocation.
May cause severe frostbite.
LIQUID:
Extremely flammable
Extremely cold liquid and gas under pressure.
Can cause rapid suffocation.
May cause severe frostbite.

Do not puncture or incinerate container. May cause target organ damage, based on animal data.

Contact with rapidly expanding gases or liquids can cause frostbite.

Target organs : May cause damage to the following organs: lungs.

Routes of entry : Inhalation

Potential acute health effects

Eyes : Contact with rapidly expanding gas may cause burns or frostbite. Contact with cryogenic liquid can cause frostbite and cryogenic burns.

Skin : Contact with rapidly expanding gas may cause burns or frostbite. Contact with cryogenic liquid can cause frostbite and cryogenic burns.

Inhalation : Acts as a simple asphyxiant.

Ingestion : Ingestion is not a normal route of exposure for gases Contact with cryogenic liquid can cause frostbite and cryogenic burns.

Potential chronic health effects

Chronic effects : May cause target organ damage, based on animal data.

Target organs : May cause damage to the following organs: lungs.

Medical conditions aggravated by over-exposure : Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (Section 11)

Build 1.1

Page: 1/6

Hydrogen

Section 3. Composition, Information on Ingredients

Name	CAS number	% Volume	Exposure limits
Hydrogen	1333-74-0	100	Oxygen Depletion [Asphyxiant]

Section 4. First aid measures

No action shall be taken involving any personal risk or without suitable training.If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus.It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Eye contact : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention 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. Clean shoes thoroughly before reuse. Get medical attention immediately.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : As this product is a gas, refer to the inhalation section.

Section 5. Fire-fighting measures

Flammability of the product : Flammable.

Auto-ignition temperature : 500 to 571°C (932 to 1059.8°F)

Flammable limits : Lower: 4% Upper: 76%

Products of combustion : No specific data.

Fire hazards in the presence of various substances : Extremely flammable in the presence of the following materials or conditions: oxidizing materials.

Fire-fighting media and instructions : Use an extinguishing agent suitable for the surrounding fire.

Apply water from a safe distance to cool container and protect surrounding area. If involved in fire, shut off flow immediately if it can be done without risk.

Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions : Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment (section 8). Shut off gas supply if this can be done safely. Isolate area until gas has dispersed.

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up : Immediately contact emergency personnel. Stop leak if without risk. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Section 7. Handling and storage

Handling : High pressure gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Never allow any unprotected part of the body to touch uninsulated pipes or vessels that contain cryogenic liquids. Prevent entrapment of liquid in closed systems or piping without pressure relief devices. Some materials may become brittle at low temperatures and will easily fracture.

Build 1.1 *Page: 2/6*

Hydrogen

Storage : Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).
For additional information concerning storage and handling refer to Compressed Gas Association pamphlets P-1 Safe Handling of Compressed Gases in Containers and P-12 Safe Handling of Cryogenic Liquids available from the Compressed Gas Association, Inc.

Section 8. Exposure controls/personal protection

Engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Personal protection

Eyes : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

When working with cryogenic liquids, wear a full face shield.

Skin : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

The applicable standards are (US) 29 CFR 1910.134 and (Canada) Z94.4-93

Hands : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Insulated gloves suitable for low temperatures

Personal protection in case of a large spill : Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product.

Product name

hydrogen	Oxygen Depletion [Asphyxiant]

Consult local authorities for acceptable exposure limits.

Section 9. Physical and chemical properties

Molecular weight : 2.02 g/mole

Molecular formula : H_2

Boiling/condensation point : -253°C (-423.4°F)

Melting/freezing point : -259.15°C (-434.5°F)

Critical temperature : -240.15°C (-400.3°F)

Vapor density : 0.07 (Air = 1) Liquid Density@BP: 4.43 lb/ft3 (70.96 kg/m3)

Specific Volume (ft^3/lb) : 191.9386

Gas Density (lb/ft^3) : 0.00521

Section 10. Stability and reactivity

Stability and reactivity : The product is stable.

Incompatibility with various substances : Extremely reactive or incompatible with the following materials: oxidizing materials.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Hydrogen

Section 11. Toxicological information

Toxicity data

Chronic effects on humans : May cause damage to the following organs: lungs.

Other toxic effects on humans : No specific information is available in our database regarding the other toxic effects of this material to humans.

Specific effects

Carcinogenic effects : No known significant effects or critical hazards.

Mutagenic effects : No known significant effects or critical hazards.

Reproduction toxicity : No known significant effects or critical hazards.

Section 12. Ecological information

Aquatic ecotoxicity

Not available.

Environmental fate : Not available.

Environmental hazards : No known significant effects or critical hazards.

Toxicity to the environment : Not available.

Section 13. Disposal considerations

Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, local regulation.Return cylinders with residual product to Airgas, Inc.Do not dispose of locally.

Section 14. Transport information

Regulatory information	UN number	Proper shipping name	Class	Packing group	Label	Additional information
DOT Classification	UN1049 UN1966	HYDROGEN, COMPRESSED Hydrogen, refrigerated liquid	2.1	Not applicable (gas).		**Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: 150 kg
TDG Classification	UN1049 UN1966	HYDROGEN, COMPRESSED Hydrogen, refrigerated liquid	2.1	Not applicable (gas).		**Explosive Limit and Limited Quantity Index** 0.125 **ERAP Index** 3000 **Passenger Carrying Ship Index** Forbidden

Build 1.1

Page: 4/6

Hydrogen

						Passenger Carrying Road or Rail Index Forbidden
Mexico Classification	UN1049 UN1966	HYDROGEN, COMPRESSED Hydrogen, refrigerated liquid	2.1	Not applicable (gas).		-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 15. Regulatory information

United States

U.S. Federal regulations : **TSCA 8(a) IUR**: This material is listed or exempted.
United States Inventory (TSCA 8b): This material is listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: hydrogen
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: hydrogen: Fire hazard, Sudden release of pressure

Clean Air Act (CAA) 112 accidental release prevention - Flammable Substances: Hydrogen

Clean Air Act (CAA) 112 regulated flammable substances: hydrogen

State regulations : **Connecticut Carcinogen Reporting**: This material is not listed.
Connecticut Hazardous Material Survey: This material is not listed.
Florida substances: This material is not listed.
Illinois Chemical Safety Act: This material is not listed.
Illinois Toxic Substances Disclosure to Employee Act: This material is not listed.
Louisiana Reporting: This material is not listed.
Louisiana Spill: This material is not listed.
Massachusetts Spill: This material is not listed.
Massachusetts Substances: This material is listed.
Michigan Critical Material: This material is not listed.
Minnesota Hazardous Substances: This material is not listed.
New Jersey Hazardous Substances: This material is listed.
New Jersey Spill: This material is not listed.
New Jersey Toxic Catastrophe Prevention Act: This material is not listed.
New York Acutely Hazardous Substances: This material is not listed.
New York Toxic Chemical Release Reporting: This material is not listed.
Pennsylvania RTK Hazardous Substances: This material is listed.
Rhode Island Hazardous Substances: This material is not listed.

Canada

WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is not listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Build 1.1 *Page: 5/6*

Hydrogen

Section 16. Other information

United States

Label requirements : GAS:
CONTENTS UNDER PRESURE.
Extremely flammable
Do not puncture or incinerate container.
Can cause rapid suffocation.
May cause severe frostbite.
LIQUID:
Extremely flammable
Extremely cold liquid and gas under pressure.
Can cause rapid suffocation.
May cause severe frostbite.

Canada

Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.) :

Health	0
Flammability	4
Physical hazards	0

liquid:

Health	3
Fire hazard	4
Reactivity	0
Personal protection	

National Fire Protection Association (U.S.A.) :

liquid:

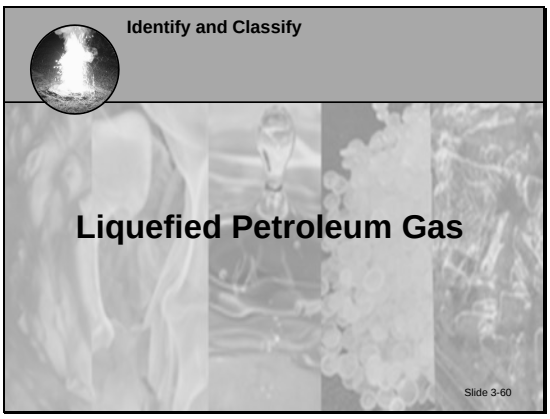
Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

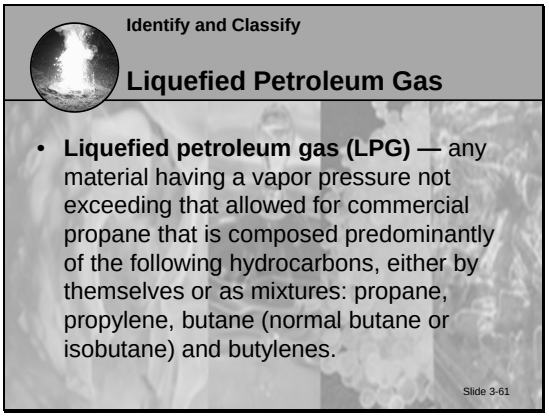
Build 1.1 *Page: 6/6*

NOTE-TAKING GUIDE (cont'd)

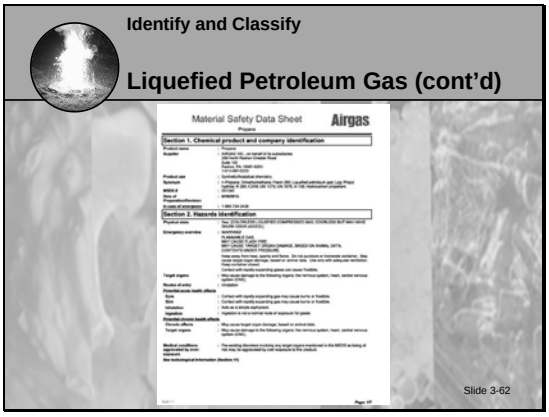
Slide 3-60



Slide 3-61



Slide 3-62



This page intentionally left blank.

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

MATERIAL SAFETY DATA SHEET
LIQUIFIED PETROLEUM GAS

IDENTIFICATION:

Chemical Name: Liquid Petroleum Gas
Synonyms: LPG
UN Number: 1075
Use: Heating, and cutting gas.

HAZARDS IDENTIFICATION:

Dangerous Goods Class and Subsidiary Risk: 2.1

HSNO Classification: 2.1.1A

Hazard Statement:
Extremely flammable gas.
Explosive, fire, blast or projectile hazard.

Precautionary Statements:
Read label before use.
Read Safety Data Sheet before use.
Protect from heat, sparks, open flames, hot surfaces and all other ignition sources
No Smoking
Store in a well-ventilated place.
Wear protective gloves and eye protection.

Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
Eliminate all ignition sources if safe to do so.
Store in a well-ventilated place.
Do not subject to any rough handling (grinding/shock/friction/banging).

Prepared By:	MAM	Document Number:	MSDS 030	Number of Copies	1
Authorised By:	WJM	Issue Date:	30/01/2012	File Location:	MASTER FILE
Reason for Amendment:	AMENDMENT	Revision Number:	REV 001	Page Number:	1

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

Explosion risk in case of fire.
Fight fire with normal precautions from a reasonable distance.
Take precautionary measures against static discharges.
Wear Protective Gloves and Eye protection.

COMPOSITION / INGREDIENTS:

Chemical Entity	CAS Number	Proportion
Liquefied Petroleum Gas	68476-85-7	100%

Contains no other components or impurities that will influence the classification of the product.

FIRST AID MEASURES:

Health Effects
Swallowed: Not applicable due to high evaporation rate.
Eye: Moderate irritation from vapour. Irritation and possible freezing if liquid enters the eye.
Skin: Liquid can cause irritation and frostburn if in contact with skin.
Inhaled: May cause irritation to respiratory tract. Moderate exposure may cause headaches or dizziness.

Elevated exposure may cause unconsciousness and respiratory arrest.

By diluting the oxygen concentration in air below the level necessary to support life; it can act as an asphyxiant.

Effects of oxygen deficiency are:
16%: breathing and pulse rate increased, impaired thinking and attention, reduced coordination;

14%: Abnormal fatigue upon exertion, emotional upset, faulty coordination, poor judgement;

12.5%: Very poor judgement and coordination, impaired respiration that can cause permanent hearing damage, nausea and vomiting;

below 10%: Inability to perform various movements, loss of consciousness, convulsions, and death.

Prepared By:	MAM	Document Number:	MSDS 030	Number of Copies	1
Authorised By:	WJM	Issue Date:	30/01/2012	File Location:	MASTER FILE
Reason for Amendment:	AMENDMENT	Revision Number:	REV 001	Page Number:	2

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

Chronic:
Long term exposure to LPG has no known health effects.
Prolonged exposure to an oxygen deficient atmosphere (below 19% oxygen in air) may affect the heart and nervous system.

First Aid:
Inhalation:
In high concentrations may cause asphyxiation. Symptoms may include loss of mobility/consciousness.
Remove victim to uncontaminated area whilst wearing self-contained breathing apparatus.
Victim may not be aware of asphyxiation.
Keep victim warm and rested.
Call a doctor.
Apply artificial respiration if breathing stopped.

Advice to Doctor:
Advise doctor that victim has been exposed to an oxygen deficient atmosphere.

General:
Rescuers should not enter an oxygen deficient atmosphere without using self-contained full face positive pressure breathing equipment.
Rescue personnel should be aware of extreme fire hazard associated with L.P.G. rich atmospheres.

FIRE FIGHTING MEASURES:

Flammability:
Highly flammable gas at normal pressure and temperatures.

Fire/Explosion Hazard:
Liquid Petroleum Gas is a highly flammable gas.
Exposure to fire my cause container to rupture/explode.
Cylinders involved in a fire/explosion may rocket.
Move cylinders from vicinity of fire if safe to do so.
Cool cylinders by spraying flooding quantities of water from a protected location.
If unable to keep cylinders cool, evacuate area, minimum distance 200 meters.
Do not extinguish a leaking gas flame unless absolutely necessary.
Spontaneous/explosive re-ignition may occur.
Extinguish any other fire.

Extinguishing Media:

Prepared By:	MAM	Document Number:	MSDS 030	Number of Copies	1
Authorised By:	WJM	Issue Date:	30/01/2012	File Location:	MASTER FILE
Reason for Amendment:	AMENDMENT	Revision Number:	REV 001	Page Number:	3

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

Water, Fog or Fine water spray

Hazchem Code: 2 YE

Recommended Protective Clothing:
Full chemical suit and breathing apparatus should be worn

ACCIDENTAL RELEASE MEASURES:

Personal Protection:
Personnel engaged in the movement of cylinders shall be provided with safety footwear, safety glasses and leather or PVC gloves.
Full cover overalls are recommended. In areas where equipment failure may cause an immediate high concentration of LPG, ensure adequate ventilation and have approved self-contained, full face respiratory equipment readily available for emergencies.

Spills and Disposal:
Ventilate area. Stop leak if it can be done without risk. Allow gas to dissipate to atmosphere. Prevent from entering sewers, basements and work pits, or any place where its accumulation can be dangerous.

Reference Guide:
Standard SNZ HB 76:2008 Dangerous Goods – Initial Emergency Response Guide.
AS/NZS 1337 – Eye Protection for Industrial Applications
AS/NZS 2161.1 – Occupational Protective Gloves – Selection, use and maintenance
AS/NZS 1715 – Selection, Use and Maintenance of Respiratory Protective Devices
AS/NZS 1716 – Respiratory Protective Devices

General:
Only experienced and properly instructed personnel should handle compressed gases. Open valve slowly to avoid pressure shock. Cylinder contents and identification labels provided by the supplier must not be removed or defaced. Colour coding should not be the only criterion used for content identification.

HANDLING AND STORAGE:

Prepared By:	MAM	Document Number:	MSDS 030	Number of Copies	1
Authorised By:	WJM	Issue Date:	30/01/2012	File Location:	MASTER FILE
Reason for Amendment:	AMENDMENT	Revision Number:	REV 001	Page Number:	4

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

Handling:
Flammability:
Highly flammable at normal temperatures and pressures.

General:
Only experienced and properly instructed personnel should handle compressed gases. Open valve slowly to avoid pressure shock. Cylinder contents and identification labels provided by the supplier must not be removed or defaced. Colour coding should not be the only criterion used for content identification.

Approved Handlers:
Approved handlers are required if more than 100 m3 is stored on site.

Storage:
Storage of compressed gas cylinders shall be in compliance with New Zealand HSNO Regulations.

Cylinders will be kept away from ignition sources (including static discharges).

Cylinders shall be stored in a cool, dry, well-ventilated area out of direct sunlight and away from heat and ignition sources.

No part of cylinders shall be exposed to temperatures above 50°C.

Cylinders shall be stored upright on a level, fireproof floor, secured in position and protected from damage.

Full cylinders shall be stored separately from empties.

Cylinders should be moved by hand-truck or cart designed for that purpose.

Separation:
Avoid any contact with oil or grease particularly to the cylinder valve.
Keep liquid petroleum gas cylinders a minimum of 5 meters away from ignition sources and from incompatible materials (e.g. HSNO classes 1, 3, 4 and 5).

Keep liquid petroleum gas cylinders a minimum of 5 meters away from edge of the controlled zone.

Prepared By:	MAM	Document Number:	MSDS 030	Number of Copies	1
Authorised By:	WJM	Issue Date:	30/01/2012	File Location:	MASTER FILE
Reason for Amendment:	AMENDMENT	Revision Number:	REV 001	Page Number:	5

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

A controlled zone is an area surrounding a hazardous substance location, beyond the controlled zone members of the public are provided with reasonable protection from adverse events.

Spills and Disposal:
Ventilate area. Stop leak if it can be done without risk. Allow gas to dissipate to atmosphere. Prevent from entering sewers, basements and work pits, or any place where its accumulation can be dangerous.

EXPOSURE CONTROLS / PERSONAL PROTECTION:

Exposure Standards:
TWA 1000 ppm v/v STEL - Not applicable

Engineering Controls:
Provide ventilation to area of use to prevent accumulation of L.P.G. at flammable concentrations.
Provide adequate local exhaust and dilution (general) ventilation and supply sufficient replacement air to maintain oxygen concentration above 19%.

Personal Protection:
Personnel engaged in the movement of cylinders shall be provided with safety footwear, safety glasses and leather or PVC gloves.
Full cover overalls are recommended. In areas where equipment failure may cause an immediate high concentration of LPG ensure adequate ventilation and have approved self-contained, full face respiratory equipment readily available for emergencies.

Reference Guide:
AS/NZS 1337 – Eye Protection for Industrial Applications
AS/NZS 2161.1 – Occupational Protective Gloves – Selection, use and maintenance
AS/NZS 1715 – Selection, Use and Maintenance of Respiratory Protective Devices
AS/NZS 1716 – Respiratory Protective Devices

PHYSICAL AND CHEMICAL PROPERTIES:

Physical Properties
Appearance: Colourless, Odourless gas at room temperature. To detect gas leak, an odorant is added to the gas for early detection.

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

Flashpoint: -104 - 60°C

Boiling Point: -42°C

Flammability Limits: (In air) 1.8 – 9.5%

Vapour Pressure: Not Applicable

Solubility in Water : Not Applicable

Other Properties
Relative Density: (Air = 1): 1.47 – 2.08
Density of Gas: (101.3 kPa, 15°C): 1.80 - 2.55 kg/m3
Molecular Weight: 42 - 58
Critical Temperature: Not Applicable

STABILITY AND REACTIVITY:

Flammability:
Extremely flammable gas .

Materials Compatibility:
LPG is compatible with most common component materials.

However LPG is not combatable with Butyl (isobutene - isoprene) rubber (IIR), Silicon (Q), Chloroprene (CR),

Ethylene - Propylene (EPDM) and hydrocarbon based lubricants.

TOXICOLOGY INFORMATION:

LPG may cause irritation to respiratory tract. Moderate exposure may cause headaches or dizziness.

ECOLOGICAL INFORMATION:

No known ecological damage is caused by this product.

Prepared By:	MAM	Document Number:	MSDS 030	Number of Copies	1
Authorised By:	WJM	Issue Date:	30/01/2012	File Location:	MASTER FILE
Reason for Amendment:	AMENDMENT	Revision Number:	REV 001	Page Number:	7

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

DISPOSAL CONSIDERATIONS:

Do not discharge into areas where there is a risk of forming an explosive mixture with air.

Waste gas should be flared through a suitable burner with flash back arrestor.

Do not discharge into any place where its accumulation could be dangerous.

TRANSPORT INFORMATION:

UN Number: 1075
Proper Shipping Name: LIQUIEFIED PETROLEUM GAS
Dangerous Goods Class and Subsidiary Risk: 2.1
Packing Group: Not applicable
Hazchem Code: 2 YE

Other Information:
Avoid transport on vehicles where the load is not separated from the driver's compartment.
Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.

Before transporting product containers:
Ensure that containers are firmly secured and upright (**Do not transport Acetylene cylinders laying down)**
Ensure cylinder valve is closed and not leaking.
Ensure there is adequate ventilation.
Compliance with applicable regulations.

REGULATORY INFORMATION:

Environmental Protection Agency Register Approval No: HSR001009

HSNO Controls:
Hazardous Substances (Classes 1 to 5 Controls) Regulations 2001.
Hazardous Substances (Disposal) Regulations 2001.
Hazardous Substances (Personnel Qualifications) Regulations 2001.
Hazardous Substances (Emergency Management) Regulations 2001.
Hazardous Substances (Identification) Regulations 2001.
Hazardous Substances (Compressed Gases) Regulations 2004.

Prepared By:	MAM	Document Number:	MSDS 030	Number of Copies	1
Authorised By:	WJM	Issue Date:	30/01/2012	File Location:	MASTER FILE
Reason for Amendment:	AMENDMENT	Revision Number:	REV 001	Page Number:	8

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

Hazardous Substances (Tank Wagon and Transportable Containers) Regulations 2004.
Schedule 10 of the Hazardous Substances (Dangerous Goods and Scheduled Toxic Substances) Transfer Notice 2004.
Schedule 12 of the Hazardous Substances (Dangerous Goods and Scheduled Toxic Substances) Transfer Notice 2004

Approved Handlers: Approved handlers are required if more than 100 m3 is stored on site.

OTHER INFORMATION:

Liquefied Petroleum Gas is supplied in low pressure cylinders specifically designed for LPG traffic.

Cylinder Colour:
Industrial: AS2700 –N24 (Silver Grey)

Cylinder Valve Outlet:
Industrial 45 kg Cylinder: AS 2473.2 Type 21.
Industrial Forklift Cylinder: AS2473.2 Type

References:
NZS 5433:2007 Transport of Dangerous Goods on Land
EPA Website – Approvals Register – www.epa.govt.nz
SNZ HB76:2008 Dangerous Goods – Initial Emergency Response Guide
AS1678 2C1 Emergency Procedure Guide – Transport – Non-Flammable, Compressed Gas
AS 4484-2004 - Gas Cylinders for Industrial, Scientific, medical and refrigerant use - Labelling and colour coding
AS 2473.2-2007 - Valves for compressed gas outlets - Part 2 Outlet connections (threaded) and stem (inlet) threads
AS 2473.3-2007 - Valves for compressed gas outlets - Part 3 Outlet connections for medical gases (including pin-indexed yoke connections)
Operators Handbook for the Transport of Dangerous Goods by Road – NZ Road Transport & Logistics Industry Training Organisation
NZCIC Code of Practice – Preparation of Safety Data Sheets

MSDS SUMMARY:

This MSDS summarises to our best knowledge, at the date of issue, the health and safety hazard information regarding this product and general guidance on how to safely handle the

SOUTHERN GAS SERVICES LTD

MATERIAL SAFETY DATA SHEET
Title: **LIQUEFIED PETROLEUM GAS MATERIAL SAFETY DATA SHEET**
Date of Issue: 1 December 2009
Date of Review: 1 March 2012

product in the workplace. All due care has been taken to include accurate and up-to-date information in this MSDS.

Each user should read this MSDS and consider the information in the context of how the product will be handled and used in the workplace in conjunction with other products. If clarification or further information is needed to ensure that an appropriate risk assessment can be made, the user should contact Southern Gas Services Limited.

As far as lawfully possible, no liability for any loss, injury or damage (including consequential loss) which may be suffered or incurred by any person as a consequence of their reliance on the information contained in this MSDS can be accepted.

Our responsibility for products sold is subject to our standard terms and conditions, a copy of which is available on request.

This MSDS has been prepared in accordance with NZCIC Code of Practice – Preparation of Safety Data Sheets.

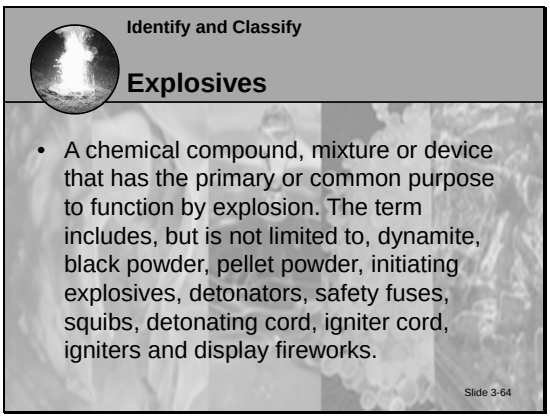
This MSDS is subject to change without notice.

Prepared By:	MAM	Document Number:	MSDS 030	Number of Copies	1
Authorised By:	WJM	Issue Date:	30/01/2012	File Location:	MASTER FILE
Reason for Amendment:	AMENDMENT	Revision Number:	REV 001	Page Number:	10

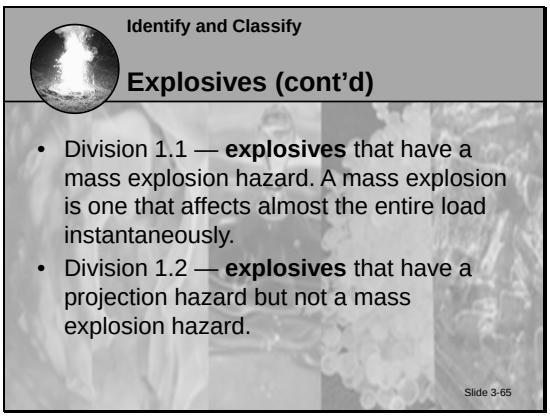
NOTE-TAKING GUIDE (cont'd)

Slide 3-63

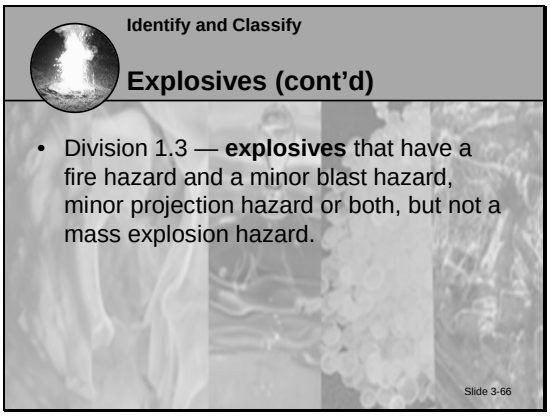
Slide 3-64



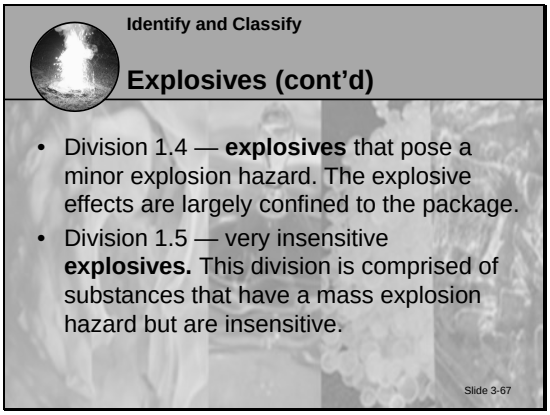
Slide 3-65



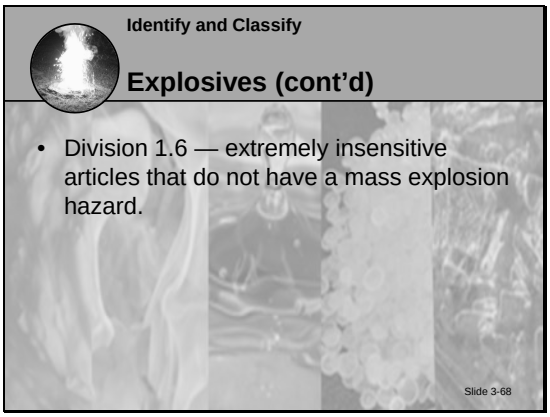
Slide 3-66



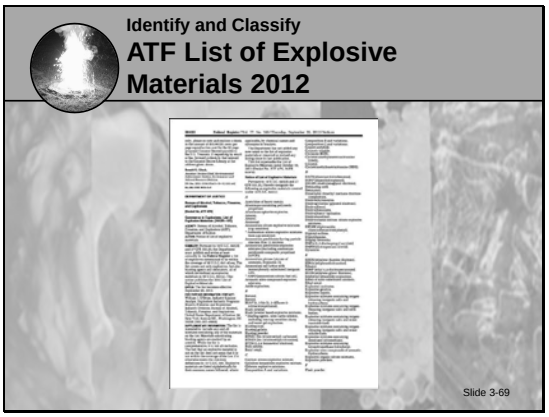
Slide 3-67



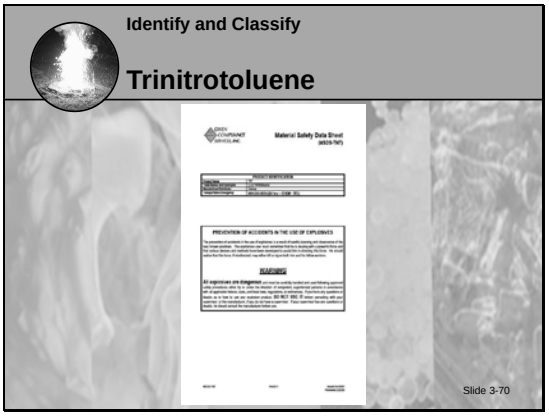
Slide 3-68



Slide 3-69



Slide 3-70



This page intentionally left blank.

OWEN COMPLIANCE SERVICES, INC.

Material Safety Data Sheet
(MSDS-TNT)

PRODUCT IDENTIFICATION	
Product Name	TNT
Trade Names and Synonyms	2,4,6 Trinitrotoluene
Manufacturer/Distributor	Various
Transportation Emergency	**800-255-3924 (24 hrs -- *CHEM • TEL*)**

PREVENTION OF ACCIDENTS IN THE USE OF EXPLOSIVES

The prevention of accidents in the use of explosives is a result of careful planning and observance of the best known practices. The explosives user must remember that he is dealing with a powerful force and that various devices and methods have been developed to assist him in directing this force. He should realize that this force, if misdirected, may either kill or injure both him and his fellow workers.

WARNING

All explosives are dangerous and must be carefully handled and used following approved safety procedures either by or under the direction of competent, experienced persons in accordance with all applicable federal, state, and local laws, regulations, or ordinances. If you have any questions or doubts as to how to use any explosive product, **DO NOT USE IT** before consulting with your supervisor, or the manufacturer, if you do not have a supervisor. If your supervisor has any questions or doubts, he should consult the manufacturer before use.

HAZARDOUS COMPONENTS			
Material or Component	**CAS No.**	**TLV**	**PEL**
TNT (Trinitrotoluene)	38082-89-2	1.5 MG/M^3	.5 MG/M^3
N/A = Not assigned NE = Not established			

PHYSICAL DATA	
Boiling Point	464° F
Vapor Pressure	.057 MPa @ 179° F
Vapor Density	N/A
Solubility in Water	Insoluble
Specific Gravity	1.5 - 1.6
Melting Point	176°F
Evaporation Rate	N/A
Appearance and Odor	Yellow Flakes, with bitter almond odor.

HAZARDOUS REACTIVITY	
Instability	Stable
Incompatibility	No data applicable
Hazardous decomposition	Nitrous Oxide
Polymerization	Polymerization will not occur

FIRE AND EXPLOSION DATA	
Flashpoint	Not applicable
Extinguishing media	None
Special fire fighting procedures	**ALL EXPLOSIVES: DO NOT FIGHT EXPLOSIVES FIRES.** Try to keep fire from reaching explosives. Isolate area. Guard against intruders. Division 1.1 Explosives: Evacuate the area for 5000 feet (1 mile). Consult *the 2000 Emergency Response Guidebook*, Guide 112 for further details.
Unusual fire and explosion hazards	Will detonate if suitably primed by heat or flame.

HEALTH HAZARDS	
General	TNT is a Division 1.1 explosive, and detonation may cause severe physical injury, including death. All explosives are dangerous and must be handled carefully and used following approved safety procedures under the direction of competent, experienced persons in accordance with all applicable federal, state, and local laws, regulations, and ordinances. Inhalation of explosives powders may cause nervous system irregularities including headaches and dizziness. Nitrogen oxides generated during use are skin, eye, and respiratory tract irritants.
Carcinogenicity	None of the components of TNT are listed as a carcinogen by NTP, IARC, or OSHA.

FIRST AID	
Inhalation	If detonation fumes are inhaled, remove to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. If breathing is difficult, give oxygen and call a physician.
Eye and skin contact	Flush eyes with water. Wash skin with soap and water.
Ingestion	Induce vomiting immediately by giving two glasses of water and sticking finger down throat.
Injury from detonation	Seek prompt medical attention.

SPILL OR LEAK PROCEDURES	
Spill/leak response	Review fire and explosion hazards before proceeding with clean up. Remove all ignition sources. Wear protective equipment during clean up. Mop up with water.
Waste disposal	Dispose of in compliance with federal regulations under the authority of the *Resource Conservation and Recovery Act* (40 CFR Parts 260-271).

SPECIAL PROTECTION INFORMATION	
Ventilation	General ventilation with local exhaust in operation area.
Respiratory	Wear fitted NIOSH approved respirator, avoid dusting by keeping wet when possible .
Eye	Chemical goggles.
Gloves	Cotton or leather gloves
Other	Flame proof coveralls and conductive boots.

SPECIAL PRECAUTIONS
Refer to manufacturer's instructions and warnings supplied with product.

STORAGE CONDITIONS
Store in accordance with the requirements of *Subpart K, ATF: Explosives Law and Regulations* (27 CFR 55.201-55.219).

MSDS-TNT PAGE 3 Issued 04/30/97
Reviewed 2/22/06

SHIPPING INFORMATION		
Proper shipping name	TNT	
Hazard class	1.1D	
UN Number	UN0209 (1.1D)	
DOT Label & Placard	DOT Label	EXPLOSIVE 1.1D
	DOT Placard	EXPLOSIVES 1.1

The information contained in this Material Safety Data Sheet is based upon available data and believed to be correct; however, as such has been obtained from various sources, including the manufacturer and independent laboratories, it is given without warranty or representation that it is complete, accurate, and can be relied upon. *OWEN COMPLIANCE SERVICES, INC.* has not attempted to conceal in any manner the deleterious aspects of the product listed herein, but makes no warranty as to such. Further, *OWEN COMPLIANCE SERVICES, INC.* cannot anticipate nor control the many situations in which the product or this information may be used; there is no guarantee that the health and safety precautions suggested will be proper under all conditions. It is the sole responsibility of each user of the product to determine and comply with the requirements of all applicable laws and regulations regarding its use. This information is given solely for the purposes of safety to persons and property. Any other use of this information is expressly prohibited.

For further information contact:

David W. Boston, President
OWEN COMPLIANCE SERVICES, INC.
12001 County Road 1000
P.O. Box 765
Godley, TX 76044
Telephone number: 817-551-0660
FAX number: 817-396-4584

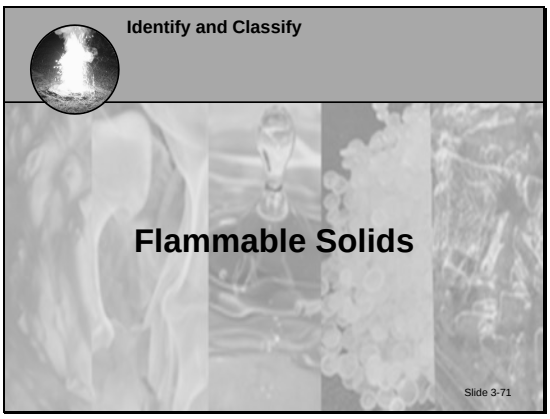
MSDS prepared by:

Johnny R. Rodriguez, Compliance Specialist
Original publication date: 04/30/97
Review date: 2/22/06
12/03/03

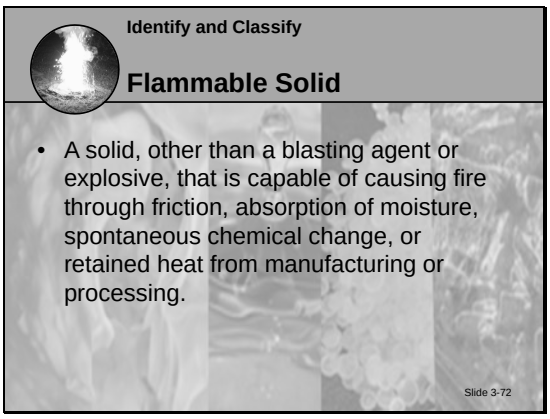
MSDS-TNT PAGE 4 Issued 04/30/97
Reviewed 2/22/06

NOTE-TAKING GUIDE (cont'd)

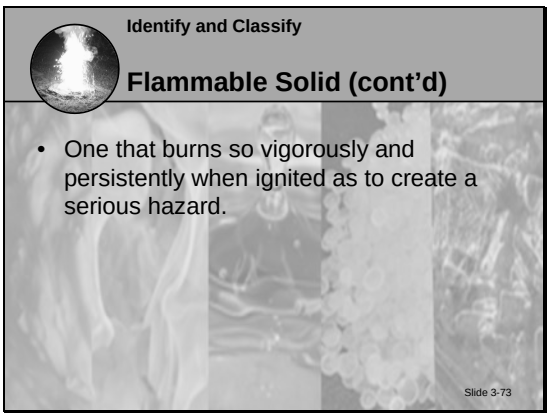
Slide 3-71



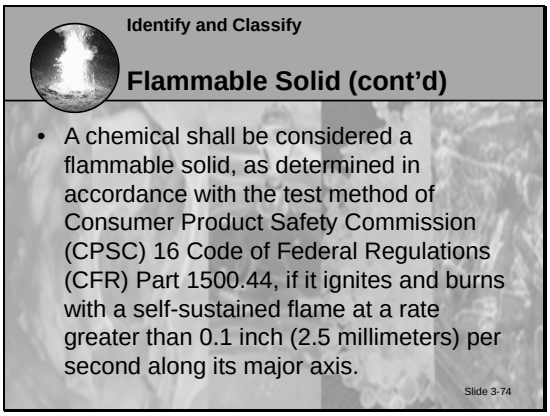
Slide 3-72



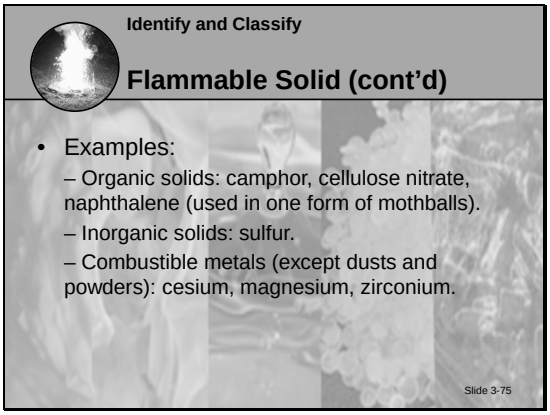
Slide 3-73



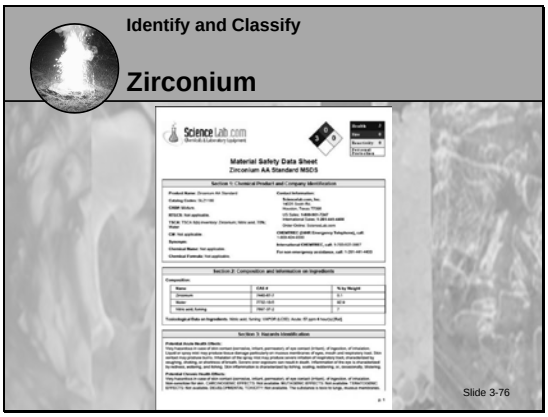
Slide 3-74



Slide 3-75



Slide 3-76



ScienceLab.com
Chemicals & Laboratory Equipment

Health	3
Fire	0
Reactivity	0
Personal Protection	

Material Safety Data Sheet
Zirconium AA Standard MSDS

Section 1: Chemical Product and Company Identification

Product Name: Zirconium AA Standard

Catalog Codes: SLZ1180

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Zirconium; Nitric acid, 70%; Water

CI#: Not applicable.

Synonym:

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Zirconium	7440-67-7	0.1
Water	7732-18-5	92.9
Nitric acid, fuming	7697-37-2	7

Toxicological Data on Ingredients: Nitric acid, fuming: VAPOR (LC50): Acute: 67 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant), of ingestion, of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant), of ingestion, of inhalation. Non-sensitizer for skin. CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, mucous membranes.

p. 1

Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs. Repeated or prolonged inhalation of vapors may lead to chronic respiratory irritation.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive to explosive in presence of reducing materials, of combustible materials, of organic materials.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

p. 2

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as alkalis.

Storage: Corrosive materials should be stored in a separate safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Zirconium TWA: 5 STEL: 10 (mg/m3) from ACGIH Nitric acid, fuming TWA: 2 CEIL: 4 (ppm) TWA: 5 CEIL: 10 (mg/m3)Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: Not applicable.

Color: Not available.

pH (1% soln/water): Acidic.

Boiling Point: The lowest known value is 82.6°C (180.7°F) (Nitric acid, fuming). Weighted average: 98.78°C (209.8°F)

Melting Point: May start to solidify at -41.6°C (-42.9°F) based on data for: Nitric acid, fuming.

Critical Temperature: Not available.

p. 3

Specific Gravity: Weighted average: 1.02 (Water = 1)

Vapor Pressure:
The highest known value is 45 mm of Hg (@ 20°C) (Nitric acid, fuming). Weighted average: 19.46 mm of Hg (@ 20°C)

Vapor Density: The highest known value is 0.62 (Air = 1) (Water).

Volatility: Not available.

Odor Threshold: The highest known value is 0.29 ppm (Nitric acid, fuming)

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Reactive with alkalis. Slightly reactive to reactive with reducing agents, combustible materials, organic materials, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Not available.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute toxicity of the vapor (LC50): 957 ppm 4 hour(s) (Rat) (Calculated value for the mixture).

Chronic Effects on Humans: The substance is toxic to lungs, mucous membranes.

Other Toxic Effects on Humans: Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 8: Corrosive liquid.

Identification: : Nitric acid, solution (Nitric acid, fuming) : UN2031 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Nitric acid, 70% Massachusetts RTK: Nitric acid, 70% TSCA 8(b) inventory: Zirconium; Nitric acid, 70%; Water SARA 302/304/311/312 extremely hazardous substances: Nitric acid, 70% SARA 313 toxic chemical notification and release reporting: Nitric acid, 70% CERCLA: Hazardous substances.: Nitric acid, 70%;

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R26- Very toxic by inhalation. R35- Causes severe burns.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

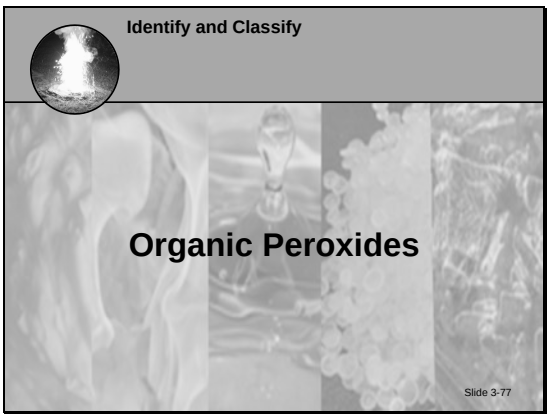
Created: 10/10/2005 12:41 AM

Last Updated: 05/21/2013 12:00 PM

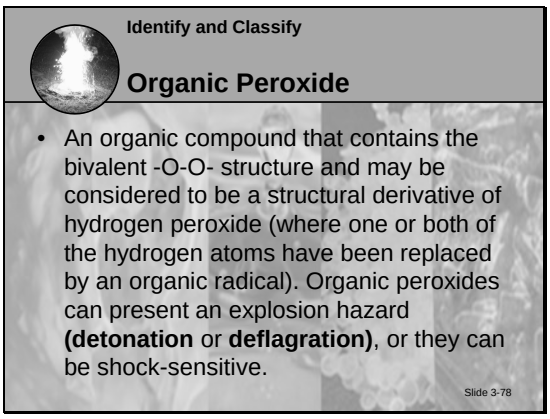
The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

NOTE-TAKING GUIDE (cont'd)

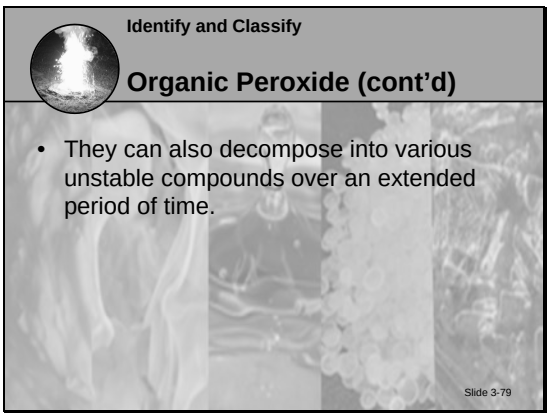
Slide 3-77



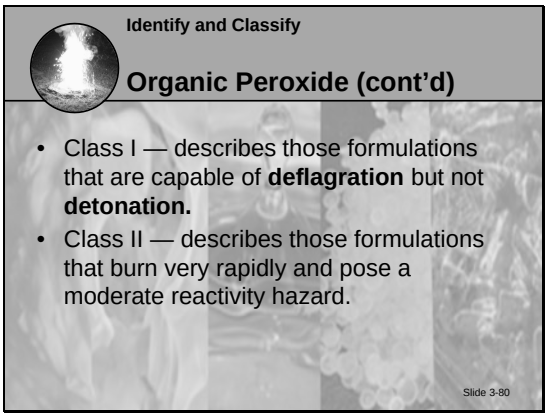
Slide 3-78



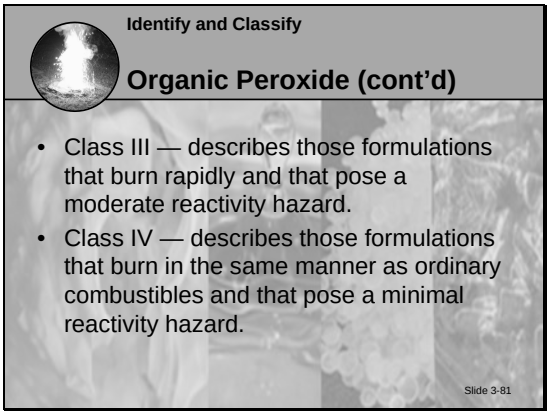
Slide 3-79



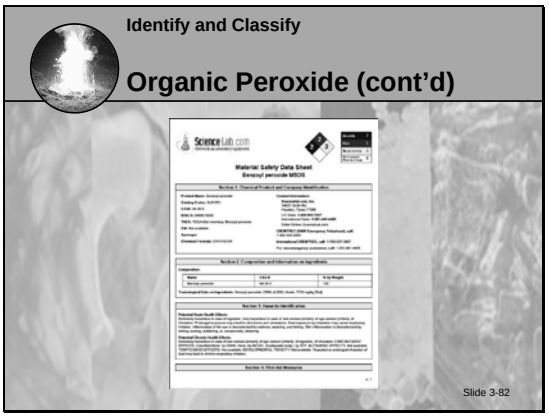
Slide 3-80



Slide 3-81



Slide 3-82



ScienceLab.com
Chemicals & Laboratory Equipment

Health	3
Fire	1
Reactivity	3
Personal Protection	E

Material Safety Data Sheet
Benzoyl peroxide MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzoyl peroxide

Catalog Codes: SLB1051

CAS#: 94-36-0

RTECS: DM8575000

TSCA: TSCA 8(b) inventory: Benzoyl peroxide

CI#: Not available.

Synonym:

Chemical Formula: C14-H10-O4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Benzoyl peroxide	94-36-0	100

Toxicological Data on Ingredients: Benzoyl peroxide: ORAL (LD50): Acute: 7710 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Extremely hazardous in case of ingestion. Very hazardous in case of skin contact (irritant), of eye contact (irritant), of inhalation. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Extremely hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. CARCINOGENIC EFFECTS: Classified None. by OSHA, None. by NIOSH. (Inadequate study.) by NTP. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged inhalation of dust may lead to chronic respiratory irritation.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention 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. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 80°C (176°F)

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Flammable in presence of combustible materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of heat. Slightly explosive in presence of shocks, of combustible materials.

Fire Fighting Media and Instructions:
Oxidizing material. Do not use water jet. Use flooding quantities of water. Avoid contact with organic materials.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Oxidizing material. Organic peroxide. Stop leak if without risk. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not use metal tools or equipment. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Keep away from direct sunlight or strong incandescent light. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Avoid shock and friction. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as combustible materials, metals, acids, alkalis.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Do not store above 40°C (104°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves (impervious).

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 5 Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 242.23 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: Decomposition temperature: 103°C (217.4°F)

Melting Point: 104.5°C (220.1°F)

Critical Temperature: Not available.

Specific Gravity: 1.33 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: Unstable.

Instability Temperature: >75°C (167°F)

Conditions of Instability: Not available.

Incompatibility with various substances:
Highly reactive with acids, alkalis. Reactive with combustible materials, metals. The product may undergo hazardous decomposition, condensation or polymerization, it may react violently with water to emit toxic gases or it may become self-reactive under conditions of shock or increase in temperature or pressure.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 7710 mg/kg [Rat].

Chronic Effects on Humans: CARCINOGENIC EFFECTS: Classified None. by OSHA, None. by NIOSH. (Inadequate study.) by NTP.

Other Toxic Effects on Humans:
Extremely hazardous in case of ingestion. Very hazardous in case of skin contact (irritant), of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 2 mg/l 96 hours [Guppy].

BOD5 and COD: Not available.

Products of Biodegradation: Possibly hazardous short/long term degradation products are to be expected.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 5.2: Organic peroxide. Type C

Identification: : Organic peroxide type C, solid (Dibenzoyl peroxide) UNNA: UN3104 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Benzoyl peroxide Massachusetts RTK: Benzoyl peroxide New Jersey: Benzoyl peroxide TSCA 8(b) inventory: Benzoyl peroxide

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS C: Oxidizing material. CLASS D-2B: Material causing other toxic effects (TOXIC). CLASS F: Dangerously reactive material.

DSCL (EEC):
R9- Explosive when mixed with combustible material. R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 3

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 2

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves (impervious). Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 04:21 PM

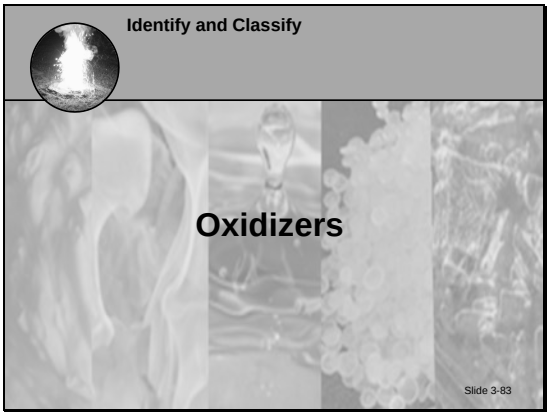
Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

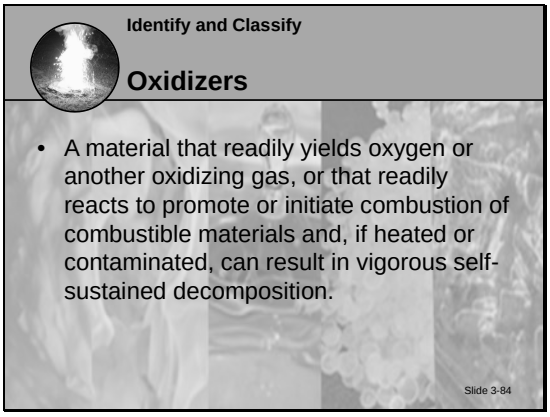
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

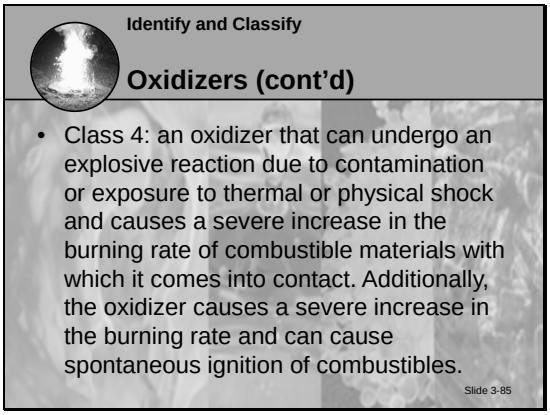
Slide 3-83



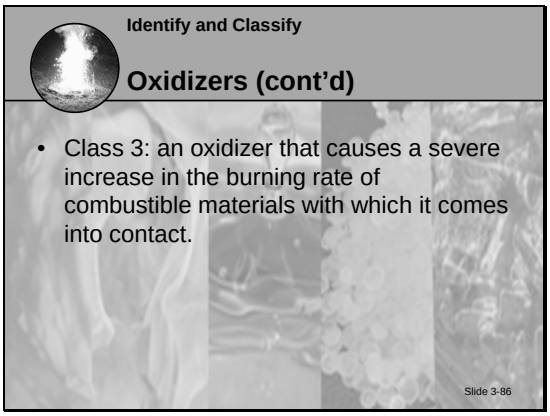
Slide 3-84



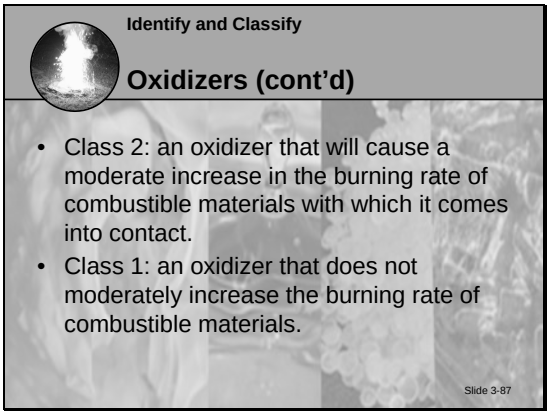
Slide 3-85



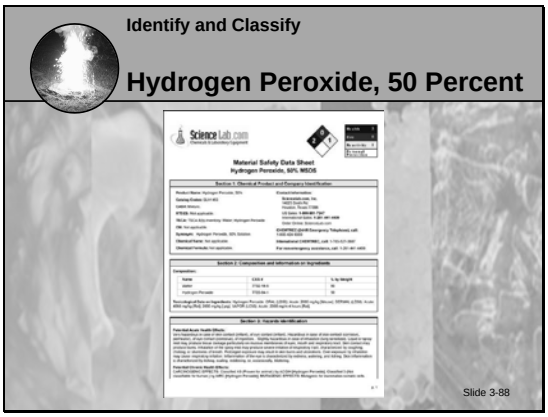
Slide 3-86



Slide 3-87



Slide 3-88



ScienceLab.com
Chemicals & Laboratory Equipment

Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet
Hydrogen Peroxide, 50% MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrogen Peroxide, 50%

Catalog Codes: SLH1453

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Water; Hydrogen Peroxide

CI#: Not applicable.

Synonym: Hydrogen Peroxide, 50% Solution

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Water	7732-18-5	50
Hydrogen Peroxide	7722-84-1	50

Toxicological Data on Ingredients: Hydrogen Peroxide: ORAL (LD50): Acute: 2000 mg/kg [Mouse]. DERMAL (LD50): Acute: 4060 mg/kg [Rat]. 2000 mg/kg [pig]. VAPOR (LC50): Acute: 2000 mg/m 4 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH [Hydrogen Peroxide]. Classified 3 (Not classifiable for human.) by IARC [Hydrogen Peroxide]. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells.

p. 1

[Hydrogen Peroxide]. Mutagenic for bacteria and/or yeast. [Hydrogen Peroxide]. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, upper respiratory tract, skin, eyes, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention 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. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of combustible materials

Explosion Hazards in Presence of Various Substances: Explosive in presence of open flames and sparks, of heat, of organic materials, of metals, of acids.

Fire Fighting Media and Instructions:
Fire: Small fires: Use water. Do not use dry chemicals or foams. CO_2, or Halon may provide limited control. Large fires: Flood fire area with water from a distance. Move containers from fire area if you can do it without risk. Do not move cargo or vehicle if cargo has been exposed to heat. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. ALWAYS stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. / Hydrogen peroxide, aqueous solution, with not less than 8% but less than 20% Hydrogen peroxide; Hydrogen peroxide,

aqueous solution, with not less than 20% but not more than 60% Hydrogen peroxide (stabilized as necessary)/ [QC Reviewed] [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-140]

Special Remarks on Fire Hazards:
Most cellulose (wood, cotton) materials contain enough catalyst to cause spontaneous ignition with 90% Hydrogen Peroxide. Hydrogen Peroxide is a strong oxider. It is not flammable itself, but it can cause spontaneous combustion of flammable materials and continued support of the combustion because it liberates oxygen as it decomposes. Hydrogen peroxide mixed with magnesium and a trace of magnesium dioxide will ignite immediately.

Special Remarks on Explosion Hazards:
Soluble fuels (acetone, ethanol, glycerol) will detonate on a mixture with peroxide over 30% concentration, the violence increasing with concentration. Explosive with acetic acid, acetic anhydride, acetone, alcohols, carboxylic acids, nitrogen containing bases, As2S3, Cl2 + KOH, FeS, FeSO4 + 2 methylpryidine + H2SO4, nitric acid, potassium permanganate, P2O5, H2Se, Alcohols + H2SO4, Alcohols + tin chloride, Antimoy trisulfide, chlorosulfonic acid, Aromatic hydrocarbons + trifluoroacetic acid, Azeliac acid + sulfuric acid (above 45 C), Benzenesulfonic anhydride, tert-butanol + sulfuric acid, Hydrazine, Sulfuric acid, Sodium iodate, Tetrahydrothiophene, Thiodiglycol, Mercurous oxide, mercuric oxide, Lead dioxide, Lead oxide, Manganese dioxide, Lead sulfide, Gallium + HCl, Ketenes + nitric acid, Iron (II) sulfate + 2-methylpyridine + sulfuric acid, Iron (II) sulfate + nitric acid, + sodium carboxymethylcellulose (when evaporated), Vinyl acetate, trioxane, water + oxygenated compounds (eg: acetaldehyde, acetic acid, acetone, ethanol, formaldehyde, formic acid, methanol, 2-propanol, propionaldehyde), organic compounds. Beware: Many mixitures of hydrogen peroxide and organic materials may not explode upon contact. However, the resulting combination is detonatable either upon catching fire or by impact. EXPLOSION HAZARD: SEVERE, WHEN HIGHLY CONCENTRATED OR PURE H2O2 IS EXPOSED TO HEAT, MECHANICAL IMPACT, OR CAUSED TO DECOMPOSE CATALYTICALLY BY METALS & THEIR SALTS, DUSTS & ALKALIES. ANOTHER SOURCE OF HYDROGEN PEROXIDE EXPLOSIONS IS FROM SEALING THE MATERIAL IN STRONG CONTAINERS. UNDER SUCH CONDITIONS EVEN GRADUAL DECOMPOSITION OF HYDROGEN PEROXIDE TO WATER + 1/2 OXYGEN CAN CAUSE LARGE PRESSURES TO BUILD UP IN THE CONTAINERS WHICH MAY BURST EXPLOSIVELY. Fire or explosion: May explode from friction, heat or contamination. These substances will accelerate burning when involved in a fire. May ignite combustibles (wood, paper, oil, clothing, etc.). Some will react explosively with hydrocarbons (fuels). Containers may explode when heated. Runoff may create fire or explosion hazard. /Hydrogen peroxide, aqueous solution, stabilized, with more than 60% Hydrogen peroxide; Hydrogen peroxide, stabilized/ [QC Reviewed] [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-143] . Fire or explosion: These substances will accelerate burning when involved in a fire. Some may decompose explosively when heated or involved in a fire. May explode from heat or contamination. Some will react explosively with hydrocarbons (fuels). May ignite combustibles (wood, paper, oil, clothing, etc.). Containers may explode when heated. Runoff may create fire or explosion hazard. /Hydrogen peroxide, aqueous solution, with not less than 8% but less than 20% Hydrogen peroxide; Hydrogen peroxide, aqueous solution, with not less than 20% but not more than 60% Hydrogen peroxide (stabilized as necessary)/ [QC Reviewed] [U.S. Department of Transportation. 2000 Emergency Response Guidebook. RSPA P 5800.8 Edition. Washington, D.C: U.S. Government Printing Office, 2000,p. G-140] (Hydrogen Peroxide)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Corrosive liquid. Oxidizing material. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient

ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Do not store above 8°C (46.4°F). Refrigerate. Sensitive to light. Store in light-resistant containers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Hydrogen Peroxide TWA: 1 (ppm) from ACGIH (TLV) [United States] TWA: 1 (ppm) from OSHA (PEL) [United States] TWA: 1 STEL: 2 [Canada] TWA: 1.4 (mg/m3) from NIOSH TWA: 1.4 (mg/m3) from OSHA (PEL) [United States] TWA: 1 (ppm) [United Kingdom (UK)] TWA: 1.4 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Odorless.

Taste: Slight acid. Bitter

Molecular Weight: Not applicable.

Color: Clear Colorless.

pH (1% soln/water): Not available

Boiling Point: 108°C (226.4°F)

Melting Point: -33°C (-27.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.2 (Water = 1)

Vapor Pressure: 3.1 kPa (@ 20°C)

Vapor Density: 1.1 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:

Easily soluble in cold water. Soluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable. It contains a stabilizer.

Instability Temperature: Not available.

Conditions of Instability: Heat, Combustible materials, incompatible materials, light

Incompatibility with various substances: Reactive with reducing agents, combustible materials, organic materials, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Light sensitive. Incompatible with reducing materials, ethers (dioxane, furfuran, tetrahydrofuran), oxidizing materials, Metals(eg. potassium, sodium lithium, iron, copper, brass, bronze, chromium, zinc, lead, silver, nickel), metal oxides (eg. cobalt oxide, iron oxide, lead oxide, lead hydroxide, manganese oxide), metal salts (eg. calcium permanganate, salts of iron), manganese, asbestos, vanadium, platinium, tungsten, molybdeum, triethylamine, palladium, sodium pyrophosphate, carboxylic acids, cyclopentadiene, formic acid, rust, ketones, sodium carbonate, alcohols, sodium borate, aniline, mercurous chloride, rust, nitric acid, sodium pyrophosphate, hexavalent chromium compounds, tetrahydrofuran, sodium fluoride organic matter, potassium permanganate, urea, chlorosulfonic acid, manganese dioxide, hydrogen selenide, charcoal, coal, sodium borate, alkalies, cyclopentadiene, glycerine, cyanides (potassium, cyanide, sodium cyanide), nitrogen compounds.. Caused to decompose catalytically by metals (in order of decreasing effectiveness): Osmium, Palladium, Platinum, Iridium, Gold, Silver, Manganese, Cobalt, Copper, Lead. Concentrated hydrogen peroxide may decompose violently or explosively in contact with iron, copper, chromium, and most other metals and their salts, and dust. (Hydrogen Peroxide)

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact.

Toxicity to Animals:
Acute oral toxicity (LD50): 4000 mg/kg (Mouse) (Calculated value for the mixture). Acute dermal toxicity (LD50): 4000 mg/kg (pig) (Calculated value for the mixture).

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH [Hydrogen Peroxide]. Classified 3 (Not classifiable for human.) by IARC [Hydrogen Peroxide]. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. [Hydrogen Peroxide]. Mutagenic for bacteria and/or yeast. [Hydrogen Peroxide]. Contains material which may cause damage to the following organs: blood, upper respiratory tract, skin, eyes, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant). Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive), of ingestion, of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause cancer and may affect genetic material based on animal data. May be tumorigenic. (Hydrogen Peroxide)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes severe skin irritation and possible burns. Absorption into skin may affect behavior/central nervous system (tremor, ataxia, convulsions), respiration (dyspnea, pulmonary emboli), brain. Eyes: Causes severe eye irritation, superficial clouding, corneal edema, and may cause burns. Inhalation: Causes respiratory tract irritation with coughing, lacrimation. May cause chemical burns to the respiratory tract. May affect behavior/Central nervous system (insomnia, headache, ataxia, nervous tremors with numb extremities) and may cause ulceration of nasal tissue, and , chemical

pneumonia, unconciousness, and possible death. At high concentrations, respiratory effects may include acute lung damage, and delayed pulmonary edema. May affect blood. Ingestion: Causes gastrointestional tract irritation with nausea, vomiting, hypermotility, and diarrhea. Causes

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification:
Class 8: Corrosive material CLASS 5.1: Oxidizing material.

Identification: : Hydrogen Peroxide, Aqueous Solution UNNA: 2014 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
New York acutely hazardous substances: Hydrogen Peroxide Rhode Island RTK hazardous substances: Hydrogen Peroxide Pennsylvania RTK: Hydrogen Peroxide Florida: Hydrogen Peroxide Minnesota: Hydrogen Peroxide Massachusetts RTK: Hydrogen Peroxide New Jersey: Hydrogen Peroxide TSCA 8(b) inventory: Hydrogen Peroxide SARA 302/304/311/312 extremely hazardous substances: Hydrogen Peroxide CERCLA: Hazardous substances.: Hydrogen Peroxide: 1 lbs. (0.4536 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS C: Oxidizing material. CLASS E: Corrosive liquid. CLASS F: Dangerously reactive material.

DSCL (EEC):
R16- Explosive when mixed with oxidizing substances. R34- Causes burns. S3- Keep in a cool place. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S28- After contact with skin, wash immediately with plenty of [***] S36/37/39- Wear suitable protective clothing, gloves and eye/face protection. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/09/2005 05:46 PM

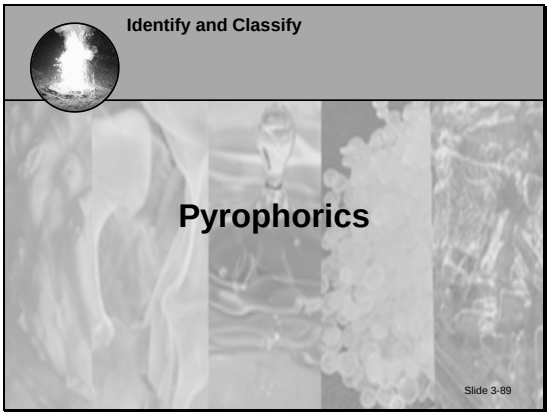
Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

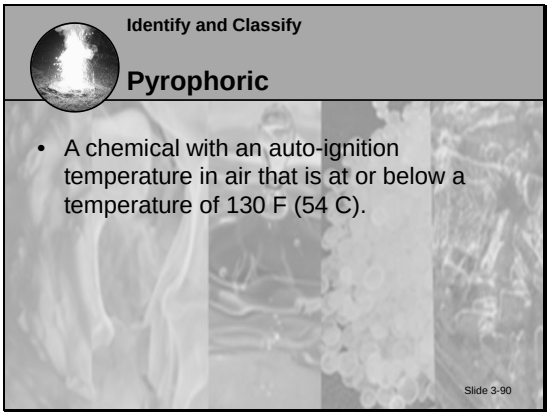
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

Slide 3-89

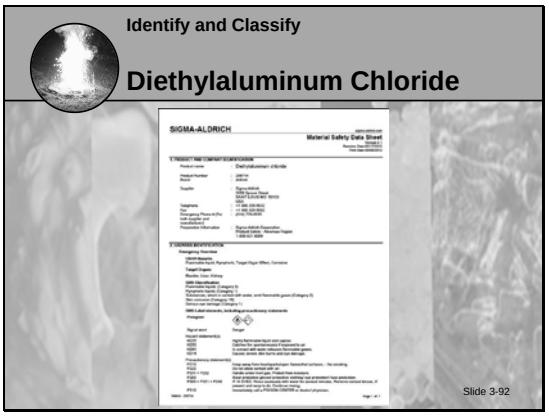


Slide 3-90



Slide 3-91

Slide 3-92


Identify and Classify
Diethylaluminum Chloride
SIGMA-ALDRICH
Material Safety Data Sheet
Slide 3-92

SIGMA-ALDRICH

sigma-aldrich.com

Material Safety Data Sheet

Version 5.1
Revision Date 05/17/2013
Print Date 09/08/2013

1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	Diethylaluminum chloride
Product Number	:	256714
Brand	:	Aldrich
Supplier	:	Sigma-Aldrich 3050 Spruce Street SAINT LOUIS MO 63103 USA
Telephone	:	+1 800-325-5832
Fax	:	+1 800-325-5052
Emergency Phone # (For both supplier and manufacturer)	:	(314) 776-6555
Preparation Information	:	Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956

2. HAZARDS IDENTIFICATION

Emergency Overview

OSHA Hazards
Flammable liquid, Pyrophoric, Target Organ Effect, Corrosive

Target Organs

Bladder, Liver, Kidney

GHS Classification
Flammable liquids (Category 2)
Pyrophoric liquids (Category 1)
Substances, which in contact with water, emit flammable gases (Category 2)
Skin corrosion (Category 1B)
Serious eye damage (Category 1)

GHS Label elements, including precautionary statements

Pictogram

Signal word: Danger

Hazard statement(s)

H225	Highly flammable liquid and vapour.
H250	Catches fire spontaneously if exposed to air.
H261	In contact with water releases flammable gases.
H314	Causes severe skin burns and eye damage.

Precautionary statement(s)

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P222	Do not allow contact with air.
P231 + P232	Handle under inert gas. Protect from moisture.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/ physician.

P422	Store contents under inert gas.

HMIS Classification

Health hazard:	3
Chronic Health Hazard:	*
Flammability:	4
Physical hazards:	3

NFPA Rating

Health hazard:	3
Fire:	3
Reactivity Hazard:	3
Special hazard.:	W

Potential Health Effects

Inhalation	May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.
Skin	May be harmful if absorbed through skin. Causes skin burns.
Eyes	Causes eye burns.
Ingestion	May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms	:	Chloro diethyl aluminum
Formula	:	$C_4H_{10}AlCl$
Molecular Weight	:	120.56 g/mol

Component		Concentration
Diethylaluminium chloride		
CAS-No.	96-10-6	-
EC-No.	202-477-2	

4. FIRST AID MEASURES

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.Continue rinsing eyes during transport to hospital.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Suitable extinguishing media
Dry powder Carbon dioxide (CO2)

Extinguishing media which shall not be used for safety reasons
Water

Special protective equipment for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas, Aluminum oxide

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Do not flush with water.

7. HANDLING AND STORAGE

Precautions for safe handling
Avoid inhalation of vapour or mist.
Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage
Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Never allow product to get in contact with water during storage.

Air sensitive. Handle and store under inert gas.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Contains no substances with occupational exposure limit values.

Personal protective equipment

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. Protective gloves against thermal risks

Eye protection
Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection
Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	liquid
Colour	colourless

Safety data

pH	no data available
Melting point/freezing point	Melting point/range: -50 °C (-58 °F) - lit.
Boiling point	125 - 126 °C (257 - 259 °F) at 67 hPa (50 mmHg) - lit.
Flash point	-18 °C (0 °F) - closed cup
Ignition temperature	no data available
Auto-ignition temperature	no data available
Lower explosion limit	no data available
Upper explosion limit	no data available
Vapour pressure	4 hPa (3 mmHg) at 60 °C (140 °F)
Density	0.961 g/cm3 at 25 °C (77 °F)
Water solubility	no data available
Partition coefficient: n-octanol/water	no data available
Relative vapour density	no data available
Odour	no data available
Odour Threshold	no data available
Evapouration rate	no data available

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions

Vapours may form explosive mixture with air.
Reacts violently with water.

Conditions to avoid
Do not allow water to enter container.
Heat, flames and sparks. Extremes of temperature and direct sunlight. Exposure to moisture.

Materials to avoid
Reacts violently with water., Oxygen, Oxidizing agents, acids, Bases

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas, Aluminum oxide
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50
Inhalation LC50

LC50 Inhalation - rat - 11,000 mg/m3

Dermal LD50
no data available

Other information on acute toxicity
no data available

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
no data available

Respiratory or skin sensitisation
no data available

Germ cell mutagenicity
no data available

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)
no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)
no data available

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.
Ingestion	May be harmful if swallowed.
Skin	May be harmful if absorbed through skin. Causes skin burns.
Eyes	Causes eye burns.

Signs and Symptoms of Exposure
Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., Cough, Shortness of breath, Headache, Nausea

Synergistic effects
no data available

Additional Information
RTECS: BD0558000

12. ECOLOGICAL INFORMATION

Toxicity

no data available

Persistence and degradability
no data available

Bioaccumulative potential
no data available

Mobility in soil
no data available

PBT and vPvB assessment
no data available

Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3394 Class: 4.2 (4.3) Packing group: I
Proper shipping name: Organometallic substance, liquid, pyrophoric, water-reactive (Diethylaluminium chloride)
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN number: 3394 Class: 4.2 (4.3) Packing group: I EMS-No: F-G, S-M
Proper shipping name: ORGANOMETALLIC SUBSTANCE, LIQUID, PYROPHORIC, WATER-REACTIVE (Diethylaluminium chloride)
Marine pollutant: No

IATA
UN number: 3394 Class: 4.2 (4.3)
Proper shipping name: Organometallic substance, liquid, pyrophoric, water-reactive (Diethylaluminium chloride)
IATA Passenger: Not permitted for transport
IATA Cargo: Not permitted for transport

15. REGULATORY INFORMATION

OSHA Hazards
Flammable liquid, Pyrophoric, Target Organ Effect, Corrosive

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Fire Hazard, Reactivity Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Diethylaluminium chloride	96-10-6	2007-03-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Diethylaluminium chloride	96-10-6	2007-03-01

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

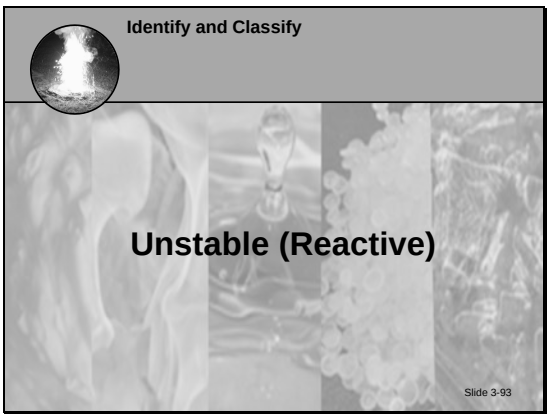
16. OTHER INFORMATION

Further information
Copyright 2013 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

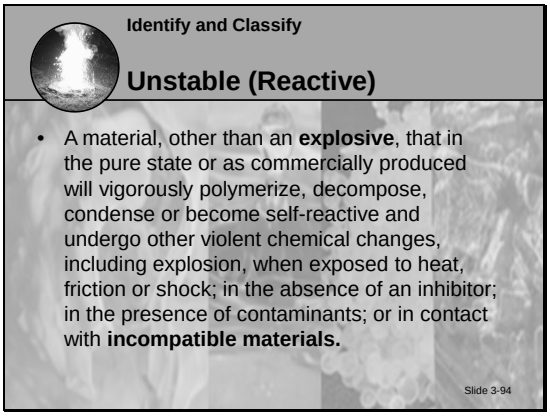
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

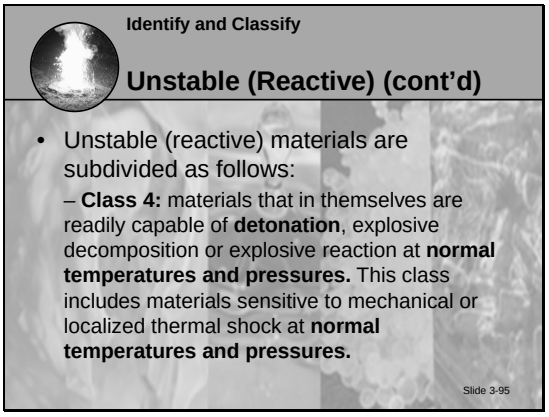
Slide 3-93



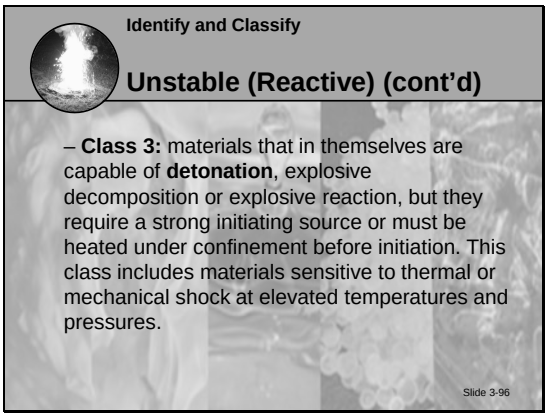
Slide 3-94



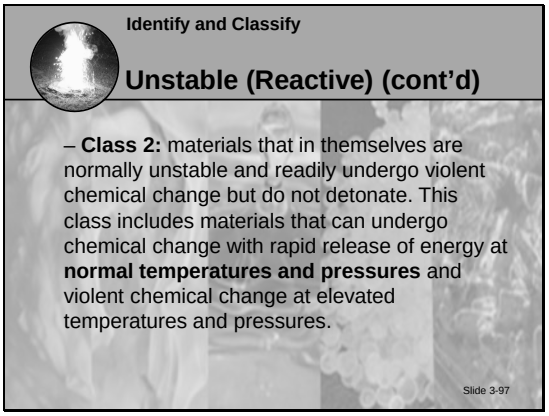
Slide 3-95



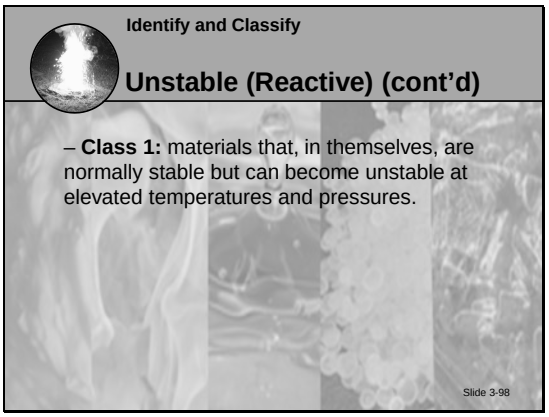
Slide 3-96



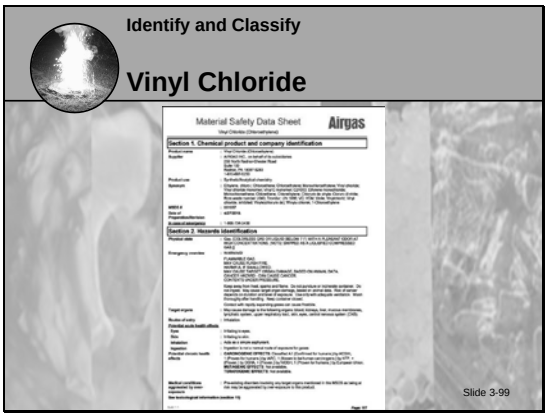
Slide 3-97



Slide 3-98



Slide 3-99


Identify and Classify
Vinyl Chloride
Material Safety Data Sheet
Airgas
Section 1. Chemical product and company identification
Section 3. Hazards identification
Slide 3-99

This page intentionally left blank.

Material Safety Data Sheet

Airgas

Vinyl Chloride (Chloroethylene)

Section 1. Chemical product and company identification

Product name : Vinyl Chloride (Chloroethylene)

Supplier : AIRGAS INC., on behalf of its subsidiaries
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Product use : Synthetic/Analytical chemistry.

Synonym : Ethylene, chloro-; Chloroethene; Chloroethylene; Monochloroethylene; Vinyl chloride; Vinyl chloride monomer; Vinyl C monomer; C2H3Cl; Ethylene monochloride; Monochloroethene; Chlorethene; Chlorethylene; Chlorure de vinyle; Cloruro di vinile; Rcra waste number U043; Trovidur; UN 1086; VC; VCM; Vinile; Vinylchlorid; Vinyl chloride, inhibited; Vinyle(chlorure de); Winylu chlorek; 1-Chloroethylene

MSDS # : 001067

Date of Preparation/Revision : **4/27/2010.**

In case of emergency : 1-866-734-3438

Section 2. Hazards identification

Physical state : Gas. [COLORLESS GAS OR LIQUID (BELOW 7 F) WITH A PLEASANT ODOR AT HIGH CONCENTRATIONS. [NOTE: SHIPPED AS A LIQUEFIED COMPRESSED GAS.]]

Emergency overview : WARNING!

FLAMMABLE GAS.
MAY CAUSE FLASH FIRE.
HARMFUL IF SWALLOWED.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CANCER HAZARD - CAN CAUSE CANCER.
CONTENTS UNDER PRESSURE.

Keep away from heat, sparks and flame. Do not puncture or incinerate container. Do not ingest. May cause target organ damage, based on animal data. Risk of cancer depends on duration and level of exposure. Use only with adequate ventilation. Wash thoroughly after handling. Keep container closed.

Contact with rapidly expanding gases can cause frostbite.

Target organs : May cause damage to the following organs: blood, kidneys, liver, mucous membranes, lymphatic system, upper respiratory tract, skin, eyes, central nervous system (CNS).

Routes of entry : Inhalation

Potential acute health effects

Eyes : Irritating to eyes.

Skin : Irritating to skin.

Inhalation : Acts as a simple asphyxiant.

Ingestion : Ingestion is not a normal route of exposure for gases

Potential chronic health effects : **CARCINOGENIC EFFECTS**: Classified A1 (Confirmed for humans.) by ACGIH, 1 (Proven for humans.) by IARC, 1 (Known to be human carcinogens.) by NTP, + (Proven.) by OSHA, + (Proven.) by NIOSH, 1 (Proven for humans.) by European Union.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.

Medical conditions aggravated by over-exposure : Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (section 11)

Build 1.1 **Page: 1/7**

Vinyl Chloride (Chloroethylene)

Section 3. Composition, Information on Ingredients

Name	CAS number	% Volume	Exposure limits
Vinyl Chloride (Chloroethylene)	75-01-4	100	**ACGIH TLV (United States, 1/2009).** TWA: 1 ppm 8 hour(s). **OSHA PEL (United States, 11/2006).** STEL: 5 ppm 15 minute(s). TWA: 1 ppm 8 hour(s). **OSHA PEL 1989 (United States, 3/1989).** STEL: 5 ppm 15 minute(s). TWA: 1 ppm 8 hour(s).

Section 4. First aid measures

No action shall be taken involving any personal risk or without suitable training.If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus.It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Eye contact : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention 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. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : As this product is a gas, refer to the inhalation section.

Section 5. Fire-fighting measures

Flammability of the product : Flammable.

Auto-ignition temperature : 471.85°C (881.3°F)

Flash point : Open cup: -79.15°C (-110.5°F).

Flammable limits : Lower: 4% Upper: 22%

Products of combustion : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
halogenated compounds

Fire-fighting media and instructions : In case of fire, use water spray (fog), foam or dry chemical.

In case of fire, allow gas to burn if flow cannot be shut off immediately. Apply water from a safe distance to cool container and protect surrounding area. If involved in fire, shut off flow immediately if it can be done without risk.

Contains gas under pressure. Flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Vinyl Chloride (Chloroethylene)

Section 6. Accidental release measures

Personal precautions : Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment (section 8). Shut off gas supply if this can be done safely. Isolate area until gas has dispersed.

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Section 7. Handling and storage

Handling : Use only with adequate ventilation. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Wash thoroughly after handling. High pressure gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Do not ingest. Keep container closed. Keep away from heat, sparks and flame. To avoid fire, eliminate ignition sources. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Storage : Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Segregate from oxidizing materials. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Personal protection

Eyes : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

The applicable standards are (US) 29 CFR 1910.134 and (Canada) Z94.4-93

Hands : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Personal protection in case of a large spill : Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product.

Product name

vinyl chloride

ACGIH TLV (United States, 1/2009).
TWA: 1 ppm 8 hour(s).
OSHA PEL (United States, 11/2006).
STEL: 5 ppm 15 minute(s).
TWA: 1 ppm 8 hour(s).
OSHA PEL 1989 (United States, 3/1989).
STEL: 5 ppm 15 minute(s).
TWA: 1 ppm 8 hour(s).

Consult local authorities for acceptable exposure limits.

Build 1.1 *Page: 3/7*

Vinyl Chloride (Chloroethylene)

Section 9. Physical and chemical properties

Molecular weight	: 62.5 g/mole
Molecular formula	: C2-H3-Cl
Boiling/condensation point	: -13.8°C (7.2°F)
Melting/freezing point	: -160°C (-256°F)
Critical temperature	: 158.5°C (317.3°F)
Vapor density	: 2.21 (Air = 1)
Specific Volume (ft ^{3}/lb)	: 6.25
Gas Density (lb/ft ^{3})	: 0.16

Section 10. Stability and reactivity

Stability and reactivity	: The product is stable.
Incompatibility with various substances	: Extremely reactive or incompatible with the following materials: oxidizing materials.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Toxicity data

Product/ingredient name	Result	Species	Dose	Exposure
vinyl chloride	LD50 Oral	Rat	500 mg/kg	-
	LC50 Inhalation Gas.	Rat	18 pph	15 minutes
	LC50 Inhalation Gas.	Rat	5000 ppm	1 hours

Chronic effects on humans : **CARCINOGENIC EFFECTS**: Classified A1 (Confirmed for humans.) by ACGIH, 1 (Proven for humans.) by IARC, 1 (Known to be human carcinogens.) by NTP, + (Proven.) by OSHA, + (Proven.) by NIOSH, 1 (Proven for humans.) by European Union. May cause damage to the following organs: blood, kidneys, liver, mucous membranes, lymphatic system, upper respiratory tract, skin, eyes, central nervous system (CNS).

Other toxic effects on humans : No specific information is available in our database regarding the other toxic effects of this material to humans.

Specific effects

Carcinogenic effects	: Can cause cancer. Risk of cancer depends on duration and level of exposure.
Mutagenic effects	: No known significant effects or critical hazards.
Reproduction toxicity	: No known significant effects or critical hazards.

Section 12. Ecological information

Aquatic ecotoxicity

Not available.

Products of degradation	: Products of degradation: carbon oxides (CO, CO_2) and water, halogenated compounds.
Environmental fate	: Not available.
Environmental hazards	: No known significant effects or critical hazards.
Toxicity to the environment	: Not available.

Vinyl Chloride (Chloroethylene)

Section 13. Disposal considerations

Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, local regulation.Return cylinders with residual product to Airgas, Inc.Do not dispose of locally.

Section 14. Transport information

Regulatory information	UN number	Proper shipping name	Class	Packing group	Label	Additional information
DOT Classification	UN1086	VINYL CHLORIDE, STABILIZED	2.1	Not applicable (gas).		**Reportable quantity** 1 lb. (0.454 kg) **Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: 150 kg **Special provisions** 21, B44, T50
TDG Classification	UN1086	VINYL CHLORIDE, STABILIZED	2.1	Not applicable (gas).		**Explosive Limit and Limited Quantity Index** 0.125 **ERAP Index** 3000 **Passenger Carrying Road or Rail Index** Forbidden
Mexico Classification	UN1086	VINYL CHLORIDE, STABILIZED	2.1	Not applicable (gas).		-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Build 1.1

Page: 5/7

Vinyl Chloride (Chloroethylene)

Section 15. Regulatory information

United States

U.S. Federal regulations : **United States Inventory (TSCA 8b):** This material is listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: vinyl chloride
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: vinyl chloride: Fire hazard, reactive, Sudden release of pressure, Immediate (acute) health hazard, Delayed (chronic) health hazard

Clean Water Act (CWA) 307: vinyl chloride

Clean Water Act (CWA) 311: No products were found.

Clean Air Act (CAA) 112 accidental release prevention: vinyl chloride

Clean Air Act (CAA) 112 regulated flammable substances: vinyl chloride

Clean Air Act (CAA) 112 regulated toxic substances: No products were found.

SARA 313

	Product name	CAS number	Concentration
Form R - Reporting requirements	Vinyl Chloride (Chloroethylene)	75-01-4	100
Supplier notification	Vinyl Chloride (Chloroethylene)	75-01-4	100

SARA 313 notifications must not be detached from the MSDS and any copying and redistribution of the MSDS shall include copying and redistribution of the notice attached to copies of the MSDS subsequently redistributed.

State regulations : **Connecticut Carcinogen Reporting:** This material is not listed.
Connecticut Hazardous Material Survey: This material is not listed.
Florida substances: This material is not listed.
Illinois Chemical Safety Act: This material is not listed.
Illinois Toxic Substances Disclosure to Employee Act: This material is not listed.
Louisiana Reporting: This material is not listed.
Louisiana Spill: This material is not listed.
Massachusetts Spill: This material is not listed.
Massachusetts Substances: This material is listed.
Michigan Critical Material: This material is not listed.
Minnesota Hazardous Substances: This material is not listed.
New Jersey Hazardous Substances: This material is listed.
New Jersey Spill: This material is not listed.
New Jersey Toxic Catastrophe Prevention Act: This material is not listed.
New York Acutely Hazardous Substances: This material is listed.
New York Toxic Chemical Release Reporting: This material is not listed.
Pennsylvania RTK Hazardous Substances: This material is listed.
Rhode Island Hazardous Substances: This material is not listed.

California Prop. 65 : **WARNING:** This product contains a chemical known to the State of California to cause cancer.

Ingredient name	Cancer	Reproductive	No significant risk level	Maximum acceptable dosage level
Vinyl Chloride (Chloroethylene)	Yes.	No.	Yes.	No.

Canada

WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).
Class F: Dangerously reactive material.

Vinyl Chloride (Chloroethylene)

CEPA Toxic substances: This material is listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

United States

Label requirements : FLAMMABLE GAS.
MAY CAUSE FLASH FIRE.
HARMFUL IF SWALLOWED.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CANCER HAZARD - CAN CAUSE CANCER.
CONTENTS UNDER PRESSURE.

Canada

Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).
Class F: Dangerously reactive material.

Hazardous Material Information System (U.S.A.) :

Health	*	2
Flammability		4
Physical hazards		2

National Fire Protection Association (U.S.A.) :

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

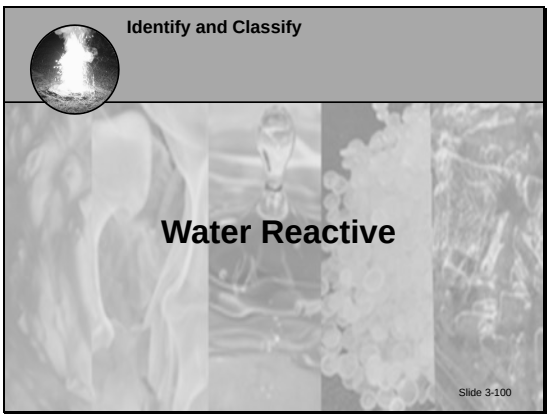
Build 1.1

Page: 7/7

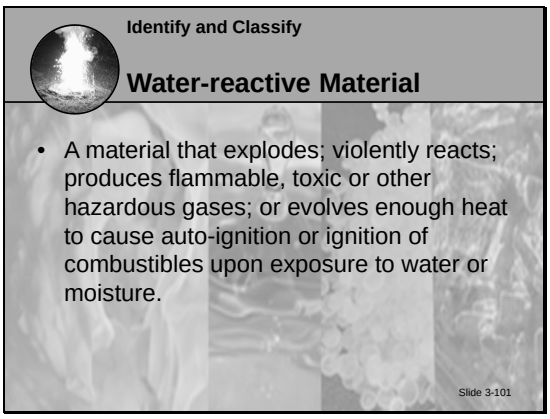
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

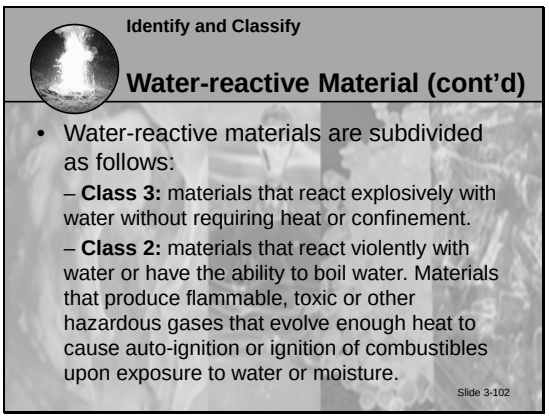
Slide 3-100



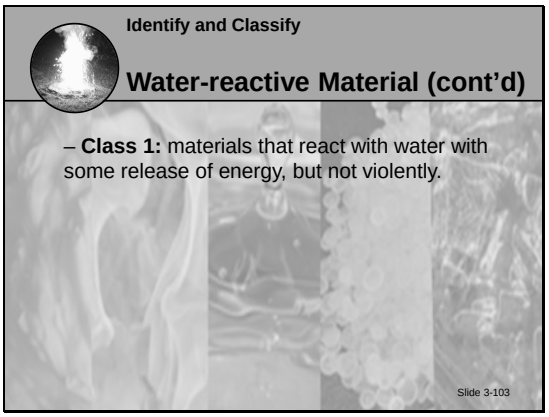
Slide 3-101



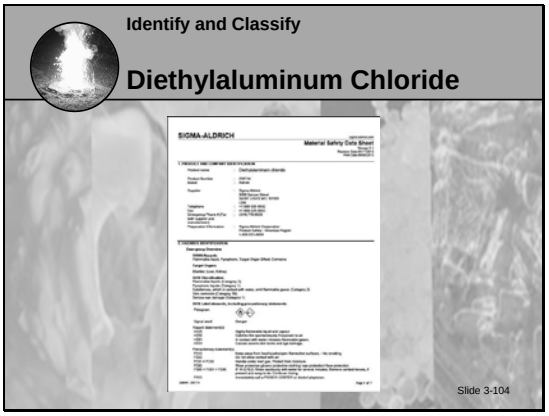
Slide 3-102



Slide 3-103



Slide 3-104



SIGMA-ALDRICH

sigma-aldrich.com

Material Safety Data Sheet

Version 5.1
Revision Date 05/17/2013
Print Date 09/08/2013

1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	Diethylaluminum chloride
Product Number	:	256714
Brand	:	Aldrich
Supplier	:	Sigma-Aldrich 3050 Spruce Street SAINT LOUIS MO 63103 USA
Telephone	:	+1 800-325-5832
Fax	:	+1 800-325-5052
Emergency Phone # (For both supplier and manufacturer)	:	(314) 776-6555
Preparation Information	:	Sigma-Aldrich Corporation Product Safety - Americas Region 1-800-521-8956

2. HAZARDS IDENTIFICATION

Emergency Overview

OSHA Hazards
Flammable liquid, Pyrophoric, Target Organ Effect, Corrosive

Target Organs

Bladder, Liver, Kidney

GHS Classification
Flammable liquids (Category 2)
Pyrophoric liquids (Category 1)
Substances, which in contact with water, emit flammable gases (Category 2)
Skin corrosion (Category 1B)
Serious eye damage (Category 1)

GHS Label elements, including precautionary statements

Pictogram

Signal word: Danger

Hazard statement(s)

H225	Highly flammable liquid and vapour.
H250	Catches fire spontaneously if exposed to air.
H261	In contact with water releases flammable gases.
H314	Causes severe skin burns and eye damage.

Precautionary statement(s)

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P222	Do not allow contact with air.
P231 + P232	Handle under inert gas. Protect from moisture.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/ physician.

P422	Store contents under inert gas.

HMIS Classification

Health hazard:	3
Chronic Health Hazard:	*
Flammability:	4
Physical hazards:	3

NFPA Rating

Health hazard:	3
Fire:	3
Reactivity Hazard:	3
Special hazard.:	W

Potential Health Effects

Inhalation	May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.
Skin	May be harmful if absorbed through skin. Causes skin burns.
Eyes	Causes eye burns.
Ingestion	May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms	:	Chloro diethyl aluminum
Formula	:	$C_4H_{10}AlCl$
Molecular Weight	:	120.56 g/mol

Component		Concentration
Diethylaluminium chloride		
CAS-No.	96-10-6	-
EC-No.	202-477-2	

4. FIRST AID MEASURES

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.Continue rinsing eyes during transport to hospital.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Suitable extinguishing media
Dry powder Carbon dioxide (CO2)

Extinguishing media which shall not be used for safety reasons
Water

Special protective equipment for firefighters
Wear self contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas, Aluminum oxide

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Methods and materials for containment and cleaning up
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Do not flush with water.

7. HANDLING AND STORAGE

Precautions for safe handling
Avoid inhalation of vapour or mist.
Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

Conditions for safe storage
Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.
Never allow product to get in contact with water during storage.

Air sensitive. Handle and store under inert gas.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Contains no substances with occupational exposure limit values.

Personal protective equipment

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands. Protective gloves against thermal risks

Eye protection
Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin and body protection
Complete suit protecting against chemicals, Flame retardant antistatic protective clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	liquid
Colour	colourless

Safety data

pH	no data available
Melting point/freezing point	Melting point/range: -50 °C (-58 °F) - lit.
Boiling point	125 - 126 °C (257 - 259 °F) at 67 hPa (50 mmHg) - lit.
Flash point	-18 °C (0 °F) - closed cup
Ignition temperature	no data available
Auto-ignition temperature	no data available
Lower explosion limit	no data available
Upper explosion limit	no data available
Vapour pressure	4 hPa (3 mmHg) at 60 °C (140 °F)
Density	0.961 g/cm3 at 25 °C (77 °F)
Water solubility	no data available
Partition coefficient: n-octanol/water	no data available
Relative vapour density	no data available
Odour	no data available
Odour Threshold	no data available
Evapouration rate	no data available

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions

Vapours may form explosive mixture with air.
Reacts violently with water.

Conditions to avoid
Do not allow water to enter container.
Heat, flames and sparks. Extremes of temperature and direct sunlight. Exposure to moisture.

Materials to avoid
Reacts violently with water., Oxygen, Oxidizing agents, acids, Bases

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas, Aluminum oxide
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50
Inhalation LC50

LC50 Inhalation - rat - 11,000 mg/m3

Dermal LD50
no data available

Other information on acute toxicity
no data available

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
no data available

Respiratory or skin sensitisation
no data available

Germ cell mutagenicity
no data available

Carcinogenicity

IARC:	No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

no data available

Teratogenicity

no data available

Specific target organ toxicity - single exposure (Globally Harmonized System)
no data available

Specific target organ toxicity - repeated exposure (Globally Harmonized System)
no data available

Aspiration hazard
no data available

Potential health effects

Inhalation	May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.
Ingestion	May be harmful if swallowed.
Skin	May be harmful if absorbed through skin. Causes skin burns.
Eyes	Causes eye burns.

Signs and Symptoms of Exposure
Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., Cough, Shortness of breath, Headache, Nausea

Synergistic effects
no data available

Additional Information
RTECS: BD0558000

12. ECOLOGICAL INFORMATION

Toxicity

no data available

Persistence and degradability
no data available

Bioaccumulative potential
no data available

Mobility in soil
no data available

PBT and vPvB assessment
no data available

Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS

Product
Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3394 Class: 4.2 (4.3) Packing group: I
Proper shipping name: Organometallic substance, liquid, pyrophoric, water-reactive (Diethylaluminium chloride)
Marine pollutant: No
Poison Inhalation Hazard: No

IMDG
UN number: 3394 Class: 4.2 (4.3) Packing group: I EMS-No: F-G, S-M
Proper shipping name: ORGANOMETALLIC SUBSTANCE, LIQUID, PYROPHORIC, WATER-REACTIVE (Diethylaluminium chloride)
Marine pollutant: No

IATA
UN number: 3394 Class: 4.2 (4.3)
Proper shipping name: Organometallic substance, liquid, pyrophoric, water-reactive (Diethylaluminium chloride)
IATA Passenger: Not permitted for transport
IATA Cargo: Not permitted for transport

15. REGULATORY INFORMATION

OSHA Hazards
Flammable liquid, Pyrophoric, Target Organ Effect, Corrosive

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Fire Hazard, Reactivity Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Diethylaluminium chloride	96-10-6	2007-03-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Diethylaluminium chloride	96-10-6	2007-03-01

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

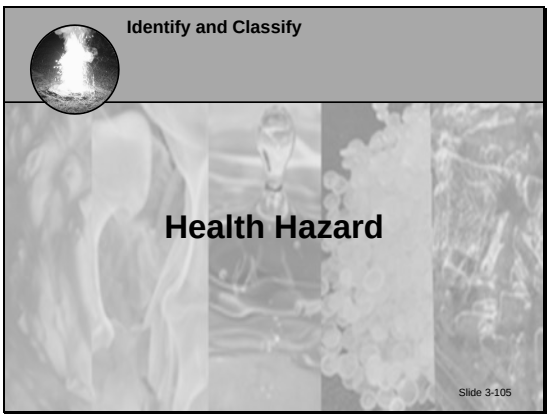
16. OTHER INFORMATION

Further information
Copyright 2013 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

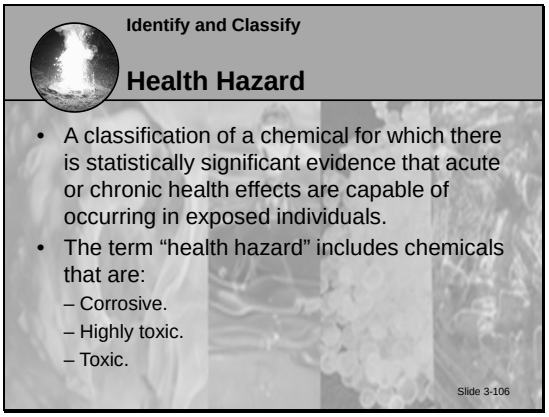
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

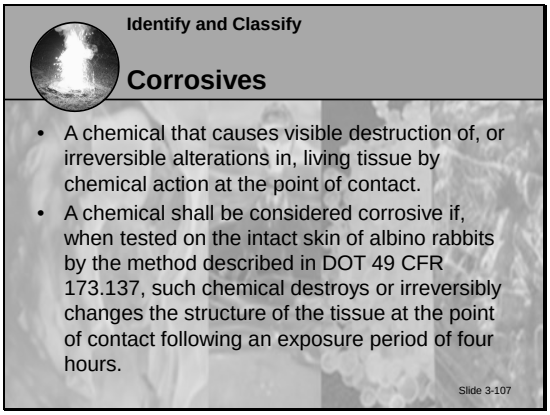
Slide 3-105



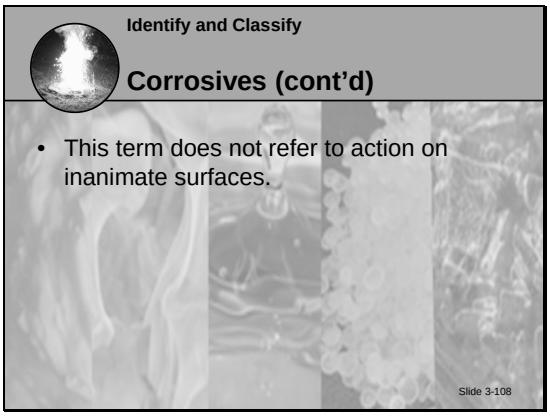
Slide 3-106



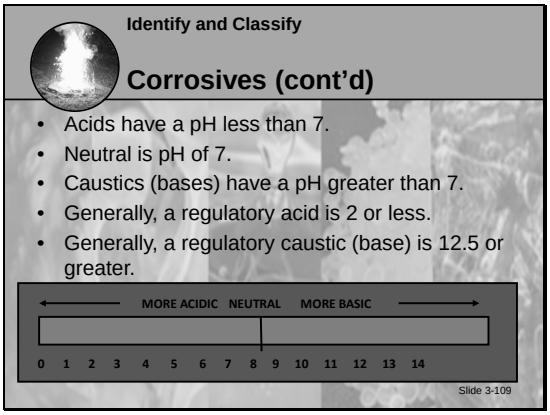
Slide 3-107



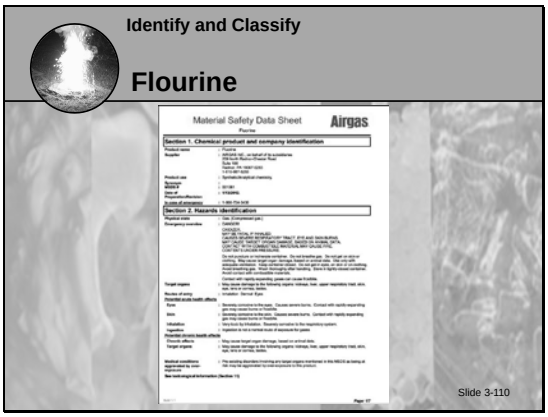
Slide 3-108



Slide 3-109



Slide 3-110



Material Safety Data Sheet

Airgas

Fluorine

Section 1. Chemical product and company identification

Product name	: Fluorine
Supplier	: AIRGAS INC., on behalf of its subsidiaries 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
Product use	: Synthetic/Analytical chemistry.
Synonym	:
MSDS #	: 001061
Date of Preparation/Revision	: **1/13/2012.**
In case of emergency	: 1-866-734-3438

Section 2. Hazards identification

Physical state	: Gas. [Compressed gas.]
Emergency overview	: DANGER! OXIDIZER. MAY BE FATAL IF INHALED. CAUSES SEVERE RESPIRATORY TRACT, EYE AND SKIN BURNS. MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA. CONTACT WITH COMBUSTIBLE MATERIAL MAY CAUSE FIRE. CONTENTS UNDER PRESSURE. Do not puncture or incinerate container. Do not breathe gas. Do not get on skin or clothing. May cause target organ damage, based on animal data. Use only with adequate ventilation. Keep container closed. Do not get in eyes, on skin or on clothing. Avoid breathing gas. Wash thoroughly after handling. Store in tightly-closed container. Avoid contact with combustible materials. Contact with rapidly expanding gases can cause frostbite.
Target organs	: May cause damage to the following organs: kidneys, liver, upper respiratory tract, skin, eye, lens or cornea, testes.
Routes of entry	: Inhalation Dermal Eyes
Potential acute health effects	
Eyes	: Severely corrosive to the eyes. Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.
Skin	: Severely corrosive to the skin. Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation	: Very toxic by inhalation. Severely corrosive to the respiratory system.
Ingestion	: Ingestion is not a normal route of exposure for gases
Potential chronic health effects	
Chronic effects	: May cause target organ damage, based on animal data.
Target organs	: May cause damage to the following organs: kidneys, liver, upper respiratory tract, skin, eye, lens or cornea, testes.
Medical conditions aggravated by over-exposure	: Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (Section 11)

Fluorine

Section 3. Composition, Information on Ingredients

Name	CAS number	% Volume	Exposure limits
Fluorine	7782-41-4	100	**ACGIH TLV (United States, 2/2010).** STEL: 3.1 mg/m³ 15 minute(s). STEL: 2 ppm 15 minute(s). TWA: 1.6 mg/m³ 8 hour(s). TWA: 1 ppm 8 hour(s). **NIOSH REL (United States, 6/2009).** TWA: 0.2 mg/m³ 10 hour(s). TWA: 0.1 ppm 10 hour(s). **OSHA PEL (United States, 6/2010).** TWA: 0.2 mg/m³ 8 hour(s). TWA: 0.1 ppm 8 hour(s). **OSHA PEL 1989 (United States, 3/1989).** TWA: 0.2 mg/m³ 8 hour(s). TWA: 0.1 ppm 8 hour(s).

Section 4. First aid measures

No action shall be taken involving any personal risk or without suitable training.If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus.It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Eye contact : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention 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. Clean shoes thoroughly before reuse. Get medical attention immediately.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Inhalation : Call medical doctor or poison control center immediately. Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : As this product is a gas, refer to the inhalation section.

Section 5. Fire-fighting measures

Flammability of the product : Non-flammable.

Products of combustion : Decomposition products may include the following materials:
halogenated compounds

Fire hazards in the presence of various substances : Extremely flammable in the presence of the following materials or conditions: reducing materials, combustible materials and organic materials.

Fire-fighting media and instructions : Use an extinguishing agent suitable for the surrounding fire.

Apply water from a safe distance to cool container and protect surrounding area. If involved in fire, shut off flow immediately if it can be done without risk.

Contains gas under pressure. Contact with combustible material may cause fire. This material increases the risk of fire and may aid combustion. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Fluorine

Section 6. Accidental release measures

Personal precautions : Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment (section 8). Eliminate all ignition sources if safe to do so. Do not touch or walk through spilled material. Shut off gas supply if this can be done safely. Isolate area until gas has dispersed.

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Section 7. Handling and storage

Handling : Use only with adequate ventilation. Wash thoroughly after handling. High pressure gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Do not get in eyes, on skin or on clothing. Keep container closed. Do not get on skin or clothing. Store in tightly-closed container. Avoid contact with combustible materials. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Storage : Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Personal protection

Eyes : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

The applicable standards are (US) 29 CFR 1910.134 and (Canada) Z94.4-93

Hands : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Personal protection in case of a large spill : Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product. Full chemical-resistant suit and self-contained breathing apparatus should be worn only by trained and authorized persons.

Product name

fluorine

ACGIH TLV (United States, 2/2010).
STEL: 3.1 mg/m³ 15 minute(s).
STEL: 2 ppm 15 minute(s).
TWA: 1.6 mg/m³ 8 hour(s).
TWA: 1 ppm 8 hour(s).
NIOSH REL (United States, 6/2009).
TWA: 0.2 mg/m³ 10 hour(s).
TWA: 0.1 ppm 10 hour(s).
OSHA PEL (United States, 6/2010).
TWA: 0.2 mg/m³ 8 hour(s).
TWA: 0.1 ppm 8 hour(s).
OSHA PEL 1989 (United States, 3/1989).

Fluorine

TWA: 0.2 mg/m³ 8 hour(s).
TWA: 0.1 ppm 8 hour(s).

Consult local authorities for acceptable exposure limits.

Section 9. Physical and chemical properties

Molecular weight	: 38 g/mole
Molecular formula	: F2
Boiling/condensation point	: -188°C (-306.4°F)
Melting/freezing point	: -219.61°C (-363.3°F)
Critical temperature	: -128.5°C (-199.3°F)
Vapor density	: 1.312 (Air = 1)
Specific Volume (ft ³/lb)	: 10.2041
Gas Density (lb/ft ³)	: 0.098

Section 10. Stability and reactivity

Stability and reactivity	: The product is stable.
Incompatibility with various substances	: Extremely reactive or incompatible with the following materials: reducing materials, combustible materials, organic materials, metals, alkalis and moisture.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Toxicity data

Product/ingredient name	Result	Species	Dose	Exposure
fluorine	LC50 Inhalation Vapor	Rat	1250 mg/m3	5 minutes
	LC50 Inhalation Vapor	Rat	250 mg/m3	60 minutes
	LC50 Inhalation Gas.	Rat	185 ppm	1 hours
	LC50 Inhalation Gas.	Rat	185 ppm	1 hours
	LC50 Inhalation Gas.	Mouse	150 ppm	1 hours

IDLH	: 25 ppm
Chronic effects on humans	: May cause damage to the following organs: kidneys, liver, upper respiratory tract, skin, eye, lens or cornea, testes.
Other toxic effects on humans	: Extremely hazardous by the following route of exposure: of skin contact (corrosive), of eye contact (corrosive), of inhalation (lung corrosive).

Specific effects

Carcinogenic effects	: No known significant effects or critical hazards.
Mutagenic effects	: No known significant effects or critical hazards.
Reproduction toxicity	: No known significant effects or critical hazards.

Section 12. Ecological information

Aquatic ecotoxicity

Product/ingredient name	Test	Result	Species	Exposure
fluorine	-	Acute EC50 >60000 ug/L Fresh water	Aquatic plants - Duckweed - Lemna minor	4 days

Environmental fate	: Not available.
Environmental hazards	: No known significant effects or critical hazards.

Build 1.1

Page: 4/7

Fluorine

Toxicity to the environment : Not available.

Section 13. Disposal considerations

Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, local regulation.Return cylinders with residual product to Airgas, Inc.Do not dispose of locally.

Section 14. Transport information

Regulatory information	UN number	Proper shipping name	Class	Packing group	Label	Additional information
DOT Classification	UN1045	FLUORINE, COMPRESSED	2.3	Not applicable (gas).		Inhalation hazard zone A **Reportable quantity** 10 lbs. (4.54 kg) **Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: Forbidden. **Special provisions** 1
TDG Classification	UN1045	FLUORINE, COMPRESSED	2.3	Not applicable (gas).		**Explosive Limit and Limited Quantity Index** 0 **ERAP Index** 25 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** Forbidden **Special provisions**

Build 1.1

Page: 5/7

Fluorine						
						38
Mexico Classification	UN1045	FLUORINE, COMPRESSED	2.3	Not applicable (gas).		-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 15. Regulatory information

United States

U.S. Federal regulations : **TSCA 8(a) IUR**: Not determined
United States Inventory (TSCA 8b): This material is listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: fluorine
SARA 302/304 emergency planning and notification: fluorine
SARA 302/304/311/312 hazardous chemicals: fluorine
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: fluorine: Fire hazard, reactive, Sudden release of pressure, Immediate (acute) health hazard

Clean Air Act (CAA) 112 accidental release prevention - Toxic Substances:
Fluorine

Clean Air Act (CAA) 112 regulated toxic substances: fluorine

SARA 313

	Product name	CAS number	Concentration
Form R - Reporting requirements :	Fluorine	7782-41-4	100
Supplier notification :	Fluorine	7782-41-4	100

SARA 313 notifications must not be detached from the MSDS and any copying and redistribution of the MSDS shall include copying and redistribution of the notice attached to copies of the MSDS subsequently redistributed.

State regulations : **Connecticut Carcinogen Reporting**: This material is not listed.
Connecticut Hazardous Material Survey: This material is not listed.
Florida substances: This material is not listed.
Illinois Chemical Safety Act: This material is not listed.
Illinois Toxic Substances Disclosure to Employee Act: This material is not listed.
Louisiana Reporting: This material is not listed.
Louisiana Spill: This material is not listed.
Massachusetts Spill: This material is not listed.
Massachusetts Substances: This material is listed.
Michigan Critical Material: This material is not listed.
Minnesota Hazardous Substances: This material is not listed.
New Jersey Hazardous Substances: This material is listed.
New Jersey Spill: This material is not listed.
New Jersey Toxic Catastrophe Prevention Act: This material is listed.
New York Acutely Hazardous Substances: This material is listed.
New York Toxic Chemical Release Reporting: This material is not listed.
Pennsylvania RTK Hazardous Substances: This material is listed.
Rhode Island Hazardous Substances: This material is not listed.

Canada

Fluorine

WHMIS (Canada) : Class A: Compressed gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).
Class E: Corrosive material
Class F: Dangerously reactive material.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

United States

Label requirements : OXIDIZER.
MAY BE FATAL IF INHALED.
CAUSES SEVERE RESPIRATORY TRACT, EYE AND SKIN BURNS.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CONTACT WITH COMBUSTIBLE MATERIAL MAY CAUSE FIRE.
CONTENTS UNDER PRESSURE.

Canada

Label requirements : Class A: Compressed gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).
Class E: Corrosive material
Class F: Dangerously reactive material.

Hazardous Material Information System (U.S.A.) :

Health	*	4
Flammability		0
Physical hazards		4

National Fire Protection Association (U.S.A.) :

Notice to reader

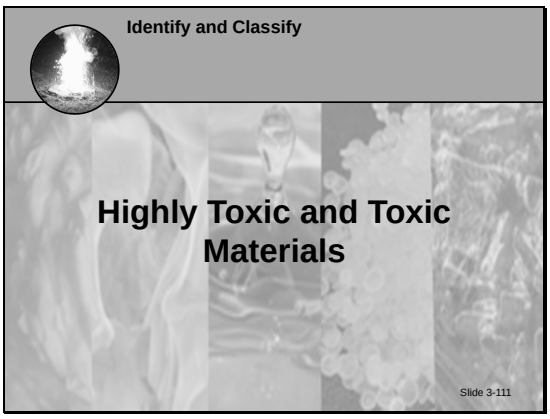
To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Build 1.1 ***Page: 7/7***

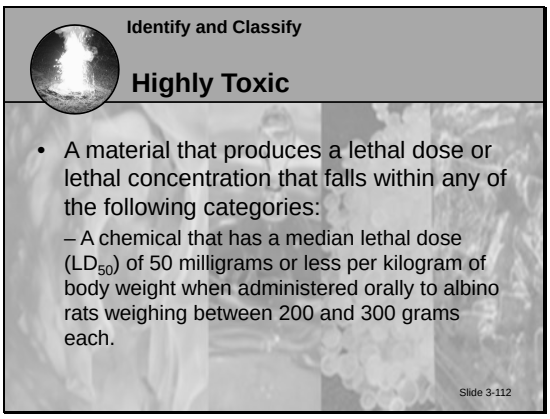
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

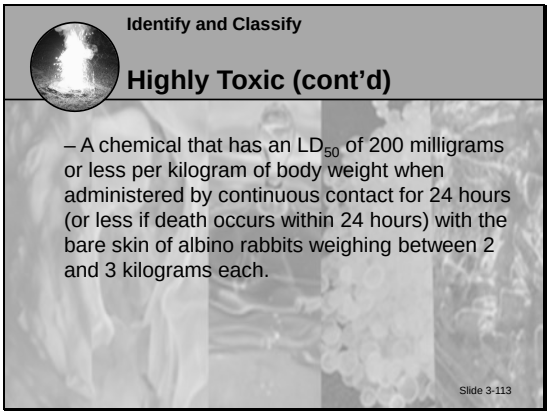
Slide 3-111



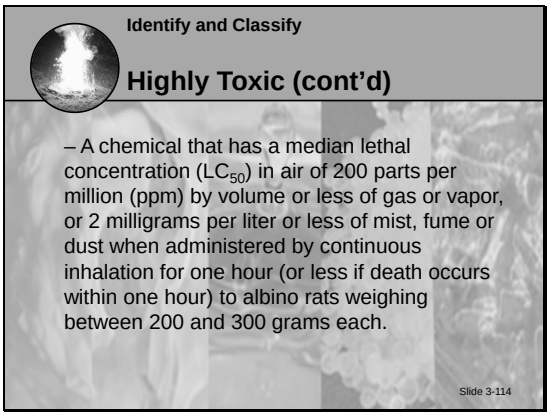
Slide 3-112



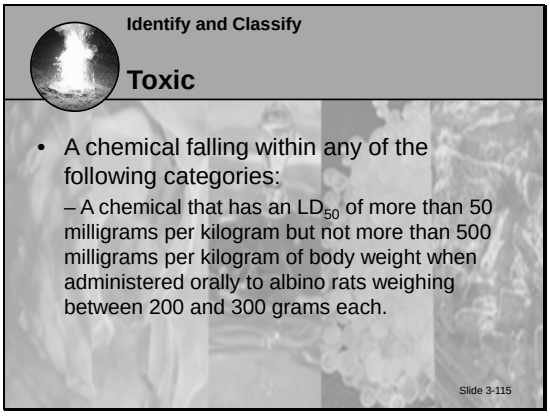
Slide 3-113



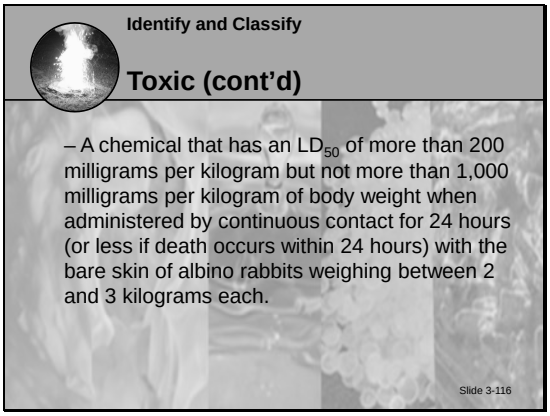
Slide 3-114



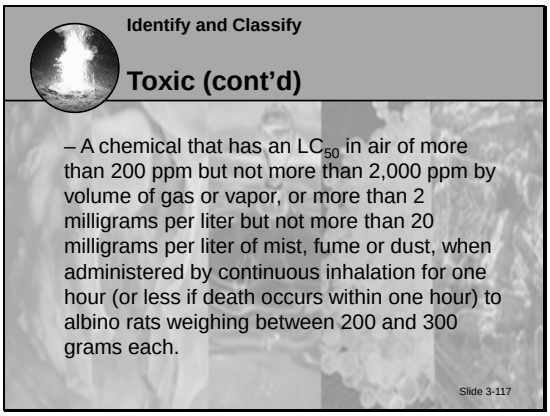
Slide 3-115



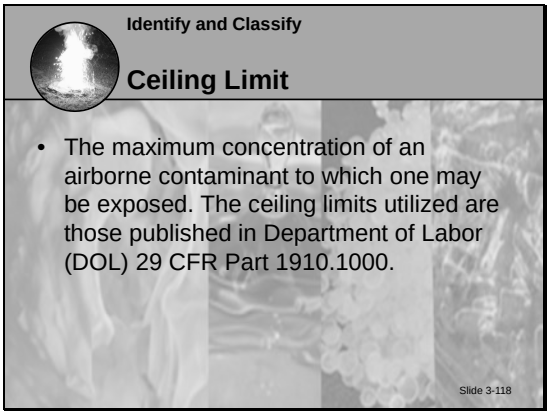
Slide 3-116



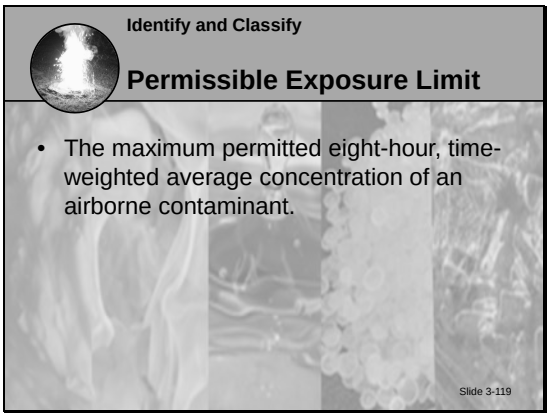
Slide 3-117



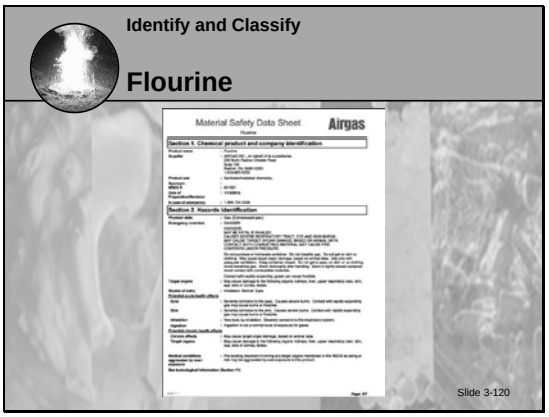
Slide 3-118



Slide 3-119



Slide 3-120


Identify and Classify
Flourine
Material Safety Data Sheet
Airgas
Section 1. Chemical product and company identification
Section 2. Hazards identification
Slide 3-120

Material Safety Data Sheet

Airgas

Fluorine

Section 1. Chemical product and company identification

Product name	:	Fluorine
Supplier	:	AIRGAS INC., on behalf of its subsidiaries 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
Product use	:	Synthetic/Analytical chemistry.
Synonym	:	
MSDS #	:	001061
Date of Preparation/Revision	:	**1/13/2012.**
In case of emergency	:	1-866-734-3438

Section 2. Hazards identification

Physical state	:	Gas. [Compressed gas.]
Emergency overview	:	DANGER! OXIDIZER. MAY BE FATAL IF INHALED. CAUSES SEVERE RESPIRATORY TRACT, EYE AND SKIN BURNS. MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA. CONTACT WITH COMBUSTIBLE MATERIAL MAY CAUSE FIRE. CONTENTS UNDER PRESSURE. Do not puncture or incinerate container. Do not breathe gas. Do not get on skin or clothing. May cause target organ damage, based on animal data. Use only with adequate ventilation. Keep container closed. Do not get in eyes, on skin or on clothing. Avoid breathing gas. Wash thoroughly after handling. Store in tightly-closed container. Avoid contact with combustible materials. Contact with rapidly expanding gases can cause frostbite.
Target organs	:	May cause damage to the following organs: kidneys, liver, upper respiratory tract, skin, eye, lens or cornea, testes.
Routes of entry	:	Inhalation Dermal Eyes
Potential acute health effects		
Eyes	:	Severely corrosive to the eyes. Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.
Skin	:	Severely corrosive to the skin. Causes severe burns. Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation	:	Very toxic by inhalation. Severely corrosive to the respiratory system.
Ingestion	:	Ingestion is not a normal route of exposure for gases
Potential chronic health effects		
Chronic effects	:	May cause target organ damage, based on animal data.
Target organs	:	May cause damage to the following organs: kidneys, liver, upper respiratory tract, skin, eye, lens or cornea, testes.
Medical conditions aggravated by over-exposure	:	Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (Section 11)

Build 1.1

Page: 1/7

Fluorine

Section 3. Composition, Information on Ingredients

Name	CAS number	% Volume	Exposure limits
Fluorine	7782-41-4	100	**ACGIH TLV (United States, 2/2010).** STEL: 3.1 mg/m³ 15 minute(s). STEL: 2 ppm 15 minute(s). TWA: 1.6 mg/m³ 8 hour(s). TWA: 1 ppm 8 hour(s). **NIOSH REL (United States, 6/2009).** TWA: 0.2 mg/m³ 10 hour(s). TWA: 0.1 ppm 10 hour(s). **OSHA PEL (United States, 6/2010).** TWA: 0.2 mg/m³ 8 hour(s). TWA: 0.1 ppm 8 hour(s). **OSHA PEL 1989 (United States, 3/1989).** TWA: 0.2 mg/m³ 8 hour(s). TWA: 0.1 ppm 8 hour(s).

Section 4. First aid measures

No action shall be taken involving any personal risk or without suitable training.If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus.It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Eye contact : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention 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. Clean shoes thoroughly before reuse. Get medical attention immediately.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Inhalation : Call medical doctor or poison control center immediately. Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : As this product is a gas, refer to the inhalation section.

Section 5. Fire-fighting measures

Flammability of the product : Non-flammable.

Products of combustion : Decomposition products may include the following materials: halogenated compounds

Fire hazards in the presence of various substances : Extremely flammable in the presence of the following materials or conditions: reducing materials, combustible materials and organic materials.

Fire-fighting media and instructions : Use an extinguishing agent suitable for the surrounding fire.

Apply water from a safe distance to cool container and protect surrounding area. If involved in fire, shut off flow immediately if it can be done without risk.

Contains gas under pressure. Contact with combustible material may cause fire. This material increases the risk of fire and may aid combustion. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Fluorine

Section 6. Accidental release measures

Personal precautions : Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment (section 8). Eliminate all ignition sources if safe to do so. Do not touch or walk through spilled material. Shut off gas supply if this can be done safely. Isolate area until gas has dispersed.

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Section 7. Handling and storage

Handling : Use only with adequate ventilation. Wash thoroughly after handling. High pressure gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Do not get in eyes, on skin or on clothing. Keep container closed. Do not get on skin or clothing. Store in tightly-closed container. Avoid contact with combustible materials. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Storage : Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Personal protection

Eyes : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

The applicable standards are (US) 29 CFR 1910.134 and (Canada) Z94.4-93

Hands : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Personal protection in case of a large spill : Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product. Full chemical-resistant suit and self-contained breathing apparatus should be worn only by trained and authorized persons.

Product name

fluorine

ACGIH TLV (United States, 2/2010).
STEL: 3.1 mg/m³ 15 minute(s).
STEL: 2 ppm 15 minute(s).
TWA: 1.6 mg/m³ 8 hour(s).
TWA: 1 ppm 8 hour(s).
NIOSH REL (United States, 6/2009).
TWA: 0.2 mg/m³ 10 hour(s).
TWA: 0.1 ppm 10 hour(s).
OSHA PEL (United States, 6/2010).
TWA: 0.2 mg/m³ 8 hour(s).
TWA: 0.1 ppm 8 hour(s).
OSHA PEL 1989 (United States, 3/1989).

Build 1.1

Page: 3/7

Fluorine

TWA: 0.2 mg/m³ 8 hour(s).
TWA: 0.1 ppm 8 hour(s).

Consult local authorities for acceptable exposure limits.

Section 9. Physical and chemical properties

Molecular weight	: 38 g/mole
Molecular formula	: F2
Boiling/condensation point	: -188°C (-306.4°F)
Melting/freezing point	: -219.61°C (-363.3°F)
Critical temperature	: -128.5°C (-199.3°F)
Vapor density	: 1.312 (Air = 1)
Specific Volume (ft ³/lb)	: 10.2041
Gas Density (lb/ft ³)	: 0.098

Section 10. Stability and reactivity

Stability and reactivity	: The product is stable.
Incompatibility with various substances	: Extremely reactive or incompatible with the following materials: reducing materials, combustible materials, organic materials, metals, alkalis and moisture.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Toxicity data

Product/ingredient name	Result	Species	Dose	Exposure
fluorine	LC50 Inhalation Vapor	Rat	1250 mg/m3	5 minutes
	LC50 Inhalation Vapor	Rat	250 mg/m3	60 minutes
	LC50 Inhalation Gas.	Rat	185 ppm	1 hours
	LC50 Inhalation Gas.	Rat	185 ppm	1 hours
	LC50 Inhalation Gas.	Mouse	150 ppm	1 hours

IDLH	: 25 ppm
Chronic effects on humans	: May cause damage to the following organs: kidneys, liver, upper respiratory tract, skin, eye, lens or cornea, testes.
Other toxic effects on humans	: Extremely hazardous by the following route of exposure: of skin contact (corrosive), of eye contact (corrosive), of inhalation (lung corrosive).

Specific effects

Carcinogenic effects	: No known significant effects or critical hazards.
Mutagenic effects	: No known significant effects or critical hazards.
Reproduction toxicity	: No known significant effects or critical hazards.

Section 12. Ecological information

Aquatic ecotoxicity

Product/ingredient name	Test	Result	Species	Exposure
fluorine	-	Acute EC50 >60000 ug/L Fresh water	Aquatic plants - Duckweed - Lemna minor	4 days

Environmental fate	: Not available.
Environmental hazards	: No known significant effects or critical hazards.

Build 1.1

Page: 4/7

Fluorine

Toxicity to the environment : Not available.

Section 13. Disposal considerations

Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, local regulation.Return cylinders with residual product to Airgas, Inc.Do not dispose of locally.

Section 14. Transport information

Regulatory Information	UN number	Proper shipping name	Class	Packing group	Label	Additional Information
DOT Classification	UN1045	FLUORINE, COMPRESSED	2.3	Not applicable (gas).		Inhalation hazard zone A **Reportable quantity** 10 lbs. (4.54 kg) **Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: Forbidden. **Special provisions** 1
TDG Classification	UN1045	FLUORINE, COMPRESSED	2.3	Not applicable (gas).		**Explosive Limit and Limited Quantity Index** 0 **ERAP Index** 25 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** Forbidden **Special provisions**

Fluorine						
						38
Mexico Classification	UN1045	FLUORINE, COMPRESSED	2.3	Not applicable (gas).		-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 15. Regulatory information

United States

U.S. Federal regulations : **TSCA 8(a) IUR**: Not determined
United States inventory (TSCA 8b): This material is listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: fluorine
SARA 302/304 emergency planning and notification: fluorine
SARA 302/304/311/312 hazardous chemicals: fluorine
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: fluorine: Fire hazard, reactive, Sudden release of pressure, Immediate (acute) health hazard

Clean Air Act (CAA) 112 accidental release prevention - Toxic Substances:
Fluorine

Clean Air Act (CAA) 112 regulated toxic substances: fluorine

SARA 313

	Product name	CAS number	Concentration
Form R - Reporting requirements :	Fluorine	7782-41-4	100
Supplier notification :	Fluorine	7782-41-4	100

SARA 313 notifications must not be detached from the MSDS and any copying and redistribution of the MSDS shall include copying and redistribution of the notice attached to copies of the MSDS subsequently redistributed.

State regulations : **Connecticut Carcinogen Reporting**: This material is not listed.
Connecticut Hazardous Material Survey: This material is not listed.
Florida substances: This material is not listed.
Illinois Chemical Safety Act: This material is not listed.
Illinois Toxic Substances Disclosure to Employee Act: This material is not listed.
Louisiana Reporting: This material is not listed.
Louisiana Spill: This material is not listed.
Massachusetts Spill: This material is not listed.
Massachusetts Substances: This material is listed.
Michigan Critical Material: This material is not listed.
Minnesota Hazardous Substances: This material is not listed.
New Jersey Hazardous Substances: This material is listed.
New Jersey Spill: This material is not listed.
New Jersey Toxic Catastrophe Prevention Act: This material is listed.
New York Acutely Hazardous Substances: This material is listed.
New York Toxic Chemical Release Reporting: This material is not listed.
Pennsylvania RTK Hazardous Substances: This material is listed.
Rhode Island Hazardous Substances: This material is not listed.

Canada

Fluorine

WHMIS (Canada) : Class A: Compressed gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).
Class E: Corrosive material
Class F: Dangerously reactive material.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

United States

Label requirements : OXIDIZER.
MAY BE FATAL IF INHALED.
CAUSES SEVERE RESPIRATORY TRACT, EYE AND SKIN BURNS.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CONTACT WITH COMBUSTIBLE MATERIAL MAY CAUSE FIRE.
CONTENTS UNDER PRESSURE.

Canada

Label requirements : Class A: Compressed gas.
Class D-1A: Material causing immediate and serious toxic effects (Very toxic).
Class E: Corrosive material
Class F: Dangerously reactive material.

Hazardous Material Information System (U.S.A.) :

Health	*	4
Flammability		0
Physical hazards		4

National Fire Protection Association (U.S.A.) :

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Build 1.1 ***Page: 7/7***

This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

Slide 3-121

This page intentionally left blank.

Activity 3.2

Researching and Classifying Chemicals

Purpose

Use reference materials for classification.

Directions

1. Use the appropriate reference materials.
2. Given the name of a hazardous material, classify it in accordance with the classifications in the fire and building code.
3. As a large group, review the answers.
4. Discuss any questions.

This page intentionally left blank.

Activity 3.2 (cont'd)

Researching and Classifying Chemicals

Name	Hazard	Class
Cellulose nitrate		
Hydrogen peroxide solution (greater than 91 percent)		
Benzoyl peroxide (over 98 percent concentration)		
Phosphine		
Acrolein		
Lithium hydride		

This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

Slide 3-122

This page intentionally left blank.

Activity 3.3

Classify

Purpose

Given several Material Safety Data Sheets (MSDS)/Safety Data Sheets (SDS) on a hazardous material, classify the hazards that the materials present to the occupancy.

Directions

1 Read the memo from the Building Department.

2. Research the assigned MSDS/SDS to determine what hazards the materials present.

3. As a group, list on an easel pad the identified hazards, and classify the hazards as they would be found in the code.

4. Be prepared to present your classified hazards to the class.

5. The instructor will assign three MSDS to each group.

Memo

To: Central City Fire Prevention Bureau

From: Central City Fire Department

Re: Request for building permit File 627780

The Central City Building and Zoning Department has received an application for permits to build a new occupancy in the Central City Industrial Park. The applicant has indicated that the manufacturing process will involve using several chemicals. The applicant has provided the MSDS of those chemicals.

The Building Department is requesting that the Fire Prevention Bureau research the chemicals and properly classify them so that we can apply the appropriate section of the code in the plans review process.

Group Assignments

Group 1.

1. Gasoline.
2. Potassium Permanganate.
3. Sulfuric Acid.

Group 2.

1. Kerosene.
2. Sodium Hydroxide.
3. Benzoyl Peroxide.

Group 3.

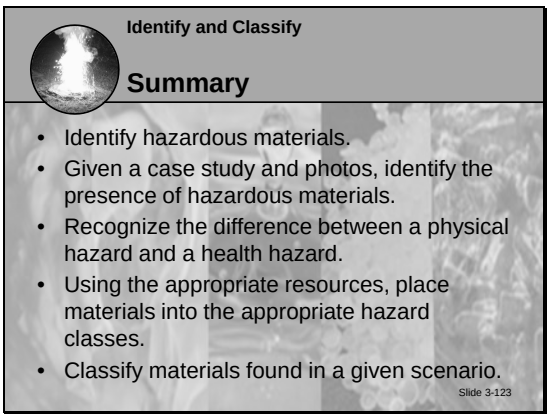
1. Methyl Alcohol.
2. Super Glue.
3. Nitric Acid.

Group 4.

1. Propane.
2. Diesel Fuel.
3. Tetrahydrofuran.

NOTE-TAKING GUIDE (cont'd)

Slide 3-123



This page intentionally left blank.

BACKGROUND TEXT

This page intentionally left blank.

IDENTIFY

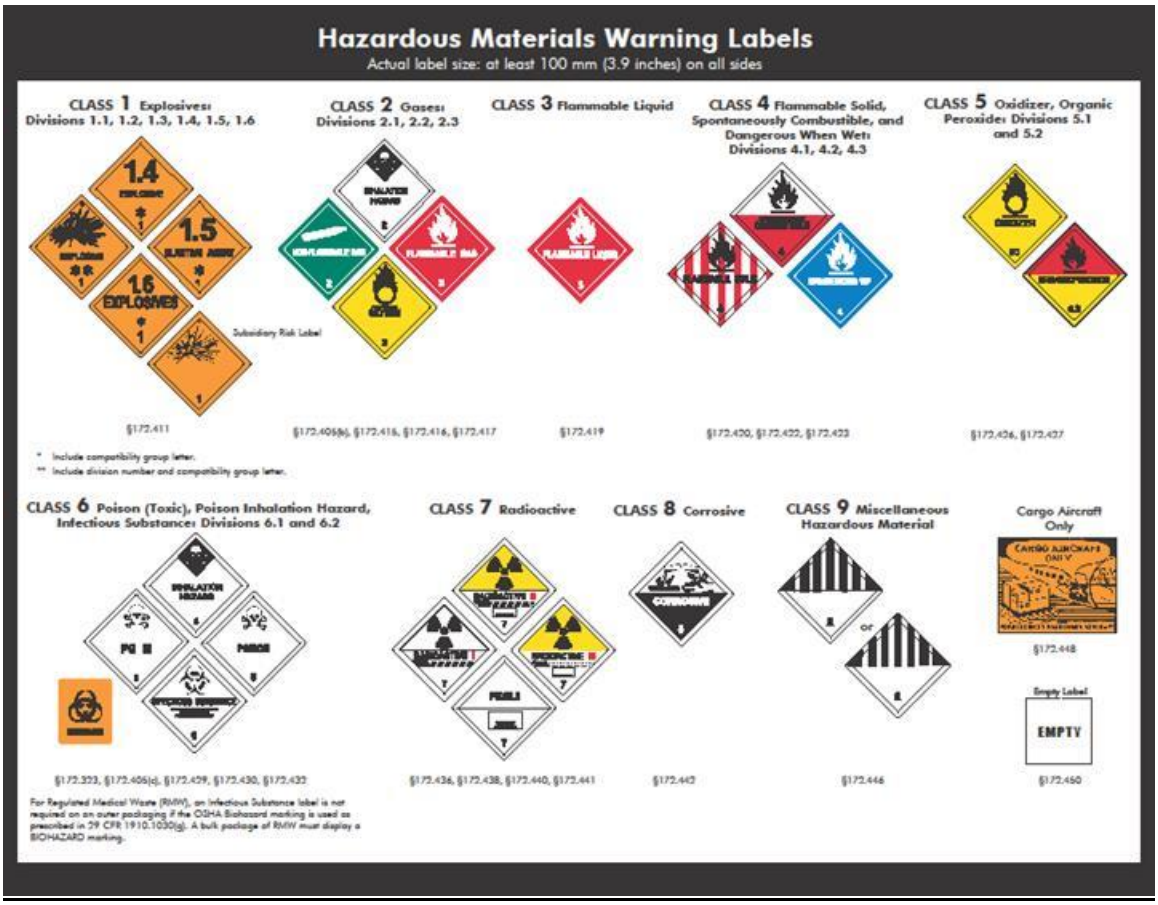
Chemicals are identified through a process of inspection. What is the occupancy and the location? What is the container shape, size and color? Are there placards, markings and labels?

There are various federal and state regulations regarding labels for shipping and storage.

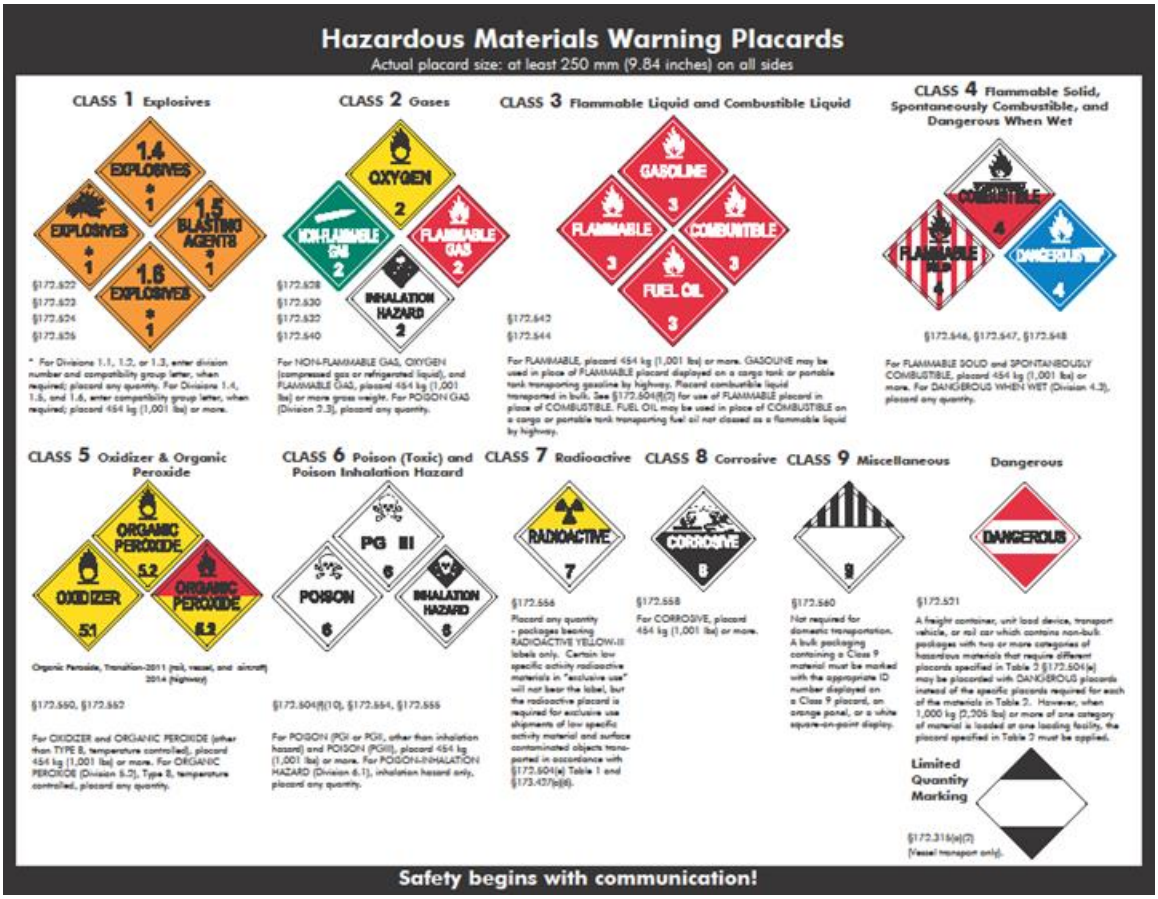
- Hazardous waste storage area.
- Satellite accumulation area.

National Fire Protection Assocation (NFPA) 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response* is similar to Department of Transportation (DOT) placards. This is recognized in model codes. Visual identification tools include recognition and identification, colors (don't be misled), shipping papers, and other documents: MSDS and product names. Senses indicate chemical characteristics.

Hazardous Materials Warning Labels



Hazardous Materials Warning Placards



Hazard Communication Standard Pictograms and Hazards

HCS Pictograms and Hazards

Health Hazard	Flame	Exclamation Mark
• Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	• Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides	• Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non Mandatory)
Gas Cylinder	**Corrosion**	**Exploding Bomb**
• Gases under Pressure	• Skin Corrosion/ burns • Eye Damage • Corrosive to Metals	• Explosives • Self-Reactives • Organic Peroxides
Flame over Circle	**Environment (Non Mandatory)**	**Skull and Crossbones**
• Oxidizers	• Aquatic Toxicity	• Acute Toxicity (fatal or toxic)

RESEARCHING AND CLASSIFYING CHEMICALS

Several government agencies have their own systems of classifying hazardous materials. While in some ways they appear similar to the building and fire code classification system, they generally serve a different purpose.

- United Nations (U.N.) (International Shipping).
- DOT (United States Transportation).
- Environmental Protection Agency (EPA) (Hazardous Waste).
- Occupational Safety and Health Administration (OSHA) (Workplace Safety).

OSHA has historically classified hazards as either physical or health hazards. Since OSHA focuses on workplace safety, its approach to hazardous materials safety was the basis for the system used in the building and fire code. So, the building and fire code uses the general hazard classes of “physical” or “health.”

Physical Hazard

A chemical that presents a fire or explosion hazard to a structure, such as:

- Combustible liquid.
- Cryogenic fluid.
- Explosive.
- Flammable (solid, liquid or gas).
- Organic peroxide (solid or liquid).
- Oxidizer (solid or liquid).
- Oxidizing gas.
- Pyrophoric (solid, liquid or gas).
- Unstable (reactive) material (solid, liquid or gas).
- Water-reactive material (solid or liquid).

Health Hazard

A classification of a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed individuals. The term “health hazard” includes chemicals that are:

- Toxic.
- Highly toxic.
- Corrosive.

Resources for Classification

Classification information — any information source that will either provide specific property characteristics of a chemical or classify the chemical according to the fire and building code.

- International Code Council (ICC) HMEx: The Hazardous Materials Expert Assistant, CD-ROM.

This is an electronic database specifically designed to classify hazardous materials according to fire and building code classifications.

There are other electronic databases out there that classify or categorize hazardous materials for other purposes but **not specifically for fire and building code classifications.**

- NFPA "Fire Protection Guide to Hazardous Materials."

  This NFPA book contains information on hazardous materials similar to that found on specific chemicals' MSDS.

- NFPA 1 Annex B: Hazardous Materials Classifications.

- International Fire Code (IFC) Appendix E: Hazard Categories.

  IFC Appendix E is the same material that is found in NFPA 1 Annex B.

MSDS — specific information may be obtained from the MSDS that can be compared to the parameters in the definition and used to classify the chemical.

Ancillary Definitions

Flash Point

Flash point is the minimum temperature in degrees Fahrenheit at which a liquid will give off sufficient vapors to form an ignitable mixture with air.

Flammable Range

Flammable range is the range between the lower flammable limit (LFL) and the upper flammable limit (UFL). The LFL is the minimum concentration of vapor in air at which propagation of flame will occur in the presence of an ignition source. The LFL is sometimes referred to as lower explosive limit (LEL). The UFL is the maximum concentration of vapor in air at which propagation of flame will occur in the presence of an ignition source. The UFL is sometimes referred to as upper explosive limit (UEL).

Vapor Pressure

Vapor pressure is the force exerted by a vapor against the sides of a container or against atmospheric pressure (normally at 68 F). It is also the pressure exerted by a volatile fluid, as determined in accordance with American Society for Testing and Materials (ASTM) D 323, at 100 F (Reid Vapor Pressure).

Boiling Point

Boiling point is the temperature at which the vapor pressure of a liquid equals the atmospheric pressure of 14.7 pounds per square inch absolute (psia) (101 kilopascals) or 760 millimeters of mercury.

Specific Gravity

Specific gravity is the weight of a chemical compared to water. If it is less than 1, then it will float, but if the specific gravity is greater than 1, then it will sink.

Water-miscible or Water-soluble

If a product is water-miscible or water-soluble, then it has the ability to mix or dissolve in water. These terms are often used interchangeably.

- Ability of product to mix or dissolve in water.
- Often used interchangeably.
- Specific gravity and miscibility/solubility.

Vapor Density

- Weight of a gas compared to air.
- If less than 1, the gas is lighter.
- If greater than 1, the gas is heavier.
- Also called “air specific gravity.”

Flammable and Combustible Liquids

Flammable Liquid

A flammable liquid is one having a closed-cup flash point below 100 F (38 C). Flammable liquids are further categorized into a group known as Class I liquids.

The Class I category is subdivided as follows:

Class IA — liquids having a flash point below 73 F (23 C) and having a boiling point below 100 F (38 C).

Class IB — liquids having a flash point below 73 F (23 C) and having a boiling point at or above 100 F (38 C).

Class IC — liquids having a flash point at or above 73 F (23 C) and below 100 F (38 C).

Combustible Liquid

A combustible liquid is one having a closed-cup flash point at or above 100 F (38 C). Combustible liquids shall be subdivided as follows:

Class II — liquids having a closed-cup flash point at or above 100 F (38 C) and below 140 F (60 C).

Class IIIA — liquids having a closed-cup flash point at or above 140 F (60 C) and below 200 F (93 C).

Class IIIB — liquids having a closed-cup flash point at or above 200 F (93 C).

Resources Specific to Flammable and Combustible Liquids

"NFPA 325M: Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids."

This NFPA book contains numerous flammable and combustible liquids in one place. Information similar to that found in this book can be found on specific chemicals' MSDS.

Gases (Flammable or Oxidizing)

A material or mixture of materials that is a gas at 68 F (20 C) or less at 14.7 psia (101 kilopascals) of pressure and has a **boiling point** of 68 F (20 C) or less at 14.7 psia (101 kilopascals), which is either liquefied, nonliquefied or in solution. Those gases that have no other health- or physical-hazard properties are not considered to be compressed until the pressure in the packaging exceeds 41 psia (28 kilopascals) at 68 F (20 C).

States of a Compressed Gas

Nonliquefied compressed gases are gases, other than those in solution, in a packaging under the charged pressure, and they are entirely gaseous at a temperature of 68 F (20 C). Liquefied compressed gases are gases that, in a packaging under the charged pressure, are partially liquid at a temperature of 68 F (20 C). Compressed gases in solution are nonliquefied gases that are dissolved in a solvent.

Flammable Gas

A material that is a gas at 68 F (20 C) or less at an absolute pressure of 14.7 psia (101.3 kilopascals) and either is ignitable at an absolute pressure of 14.7 psia (101.3 kilopascals) when in a mixture of 13 percent or less by volume with air or has a flammable range at an absolute pressure of 14.7 psia (101.3 kilopascals) with air of at least 12 percent, regardless of the lower limit.

Oxidizing Gas

A gas that can support and accelerate combustion of other materials more than air does.

Cryogenic (Flammable or Oxidizing)

Cryogenic fluid is a fluid having a boiling point lower than -130 F (-89.9 C) at 14.7 pounds per square inch (psi) atmosphere (an absolute pressure of 101.3 kilopascals).

Cryogenic fluids expand at a ratio of 1000-to-1. If spilled in a closed space, they can expand to displace air or cause a flammable atmosphere. Example: 40 gallons of liquid would expand to 5,347 cubic feet of gas or a room with dimensions 8 by 26 by 26 feet.

Liquefied Petroleum Gas (LPG)

LPG is any material having a vapor pressure not exceeding that allowed for commercial propane that is composed predominantly of the following hydrocarbons, either by themselves or as mixtures: propane, propylene, butane (normal butane or isobutane) and butylenes.

Explosives

An explosive is a chemical compound, mixture or device that has the primary or common purpose to function by explosion. The term includes, but is not limited to, dynamite, black powder, pellet powder, initiating explosives, detonators, safety fuses, squibs, detonating cord, igniter cord, igniters and display fireworks.

Division 1.1

Explosives that have a mass explosion hazard. A mass explosion is one that affects almost the entire load instantaneously.

Division 1.2

Explosives that have a projection hazard but not a mass explosion hazard.

Division 1.3

Explosives that have a fire hazard and a minor blast hazard, minor projection hazard or both, but not a mass explosion hazard.

Division 1.4

Explosives that pose a minor explosion hazard. The explosive effects are largely confined to the package.

Division 1.5

Very insensitive **explosives.** This division is comprised of substances that have a mass explosion hazard but are insensitive.

Division 1.6

Extremely insensitive articles that do not have a mass explosion hazard.

Classification Resources Specific to Explosives

Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) List of Explosive Materials. ATF produces a standardized list of what they consider explosives (found in this unit's Appendix C).

Flammable Solids

A solid, other than a blasting agent or explosive, that is capable of causing fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing. Or one that burns so vigorously and persistently when ignited as to create a serious hazard. A chemical shall be considered a flammable solid, as determined in accordance with the

test method of Consumer Product Safety Commission (CPSC) 16 CFR Part 1500.44, if it ignites and burns with a self-sustained flame at a rate greater than 0.1 inch (2.5 millimeters) per second along its major axis.

Examples include:

- Organic solids: camphor, cellulose nitrate, naphthalene (used in one form of moth balls).
- Inorganic solids: sulfur.
- Combustible metals (except dusts and powders): cesium, magnesium, zirconium.

Organic Peroxides

An organic peroxide is an organic compound that contains the bivalent -O-O- structure and may be considered to be a structural derivative of hydrogen peroxide (where one or both of the hydrogen atoms have been replaced by an organic radical).

Organic peroxides can present an explosion hazard (**detonation** or **deflagration**), or they can be shock-sensitive. They can also decompose into various unstable compounds over an extended period of time.

The highest hazard for an oxidizer is Class 4, whereas the highest hazard for organic peroxides is Class I.

Organic Peroxides Are Divided Into Several Classes

Class I — describes formulations that are capable of **deflagration** but not **detonation.**

Class II — describes formulations that burn very rapidly and pose a moderate reactivity hazard.

Class III — describes formulations that burn rapidly and pose a moderate reactivity hazard.

Class IV — describes formulations that burn in the same manner as ordinary combustibles and pose a minimal reactivity hazard.

Classification Resources Specific to Organic Peroxides

NFPA 400 Annex F: Typical Organic Peroxide Formulations.

Oxidizers

An oxidizer is a material that readily yields oxygen or another oxidizing gas or that readily reacts to promote or initiate combustion of combustible materials and, if heated or contaminated, can result in vigorous self-sustained decomposition.

The highest hazard for an oxidizer is Class 4, whereas the highest hazard for organic peroxides is Class I.

Oxidizers Are Divided Into Several Classes

Class 4: an oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock and causes a severe increase in the burning rate of combustible materials with which it comes into contact. Additionally, the oxidizer causes a severe increase in the burning rate and can cause spontaneous ignition of combustibles.

Class 3: an oxidizer that causes a severe increase in the burning rate of combustible materials with which it comes in contact.

Class 2: an oxidizer that will cause a moderate increase in the burning rate of combustible materials with which it comes in contact.

Class 1: an oxidizer that does not moderately increase the burning rate of combustible materials.

Classification Information Specific to Oxidizers

NFPA 400 Annex G: Oxidizers.

Pyrophorics

A chemical with an auto-ignition temperature in air that is at or below a temperature of 130 F (54 C).

Unstable (Reactive)

An unstable (reactive) is a material, other than an **explosive,** that in the pure state or as commercially produced will vigorously polymerize, decompose, condense or become self-reactive and undergo other violent chemical changes, including explosion, when exposed to heat, friction or shock; in the absence of an inhibitor; or in the presence of contaminants; or in contact with **incompatible materials.**

Unstable (reactive) materials are subdivided as follows:

Class 4: materials readily capable of **detonation,** explosive decomposition or explosive reaction at **normal temperatures and pressures.** This class includes materials that are sensitive to mechanical or localized thermal shock at **normal temperatures and pressures.**

Class 3: materials capable of **detonation,** explosive decomposition or explosive reaction, but which require a strong initiating source or must be heated under confinement before initiation. This class includes materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.

Class 2: materials that in themselves are normally unstable and readily undergo violent chemical change but do not detonate. This class includes materials that can undergo chemical change with rapid release of energy at **normal temperatures and pressures** and violent chemical change at elevated temperatures and pressures.

Class 1: materials that, in themselves, are normally stable but can become unstable at elevated temperatures and pressures.

Water Reactive

A material that explodes; violently reacts; produces flammable, toxic or other hazardous gases; or evolves enough heat to cause auto-ignition or ignition of combustibles upon exposure to water or moisture.

Water-reactive materials are subdivided as follows:

Class 3: materials that react explosively with water without requiring heat or confinement.

Class 2: materials that react violently with water or have the ability to boil water. Materials that produce flammable, toxic or other hazardous gases or materials that evolve enough heat to cause auto-ignition or ignition of combustibles upon exposure to water or moisture.

Class 1: materials that react with water with some release of energy, but not in a violent manner.

HEALTH HAZARD

Health hazard is a classification for a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed individuals.

The term “health hazard” includes chemicals that are:

- Corrosive.

- Highly Toxic.
- Toxic.

Corrosive

A corrosive is a chemical that causes visible destruction of, or irreversible alterations in, living tissue at the point of contact. A chemical shall be considered corrosive if, when tested on the intact skin of albino rabbits by the method described in DOT 49 CFR 173.137, the chemical destroys or irreversibly changes the structure of the tissue at the point of contact following an exposure period of four hours. This term does not refer to action on inanimate surfaces.

- Acids have a pH less than 7.
- Neutral is pH of 7.
- Caustics (bases) have a pH greater than 7.
- Generally, a regulatory acid is 2 or less.
- Generally, a regulatory caustic (base) is 12.5 or greater.

Highly Toxic

A material that produces a lethal dose or lethal concentration that falls within any of the following categories is highly toxic:

- 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.
- A chemical that has an 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.
- A chemical that has a median lethal concentration (LC_{50}) in air of 200 parts per million (ppm) by volume or less of gas or vapor or 2 milligrams per liter or less of mist, fume or dust when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

Toxic

A chemical falling within any of the following categories is considered toxic:

- A chemical that has an LD_{50} of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

- A chemical that has an LD_{50} of more than 200 milligrams per kilogram but not more than 1,000 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.

- A chemical that has an LC_{50} in air of more than 200 ppm but not more than 2,000 ppm by volume of gas or vapor, or more than 2 milligrams per liter but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

Ceiling Limit

This is the maximum concentration of an airborne contaminant to which one may be exposed. The ceiling limits utilized are published in Department of Labor (DOL) 29 CFR Part 1910.1000.

Permissible Exposure Limit (PEL)

The maximum permitted eight-hour, time-weighted average concentration of an airborne contaminant.

SUMMARY

During this unit, the following objectives were accomplished:

- Identified hazardous materials.

- Given a case study and photos, identified the presence of hazardous materials.

- Recognized the difference between a physical hazard and a health hazard.

- Using the appropriate resources, placed materials into the appropriate hazard classes.

- Classified materials found in a given scenario.

APPENDIX A:
NFPA 1 ANNEX B:
HAZARDOUS MATERIALS CLASSIFICATIONS

This page intentionally left blank.

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquiries or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 09/31/2013.

Table A.66.29.3.28 Typical Fire Protection for Wharves and Marine Terminals

Locations	Water Demand (gpm)	Hydrant Monitors[a] (gpm)	Hose Reels	Fire Extinguisher Dry Chemical 30 lb	Fire Extinguisher Dry Chemical 150 lb Wheeled	International Shore Connection	Emergency Equipment Lockers	Monitors and Hose Foam Concentrate Required (gal)	Fire Boat Connection
Barge terminals	500–1000	Two 500	Two 1¼	2	NR	NR	1	100[b]	NR
Tankers 20,000 DWT and under	1000–2000	Two 500	Two 1¼	2	1	1	1	300[b]	2
20,001–70,000 DWT	2000	Two 1000	Four 1¼[c]	2	2[d]	2	1	2000	2
70,001 DWT and over	2000[e]	Two 1000	Four 1¼[c]	3	2[d]	2	1	2000[f]	2
Sea islands	2000–4000[e]	Three 1000	Four 1¼[c]	4	2	3	2	3000	2

For SI units, 1 gpm = 3.8 L/min; 1 gal = 3.8 L; 1 lb = 0.45 kg.
NR: Not required.
[a]A minimum of two 1½ in. (38 mm) hydrant outlets should be provided at each monitor riser.
[b]Can be provided by onshore mobile equipment.
[c]One hose reel at each berth should have foam capability.
[d]The proximity of adjacent berths can reduce total required.
[e]Under-dock systems are optional. Add water for under-dock system (0.16 × area).
[f]Under-dock systems are optional. Add foam for under-dock system (0.16 × 0.3 × 30 × area).
[30: Table A.29.3.28]

A.69.3.10.2.7 The requirement for a pilot or an electronic ignition system became effective for heaters with inputs over 50,000 Btu/hr manufactured on or after May 17, 1967. [58: A.6.19.2.7]

A.69.3.10.8.3 The weight of the cylinders will be affected by the specific gravity of the LP-Gas. Weights varying from 16.0 oz to 16.8 oz (454 g to 476 g) are recognized as being within the range of what is nominal. [58: A.6.19.9.3]

A.69.3.12.1 Typical non-engine fuel systems include those on commercial, industrial, construction, and public service vehicles such as trucks, semitrailers, trailers, portable tar kettles, road surface heating equipment, mobile laboratories, clinics, and mobile cooking units (such as catering and canteen vehicles). [58: A.6.23.1]

A.69.3.12.7.6 Requirements for the design of containers are located in Section 5.2 of NFPA 58. Requirements for container appurtenances are located in Section 5.3 of NFPA 58. [58: A.6.23.7.6]

A.69.4.1 Ignition source control at transfer locations is covered in Section 6.22 of NFPA 58. Fire protection is covered in Section 6.25 of NFPA 58. [58: A.7.1]

A.69.4.2.2.5 Examples of an effective seal are a POL plug or cap. Listed quick-closing couplings with CGA V-1 connection numbers 790 (fork lift ACME connection), 791 (portable cylinder ACME/POL connection), and 810 (socket/plug quick connection) have secondary seals. Therefore, plugs or caps for these connections are not required or recommended. [58: A.7.2.2.5]

A.69.5.4.1 The filling process in 69.5.4.1.4 refers to the time period beginning when a cylinder or cylinders are brought to a dispensing station to be filled and ending when the last cylinder is filled and all the cylinders are removed from the filling area. This is meant to define a continuous process, with the cylinders being unattended for only brief periods, such as operator breaks or lunch. [58: A.8.4.1]

A.69.5.4.2.1 The shelves should be made of any material with a flame spread index, in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials*, of less than 25 and should be of sufficient strength to support the cylinders. [58: A.8.4.2.1]

A.69.5.4.2.2 There are numerous effective means to provide protection against accidental vehicle impact or damage. The method selected depends upon local conditions with regard to the kinds of traffic that can be reasonably expected and the environment surrounding the location. While additional protection over and above that used to protect the building might not be needed at some locations, others might need additional protection. Examples of such additional protection could be the following:

(1) Guard rails
(2) Steel bollards
(3) Raised sidewalks [58: A.8.4.2.2]

A.69.5.5 See 6.25.4.3 of NFPA 58. [58: A.8.5]

Annex B Hazardous Materials Classifications

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Scope. Annex B provides information, explanations, and examples to illustrate and clarify the hazard categories contained in Chapter 60. The hazard categories are based upon Title 29 of the Code of Federal Regulations. Where numerical classifications are included, they are in accordance with nationally recognized standards. Annex B should not be used as the sole means of hazardous materials classification.

B.2 Hazard Categories.

B.2.1 Physical Hazards.

B.2.1.1 Explosives and Blasting Agents.

B.2.1.1.1 High Explosives. Can be detonated by means of blasting cap when unconfined. Examples: dynamite, TNT, nitroglycerine, C-3, and C-4.

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquiries or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 06/31/2013.

B.2.1.1.2 Low Explosives. Can be deflagrated when confined. Examples: black powder, smokeless powder, propellant explosives, and display fireworks.

B.2.1.1.3 Blasting Agents. Oxidizer and liquid fuel slurry mixtures. Example: ammonium nitrate combined with fuel oil.

B.2.1.2 Compressed Gases.

B.2.1.2.1 Flammable. Examples: acetylene, carbon monoxide, ethane, ethylene, hydrogen, and methane.

B.2.1.2.2 Oxidizing. Examples: oxygen, ozone, oxides of nitrogen, chlorine, and fluorine. Chlorine and fluorine do not contain oxygen but reaction with flammables is similar to that of oxygen.

B.2.1.2.3 Corrosive. Examples: ammonia, hydrogen chloride, and fluorine.

B.2.1.2.4 Highly Toxic. Examples: arsine, cyanogen, fluorine, germane, hydrogen cyanide, hydrogen selenide, nitric oxide, phosphine, and stibene.

B.2.1.2.5 Toxic. Examples: chlorine, hydrogen fluoride, hydrogen sulfide, silicon tetrafluoride, and phosgene.

B.2.1.2.6 Inert (Chemically Unreactive). Examples: argon, helium, krypton, neon, nitrogen, and xenon.

B.2.1.2.7 Pyrophoric. Examples: diborane, dichloroborane, phosphine, and silane.

B.2.1.2.8 Unstable (Reactive). Examples: butadiene (unstabilized), ethylene oxide, and vinyl chloride.

B.2.1.3 Flammable and Combustible Liquids.

B.2.1.3.1 Flammable Liquids.

B.2.1.3.1.1 Class I-A liquids include those having flash points below 73°F (22.8°C) and having a boiling point below 100°F (37.8°C).

B.2.1.3.1.2 Class I-B liquids include those having flash points below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C).

B.2.1.3.1.3 Class I-C liquids include those having flash points at or above 73°F (22.8°C) and below 100°F (37.8°C).

B.2.1.3.2 Combustible Liquids.

B.2.1.3.2.1 Class II liquids include those having flash points at or above 100°F (37.8°C) and below 140°F (60°C).

B.2.1.3.2.2 Class III-A liquids include those having flash points at or above 140°F (60°C) and below 200°F (93.3°C).

B.2.1.3.2.3 Class III-B liquids include those liquids having flash points at or above 200°F (93.3°C).

B.2.1.4 Flammable Solids.

B.2.1.4.1 Organic Solids. Examples: camphor, cellulose nitrate, and naphthalene.

B.2.1.4.2 Inorganic Solids. Examples: decaborane, lithium amide, phosphorous heptasulfide, phosphorous sesquisulfide, potassium sulfide, anhydrous sodium sulfide, and sulfur.

B.2.1.4.3 Combustible Metals (Except Dusts and Powders). Examples: cesium, magnesium, and zirconium.

B.2.1.4.4 Combustible Dusts and Powders (Including Metals). Examples: wood sawdust, plastics, coal, flour, and powdered metals (few exceptions).

B.2.1.5 Oxidizers.

B.2.1.5.1 Gases. Examples: oxygen, ozone, oxides of nitrogen, fluorine, and chlorine (reaction with flammables is similar to that of oxygen).

B.2.1.5.2 Liquids. Examples: bromine, hydrogen peroxide, nitric acid, perchloric acid, and sulfuric acid.

B.2.1.5.3 Solids. Examples: chlorates, chromates, chromic acid, iodine, nitrates, perchlorates, and peroxides.

B.2.1.5.4 Examples of Liquid and Solid Oxidizers According to Hazard.

B.2.1.5.4.1 Class 4. Examples: ammonium perchlorate (particle size greater than 15 microns), ammonium permanganate, guanidine nitrate, hydrogen peroxide solutions (greater than 91 percent), and tetranitromethane.

B.2.1.5.4.2 Class 3. Examples: ammonium dichromate, calcium hypochlorite (over 50 percent by weight), chloric acid (10 percent maximum concentration), hydrogen peroxide solutions (greater than 52 percent up to 91 percent), mono-(trichloro)-tetra-(monopotassium dichloro)-penta-s-triazinetrione, nitric acid, fuming (more than 86 percent concentration), perchloric acid solutions (60 percent to 72 percent by weight), potassium bromate, potassium chlorate, potassium dichloro-s-triazinetrione (potassium dichloroisocyanurate), sodium bromate, sodium chlorate, sodium chlorite (over 40 percent by weight), and sodium dichloro-s-triazinetrione (sodium dichloroisocyanurate).

B.2.1.5.4.3 Class 2. Examples: barium bromate, barium chlorate, barium hypochlorite, barium perchlorate, barium permanganate, 1-bromo-3-chloro-5, 5-dimethylhydantoin, calcium chlorate, calcium chlorite, calcium hypochlorite (50 percent or less by weight), calcium perchlorate, calcium permanganate, chromium trioxide (chromic acid), copper chlorate, halane (1,3-dichloro-5, 5-dimethylhydantoin), hydrogen peroxide (greater than 27.5 percent up to 52 percent), lead perchlorate, lithium chlorate, lithium hypochlorite (more than 39 percent available chlorine), lithium perchlorate, magnesium bromate, magnesium chlorate, magnesium perchlorate, mercurous chlorate, nitric acid (more than 40 percent but less than 86 percent), perchloric acid solutions (more than 50 percent but less than 60 percent), potassium perchlorate, potassium permanganate, potassium peroxide, potassium superoxide, silver peroxide, sodium chlorite (40 percent or less by weight), sodium perchlorate, sodium perchlorate monohydrate, sodium permanganate, sodium peroxide, strontium chlorate, strontium perchlorate, thallium chlorate, trichloro-s-triazinetrione (trichloroisocyanuric acid), urea hydrogen peroxide, zinc bromate, zinc chlorate, and zinc permanganate.

B.2.1.5.4.4 Class 1. Examples: all inorganic nitrates (unless otherwise classified), all inorganic nitrites (unless otherwise classified), ammonium persulfate, barium peroxide, calcium peroxide, hydrogen peroxide solutions (greater than 8 percent up to 27.5 percent), lead dioxide, lithium hypochlorite (39 percent or less available chlorine), lithium peroxide, magnesium peroxide, manganese dioxide, nitric acid (40 percent concentration or less), perchloric acid solutions (less than 50 percent by weight), potassium dichromate, potassium percarbonate, potassium persulfate, sodium carbonate peroxide, sodium dichloro-s-triazinetrione dihydrate, sodium dichromate, sodium perborate (anhydrous), sodium perborate monohydrate, sodium perbo-

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquiries or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 06/31/2013.

rate tetrahydrate, sodium percarbonate, sodium persulfate, strontium peroxide, and zinc peroxide.

B.2.1.6 Organic Peroxides. Examples of organic peroxides according to hazard: Unclassified. Unclassified organic peroxides are capable of detonation and are regulated in accordance with Chapter 75.

B.2.1.6.1 Class I. Examples: acetyl cyclohexane sulfonyl 60-65 percent concentration by weight, fulfonyl peroxide, benzoyl peroxide over 98 percent concentration, *t*-butyl hydroperoxide 90 percent, *t*-butyl peroxyacetate 75 percent, *t*-butyl peroxyisopropylcarbonate 92 percent, diisopropyl peroxydicarbonate 100 percent, di-n-propyl peroxydicarbonate 98 percent, and di-n-propyl peroxydi-carbonate 85 percent.

B.2.1.6.2 Class II. Examples: acetyl peroxide 25 percent, *t*-butyl hydroperoxide 70 percent, *t*-butyl peroxybenzoate 98 percent, *t*-butyl peroxy-2-ethylhex-anoate 97 percent, *t*-butyl peroxyisobutyrate 75 percent, *t*-butyl peroxyisopropylcarbonate 75 percent, *t*-butyl peroxypivalate 75 percent, dybenz-oyl peroxydicarbonate 85 percent, di-sec-butyl peroxydicarbonate 98 percent, di-sec-butyl peroxydicarbonate 75 percent, 1,1-di-(*t*-butylperoxy)-3,5,5-trimethyecyclohexane 95 percent, di-(2-ethythexyl) peroxydicarbonate 97 percent, 2,5-dymethyl-2-5 di (benzoylperoxy) hexane 92 percent, and peroxyacetic acid 43 percent.

B.2.1.6.3 Class III. Examples: acetyl cyclohexane sulfonal peroxide 29 percent, benzoyl peroxide 78 percent, benzoyl peroxide paste 55 percent, benzoyl peroxide paste 50 percent peroxide/50 percent butylbenzylphthalate diluent, cumene hydroperoxide 86 percent, di-(4-butylcyclohexyl) peroxydicarbonate 98 percent, *t*-butyl peroxy-2-ethytchexanoate 97 percent, *t*-butyl peroxyneodecanoate 75 percent, decanoyl peroxide 98.5 percent, di-*t*-butyl peroxide 99 percent, 1,1-di-(*t*-butylperoxy)-3,5,5-trimethylcyclohexane 75 percent, 2,4-dichlorobenzoyl peroxide 50 percent, diisopropyl peroxydi-carbonate 30 percent, 2,-5-dimethyl-2,5-di- (2-ethylhexanolyperoxy)-hexane 90 percent, 2,5-dimethyl-2,5-di- (*t*-butylperoxy) hexane 90 percent, and methyl ethyl ketone peroxide 9 percent active oxygen diluted in dimethyl phthalate.

B.2.1.6.4 Class IV. Examples: benzoyl peroxide 70 percent, benzoyl peroxide paste 50 percent peroxide/15 percent water/35 percent butylphthalate diluent, benzoyl peroxide slurry 40 percent, benzoyl peroxide powder 35 percent, *t*-butyl hydroperoxide 70 percent, *t*-butyl peroxy-2-ethylhexanoate 50 percent, decumyl peroxide 98 percent, di-(2-ethylhexal) peroxydicarbonate 40 percent, laurel peroxide 98 percent, p-methane hydroperoxide 52.5 percent, methyl ethyl ketone peroxide 5.5 percent active oxygen and methyl ethyl ketone peroxide 9 percent active oxygen diluted in water and glycols.

B.2.1.6.5 Class V. Examples: benzoyl peroxide 35 percent, 1,1-di-*t*-butyl peroxy 3,5,5-trimethylcyclohexane 40 percent, 2,5-di-(*t*-butyl peroxy) hexane 47 percent, and 2,4-pentanedione peroxide 4 percent active oxygen.

B.2.1.7 Pyrophoric Materials.

B.2.1.7.1 Gases. Examples: diborane, phosphine, and silane.

B.2.1.7.2 Liquids. Examples: diethyl aluminum chloride, diethyl beryllium, diethyl phosphine, diethyl zinc, dimethyl arsine, triethyl aluminum etherate, thriethyl bismuthine, thriethyl boron, trimethyl aluminum, and trimethyl gallium.

B.2.1.7.3 Solids. Examples: cesium, hafnium, lithium, white or yellow phosphorus, plutonium, potassium, rubidium, sodium, and thorium.

B.2.1.8 Examples of Unstable (Reactive) Materials According to Hazard. Classification by degree of hazard must be in accordance with Chapter 71.

B.2.1.8.1 Class 4. Examples: acetyl peroxide, dibutyl peroxide, dinitrobenzene, ethyl nitrate, peroxyacetic acid, and picric acid (dry) trinitrobenzene.

B.2.1.8.2 Class 3. Examples: hydrogen peroxide (greater than 52 percent), hydroxylamine, nitromethane, paranitroaniline, perchloric acid, and tetrafluoroethylene monomer.

B.2.1.8.3 Class 2. Examples: acrolein, acrylic acid, hydrazine, methacrylic acid, sodium perchlorate, styrene, and vinyl acetate.

B.2.1.8.4 Class 1. Examples: acetic acid, hydrogen peroxide 35 percent to 52 percent, paraldehyde, and tetrahydrofuran.

B.2.1.9 Examples of Water-Reactive Materials According to Hazard. Classification by degree of hazard must be in accordance with Chapter 73.

B.2.1.9.1 Class 3. Examples: aluminum alkyls such as triethylaluminum, isobutylaluminum, and trimethylaluminum; bromine pentafluoride, bromine trifluoride, chlorodiethylaluminium, and diethylzinc.

B.2.1.9.2 Class 2. Examples: calcium carbide, calcium metal, cyanogen bromide, lithium hydride, methyldichlorosilane, potassium metal, potassium peroxide, sodium metal, sodium peroxide, sulfuric acid, and trichlorosilane.

B.2.1.9.3 Class 1. Examples: acetic anhydride, sodium hydroxide, sulfur monochloride, and titanium tetrachloride.

B.2.1.10 Cryogenic Fluids. All of the cryogenics listed will exist as compressed gases when they are stored at ambient temperatures.

B.2.1.10.1 Flammable. Examples: carbon monoxide, deuterium (heavy hydrogen), ethylene, hydrogen, and methane.

B.2.1.10.2 Oxidizing. Examples: fluorine, nitric oxide, and oxygen.

B.2.1.10.3 Corrosive. Examples: fluorine and nitric oxide.

B.2.1.10.4 Inert (Chemically Unreactive). Examples: argon, helium, krypton, neon, nitrogen, and xenon.

B.2.1.10.5 Highly Toxic. Examples: fluorine and nitric oxide.

B.2.2 Health Hazards.

B.2.2.1 Highly Toxic and Toxic Materials.

B.2.2.1.1 Highly Toxic Materials.

B.2.2.1.1.1 Gases. Examples: arsine, chlorine trifluoride, cyanogen, diborane, fluorine, germane, hydrogen cyanide, nitric oxide, nitrogen dioxide, ozone, phosphine, hydrogen selenide, and stibene.

B.2.2.1.1.2 Liquids. Examples: acrolein, acrylic acid, 2-chloroethanol (ethylene chlorohydrin), hydazine, hydrocyanic acid, 2-methylaziridine (propylenimine), 2-methyllactonitrile (acetone cyanohydrin), methyl ester isocyanic acid (methyl isocyanate), nicotine, tetranitromethane, and tetraethylstannane (tetraethyl tin).

B.2.2.1.1.3 Solids. Examples: (acetato) phenylmercury (phenyl mercuric acetate), 4-aminopyridine, arsenic pentoxide, arsenic trioxide, calcium cyanide, 2-choloroacetophenone, aflatoxin B, decaborane (14), mercury (II) bromide (mercuric

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquiries or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 06/31/2013.

bromide), mercury (II) chloride (corrosive mercury chloride), pentachlorophenol, methyl parathion, phosphorus (white), and sodium azide.

B.2.2.1.2 Toxic Materials.

B.2.2.1.2.1 Gases. Examples: boron trichloride, boron trifluoride, chlorine, hydrogen fluoride, hydrogen sulfide, phosgene, and silicon tetrafluoride.

B.2.2.1.2.2 Liquids. Examples: acrylonitrile, allyl alcohol, alpha-chlorotoluene, aniline, 1-chloro-2, 3-epoxypropane, chloroformic acid (allyl ester), 3-chloropropene (allyl chloride), o-cresol, crotonaldehyde, dibromomethane, diisopropylamine, diethyl ester sulfuric acid, dimethyl ester sulfuric acid, 2-furaldehyde (furfural), furfuryl alcohol, phosphorus chloride, phosphoryl chloride (phosphorus oxychloride), and thionyl chloride.

B.2.2.1.2.3 Solids. Examples: acrylamide, barium chloride, barium (II) nitrate, benzidine, p-benzoquinone, beryllium chloride, cadmium chloride, cadmium oxide, chloroacetic acid, chlorophenylmercury (phenyl mercuric chloride), chromium (VI) oxide (chromic acid, solid), 2,4-dinitrotoluene, hydroquinone, mercury chloride (calomel), mercury (II) sulfate (mercuric sulfate), osmium tetroxide, oxalic acid, phenol, P-phenylenediamine, phenylhydrazine, 4-phenylmorpholine, phosphorus sulfide, potassium fluoride, potassium hydroxide, selenium (IV) disulfide, and sodium fluoride.

B.2.2.2 Radioactive Materials. (Reserved)

B.2.2.3 Corrosives.

B.2.2.3.1 Acids. Examples: chromic, formic, hydrochloric (muriatic greater than 15 percent), hydrofluoric, nitric (greater than 6 percent), perchloric, and sulfuric (4 percent or more).

B.2.2.3.2 Bases (Alkalis). Examples: hydroxides — ammonium (greater than 10 percent), calcium, potassium (greater than 1 percent), sodium (greater than 1 percent), and certain carbonates — potassium.

B.2.2.3.3 Other Corrosives. Examples: bromine, chlorine, fluorine, iodine, and ammonia.

Note: Corrosives that are oxidizers, e.g., nitric acid, chlorine, fluorine; or are compressed gases, e.g., ammonia, chlorine, fluorine; or are water-reactive, e.g., concentrated sulfuric acid, sodium hydroxide, are physical hazards in addition to being health hazards.

B.2.2.4 Carcinogens, Irritants, Sensitizers, and Other Health Hazard Materials. (Reserved)

B.3 Evaluation of Hazards.

B.3.1 Degree of Hazard. The degree of hazard present depends upon many variables that should be considered individually and in combination. Some of the variables are as follows in B.3.1.1 through B.3.1.3.

B.3.1.1 Chemical Properties of the Material. Chemical properties of the material determine self-reactions and reactions that can occur with other materials. Generally, materials within subdivisions of hazard categories exhibit similar chemical properties. However, materials with similar chemical properties can present very different hazards. Each individual material should be researched to determine its hazardous properties and then considered in relation to other materials that it could contact and the surrounding environment.

B.3.1.2 Physical Properties of the Material. Physical properties, such as whether a material is a solid, liquid, or gas at ordinary temperatures and pressures, considered along with chemical properties determines requirements for containment of the material. Specific gravity (weight of a liquid compared to water) and vapor density (weight of a gas compared to air) are both physical properties that are important in evaluating the hazards of a material.

B.3.1.3 Amount and Concentration of the Material.

B.3.1.3.1 General. The amount of material present and its concentration must be considered along with physical and chemical properties to determine the magnitude of the hazard. Hydrogen peroxide, for example, is used as an antiseptic and a hair bleach in low concentrations (approximately 8 percent in water solution). Over 8 percent, hydrogen peroxide is classed as an oxidizer and is toxic. Above 90 percent, it is a Class 4 oxidizer "that can undergo an explosive reaction when catalyzed or exposed to heat, shock, or friction," a definition that incidentally also places hydrogen peroxide over 90 percent concentration in the unstable (reactive) category. Small amounts at high concentrations can present a greater hazard than large amounts at low concentrations.

B.3.1.3.2 Mixtures. Gases — toxic and highly toxic gases include those gases that have an LC_{50} of 2000 parts per million (ppm) or less when rats are exposed for a period of 1 hour or less. To maintain consistency with the definitions for these materials, exposure data for periods other than 1 hour must be normalized to 1 hour. To classify mixtures of compressed gases that contain one or more toxic or highly toxic components, the LC_{50} of the mixture must be determined. Mixtures that contain only two components are binary mixtures. Those that contain more than two components are multicomponent mixtures. When two or more hazardous substances (components) having an LC_{50} below 2000 ppm are present in a mixture, their combined effect, rather than that of the individual substances (components), must be considered. In the absence of information to the contrary, the effects of the hazards present must be considered as additive. Exceptions to the above rule can be made when there is a good reason to believe that the principal effects of the different harmful substances (components) are not additive.

For binary mixtures where the hazardous component is diluted with a nontoxic gas such as an inert gas, the LC_{50} of the mixture is estimated by use of the following formula:

$$LC_{50m} = \frac{1}{\left(\frac{C_1}{LC_{501}}\right)}$$

For multicomponent mixtures where more than one component has a listed LC_{50}, the LC_{50} of the mixture is estimated by use of the following formula:

$$LC_{50m} = \frac{1}{\left(\frac{C_{11}}{LC_{501}}\right) + \left(\frac{C_{12}}{LC_{502}}\right) + \left(\frac{C_{1n}}{LC_{50n}}\right)}$$

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

where:

LC_{50m} = LC_{50} of the mixture in parts per million (ppm).

C = concentration of component (i) in decimal percent. The concentration of the individual components in a mixture of gases is to be expressed in terms of percent by volume.

LC_{50i} = LC_{50} of component (i). The LC_{50} of the component is based on a 1-hour exposure. LC_{50} data that are for other than 1-hour exposures must be normalized to 1 hour by multiplying the LC_{50} for the time determined by the factor indicated in Table B.3.1.3.2. The preferred mammalian species for LC_{50} data is the rat, as specified in the definitions of toxic and highly toxic in Chapter 3. If data for rats are unavailable, and in the absence of information to the contrary, data for other species can be utilized. The data must be taken in the following order of preference: rat, mouse, rabbit, guinea pig, cat, dog, and monkey.

i_n = component 1, component 2, and so on to the nth component.

Examples:

A. What is the LC_{50} of a mixture of 15 percent chlorine, 85 percent nitrogen? The 1-hour (rat) LC_{50} of pure chlorine is 293 ppm.

$LC_{50m} = 1 / (0.15 / 293)$ or 1953 ppm. Therefore the mixture is toxic.

B. What is the LC_{50} of a mixture of 15 percent chlorine, 15 percent fluorine, and 70 percent nitrogen? The 1-hour (rat) LC_{50} of chlorine is 293 ppm. The 1-hour (rat) LC_{50} of fluorine is 185 ppm.

$LC_{50m} = 1 / (0.15 / 293) + (0.15 / 185)$ or 755 ppm. Therefore the mixture is toxic.

C. Is the mixture of 1 percent phosphine in argon toxic or highly toxic? The 4-hour (rat) LC_{50} is 11 ppm.

$LC_{50m} = 1 / [0.01 / (11 \times 2)]$ or 2200 ppm. Therefore the mixture is neither toxic nor highly toxic. Note that the 4-hour LC_{50} of 11 ppm was normalized to 1 hour by use of Table B.3.1.3.2.

Table B.3.1.3.2 Normalization Factor

Time (hours)	Multiply By
0.5	0.7
1.0	1.0
1.5	1.2
2.0	1.4
3.0	1.7
4.0	2.0
5.0	2.2
6.0	2.4
7.0	2.6
8.0	2.8

B.3.1.3.3 Actual Use, Activity, or Process Involving the Material. The definition of handling, storage, and use in closed systems refers to materials in packages or containers. Dispensing and use in open containers or systems describes situations where a material is exposed to ambient conditions or vapors are liberated to the atmosphere. Dispensing and use in open systems, then, are generally more hazardous situations than handling, storage, or use in closed systems. The actual use or process can include heating, electric or other sparks, catalytic or reactive materials, and many other factors that could affect the hazard and must therefore be thoroughly analyzed.

B.3.1.3.4 Surrounding Conditions. Conditions such as other materials or processes in the area, type of construction of the structure, fire protection features (e.g., fire walls, sprinkler systems, alarms, etc.), occupancy (use) of adjoining areas, normal temperatures, exposure to weather, etc., must be taken into account in evaluating the hazard.

B.3.2 Evaluation Questions. The following are sample evaluation questions:

(1) What is the material? Correct identification is important; exact spelling is vital. Check labels, MSDS, ask responsible persons, etc.
(2) What are the concentration and strength?
(3) What is the physical form of the material? Liquids, gases, and finely divided solids have differing requirements for spill and leak control and containment.
(4) How much material is present? Consider in relation to permit amounts, exempt amounts (from Group H Occupancy requirements), amounts that require detached storage, and overall magnitude of the hazard.
(5) What other materials (including furniture, equipment, and building components) are close enough to interact with the material?
(6) What are the likely reactions?
(7) What is the activity involving the material?
(8) How does the activity impact the hazardous characteristics of the material? Consider vapors released or hazards otherwise exposed.
(9) What must the material be protected from? Consider other materials, temperature, shock, pressure, etc.
(10) What effects of the material must people and the environment be protected from?
(11) How can protection be accomplished? Consider the following:
    (a) Proper containers and equipment
    (b) Separation by distance or construction
    (c) Enclosure in cabinets or rooms
    (d) Spill control, drainage, and containment
    (e) Control systems — ventilation, special electrical, detection and alarm, extinguishment, explosion venting, limit controls, exhaust scrubbers, and excess flow control
    (f) Administrative (operational) controls — signs, ignition source control, security, personnel training, established procedures, storage plans, and emergency plans

Evaluation of the hazard is a strongly subjective process; therefore, the person charged with this responsibility must gather as much relevant data as possible so that the decision is objective and within the limits prescribed in laws, policies, and standards.

It could be necessary to cause the responsible persons in charge to have tests made by qualified persons or testing laboratories to support contentions that a particular material or process is or is not hazardous. See 1.4.2.

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

B.4 Reference Publications. (Reserved)

B.5 Oxidizers and Organic Peroxides.

B.5.1 General. This annex provides information, explanations, and examples to illustrate and clarify the hazard categories contained in Chapter 70 and Chapter 75 of this *Code*. The hazard categories are based on 29 CFR. Where numerical classifications are included, they are in accordance with nationally recognized standards.

B.5.2 Oxidizers.

B.5.2.1 General. The oxidizers on the following lists are typical for their class. Each oxidizer is undiluted unless a concentration is specified.

Unless concentration is specified, undiluted material is referenced. The following lists of oxidizers are provided to clarify how the NFPA Hazardous Chemicals Committee has classified typical oxidizers. The lists are not all-inclusive and are amended to reflect typical oxidizers used.

B.5.2.2 Class 1 Oxidizers. The following are typical Class 1 oxidizers:

(1) All inorganic nitrates (unless otherwise classified)
(2) All inorganic nitrites (unless otherwise classified)
(3) Ammonium persulfate
(4) Barium peroxide
(5) Calcium hypochlorite (nominal 80 percent, maximum 81 percent) blended with magnesium sulfate heptahydrate (nominal 20 percent, minimum 19 percent) having an available chlorine of less than or equal to 66 percent and a total water content of at least 17 percent.
(6) Calcium peroxide
(7) Hydrogen peroxide solutions (greater than 8 percent up to 27.5 percent)
(8) Lead dioxide
(9) Lithium hypochlorite (39 percent or less available chlorine)
(10) Lithium peroxide
(11) Magnesium peroxide
(12) Manganese dioxide
(13) Nitric acid (40 percent concentration or less)
(14) Perchloric acid solutions (less than 50 percent by weight)
(15) Potassium dichromate
(16) Potassium percarbonate
(17) Potassium persulfate
(18) Sodium carbonate peroxide
(19) Sodium dichloro-s-triazinetrione dihydrate (sodium dicholorisocyanurate dihydrate)
(20) Sodium dichromate
(21) Sodium perborate (anhydrous)
(22) Sodium perborate monohydrate
(23) Sodium perborate tetrahydrate
(24) Sodium percarbonate
(25) Sodium persulfate
(26) Strontium peroxide
(27) Trichloro-s-triazinetrione [trichloroisocyanuric acid (TCCA; trichlor), all physical forms]
(28) Zinc peroxide [**400:** G.1.2]

B.5.2.3 Class 2 Oxidizers. The following are typical Class 2 oxidizers:

(1) Barium bromate
(2) Barium chlorate
(3) Barium hypochlorite
(4) Barium perchlorate
(5) Barium permanganate
(6) 1-Bromo-3-chloro-5,5-dimethylhydantoin (BCDMH)
(7) Calcium chlorate
(8) Calcium chlorite
(9) Calcium hypochlorite (50 percent or less by weight unless covered by other formulations in B.5.2)
(10) Calcium perchlorate
(11) Calcium permanganate
(12) Chromium trioxide (chromic acid)
(13) Copper chlorate
(14) Halane (1,3-dichloro-5,5-dimethylhydantoin)
(15) Hydrogen peroxide (greater than 27.5 percent up to 52 percent)
(16) Lead perchlorate
(17) Lithium chlorate
(18) Lithium hypochlorite (more than 39 percent available chlorine)
(19) Lithium perchlorate
(20) Magnesium bromate
(21) Magnesium chlorate
(22) Magnesium perchlorate
(23) Mercurous chlorate
(24) Nitric acid (more than 40 percent but less than 86 percent)
(25) Nitrogen tetroxide
(26) Perchloric acid solutions (more than 50 percent but less than 60 percent)
(27) Potassium perchlorate
(28) Potassium permanganate
(29) Potassium peroxide
(30) Potassium superoxide
(31) Silver peroxide
(32) Sodium chlorite (40 percent or less by weight)
(33) Sodium perchlorate
(34) Sodium perchlorate monohydrate
(35) Sodium permanganate
(36) Sodium peroxide
(37) Strontium chlorate
(38) Strontium perchlorate
(39) Thallium chlorate
(40) Urea hydrogen peroxide
(41) Zinc bromate
(42) Zinc chlorate
(43) Zinc permanganate [**400:** G.1.3]

B.5.2.4 Class 3 Oxidizers. The following are typical Class 3 oxidizers:

(1) Ammonium dichromate
(2) Calcium hypochlorite (over 50 percent by weight unless covered in other formulations in B.5.2)
(3) Calcium hypochlorite (over 50 percent by weight)
(4) Chloric acid (10 percent maximum concentration)
(5) Hydrogen peroxide solutions (greater than 52 percent up to 91 percent)
(6) Mono-(trichloro)-tetra-(monopotassium dichloro)-penta-s-triazinetrione
(7) Nitric acid, fuming (more than 86 percent concentration)
(8) Perchloric acid solutions (60 percent to 72 percent by weight)
(9) Potassium bromate
(10) Potassium chlorate
(11) Potassium dichloro-s-triazinetrione (potassium dichloroisocyanurate)
(12) Sodium bromate
(13) Sodium chlorate

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

(14) Sodium chlorite (over 40 percent by weight)
(15) Sodium dichloro-s-triazinetrione anhydrous (sodium dichloroisocyanurate anhydrous) [**400:** G.1.4]

B.5.2.5 Class 4 Oxidizers. The following are typical Class 4 oxidizers:

(1) Ammonium perchlorate (particle size greater than 15 microns)
(2) Ammonium permanganate
(3) Guanidine nitrate
(4) Hydrogen peroxide solutions (greater than 91 percent)
(5) Tetranitromethane

Ammonium perchlorate less than 15 microns is classified as an explosive and, as such, is not covered by NFPA 400. *(See NFPA 495.)* [**400:** G.1.5]

B.5.3 Typical Organic Peroxide Formulations.

B.5.3.1 General. The assignment of the organic peroxide formulation classifications shown in the tables in this annex are based on the container sizes shown. A change in the container size could affect the classification.

For an alphabetical listing of typical organic peroxide formulations, see Table B.5.3.1. [**400:** F.1]

Table B.5.3.1 Typical Organic Peroxide Formulations

			Recommended Maximum Temperatures[1]								
			Control		Emergency		Hazard Identification[2]				
Organic Peroxide	Concentration	Diluent	°F	°C	°F	°C	Health	Flammability	Reactivity	Class	Container
t-Amyl hydroperoxide	88	Water					3	3	2	III	55 gal (208 L)
t-Amyl peroxyacetate	60	OMS					2	3	2	III	5 gal (19 L)
t-Amyl peroxybenzoate	96	—					2	3	2	II	5 gal (19 L)
t-Amyl peroxy-2-ethylhexanoate	96	—	68	20	77	25	0	3	2	III	55 gal (208 L)
t-Amyl peroxyneodecanoate	75	OMS	32	0	50	10	1	3	2	III	5 gal (19 L)
t-Amyl peroxypivalate	75	OMS	50	10	59	15	1	3	2	III	5 gal (19 L)
t-Butyl cumyl peroxide	95	—					2	2	2	IV	55 gal (208 L)
n-Butyl-4,4-di(*t*-butyl peroxy) valerate	98	—					2	3	2	II	5 gal (19 L)
t-Butyl hydroperoxide	90	Water and *t*-BuOH					3	3	3	I	5 gal (19 L)
t-Butyl hydroperoxide[3]	70	DTBP and *t*-BuOH					3	3	3	II	55 gal (208 L)
t-Butyl hydroperoxide[3]	70	Water					3	2	2	IV	55 gal (208 L)
t-Butyl monoperoxymaleate	98	—					2	3	3	I	50 @ 1 lb (50 @ 0.5 kg)
t-Butyl peroxyacetate	75	OMS					1	3	3	I	5 gal (19 L)
t-Butyl peroxyacetate	60	OMS					1	3	3	I	5 gal (19 L)
t-Butyl peroxybenzoate	98	—					1	3	3	II	5 gal (19 L)
t-Butyl peroxy-2-ethylhexanoate	97	—	68	20	77	25	1	3	3	III	5 gal (19 L)
t-Butyl peroxy-2-ethylhexanoate	97	—	68	20	77	25	1	3	3	II	55 gal (208 L)
t-Butyl peroxy-2-ethylhexanoate	50	DOP or OMS	86	30	95	35	1	2	2	IV	5 gal (19 L)
t-Butyl peroxy-2-ethylhexanoate	50	DOP or OMS	86	30	95	35	1	2	2	III	55 gal (208 L)
t-Butylperoxy 2-ethylhexyl carbonate	95	—					1	3	2	III	5 gal (19 L)
t-Butyl peroxyisobutyrate	75	OMS	59	15	68	20	2	3	3	II	5 gal (19 L)
t-Butylperoxy isopropyl carbonate	92	OMS					1	3	3	I	5 gal (19 L)
t-Butylperoxy isopropyl carbonate	75	OMS					1	3	3	II	5 gal (19 L)
t-Butyl peroxyneodecanoate	75	OMS	32	0	50	10	2	3	2	III	5 gal (19 L)
t-Butyl peroxypivalate	75	OMS	32	0	50	10	2	3	3	II	5 gal (19 L)
t-Butyl peroxypivalate	45	OMS	32	0	50	10	2	2	2	IV	5 gal (19 L)
Cumyl hydroperoxide	88	Cumene					3	2	2	III	55 gal (208 L)
Cumyl peroxyneodecanoate	75	OMS	14	−10	32	0	1	3	2	III	5 gal (19 L)
Cumyl peroxyneoheptanoate	75	OMS	32	0	50	10	2	3	2	III	5 gal (19 L)
Diacetyl peroxide	25	DMP	68	20	77	25	2	3	3	II	5 gal (19 L)

(continues)

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table B.5.3.1 *Continued*

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Class	Container
1,1-Di(*t*-amylperoxy) cyclohexane	80	OMS or BBP					2	3	2	III	5 gal (19 L)
Dibenzoyl peroxide	98	—					1	3	4	I	1 lb (0.5 kg)
Dibenzoyl peroxide	78	Water					1	2	3	II	25 lb (11 kg)
Dibenzoyl peroxide	75	Water					1	2	2	III	25 lb (11 kg)
Dibenzoyl peroxide	70	Water					1	2	2	IV	25 lb (11 kg)
Dibenzoyl peroxide (paste)	55	Plasticizer		T[4]			1	2	2	III	350 lb (160 kg)
Dibenzoyl peroxide (paste)	55	Plasticizer and water		T			1	2	2	IV	350 lb (160 kg)
Dibenzoyl peroxide (paste)	50	Plasticizer		T			1	2	2	III	380 lb (170 kg)
Dibenzoyl peroxide (paste)	50	Plasticizer and water		T			1	2	2	IV	380 lb (170 kg)
Dibenzoyl peroxide (slurry)	40	Water and plasticizer		T			1	2	2	IV	380 lb (170 kg)
Dibenzoyl peroxide (slurry)	40	Water					1	2	2	IV	5 gal (19 L)
Dibenzoyl peroxide (powder)	35	Dicalcium phosphate dihydrate or calcium sulfate dihydrate					1	0	0	V	100 lb (45 kg)
Dibenzoyl peroxide (powder)	35	Starch					1	2	2	IV	100 lb (45 kg)
Di (4-*t*-butylcyclohexyl) peroxydicarbonate	98	—	86	30	95	35	1	3	2	III	88 lb (40 kg)
Di-*t*-butyl peroxide[3]	99	—					1	3	2	III	55 gal (208 L)
2,2-Di(*t*-butylperoxy) butane	50	Toluene					1	3	3	I	1 gal (4 L)
1,1-Di(*t*-butylperoxy) cyclohexane	80	OMS or BBP					1	3	3	II	5 gal (19 L)
Di-*sec*-butyl peroxydicarbonate	98	—	−4	−20	14	−10	1	3	3	II	1 gal (4 L)
Di-*sec*-butyl peroxydicarbonate	75	OMS	−4	−20	14	−10	1	3	3	II	5 gal (19 L)
Di(2-*t*-butylperoxy-iso-propyl) benzene	96	—					1	2	2	III	100 lb (45 kg)
Di(2-*t*-butylperoxyiso-propyl) benzene	40	Clay					1	1	0	V	100 lb (45 kg)
Di(butylperoxy) phthalate	40	DBP					2	2	2	IV	30 gal (110 L)
1,1-Di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane	75–95	—					2	3	3	II	5 gal (19 L)
1,1-Di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane	40	Calcium carbonate					1	1	1	V	100 lb (45 kg)
Diceryl peroxydicarbonate	85	—	86	30	95	35	1	2	2	IV	44 lb (20 kg)
Dicumyl peroxide	98	—					2	2	2	IV	55 gal (208 L)
Dicumyl peroxide	40	Clay or calcium carbonate					1	1	1	V	100 lb (45 kg)
Didecanoyl peroxide	98	—	86	30	95	35	1	3	2	III	50 lb (23 kg)
Di-2,4-dichlorobenzoyl peroxide	50	DBP and silicone		T			1	2	2	III	5 gal (19 L)
Di(2-ethylhexyl) peroxydicarbonate	97	—	−4	−20	14	−10	1	3	3	II	1 gal (4 L)

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table B.5.3.1 *Continued*

			Recommended Maximum Temperatures[1]				Hazard Identification[2]				
			Control		Emergency						
Organic Peroxide	Concentration	Diluent	°F	°C	°F	°C	Health	Flammability	Reactivity	Class	Container
Di(2-ethylhexyl) peroxydicarbonate	40	OMS	5	−15	23	−5	1	2	2	IV	5 gal (19 L)
Diisopropyl peroxydicarbonate	99	—	5	−15	23	−5	2	3	4	I	10 lb (4.5 kg)
Diisopropyl peroxydicarbonate	30	Toluene	14	−10	32	0	2	3	2	III	5 lb (2.3 kg)
Di-*n*-propyl peroxydicarbonate	98	—	−13	−25	5	−15	2	3	4	I	1 gal (4 L)
Di-*n*-propyl peroxydicarbonate	85	OMS	−13	−25	5	−15	2	3	4	I	1 gal (4 L)
Dilauroyl peroxide	98	—					1	2	2	IV	110 lb (50 kg)
2,5-Dimethyl-2,5-di (benzoylperoxy)hexane	95	—					2	3	3	II	4 @ 5 lb (4 @ 2.3 kg)
2,5-Dimethyl-2,5-di (*t*-butylperoxy)hexane	92	—					2	3	2	III	30 gal (110 L)
2,5-Dimethyl-2,5-di (*t*-butylperoxy)hexane	47	Calcium carbonate or silica					1	1	1	V	100 lb (45 kg)
2,5-Dimethyl-2,5-di (2-ethylhexanoylperoxy) hexane	90	—	68	20	77	25	0	3	2	III	5 gal (19 L)
2,5-Dimethyl-2,5-dihydroperoxyhexane	70	Water					2	3	3	II	100 lb (45 kg)
Ethyl-3,3-di(*t*-amylperoxy) butyrate	75	OMS					1	3	2	III	5 gal (19 L)
Ethyl-3,3-di(*t*-butylperoxy) butyrate	75	OMS					2	2	2	III	5 gal (19 L)
Ethyl-3,3-di(*t*-butylperoxy) butyrate	40	Clay or calcium silicate					1	3	2	V	100 lb (45 kg)
p-Menthyl hydroperoxide	54	Alcohols and ketones					3	2	2	IV	55 gal (208 L)
Methyl ethyl ketone peroxide	9.0% AO	DMP					3	2	2	III	5 gal (19 L)
Methyl ethyl ketone peroxide	5.5% AO	DMP					3	2	2	IV	5 gal (19 L)
Methyl ethyl ketone peroxide	9.0% AO	Water and glycols					3	2	2	IV	5 gal (19 L)
Methyl ethyl ketone peroxide and Cyclohexanone peroxide mixture	9.0% AO	DMP					3	2	2	III	5 gal (19 L)
2,4-Pentanedione peroxide	4.0% AO	Water and solvent					2	1	1	IV	5 gal (19 L)
Peroxyacetic acid, Type E, stabilized	43	Water, HOAc, and H_2O_2					3	2	3	II	30 gal (110 L)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.
[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.
[3]See NFPA 30, *Flammable and Combustible Liquids Code*, for additional storage requirements.
[4]T — Temperature control should be considered to reduce fire hazard depending on packaging size and recommendations in manufacturers' literature.
Note: Diluents: AO — Active oxygen; BBP — Butyl benzyl phthalate; DBP — Dibutyl phthalate; DMP — Dimethyl phthalate; DOP — Dioctyl phthalate; DTBP — Di-tertiary-butyl peroxide; HOAc — Acetic acid; H_2O_2 — Hydrogen peroxide; OMS — Odorless mineral spirits; *t*-BuOH — Tertiary butanol.
[**400:** Table F.1]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

B.5.3.2 Class I Formulations.

B.5.3.2.1 Fire Hazard Characteristics. Class I formulations present a deflagration hazard through easily initiated, rapid explosive decomposition. Class I includes some formulations that are relatively safe only under closely controlled temperatures. Either excessively high or low temperatures can increase the potential for severe explosive decomposition. [**400:** F.2.1]

B.5.3.2.2 Fire-Fighting Information. The immediate area should be evacuated and the fire should be fought from a remote location. Some damage to structures from overpressure can be expected should a deflagration occur. [**400:** F.2.2]

B.5.3.2.3 Typical Class I Formulations. See Table B.5.3.2.3. [**400:** F.2.3]

B.5.3.3 Class II Formulations.

B.5.3.3.1 Fire Hazard Characteristics. Class II formulations present a severe fire hazard similar to Class I flammable liquids. The decomposition is not as rapid, violent, or complete as that produced by Class I formulations. As with Class I formulations, this class includes some formulations that are relatively safe when under controlled temperatures or when diluted. [**400:** F.3.1]

B.5.3.3.2 Fire-Fighting Information. Fires should be fought from a safe distance, because a hazard exists from rupturing containers. [**400:** F.3.2]

B.5.3.3.3 Typical Class II Formulations. See Table B.5.3.3.3. [**400:** F.3.3]

B.5.3.4 Class III Formulations.

B.5.3.4.1 Fire Hazard Characteristics. Class III formulations present a fire hazard similar to Class II combustible liquids. They are characterized by rapid burning and high heat liberation due to decomposition. [**400:** F.4.1]

B.5.3.4.2 Fire-Fighting Information. Caution should be observed due to possible unexpected increases in fire intensity. [**400:** F.4.2]

B.5.3.4.3 Typical Class III Formulations. See Table B.5.3.4.3. [**400:** F.4.3]

B.5.3.5 Class IV Formulations.

B.5.3.5.1 Fire Hazard Characteristics. Class IV formulations present fire hazards that are easily controlled. Reactivity has little effect on fire intensity. [**400:** F.5.1]

B.5.3.5.2 Fire-Fighting Information. Normal fire-fighting procedures can be used. [**400:** F.5.2]

B.5.3.5.3 Typical Class IV Formulations. See Table B.5.3.5.3. [**400:** F.5.3]

B.5.3.6 Class V Formulations.

B.5.3.6.1 Fire Hazard Characteristics. Class V formulations do not present severe fire hazards. Those that do burn do so with less intensity than ordinary combustibles. [**400:** F.6.1]

B.5.3.6.2 Fire-Fighting Information. Fire-fighting procedures need primarily consider the combustibility of containers. [**400:** F.6.2]

B.5.3.6.3 Typical Class V Formulations. See Table B.5.3.6.3. [**400:** F.6.3]

Table B.5.3.2.3 Typical Class I Formulations

			Recommended Maximum Temperatures[1]							
			Control		Emergency		Hazard Identification[2]			
Organic Peroxide	Concentration	Diluent	°F	°C	°F	°C	Health	Flammability	Reactivity	Container
t-Butyl hydroperoxide	90	Water & *t*-BuOH					3	3	3	5 gal (19 L)
t-Butyl monoperoxymaleate	98	—					2	3	3	50 @ 1 lb (50 @ 0.5 kg)
t-Butyl peroxyacetate	75	OMS					1	3	3	5 gal (19 L)
t-Butyl peroxyacetate	60	OMS					1	3	3	5 gal (19 L)
t-Butylperoxy isopropyl carbonate	92	OMS					1	3	3	5 gal (19 L)
Dibenzoyl peroxide	98	—					1	3	4	1 lb (0.5 kg)
2,2-Di(*t*-butylperoxy) butane	50	Toluene					1	3	3	1 gal (4 L)
Diisopropyl peroxydicarbonate	99	—	5	−15	23	−5	2	3	4	10 lb (4.5 kg)
Di-*n*-propyl peroxydicarbonate	98	—	−13	−25	5	−15	2	3	4	1 gal (4 L)
Di-*n*-propyl peroxydicarbonate	85	OMS	−13	−25	5	−15	2	3	4	1 gal (4 L)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.
[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.
Note: Diluents: OMS — Odorless mineral spirits; *t*-BuOH — Tertiary butanol.
[**400:** Table F.2.3]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table B.5.3.3.3 Typical Class II Formulations

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Container
t-Amyl peroxybenzoate	96	—					2	3	2	5 gal (19 L)
n-Butyl- 4,4-di(*t*-butylperoxy) valerate	98	—					2	3	2	5 gal (19 L)
t-Butyl hydroperoxide	70	DTBP and *t*-BuOH					3	3	3	55 gal (208 L)
t-Butyl peroxybenzoate	98	—					1	3	3	5 gal (19 L)
t-Butyl peroxy-2-ethyl-hexanoate	97	—	68	20	77	25	1	3	3	55 gal (208 L)
t-Butyl peroxyisobutyrate	75	OMS	59	15	68	20	2	3	3	5 gal (19 L)
t-Butylperoxy isopropyl carbonate	75	OMS					1	3	3	5 gal (19 L)
t-Butyl peroxypivalate	75	OMS	32	0	50	10	2	3	3	5 gal (19 L)
Diacetyl peroxide	25	DMP	68	20	77	25	2	3	3	5 gal (19 L)
Dibenzoyl peroxide	78	Water					1	2	3	25 lb (11 kg)
1,1-Di(*t*-butylperoxy) cyclohexane	80	OMS or BBP					1	3	3	5 gal (19 L)
Di-*sec*-butyl peroxydicarbonate	98	—	−4	−20	14	−10	1	3	3	1 gal (4 L)
Di-*sec*-butyl peroxydicarbonate	75	OMS	−4	−20	14	−10	1	3	3	5 gal (19 L)
1,1-Di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane	75–95	—					2	3	3	5 gal (19 L)
Di(2-ethylhexyl) peroxydicarbonate	97	—	−4	−20	14	−10	1	3	3	1 gal (4 L)
2,5-Dimethyl-2,5-di(benzoylperoxy) hexane	95	—					2	3	3	4 @ 5 lb (4 @ 2.3 kg)
2,5-Dimethyl-2,5-dihydroperoxy hexane	70	Water					2	3	3	100 lb (45 kg)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.

[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.

Note: Diluents: BBP — Butyl benzyl phthalate; DMP — Dimethyl phthalate; DTBP — Di-tertiary-butyl peroxide; OMS — Odorless mineral spirits; *t*-BuOH — Tertiary butanol.

[**400:** Table E.3.3]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table B.5.3.5.3 Typical Class IV Formulations

Organic Peroxide	Concentration	Diluent	Recommended Maximum Temperatures[1] Control °F	Control °C	Emergency °F	Emergency °C	Hazard Identification[2] Health	Flammability	Reactivity	Container
t-Butyl cumyl peroxide	95	—					2	2	2	55 gal (208 L)
t-Butyl hydroperoxide	70	Water					3	2	2	55 gal (208 L)
t-Butyl peroxy-2-ethylhexanoate	50	DOP or OMS	86	30	95	35	1	2	2	5 gal (19 L)
t-Butyl peroxypivalate	45	OMS	32	0	50	10	2	2	2	5 gal (19 L)
Dibenzoyl peroxide	70	Water					1	2	2	25 lb (11 kg)
Dibenzoyl peroxide (paste)	55	Plasticizer and water		T			1	2	2	350 lb (160 kg)
Dibenzoyl peroxide (paste)	50	Plasticizer and water		T			1	2	2	380 lb (170 kg)
Dibenzoyl peroxide (slurry)	40	Water and plasticizer		T			1	2	2	380 lb (170 kg)
Dibenzoyl peroxide (slurry)	40	Water					1	2	2	5 gal (19 L)
Dibenzoyl peroxide (powder)	35	Starch					1	2	2	100 lb (45 kg)
Di(*t*-butylperoxy) phthalate	40	DBP					2	2	2	30 gal (110 L)
Dicetyl peroxydicarbonate	85	—	86	30	95	35	1	2	2	44 lb (20 kg)
Dicumyl peroxide	98	—					2	2	2	55 gal (208 L)
Di(2-ethylhexyl) peroxydicarbonate	40	OMS	5	−15	23	−5	1	2	2	5 gal (19 L)
Dilauroyl peroxide	98	—					1	2	2	110 lb (50 kg)
p-Menthyl hydroperoxide	54	Alcohols and ketones		T			3	2	2	55 gal (208 L)
Methyl ethyl ketone peroxide	55% AO	DMP					3	2	2	5 gal (19 L)
Methyl ethyl ketone peroxide	9.0% AO	Water and glycols					3	2	2	5 gal (19 L)
2,4-Pentanedione peroxide	4.0% AO	Water and solvent					2	1	1	5 gal (19 L)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.

[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.

[4]T — Temperature control should be considered to reduce fire hazard depending on packaging size and recommendations in manufacturers' literature.

Note: Diluents: BP — Dibutyl phthalate; DMP — Dimethyl phthalate; DOP— Dioctyl phthalate; OMS — Odorless mineral spirits; AO — Active oxygen.

[**400:** Table F.5.3]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table B.5.3.6.3 Typical Class V Formulations

			Recommended Maximum Temperatures[1]							
			Control		Emergency		Hazard Identification[2]			
Organic Peroxide	Concentration	Diluent	°F	°C	°F	°C	Health	Flammability	Reactivity	Container
Dibenzoyl peroxide (powder)	35	Dicalcium phosphate dihydrate or Calcium sulfate dihydrate					1	0	0	100 lb (45 kg)
Di(2-*t*-butylperoxy-isopropyl) benzene	40	Clay					1	1	0	100 lb (45 kg)
1,1-Di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane	40	Calcium carbonate					1	1	1	100 lb (45 kg)
Dicumyl peroxide	40	Clay or calcium carbonate					1	1	1	100 lb (45 kg)
2,5-Dimethyl-2,5-di(*t*-butylperoxy) hexane	47	Calcium carbonate or silica					1	1	1	100 lb (45 kg)
Ethyl-3,3-di(*t*-butylperoxy) butyrate	40	Clay or calcium silicate					1	3	2	100 lb (45 kg)

[1]These columns refer to temperatures in the Department of Transportation (DOT) Organic Peroxides Table. Refer to document 49 CFR 173.225 for details.
[2]The column refers to NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, hazard ratings for health, flammability, and reactivity. See NFPA 704 for details.
AO — Active oxygen.
[**400**: Table F.6.3]

Annex C Sample Ordinance Adopting the NFPA 1, *Fire Code*

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

C.1 The following sample ordinance is provided to assist a jurisdiction in the adoption of this *Code* and is not part of this *Code*.

ORDINANCE NO. _____

An ordinance of the *[jurisdiction]* adopting the *[year]* edition of NFPA 1, *Fire Code*, 2012 edition; and documents listed in Chapter 2 of that *Code*; prescribing regulations governing conditions hazardous to life and property from fire or explosion; providing for the issuance of permits and collection of fees; repealing Ordinance No. _____ of the [jurisdiction] and all other ordinances and parts of ordinances in conflict therewith; providing a penalty; providing a severability clause; and providing for publication; and providing an effective date.

BE IT ORDAINED BY THE *[governing body]* **OF THE** *[jurisdiction]*:

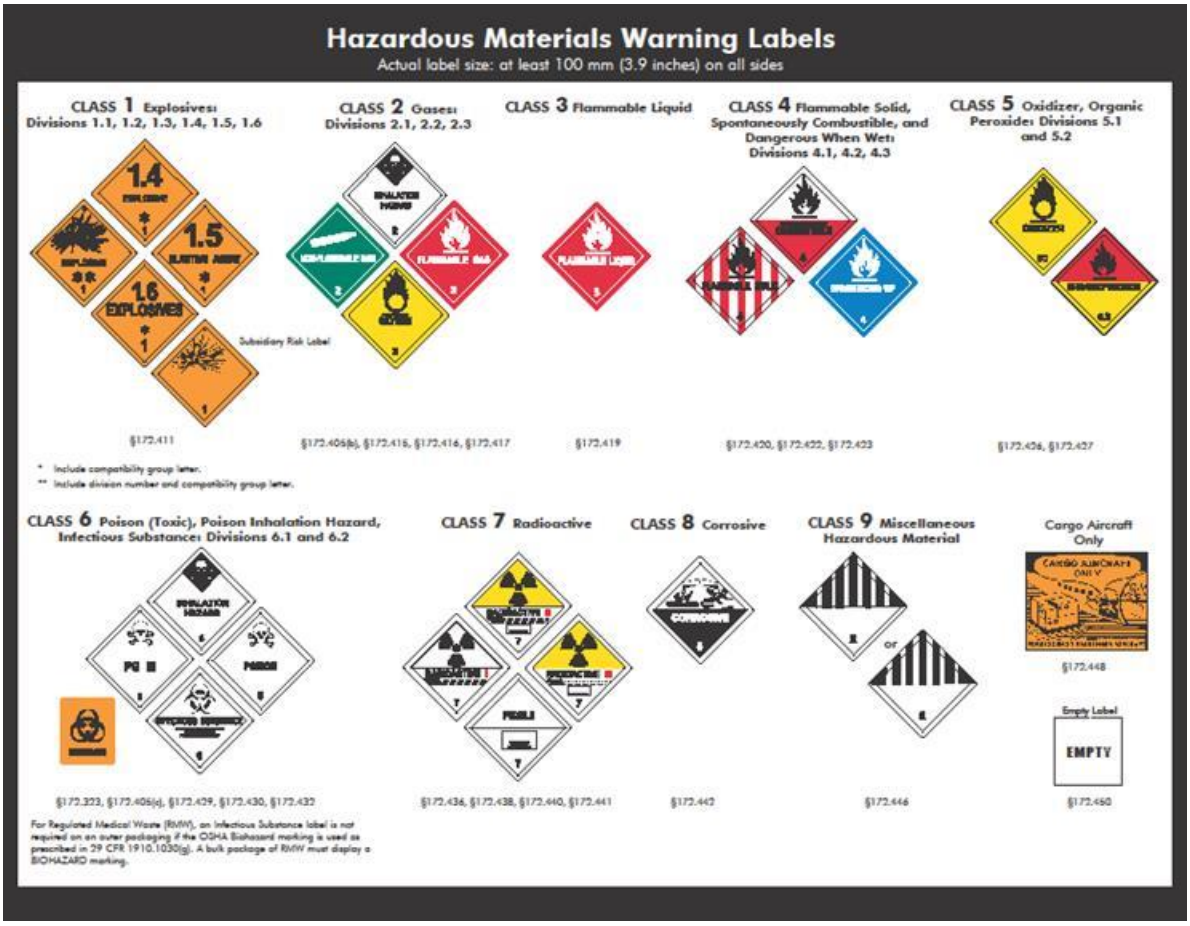
SECTION 1 That the NFPA 1, *Fire Code*, 2012 edition, and documents adopted by Chapter 2, three (3) copies of which are on file and are open to inspection by the public in the office of the *[jurisdiction's keeper of records]* of the *[jurisdiction]*, are hereby adopted and incorporated into this ordinance as fully as if set out at length herein, and from the date on which this ordinance shall take effect, the provisions thereof shall be controlling within the limits of the *[jurisdiction]*. The same are hereby adopted as the *Code* of the *[jurisdiction]* for the purpose of prescribing regulations governing conditions hazardous to life and property from fire or explosion and providing for issuance of permits and collection of fees.

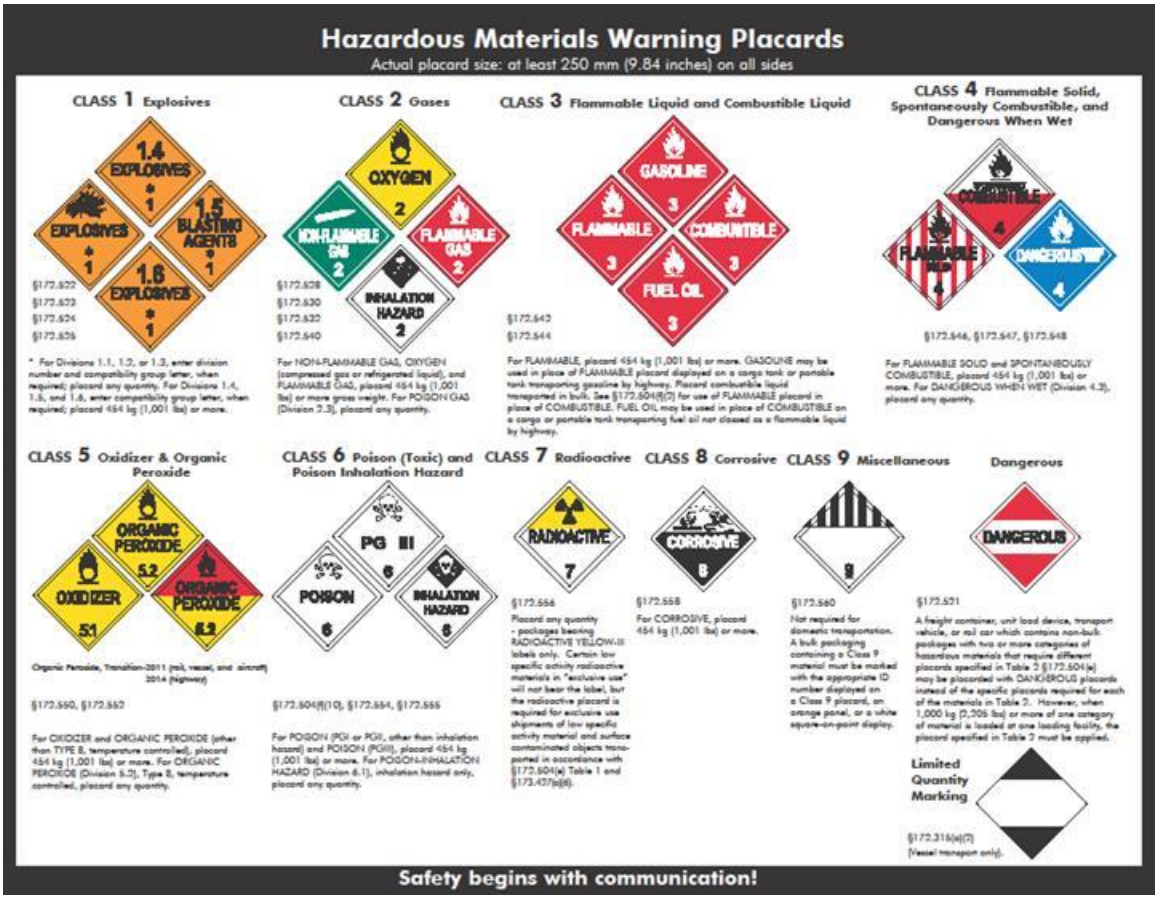
SECTION 2 Any person who shall violate any provision of this code or standard hereby adopted or fail to comply therewith; or who shall violate or fail to comply with any order made thereunder; or who shall build in violation of any detailed statement of specifications or plans submitted and approved thereunder; or fail to operate in accordance with any certificate or permit issued thereunder; and from which no appeal has been taken; or who shall fail to comply with such an order as affirmed or modified by a court of competent jurisdiction,

This page intentionally left blank.

APPENDIX B: PLACARDS, WARNINGS AND PICTOGRAMS

This page intentionally left blank.


Hazardous Materials Warning Labels
Actual label size: at least 100 mm (3.9 inches) on all sides
CLASS 1 Explosives: Divisions 1.1, 1.2, 1.3, 1.4, 1.5, 1.6
1.4
1.5
1.6
EXPLOSIVES
Subsidiary Risk Label
§172.411
CLASS 2 Gases: Divisions 2.1, 2.2, 2.3
§172.406(b), §172.415, §172.416, §172.417
CLASS 3 Flammable Liquid
§172.419
CLASS 4 Flammable Solid, Spontaneously Combustible, and Dangerous When Wet: Divisions 4.1, 4.2, 4.3
§172.420, §172.422, §172.423
CLASS 5 Oxidizer, Organic Peroxide: Divisions 5.1 and 5.2
§172.426, §172.427
* Include compatibility group letter.
** Include division number and compatibility group letter.
CLASS 6 Poison (Toxic), Poison Inhalation Hazard, Infectious Substance: Divisions 6.1 and 6.2
PG III
POISON
§172.323, §172.406(c), §172.429, §172.430, §172.432
For Regulated Medical Waste (RMW), an Infectious Substance label is not required on an outer packaging if the OSHA Biohazard marking is used as prescribed in 29 CFR 1910.1030(g). A bulk package of RMW must display a BIOHAZARD marking.
CLASS 7 Radioactive
§172.436, §172.438, §172.440, §172.441
CLASS 8 Corrosive
§172.442
CLASS 9 Miscellaneous Hazardous Material
or
§172.446
Cargo Aircraft Only
CARGO AIRCRAFT ONLY
§172.448
Empty Label
EMPTY
§172.450



HCS Pictograms and Hazards

Health Hazard	Flame	Exclamation Mark
• Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	• Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides	• Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non Mandatory)
Gas Cylinder	**Corrosion**	**Exploding Bomb**
• Gases under Pressure	• Skin Corrosion/ burns • Eye Damage • Corrosive to Metals	• Explosives • Self-Reactives • Organic Peroxides
Flame over Circle	**Environment (Non Mandatory)**	**Skull and Crossbones**
• Oxidizers	• Aquatic Toxicity	• Acute Toxicity (fatal or toxic)

APPENDIX C:
BUREAU OF ALCOHOL, TOBACCO, FIREARMS AND EXPLOSIVES LIST OF EXPLOSIVE MATERIALS

This page intentionally left blank.

58410 Federal Register / Vol. 77, No. 183 / Thursday, September 20, 2012 / Notices

only, please so note and enclose a check in the amount of $15.00 (25 cents per page reproduction cost for the 60 page proposed Consent Decree) payable to the U.S. Treasury. If requesting by email or fax, forward a check in that amount to the Consent Decree Library at the address given above.

Ronald G. Gluck,

Assistant Section Chief, Environmental Enforcement Section, Environment and Natural Resource Division.

[FR Doc. 2012–23146 Filed 9–19–12; 8:45 am]

BILLING CODE 4410–15–P

DEPARTMENT OF JUSTICE

Bureau of Alcohol, Tobacco, Firearms, and Explosives

[Docket No. ATF 47N]

Commerce in Explosives; List of Explosive Materials (2012R–10T)

AGENCY: Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), Department of Justice.

ACTION: Notice of list of explosive materials.

SUMMARY: Pursuant to 18 U.S.C. 841(d) and 27 CFR 555.23, the Department must publish and revise at least annually in the **Federal Register** a list of explosives determined to be within the coverage of 18 U.S.C. 841 *et seq.* The list covers not only explosives, but also blasting agents and detonators, all of which are defined as explosive materials in 18 U.S.C. 841(c). This notice publishes the 2012 List of Explosive Materials.

DATES: The list becomes effective September 20, 2012.

FOR FURTHER INFORMATION CONTACT: William J. O'Brien, Industry Liaison Analyst; Explosives Industry Programs Branch; Firearms and Explosives Industry Division; Bureau of Alcohol, Tobacco, Firearms, and Explosives; United States Department of Justice; 99 New York Avenue NE., Washington, DC 20226 (202–207–8969).

SUPPLEMENTARY INFORMATION: The list is intended to include any and all mixtures containing any of the materials on the list. Materials constituting blasting agents are marked by an asterisk. While the list is comprehensive, it is not all-inclusive. The fact that an explosive material is not on the list does not mean that it is not within the coverage of the law if it otherwise meets the statutory definitions in 18 U.S.C. 841. Explosive materials are listed alphabetically by their common names followed, where applicable, by chemical names and synonyms in brackets.

The Department has not added any new terms to the list of explosive materials or removed or revised any listing since its last publication.

This list supersedes the List of Explosive Materials dated October 19, 2011 (Docket No. ATF 47N, 76 FR 64974).

Notice of List of Explosive Materials

Pursuant to 18 U.S.C. 841(d) and 27 CFR 555.23, I hereby designate the following as explosive materials covered under 18 U.S.C. 841(c):

A

Acetylides of heavy metals.
Aluminum containing polymeric propellant.
Aluminum ophorite explosive.
Amatex.
Amatol.
Ammonal.
Ammonium nitrate explosive mixtures (cap sensitive).
* Ammonium nitrate explosive mixtures (non-cap sensitive).
Ammonium perchlorate having particle size less than 15 microns.
Ammonium perchlorate explosive mixtures (excluding ammonium perchlorate composite propellant (APCP)).
Ammonium picrate [picrate of ammonia, Explosive D].
Ammonium salt lattice with isomorphously substituted inorganic salts.
* ANFO [ammonium nitrate-fuel oil].
Aromatic nitro-compound explosive mixtures.
Azide explosives.

B

Baranol.
Baratol.
BEAF [1, 2-bis (2, 2-difluoro-2-nitroacetoxyethane)].
Black powder.
Black powder based explosive mixtures.
* Blasting agents, nitro-carbo-nitrates, including non-cap sensitive slurry and water gel explosives.
Blasting caps.
Blasting gelatin.
Blasting powder.
BTNEC [bis (trinitroethyl) carbonate].
BTNEN [bis (trinitroethyl) nitramine].
BTTN [1,2,4 butanetriol trinitrate].
Bulk salutes.
Butyl tetryl.

C

Calcium nitrate explosive mixture.
Cellulose hexanitrate explosive mixture.
Chlorate explosive mixtures.
Composition A and variations.
Composition B and variations.
Composition C and variations.
Copper acetylide.
Cyanuric triazide.
Cyclonite [RDX].
Cyclotetramethylenetetranitramine [HMX].
Cyclotol.
Cyclotrimethylenetrinitramine [RDX].

D

DATB [diaminotrinitrobenzene].
DDNP [diazodinitrophenol].
DEGDN [diethyleneglycol dinitrate].
Detonating cord.
Detonators.
Dimethylol dimethyl methane dinitrate composition.
Dinitroethyleneurea.
Dinitroglycerine [glycerol dinitrate].
Dinitrophenol.
Dinitrophenolates.
Dinitrophenyl hydrazine.
Dinitroresorcinol.
Dinitrotoluene-sodium nitrate explosive mixtures.
DIPAM [dipicramide; diaminohexanitrobiphenyl].
Dipicryl sulfone.
Dipicrylamine.
Display fireworks.
DNPA [2,2-dinitropropyl acrylate].
DNPD [dinitropentano nitrile].
Dynamite.

E

EDDN [ethylene diamine dinitrate].
EDNA [ethylenedinitramine].
Ednatol.
EDNP [ethyl 4,4-dinitropentanoate].
EGDN [ethylene glycol dinitrate].
Erythritol tetranitrate explosives.
Esters of nitro-substituted alcohols.
Ethyl-tetryl.
Explosive conitrates.
Explosive gelatins.
Explosive liquids.
Explosive mixtures containing oxygen-releasing inorganic salts and hydrocarbons.
Explosive mixtures containing oxygen-releasing inorganic salts and nitro bodies.
Explosive mixtures containing oxygen-releasing inorganic salts and water insoluble fuels.
Explosive mixtures containing oxygen-releasing inorganic salts and water soluble fuels.
Explosive mixtures containing sensitized nitromethane.
Explosive mixtures containing tetranitromethane (nitroform).
Explosive nitro compounds of aromatic hydrocarbons.
Explosive organic nitrate mixtures.
Explosive powders.

F

Flash powder.

Fulminate of mercury.
Fulminate of silver.
Fulminating gold.
Fulminating mercury.
Fulminating platinum.
Fulminating silver.

G

Gelatinized nitrocellulose.
Gem-dinitro aliphatic explosive mixtures.
Guanyl nitrosamino guanyl tetrazene.
Guanyl nitrosamino guanylidene hydrazine.
Guncotton.

H

Heavy metal azides.
Hexanite.
Hexanitrodiphenylamine.
Hexanitrostilbene.
Hexogen [RDX].
Hexogene or octogene and a nitrated N-methylaniline.
Hexolites.
HMTD [hexamethylenetriperoxidediamine].
HMX [cyclo-1,3,5,7-tetramethylene 2,4,6,8-tetranitramine; Octogen].
Hydrazinium nitrate/hydrazine/aluminum explosive system.
Hydrazoic acid.

I

Igniter cord.
Igniters.
Initiating tube systems.

K

KDNBF [potassium dinitrobenzo-furoxane].

L

Lead azide.
Lead mannite.
Lead mononitroresorcinate.
Lead picrate.
Lead salts, explosive.
Lead styphnate [styphnate of lead, lead trinitroresorcinate].
Liquid nitrated polyol and trimethylolethane.
Liquid oxygen explosives.

M

Magnesium ophorite explosives.
Mannitol hexanitrate.
MDNP [methyl 4,4-dinitropentanoate].
MEAN [monoethanolamine nitrate].
Mercuric fulminate.
Mercury oxalate.
Mercury tartrate.
Metriol trinitrate.
Minol-2 [40% TNT, 40% ammonium nitrate, 20% aluminum].
MMAN [monomethylamine nitrate]; methylamine nitrate.
Mononitrotoluene-nitroglycerin mixture.
Monopropellants.

N

NIBTN [nitroisobutametriol trinitrate].
Nitrate explosive mixtures.
Nitrate sensitized with gelled nitroparaffin.
Nitrated carbohydrate explosive.
Nitrated glucoside explosive.
Nitrated polyhydric alcohol explosives.
Nitric acid and a nitro aromatic compound explosive.
Nitric acid and carboxylic fuel explosive.
Nitric acid explosive mixtures.
Nitro aromatic explosive mixtures.
Nitro compounds of furane explosive mixtures.
Nitrocellulose explosive.
Nitroderivative of urea explosive mixture.
Nitrogelatin explosive.
Nitrogen trichloride.
Nitrogen tri-iodide.
Nitroglycerine [NG, RNG, nitro, glyceryl trinitrate, trinitroglycerine].
Nitroglycide.
Nitroglycol [ethylene glycol dinitrate, EGDN].
Nitroguanidine explosives.
Nitronium perchlorate propellant mixtures.
Nitroparaffins Explosive Grade and ammonium nitrate mixtures.
Nitrostarch.
Nitro-substituted carboxylic acids.
Nitrourea.

O

Octogen [HMX].
Octol [75 percent HMX, 25 percent TNT].
Organic amine nitrates.
Organic nitramines.

P

PBX [plastic bonded explosives].
Pellet powder.
Penthrinite composition.
Pentolite.
Perchlorate explosive mixtures.
Peroxide based explosive mixtures.
PETN [nitropentaerythrite, pentaerythrite tetranitrate, pentaerythritol tetranitrate].
Picramic acid and its salts.
Picramide.
Picrate explosives.
Picrate of potassium explosive mixtures.
Picratol.
Picric acid (manufactured as an explosive).
Picryl chloride.
Picryl fluoride.
PLX [95% nitromethane, 5% ethylenediamine].
Polynitro aliphatic compounds.
Polyolpolynitrate-nitrocellulose explosive gels.
Potassium chlorate and lead sulfocyanate explosive.
Potassium nitrate explosive mixtures.
Potassium nitroaminotetrazole.
Pyrotechnic compositions.
PYX [2,6-bis(picrylamino)] 3,5-dinitropyridine.

R

RDX [cyclonite, hexogen, T4, cyclo-1,3,5,-trimethylene-2,4,6,-trinitramine; hexahydro-1,3,5-trinitro-S-triazine].

S

Safety fuse.
Salts of organic amino sulfonic acid explosive mixture.
Salutes (bulk).
Silver acetylide.
Silver azide.
Silver fulminate.
Silver oxalate explosive mixtures.
Silver styphnate.
Silver tartrate explosive mixtures.
Silver tetrazene.
Slurried explosive mixtures of water, inorganic oxidizing salt, gelling agent, fuel, and sensitizer (cap sensitive).
Smokeless powder.
Sodatol.
Sodium amatol.
Sodium azide explosive mixture.
Sodium dinitro-ortho-cresolate.
Sodium nitrate explosive mixtures.
Sodium nitrate-potassium nitrate explosive mixture.
Sodium picramate.
Special fireworks.
Squibs.
Styphnic acid explosives.

T

Tacot [tetranitro-2,3,5,6-dibenzo-1,3a,4,6a tetrazapentalene].
TATB [triaminotrinitrobenzene].
TATP [triacetonetriperoxide].
TEGDN [triethylene glycol dinitrate].
Tetranitrocarbazole.
Tetrazene [tetracene, tetrazine, 1(5-tetrazolyl)-4-guanyl tetrazene hydrate].
Tetrazole explosives.
Tetryl [2,4,6 tetranitro-N-methylaniline].
Tetrytol.
Thickened inorganic oxidizer salt slurried explosive mixture.
TMETN [trimethylolethane trinitrate].
TNEF [trinitroethyl formal].
TNEOC [trinitroethylorthocarbonate].
TNEOF [trinitroethylorthoformate].
TNT [trinitrotoluene, trotyl, trilite, triton].
Torpex.
Tridite.
Trimethylol ethyl methane trinitrate composition.
Trimethylolthane trinitrate-nitrocellulose.

Trimonite.
Trinitroanisole.
Trinitrobenzene.
Trinitrobenzoic acid.
Trinitrocresol.
Trinitro-meta-cresol.
Trinitronaphthalene.
Trinitrophenetol.
Trinitrophloroglucinol.
Trinitroresorcinol.
Tritonal.

U

Urea nitrate.

W

Water-bearing explosives having salts of oxidizing acids and nitrogen bases, sulfates, or sulfamates (cap sensitive).
Water-in-oil emulsion explosive compositions.

X

Xanthamonas hydrophilic colloid explosive mixture.

B. Todd Jones,

Acting Director.

[FR Doc. 2012–23241 Filed 9–19–12; 8:45 am]

BILLING CODE 4410–FY–P

DEPARTMENT OF JUSTICE

Antitrust Division

Notice Pursuant to the National Cooperative Research and Production Act of 1993; American Society of Mechanical Engineers

Notice is hereby given that, on August 27, 2012, pursuant to Section 6(a) of the National Cooperative Research and Production Act of 1993, 15 U.S.C. 4301 *et seq.* ("the Act"), the American Society of Mechanical Engineers ("ASME") has filed written notifications simultaneously with the Attorney General and the Federal Trade Commission disclosing additions or changes to its standards development activities. The notifications were filed for the purpose of extending the Act's provisions limiting the recovery of antitrust plaintiffs to actual damages under specified circumstances. Specifically, since April 26, 2012, ASME has published six new standards, initiated one new standards activity, withdrawn one published standard, and withdrawn one proposed standard from consideration within the general nature and scope of ASME's standards development activities, as specified in its original notification. More detail regarding these changes can be found at *www.asme.org.*

On September 15, 2004, ASME filed its original notification pursuant to Section 6(a) of the Act. The Department of Justice published a notice in the **Federal Register** pursuant to Section 6(b) of the Act on October 13, 2004 (69 FR 60895).

The last notification was filed with the Department on April 27, 2012. A notice was published in the **Federal Register** pursuant to Section 6(b) of the Act on May 24, 2012 (77 FR 31041).

Patricia A. Brink,

Director of Civil Enforcement, Antitrust Division.

[FR Doc. 2012–23167 Filed 9–19–12; 8:45 am]

BILLING CODE P

DEPARTMENT OF JUSTICE

Office of Justice Programs

[OJP (BJA) Docket No. 1605]

Meeting of the Global Justice Information Sharing Initiative Federal Advisory Committee

AGENCY: Office of Justice Programs (OJP), Justice.

ACTION: Notice of meeting.

SUMMARY: This is an announcement of a meeting of the Global Justice Information Sharing Initiative (Global) Federal Advisory Committee (GAC) to discuss the Global Initiative, as described at *www.it.ojp.gov/global.*

DATES: The meeting will take place on Wednesday, October 24, 2012, from 8:30 a.m. to 4:00 p.m. ET.

ADDRESSES: The meeting will take place at the Sheraton Premiere at Tysons Corner hotel, 8661 Leesburg Pike, Vienna (Tysons Corner), VA 22182, Phone: (703) 448–1234.

FOR FURTHER INFORMATION CONTACT: J. Patrick McCreary, Global Designated Federal Employee (DFE), Bureau of Justice Assistance, Office of Justice Programs, 810 7th Street, Washington, DC 20531; Phone: (202) 616–0532 [note: This is not a toll-free number]; Email: *James.P.McCreary@usdoj.gov.*

SUPPLEMENTARY INFORMATION: This meeting is open to the public. Due to security measures, however, members of the public who wish to attend this meeting must register with Mr. J. Patrick McCreary at the above address at least (7) days in advance of the meeting. Registrations will be accepted on a space available basis. Access to the meeting will not be allowed without registration. All attendees will be required to sign in at the meeting registration desk. Please bring photo identification and allow extra time prior to the meeting.

Anyone requiring special accommodations should notify Mr. McCreary at least seven (7) days in advance of the meeting.

Purpose

The GAC will act as the focal point for justice information systems integration activities in order to facilitate the coordination of technical, funding, and legislative strategies in support of the Administration's justice priorities.

The GAC will guide and monitor the development of the Global information sharing concept. It will advise the Assistant Attorney General, OJP; the Attorney General; the President (through the Attorney General); and local, state, tribal, and federal policymakers in the executive, legislative, and judicial branches. The GAC will also advocate for strategies for accomplishing a Global information sharing capability.

Interested persons whose registrations have been accepted may be permitted to participate in the discussions at the discretion of the meeting chairman and with approval of the DFE.

J. Patrick McCreary,

Global Designated Federal Employee, Bureau of Justice Assistance, Office of Justice Programs.

[FR Doc. 2012–23157 Filed 9–19–12; 8:45 am]

BILLING CODE 4410–18–P

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

[Notice 12–075]

NASA Advisory Council; Science Committee; Earth Science Subcommittee; Meeting

AGENCY: National Aeronautics and Space Administration.

ACTION: Notice of meeting.

SUMMARY: In accordance with the Federal Advisory Committee Act, Public Law 92–463, as amended, the National Aeronautics and Space Administration (NASA) announces a meeting of the Earth Science Subcommittee of the NASA Advisory Council (NAC). This Subcommittee reports to the Science Committee of the NAC. The meeting will be held for the purpose of soliciting, from the scientific community and other persons, scientific and technical information relevant to program planning.

DATES: Wednesday, October 10, 2012, 12:30 a.m. to 2:30 p.m., Local Time.

ADDRESSES: This meeting will take place telephonically. Any interested person may call the USA toll free conference

This page intentionally left blank.

UNIT 4: MAXIMUM ALLOWABLE QUANTITIES AND CONTROL AREAS

TERMINAL OBJECTIVE

The students will be able to demonstrate how to determine maximum allowable quantities (MAQs) of hazardous materials per control area.

ENABLING OBJECTIVES

The students will:

1. *Describe the relationship between the building code, fire codes and hazardous materials standards.*
2. *Illustrate examples of situations where consultation from technical specialists and/or third-party entities may be advisable.*
3. *Summarize the concepts involved in the safe use and storage of hazardous materials.*
4. *Given a scenario, determine the application and use of MAQs and control areas.*
5. *Describe the characteristics of a high-hazard (H) occupancy and its relationship between the fire and building codes.*

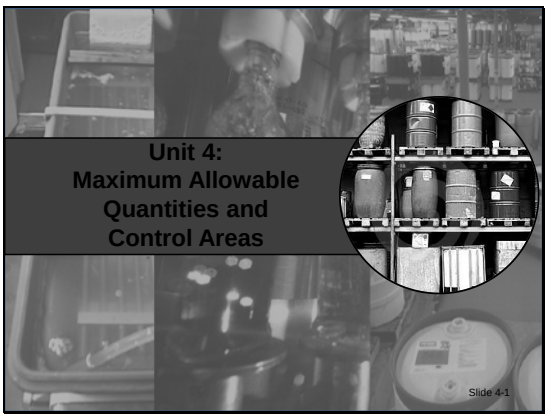
This page intentionally left blank.

NOTE-TAKING GUIDE AND ACTIVITIES

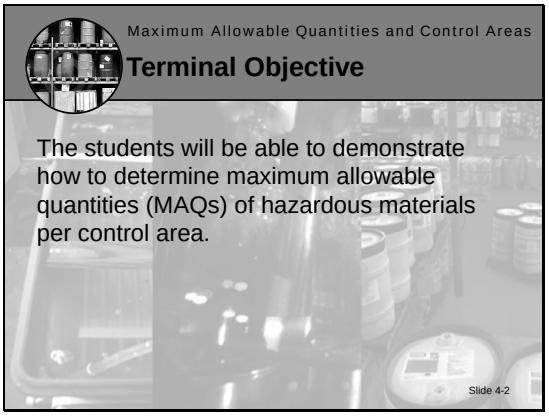
This page intentionally left blank.

NOTE-TAKING GUIDE

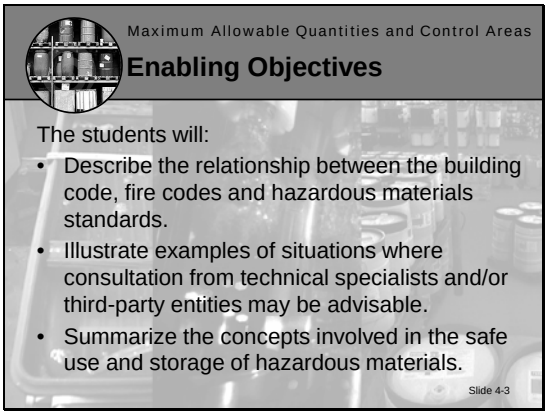
Slide 4-1



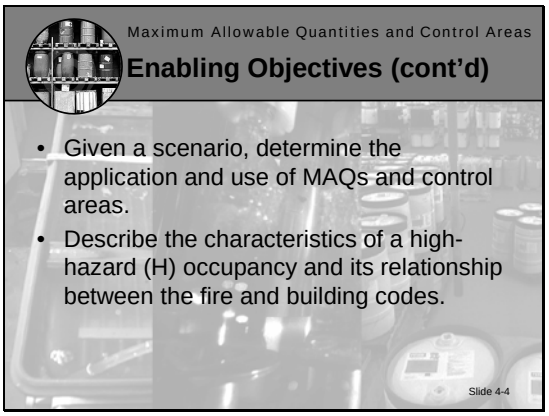
Slide 4-2



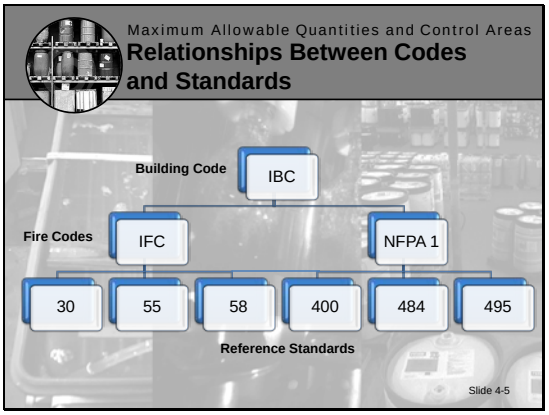
Slide 4-3



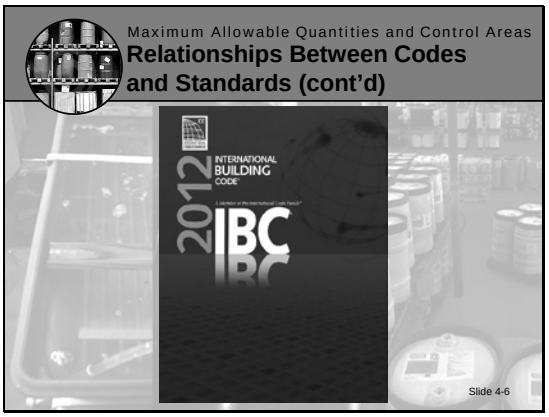
Slide 4-4



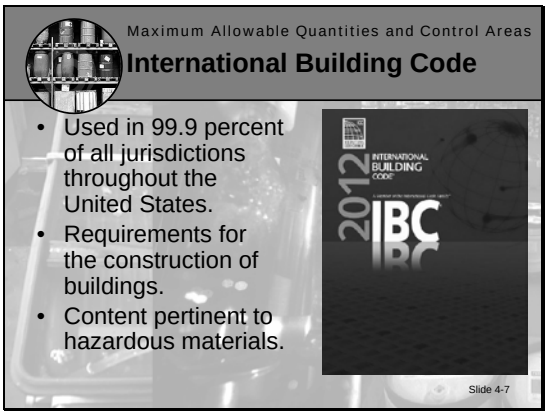
Slide 4-5



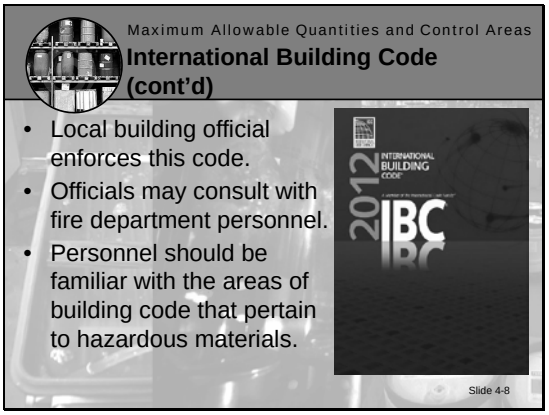
Slide 4-6



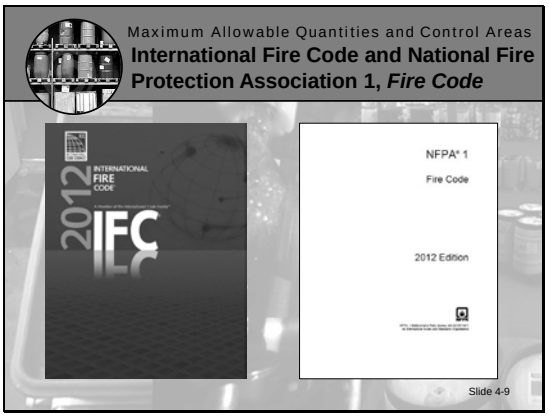
Slide 4-7



Slide 4-8

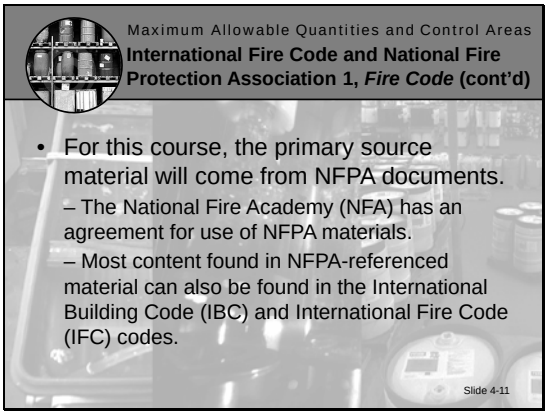


Slide 4-9

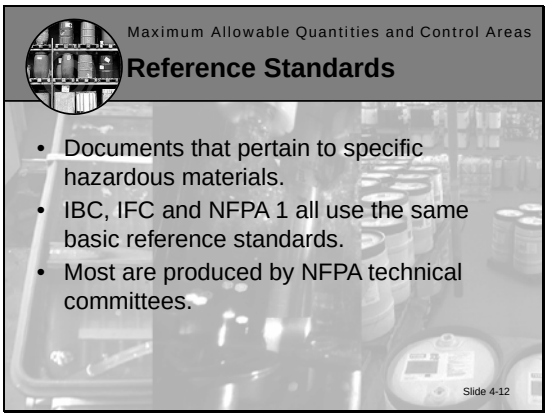


Slide 4-10

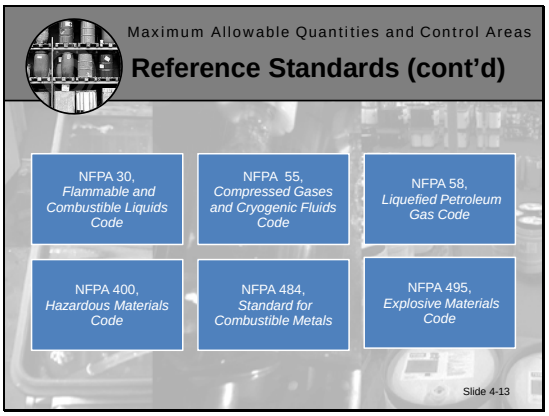
Slide 4-11



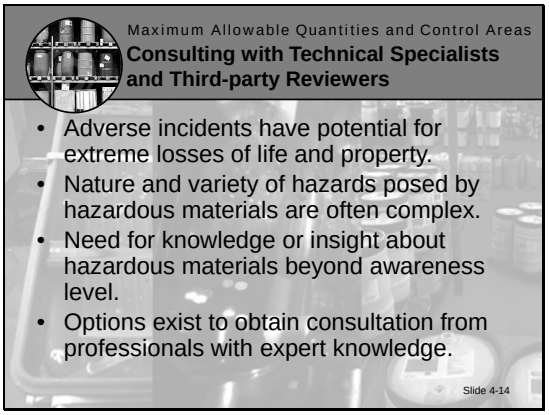
Slide 4-12



Slide 4-13

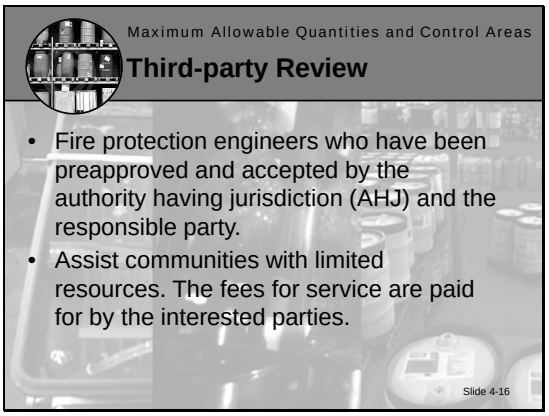


Slide 4-14

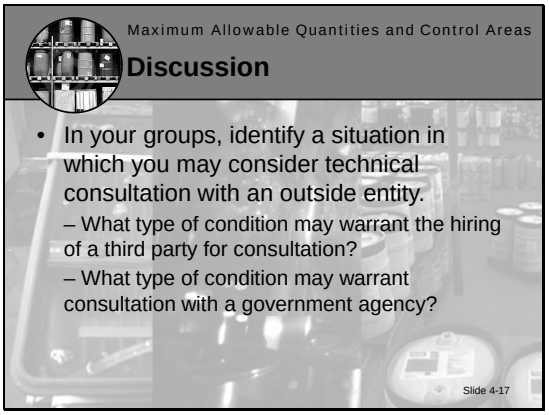


Slide 4-15

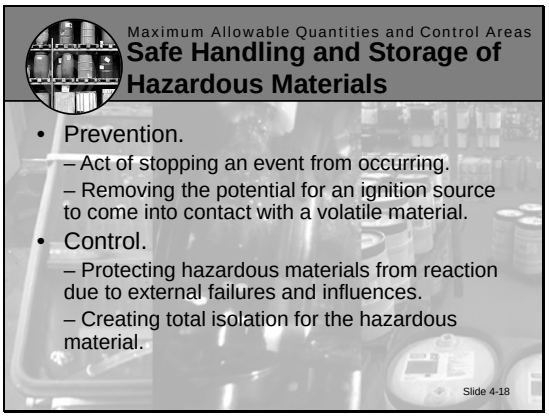
Slide 4-16



Slide 4-17



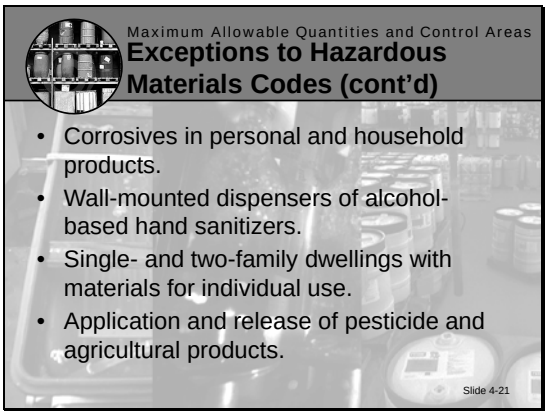
Slide 4-18



Slide 4-19

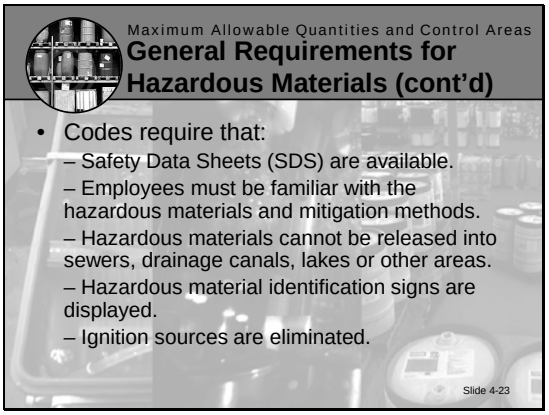
Slide 4-20

Slide 4-21

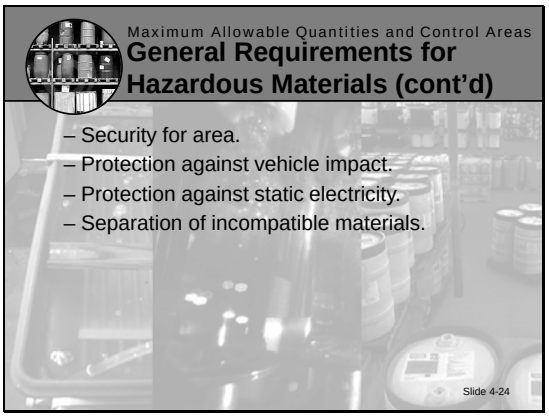


Slide 4-22

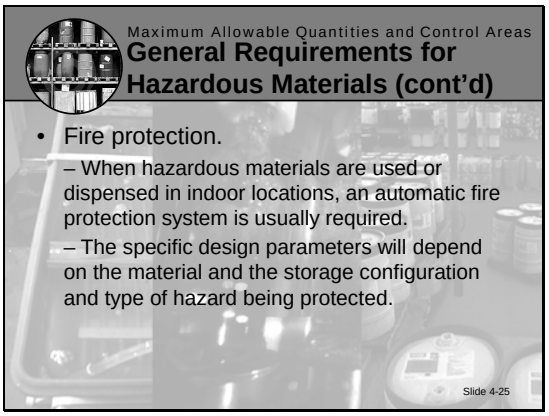
Slide 4-23



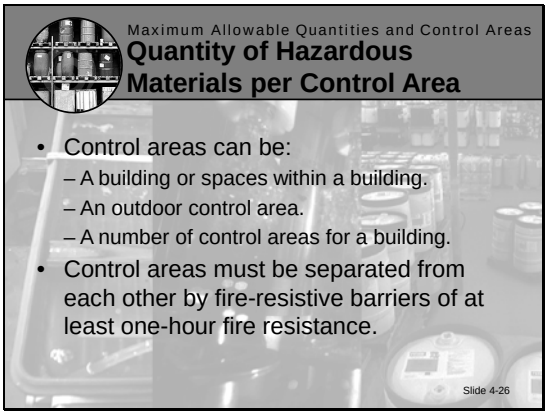
Slide 4-24



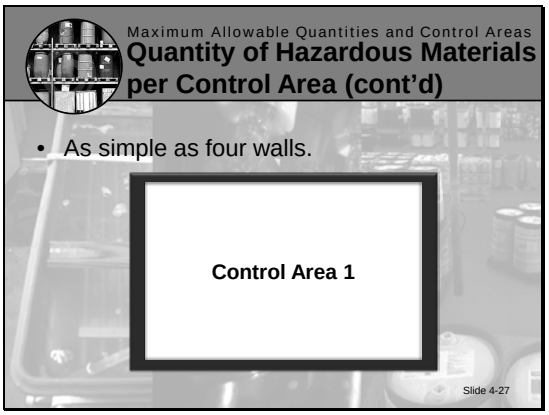
Slide 4-25



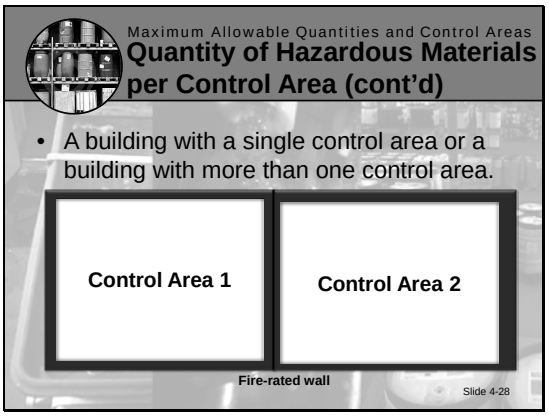
Slide 4-26



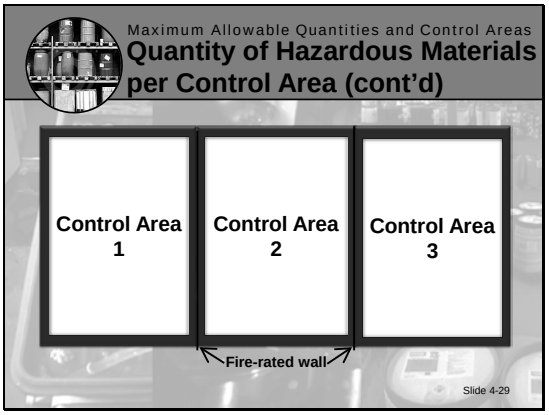
Slide 4-27



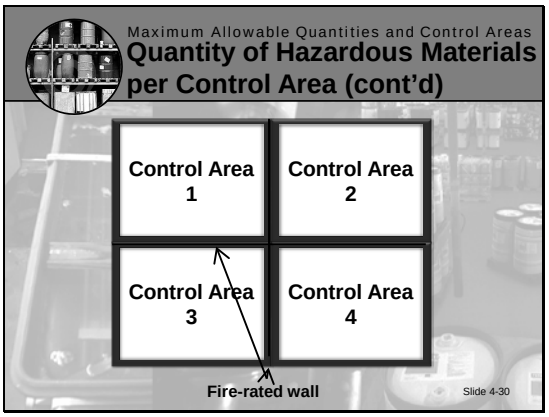
Slide 4-28



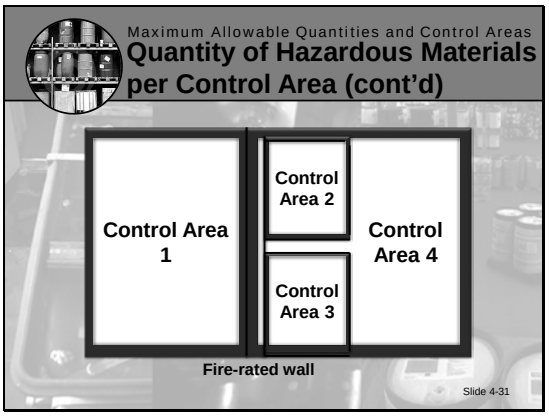
Slide 4-29



Slide 4-30

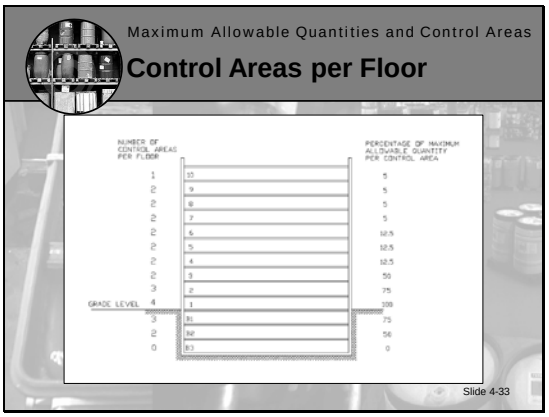


Slide 4-31

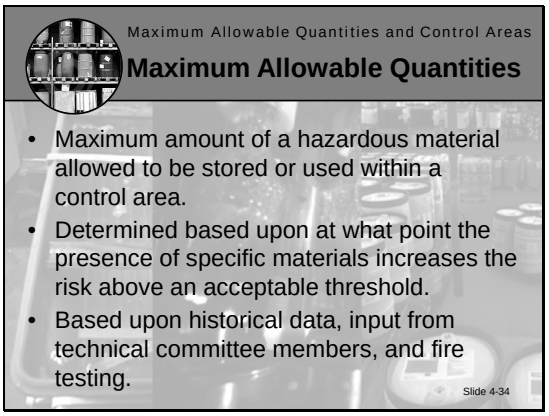


Slide 4-32

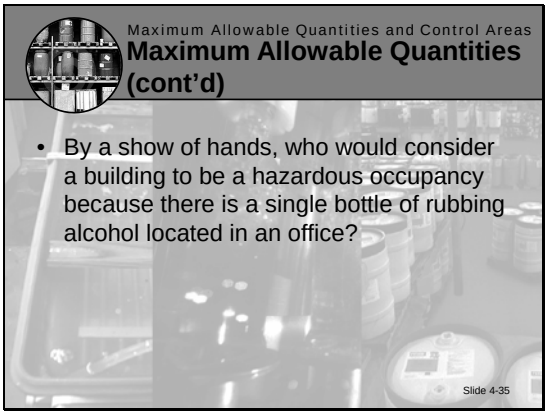
Slide 4-33



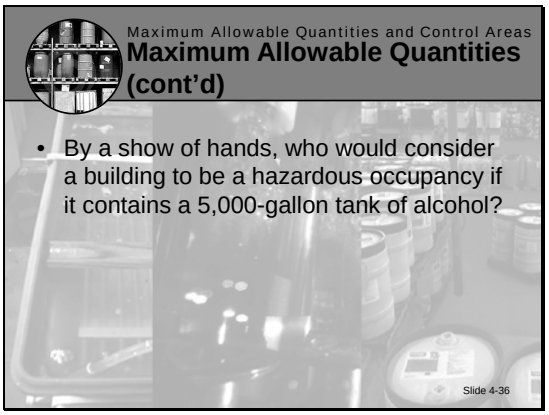
Slide 4-34



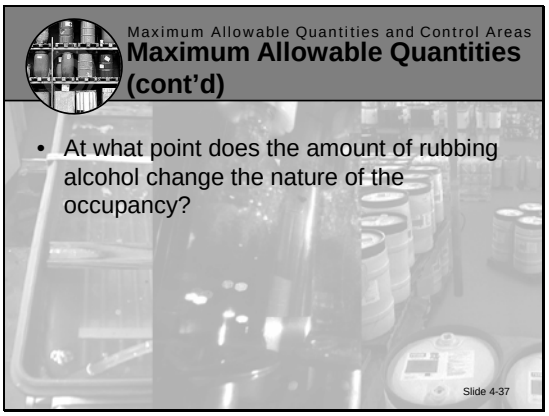
Slide 4-35



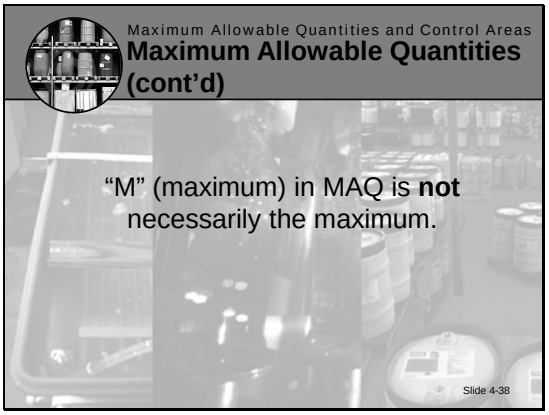
Slide 4-36



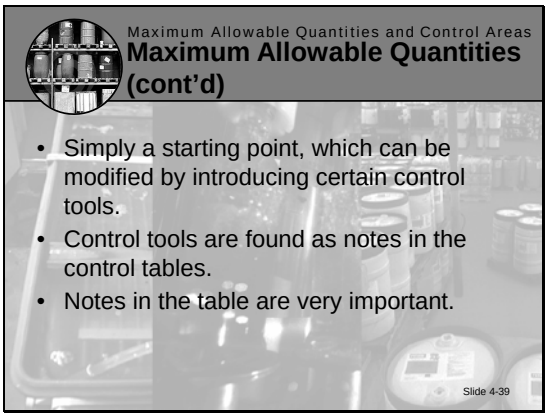
Slide 4-37



Slide 4-38

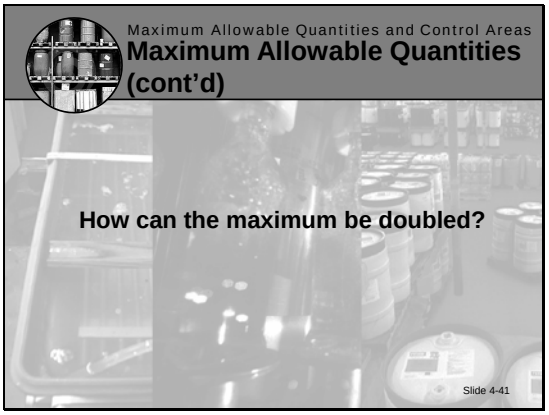


Slide 4-39

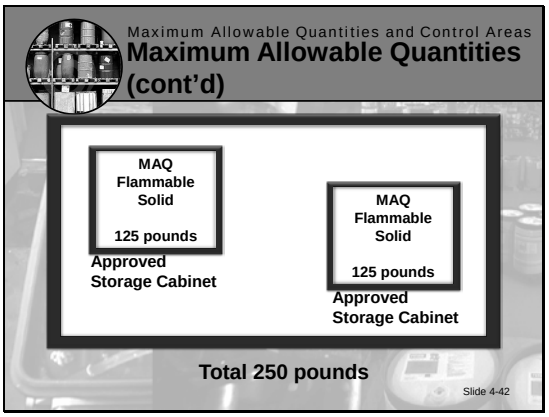


Slide 4-40

Slide 4-41

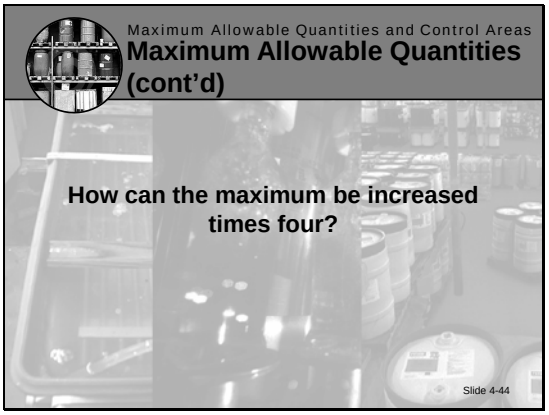


Slide 4-42

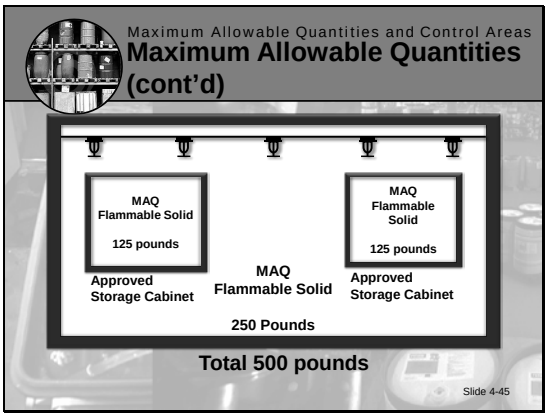


Slide 4-43

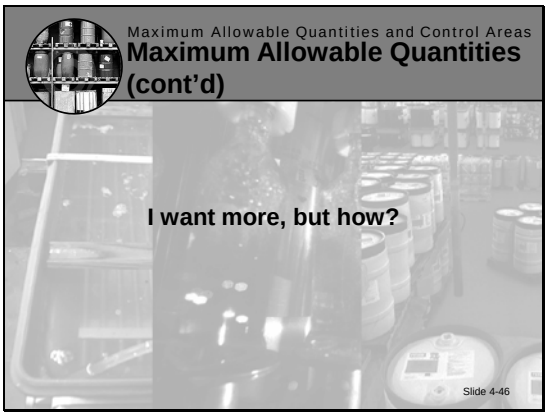
Slide 4-44



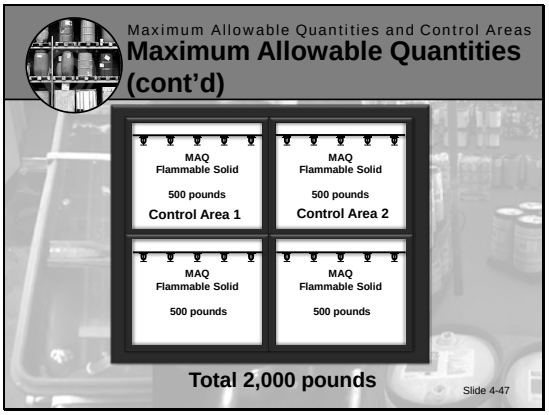
Slide 4-45



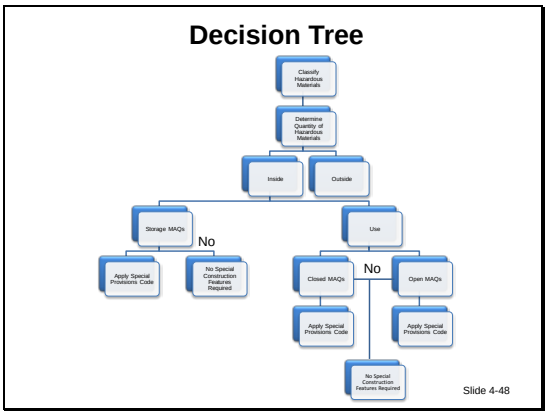
Slide 4-46



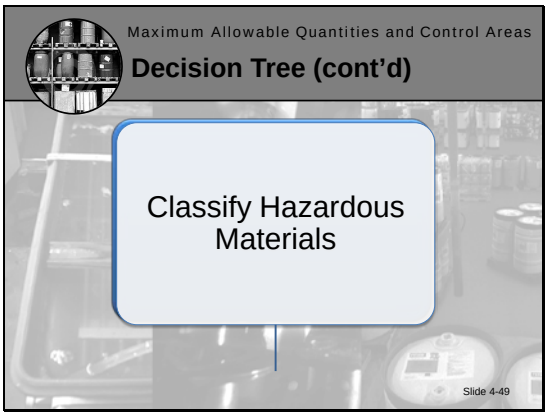
Slide 4-47



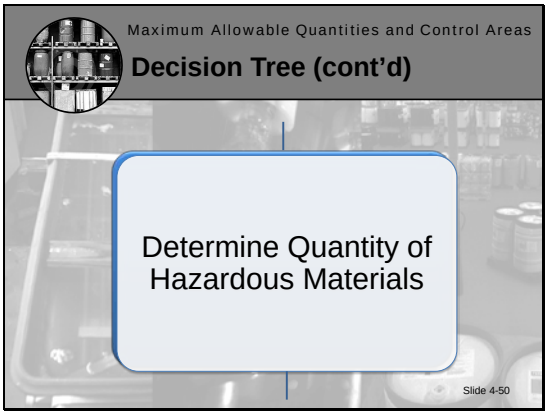
Slide 4-48



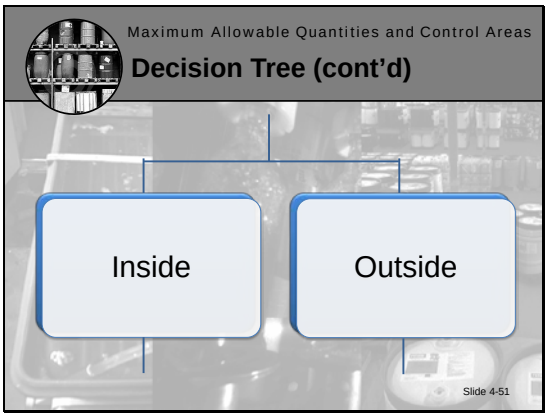
Slide 4-49



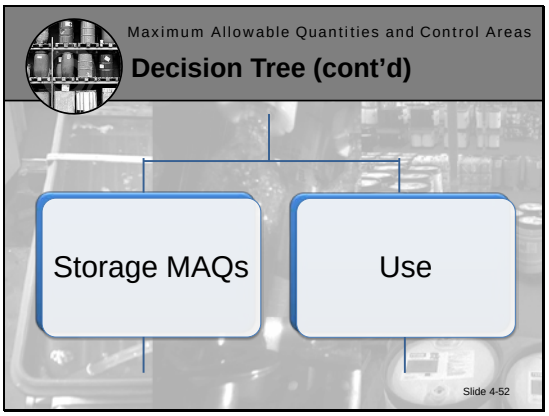
Slide 4-50



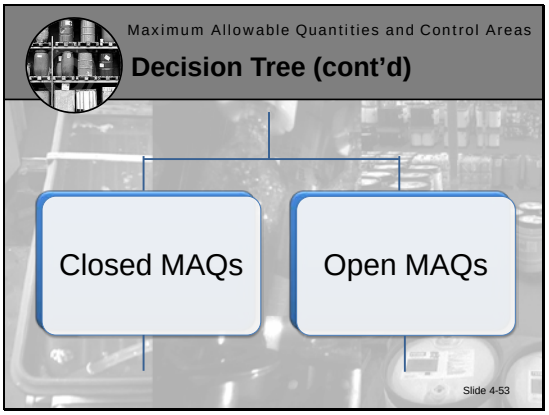
Slide 4-51



Slide 4-52



Slide 4-53



Slide 4-54

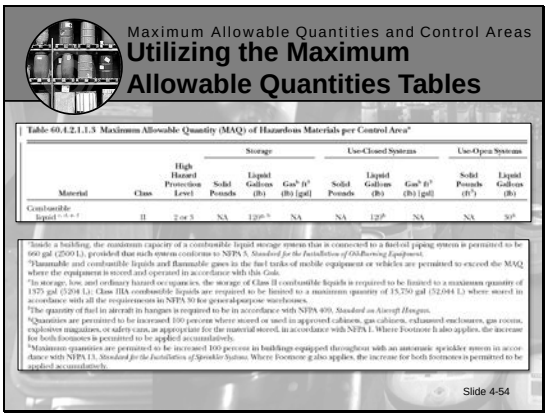


Table 60.4.2.1.1.3 Maximum Allowable Quantity (MAQ) of Hazardous Materials per Control Area[a]

Material	Class	High Hazard Protection Level	Storage: Solid Pounds	Storage: Liquid Gallons (lb)	Storage: Gas[b] [c] (lb) [gal]	Use-Closed Systems: Solid Pounds	Use-Closed Systems: Liquid Gallons (lb)	Use-Closed Systems: Gas[b] [c] (lb) [gal]	Use-Open Systems: Solid Pounds (ft³)	Use-Open Systems: Liquid Gallons (lb)
Combustible liquid[e, f, g, h]	II	2 or 3	NA	120[d, h]	NA	NA	120[h]	NA	NA	50[h]

[a]Inside a building, the maximum capacity of a combustible liquid storage system that is connected to a fuel-oil piping system is permitted to be 660 gal (2500 L), provided that such system conforms to NFPA 5, *Standard for the Installation of Oil-Burning Equipment*.

[b]Flammable and combustible liquids and flammable gases in the fuel tanks of mobile equipment or vehicles are permitted to exceed the MAQ where the equipment is stored and operated in accordance with this Code.

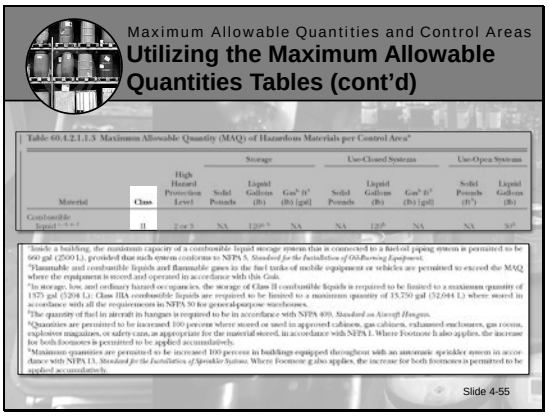
[c]In storage, low, and ordinary hazard occupancies, the storage of Class II combustible liquids is required to be limited to a maximum quantity of 1375 gal (5204 L); Class IIIA combustible liquids are required to be limited to a maximum quantity of 15,750 gal (52,044 L) where stored in accordance with all the requirements in NFPA 30 for general-purpose warehouses.

[d]The quantity of fuel in aircraft in hangars is required to be in accordance with NFPA 409, *Standard on Aircraft Hangars*.

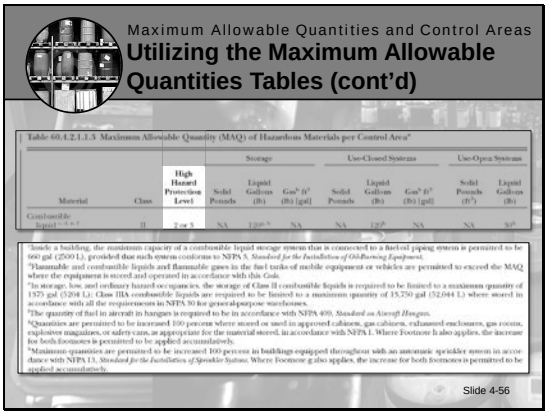
[e]Quantities are permitted to be increased 100 percent where stored or used in approved cabinets, gas cabinets, exhausted enclosures, gas rooms, explosives magazines, or safety cans, as appropriate for the material stored, in accordance with NFPA 1. Where Footnote h also applies, the increase for both footnotes is permitted to be applied accumulatively.

[f]Maximum quantities are permitted to be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. Where Footnote g also applies, the increase for both footnotes is permitted to be applied accumulatively.

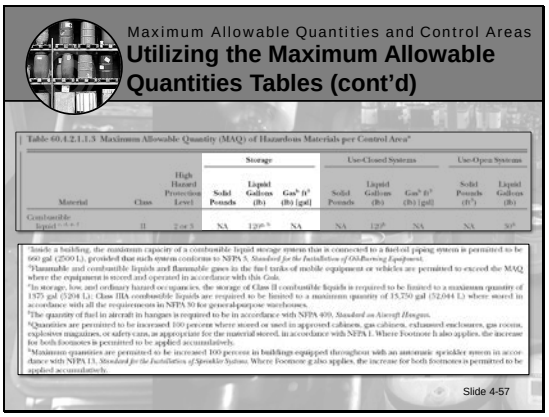
Slide 4-55



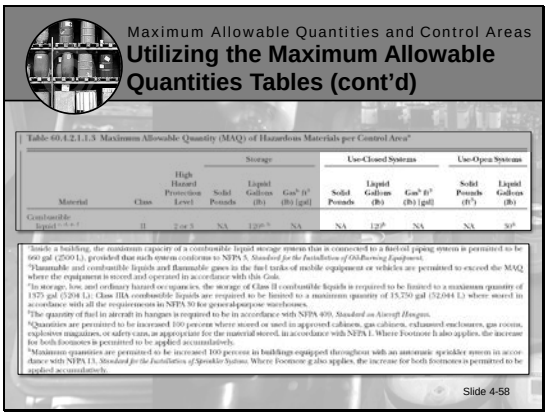
Slide 4-56



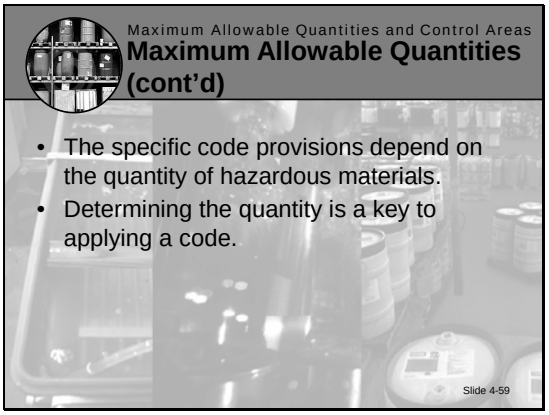
Slide 4-57



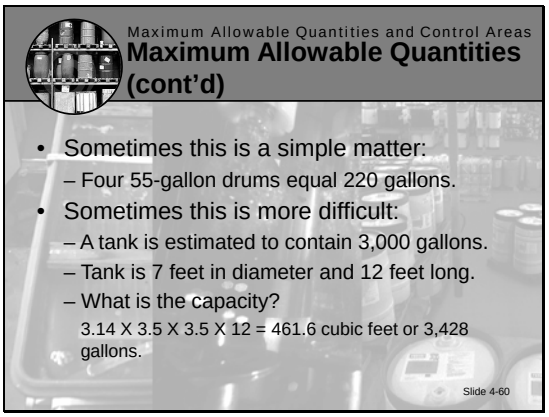
Slide 4-58



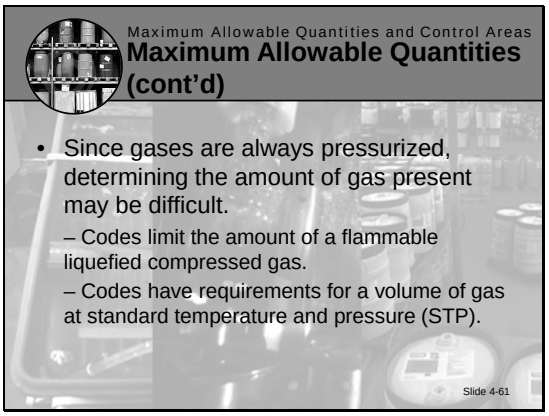
Slide 4-59



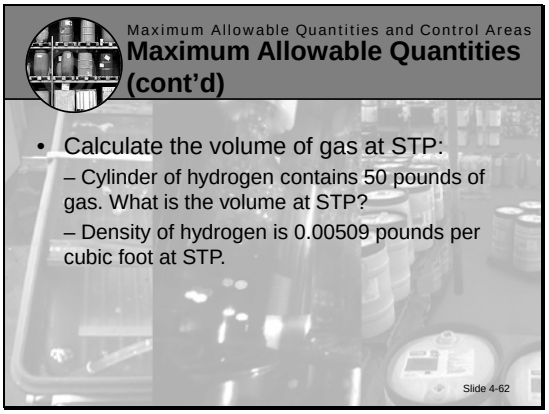
Slide 4-60



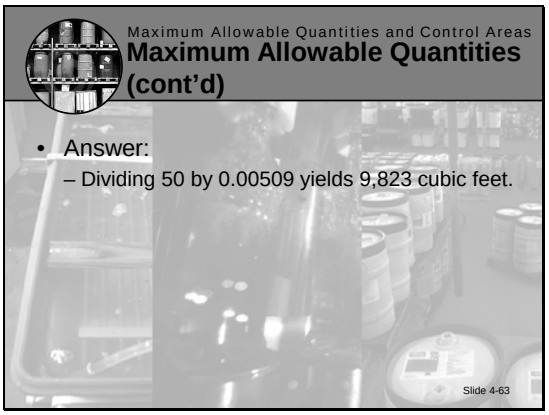
Slide 4-61



Slide 4-62



Slide 4-63



Slide 4-64

Activity 4.1
Identify Maximum
Allowable Quantities
Slide 4-64

Activity 4.1

Identify Maximum Allowable Quantities

Purpose

To determine maximum allowable quantities (MAQs).

Directions

1. Working individually, use the MAQ tables to determine the MAQ per control area for the following hazardous materials:

   a. **Liquid Class II** — general purpose, low-hazard warehouse stored in cabinets; building is equipped with a sprinkler system.

   _____

   _____

   b. **Oxidizer Class 3 Solid** — used for water treatment in assembly occupancy for a swimming pool.

   _____

   _____

   c. **Organic Peroxide Class IV Solid** — used in a high school chemistry lab.

   _____

   _____

   d. **Highly Toxic Liquid** — day care (cleaning product under the sink).

   _____

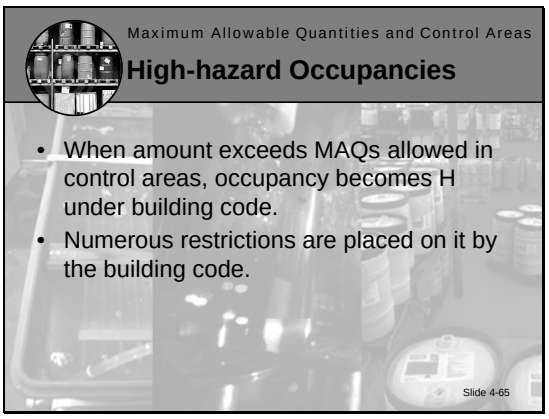
   _____

2. Instructor will review the answers with the class.

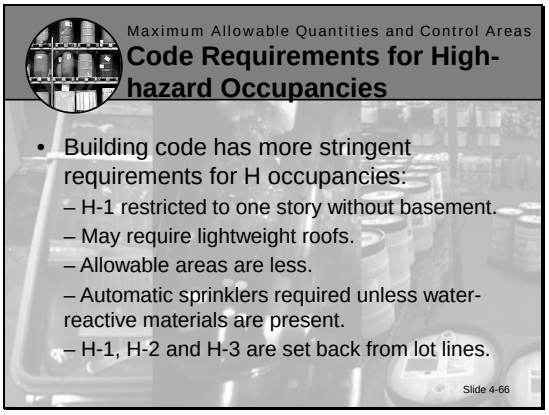
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

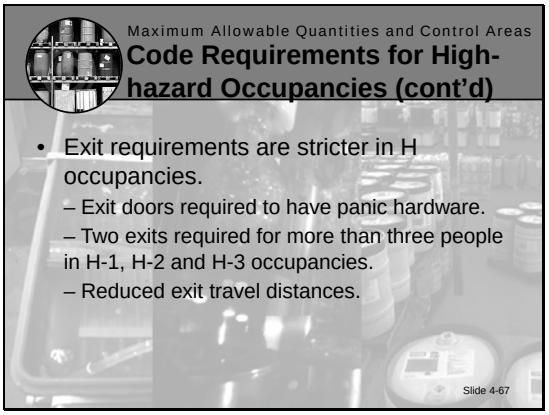
Slide 4-65



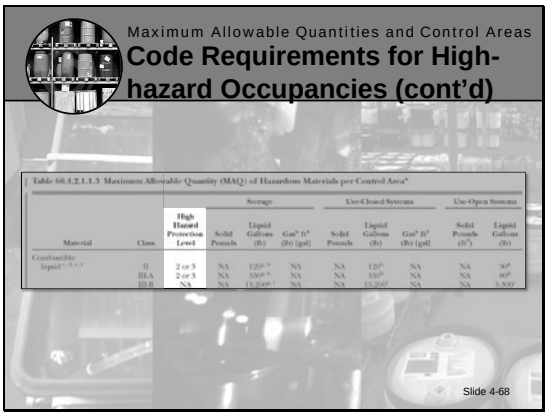
Slide 4-66



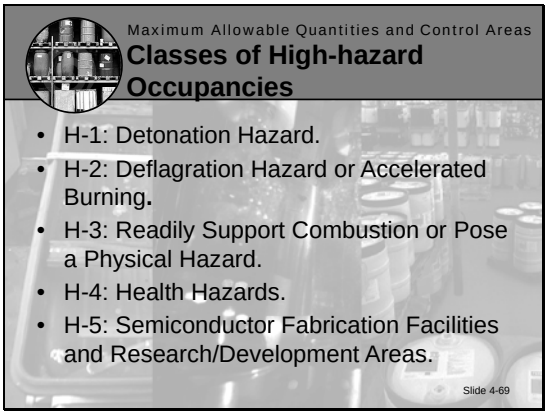
Slide 4-67



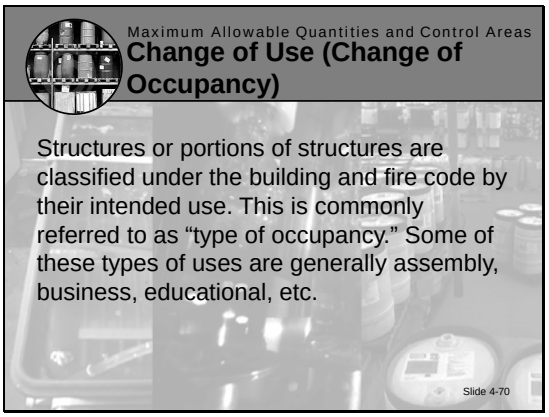
Slide 4-68



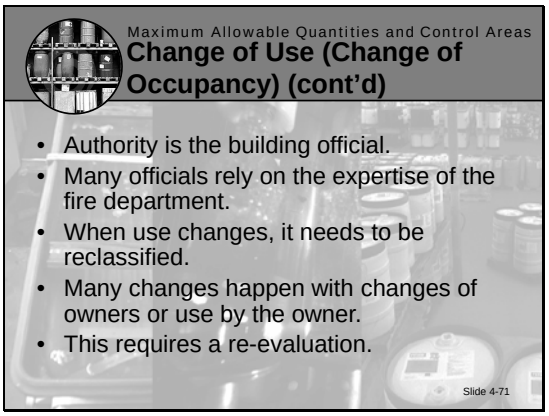
Slide 4-69



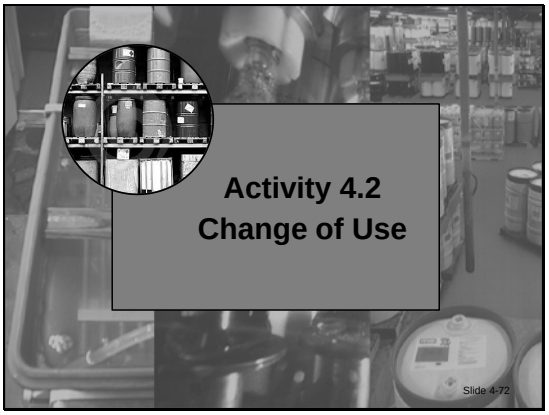
Slide 4-70



Slide 4-71



Slide 4-72



This page intentionally left blank.

Activity 4.2

Change of Use

Purpose

To apply the principles of MAQs to an occupancy located in or near your home community.

Directions

Read the following case study of a change of use from a general storage occupancy to an occupancy storing hazardous materials.

Case Study — 1996 — Houston Distribution Center

In the early 1980s, a company by the name of Houston Distribution Inc. began operating a public storage warehouse in southeast Houston. The warehouse was located in an industrial area. Directly next to the warehouse was a residential area known as Pleasantville. The structure was one story in height and consisted of approximately 319,000 square feet. The structure was built in a "U" configuration. The building was protected by an automatic sprinkler system that was designed to protect light- and medium-hazard type storage. In the early 1990s, a decision was made to increase the profit margin of the storage by allowing hazardous materials to be stored within the building. It was determined that the owner could charge more per square foot for the storage of the hazardous materials.

At 8:33 a.m., on June 27, 1995, the Houston Fire Department received notification of a water flow alarm at the warehouse. This would turn out to be one of the largest and most costly fires to take place in the history of the City of Houston. Unbeknownst to the arriving firefighters, there were copious amounts of hazardous materials being stored in the warehouse. There were large quantities of organic peroxide in the area where the fire was originally discovered. Arriving on the scene, engine 41 found the south half of the complex to be heavily involved in fire. There was no indication that the sprinkler system was having any effect on reducing the spread of the fire. Over the next four hours, the fire would escalate to a seven-alarm fire. By noon that day, the Houston Fire Department had dispatched 31 engine companies, 14 ladder companies and numerous specialized units.

With the rapid response of large numbers of suppression units, it was believed that the fire could be contained. As a majority of the engine and ladder companies were setting up to fight the fire, they were confronted by a river of fire flowing on top of the water exiting the structure. This situation caused the fastest redeployment of committed equipment in the history of the department. The 4-inch supply lines were cut with axes. Some equipment retreated without disconnecting any of the lines. Ladder 14 found itself in a lake of fire and was destroyed. This was the only unit ever lost to a fire by the Houston Fire Department in a fire.

Firefighters fought the fire for 18 hours before bringing it under control. Through the efforts of the firefighters, the north half of the complex was saved. Because of the mixture of hazardous materials remaining after the fire, it was necessary for the Houston Fire Department to post a fire watch for the next four months. During this time, chemical reactions caused several fires to break out.

It was not until Oct. 24, 1995, that remediation of the site could begin. The remediation process took approximately eight months to be completed. During this time, the remediation company recovered over 6,000 barrels of waste runoff. The investigation found there were over 13,000 barrels of hazardous materials located within the south section of the structure when the fire took place. In addition to the barrels, there was an undetermined number of other types of containers that also contained hazardous materials. Each material found had to be properly identified, stabilized and then promptly disposed.

In 2005, the Pleasantville Environmental Coalition was formed to address the neighborhood's concerns as to the health issues resulting from the exposure to the burning hazardous chemicals. The same concern was being expressed by the firefighters who responded to this incident. Many with the Houston Fire Department believe that the burning chemicals at this fire are the primary cause for the abnormal high rate of cancer being experienced by the firefighters who fought this fire.

Part 1

1. Identify an existing structure in your jurisdiction (or one you are familiar with in a nearby locality) that was built with the intent of being a nonhazardous material using or storing occupancy. Examples may include but are not limited to:

    a. General storage spec warehouse, large retail (big box) facility, manufacturing plant, etc.

    b. Due to economic conditions, the original tenant vacated the property and the structure sat empty for a period of time.

    c. In recent months, a new tenant has occupied the structure and is storing (or using) large quantities of hazardous materials.

2. Individually, write up your answers on the form provided. Turn in your written answers to the instructor.

a. Identify the current occupant and use of the building.

_____

_____

_____

_____

_____

b. Identify the general hazard class of the hazardous materials currently being stored (or used) in the building.

_____

_____

_____

_____

_____

c. Render a decision if the potential exists that the building was not designed to have the hazardous materials present or utilized.

_____

_____

_____

_____

_____

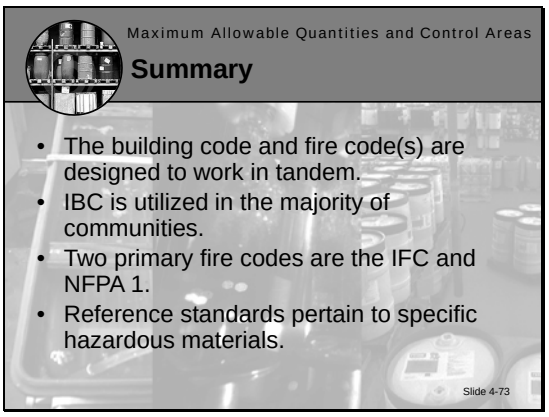
Part 2

Your instructor will select certain cases and allow you to present them to the class.

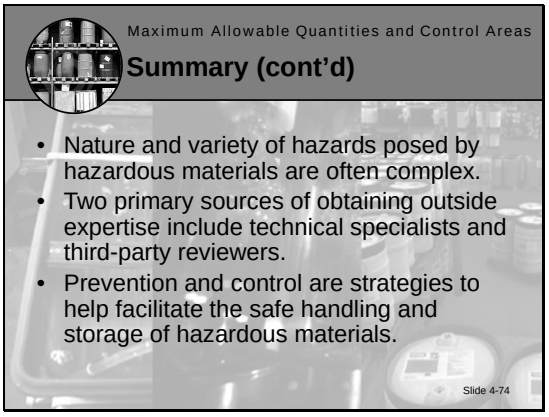
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

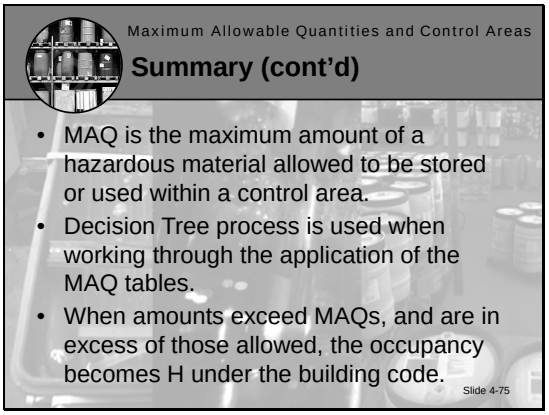
Slide 4-73



Slide 4-74



Slide 4-75



This page intentionally left blank.

BACKGROUND TEXT

This page intentionally left blank.

RELATIONSHIPS BETWEEN CODES AND STANDARDS

The building code and fire code(s) are designed to work in tandem to direct the safe use and storage of hazardous materials.

There is one building code and two primary fire codes that are utilized nationwide.

International Building Code (IBC)

The IBC is used in 99.9 percent of all jurisdictions throughout the United States. The building code contains the requirements for the construction of buildings. The building code includes significant content pertinent to hazardous materials. The primary responsibility for enforcing the building code rests with the local building official. Most building officials consult with fire department personnel on matters pertaining to hazardous materials. Fire department personnel should be familiar with the areas of building codes that pertain to hazardous materials.

International Fire Code (IFC) and National Fire Protection Association (NFPA) 1, *Fire Code*

The local jurisdiction selects the fire code for its community. It is normally either the IFC or NFPA 1. The International Code Council (ICC) and NFPA are competing code organizations. Both codes contain similar material, but are produced by two different organizations.

For the purposes of this course, the primary source material pertaining to fire protection codes and standards will come from NFPA documents. The National Fire Academy (NFA) has an agreement for use of NFPA materials. Most content found in NFPA-referenced material can also be found in the IBC and IFC codes.

Reference Standards

Reference standards are documents that pertain to specific hazardous materials. IBC, IFC and NFPA 1 all use the same basic reference standards. Most of the reference standards are produced by NFPA technical committees.

Examples of reference standards pertaining to hazardous materials include but are not limited to:

- NFPA 30, *Flammable and Combustible Liquids Code*.
- NFPA 55, *Compressed Gases and Cryogenic Fluids Code*.
- NFPA 58, *Liquefied Petroleum Gas Code*.

- NFPA 400, *Hazardous Materials Code*. Products include:
  - Ammonium nitrate.
  - Corrosives.
  - Flammable solids.
  - Organic peroxides.
  - Oxidizers.
  - Pyrophorics.
  - Toxic or highly toxic materials.
  - Unstable materials (reactive).
  - Water reactive.
- NFPA 484, *Standard for Combustible Metals*.
- NFPA 495, *Explosive Materials Code*.

CONSULTING WITH TECHNICAL SPECIALISTS AND THIRD-PARTY REVIEWERS

Adverse incidents involving hazardous materials have the potential for extreme losses of life and property.

The nature and variety of hazards posed by hazardous materials are often complex.

This complexity and risk may create the need for knowledge or insight about hazardous materials that extends beyond the awareness level.

Options exist to obtain consultation from professionals who possess expert knowledge in the field of specific hazardous materials.

Technical Consultation

Technical consultation on a specific product may be obtained from one (or several) of the following sources:

- Code organizations.

- ICC.
- NFPA.

- Individual members of a code organization's technical committee.
- The interested private company's technical expert.
- Product manufacturers.
  - DOW Chemical Co.
  - DuPont.
  - PPG Industries.
  - Air Products and Chemicals.
  - Exxon Mobile Corp.
- Trade organizations.
  - American Petroleum Institute (API).
  - Institute of Makers of Explosives (IME).
  - Society of the Plastics Industry (SPI).
  - Compressed Gas Association (CGA).
  - American Chemistry Council (ACC).
- Other federal or state governmental entities such as:
  - Department of Transportation (DOT).
  - Occupational Safety and Health Administration (OSHA).
  - Environmental Protection Agency (EPA).
  - Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF).
- Private consultants.
  - Often, these individuals serve on the reference standards committees.

Third-party Review

This type of assistance often comes from professionals such as fire protection engineers who have been preapproved and accepted by the authority having jurisdiction (AHJ) and the responsible party.

To assist communities with limited resources, the code provides the option of employing outside expertise. The fees for service are paid for by the interested parties.

SAFE HANDLING AND STORAGE OF HAZARDOUS MATERIALS

Prevention and control are strategies to help facilitate the safe handling and storage of hazardous materials.

Prevention

Prevention is the act of stopping an event from occurring.

Removing the potential for an ignition source to come into contact with a volatile material would be considered an act of prevention.

Control

Control by protecting hazardous materials from reaction due to external failures and influences can be another strategy. Examples include:

- Keeping a fire from spreading into an area where hazardous materials are located.
- Preventing outside contamination from elements such as:
  - Heat.
  - Cold.
  - Water.
  - Dirt and dust.
  - Static discharge.
  - Contact with other hazardous materials.

Control entails creating total isolation for the hazardous material through methods such as:

- Detached storage.
- Disposable building.
- Frangible building.

Prevention and Control Tools

Tools for preventing or reducing the severity/impact of an event involving hazardous materials include:

Limiting Quantities

The amount of material present is often directly proportionate to the damage that can be created.

Physical Barriers or Rated Construction

Separate the hazardous material(s) through use of approved methods such as rated walls, rooms or other nonreactive barriers.

Separation Through Distance

Limiting the amount of material in a contiguous area or separating incompatibles.

Fire Protection Systems

Installation of compatible, specially designed fire protection systems that help prevent incidents from spreading from (or to) hazardous materials. Examples include:

- Sprinkler systems.
- Carbon dioxide (CO_2).
- Systems (replacements for Halon) that create an inert environment.

Cabinets

Specially constructed storage cabinets designed to contain hazardous materials.

Exhaust

Use of specially designed ventilation systems to exhaust products that could contribute to hazardous materials reactions.

Liquid Control

The use of measures to prevent spread of spills.

- Liquid-tight floors.
- Containment curbs.
- Prohibiting installation of drains or requiring special type drains.

EXCEPTIONS TO HAZARDOUS MATERIALS CODES

Hazardous materials codes often contain exceptions pertaining to their applicability. Typical exceptions may include but are not limited to:

- Retail and wholesale occupancies with products such as medicines, foodstuffs, and industrial products with water-miscible (mixable) products.
- Alcoholic beverages in retail or wholesale occupancies when individual containers are less than 1.3 gallons.
- Off-site transportation when shipped in accordance with DOT regulations.
- Refrigeration systems (regulated separately in another section of the fire code and mechanical code).
- Stationary storage battery systems.
- Display and use of fireworks that are otherwise regulated.
- Corrosives in personal and household products in original packaging in mercantile occupancies.
- Wall-mounted dispensers of alcohol-based hand sanitizers.
- Single- and two-family dwellings with materials for individual use.

- Application and release of pesticide and agricultural products and materials intended for use in weed abatement, erosion control, soil amendment or similar applications when applied in accordance with the manufacturer's instructions and label directions.

GENERAL REQUIREMENTS FOR HAZARDOUS MATERIALS

The general requirements for hazardous materials apply in all situations, regardless of the amount.

Codes contain general requirements for the storage, use and handling of hazardous materials in any quantity, including amounts less than the MAQs for control areas.

Some of the requirements are intended to provide for employee safety and environmental protection, as well as fire safety.

Codes require that:

- Safety Data Sheets (SDS) are available.
- Employees must be familiar with the hazardous materials present at their occupancy and all associated mitigation methods.
- Hazardous materials cannot be released into sewers, drainage canals, lakes or other areas. State and federal regulations require that an unauthorized release of a hazardous material above certain amounts be reported to the local fire official.
- Hazardous material identification signs are displayed on stationary containers and tanks and at locations where hazardous materials are used.
- Ignition sources are eliminated. These include smoking, open flames, high temperature devices and electrical equipment.
- Security for area.
- Protection against vehicle impact for tanks and associated piping.
- Protection against static electricity.
- Separation of incompatible materials.

Fire Protection

When hazardous materials are used or dispensed in indoor locations, an automatic fire protection system is required.

The specific design parameters (i.e., density and area of application) will depend on the material and the storage configuration (i.e., the class of a flammable liquid and the height of the container storage).

DETERMINING THE QUANTITY OF HAZARDOUS MATERIALS PER CONTROL AREA

Control Areas

Building control areas can be a building, or spaces within a building, where quantities of hazardous materials do not exceed the amount allowed by the code for that area.

An outdoor control area is an outdoor area that contains quantities of hazardous materials that do not exceed the amount allowed by the code for that area.

A control area can be as simple as four walls. A building can be a single control area, or a building can have more than one control area.

Control areas must be separated from each other by fire-resistive barriers of at least one-hour fire resistance. When a control area is located in a multilevel building, separations for control areas must be horizontal as well as vertical.

The maximum number of control areas per floor depends on the floor level. Typically, a code will permit four control areas on the first-floor level. On the upper floors of a building, the number of control areas per floor is reduced.

MAQs

The MAQ is the maximum amount of a hazardous material allowed to be stored or used within a control area.

MAQs are determined based upon at what point the presence of specific materials increases the risk to the occupancy above an acceptable threshold.

The quantities of materials established as MAQs are amounts that are randomly set based upon historical data, input from technical committee members, and (sometimes) fire testing.

It is important to remember that the “M” (maximum) in MAQ is **not** necessarily the maximum.

MAQs are simply a starting point, or a threshold, which can be modified by introducing certain control tools.

MAQs, in some cases, can be increased by the use of control tools.

Control tools are found as notes in the control tables.

Examples of control tools that increase the MAQ of certain hazardous materials include:

- Cabinets, which allow the MAQ to be doubled.
- Sprinklers, which allow the MAQ to be doubled.
- Control areas, which in some instances allow up to four times the MAQs per floor.

Notes are just as important, if not more important, as the actual table.

MAQ Tables

Decision Tree

A Decision Tree process is used when working through the application of the MAQ tables. (See graphic of Decision Tree on the following page.)

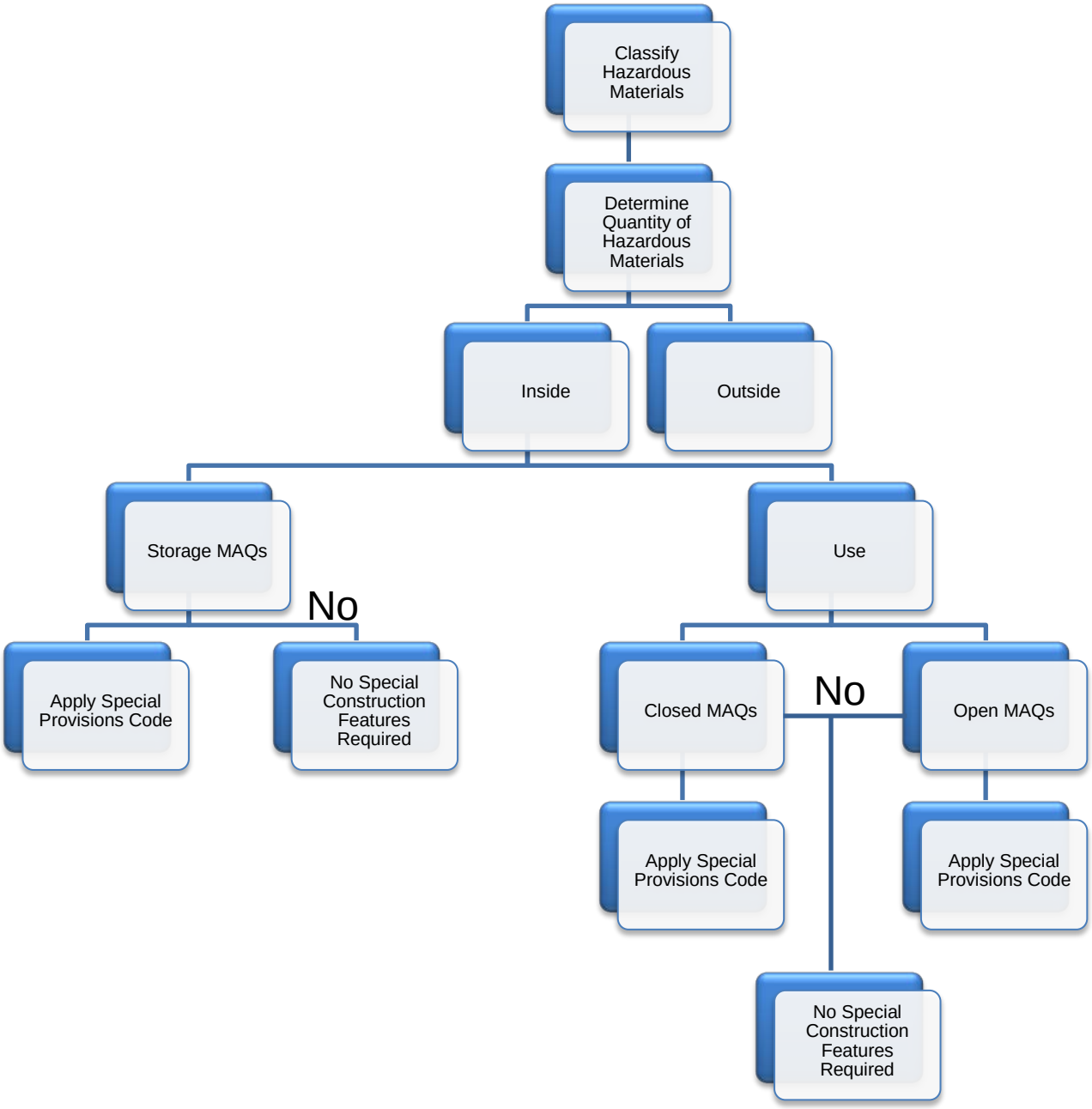
1. Step 1: Classify the hazardous materials that are present.
2. Step 2: Determine the quantity of hazardous materials that are present.
3. Step 3: Identify the physical location of the materials (inside or outside a building).
    - If outside storage is utilized, check the MAQ.
    - If the MAQ is not exceeded, no additional code requirements will apply.
    - If the MAQ is exceeded, apply additional code requirements.
    - If inside storage is utilized, proceed to Step 4.
4. Step 4: Determine use or storage of the hazardous material.
    - "Use" is defined in the codes as:

      - "Placing a material, including solids, liquids, and gases, into action."

      - This is a broad and very general definition.

      - Simply stated, "use of a material" is using it for the purpose for which it was acquired.
    - Storage is defined as "keeping, retention, or leaving of hazardous materials in closed containers, tanks, cylinders, or similar vessels; or vessels supplying operations through closed connections to the vessel."

Decision Tree



- For example, a manufacturer of fiberglass receives benzoyl peroxide to be used as a catalyst in the production of fiberglass.

- The purpose in acquiring the benzoyl peroxide is to use it in the production of fiberglass.

- By contrast, a chemical vendor who supplies the benzoyl peroxide does not use it. The vendor simply stores it and/or transports it.

- Similarly, a manufacturer of glass products may use a hydrogen-fueled torch.

  - The cylinder of hydrogen fueling the torch is in use.

  - Any cylinders of gas awaiting use are being stored.

- If storage is being performed, check the MAQ.

  - If the MAQ is not exceeded, no additional code requirements will apply.

  - If the MAQ is exceeded, apply additional code requirements.

- If actual use of the product is performed, proceed to Step 5.

5. Step 5: Determine use of the product (open or closed system).

   - Closed-system use is where a solid or liquid material remains in a closed vessel or system during normal operations and vapors emitted by the product are not liberated outside of the system. In sum, the product is not exposed to the atmosphere.

     - A closed system includes all uses of compressed gases (NFPA 400).

   - An open system is the use of a solid or liquid that is continuously open to the atmosphere during normal operations, and the product is exposed to the atmosphere (NFPA 400).

   - Once you have determined use — closed or open — check the MAQ.

     - If the MAQ is not exceeded, no additional code requirements will apply.

     - If the MAQ is exceeded, apply additional code requirements.

     - A **very** important concept to remember: Table notes are just as important, if not more important, than the actual table itself.

Specific code provisions are required depending on the quantity of hazardous materials.

Determining the quantity is a key to applying the code.

Sometimes this is a simple matter. Here is an example:

- Storage in drums.
- Four 55-gallon drums equal 220 gallons.

In other cases, determining the quantity may require some investigation. It may be necessary to measure a tank to determine its capacity. Here is an example:

- An aboveground tank estimated at 3,000 gallons measures 7 feet in diameter, and it is 12 feet in length.
- The question: Does it contain more or less than 3,000 gallons of product?
- The answer: A cylinder 7 feet in diameter and 12 feet in length contains 461.6 cubic feet.
- 3,000 gallons equals 401 cubic feet, so the tank exceeds 3,000 gallons.
- If the thickness of the tank shell were 0.125 inch, then the volume would be 3,428 gallons. This would also be more than 3,000 gallons.

Since gases are always pressurized, determining the amount of gas present may be difficult.

The codes deal with compressed gases either on the basis of weight or volume. Thus, a code may limit the amount of a flammable liquefied compressed gas stored in one area to 150 pounds or 1,000 cubic feet.

Nonliquefied gases are in cubic feet only.

Codes have requirements for a volume of gas (cubic feet) at standard temperature and pressure (STP), 68 F and 14.7 pounds per square inch absolute (psia).

Calculate the volume of gas at STP.

Here is an example:

- The question: A cylinder of hydrogen contains 50 pounds of gas. What is the volume at STP?
- Here’s how to calculate the answer:
  - Density of hydrogen is 0.00509 pounds per cubic feet at STP.
  - Dividing 50 by 0.00509 yields 9,823 cubic feet.
  - The density of hydrogen is available in references (NFPA 400).

HIGH-HAZARD OCCUPANCIES

When amounts exceed MAQs, and are in excess of those allowed in the control area, the occupancy becomes high hazard (H) under the building code.

Once an occupancy is designated as an H, numerous restrictions are placed on it by the building code.

The allowable square foot area (footprint) of the occupancy is severely limited. An H occupancy has the lowest allowable square foot area of all occupancies.

The building code does not allow any increases in square foot area based on the installation of a sprinkler system in an H occupancy.

The separation requirements of an H occupancy are greater.

The building code contains special requirements for certain types of hazardous materials.

H-1 occupancies are restricted to one story without a basement. This type of occupancy may require a lightweight roof.

Allowable areas are less than for other occupancies of similar construction.

Automatic sprinklers are required unless water-reactive materials are present.

H-1, H-2 and H-3 occupancies are required to be set back from lot lines. The distance will vary with the specific occupancy. For class H-1 occupancies, a 75-foot setback is required. For H-2 and H-3 occupancies, 30- to 50-foot setbacks are required.

Exit requirements are stricter in H occupancies than in other occupancies. Exit doors are required to have panic hardware. Two exits are required if more than three people will be working in H-1, H-2 and H-3 occupancies. Exit travel distances are reduced to expedite escape from the building.

H occupancies are further subdivided into five groups. The five groups are based on the hazards presented by the material.

H-1: Detonation Hazard

Examples: detonable pyrophoric materials, detonable organic peroxides, explosives, Class 4 oxidizers, and unstable materials Class 3 and 4.

H-2: Deflagration Hazard or Accelerated Burning

Examples: Class I, II or IIIA flammable and combustible liquids in open systems, flammable cryogenic fluids, flammable gases, Class I organic peroxides, Class 3 oxidizers, and others.

H-3: Readily Support Combustion or Pose a Physical Hazard

Examples: flammable and combustible liquids in closed containers, consumer fireworks, oxidizing cryogenic fluids, Class II and III organic peroxides, Class 2 oxidizers, oxidizing gases, and others.

H-4: Health Hazards

Examples: corrosives and toxic and highly toxic materials.

H-5: Semiconductor Fabrication Facilities and Research/Development Areas.

Example: operations in which hazardous production materials are used.

Semiconductor facilities (H-5) present unusual hazards due to the extremely precise nature of the work.

Work areas in semiconductor facilities are unusual due to the high degree of environmental purification which must be maintained.

Hazardous materials frequently found in these industries includes:

- Flammable liquids and flammable gases.
- Pyrophoric gases and toxic materials.

Certain hazardous materials used directly in research, laboratory and production may be categorized as hazardous production materials (HPMs).

HPMs may be present in an area that performs a specific type of fabrication.

HPMs have a Class 3 or 4 rating according to the NFPA 704 warning system and are used directly in research, laboratory or production processes that have, as their end product, materials that are not hazardous.

HPMs used for fabrication are required to be stored in specialized storage cabinets or gas cabinets.

Here is an example:

Class 1B flammable liquid — the maximum quantity allowed is 0.025 gallons per square foot of area.

CHANGE OF USE (CHANGE OF OCCUPANCY)

Structures or portions of structures are classified under the building and fire code by their intended use. This is commonly referred to as "type of occupancy." Some of these types of uses are generally assembly, business, educational, etc.

In most jurisdictions, the ultimate authority for classifying occupancies according to use is the responsibility of the building official.

In matters pertaining to occupancies containing hazardous materials, many building officials rely on the expertise of the fire department.

When an occupancy's use changes, it needs to be reclassified and re-evaluated based on the code requirements of its new use or occupancy.

Many structures, after originally being built and occupied, change uses by introducing hazardous materials to the property. At this point, or when discovered, the structure should be re-evaluated as a change of use.

SUMMARY

The building code and fire code(s) are designed to work in tandem to direct the safe use and storage of hazardous materials.

IBC is utilized in the majority of communities.

The two primary fire codes are the IFC and NFPA 1.

Reference standards are documents that pertain to specific hazardous materials.

The nature and variety of hazards posed by hazardous materials are often complex.

The two primary sources of obtaining outside expertise include technical specialists and third-party reviewers.

Prevention and control are strategies to help facilitate the safe handling and storage of hazardous materials.

The MAQ is the maximum amount of a hazardous material allowed to be stored or used within a control area.

A Decision Tree process is used when working through the application of the MAQ tables.

When amounts exceed MAQs, and are in excess of those allowed in the control area, the occupancy becomes H under the building code.

This page intentionally left blank.

APPENDIX:
NFPA 1 — TABLES

This page intentionally left blank.

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

60.3.3 Mixtures. Mixtures shall be classified in accordance with the hazards of the mixture as a whole by an approved, qualified organization, individual, or testing laboratory. [**400:**4.3]

60.3.4* Multiple Hazards. Hazardous materials that have multiple hazards shall conform to the code requirements for each applicable hazard category. [**400:**4.4]

60.3.5* Classification of Waste. Waste comprised of or containing hazardous materials shall be classified in accordance with 60.3.1 through 60.3.4 as applicable. [**400:**4.5]

60.4 Permissible Storage and Use Locations.

60.4.1* General.

60.4.1.1 Control Areas or Special Protection Required. Hazardous materials shall be stored and used in control areas complying with 60.4.2, in occupancies complying with requirements for Protection Level 1, Protection Level 2, Protection Level 3, or Protection Level 4 in accordance with 60.4.3, or in outdoor areas complying with 60.4.4. [**400:**5.1.1]

60.4.1.2 Weather Protection Structures. Weather protection, when provided, shall comply with 6.2.7.2 of NFPA 400. [**400:**5.1.2]

60.4.2 Control Areas.

60.4.2.1 Hazardous materials shall be permitted to be stored and used in control areas in accordance with 60.4.2.1 and 60.4.2.2. [**400:**5.2.1]

60.4.2.1.1 General.

60.4.2.1.1.1 All occupancies shall be permitted to have one or more control area in accordance with 60.4.2. [**400:**5.2.1.1.1]

60.4.2.1.1.2 The quantity of hazardous materials in an individual control area shall not exceed the maximum allowable quantity (MAQ) per control area for the applicable occupancy set forth in 60.4.2.1.2 through 60.4.2.1.13. [**400:**5.2.1.1.2]

60.4.2.1.1.3 For all occupancies not covered by 60.4.2.1.2 through 60.4.2.1.13, the maximum allowable quantities of hazardous materials per control area shall be as specified in Table 60.4.2.1.1.3. [**400:**5.2.1.1.3]

60.4.2.1.2 Assembly Occupancies. The maximum allowable quantities of hazardous materials per control area in assembly occupancies shall be as specified in Table 60.4.2.1.2. [**400:**5.2.1.2]

60.4.2.1.3 Educational Occupancies. The maximum allowable quantities of hazardous materials per control area in educational occupancies shall be as specified in Table 60.4.2.1.3. [**400:**5.2.1.3]

60.4.2.1.4 Day-Care Occupancies. The maximum allowable quantities of hazardous materials per control area in day-care occupancies shall be as specified in Table 60.4.2.1.4. [**400:**5.2.1.4]

60.4.2.1.5 Health Care Occupancies. The maximum allowable quantities of hazardous materials per control area in health care occupancies shall be as specified in Table 60.4.2.1.5. [**400:**5.2.1.5]

60.4.2.1.6 Ambulatory Health Care Occupancies. The maximum allowable quantities of hazardous materials per control area in ambulatory health care occupancies shall be as specified in Table 60.4.2.1.6. [**400:**5.2.1.6]

60.4.2.1.7 Detention and Correctional Occupancies. The maximum allowable quantities of hazardous materials per control area in detention and correctional occupancies shall be as specified in Table 60.4.2.1.7. [**400:**5.2.1.7]

60.4.2.1.8 Residential Occupancies. The maximum allowable quantities of hazardous materials per control area in residential occupancies, including lodging and rooming houses, hotels, dormitories, apartments, and residential board and care facilities, shall be as specified in Table 60.4.2.1.8. [**400:**5.2.1.8]

60.4.2.1.9 Mercantile Occupancies. The maximum allowable quantities of hazardous materials per control area in mercantile occupancies shall be as specified in Table 60.4.2.1.1.3, with increased quantities permitted where storage or display areas comply with 60.4.2.1.13. [**400:**5.2.1.9]

60.4.2.1.10 Business Occupancies.

60.4.2.1.10.1 The maximum allowable quantities of hazardous materials per control area in business occupancies, other than laboratories, shall be as specified in Table 60.4.2.1.10.1. [**400:**5.2.1.10.1]

60.4.2.1.10.2 The maximum allowable quantities of hazardous materials per control area in laboratories classified as business occupancies shall be as specified in Table 60.4.2.1.1.3. [**400:**5.2.1.10.2]

60.4.2.1.11 Industrial Occupancies. The maximum allowable quantities of hazardous materials per control area in industrial occupancies shall be as specified in Table 60.4.2.1.1.3, with increased quantities permitted where storage areas comply with 60.4.2.1.13. [**400:**5.2.1.11]

60.4.2.1.12 Storage Occupancies. The maximum allowable quantities of hazardous materials per control area in storage occupancies shall be as specified in Table 60.4.2.1.1.3, with increased quantities permitted where storage areas comply with 60.4.2.1.13. [**400:**5.2.1.12]

60.4.2.1.13 Special Quantity Limits for Mercantile, Industrial, and Storage Occupancies.

60.4.2.1.13.1 General. Where storage in mercantile, industrial, and storage occupancies is in compliance with all of the special controls set forth in 60.4.2.1.13.2, the maximum allowable quantity of selected hazardous materials shall be permitted to be increased in accordance with 60.4.2.1.13.3. [**400:**5.2.1.13.1]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.1.3 Maximum Allowable Quantity (MAQ) of Hazardous Materials per Control Area[a]

			Storage			Use-Closed Systems			Use-Open Systems	
Material	Class	High Hazard Protection Level	Solid Pounds	Liquid Gallons (lb)	Gas[b] ft^3 (lb) [gal]	Solid Pounds	Liquid Gallons (lb)	Gas[b] ft^3 (lb) [gal]	Solid Pounds (ft^3)	Liquid Gallons (lb)
Combustible liquid[c, d, e, f]	II	2 or 3	NA	120[g, h]	NA	NA	120[h]	NA	NA	30[h]
	III-A	2 or 3	NA	330[g, h]	NA	NA	330[h]	NA	NA	80[h]
	III-B	NA	NA	13,200[g, i]	NA	NA	13,200[i]	NA	NA	3,300[i]
Consumer fireworks	1.4G	3	125[g, h, k]	NA	NA	NA	NA	NA	NA	NA
Cryogenic fluid	flammable	2	NA	45[h, t, u]	NA	NA	45[h, t, u]	NA	NA	45[t, u]
	oxidizing	3	NA	45[g, h]	NA	NA	45[g, h]	NA	NA	45[g, h]
	inert	NA	NA	NL	NA	NA	NL	NA	NA	NL
Explosives	NA	1	1[g, l, m, n]	(1)[g, l, n]	NA	1/4[l]	(1/4)[l]	NA	(1/4)[l]	(1/4)[l]
Flammable, gas	Gaseous	2	NA	NA	1000[g, h]	NA	NA	1000[g, h]	NA	NA
	Liquefied	2	NA	NA	(150)[g,h]	NA	NA	(150)[g,h]	NA	NA
	Liquefied Petroleum (LP)	2	NA	NA	(300)[o,p]	NA	NA	(300)	NA	NA
Flammable liquid[c, d, f, q]	I-A	2 or 3	NA	30[g, h]	NA	NA	30[h]	NA	NA	10[h]
	I-B and IC		NA	120[g, h]	NA	NA	120[g, h]	NA	NA	30[g, h]
	Combination I-A, I-B, I-C		NA	120[g, h, r]	NA	NA	120[g, h, r]	NA	NA	30[h, r]
Flammable solid	NA	3	125[g, h]	NA	NA	25[h]	NA	NA	25[g, h]	NA
Inert gas	Gaseous	NA	NA	NA	NL	NA	NA	NL	NA	NA
	Liquefied	NA	NA	NA	NL	NA	NA	NL	NA	NA
Organic peroxide	UD	1	1[g, l]	(1)[g, l]	NA	1/4[l]	(1/4)[l]	NA	1/4[l]	(1/4)[l]
	I	1	5[g, h]	(5)[g, h]	NA	1[h]	(1)[h]	NA	1[h]	(1)[h]
	II	2	50[g, h]	(50)[g, h]	NA	50[h]	(50)[h]	NA	10[h]	(10)[h]
	III	3	125[g, h]	(125)[g, h]	NA	125[h]	(125)[h]	NA	25[h]	(25)[h]
	IV	NA	NL	NL	NA	NL	NL	NA	NL	NL
	V	NA	NL	NL	NA	NL	NL	NA	NL	NL
Oxidizer	4	1	1[g, l]	(1)[g, l]	NA	¼[l]	(1/4)[l]	NA	¼[l]	(1/4)[l]
	3[j]	2 or 3	10[g, h]	(10)[g, h]	NA	2[h]	(2)[h]	NA	2[h]	(2)[h]
	2	3	250[g, h]	(250)[g, h]	NA	250[h]	(250)[h]	NA	50[h]	(50)[h]
	1	NA	4,000[g, i]	(4,000)[g, i]	NA	4,000[g]	(4,000)	NA	1,000[g]	(1,000)[g]
Oxidizing gas	Gaseous	3	NA	NA	1,500[g, h]	NA	NA	1,500[g, h]	NA	NA
	Liquefied	3	NA		(150)[g, h]	NA		(150)[g, h]	NA	NA
Pyrophoric		2	4[g, l]	(4)[g, l]	NA	1[l]	(1)[l]	NA	0	0
Pyrophoric Gas	Gaseous	2	NA	NA	50[g, l]	NA	NA	50[g, l]	NA	NA
	Liquefied	2	NA	NA	(4)[g, l]	NA	NA	(4)[g, l]	NA	NA
Unstable (reactive)	4	1	1[g, l]	(1)[g, l]	NA	¼[l]	(¼)[l]	NA	¼[l]	(¼)[h]
	3	1 or 2	5[g, h]	(5)[g, h]	NA	1[h]	(1)[h]	NA	1[h]	(1)[h]
	2	2	50[g, h]	(50)[g, h]	NA	50[h]	(50)[h]	NA	10[h]	(10)[h]
	1	NA	NL	NL	NA	NL	NL	NA	NL	NL
Unstable (reactive) Gas	Gaseous									
	4 or 3 detonable	1	NA	NA	10[g,l]	NA	NA	10[g,l]	NA	NA
	3 non-detonable	2	NA	NA	50[g,h]	NA	NA	50[g,h]	NA	NA
	2	3	NA	NA	750[g, h]	NA	NA	750[g, h]	NA	NA
	1	NA	NA	NA	NL	NA	NA	NL	NA	NA
Unstable (reactive) Gas	Liquefied									
	4 or 3 detonable	1	NA	NA	(1)[g,l]	NA	NA	(1)[g,l]	NA	NA
	3 non-detonable	2	NA	NA	(2)[g, h]	NA	NA	(2)[g, h]	NA	NA
	2	3	NA	NA	[30][g, h]	NA	NA	[30][g, h]	NA	NA
	1	NA	NA	NA	NL	NA	NA	NL	NA	NA
Water (reactive)	3	2	5[g, h]	(5)[g, h]	NA	5[h]	(5)[h]	NA	1[h]	(1)[h]
	2	3	50[g, h]	(50)[g, h]	NA	50[h]	(50)[h]	NA	10[h]	(10)[h]

(continues)

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.1.3 *Continued*

Material	Class	High Hazard Protection Level	Storage: Solid Pounds	Storage: Liquid Gallons (lb)	Storage: Gas[b] ft³ (lb) [gal]	Use-Closed Systems: Solid Pounds	Use-Closed Systems: Liquid Gallons (lb)	Use-Closed Systems: Gas[b] ft³ (lb) [gal]	Use-Open Systems: Solid Pounds (ft³)	Use-Open Systems: Liquid Gallons (lb)
	1	NA	NL	NL	NA	NL	NL	NA	NL	NL
Corrosive	NA	4	5,000[g, h]	500[g, h]	NA	5,000[h]	500	NA	1,000[h]	100[h]
Corrosive gas	Gaseous	4	NA	NA	810[g, h]	NA	NA	810[g, h]	NA	NA
	Liquefied		NA	NA	(150)[g, h]	NA	NA	(150)[g, h]	NA	NA
Highly toxic	NA	4	10[g, h]	(10)[g, h]	NA	10[h]	(10)[h]	NA	3[h]	(3)[h]
Highly toxic gas	Gaseous	4	NA	NA	20[h, s]	NA	NA	20[h, s]	NA	NA
	Liquefied		NA	NA	(4)[h, s]	NA	NA	(4)[h, s]	NA	NA
Toxic	NA	4	500[g, h]	(500)[g, h]	NA	500[h]	(500)[h]	NA	125[h]	(125)[h]
Toxic gas	Gaseous	4	NA	NA	810[g, h]	NA	NA	810[g, h]	NA	NA
	Liquefied		NA	NA	(150)[g, h]	NA	NA	(150)[g, h]	NA	NA

[a]See 60.1.26.2 for exceptions to tabular amounts. For use of control areas, see 60.2.3. Table values in parentheses correspond to the unit name in parentheses at the top of the column. The aggregate quantity in use and storage is not permitted to exceed the quantity listed for storage. In addition, quantities in specific occupancies are not permitted to exceed the limits in 60.1.26.2.

[b]Measured at 70 °F (21°C) and 14.7 psi (30 kPa).

[c]Inside a building, the maximum capacity of a combustible liquid storage system that is connected to a fuel-oil piping system is permitted to be 660 gal (2500 L), provided that such system conforms to NFPA 3, *Standard for the Installation of Oil-Burning Equipment*.

[d]Flammable and combustible liquids and flammable gases in the fuel tanks of mobile equipment or vehicles are permitted to exceed the MAQ where the equipment is stored and operated in accordance with this *Code*.

[e]In storage, low, and ordinary hazard occupancies, the storage of Class II combustible liquids is required to be limited to a maximum quantity of 1375 gal (5204 L); Class IIIA combustible liquids are required to be limited to a maximum quantity of 13,750 gal (52,044 L) where stored in accordance with all the requirements in NFPA 30 for general-purpose warehouses.

[f]The quantity of fuel in aircraft in hangars is required to be in accordance with NFPA 409, *Standard on Aircraft Hangars*.

[g]Quantities are permitted to be increased 100 percent where stored or used in approved cabinets, gas cabinets, exhausted enclosures, gas rooms, explosives magazines, or safety cans, as appropriate for the material stored, in accordance with NFPA 1. Where Footnote h also applies, the increase for both footnotes is permitted to be applied accumulatively.

[h]Maximum quantities are permitted to be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. Where Footnote g also applies, the increase for both footnotes is permitted to be applied accumulatively.

[i]The permitted quantities are not limited in a building equipped throughout with an automatic sprinkler system in accordance with NFPA 13.

[j]A maximum quantity of 200 lb (91 kg) of solid or 20 gal (76 L) of liquid Class 3 oxidizers is permitted where such materials are necessary for maintenance purposes, operation, or sanitation of equipment. Storage containers and the manner of storage are required to be approved.

[k]Unless the actual weight of the pyrotechnic composition of the consumer fireworks, 1.4G, is known, 25 percent of the gross weight of the fireworks, including packaging, is permitted to be used to determine the weight of the fireworks for the purpose of this table.

[l]Permitted only in buildings equipped throughout with an automatic sprinkler system in accordance with NFPA 13.

[m]Maximum quantities of black powder, smokeless propellant, and small arms primers stored or displayed in mercantile occupancies or stored in one- or two-family dwellings are permitted to exceed the amount specified by this table where such storage complies with the requirements of NFPA 495, *Explosive Materials Code*, Chapter 13.

[n]In lieu of the maximum allowable quantity limit per control area, the maximum aggregate quantity per building of special explosive devices in industrial, mercantile, and storage occupancies shall be limited to 50 lb.

[o]Additional storage locations are required to be separated by a minimum of 300 ft (92 m).

[p]In mercantile occupancies, storage of LP-Gas is limited to a maximum of 200 lb (91 kg) in nominal 1 lb (0.45 kg) LP-Gas Containers.

[q]In storage, low, and ordinary hazard occupancies, the storage of Class IA flammable liquids is not permitted, and the combination storage of Class IB and Class IC flammable liquids is required to be limited to a maximum quantity of 660 gal (2500 L) where stored in accordance with all the requirements in NFPA 30 for general-purpose warehouses.

[r]Containing not more than the maximum allowable quantity per control area of Class I-A, Class I-B, or Class I-C flammable liquids.

[s]Allowed only where stored or used in gas rooms or in approved gas cabinets or exhausted enclosures, as specified in this *Code*.

[t]None allowed in unsprinklered buildings unless stored or used in gas rooms or in approved gas cabinets or exhausted enclosures, as specified in this *Code*.

[u]With pressure-relief devices for stationary or portable containers vented directly outdoors or to an exhaust hood. [**5000:** Table 34.1.3.1]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.2 Maximum Allowable Quantities (MAQ) of Hazardous Materials per Control Area in Assembly Occupancies

Material	Class	Solid	Liquid[k]	Gas[a] (at NTP)
Flammable and combustible liquid[b,c,l]	See note	See note	See note	See note
Cryogenic fluid	Flammable	NA	10 gal	NA
	Oxidizing	NA	10 gal	NA
Explosives[d,e,f,g]	See note	See note	See note	See note
Flammable gas[c,h]	Gaseous	NP	NP	NP
	Liquefied	NP	20 lb	NA
Consumer fireworks	See note	See note	See note	See note
Flammable solid	NA	5 lb	N/A	N/A
Oxidizers	4	NP	NP	NA
	3	10 lb[i]	1 gal[i]	NA
	2	250 lb	25 gal	NA
	1	4,000 lb	400 gal	NA
Oxidizing gas[h]	Gaseous	NA	NA	NP
	Liquefied	NA	NP	NA
Organic peroxides	I	NP	NP	NA
	II	NP	NP	NA
	III	1,500 lb	1,500 lb	NA
	IV	100,000 lb	100,000 lb	NA
	V	NL	NL	NA
Pyrophoric materials	NA	1 lb	1 lb	NP
Unstable reactives	4	¼ lb	¼ lb	NP
	3	1 lb	1 lb	NP
	2	10 lb	10 lb	NP[h]
	1	NL	NL	NP
Water-reactive	3	1 lb	1 lb	NA
	2	10 lb	10 lb	NA
	1	NL	NL	NA
Corrosives	NA	1,000 lb	100 gal	NP
Highly toxic	NA	3 lb	3 lb	NP[j]
Toxic	NA	125 lb	125 lb	NP[j]

For SI units, 1 lb = 0.454 kg; 1 gal = 3.785 L.

NTP: Normal temperature and pressure [measured at 70°F (21°C) and 14.7 psi (101 kPa)]. NA: Not applicable. NP: Not permitted. NL: Not limited.

Note: The hazardous material categories and MAQs that are shaded in this table are not regulated by NFPA 400 but are provided here for informational purposes. See Chapter 2 of NFPA 400 for the reference code or standard governing these materials and establishing the MAQs. In accordance with 1.1.1.2 of NFPA 400, materials having multiple hazards that fall within the scope of NFPA 400 shall comply with NFPA 400.

[a]Unlimited amounts of gas are permitted to be used for personal medical or emergency medical use.

[b]Storage in excess of 10 gal (38 L) of Class I and Class II liquids combined or 60 gal (227 L) of Class IIIA liquids is permitted where stored in safety cabinets with an aggregate quantity not to exceed 180 gal (681 L).

[c]Fuel in the tank of operating mobile equipment is permitted to exceed the specified quantity where the equipment is operated in accordance with this code

[d]The use of explosive materials required by federal, state, or municipal agencies while engaged in normal or emergency performance of duties is not required to be limited. The storage of explosive materials is required to be in accordance with the requirements of NFPA 495, *Explosive Materials Code*.

[e]The storage and use of explosive materials in medicines and medicinal agents in the forms prescribed by the official United States Pharmacopoeia or the National Formulary are not required to be limited.

[f]The storage and use of propellant-actuated devices or propellant-actuated industrial tools manufactured, imported, or distributed for their intended purposes are required to be limited to 50 lb (23 kg) net explosive weight.

[g]The storage and use of small arms ammunition, and components thereof, are permitted where in accordance with NFPA 495, *Explosive Materials Code*.

[h]Containers, cylinders or tanks not exceeding 250 ft^3 (7.1 m^3) content at normal temperature and pressure (NTP) and used for maintenance purposes, patient care, or operation of equipment shall be permitted.

[i]A maximum quantity of 200 lb (91 kg) of solid or 20 gal (76 L) of liquid Class 3 oxidizer is permitted where such materials are necessary for maintenance purposes, operation, or sanitation of equipment. Storage containers and the manner of storage are required to be approved.

[j]Gas cylinders not exceeding 20 ft^3 (0.57 m^3) at NTP are permitted in gas cabinets or fume hoods. [**5000:** Table 34.1.3.2(a)]

[k]Conversion. Where quantities are indicated in pounds and when the weight per gallon of the liquid is not provided to the AHJ, a conversion factor of 10 lb/gal (1.2 kg/L) shall be used.

[l]The quantities of alcohol-based hand rubs classified as Class I and II liquids and Level 1 aerosols are not limited when installed in individual dispensers in accordance with 66.18.6. [**400:** Table 5.2.1.2]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.3 Maximum Allowable Quantities (MAQ) of Hazardous Materials per Control Area in Educational Occupancies

Material	Class	Solid	Liquid[m]	Gas[a] (at NTP)
Flammable and combustible liquid[b,c,n]	See note	See note	See note	See note
Cryogenic fluid	Flammable Oxidizing	NA NA	10 gal 10 gal	NA NA
Explosives[d,e,f,g]	See note	See note	See note	See note
Flammable gas[c,h]	Gaseous Liquefied	NP NP	NP 20 lb	NP NA
Consumer fireworks	See note	See note	See note	See note
Flammable solid	NA	5 lb	N/A	N/A
Oxidizers	4 3 2 1	NP 10 lb[i] 250 lb 4,000 lb	NP 1 gal[i] 25 gal 400 gal	NA NA NA NA
Oxidizing gas[h]	Gaseous Liquefied	NA NA	NA NP	NP NA
Organic peroxides	I II III IV V	NP NP 1,500 lb 100,000 lb NL	NP NP 1,500 lb 100,000 lb NL	NA NA NA NA NA
Pyrophoric materials	NA	1 lb	1 lb	NP
Unstable reactives	4 3 2 1	¼ lb 1 lb 10 lb NL	¼ lb 1 lb 10 lb NL	NP NP NP[h] NP
Water-reactive	3 2 1	1 lb 10 lb NL	1 lb 10 lb NL	NA NA NA
Corrosives	NA	1,000 lb	100 gal	NP
Highly toxic	NA	3 lb	3 lb	NP[j]
Toxic	NA	125 lb	125 lb	NP[j]

For SI units, 1 lb = 0.454 kg; 1 gal = 3.785 L; 1 ft^3 = 0.0283 m^3.

NTP: Normal temperature and pressure [measured at 70°F (21°C) and 14.7 psi (101 kPa)]. NA: Not applicable. NP: Not permitted. NL: Not limited.

Note: The hazardous material categories and MAQs that are shaded in this table are not regulated by NFPA 400 but are provided here for informational purposes. See Chapter 2 of NFPA 400 for the reference code or standard governing these materials and establishing the MAQs. In accordance with 1.1.1.2 of NFPA 400, materials having multiple hazards that fall within the scope of NFPA 400 shall comply with NFPA 400.

[a]Unlimited amounts of gas are permitted to be used for personal medical or emergency medical use.

[b]Storage in excess of 10 gal (38 L) of Class I and Class II liquids combined or 60 gal (227 L) of Class IIIA liquids is permitted where stored in safety cabinets with an aggregate quantity not to exceed 180 gal (681 L).

[c]Fuel in the tank of operating mobile equipment is permitted to exceed the specified quantity where the equipment is operated in accordance with this code.

[d]The use of explosive materials required by federal, state, or municipal agencies while engaged in normal or emergency performance of duties is not required to be limited. The storage of explosive materials is required to be in accordance with the requirements of NFPA 495, *Explosive Materials Code*.

[e]The storage and use of explosive materials in medicines and medicinal agents in the forms prescribed by the official United States Pharmacopoeia or the National Formulary are not required to be limited.

[f]The storage and use of propellant-actuated devices or propellant-actuated industrial tools manufactured, imported, or distributed for their intended purposes are required to be limited to 50 lb (23 kg) net explosive weight.

[g]The storage and use of small arms ammunition, and components thereof, are permitted where in accordance with NFPA 495, *Explosive Materials Code*.

[h]Containers, cylinders or tanks not exceeding 250 ft^3 (7.1 m^3) content at normal temperature and pressure (NTP) and used for maintenance purposes, patient care, or operation of equipment shall be permitted.

[i]A maximum quantity of 200 lb (91 kg) of solid or 20 gal (76 L) of liquid Class 3 oxidizer is permitted where such materials are necessary for maintenance purposes, operation, or sanitation of equipment. Storage containers and the manner of storage are required to be approved.

[j]The permitted quantities are not limited in a building protected throughout by automatic sprinkler systems in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

[k]Storage in laboratories only; additional 20 lb (9 kg) units are permitted where minimum 20 ft (6.1 m) separation is provided.

[l]Gas cylinders not exceeding 20 ft^3 (0.57 m^3) at NTP are permitted in gas cabinets or fume hoods. [**5000:** Table 34.1.3.2(d)]

[m]Conversion. Where quantities are indicated in pounds and when the weight per gallon of the liquid is not provided to the AHJ, a conversion factor of 10 lb/gal (1.2 kg/L) shall be used.

[n]The quantities of alcohol-based hand rubs classified as Class I and II liquids and Level 1 aerosols are not limited when installed in individual dispensers in accordance with 66.18.6. [**400:** Table 5.2.1.3]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.4 Maximum Allowable Quantities (MAQ) of Hazardous Materials per Control Area in Day-Care Occupancies

Material	Class	Solid	Liquid[k]	Gas[a] (at NTP)
Flammable and combustible liquid[b,c,l]	See note	See note	See note	See note
Cryogenic fluid	Flammable Oxidizing	NA NA	10 gal 10 gal	NA NA
Explosives[d,e,f,g]	See note	See note	See note	See note
Flammable gas[c,h]	Gaseous Liquefied	NP NP	NP 20 lb	NP NA
Consumer fireworks	See note	See note	See note	See note
Flammable solid	NA	5 lb	N/A	N/A
Oxidizers	4 3 2 1	NP 10 lb[i] 250 lb 4,000 lb	NP 1 gal[i] 25 gal 400 gal	NA NA NA NA
Oxidizing gas[h]	Gaseous Liquefied	NA NA	NA NP	NP NA
Organic peroxides	I II III IV V	NP NP 1,500 lb 100,000 lb NL	NP NP 1,500 lb 100,000 lb NL	NA NA NA NA NA
Pyrophoric materials	NA	1 lb	1 lb	NP
Unstable reactives	4 3 2 1	¼ lb 1 lb 10 lb NL	¼ lb 1 lb 10 lb NL	NP NP NP[h] NP
Water-reactive	3 2 1	1 lb 10 lb NL	1 lb 10 lb NL	NA NA NA
Corrosives	NA	1,000 lb	100 gal	NP
Highly toxic	NA	3 lb	3 lb	NP[j]
Toxic	NA	125 lb	125 lb	NP[j]

For SI units, 1 lb = 0.454 kg; 1 gal = 3.785 L.

NTP: Normal temperature and pressure [measured at 70°F (21°C) and 14.7 psi (101 kPa)]. NA: Not applicable. NP: Not permitted. NL: Not limited.

Note: The hazardous material categories and MAQs that are shaded in this table are not regulated by NFPA 400 but are provided here for informational purposes. See Chapter 2 of NFPA 400 for the reference code or standard governing these materials and establishing the MAQs. In accordance with 1.1.1.2 of NFPA 400, materials having multiple hazards that fall within the scope of NFPA 400 shall comply with NFPA 400.

[a]Unlimited amounts of gas are permitted to be used for personal medical or emergency medical use.

[b]Storage in excess of 10 gal (38 L) of Class I and Class II liquids combined or 60 gal (227 L) of Class IIIA liquids is permitted where stored in safety cabinets with an aggregate quantity not to exceed 180 gal (681 L).

[c]Fuel in the tank of operating mobile equipment is permitted to exceed the specified quantity where the equipment is operated in accordance with this code.

[d]The use of explosive materials required by federal, state, or municipal agencies while engaged in normal or emergency performance of duties is not required to be limited. The storage of explosive materials is required to be in accordance with the requirements of NFPA 495, *Explosive Materials Code*.

[e]The storage and use of explosive materials in medicines and medicinal agents in the forms prescribed by the official United States Pharmacopoeia or the National Formulary are not required to be limited.

[f]The storage and use of propellant-actuated devices or propellant-actuated industrial tools manufactured, imported, or distributed for their intended purposes are required to be limited to 50 lb (23 kg) net explosive weight.

[g]Containers, cylinders or tanks not exceeding 250 ft^3 (7.1 m^3) content at normal temperature and pressure (NTP) and used for maintenance purposes, patient care, or operation of equipment shall be permitted.

[h]The permitted quantities are not limited in a building protected throughout by automatic sprinkler systems in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

[i]A maximum quantity of 200 lb (91 kg) of solid or 20 gal (76 L) of liquid Class 3 oxidizer is permitted where such materials are necessary for maintenance purposes, operation, or sanitation of equipment. Storage containers and the manner of storage are required to be approved.

[j]Gas cylinders not exceeding 20 ft^3 (0.57 m^3) at NTP are permitted in gas cabinets or fume hoods. [**5000:** Table 34.1.3.2(e)]

[k]Conversion. Where quantities are indicated in pounds and when the weight per gallon of the liquid is not provided to the AHJ, a conversion factor of 10 lb/gal (1.2 kg/L) shall be used.

[l]The quantities of alcohol-based hand rubs classified as Class I and Class II liquids and Level 1 aerosols are not limited when installed in individual dispensers in accordance with 66.18.6. [**400:** Table 5.2.1.4]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.5 Maximum Allowable Quantities (MAQ) of Hazardous Materials per Control Area in Health Care Occupancies

Material	Class	Solid	Liquid[k]	Gas[a] (at NTP)
Flammable and combustible liquid[b,c,l]	See note	See note	See note	
Cryogenic fluid	Flammable Oxidizing	NA NA	10 gal 10 gal	NA NA
Explosives[d,e,f]	See note	See note	See note	See note
Flammable gas[c,g]	Gaseous Liquefied	NA NA	NA 20 gal	NP NA
Consumer fireworks	See note	See note	See note	See note
Flammable solid	NA	5 lb	NA	NA
Oxidizers	4 3 2 1	NP 10 lb[h] 250 lb 4,000 lb[i]	NP 1 gal[h] 25 gal 400 gal[i]	NA NA NA NA
Oxidizing gas	Gaseous Liquefied	NA NA	NA 15 gal	Per NFPA 99 NA
Organic peroxides	I II III IV V	NP NP 1,500 lb 100,000 lb NL	NP NP 1,500 lb 100,000 lb NL	NA NA NA NA NA
Pyrophoric materials	NA	NP	NP	NP
Unstable reactives	4 3 2 1	NP NP 10 lb NL	NP NP 10 lb NL	NP NP NP[g] NP
Water-reactive	3 2 1	1 lb 10 lb NL	1 lb 10 lb NL	NA NA NA
Corrosives	NA	1,000 lb	100 gal	NP
Highly toxic	NA	3 lb	3 lb	NP[j]
Toxic	NA	125 lb	125 lb	NP[j]

For SI units, 1 lb = 0.454 kg; 1 gal = 3.785 L.

NTP: Normal temperature and pressure [measured at 70°F (21°C) and 14.7 psi (101 kPa)]. NA: Not applicable. NP: Not permitted. NL: Not limited.

Note: The hazardous material categories and MAQs that are shaded in this table are not regulated by NFPA 400 but are provided here for informational purposes. See Chapter 2 of NFPA 400 for the reference code or standard governing these materials and establishing the MAQs. In accordance with 1.1.1.2 of NFPA 400, materials having multiple hazards that fall within the scope of NFPA 400 shall comply with NFPA 400.

[a]Unlimited amounts of gas are permitted to be used for personal medical or emergency medical use.

[b]Storage in excess of 10 gal (38 L) of Class I and Class II liquids combined or 60 gal (227 L) of Class IIIA liquids is permitted where stored in safety cabinets with an aggregate quantity not to exceed 180 gal (681 L).

[c]Fuel in the tank of operating mobile equipment is permitted to exceed the specified quantity where the equipment is operated in accordance with this code.

[d]The use of explosive materials required by federal, state, or municipal agencies while engaged in normal or emergency performance of duties is not required to be limited. The storage of explosive materials is required to be in accordance with the requirements of NFPA 495, *Explosive Materials Code*.

[e]The storage and use of explosive materials in medicines and medicinal agents in the forms prescribed by the official United States Pharmacopoeia or the National Formulary are not required to be limited.

[f]The storage and use of propellant-actuated devices or propellant-actuated industrial tools manufactured, imported, or distributed for their intended purposes are required to be limited to 50 lb (23 kg) net explosive weight.

[g]Containers, cylinders or tanks not exceeding 250 ft^3 (7.1 m^3) content at normal temperature and pressure (NTP) and used for maintenance purposes, patient care, or operation of equipment shall be permitted.

[h]A maximum quantity of 200 lb (91 kg) of solid or 20 gal (76 L) of liquid Class 3 oxidizer is permitted where such materials are necessary for maintenance purposes, operation, or sanitation of equipment. Storage containers and the manner of storage are required to be approved.

[i]The permitted quantities are not limited in a building protected throughout by automatic sprinkler systems in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

[j]Gas cylinders not exceeding 20 ft^3 (0.57 m^3) at NTP are permitted in gas cabinets or fume hoods. [**5000:** Table 34.1.3.2(f)]

[k]Conversion. Where quantities are indicated in pounds and when the weight per gallon of the liquid is not provided to the AHJ, a conversion factor of 10 lb/gal (1.2 kg/L) shall be used.

[l]The quantities of alcohol-based hand rubs classified as Class I and Class II liquids and Level 1 aerosols are not limited when installed in individual dispensers in accordance with 66.18.6. [**400:** Table 5.2.1.5]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.6 Maximum Allowable Quantities (MAQ) of Hazardous Materials per Control Area in Ambulatory Health Care Occupancies

Material	Class	Solid	Liquid[k]	Gas[a] (at NTP)
Flammable and combustible liquid[b,c,l]	See note	See note	See note	See note
Cryogenic fluid	Flammable	NA	10 gal	NA
	Oxidizing	NA	10 gal	NA
Explosives[d,e,f]	See note	See note	See note	See note
Flammable gas[c,g]	Gaseous	NA	NA	NP
	Liquefied	NA	20 lb	NA
Consumer fireworks	See note	See note	See note	See note
Flammable solid	NA	5 lb	NA	NA
Oxidizers	4	NP	NP	NP
	3	10 lb[h]	1 gal[h]	NP
	2	250 lb	25 gal	NP
	1	4,000 lb[i]	400 gal[i]	NP
Oxidizing gas	Gaseous	NA	NA	Per NFPA 99
	Liquefied	NA	15 gal	NA
Organic peroxides	I	NP	NP	NA
	II	NP	NP	NA
	III	1,500 lb	1,500 lb	NA
	IV	100,000 lb	100,000 lb	NA
	V	NL	NL	NA
Pyrophoric materials	NA	NP	NP	NP
Unstable reactives	4	NP	NP	NP
	3	NP	NP	NP
	2	10 lb	10 lb	NP[g]
	1	NL	NL	NP
Water-reactive	3	1 lb	1 lb	NA
	2	10 lb	10 lb	NA
	1	NL	NL	NA
Corrosives	NA	1,000 lb	100 gal	NP
Highly toxic	NA	3 lb	3 lb	NP[j]
Toxic	NA	125 lb	125 lb	NP[j]

For SI units, 1 lb = 0.454 kg; 1 gal = 3.785 L.

NTP: Normal temperature and pressure [70°F (21°C) and 14.7 psi (101 kPa)]. NA: Not applicable. NP: Not permitted. NL: Not limited.

Note: The hazardous material categories and MAQs that are shaded in this table are not regulated by NFPA 400 but are provided here for informational purposes. See Chapter 2 of NFPA 400 for the reference code or standard governing these materials and establishing the MAQs. In accordance with 1.1.1.2 of NFPA 400, materials having multiple hazards that fall within the scope of NFPA 400 shall comply with NFPA 400.

[a]Unlimited amounts of gas are permitted to be used for personal medical or emergency medical use.

[b]Storage in excess of 10 gal (38 L) of Class I and Class II liquids combined or 60 gal (227 L) of Class IIIA liquids is permitted where stored in safety cabinets with an aggregate quantity not to exceed 180 gal (681 L).

[c]Fuel in the tank of operating mobile equipment is permitted to exceed the specified quantity where the equipment is operated in accordance with this code.

[d]The use of explosive materials required by federal, state, or municipal agencies while engaged in normal or emergency performance of duties is not required to be limited. The storage of explosive materials is required to be in accordance with the requirements of NFPA 495, *Explosive Materials Code*.

[e]The storage and use of explosive materials in medicines and medicinal agents in the forms prescribed by the official United States Pharmacopoeia or the National Formulary are not required to be limited.

[f]The storage and use of propellant-actuated devices or propellant-actuated industrial tools manufactured, imported, or distributed for their intended purposes are required to be limited to 50 lb (23 kg) net explosive weight.

[g]Containers, cylinders or tanks not exceeding 250 ft^3 (7.1 m^3) content at normal temperature and pressure (NTP) and used for maintenance purposes, patient care, or operation of equipment shall be permitted.

[h]A maximum quantity of 200 lb (91 kg) of solid or 20 gal (76 L) of liquid Class 3 oxidizer is permitted where such materials are necessary for maintenance purposes, operation, or sanitation of equipment. Storage containers and the manner of storage are required to be approved.

[i]The permitted quantities are not limited in a building protected throughout by automatic sprinkler systems in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

[j]Gas cylinders not exceeding 20 ft^3 (0.57 m^3) at NTP are permitted in gas cabinets or fume hoods. [**5000:** Table 34.1.3.2(b)]

[k]Conversion. Where quantities are indicated in pounds and when the weight per gallon of the liquid is not provided to the AHJ, a conversion factor of 10 lb/gal (1.2 kg/L) shall be used.

[l]The quantities of alcohol-based hand rubs classified as Class I and Class II liquids and Level 1 aerosols are not limited when installed in individual dispensers in accordance with 66.18.6. [**400:** Table 5.2.1.6]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.7 Maximum Allowable Quantities (MAQ) of Hazardous Materials per Control Area in Detention and Correctional Occupancies[a]

Material	Class	Solid	Liquid[k]	Gas[a] (at NTP)
Flammable and combustible liquid[b,c,l]	See note	See note	See note	See note
Cryogenic fluid	Flammable Oxidizing	NA NA	10 gal 10 gal	NA NA
Explosives[d,e,f,g]	See note	See note	See note	See note
Flammable gas[c,h]	Gaseous Liquefied	NA NA	NA 20 lb	NP NA
Consumer fireworks	See note	See note	See note	See note
Flammable solid	NA	5 lb	NA	NA
Oxidizers	4 3 2 1	NP 10 lb[i] 250 lb 4,000 lb	NP 1 gal[i] 25 gal 400 gal	NA NA NA NA
Oxidizing gas[h]	Gaseous Liquefied	NA NA	NA 15 gal	NP NA
Organic peroxides	I II III IV V	NP NP 1,500 lb 100,000 lb NL	NP NP 1,500 lb 100,000 lb NL	NA NA NA NA NA
Pyrophoric materials	NA	NP	NP	NP
Unstable reactives	4 3 2 1	NP NP 10 lb NL	NP NP 10 lb NL	NP NP NP[h] NP
Water-reactive	3 2 1	1 lb 10 lb NL	1 lb 10 lb NL	NA NA NA
Corrosives	NA	1,000 lb	100 gal	NP
Highly toxic	NA	3 lb	3 lb	NP[j]
Toxic	NA	125 lb	125 lb	NP[j]

For SI units, 1 lb = 0.454 kg; 1 gal = 3.785 L.

NTP: Normal temperature and pressure [measured at 70°F (21°C) and 14.7 psi (101 kPa)]. NA: Not applicable. NP: Not permitted. NL: Not limited.

Note: The hazardous material categories and MAQs that are shaded in this table are not regulated by NFPA 400 but are provided here for informational purposes. See Chapter 2 of NFPA 400 for the reference code or standard governing these materials and establishing the MAQs. In accordance with 1.1.1.2 of NFPA 400, materials having multiple hazards that fall within the scope of NFPA 400 shall comply with NFPA 400.

[a]Unlimited amounts of gas are permitted to be used for personal medical or emergency medical use.

[b]Storage in excess of 10 gal (38 L) of Class I and Class II liquids combined or 60 gal (227 L) of Class IIIA liquids is permitted where stored in safety cabinets with an aggregate quantity not to exceed 180 gal (681 L).

[c]Fuel in the tank of operating mobile equipment is permitted to exceed the specified quantity where the equipment is operated in accordance with this code.

[d]The use of explosive materials required by federal, state, or municipal agencies while engaged in normal or emergency performance of duties is not required to be limited. The storage of explosive materials is required to be in accordance with the requirements of NFPA 495, *Explosive Materials Code*.

[e]The storage and use of explosive materials in medicines and medicinal agents in the forms prescribed by the official United States Pharmacopoeia or the National Formulary are not required to be limited.

[f]The storage and use of propellant-actuated devices or propellant-actuated industrial tools manufactured, imported, or distributed for their intended purposes are required to be limited to 50 lb (23 kg) net explosive weight.

[g]The storage and use of small arms ammunition, and components thereof, are permitted where in accordance with NFPA 495, *Explosive Materials Code*.

[h]Containers, cylinders or tanks not exceeding 250 ft^3 (7.1 m^3) content at normal temperature and pressure (NTP) and used for maintenance purposes, patient care, or operation of equipment shall be permitted.

[i]A maximum quantity of 200 lb (91 kg) of solid or 20 gal (76 L) of liquid Class 3 oxidizer is permitted where such materials are necessary for maintenance purposes, operation, or sanitation of equipment. Storage containers and the manner of storage are required to be approved.

[j]Gas cylinders not exceeding 20 ft^3 (0.57 m^3) at NTP are permitted in gas cabinets or fume hoods. [**5000:** Table 34.1.3.2(g)]

[k]Conversion. Where quantities are indicated in pounds and when the weight per gallon of the liquid is not provided to the AHJ, a conversion factor of 10 lb/gal (1.2 kg/L) shall be used.

[l]The quantities of alcohol-based hand rubs classified as Class I and Class II liquids and Level 1 aerosols are not limited when installed in individual dispensers in accordance with 66.18.6. [**400:** Table 5.2.1.7]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.8 Maximum Allowable Quantities of Hazardous Materials per Control Area in Residential Occupancies Consisting of Lodging and Rooming Houses, Hotels, Dormitories, Apartments, and Residential Board and Care Facilities

Material	Class	Solid	Liquid[l]	Gas[a] (at NTP)
Flammable and combustible liquid[b,c,m]	See note	See note	See note	See note
Cryogenic fluid	Flammable Oxidizing	NA NA	10 gal 10 gal	NA NA
Explosives[d,e,f,g]	See note	See note	See note	See note
Flammable gas[c,h]	Gaseous Liquefied[j]	NA NA	NA 20 lb	NP NA
Consumer fireworks	See note	See note	See note	See note
Flammable solid	NA	5 lb	NA	NA
Oxidizers	4 3 2 1	NP 10 lb[i] 250 lb 4,000 lb	NP 1 gal[i] 25 gal 400 gal	NA NA NA NA
Oxidizing gas[h]	Gaseous Liquefied	NA NA	NA 15 gal	NP NA
Organic peroxides	I II III IV V	NP NP 1,500 lb 100,000 lb NL	NP NP 1,500 lb 100,000 lb NL	NA NA NA NA NA
Pyrophoric materials	NA	1 lb	1 lb	NP
Unstable reactives	4 3 2 1	¼ lb 1 lb 10 lb NL	¼ lb 1 lb 10 lb NL	NP NP NP[h] NP
Water-reactive	3 2 1	1 lb 10 lb NL	1 lb 10 lb NL	NA NA NA
Corrosives	NA	1,000 lb	100 gal	NP
Highly toxic	NA	3 lb	3 lb	NP[k]
Toxic	NA	125 lb	125 lb	NP[k]

For SI units, 1 lb = 0.454 kg; 1 gal = 3.785 L.

NTP: Normal temperature and pressure [measured at 70°F (21°C) and 14.7 psi (101 kPa)]. NA: Not applicable. NP: Not permitted. NL: Not limited.

Note: The hazardous material categories and MAQs that are shaded in this table are not regulated by NFPA 400 but are provided here for informational purposes. See Chapter 2 of NFPA 400 for the reference code or standard governing these materials and establishing the MAQs. In accordance with 1.1.1.2 of NFPA 400, materials having multiple hazards that fall within the scope of NFPA 400 shall comply with NFPA 400.

[a]Unlimited amounts of gas are permitted to be used for personal medical or emergency medical use.

[b]Storage in excess of 10 gal (38 L) of Class I and Class II liquids combined or 60 gal (227 L) of Class IIIA liquids are permitted where stored in safety cabinets with an aggregate quantity not to exceed 180 gal (681 L).

[c]Fuel in the tank of operating mobile equipment is permitted to exceed the specified quantity where the equipment is operated in accordance with this code.

[d]The use of explosive materials required by federal, state, or municipal agencies while engaged in normal or emergency performance of duties is not required to be limited. The storage of explosive materials is required to be in accordance with the requirements of NFPA 495, *Explosive Materials Code*.

[e]The storage and use of explosive materials in medicines and medicinal agents in the forms prescribed by the official United States Pharmacopoeia or the National Formulary are not required to be limited.

[f]The storage and use of propellant-actuated devices or propellant-actuated industrial tools manufactured, imported, or distributed for their intended purposes are required to be limited to 50 lb (23 kg) net explosive weight.

[g]The storage and use of small arms ammunition, and components thereof, are permitted where in accordance with NFPA 495, *Explosive Materials Code*.

[h]Containers, cylinders or tanks not exceeding 250 ft^3 (7.1 m^3) content at normal temperature and pressure (NTP) and used for maintenance purposes, patient care, or operation of equipment shall be permitted.

[i]A maximum quantity of 200 lb (91 kg) of solid or 20 gal (76 L) of liquid Class 3 oxidizer is permitted where such materials are necessary for maintenance purposes, operation, or sanitation of equipment. Storage containers and the manner of storage are required to be approved.

[j]Storage containers are not permitted to exceed 0.325 ft^3 (0.0092 m^3) capacity.

[k]Gas cylinders not exceeding 20 ft^3 (0.57 m^3) at NTP are permitted in gas cabinets or fume hoods. [**5000:** Table 34.1.3.2(h)]

[l]Conversion. Where quantities are indicated in pounds and when the weight per gallon of the liquid is not provided to the AHJ, a conversion factor of 10 lb/gal (1.2 kg/L) shall be used.

[m]The quantities of alcohol-based hand rubs classified as Class I and Class II liquids and Level 1 aerosols are not limited when installed in individual dispensers in accordance with 66.18.6. [**400:** Table 5.2.1.8]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.10.1 Maximum Allowable Quantities (MAQ) of Hazardous Materials per Control Area in Business Occupancies

Material	Class	Solid	Liquid[j]	Gas[a,i] (at NTP)
Flammable and combustible liquid[b,c,k]	See note	See note	See note	See note
Cryogenic fluid	Flammable Oxidizing	NA NA	10 gal 10 gal	NA NA
Explosives[d,e,f,g]	See note	See note	See note	See note
Flammable gas[c]	Gaseous Liquefied	NA NA	NA 20 lb	1000 ft^3 NA
Consumer fireworks	See note	See note	See note	See note
Flammable solid	NA	5 lb	NA	NA
Oxidizers	4 3 2 1	NP 10 lb[h] 250 lb 4,000 lb	NP 1 gal[h] 25 gal 400 gal	NP NP NP NP
Oxidizing gas	Gaseous Liquefied	NA NA	NA 15 gal	1500 ft^3 NA
Organic peroxides	I II III IV V	NP NP 1500 lb 100,000 lb NL	NP NP 1500 lb 100,000 lb NL	NA NA NA NA NA
Pyrophoric materials	NA	1 lb	1 lb	10 ft^3
Unstable reactives	4 3 2 1	¼ lb 1 lb 10 lb NL	¼ lb 1 lb 10 lb NL	2 ft^3 10 ft^3 750 ft^3 NL
Water-reactive	3 2 1	1 lb 10 lb NL	1 lb 10 lb NL	NA NA NA
Corrosives	NA	1000 lb	100 gal	810 ft^3
Highly toxic[i]	NA	3 lb	3 lb	20 ft^3
Toxic[i]	NA	125 lb	125 lb	810 ft^3

For SI units, 1 lb = 0.454 kg; 1 gal = 3.785 L; 1 ft^3 = 0.0283 m^3.

NTP: Normal temperature and pressure [measured at 70°F (21°C) and 14.7 psi (101 kPa)]. NA: Not applicable. NP: Not permitted. NL: Not limited.

Note: The hazardous material categories and MAQs that are shaded in this table are not regulated by NFPA 400 but are provided here for informational purposes. See Chapter 2 of NFPA 400 for the reference code or standard governing these materials and establishing the MAQs. In accordance with 1.1.1.2 of NFPA 400, materials having multiple hazards that fall within the scope of NFPA 400 shall comply with NFPA 400.

[a]Unlimited amounts of gas are permitted to be used for personal medical or emergency medical use.

[b]Storage in excess of 10 gal (38 L) of Class I and Class II liquids combined or 60 gal (227 L) of Class IIIA liquids is permitted where stored in safety cabinets with an aggregate quantity not to exceed 180 gal (681 L).

[c]Fuel in the tank of operating mobile equipment is permitted to exceed the specified quantity where the equipment is operated in accordance with this code.

[d]The use of explosive materials required by federal, state, or municipal agencies while engaged in normal or emergency performance of duties is not required to be limited. The storage of explosive materials is required to be in accordance with the requirements of NFPA 495, *Explosive Materials Code*.

[e]The storage and use of explosive materials in medicines and medicinal agents in the forms prescribed by the official United States Pharmacopoeia or the National Formulary are not required to be limited.

[f]The storage and use of propellant-actuated devices or propellant-actuated industrial tools manufactured, imported, or distributed for their intended purposes are required to be limited to 50 lb (23 kg) net explosive weight.

[g]The storage and use of small arms ammunition, and components thereof, are permitted where in accordance with NFPA 495, *Explosive Materials Code*.

[h]A maximum quantity of 200 lb (91 kg) of solid or 20 gal (76 L) of liquid Class 3 oxidizer is permitted where such materials are necessary for maintenance purposes, operation, or sanitation of equipment. Storage containers and the manner of storage are required to be approved.

[i]Gas cylinders not exceeding 20 ft^3 (0.57 m^3) at NTP are permitted in gas cabinets or fume hoods. [**5000:** Table 34.1.3.2(c)]

[j]Conversion. Where quantities are indicated in pounds and when the weight per gallon of the liquid is not provided to the AHJ, a conversion factor of 10 lb/gal (1.2 kg/L) shall be used.

[k]The quantities of alcohol-based hand rubs classified as Class I and Class II liquids and Level 1 aerosols are not limited when installed in individual dispensers in accordance with 66.18.6. [**400:** Table 5.2.1.10.1]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

60.4.2.1.13.2 Special Controls Required for Increased Quantities. Where quantities of hazardous materials are increased in accordance with 60.4.2.1.13.3, such materials shall be stored in accordance with the following limitations:

(1) Storage and display of solids shall not exceed 200 lb/ft^2 (976.4 kg/m^2) of floor area actually occupied by solid merchandise.
(2) Storage and display of liquids shall not exceed 20 gal/ft^2 (76 L/m^2) of floor area actually occupied by liquid merchandise.
(3) Storage and display height shall not exceed 6 ft (1.8 m) above the finished floor.
(4) Individual containers less than 5 gal (19 L) or less than 25 lb (11 kg) shall be stored or displayed on pallets, racks, or shelves.
(5) Racks and shelves used for storage or display shall be in accordance with 60.5.1.13.
(6) Containers shall be listed or approved for the intended use.
(7) Individual containers shall not exceed 100 lb (45.4 kg) capacity for solids or a 5 gal (19 L) capacity for liquids.
(8) Incompatible materials shall be separated in accordance with 60.5.1.12.
(9) Except for surfacing, floors shall be of noncombustible construction.
(10) Aisles 4 ft (1.2 m) in width shall be maintained on three sides of the storage or display area.
(11) Hazard identification signs shall be provided in accordance with 60.5.1.8. [**400:**5.2.1.13.2]

60.4.2.1.13.3 Special Maximum Allowable Quantity Increases for Storage in Mercantile, Storage, and Industrial Occupancies. The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials permitted within a single control area of a mercantile, storage, or industrial occupancy shall be permitted to exceed the maximum allowable quantities specified in Table 60.4.2.1.1.3, without complying with Protection Level 2, Protection Level 3, or Protection Level 4, provided that the quantities comply with Table 60.4.2.1.13.3(a) and Table 60.4.2.1.13.3(b) and that materials are displayed and stored in accordance with the special limitations in 60.4.2.1.13.2. [**400:**5.2.1.13.3]

60.4.2.2 Construction Requirements for Control Areas.

60.4.2.2.1 Number of Control Areas. The maximum number of control areas within a building shall be in accordance with Table 60.4.2.2.1. [**400:**5.2.2.1]

60.4.2.2.2 Where only one control area is present in a building, no special construction provisions shall be required. [**400:**5.2.2.2]

60.4.2.2.3 Where more than one control area is present in a building, control areas shall be separated from each other by fire barriers in accordance with Table 60.4.2.2.1. [**400:**5.2.2.3]

60.4.3 Protection Levels.

60.4.3.1 Where the quantity of hazardous materials in storage or use exceeds the maximum allowable quantity for indoor control areas as set forth in 60.4.2, the occupancy shall comply with the requirements for Protection Level 1, Protection Level 2, Protection Level 3, or Protection Level 4, as required for the material in storage or use as defined in 6.2.2 through 6.2.5 of NFPA 400. [**400:**5.3.1]

Table 60.4.2.1.13.3(a) Maximum Allowable Quantity (MAQ) per Control Area Increases for Selected Hazard Categories in Mercantile, Storage, and Industrial Occupancies

	Maximum Allowable Quantity[a,b]			
	Solids		Liquids	
Hazard Category	lb	kg	gal	L
Physical Hazard Materials: Nonflammable and Noncombustible Solids and Liquids				
Oxidizers				
Class 3	1,150	522	115	435
Class 2	2,250	1,022	225	852
Class 1[c]	18,000	8,172	1,800	6,813

Note: Maximum quantities for hazard categories not shown are required to be in accordance with Table 60.4.2.1.1.3.
[a]Maximum quantities are permitted to be increased 100 percent in buildings that are sprinklered in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. Where footnote b also applies, the increase for both footnotes is permitted to be applied.
[b]Maximum quantities are permitted to be increased 100 percent where stored in approved storage cabinets, gas cabinets, or exhausted enclosures in accordance with NFPA 1, *Fire Code*. Where footnote a also applies, the increase for both footnotes is permitted to be applied.
[c]Quantities are not limited in buildings protected by an automatic sprinkler system complying with NFPA 13. [**5000:** Table 34.1.3.3.1(a)] [**400:** Table 5.2.1.13.3(a)]

60.4.3.2 Protection Level 5 shall apply to semiconductor fabrication facilities where required by the building code. [**400:**5.3.2]

60.4.3.3 Protection Level 1.

60.4.3.3.1 Buildings containing quantities of hazardous materials exceeding the maximum allowable quantities of high hazard Level 1 contents permitted in control areas shall comply with applicable regulations for Protection Level 1, as set forth in the applicable sections of Chapter 6 and Chapters 11 through 21 of NFPA 400, and the building code. [**400:**5.3.3.1]

60.4.3.3.2 High hazard Level 1 contents shall include materials that present a detonation hazard as defined in 60.3.2.1.2.2. [**400:**5.3.3.2]

60.4.3.4 Protection Level 2.

60.4.3.4.1 Buildings, and portions thereof, containing quantities of hazardous materials exceeding the maximum allowable quantities of high hazard Level 2 contents permitted in control areas shall comply with applicable regulations for Protection Level 2, as set forth in the applicable sections of Chapter 6 and Chapters 11 through 21 of NFPA 400, and the building code. [**400:**5.3.4.1]

60.4.3.4.2 High hazard Level 2 contents shall include materials that present a deflagration hazard or a hazard from accelerated burning as defined in 60.3.2.1.2.3. [**400:**5.3.4.2]

60.4.3.5 Protection Level 3.

60.4.3.5.1 Buildings, and portions thereof, containing quantities of hazardous materials exceeding the maximum allowable quantities of high hazard Level 3 contents permitted in

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.2.1.13.3(b) Maximum Allowable Quantity (MAQ) per Control Area Increases for Selected Hazard Categories in Mercantile and Storage Occupancies

Hazard Category	Maximum Allowable Quantity[a,b,c]			
	Solids		Liquids	
	lb	kg	gal	L
Physical Hazard Materials: Nonflammable and Noncombustible Solids and Liquids				
Unstable (reactive)				
Class 3	550	250	55	208
Class 2	1,150	522	115	435
Water-reactive				
Class 3	550	250	55	208
Class 2	1,150	522	115	435
Health Hazard Materials: Nonflammable and Noncombustible Solids and Liquids				
Corrosive	10,000	4,540	1,000	3,785
Highly toxic[d]	20	9	2	8
Toxic[d]	1,000	454	100	379

[a]Maximum quantities for hazard categories not shown are required to be in accordance with Table 60.4.2.1.1.3.

[b]Maximum quantities are permitted to be increased 100 percent in buildings that are sprinklered in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. Where footnote b also applies, the increase for both footnotes can be applied.

[c]Maximum quantities are permitted to be increased 100 percent where stored in approved storage cabinets, gas cabinets, or exhausted enclosures in accordance with NFPA 1, *Fire Code*. Where footnote (a) also applies, the increase for both footnotes is permitted to be applied. [**5000:** Table 34.1.3.3.1(b)]

[d]Toxic or highly toxic solids or liquids displayed in original packaging in mercantile or storage occupancies and intended for maintenance, operation of equipment, or sanitation when contained in individual packaging not exceeding 100 lb (45.4 kg) shall be limited to an aggregate of 1200 lb (544.3 kg) or 220 gal (832.8 L). The increases allowed by footnotes a, b, and c shall not apply to highly toxic solids and liquids. [**400:** Table 5.2.1.13.3(b)]

control areas shall comply with applicable regulations for Protection Level 3, as set forth in the applicable sections of Chapter 6 and Chapters 11 through 21 of NFPA 400, and the building code. [**400:**5.3.5.1]

60.4.3.5.2 High hazard Level 3 contents shall include materials that readily support combustion or present a physical hazard as defined in 60.3.2.1.2.4. [**400:**5.3.5.2]

60.4.3.6 Protection Level 4.

60.4.3.6.1 Buildings, and portions thereof, containing quantities of hazardous materials exceeding the maximum allowable quantities of high hazard Level 4 contents permitted in control areas shall comply with applicable regulations for Protection Level 4, as set forth in the applicable sections of Chapter 6 and Chapters 11 through 21 of NFPA 400, and the building code. [**400:**5.3.6.1]

Table 60.4.2.2.1 Design and Number of Control Areas

Floor Level	Maximum Allowable Quantity per Control Area (%)*	Number of Control Areas per Floor	Fire Resistance Rating for Fire Barriers† (hr)
Above grade plane			
>9	5.0	1	2
7–9	5.0	2	2
4–6	12.5	2	2
3	50.0	2	1
2	75.0	3	1
1	100.0	4	1
Below grade plane			
1	75	3	1
2	50	2	1
Lower than 2	NA	NA	NA

NA: Not applicable.

*Percentages represent the maximum allowable quantities per control area shown in Table 60.4.2.1.1.3, with all the increases permitted in the footnotes of that table.

†Fire barriers are required to include floors and walls, as necessary, to provide a complete separation from other control areas. [**5000:** Table 34.2.5.1.1] [**400:** Table 5.2.2.1]

60.4.3.6.2 High hazard Level 4 contents shall include materials that are acute health hazards as defined in 60.3.2.1.2.5. [**400:**5.3.6.2]

60.4.3.7 Detached Building Required for High Hazard Level 2 and High Hazard Level 3 Materials. Buildings required to comply with Protection Level 2 or 3 and containing quantities of high hazard contents exceeding the quantity limits set forth in Table 60.4.3.7 shall be in accordance with 6.2.3.4 or 6.2.4.4 of NFPA 400, as applicable. [**400:**5.3.7]

60.4.4 Outdoor Areas.

60.4.4.1 Outdoor Control Areas.

60.4.4.1.1 General.

60.4.4.1.1.1 Hazardous materials shall be permitted to be stored or used in outdoor control areas in accordance with 60.4.5.1.2 and 60.4.5.1.3. [**400:**5.4.1.1.1]

60.4.4.1.1.2 Where storage or use is in an outdoor control area, compliance with the outdoor storage and use requirements in Chapters 11 through 21 of NFPA 400 shall not be required. [**400:**5.4.1.1.2]

60.4.4.1.2 Maximum Allowable Quantity per Outdoor Control Area. Maximum allowable quantities of hazardous materials in an outdoor control area shall be as specified in Table 60.4.4.1.2. [**400:**5.4.1.2]

60.4.4.1.3 Number of Outdoor Control Areas.

60.4.4.1.3.1 A single outdoor control area shall be permitted on any property. [**400:**5.4.1.3.1]

60.4.4.1.3.2 Where a property exceeds 10,000 ft^2 (929 m^2), a group of two outdoor control areas shall be permitted where approved and where each control area is separated by a minimum distance of 50 ft (15 m). [**400:**5.4.1.3.2]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.3.7 High Hazard Level 2 and High Hazard Level 3 Materials — Detached Building Required

Material	Class	Maximum Quantity Without a Detached Building: Solids and Liquids (tons)	Maximum Quantity Without a Detached Building: Gases (ft^3) [m^3]* [55:Table 6.5]
Oxidizers	3	1,200	NA
	2	2,000	NA
Organic peroxides	II	25	NA
	III	50	NA
Unstable (reactive) materials	3, nondetonable	1	2,000 (57)
	2	25	10,000 (283)
Water-reactive materials	3	1	NA
	2, deflagrating	25	NA
Pyrophoric gases		NA	2,000 (57)

For SI units, 1 ton = 0.9 met ton.
*See Table 21.2.5 of NFPA 400. [**400:** Table 5.3.7]

60.5 Fundamental Requirements.

60.5.1 General Requirements.

60.5.1.1 Applicability. Storage, use, and handling of hazardous materials in any quantity shall comply with 60.5.1. [**400:**6.1.1]

60.5.1.1.1* Storage of hazardous materials in quantities exceeding the maximum allowable quantity permitted in control areas set forth in Section 60.4 shall comply with Section 6.2 of NFPA 400 and the applicable material specific requirements in Chapters 11 through 21 of NFPA 400. [**400:**6.1.1.1]

60.5.1.1.2* The use, dispensing, and handling of hazardous materials in quantities exceeding the maximum allowable quantity (MAQ) permitted in control areas set forth in Section 60.4 shall comply with Section 6.3 of NFPA 400 and the applicable material specific requirements in Chapters 11 through 21 of NFPA 400. [**400:**6.1.1.2]

60.5.1.2* Material Safety Data Sheets (MSDS). Material safety data sheets (MSDS) shall be available on the premises for hazardous materials regulated by this code. When approved, MSDSs shall be permitted to be retrievable by electronic access. [**400:**6.1.2]

60.5.1.3 Release of Hazardous Materials.

60.5.1.3.1 Prohibited Releases. Hazardous materials shall not be released into a sewer, storm drain, ditch, drainage canal, lake, river, or tidal waterway; upon the ground, a sidewalk, a street, or a highway; or into the atmosphere, unless such release is permitted by the following:

(1) Federal, state, or local governing regulations
(2) Permits of the jurisdictional air quality management board
(3) National Pollutant Discharge Elimination System permit
(4) Waste discharge requirements established by the jurisdictional water quality control board
(5) Sewer pretreatment requirements for publicly or privately owned treatment works [**400:**6.1.3.1]

60.5.1.3.2 Control and Mitigation of Unauthorized Releases. Provisions shall be made for controlling and mitigating unauthorized releases. [**400:**6.1.3.2]

60.5.1.3.3 Records of Unauthorized Releases. Accurate records of the unauthorized release of hazardous materials shall be kept by the permittee. [**400:**6.1.3.3]

60.5.1.3.4* Notification of Unauthorized Releases. The fire department shall be notified immediately or in accordance with approved emergency procedures when an unauthorized release becomes reportable under state, federal, or local regulations. [**400:**6.1.3.4]

60.5.1.3.5 Container Failure. When an unauthorized release due to primary container failure is discovered, the involved primary container shall be repaired or removed from service. [**400:**6.1.3.5]

60.5.1.3.6 Overpack Containers. Overpack containers shall be permitted to be used as a means to provide protection for primary containers to be transported for repair or removal from service. [**400:**6.1.3.6]

60.5.1.3.7 Responsibility for Cleanup of Unauthorized Releases.

60.5.1.3.7.1 The person, firm, or corporation responsible for an unauthorized release shall institute and complete all actions necessary to remedy the effects of such unauthorized release, whether sudden or gradual, at no cost to the AHJ. [**400:**6.1.3.7.1]

60.5.1.3.7.2 When deemed necessary by the AHJ, cleanup of an unauthorized release shall be permitted to be initiated by the fire department or by an authorized individual or firm, and costs associated with such cleanup shall be borne by the owner, operator, or other person responsible for the unauthorized release. [**400:**6.1.3.7.2]

60.5.1.4* Personnel Training. Persons in areas where hazardous materials are stored, dispensed, handled, or used shall be trained in the hazards of the materials employed and actions required by the emergency plan. The level of training to be conducted shall be consistent with the responsibilities of the persons to be trained in accordance with 60.5.1.4.1 through 60.5.1.4.5. [**400:**6.1.4]

60.5.1.4.1 Awareness. The training provided for persons designated in 60.5.1.4 shall include awareness training in accordance with 60.5.1.4.1.1 through 60.5.1.4.1.3. [**400:**6.1.4.1]

60.5.1.4.1.1 Completion. Initial training shall be completed prior to beginning work in the work area. [**400:**6.1.4.1.1]

60.5.1.4.1.2 Hazard Communications. Training shall be provided prior to beginning work in the work area to enable personnel to recognize and identify hazardous materials, stored, dispensed, handled, or used on site and where to find hazard safety information pertaining to the materials employed. [**400:**6.1.4.1.2]

60.5.1.4.1.3 Emergency Plan. Training shall be provided prior to beginning work in the work area to enable personnel to implement the emergency plan. [**400:**6.1.4.1.3]

Copyright 2013 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via NFCSS All Access on April 5, 2013 to DEPT OF HOMELAND SECURITY for designated user USFA. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS All Access subscription expires on 08/31/2013.

Table 60.4.4.1.2 Maximum Allowable Quantities of Hazardous Materials per Outdoor Control Area

		Storage			Use — Closed Systems			Use — Open Systems	
Material	Class	Solid Pounds	Liquid Gallons (lb)	Gas Cubic Feet at NTP	Solid Pounds	Liquid Gallons (lb)	Gas Cubic Feet at NTP	Solid Pounds	Liquid Gallons (lb)
Physical Hazard Materials									
Flammable gas									
Gaseous		NA	NA	750	NA	NA	750	NA	NA
Liquefied		NA	15	NA	NA	15	NA	NA	NA
Flammable solid		125	NA	NA	25	NA	NA	25	NA
Organic peroxide	Detonatable	1	(1)	NA	¼	(¼)	NA	¼	(¼)
Organic peroxide	I	5	(5)	NA	1	(1)	NA	1	(1)
	II	50	(50)	NA	50	(50)	NA	10	(10)
	III	125	(125)	NA	125	(125)	NA	25	(25)
	IV	500	(500)	NA	500	(500)	NA	100	(100)
	V	NL	NL	NA	NL	NL	NA	NL	NL
Oxidizer	4	1	(1)	NA	¼	(¼)	NA	¼	(¼)
	3	10	(10)	NA	2	(2)	NA	2	(2)
	2	250	(250)	NA	250	(250)	NA	50	(50)
	1	4000	(4000)	NA	4000	(4000)	NA	1000	(1000)
Oxidizing gas									
Gaseous		NA	NA	1500	NA	NA	1500	NA	NA
Liquefied		NA	15	NA	NA	15	NA	NA	NA
Pyrophoric		4	4	50	1	(1)	10	0	0
Unstable (reactive)	4	1	(1)	10	¼	(¼)	2	¼	(¼)
	3	5	(5)	50	1	(1)	10	1	(1)
	2	50	(50)	250	50	(50)	250	10	(10)
	1	NL	NL	750	NL	NL	NL	NL	NL
Water-reactive	3	5	(5)	NA	5	(5)	NA	1	(1)
	2	50	(50)	NA	50	(50)	NA	10	(10)
	1	NL	NL	NA	NL	NL	NA	NL	NL
Health Hazard Materials									
Corrosive		5000	500	810	5000	500	810	1000	100
Highly toxic		10	(10)	20*	10	(10)	20*	3	(3)
Toxic		500	(500)	810	500	50	810	25	(25)

For SI units, 1 lb = 0.454 kg; 1 gal = 3.785 L; 1 ft^3 = 0.0283 m^3.
NA: Not applicable. NL: Not limited.
Notes:
(1) Table values in parentheses correspond to the unit name in parentheses at the top of the column. For gallons of liquids, divide the amount in pounds by 10.
(2) The aggregate quantities in storage and use shall not exceed the quantity listed for storage.
*Permitted only where used in approved exhausted gas cabinets, exhausted enclosures, or fume hoods. [**400:** Table 5.4.1.2]

This page intentionally left blank.

UNIT 5: APPLICATION OF THE CODE AND CONTROL METHODS

TERMINAL OBJECTIVE

The students will be able to apply the code, regulation and/or standards to control the hazards, given a hazardous materials classification, location and quantity.

ENABLING OBJECTIVES

The students will:

1. *Identify methods to control hazards.*
2. *Identify codes, regulations and standards that provide the authority to implement controls.*
3. *Given an occupancy, quantity and hazardous material classification, determine the maximum allowable quantities (MAQs).*

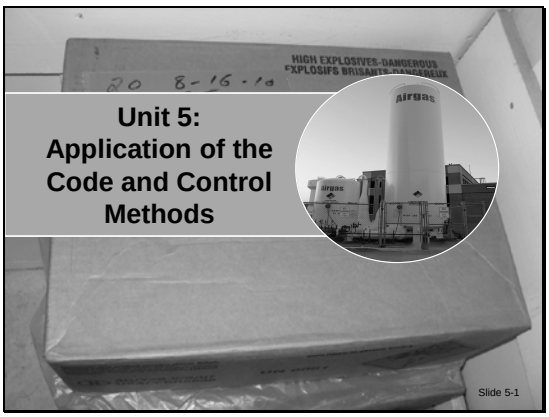
This page intentionally left blank.

NOTE-TAKING GUIDE AND ACTIVITY

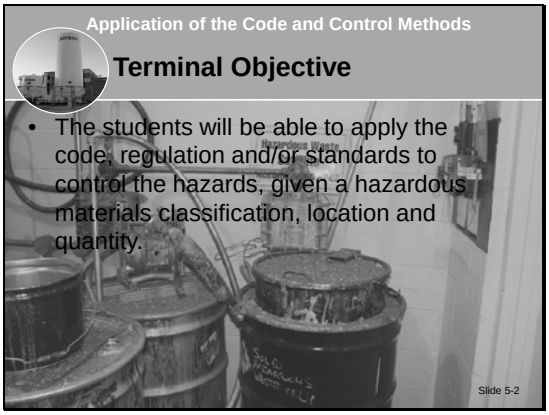
This page intentionally left blank.

NOTE-TAKING GUIDE

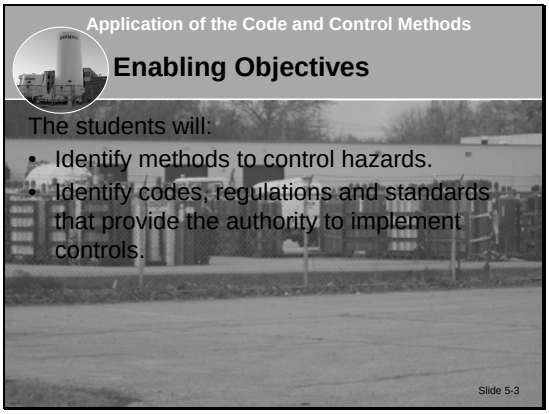
Slide 5-1



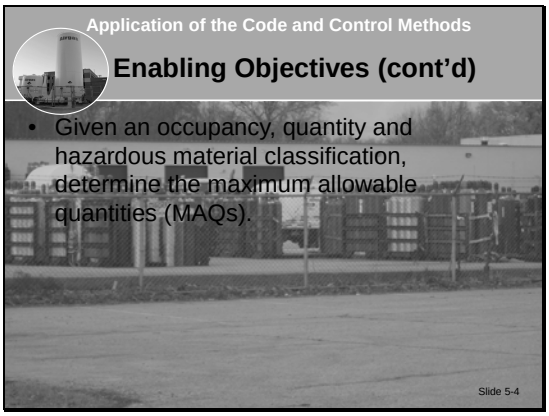
Slide 5-2



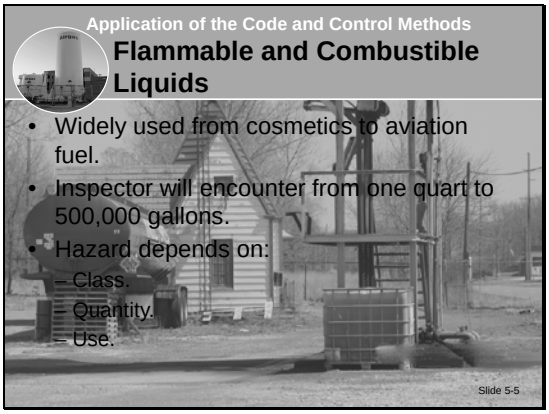
Slide 5-3



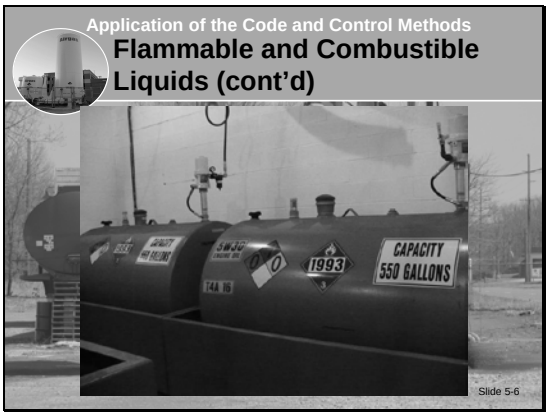
Slide 5-4



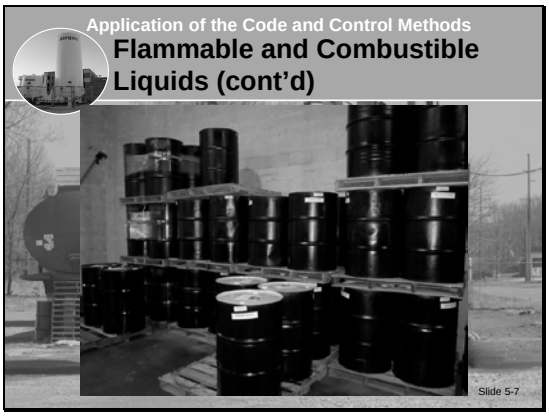
Slide 5-5



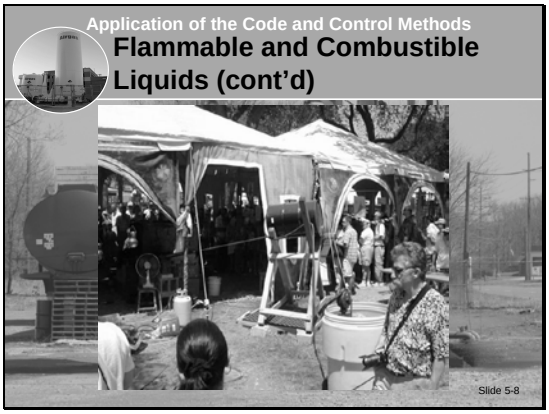
Slide 5-6



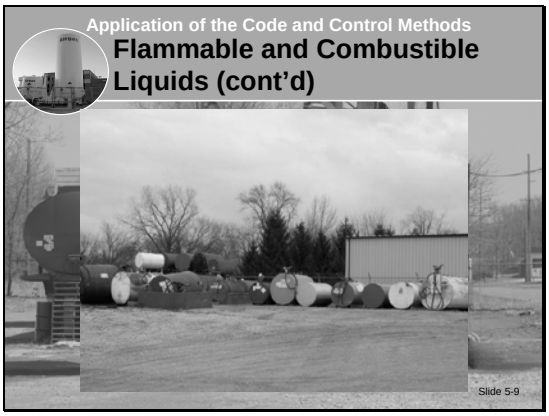
Slide 5-7



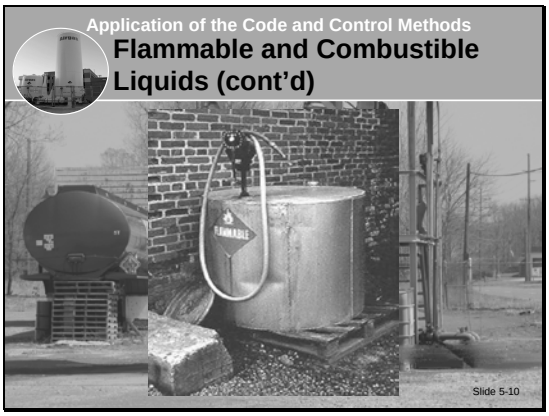
Slide 5-8



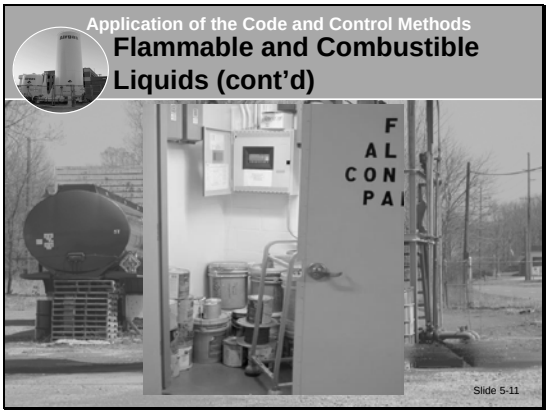
Slide 5-9



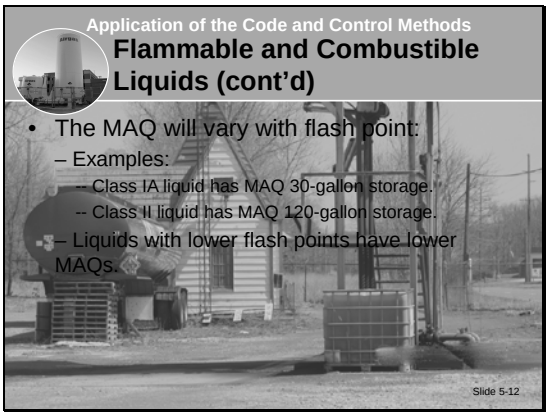
Slide 5-10



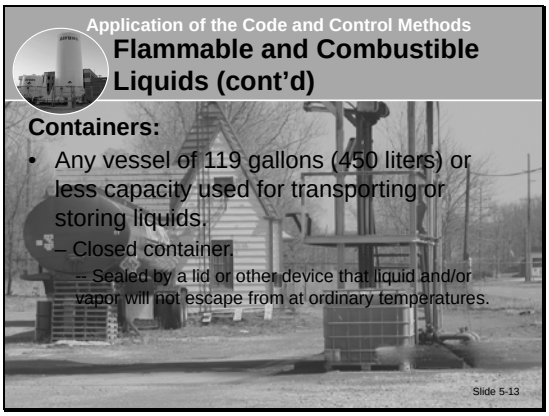
Slide 5-11



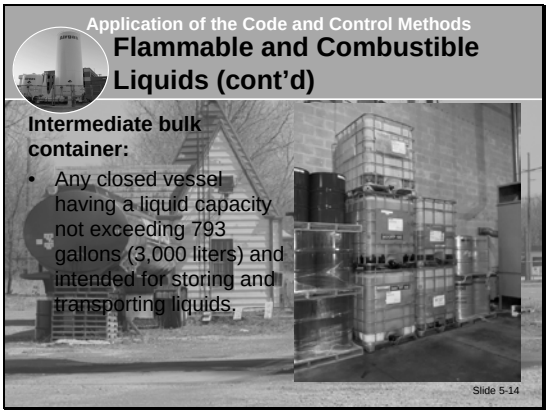
Slide 5-12



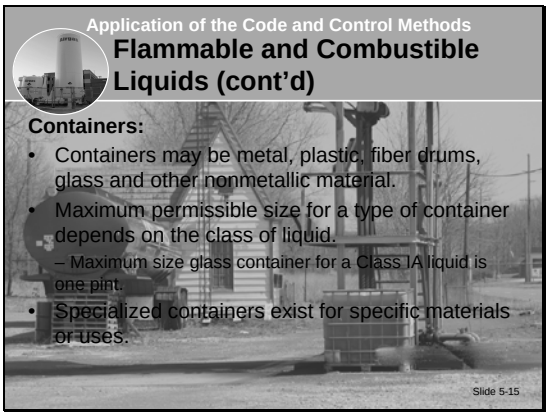
Slide 5-13



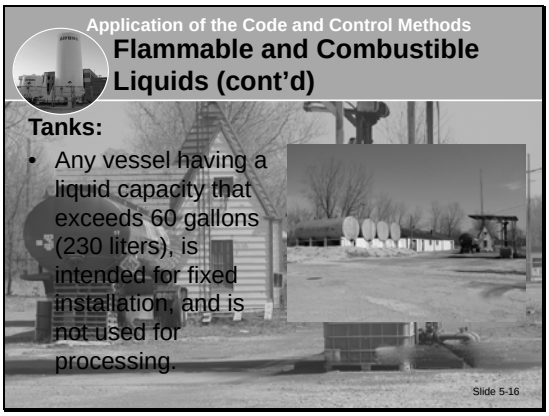
Slide 5-14



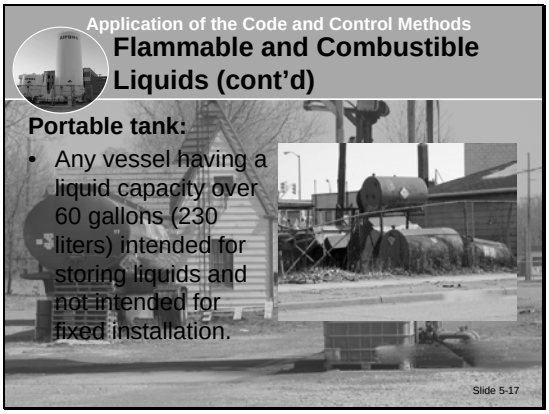
Slide 5-15



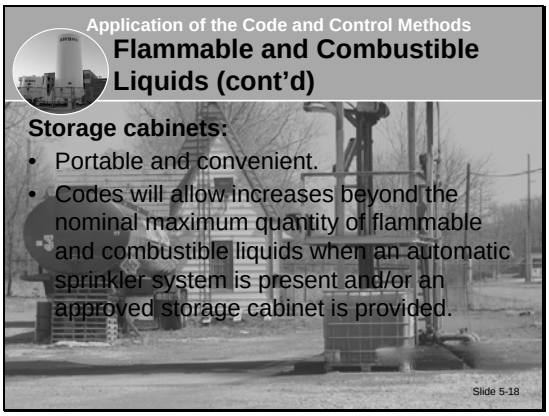
Slide 5-16



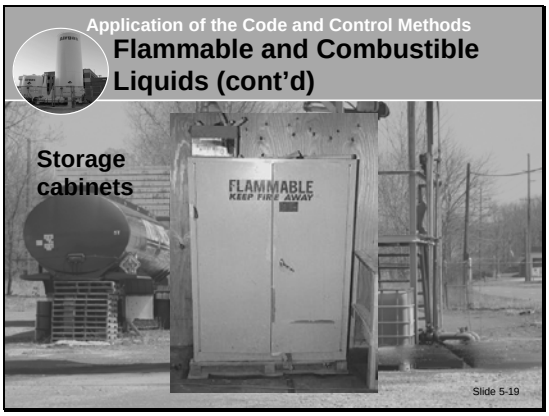
Slide 5-17



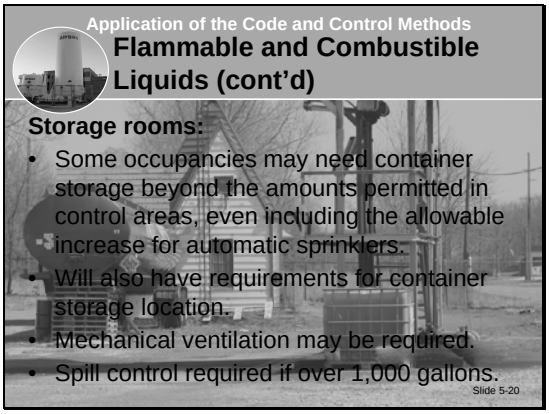
Slide 5-18



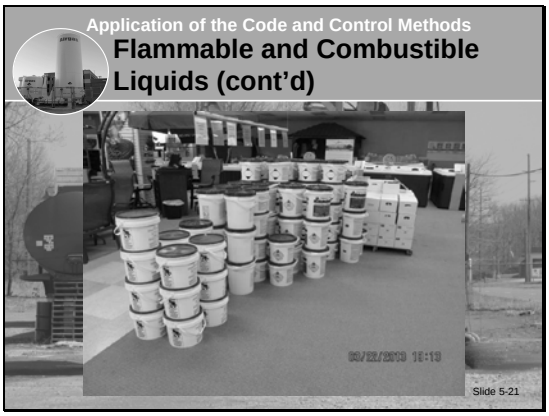
Slide 5-19



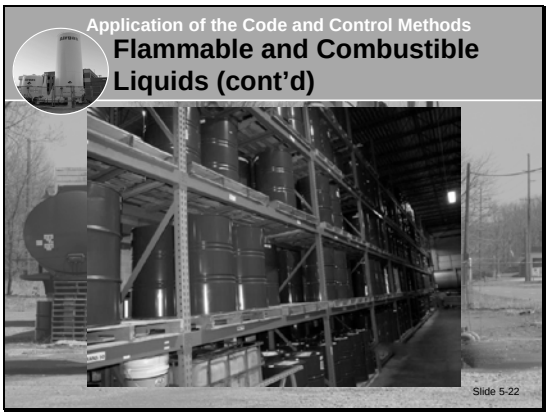
Slide 5-20



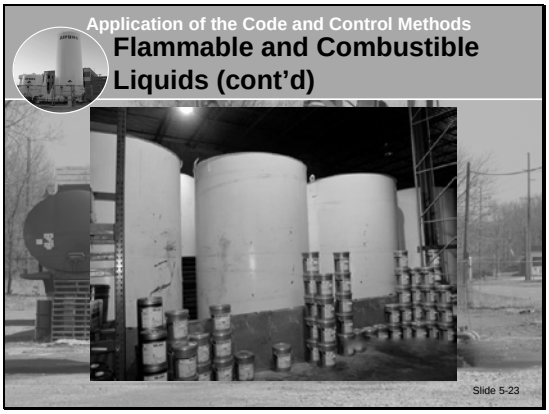
Slide 5-21



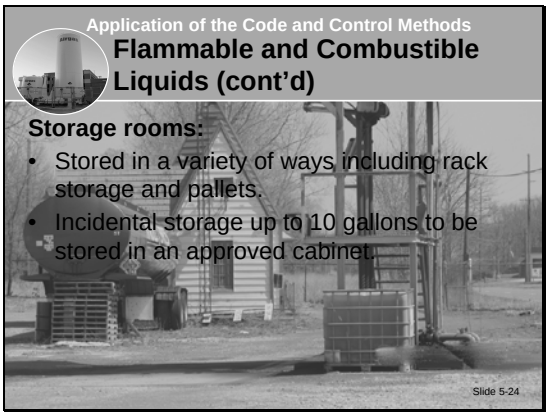
Slide 5-22



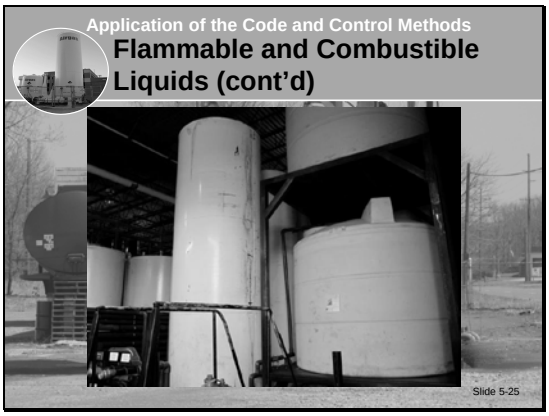
Slide 5-23



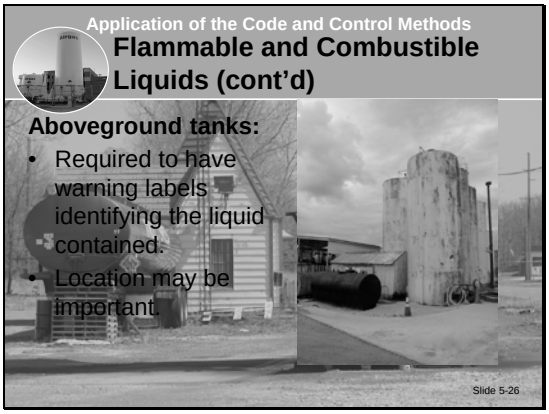
Slide 5-24



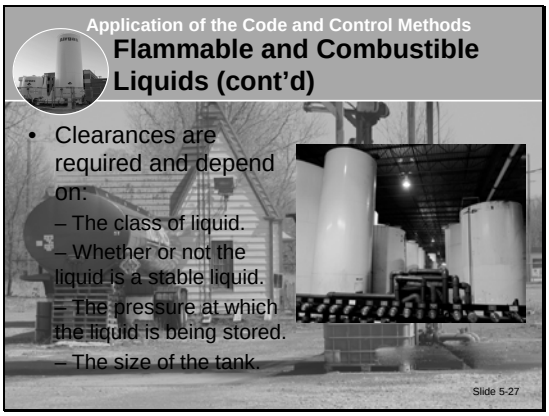
Slide 5-25



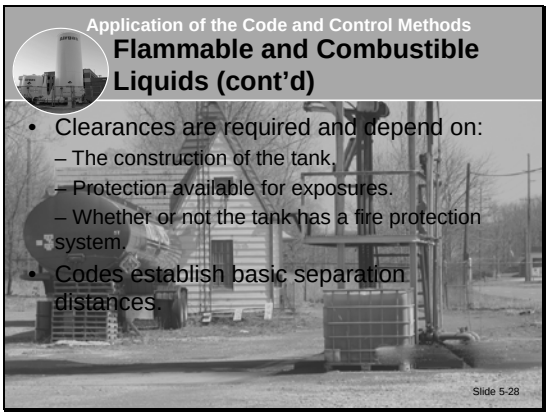
Slide 5-26



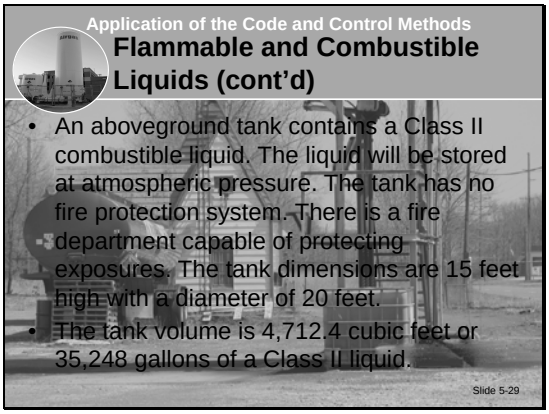
Slide 5-27



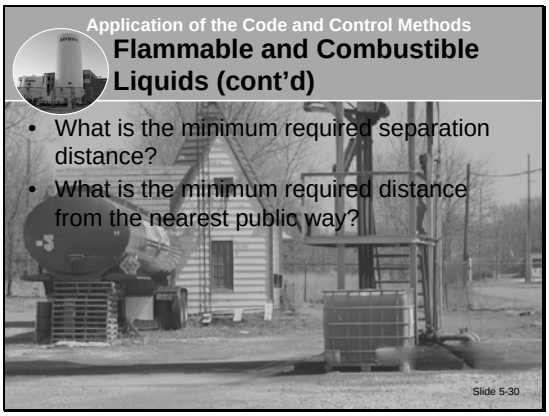
Slide 5-28



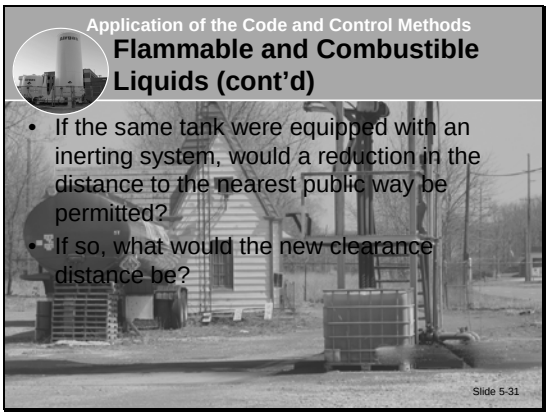
Slide 5-29



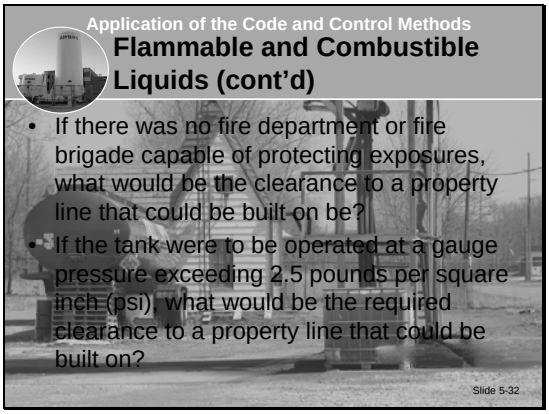
Slide 5-30



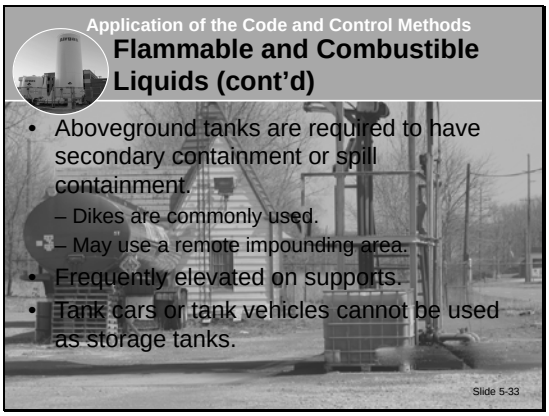
Slide 5-31



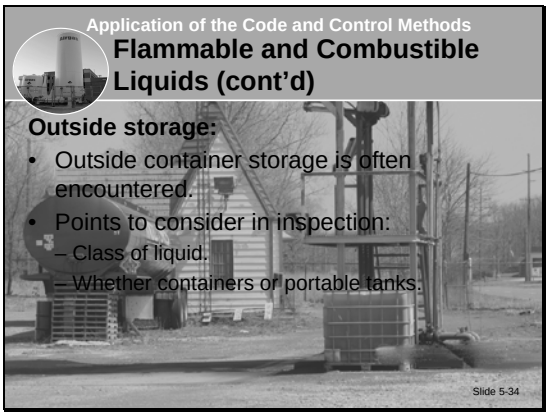
Slide 5-32



Slide 5-33

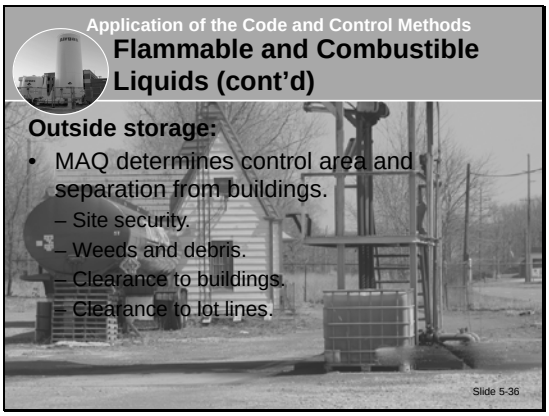


Slide 5-34

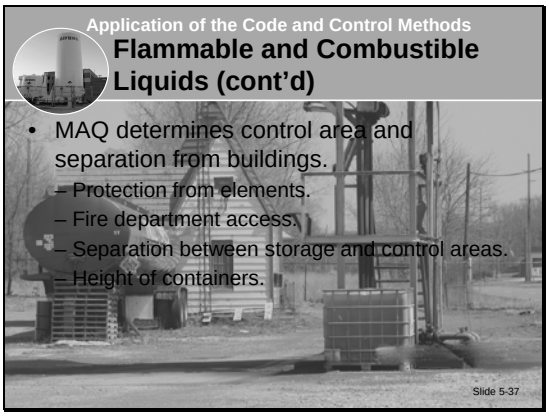


Slide 5-35

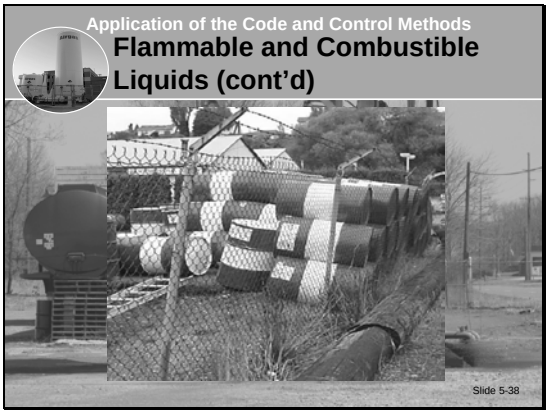
Slide 5-36



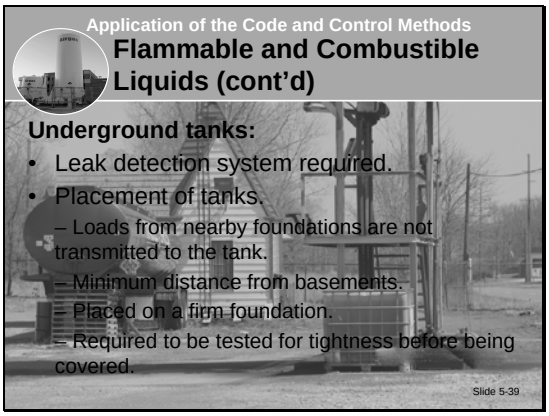
Slide 5-37



Slide 5-38

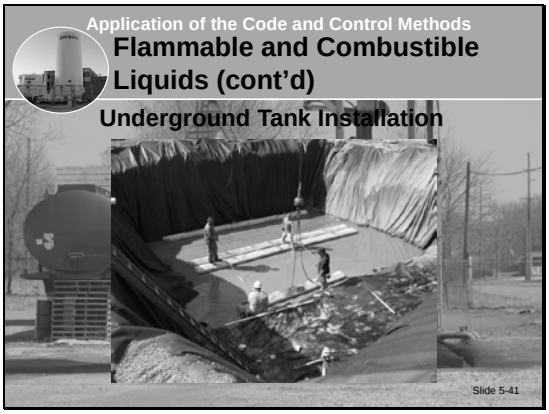


Slide 5-39

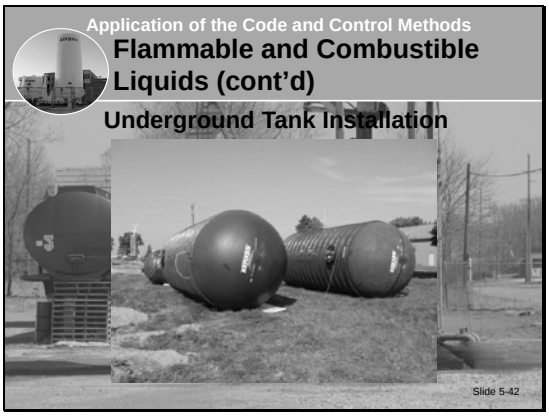


Slide 5-40

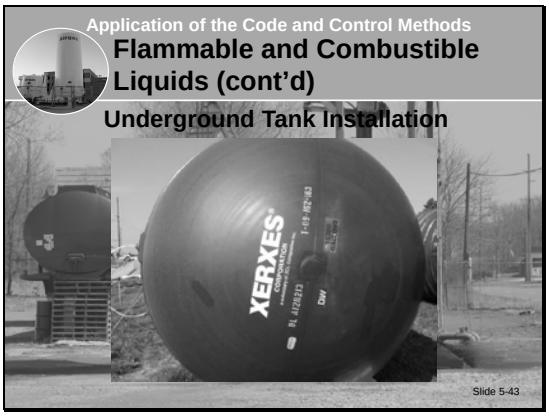
Slide 5-41



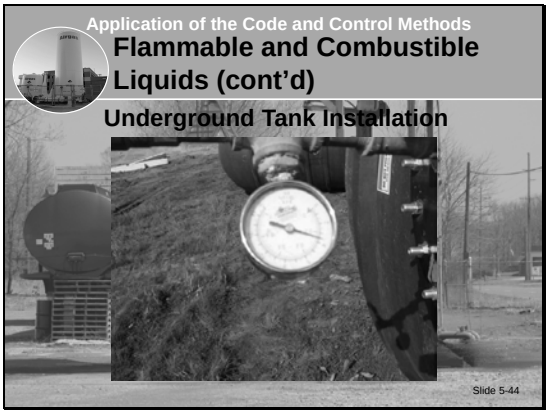
Slide 5-42



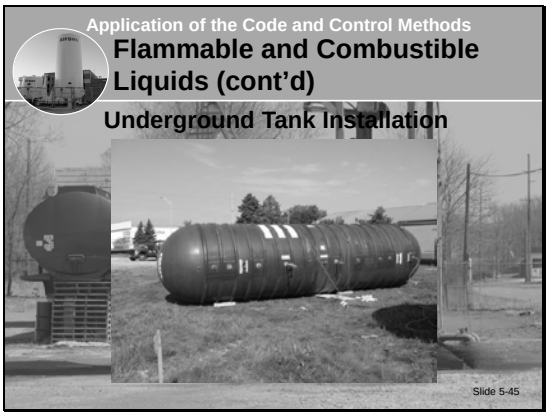
Slide 5-43



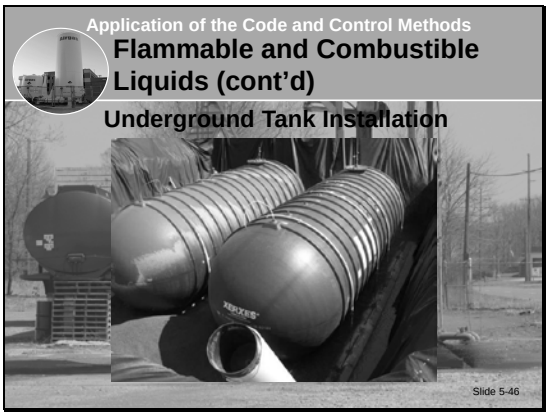
Slide 5-44



Slide 5-45

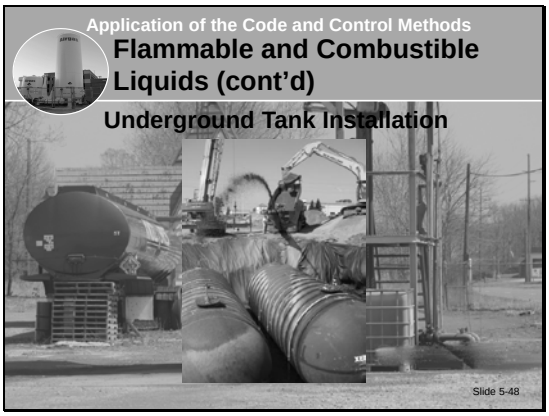


Slide 5-46

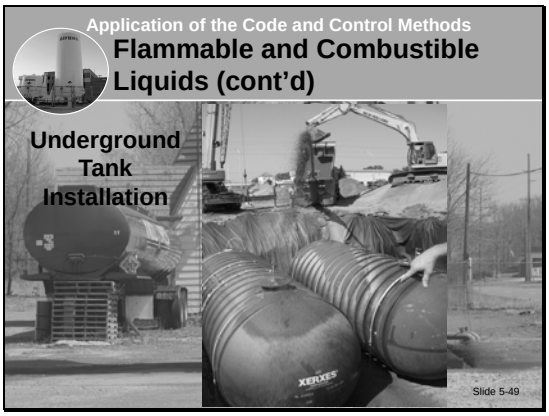


Slide 5-47

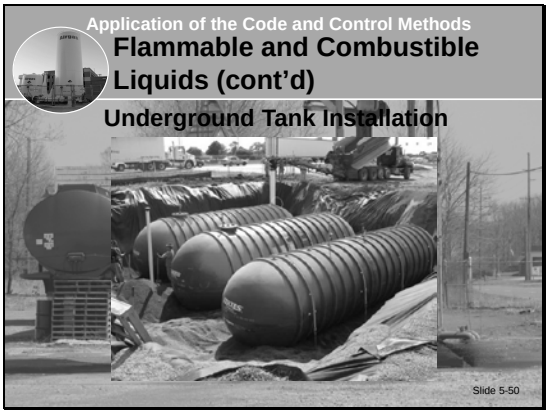
Slide 5-48



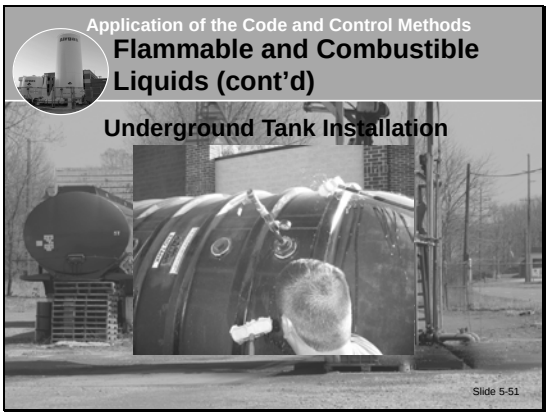
Slide 5-49



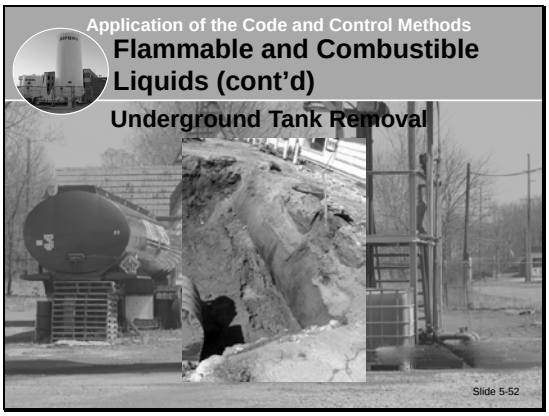
Slide 5-50



Slide 5-51

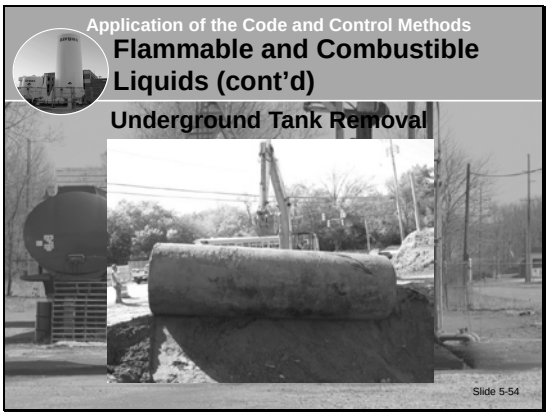


Slide 5-52

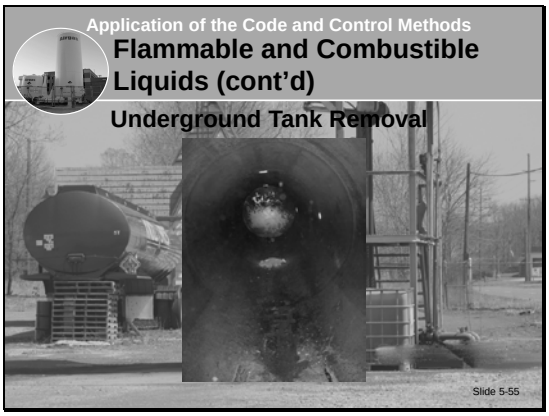


Slide 5-53

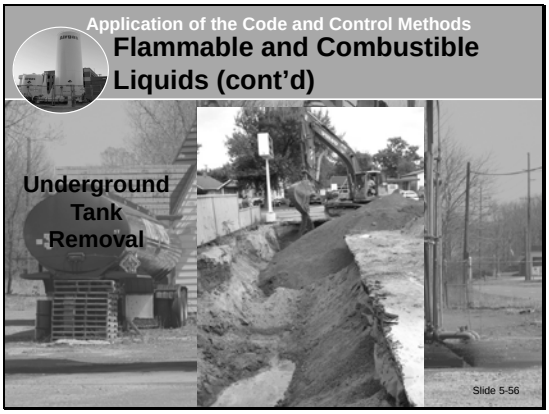
Slide 5-54



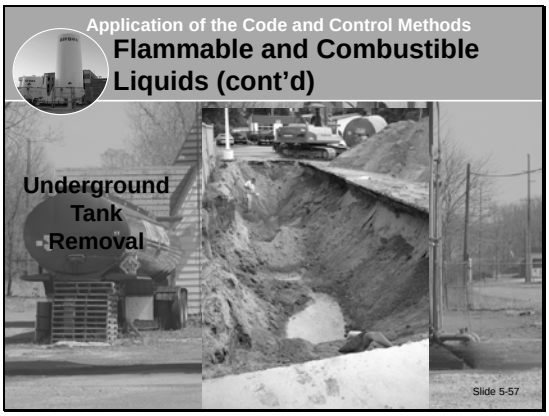
Slide 5-55



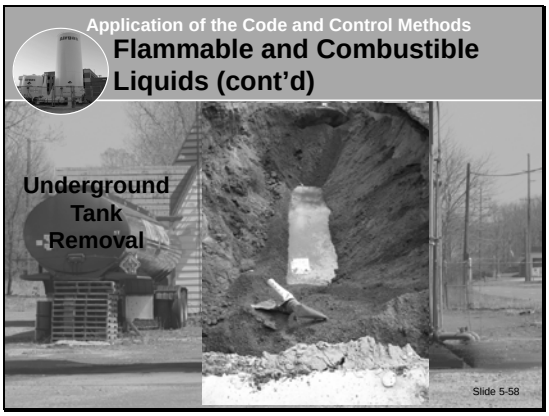
Slide 5-56



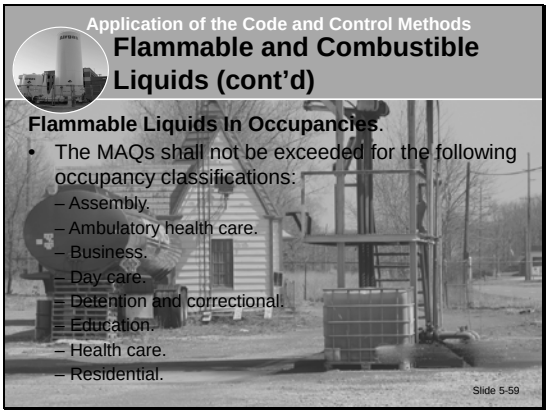
Slide 5-57



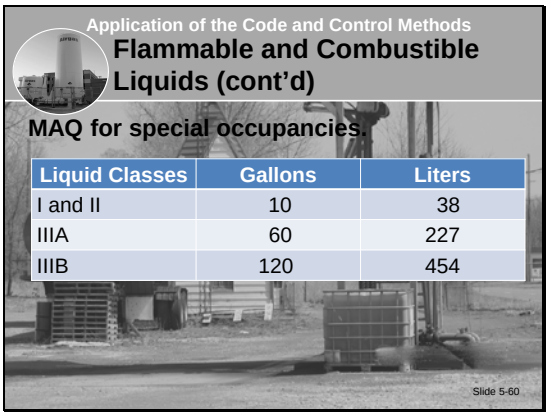
Slide 5-58



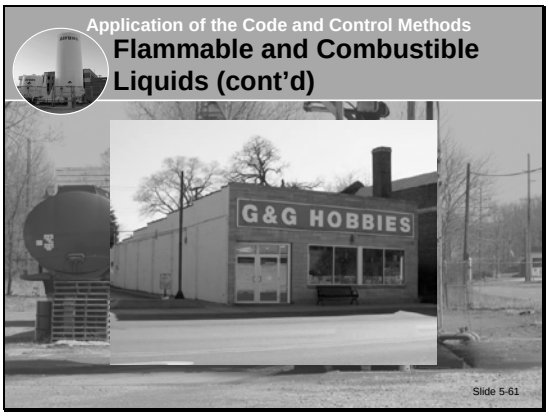
Slide 5-59



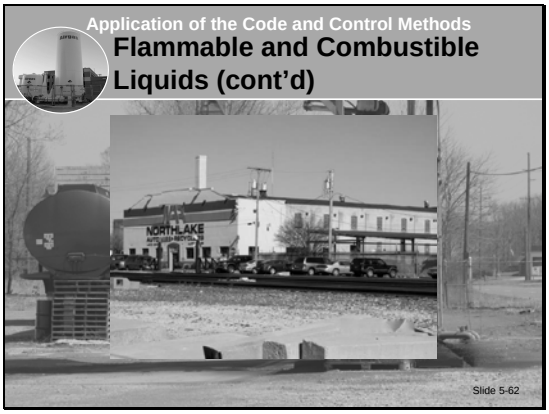
Slide 5-60



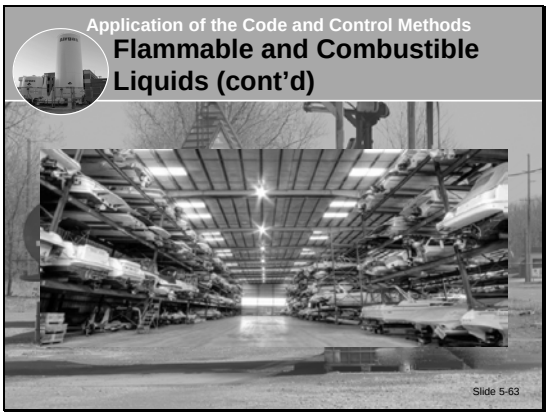
Slide 5-61



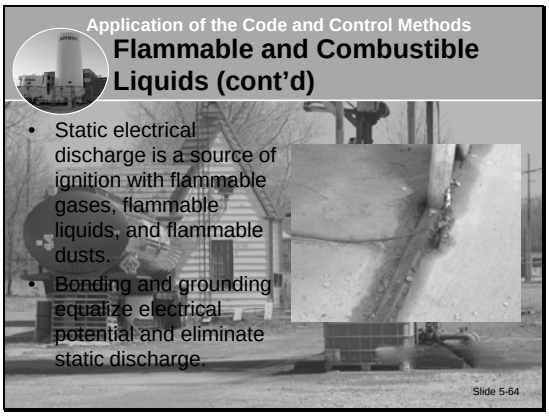
Slide 5-62



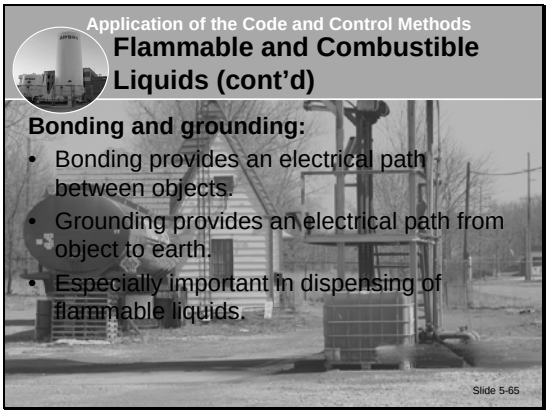
Slide 5-63



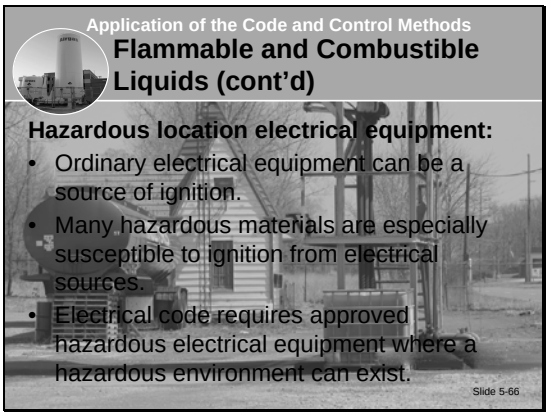
Slide 5-64



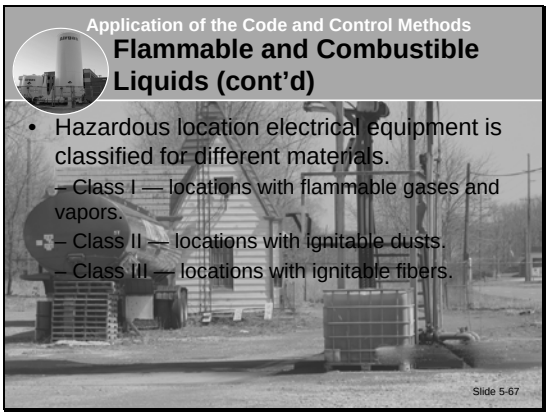
Slide 5-65



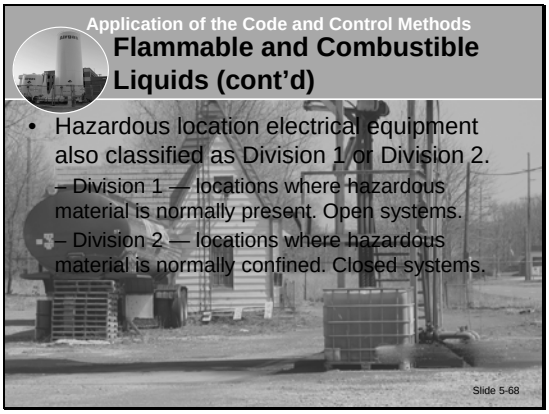
Slide 5-66



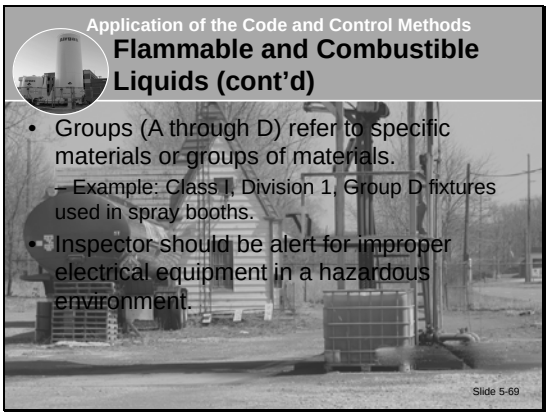
Slide 5-67



Slide 5-68

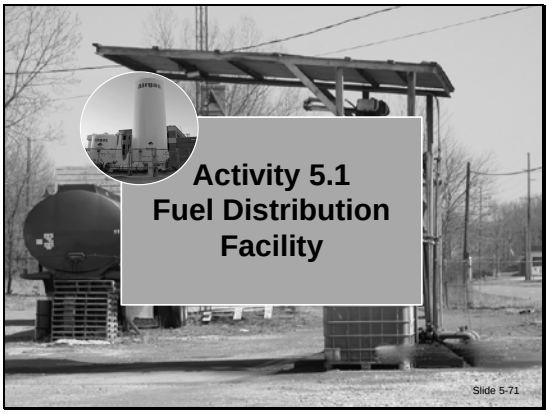


Slide 5-69



Slide 5-70

Slide 5-71



Slide 5-72

Slide 5-73

Slide 5-74

Slide 5-75

This page intentionally left blank.

Activity 5.1

Fuel Distribution Facility

Purpose

1. To identify methods to control hazards.

2. To identify codes, regulations and standards that provide the authority to implement controls.

Directions

1. Use the visuals to review the scenario as a large group.

2. As a table group, answer the questions regarding this scenario.

Scenario

You are inspecting a municipal distribution facility with on-road and off-road fuel (diesel, gas, etc.).

The Hazardous Materials Inventory Statement (HMIS) for this facility documents the following products on-site:

- Gasoline.
- Diesel fuel.
- Kerosene.
- No. 2 diesel.

This photograph shows the aboveground storage tanks (ASTs) Fuel Distribution Center, including outside ASTs. (Note the colors.)

There are four dispensers and four tanks.

- Largest tank is 5,000 gallons.
- Tank 2 is 2,000.
- Tank 3 is 3,000.
- Tank 4 is 2,000.
- The wall around the tanks is a containment pit.

Directions

Part 1

1. What is the classification of the material?
    - Gasoline. _____
    - Diesel fuel. _____

- Kerosene. _____
- No. 2 diesel. _____

2. For gasoline, identify how the inspector will determine associated hazards.

   a. Based on your knowledge of this product, what are some of the hazards?

   _____

   _____

   _____

   b. What are some other hazards posed by this/these hazard classes?

   _____

   _____

   _____

   c. Where would you go to find this information?

   _____

   _____

   _____

3. For diesel, identify how the inspector will determine associated hazards.

   a. Based on your knowledge of this product, what are some of the hazards?

   _____

   _____

   _____

b. What are some other hazards posed by this/these hazard classes?

_____

_____

_____

c. Where would you go to find this information?

_____

_____

_____

4. For kerosene, identify how the inspector will determine associated hazards.

a. Based on your knowledge of this product, what are some of the hazards?

_____

_____

_____

b. What are some other hazards posed by this/these hazard classes?

_____

_____

_____

c. Where would you go to find this information?

_____

_____

_____

5. For No. 2 diesel, identify how the inspector will determine associated hazards.

   a. Based on your knowledge of this product, what are some of the hazards?

   _____

   _____

   _____

   b. What are some other hazards posed by this/these hazard classes?

   _____

   _____

   _____

   c. Where would you go to find this information?

   _____

   _____

   _____

6. What is the required size of the containment pit for spill containment (based on sizes of tanks)?

   _____

   _____

   _____

7. Is fire protection required for this type of facility?

   a. Are there fire protection requirements for this type of facility?

   _____

   _____

   _____

b. Is there any other fire protection necessary for this facility based on what you see?

_____

_____

_____

8. Is bonding and grounding required?

_____

_____

_____

9. What type of ventilation is required for this facility?

_____

_____

_____

10. What documentation should be available to the inspector from the facility owner or representative?

_____

_____

_____

This photograph of the Fuel Distribution Center shows bulk dispensing of fuel; you can fill your own vehicle. (Note the suppression system under a canopy.)

Speed bump.

This photograph is a close-up of the ground rod.

Part 2

Answer the following questions again about the canopy area.

1. What is the required size for spill containment?

_____

_____

_____

2. Is fire protection required for this type of facility?

_____

_____

_____

3. Is bonding and grounding required?

_____

_____

_____

4. What type of ventilation is required for this facility?

_____

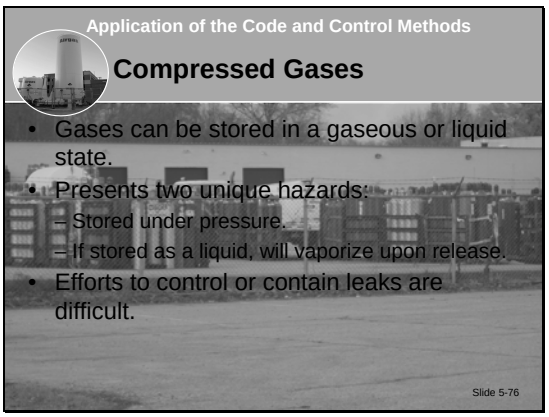
_____

_____

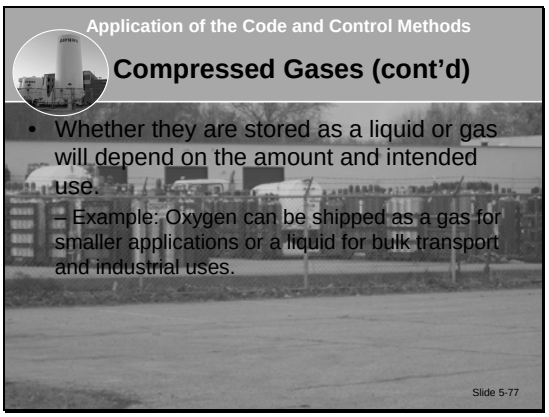
This page intentionally left blank.

NOTE-TAKING GUIDE (cont'd)

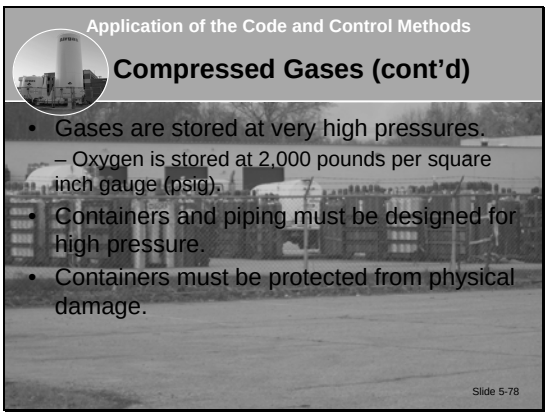
Slide 5-76



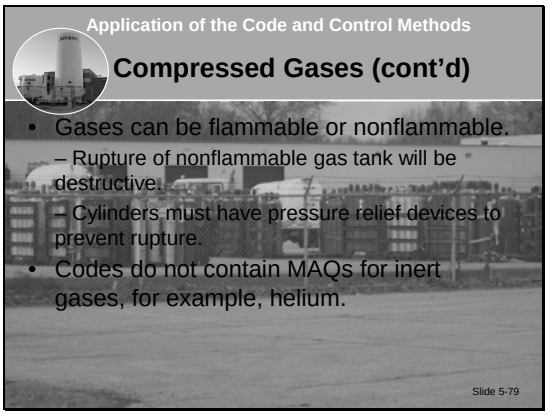
Slide 5-77



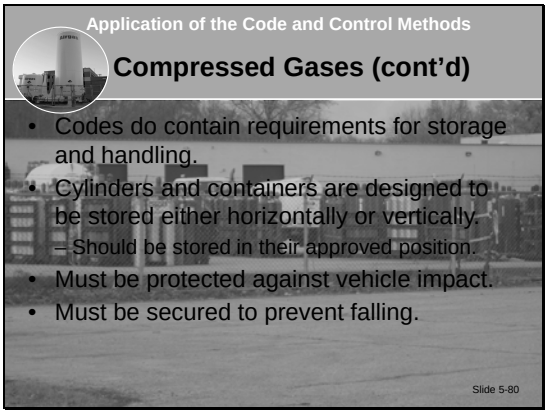
Slide 5-78



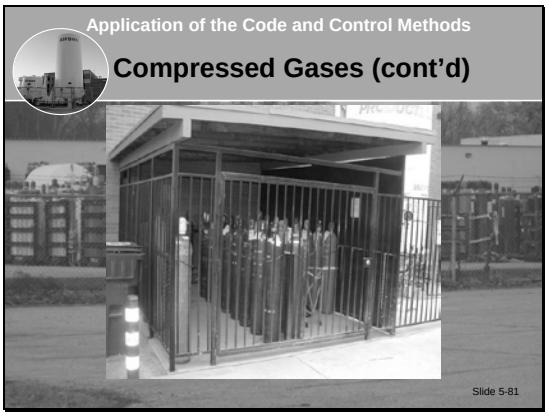
Slide 5-79



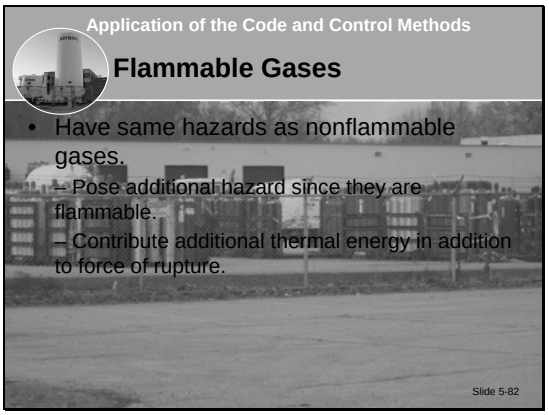
Slide 5-80



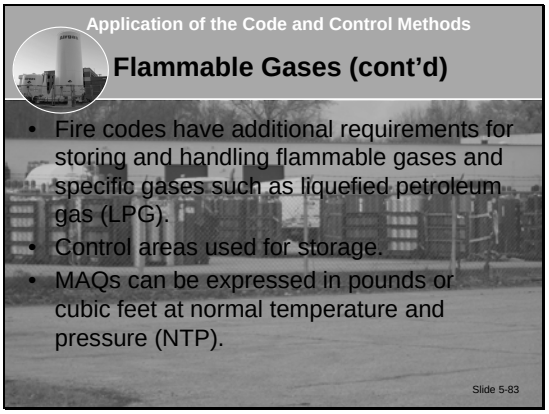
Slide 5-81



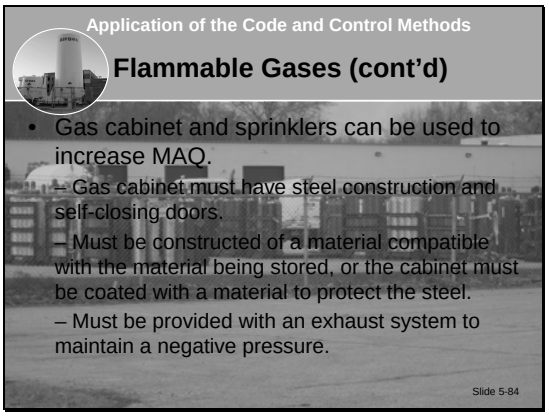
Slide 5-82



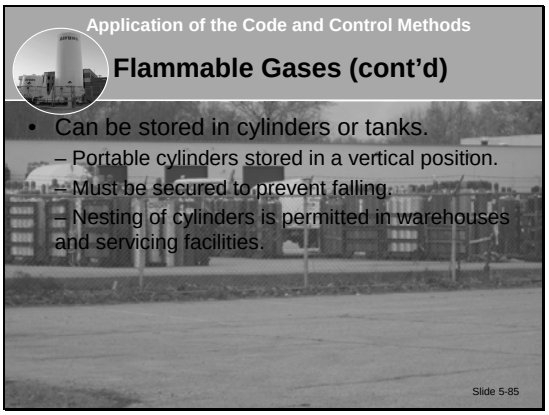
Slide 5-83



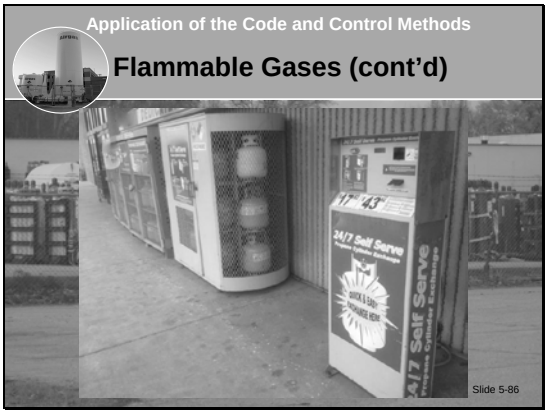
Slide 5-84



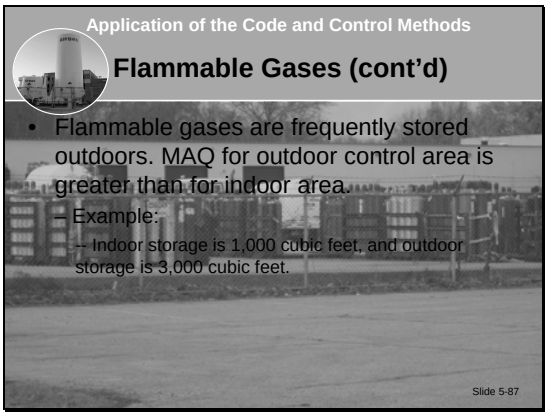
Slide 5-85



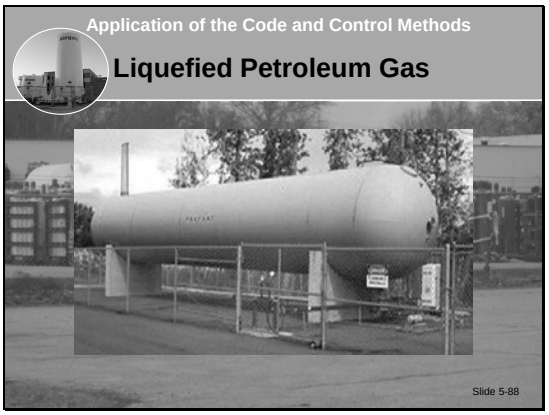
Slide 5-86



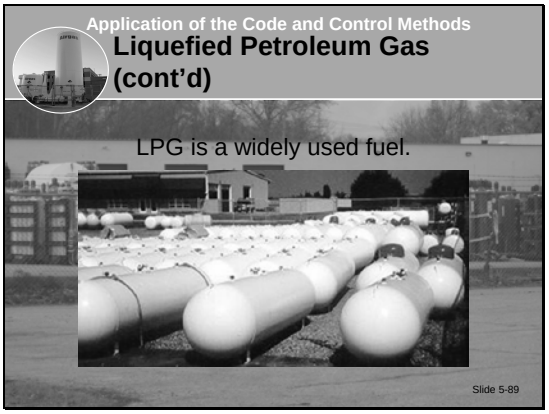
Slide 5-87



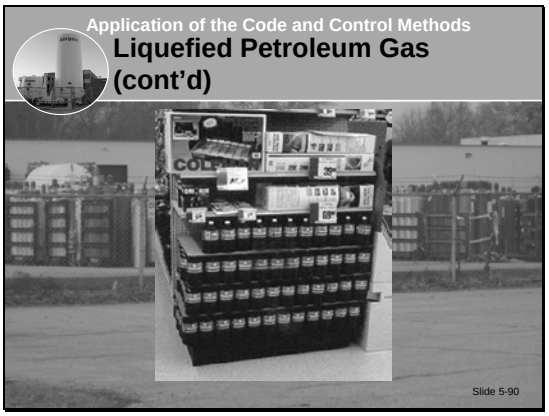
Slide 5-88



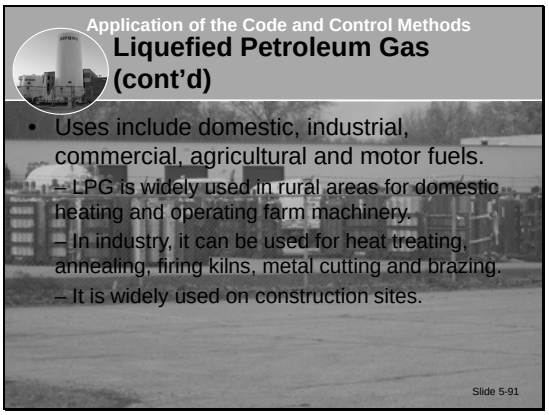
Slide 5-89



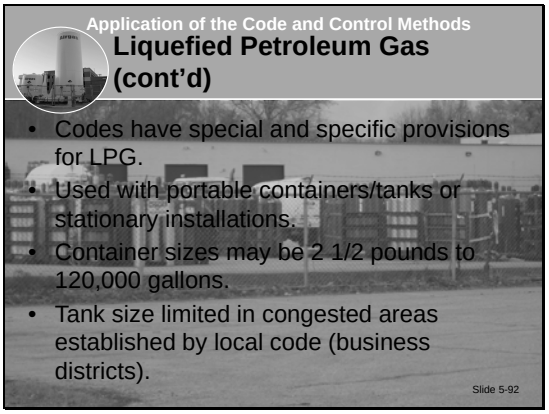
Slide 5-90



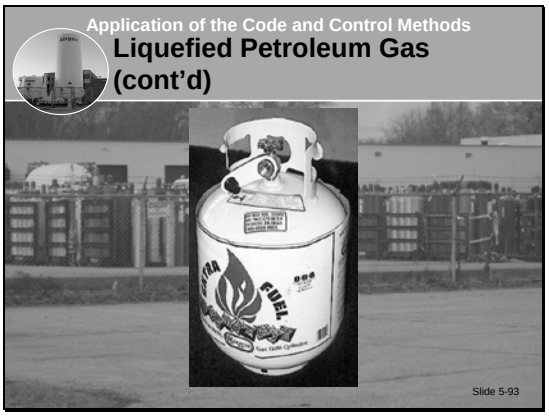
Slide 5-91



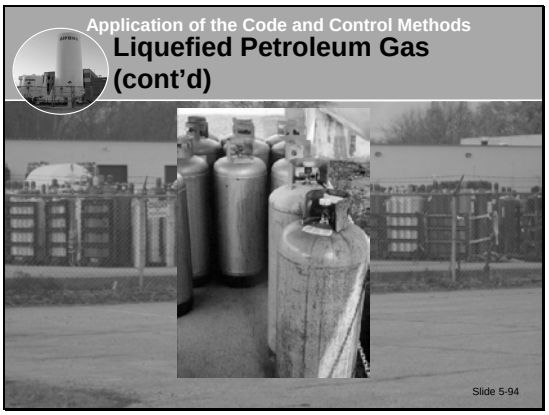
Slide 5-92



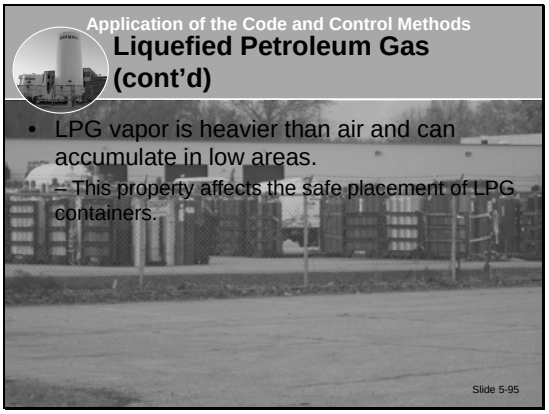
Slide 5-93



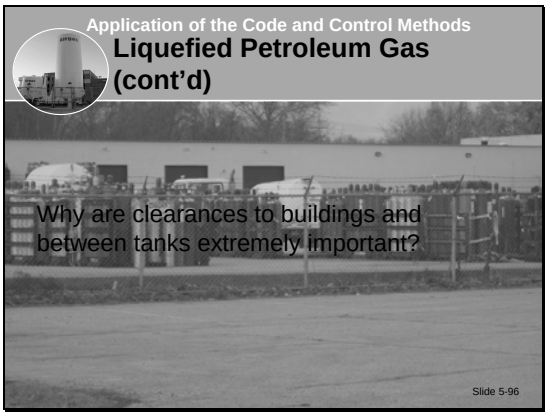
Slide 5-94



Slide 5-95



Slide 5-96



Slide 5-97

Application of the Code and Control Methods

Liquefied Petroleum Gas (cont'd)

Examples of aboveground tank clearances:

Size (Gallons)	Clearance to Building	Separation Between Containers
125-250	10 feet	0 feet
251-500	10 feet	3 feet
501-2,000	25 feet	3 feet
2,001-30,000	50 feet	5 feet
30,001-70,000	75 feet	25 feet or the sum of the diameter of the container

Slide 5-97

Slide 5-98

Application of the Code and Control Methods

Liquefied Petroleum Gas (cont'd)

- Containers are **generally** required to be outside, but there are exceptions:
  - Industrial occupancies.
  - Limited amounts in educational and institutional occupancies.
  - In restaurants for food preparation.
  - In buildings not accessible to the public.

Slide 5-98

Slide 5-99

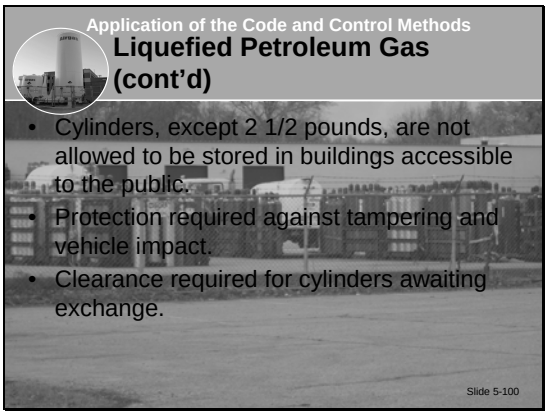
Application of the Code and Control Methods

Liquefied Petroleum Gas (cont'd)

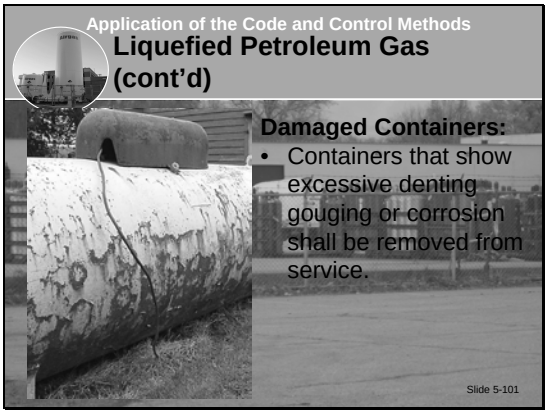
- Industrial forklift trucks.
  - Generally to be fueled outdoors.
  - Cylinder size limited to 45 pounds.
  - Restricted in buildings frequented by the public.
- Cylinder refueling to be conducted by trained personnel who shall remain in attendance.
- Containers not to be stored in basements.

Slide 5-99

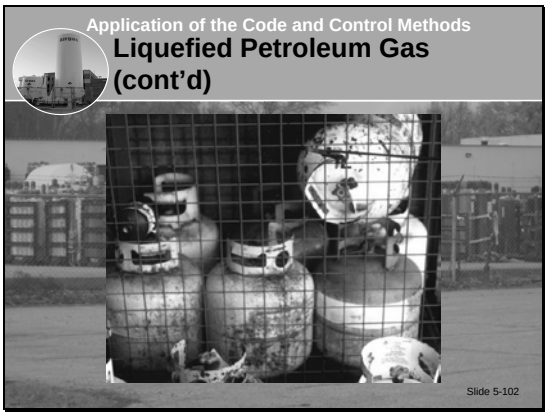
Slide 5-100



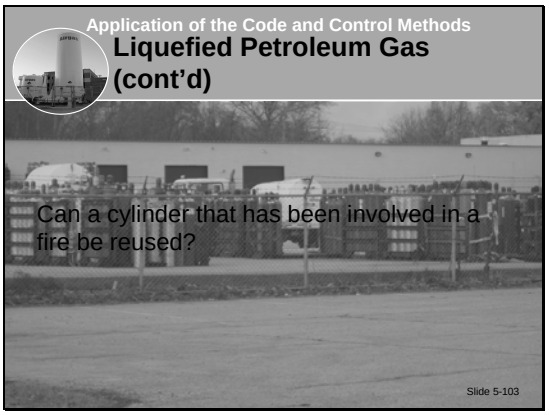
Slide 5-101



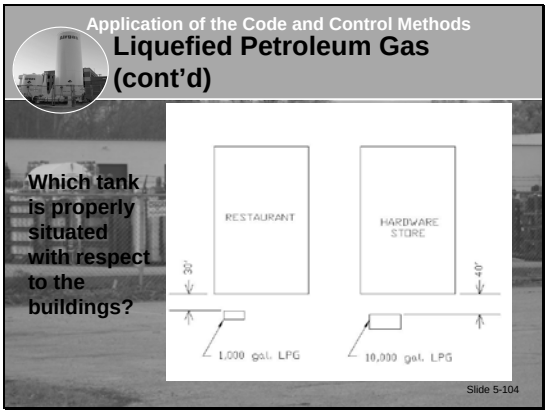
Slide 5-102



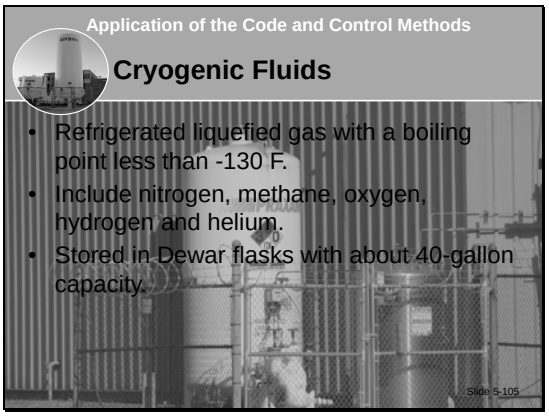
Slide 5-103



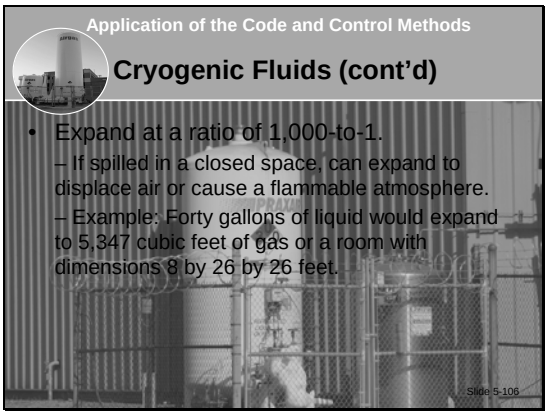
Slide 5-104



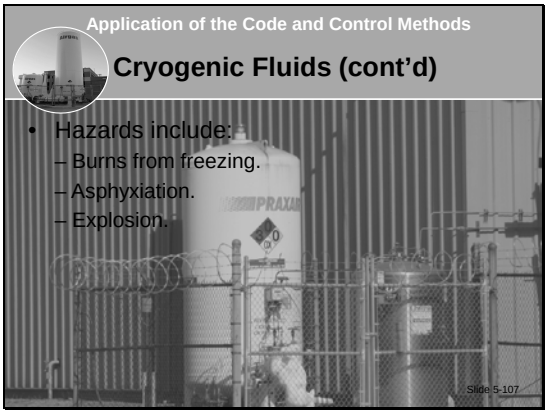
Slide 5-105



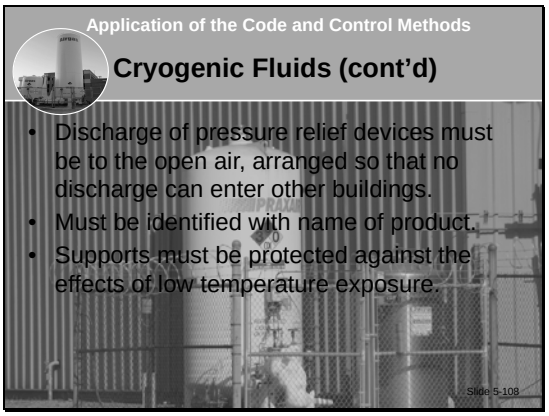
Slide 5-106



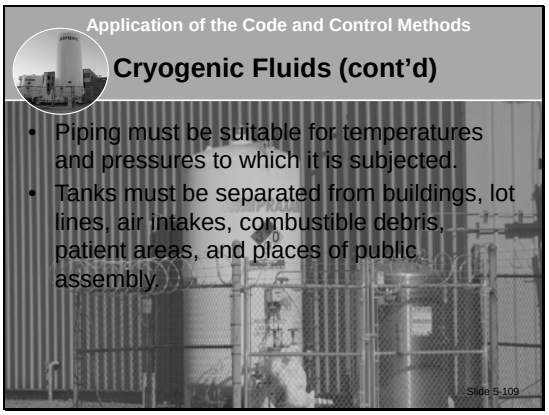
Slide 5-107



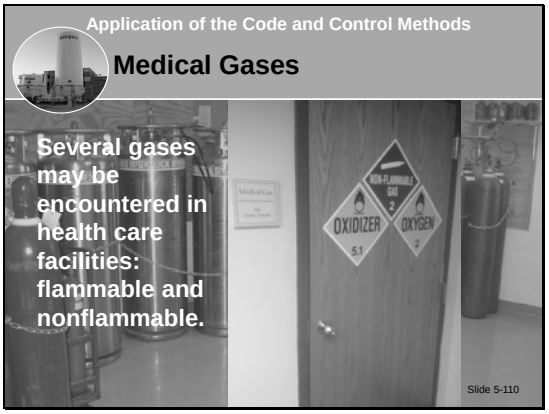
Slide 5-108



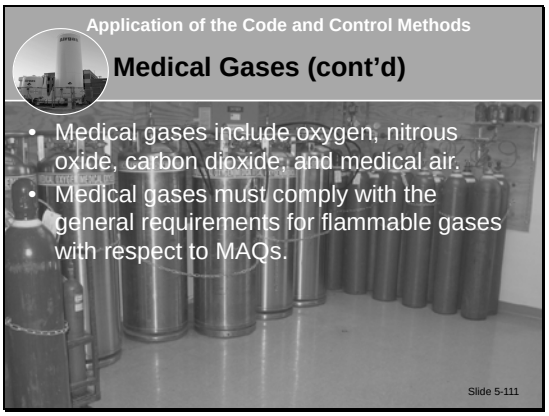
Slide 5-109



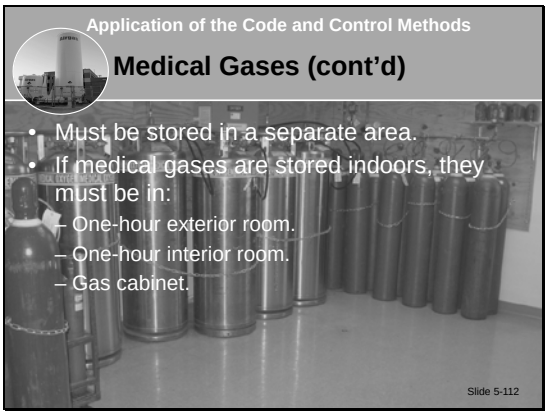
Slide 5-110



Slide 5-111

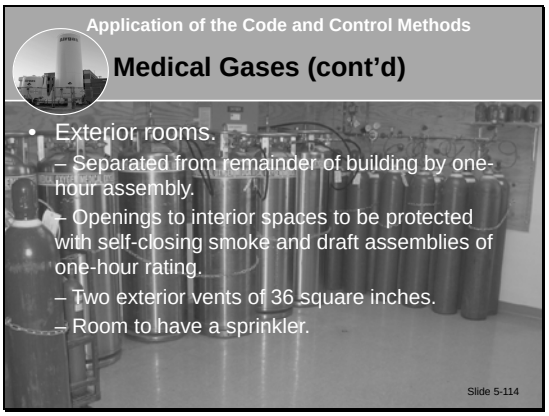


Slide 5-112

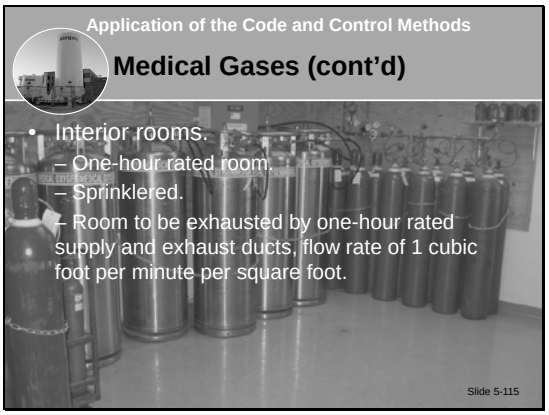


Slide 5-113

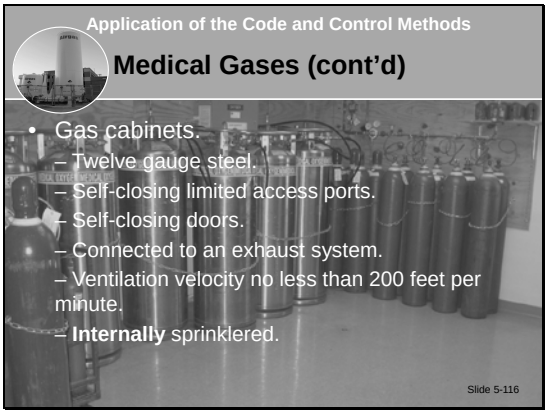
Slide 5-114



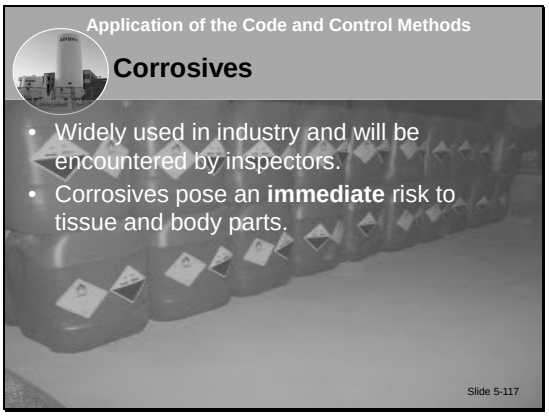
Slide 5-115



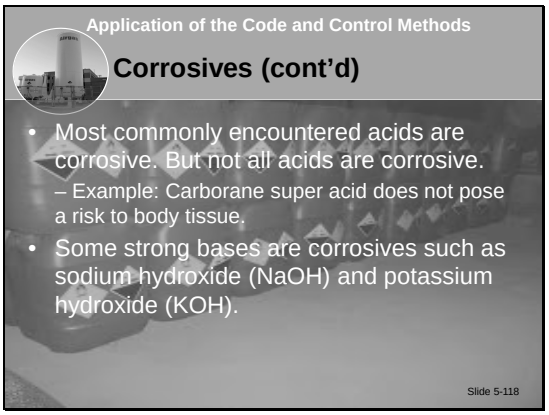
Slide 5-116



Slide 5-117

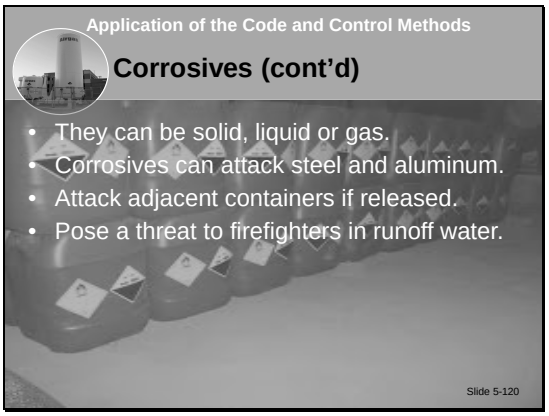


Slide 5-118

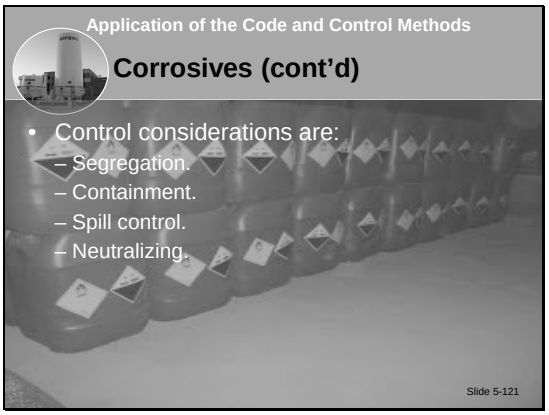


Slide 5-119

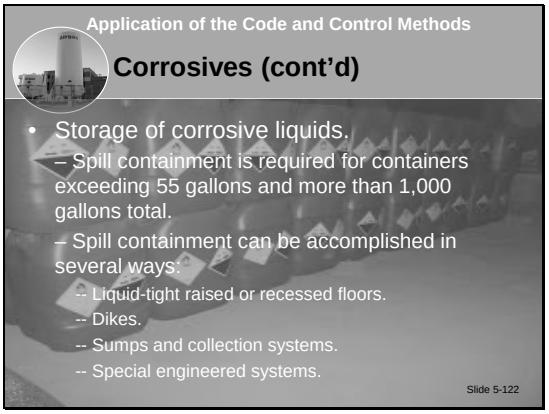
Slide 5-120



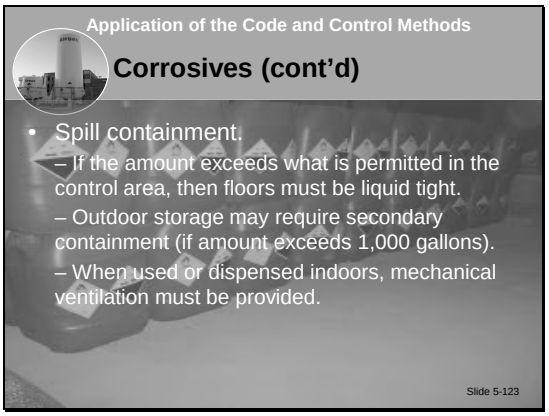
Slide 5-121



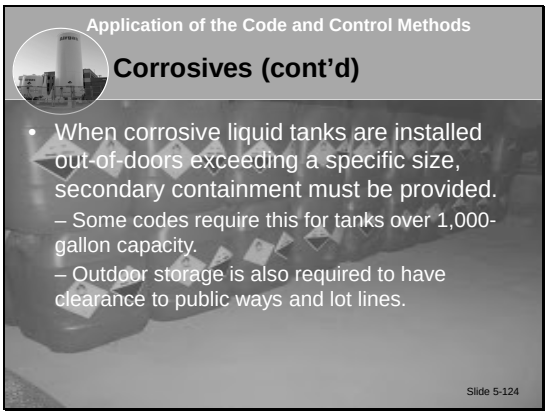
Slide 5-122



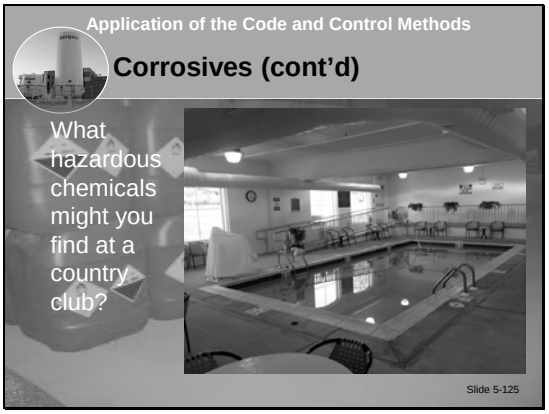
Slide 5-123



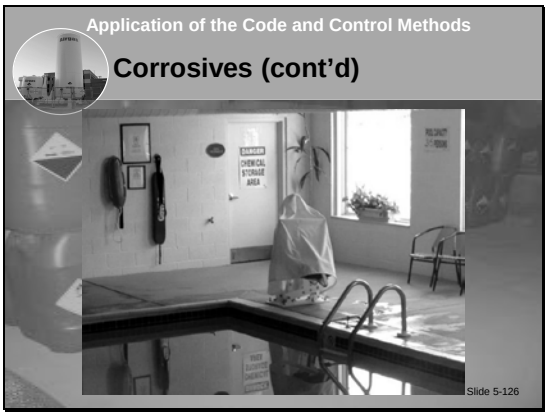
Slide 5-124



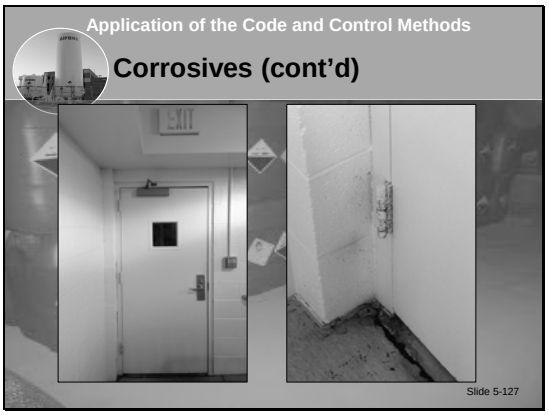
Slide 5-125



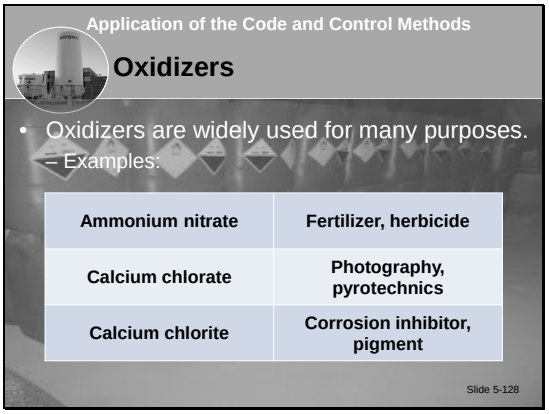
Slide 5-126



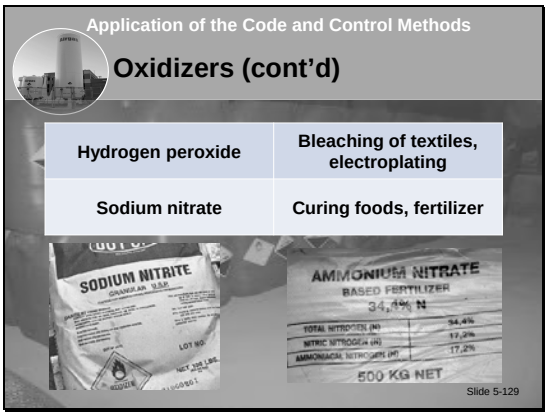
Slide 5-127



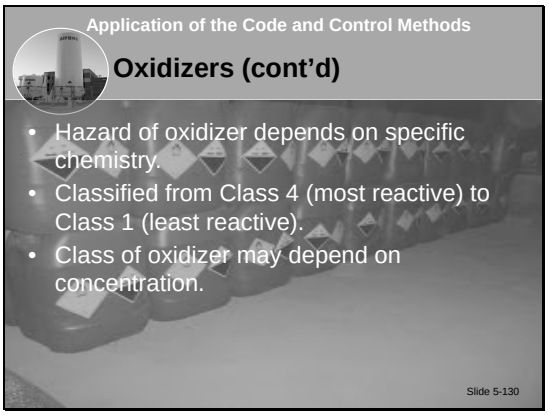
Slide 5-128



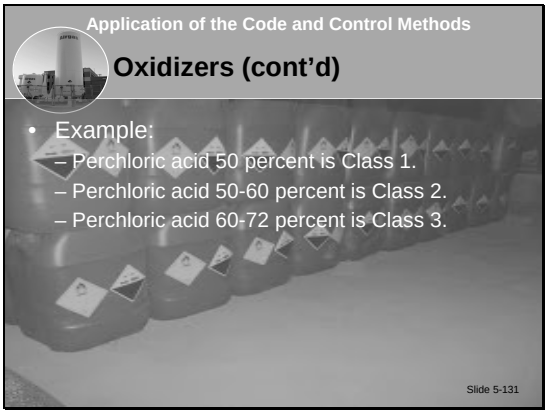
Slide 5-129



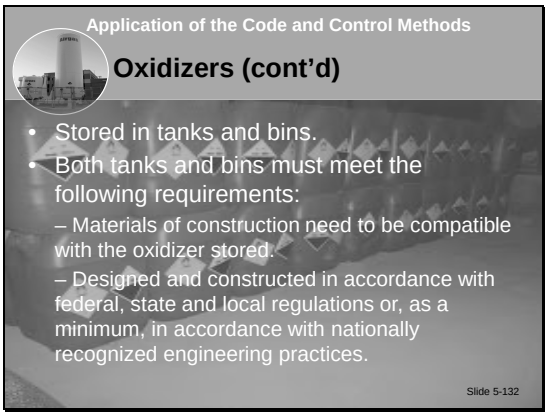
Slide 5-130



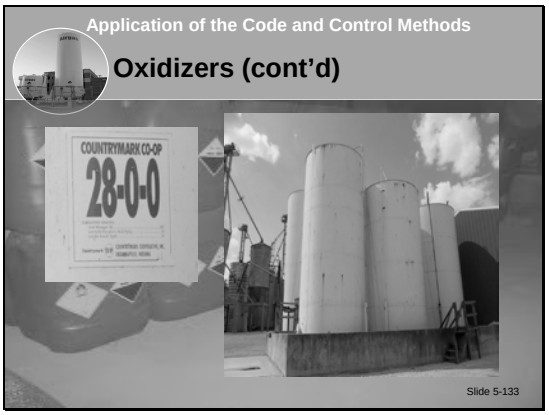
Slide 5-131



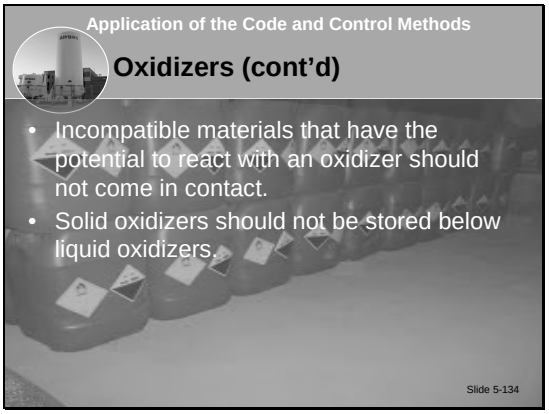
Slide 5-132



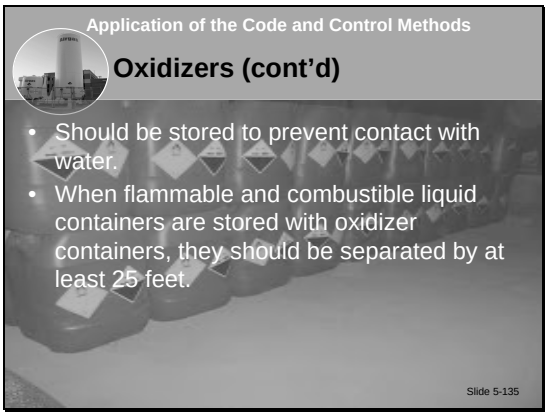
Slide 5-133



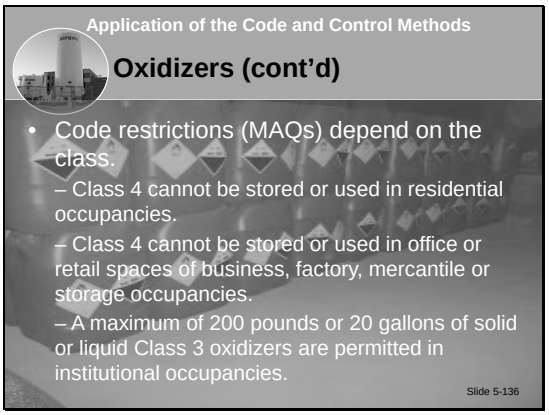
Slide 5-134



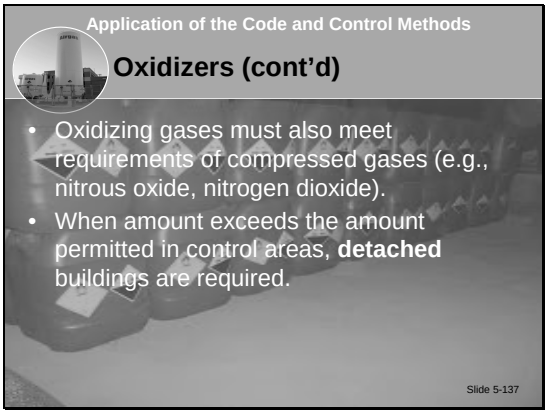
Slide 5-135



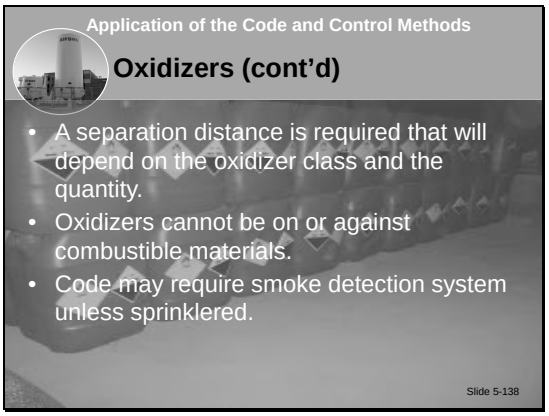
Slide 5-136



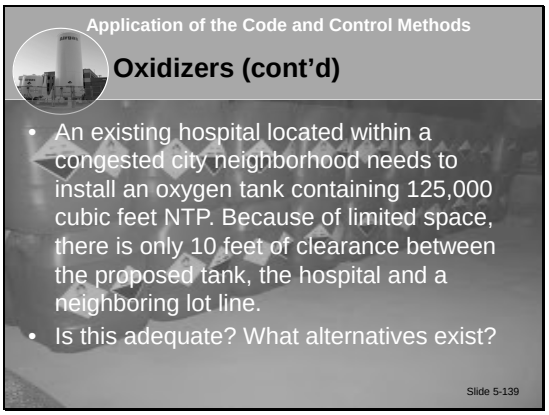
Slide 5-137



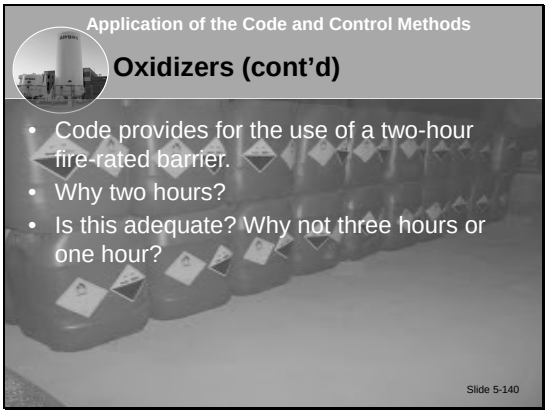
Slide 5-138



Slide 5-139



Slide 5-140



Slide 5-141

Activity 5.2

Cosmetics Manufacturer

Purpose

1. To identify methods to control hazards.

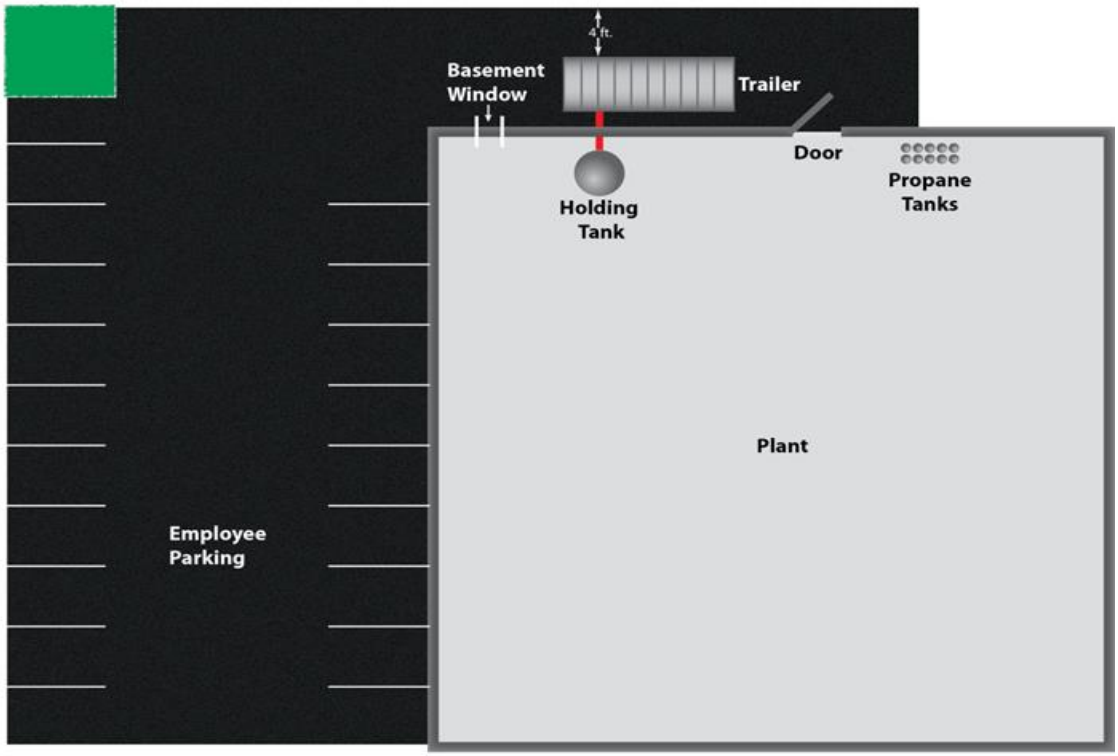
2. To identify codes, regulations and standards that provide the authority to implement controls.

Directions

Working in groups and using the provided fire code, analyze the scenario and answer the following questions.

Scenario

A cosmetics manufacturer has placed a semitrailer tank body with a capacity of 3,000 gallons in an employee parking lot to use as an AST to hold and dispense methyl alcohol, a Class IB flammable liquid. The tank is approximately 3 feet from the building and 4 feet from the property line. The tank is supported approximately 4 feet off the ground by wooden railroad ties. The parking lot is sloped to allow rain and runoff to enter a storm drain near the edge of the property. A 1-inch pipe connected to the tank enters the building through a hole in a masonry wall and fills a blending tank in an inside storage room. The flow of liquid is by gravity and is controlled manually with a valve on the inside of the building. An exit door is located approximately 3 feet from the tank, and a basement window is located approximately 10 feet from the tank. Ten 50-pound propane cylinders are located against an interior wall near the exit door and are used to power an industrial fork truck.



1. What is the minimum distance to property line required for this facility?

2. Does the installation meet minimum code requirements for distance to property lines?

3. Is the elevated support system adequate for this tank?

4. Are spill control/containment measures required?

5. Is vehicle protection required for this installation?

6. Is the piping into the building adequate?

7. Is the storage of propane tanks satisfactory?

8. What other code concerns should be addressed?

Copyright 2012 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via the National Fire Codes Subscription Service on September 12, 2012 to DEPT OF HOMELAND SECURITY for designated user RG. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS subscription expires on 09/30/2012.

(2) A fixed metal roof with ventilation at the top and roof eaves constructed in accordance with API Standard 650 and containing a closed-top pontoon or double-deck metal floating roof meeting the requirements of API Standard 650

(3) A fixed metal roof with ventilation at the top and roof eaves constructed in accordance with API Standard 650 and containing a metal floating cover supported by liquidtight metal floating devices that provide buoyancy to prevent the liquid surface from being exposed when half of the flotation is lost

22.2.2.1 For the purposes of this chapter, an aboveground storage tank with an internal metal floating pan, roof, or cover that does not meet 22.2.2 or one that uses plastic foam (except for seals) for flotation, even if encapsulated in metal or fiberglass, shall meet the requirements for a fixed roof tank.

22.2.3 Protected Aboveground Tank. An atmospheric aboveground storage tank with integral secondary containment and thermal insulation that has been evaluated for resistance to physical damage and for limiting the heat transferred to the primary tank when exposed to a hydrocarbon pool fire and is listed in accordance with ANSI/UL 2085, *Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids*, or an equivalent test procedure.

22.3 General Requirements. Storage of Class II and Class III liquids heated at or above their flash point shall follow the requirements for Class I liquids, unless an engineering evaluation conducted in accordance with Chapter 6 justifies following the requirements for some other liquid class.

22.4* Location of Aboveground Storage Tanks.

22.4.1 Location with Respect to Property Lines, Public Ways, and Important Buildings.

22.4.1.1 Tanks storing Class I, Class II, or Class IIIA stable liquids whose internal pressure is not permitted to exceed a gauge pressure of 2.5 psi (17 kPa) shall be located in accordance with Table 22.4.1.1(a) and Table 22.4.1.1(b). Where tank spacing is based on a weak roof-to-shell seam design, the user shall present evidence certifying such construction to the authority having jurisdiction upon request.

Table 22.4.1.1(a) Location of Aboveground Storage Tanks Storing Stable Liquids — Internal Pressure Not to Exceed a Gauge Pressure of 2.5 psi (17 kPa)

		Minimum Distance (ft)	
Type of Tank	**Protection**	**From Property Line That Is or Can Be Built Upon, Including the Opposite Side of a Public Way[a]**	**From Nearest Side of Any Public Way or from Nearest Important Building on the Same Property[a]**
Floating roof	Protection for exposures[b]	½ × diameter of tank	⅙ × diameter of tank
	None	Diameter of tank but need not exceed 175 ft	⅙ × diameter of tank
Vertical with weak roof-to-shell seam	Approved foam or inerting system[c] on tanks not exceeding 150 ft in diameter[d]	½ × diameter of tank	⅙ × diameter of tank
	Protection for exposures[b]	Diameter of tank	⅓ × diameter of tank
	None	2 × diameter of tank but need not exceed 350 ft	⅓ × diameter of tank
Horizontal and vertical tanks with emergency relief venting to limit pressures to 2.5 psi (gauge pressure of 17 kPa)	Approved inerting system[b] on the tank or approved foam system on vertical tanks	½ × value in Table 22.4.1.1(b)	½ × value in Table 22.4.1.1(b)
	Protection for exposures[b]	Value in Table 22.4.1.1(b)	Value in Table 22.4.1.1(b)
	None	2 × value in Table 22.4.1.1(b)	Value in Table 22.4.1.1(b)
Protected aboveground tank	None	½ × value in Table 22.4.1.1(b)	½ × value in Table 22.4.1.1(b)

For SI units, 1 ft = 0.3 m.

[a]The minimum distance cannot be less than 5 ft (1.5 m).

[b]See definition 3.3.46, Protection for Exposures.

[c]See NFPA 69, *Standard on Explosion Prevention Systems.*

[d]For tanks over 150 ft (45 m) in diameter, use "Protection for Exposures" or "None," as applicable.

Copyright 2012 National Fire Protection Association (NFPA). Licensed, by agreement, for individual use and single download via the National Fire Codes Subscription Service on September 12, 2012 to DEPT OF HOMELAND SECURITY for designated user RG. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquires or to report unauthorized use, contact licensing@nfpa.org. This NFCSS subscription expires on 09/30/2012.

Table 22.4.1.1(b) Reference Table for Use with Tables 22.4.1.1(a), 22.4.1.3, and 22.4.1.5

	Minimum Distance (ft)	
Tank Capacity (gal)	**From Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way**	**From Nearest Side of Any Public Way or from Nearest Important Building on the Same Property**
275 or less	5	5
276 to 750	10	5
751 to 12,000	15	5
12,001 to 30,000	20	5
30,001 to 50,000	30	10
50,001 to 100,000	50	15
100,001 to 500,000	80	25
500,001 to 1,000,000	100	35
1,000,001 to 2,000,000	135	45
2,000,001 to 3,000,000	165	55
3,000,001 or more	175	60

For SI units, 1 ft = 0.3 m; 1 gal = 3.8 L.

22.4.1.2 Vertical tanks with weak roof-to-shell seams *(see 22.7.2)* that store Class IIIA liquids shall be permitted to be located at one-half the distances specified in Table 22.4.1.1(a), provided the tanks are not within the same diked area as, or within the drainage path of, a tank storing a Class I or Class II liquid.

22.4.1.3 Tanks storing Class I, Class II, or Class IIIA stable liquids and operating at pressures that exceed a gauge pressure of 2.5 psi (17 kPa), or are equipped with emergency venting that will permit pressures to exceed a gauge pressure of 2.5 psi (17 kPa), shall be located in accordance with Table 22.4.1.3 and Table 22.4.1.1(b).

22.4.1.4 Tanks storing liquids with boil-over characteristics shall be located in accordance with Table 22.4.1.4. Liquids with boil-over characteristics shall not be stored in fixed roof tanks larger than 150 ft (45 m) in diameter, unless an approved inerting system is provided on the tank.

22.4.1.5 Tanks storing unstable liquids shall be located in accordance with Table 22.4.1.5 and Table 22.4.1.1(b).

22.4.1.6 Tanks storing Class IIIB stable liquids shall be located in accordance with Table 22.4.1.6.

Exception: If located within the same diked area as, or within the drainage path of, a tank storing a Class I or Class II liquid, the tank storing Class IIIB liquid shall be located in accordance with 22.4.1.1.

22.4.1.7 Where two tank properties of diverse ownership have a common boundary, the authority having jurisdiction shall be permitted, with the written consent of the owners of the two properties, to substitute the distances provided in 22.4.2 for the minimum distances set forth in 22.4.1.1.

22.4.1.8 Where end failure of a horizontal pressure tank or vessel can expose property, the tank or vessel shall be placed with its longitudinal axis parallel to the nearest important exposure.

Table 22.4.1.3 Location of Aboveground Storage Tanks Storing Stable Liquids — Internal Pressure Permitted to Exceed a Gauge Pressure of 2.5 psi (17 kPa)

		Minimum Distance (ft)	
Type of Tank	**Protection**	**From Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way**	**From Nearest Side of Any Public Way or from Nearest Important Building on the Same Property**
Any type	Protection for exposures*	1½ × value in Table 22.4.1.1(b) but not less than 25 ft	1½ × value in Table 22.4.1.1(b) but not less than 25 ft
	None	3 × value in Table 22.4.1.1(b) but not be less than 50 ft	1½ × value in Table 22.4.1.1(b) but not less than 25 ft

For SI units, 1 ft = 0.3 m.
*See definition 3.3.46, Protection for Exposures.

Copyright by National Fire Protection Association (NFPA). NFPA 30 is licensed, by agreement for individual use. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquiries or to report unauthorized use, contact licensing@nfpa.org.

Table 22.4.1.1(a) Location of Aboveground Storage Tanks Storing Stable Liquids — Internal Pressure Not to Exceed a Gauge Pressure of 2.5 psi (17 kPa)

		Minimum Distance (ft)	
Type of Tank	Protection	From Property Line That Is or Can Be Built Upon, Including the Opposite Side of a Public Way[a]	From Nearest Side of Any Public Way or from Nearest Important Building on the Same Property[a]
Floating roof	Protection for exposures[b]	½ × diameter of tank	⅙ × diameter of tank
	None	Diameter of tank but need not exceed 175 ft	⅙ × diameter of tank
Vertical with weak roof-to-shell seam	Approved foam or inerting system[c] on tanks not exceeding 150 ft in diameter[d]	½ × diameter of tank	⅙ × diameter of tank
	Protection for exposures[b]	Diameter of tank	⅓ × diameter of tank
	None	2 × diameter of tank but need not exceed 350 ft	⅓ × diameter of tank
Horizontal and vertical tanks with emergency relief venting to limit pressures to 2.5 psi (gauge pressure of 17 kPa)	Approved inerting system[b] on the tank or approved foam system on vertical tanks	½ × value in Table 22.4.1.1(b)	½ × value in Table 22.4.1.1(b)
	Protection for exposures[b]	Value in Table 22.4.1.1(b)	Value in Table 22.4.1.1(b)
	None	2 × value in Table 22.4.1.1(b)	Value in Table 22.4.1.1(b)
Protected aboveground tank	None	½ × value in Table 22.4.1.1(b)	½ × value in Table 22.4.1.1(b)

For SI units, 1 ft = 0.3 m.
[a]The minimum distance cannot be less than 5 ft (1.5 m).
[b]See definition 3.3.46, Protection for Exposures.
[c]See NFPA 69, *Standard on Explosion Prevention Systems*.
[d]For tanks over 150 ft (45 m) in diameter, use "Protection for Exposures" or "None," as applicable.

Copyright by National Fire Protection Association (NFPA). NFPA 30 is licensed, by agreement for individual use. No other reproduction or transmission in any form permitted without written permission of NFPA. For inquiries or to report unauthorized use, contact licensing@nfpa.org.

Table 22.4.1.1(b) Reference Table for Use with Tables 22.4.1.1(a), 22.4.1.3, and 22.4.1.5

	Minimum Distance (ft)	
Tank Capacity (gal)	From Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way	From Nearest Side of Any Public Way or from Nearest Important Building on the Same Property
275 or less	5	5
276 to 750	10	5
751 to 12,000	15	5
12,001 to 30,000	20	5
30,001 to 50,000	30	10
50,001 to 100,000	50	15
100,001 to 500,000	80	25
500,001 to 1,000,000	100	35
1,000,001 to 2,000,000	135	45
2,000,001 to 3,000,000	165	55
3,000,001 or more	175	60

For SI units, 1 ft = 0.3 m; 1 gal = 3.8 L.

This page intentionally left blank.

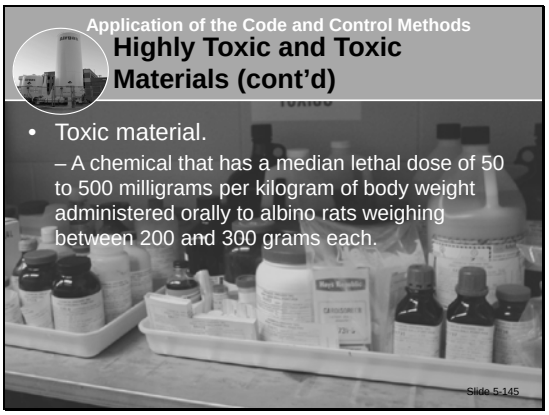
NOTE-TAKING GUIDE (cont'd)

Slide 5-142

Slide 5-143

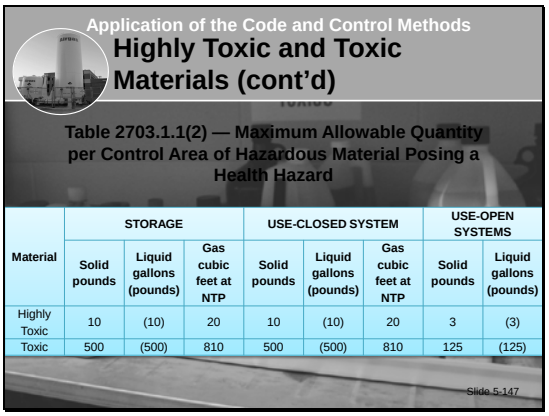
Slide 5-144

Slide 5-145



Slide 5-146

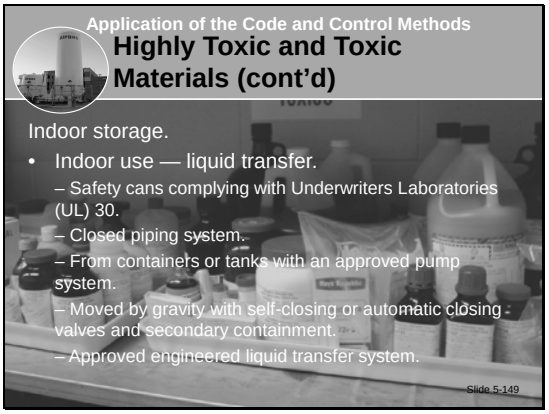
Slide 5-147



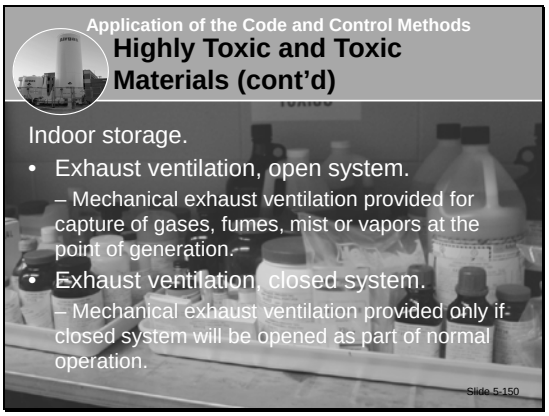
Material	STORAGE			USE-CLOSED SYSTEM			USE-OPEN SYSTEMS	
	Solid pounds	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid pounds	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid pounds	Liquid gallons (pounds)
Highly Toxic	10	(10)	20	10	(10)	20	3	(3)
Toxic	500	(500)	810	500	(500)	810	125	(125)

Slide 5-148

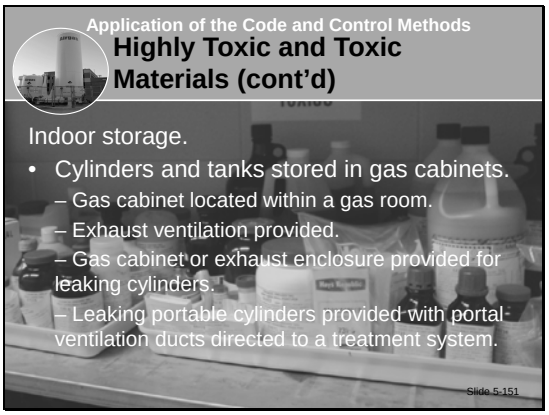
Slide 5-149



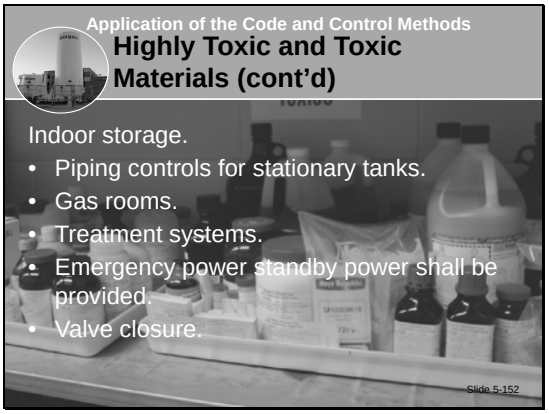
Slide 5-150



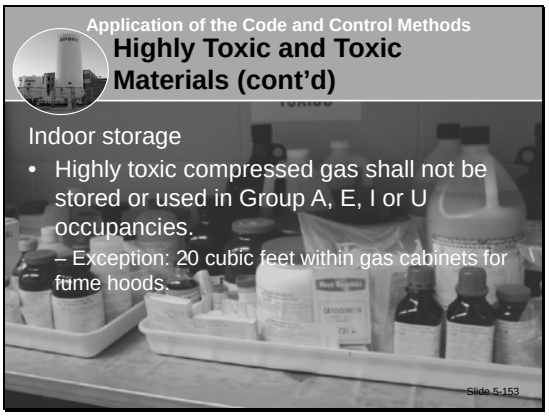
Slide 5-151



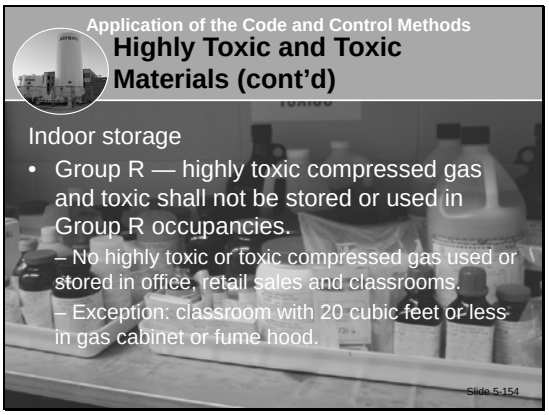
Slide 5-152



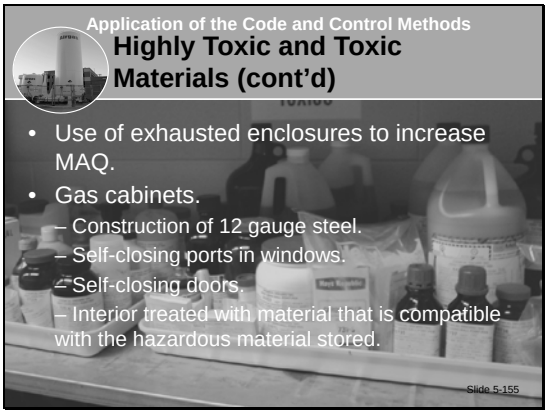
Slide 5-153



Slide 5-154

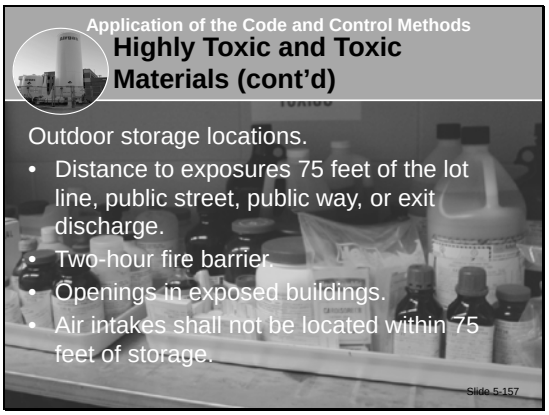


Slide 5-155



Slide 5-156

Slide 5-157



Slide 5-158

Slide 5-159

Activity 5.3

Health Hazards

Purpose

1. To identify methods to control hazards.

2. To identify codes, regulations and standards that provide the authority to implement controls.

Directions

1. Read over the following health hazards.

    a. Chlorine in a hotel or motel for pool chemicals.

    b. Ammonia in an ice cream production facility.

    c. Asbestos in an old commercial building basement.

2. Now answer the questions that follow.

This page intentionally left blank.

Activity 5.3 (cont'd)

Health Hazards

Questions

Chlorine in a hotel or motel for pool chemicals.

1. What are the potential hazards?

_____

_____

_____

2. What control measures are or should be in place to address these hazards?

_____

_____

_____

3. What are the applicable codes for control of each of these hazards?

_____

_____

_____

Ammonia in an ice cream production facility.

1. What are the potential hazards?

_____

_____

_____

2. What control measures are or should be in place to address these hazards?

_____

_____

_____

3. What are the applicable codes for control of each of these hazards?

_____

_____

_____

Asbestos in an old commercial building basement.

1. What are the potential hazards?

_____

_____

_____

2. What control measures are or should be in place to address these hazards?

_____

_____

_____

3. What are the applicable codes for control of each of these hazards?

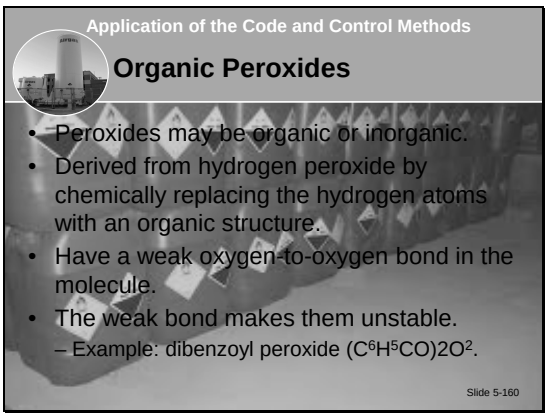
_____

_____

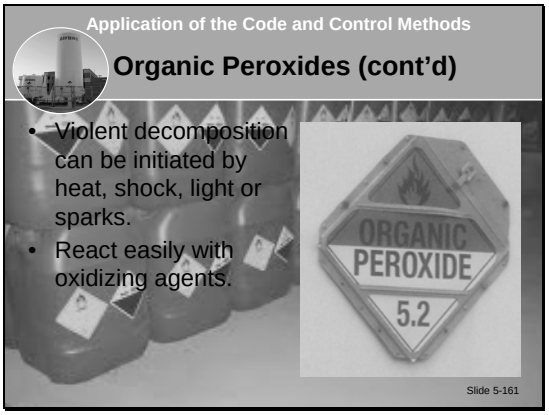
_____

NOTE-TAKING GUIDE (cont'd)

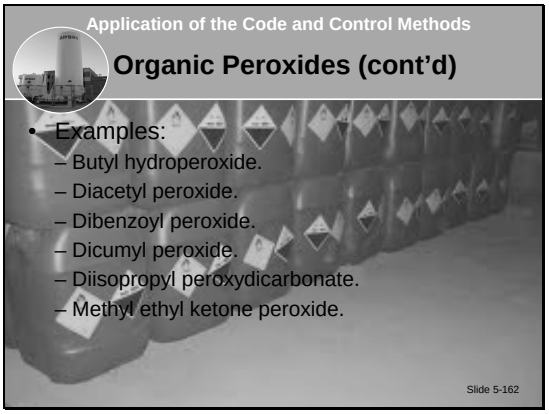
Slide 5-160



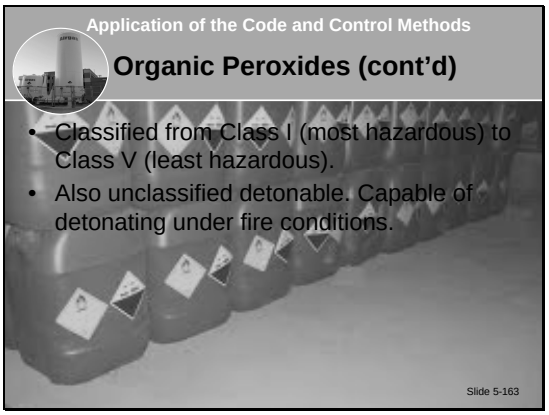
Slide 5-161



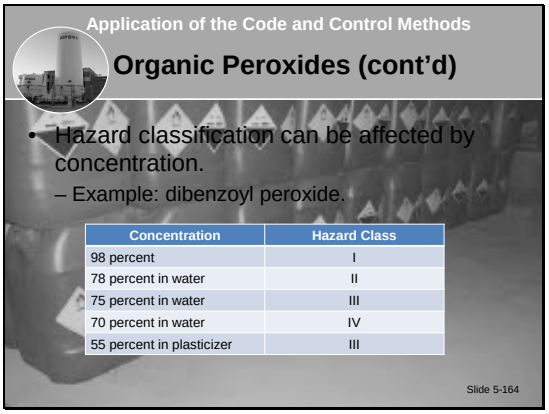
Slide 5-162



Slide 5-163

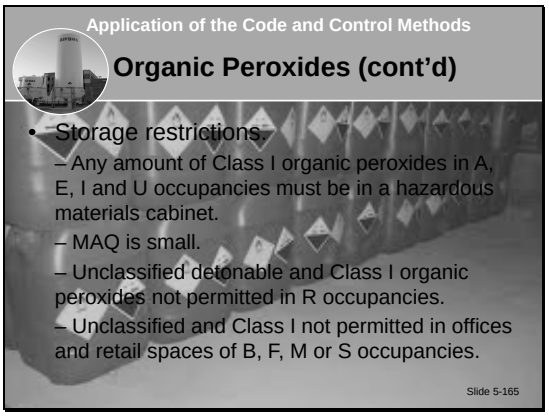


Slide 5-164

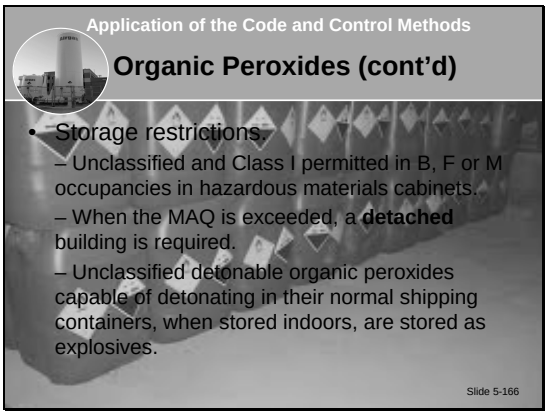


Concentration	Hazard Class
98 percent	I
78 percent in water	II
75 percent in water	III
70 percent in water	IV
55 percent in plasticizer	III

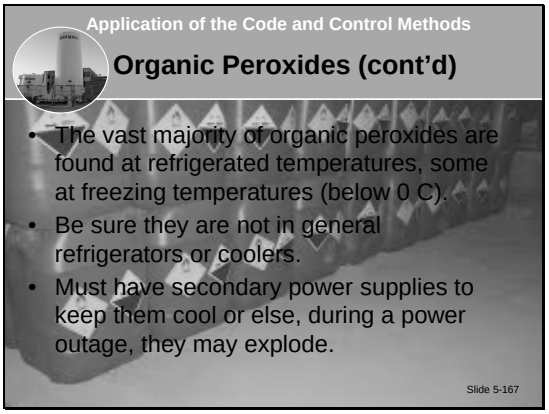
Slide 5-165



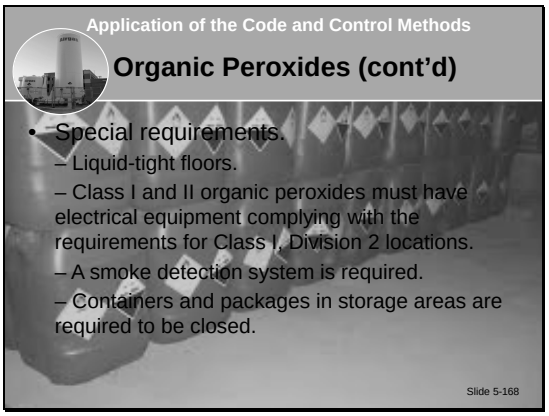
Slide 5-166



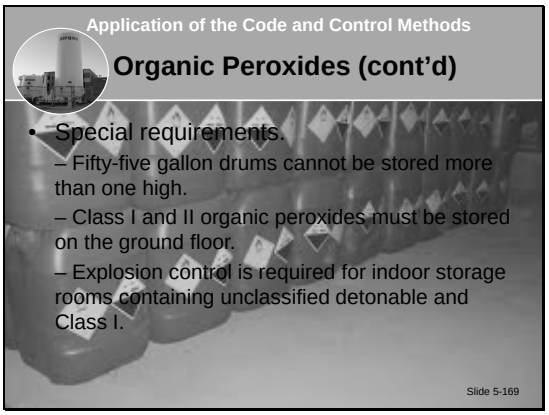
Slide 5-167



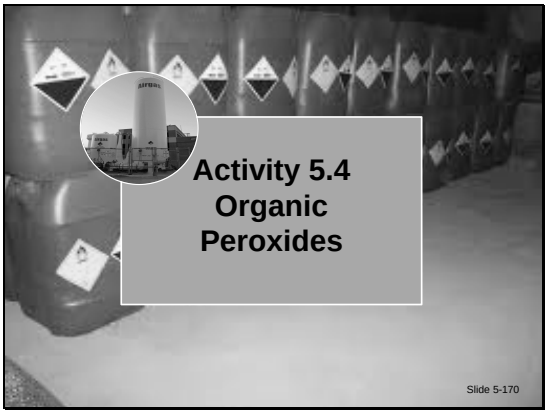
Slide 5-168



Slide 5-169



Slide 5-170



Activity 5.4

Organic Peroxides

Purpose

1. To identify methods to control hazards.

2. To identify codes, regulations and standards that provide the authority to implement controls.

Directions

1. Research the assigned group of organic peroxides using National Fire Protection Association (NFPA) 1, *Fire Code* Annex B to determine what hazards the materials present.

2. As a group, list on an easel pad the identified hazards, and classify the hazards as they are found in the code.

   a. Does the concentration change the hazard class for this chemical?

   _____

   _____

   _____

   _____

   _____

   b. What is the result of changing the container size?

   _____

   _____

   _____

   _____

   _____

Group Assignments

Group 1

1. t-Amyl hydroperoxide.
2. t-Butyl hydroperoxide.
3. Dibenzoyl peroxide.

Group 2

1. Dicumyl peroxide.
2. Diisopropyl peroxydicarbonate.
3. Di-t-butyl peroxide.

Group 3

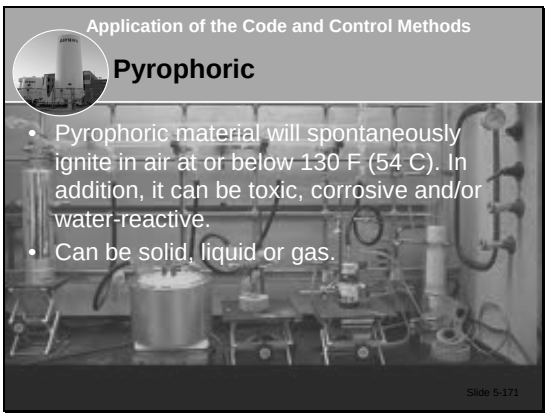
1. 2,5-Dimethyl-2,5-dihydroperoxyhexane.
2. Methyl ethyl ketone peroxide.
3. Dilauroyl peroxide.

Group 4

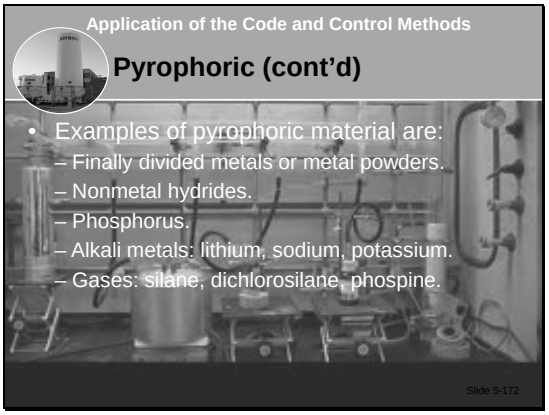
1. Peroxyacetic acid, Type E.
2. t-Butylperoxy isopropylcarbonate.
3. Cumyl hydroperoxide.

NOTE-TAKING GUIDE (cont'd)

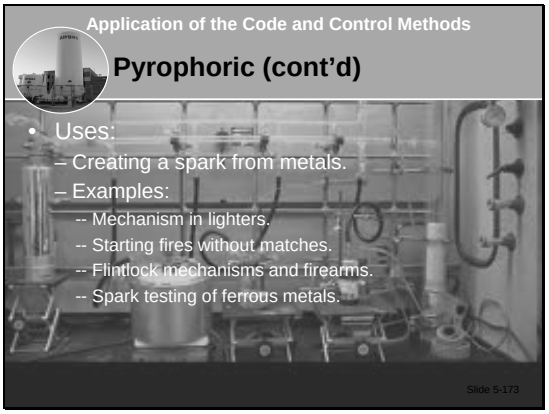
Slide 5-171



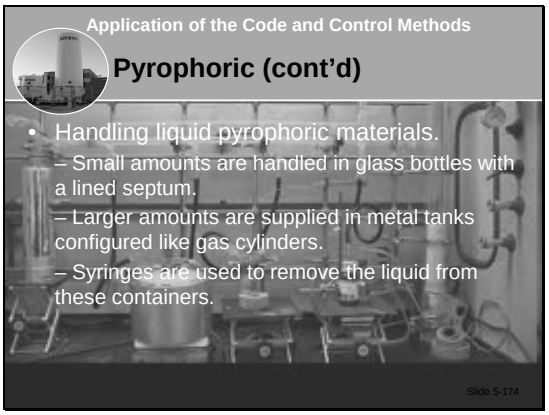
Slide 5-172



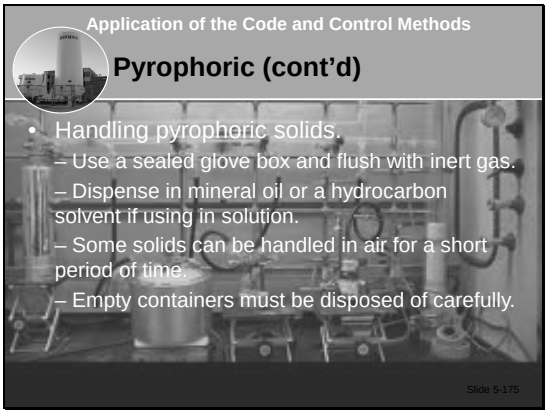
Slide 5-173



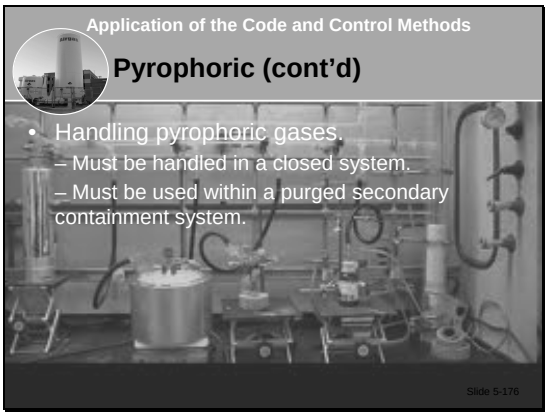
Slide 5-174



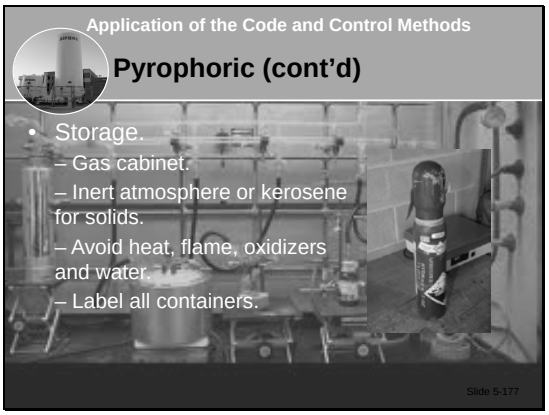
Slide 5-175



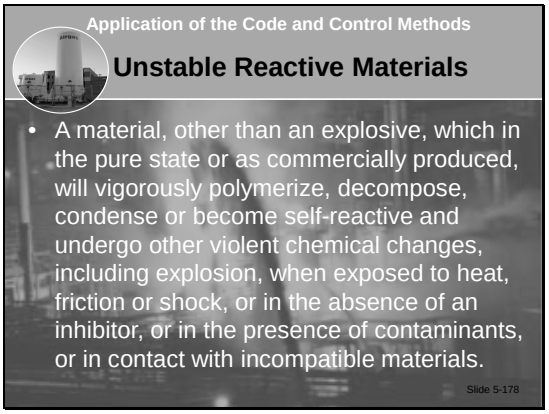
Slide 5-176



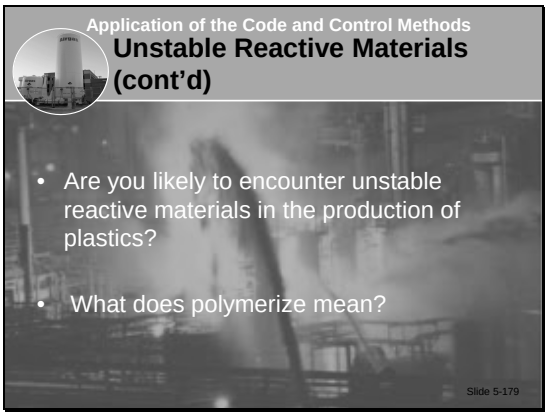
Slide 5-177



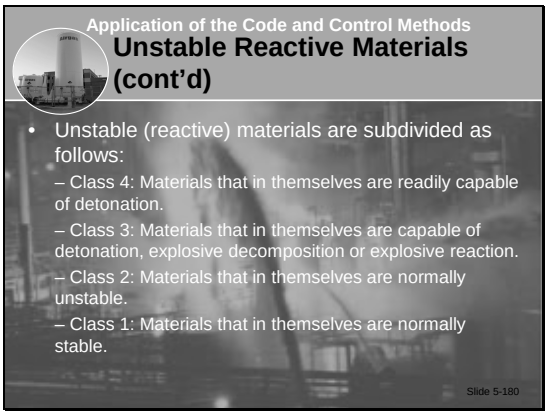
Slide 5-178



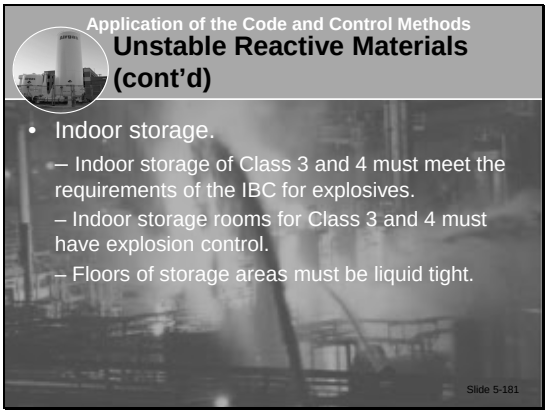
Slide 5-179



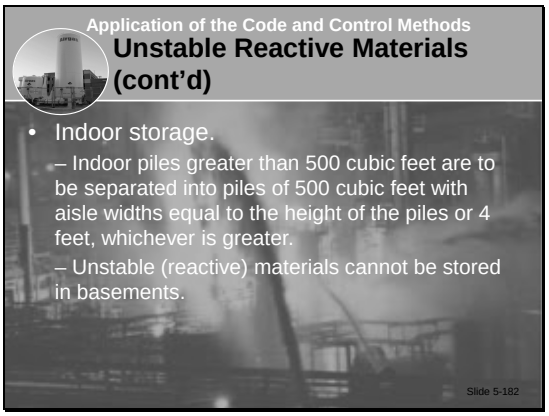
Slide 5-180



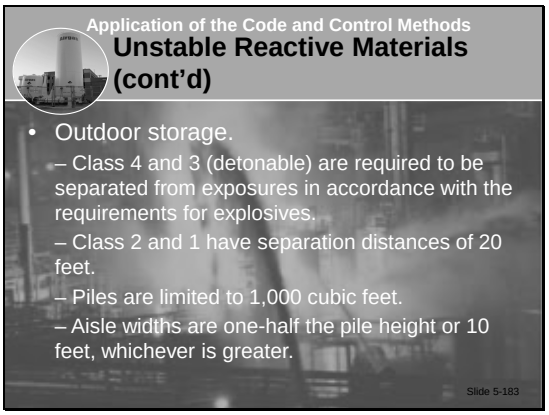
Slide 5-181



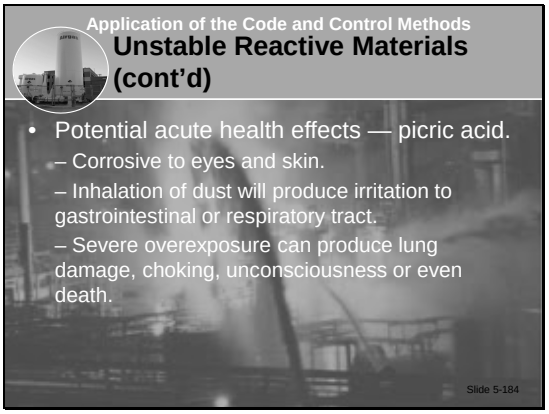
Slide 5-182



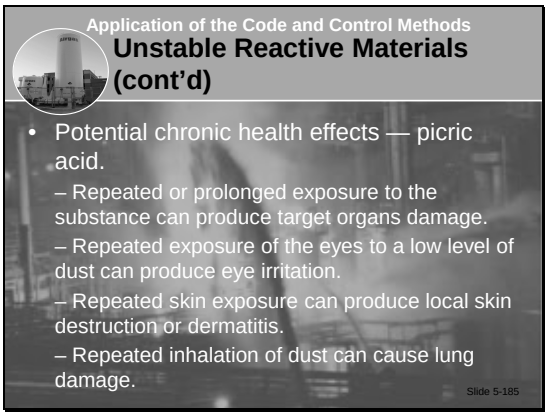
Slide 5-183



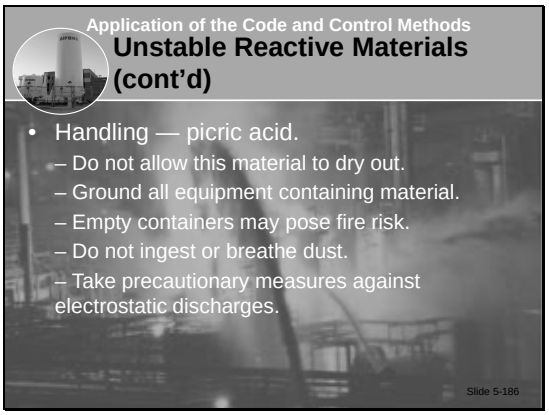
Slide 5-184



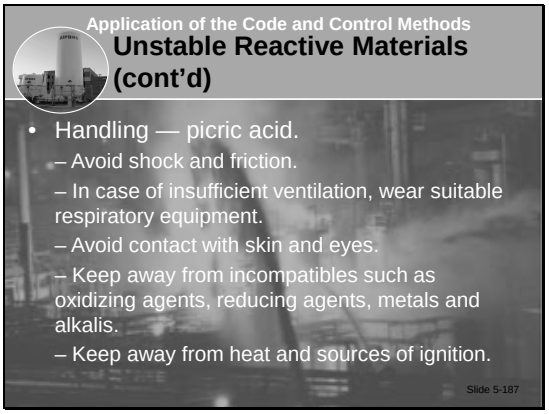
Slide 5-185



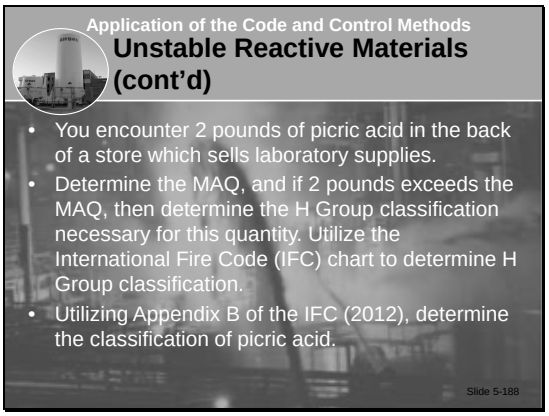
Slide 5-186



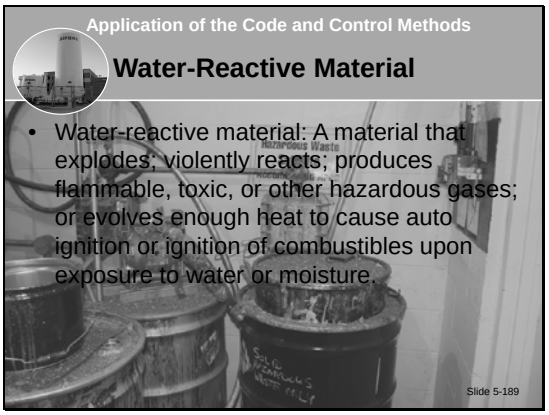
Slide 5-187



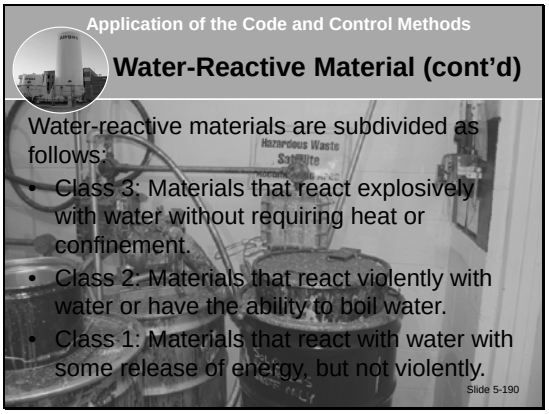
Slide 5-188



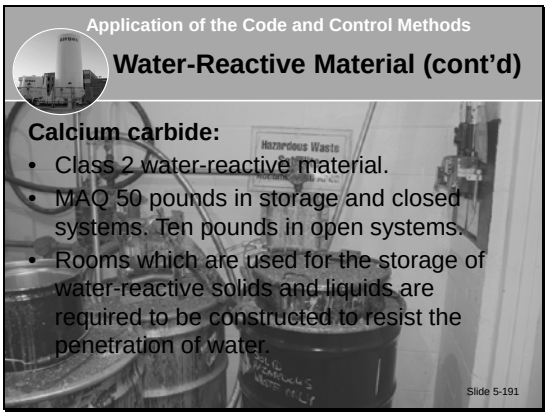
Slide 5-189



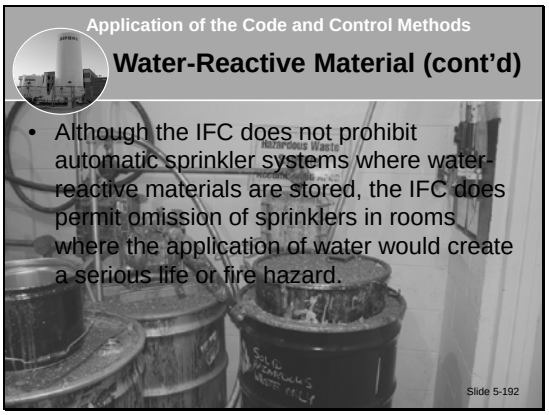
Slide 5-190



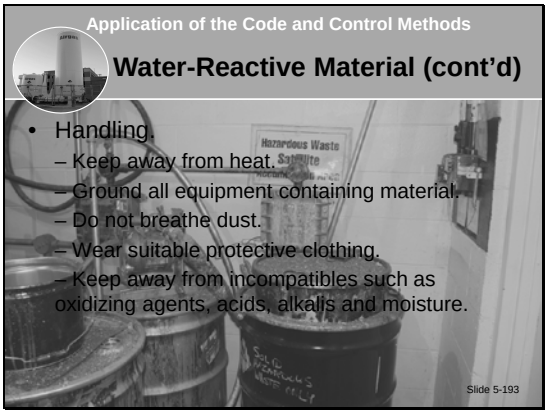
Slide 5-191



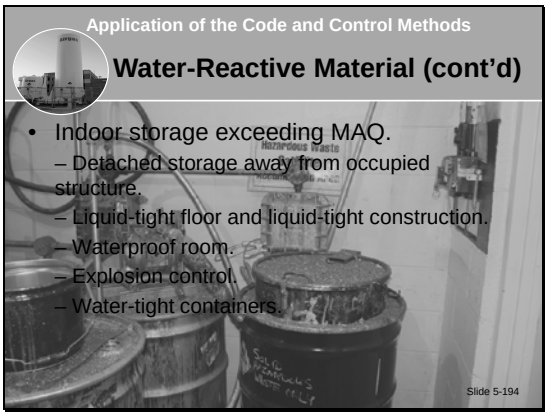
Slide 5-192



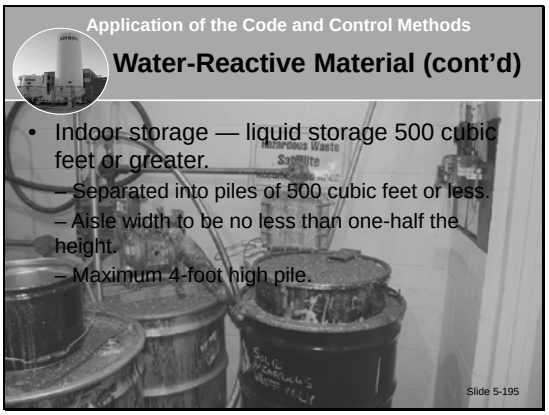
Slide 5-193



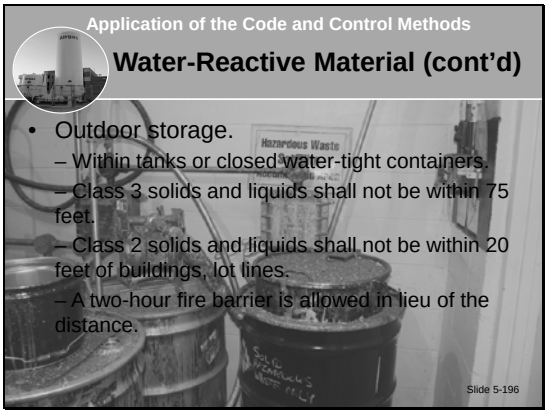
Slide 5-194



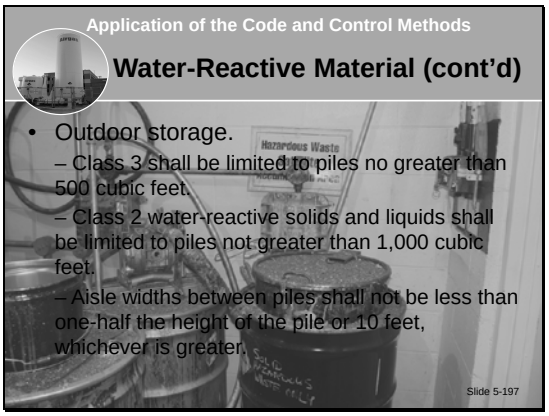
Slide 5-195



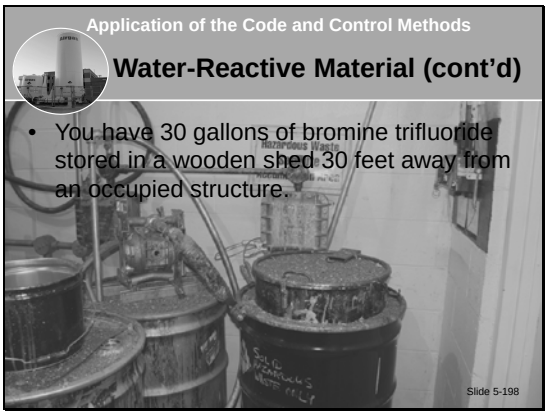
Slide 5-196



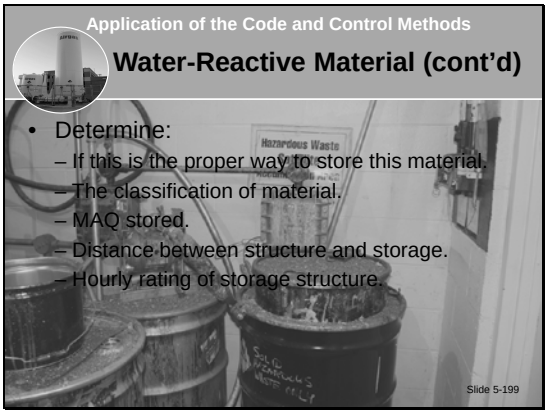
Slide 5-197



Slide 5-198



Slide 5-199



Slide 5-200

Activity 5.5

Plastics Manufacturing

Purpose

1. To identify methods to control hazards.

2. To identify codes, regulations and standards that provide the authority to implement controls.

3. Given an occupancy, quantity and hazardous material classification, determine the maximum allowable quantities (MAQs).

Directions

Working in your group, read the scenario and answer the questions.

Scenario

You are inspecting a plastics manufacturing company. You find five 55-gallon drums of styrene stored inside the building. The building is ordinary construction with no fire resistance ratings or separations between rooms and no automatic fire suppression system. You also find two gasoline-powered tow motors (industrial trucks) stored in the same area. Each tow motor holds 25 gallons of gasoline. The styrene has leaked on the floor from the dispensing operation. A storage room has two 50-pound bags of fertilizer stored in it, 40 gallons of sulfuric acid in a 55-gallon drum upright, and an acetylene torch with oxygen cylinder on a cart. The torch doesn't seem to have been used for some time.

1. Classification of the hazardous material.

   - Styrene _____
   - Sulfuric acid _____
   - Acetylene — triethylsilyl and triisopropylsilyl _____
   - Gasoline _____
   - Fertilizer — (ammonium nitrate) _____

2. MAQ.

- Styrene _____
- Sulfuric acid _____
- Acetylene _____
- Gasoline _____
- The fertilizer is not further identified _____

3. Classification of occupancy.

_____

_____

_____

4. Is the fire protection system adequate?

_____

_____

_____

5. Is the construction classification adequate for this type of occupancy?

_____

_____

_____

6. Based on the site plan on the following page, what other code concerns may exist?

_____

_____

_____

7. What can be done to resolve this situation?

_____

_____

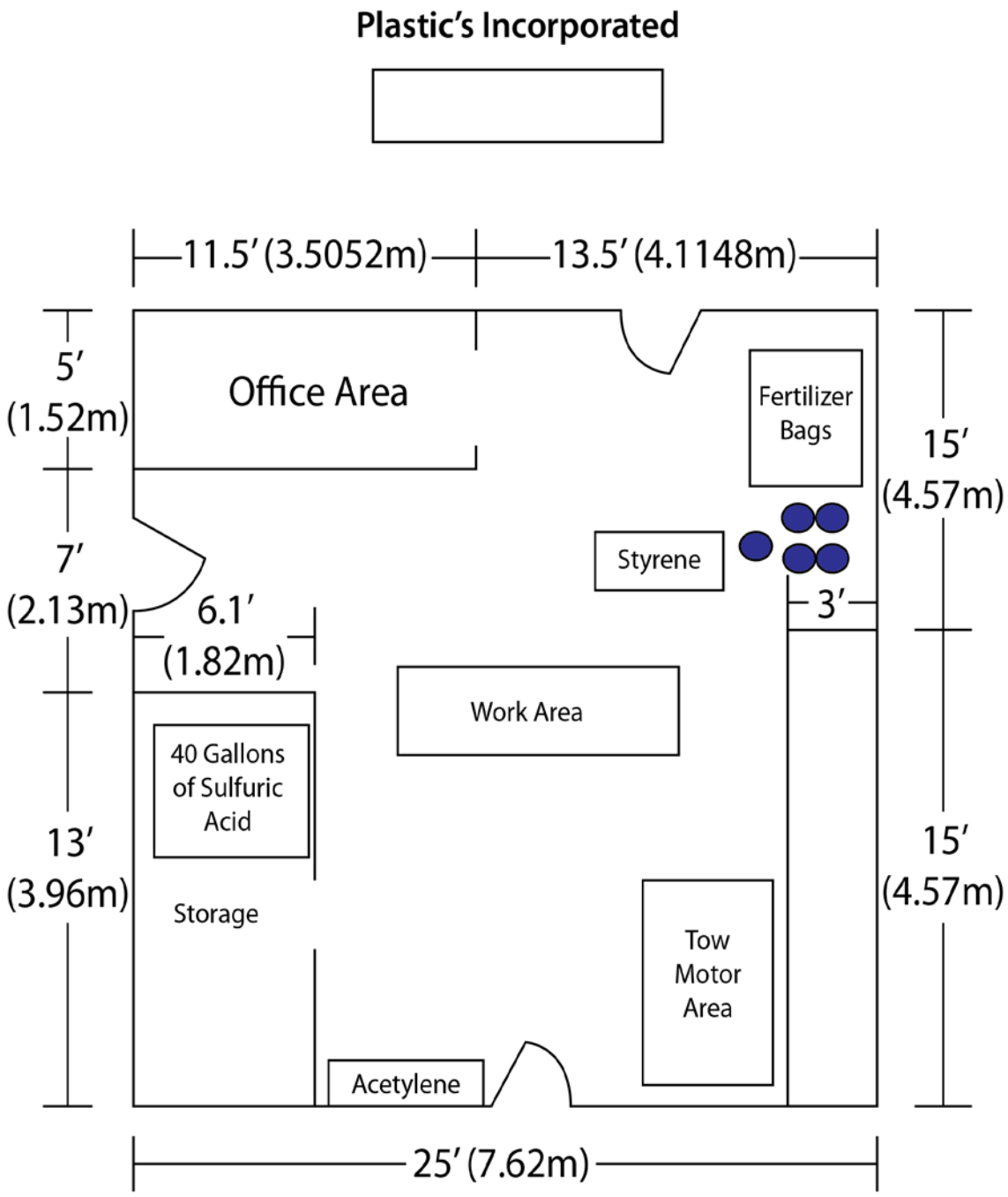
_____

8. Would you recommend that the company hire an outside consultant? Why or why not?

_____

_____

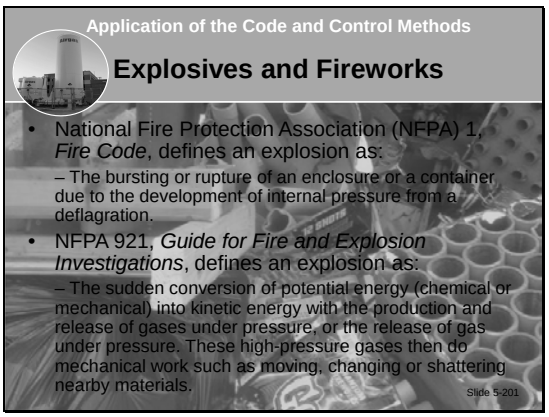
_____


Plastic's Incorporated
11.5′ (3.5052m)
13.5′ (4.1148m)
5′
(1.52m)
Office Area
Fertilizer
Bags
15′
(4.57m)
7′
(2.13m)
Styrene
3′
6.1′
(1.82m)
Work Area
40 Gallons
of Sulfuric
Acid
13′
(3.96m)
Storage
15′
(4.57m)
Tow
Motor
Area
Acetylene
25′ (7.62m)

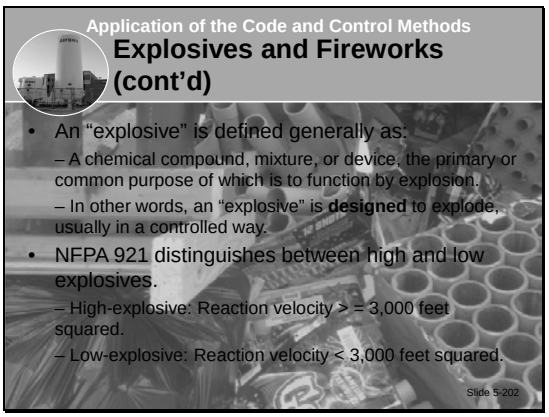
Scenario

NOTE-TAKING GUIDE (cont'd)

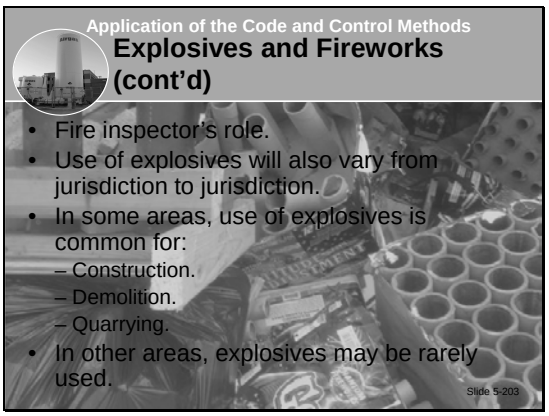
Slide 5-201



Slide 5-202



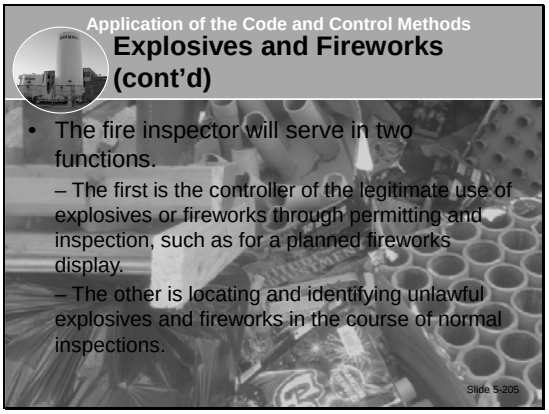
Slide 5-203



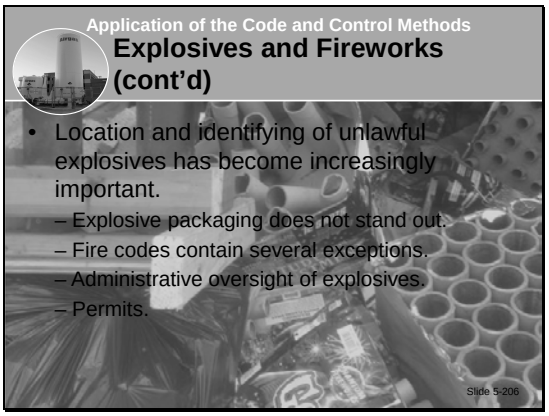
Slide 5-204

Slide 5-204

Slide 5-205

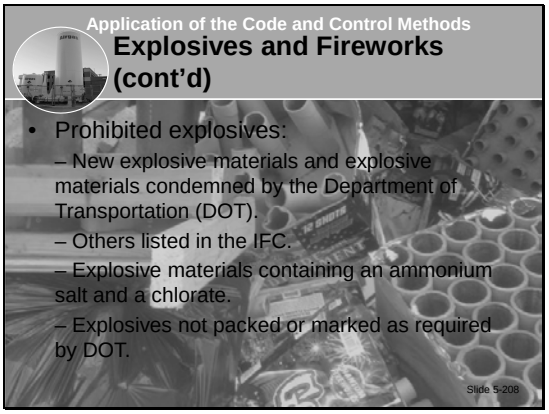


Slide 5-206

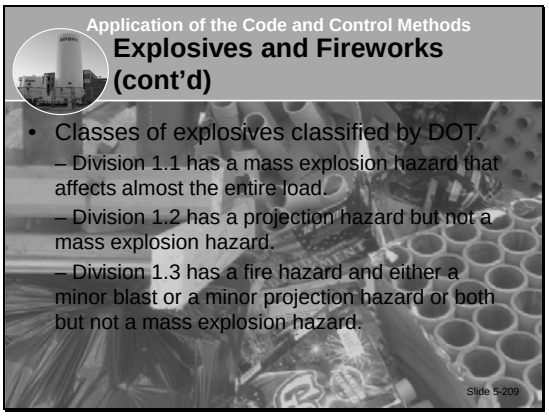


Slide 5-207

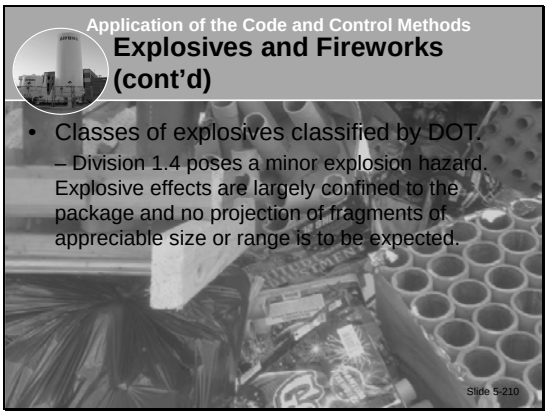
Slide 5-208



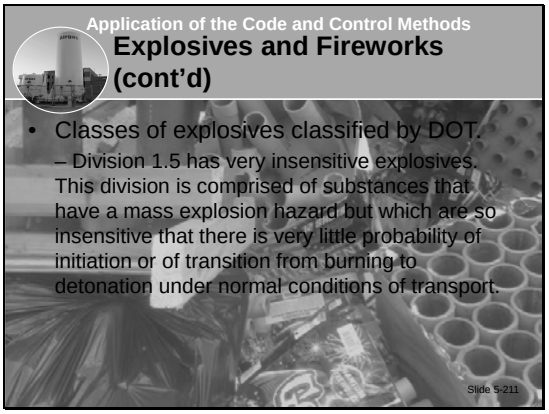
Slide 5-209



Slide 5-210

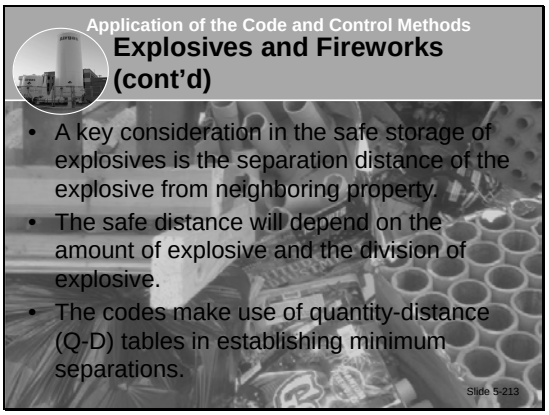


Slide 5-211

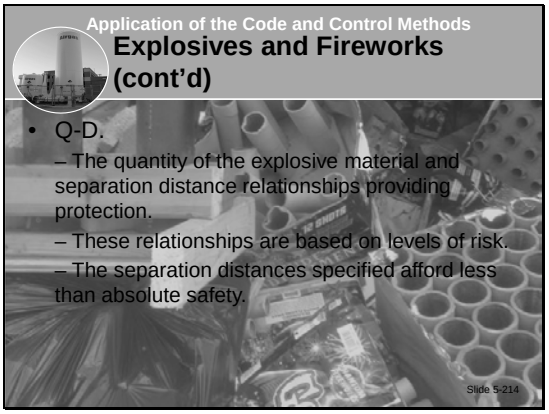


Slide 5-212

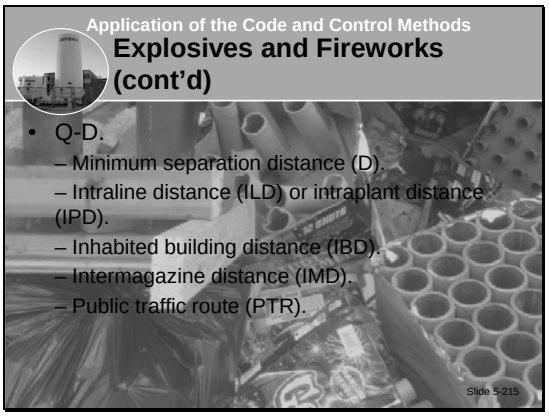
Slide 5-213



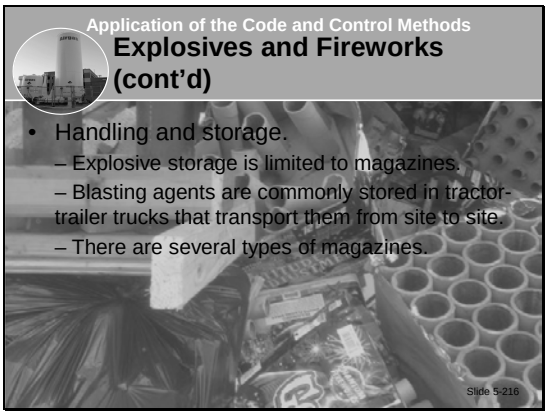
Slide 5-214



Slide 5-215

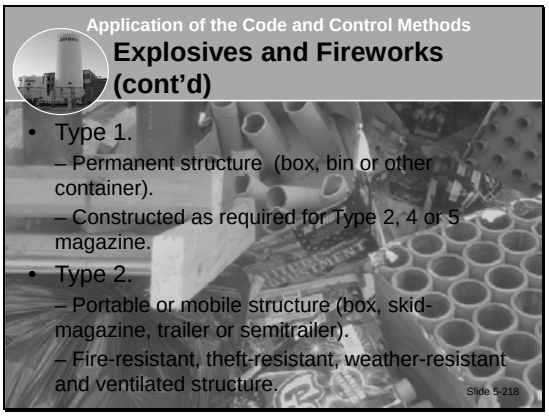


Slide 5-216

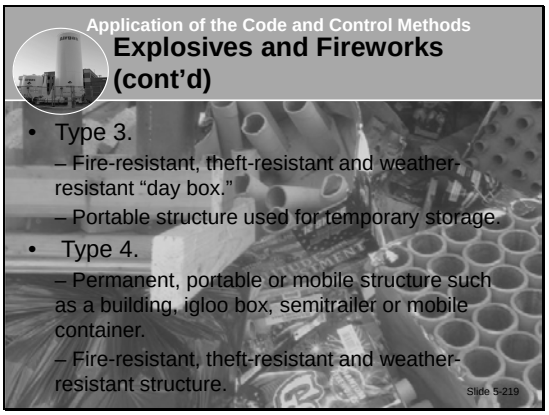


Slide 5-217

Slide 5-218

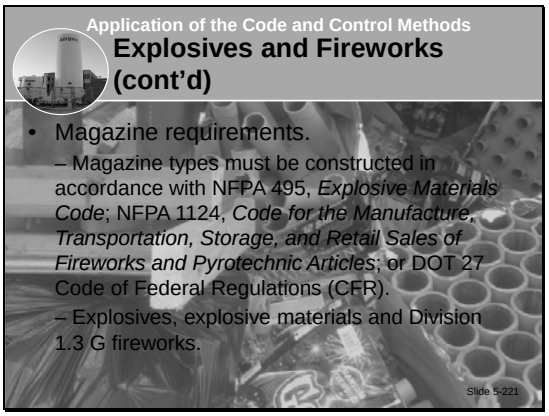


Slide 5-219



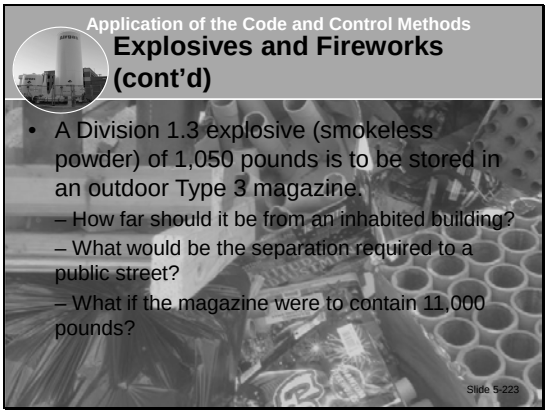
Slide 5-220

Slide 5-221

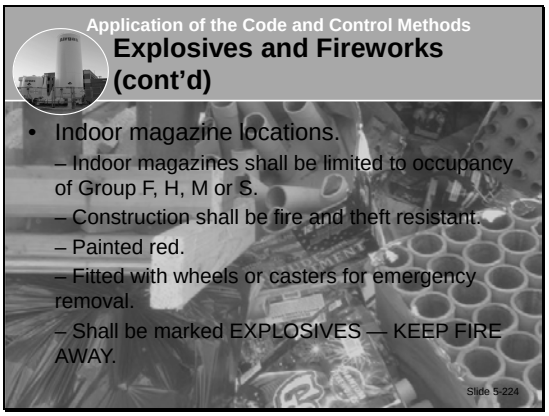


Slide 5-222

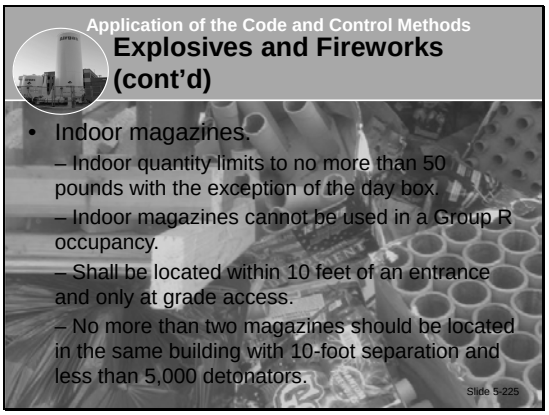
Slide 5-223



Slide 5-224



Slide 5-225

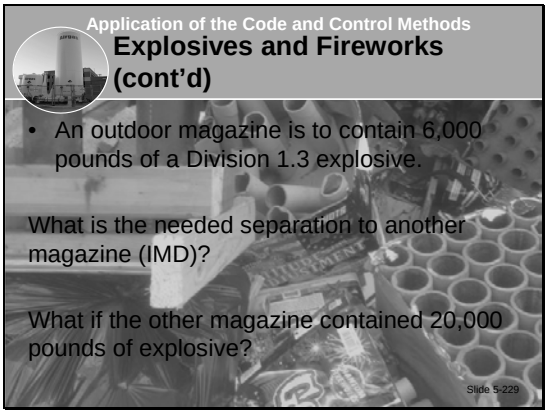


Slide 5-226

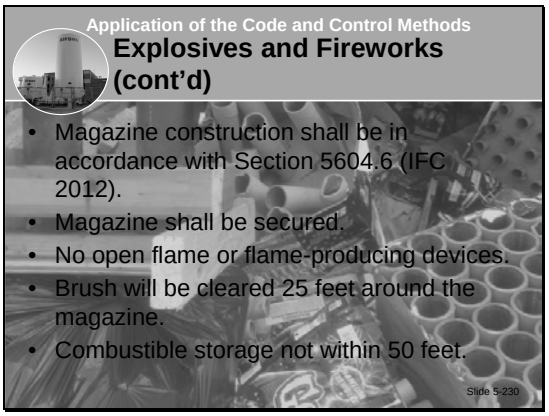
Slide 5-227

Slide 5-228

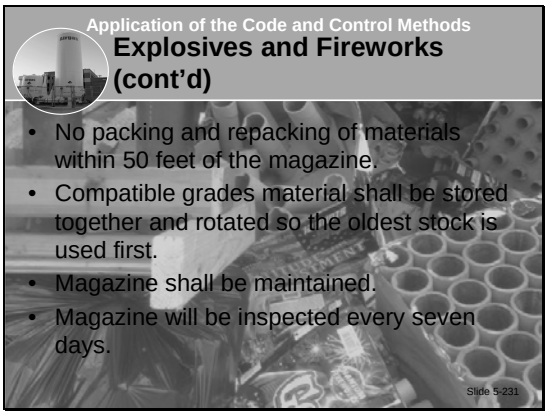
Slide 5-229



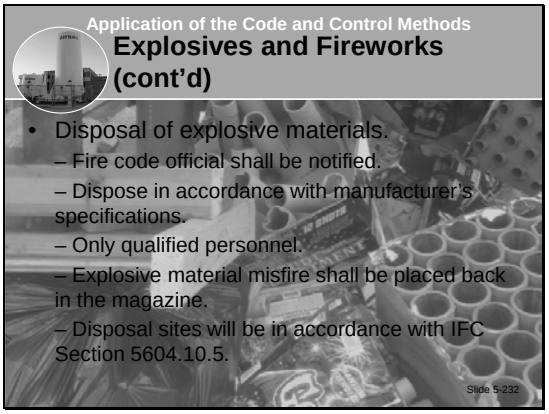
Slide 5-230



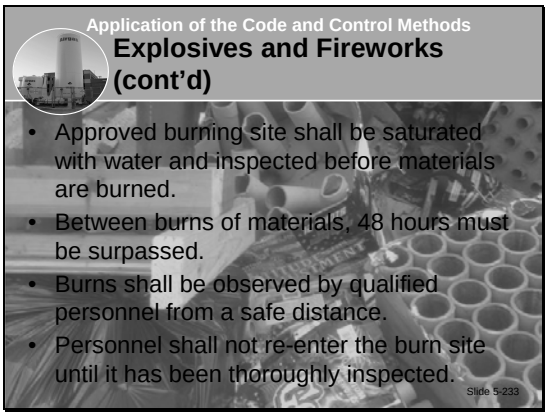
Slide 5-231



Slide 5-232

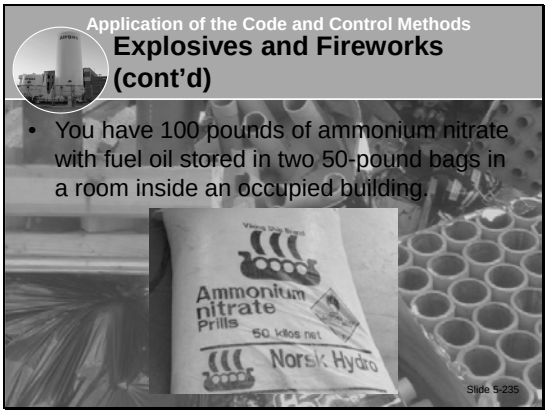


Slide 5-233



Slide 5-234

Slide 5-235



Slide 5-236

Slide 5-237

This page intentionally left blank.

Activity 5.6

Explosives and Fireworks

Purpose

1. To identify methods to control hazards.

2. To identify codes, regulations and standards that provide the authority to implement controls.

3. Given an occupancy, quantity and hazardous material classification, determine the MAQs.

Directions

Read the following case studies and answer the questions in your table groups.

Case Study 1 — Retail Fireworks

A fire occurred at a temporary northwest Indiana retail fireworks store in 2007. Workers at the facility were destroying damaged fireworks by breaking them in half and disposing of them in a 55-gallon metal container. The building was two-story, 3,500 square foot, and classified as Type 5 construction. A mechanic who utilized an oxygen/acetylene torch kit and uses and stores flammable and combustible liquids rented an attached garage. Once the fire erupted, it quickly spread to other nearby fireworks and eventually consumed the building. The investigation revealed extension cords and smoking materials in the area of fire origin, two 55-gallon drums of motor oil and waste motor oil, and two five-gallon cans of gasoline.

1. What code issues should have been addressed?

_____

_____

_____

2. What does the code require for this type of occupancy?

_____

_____

_____

3. What is the maximum amount of fireworks that would be allowed in this facility?

_____

_____

_____

4. What recommendations would you have to implement control mechanisms to reduce the risk of fire?

_____

_____

_____

Case Study 2 — Indoor Pyrotechnics

The Station Nightclub in West Warrick, Rhode Island, was one of the largest life-loss fires in U.S. history. The fire occurred in February 2003, when pyrotechnics, used as part of a live stage performance, ignited nearby combustible materials used as interior sound deadening. The result was a fast-moving fire with excessive smoke development, which subsequently trapped occupants. The building was said to have exceeded the occupancy capacity at the time of the performance. The building was not equipped with fire sprinklers but did have an occupant notification system. As a result of this incident, 100 people lost their lives and countless others suffered permanent injuries.

What standards and code requirements would apply?

_____

_____

_____

_____

Case Study 3 — Magazines Containing Explosives

You are called to conduct an inspection at a facility that uses explosives in an industrial setting. The company has two magazine locations for storage of explosive materials.

Magazine 1 is outside. It stores Division 1.2 high-explosives, black powder and a detonation cord for manufacturing.

Magazine 2 is located adjacent to the rear exit door of the office portion of the facility. The magazine houses 50 pounds of black powder, a detonating cord, and cap-sensitive materials. It also contains Division 1.1 explosives.

Magazine 2 is portable. It is fitted with wheels and casters for emergency removal.

Verify that both of these magazines are compliant. If they are not compliant for the product they are storing, explain why.

_____

_____

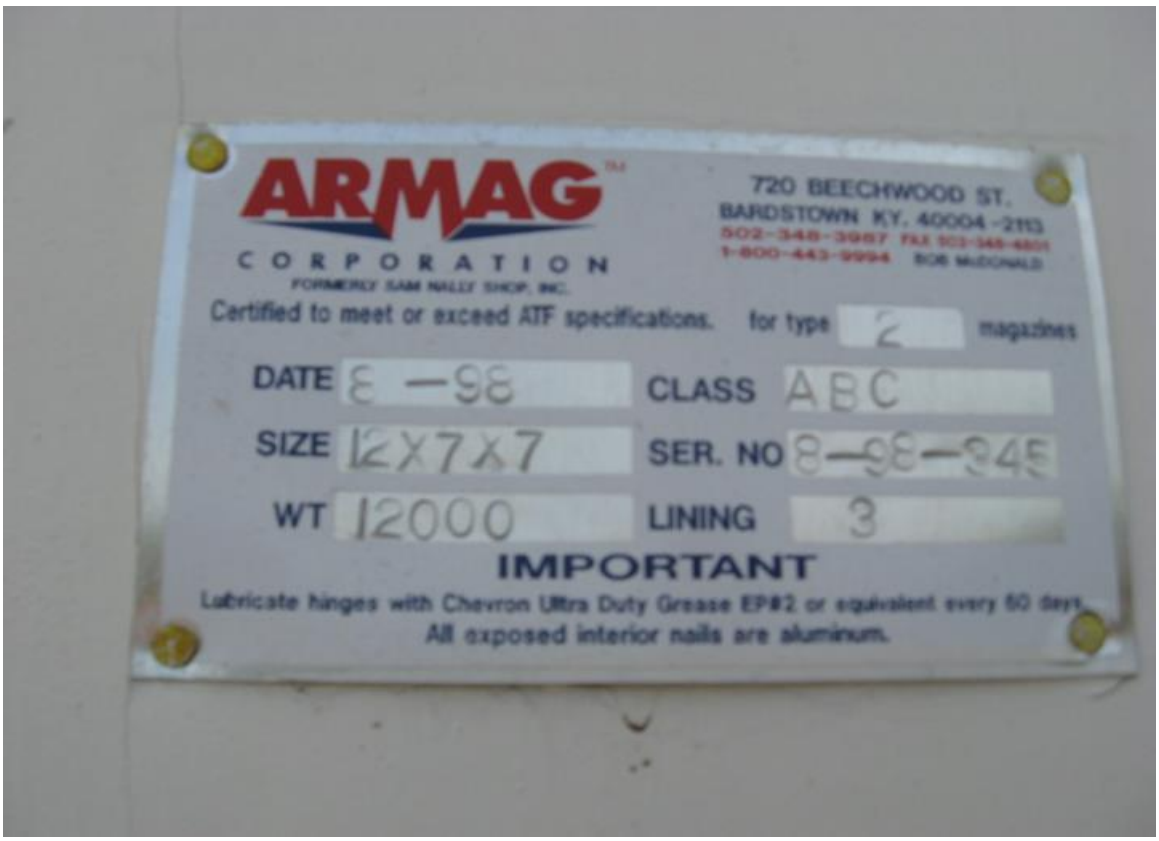
_____

_____

Magazine 1 — Berm Surrounding Magazine

Magazine 1

Label for Magazine 1



Magazine 2 — Photo 1

Magazine 2 — Photo 2

Magazine 2 — Photo 3

Case Study 4 — Fertilizer Manufacturing Plant

A small southwestern town is home to a factory that manufactures fertilizer. The town has approximately 2,500 residents, is 30 miles from larger cities, and is primarily residential. Two pipelines run through the property carrying various petroleum products, and the facility is served by a railroad spur connected to tracks located approximately 20 feet from the property line. Other industries in this area include oil and natural gas exploration, which generates a large amount of truck traffic through the area. The facility has the following materials used in processing and located on-site:

- Approximately 70,000 pounds of anhydrous ammonia (main product).
- Propane cylinders used for industrial fork trucks.
- Two aboveground storage tanks of diesel fuel, 250 gallons each.
- Combustible materials used for packaging and shipping the fertilizer.

Questions

1. What are the hazards associated with the chemicals used at this facility?

2. What is the MAQ for these products in this type of occupancy?

3. What other code requirements exist for this type of occupancy?

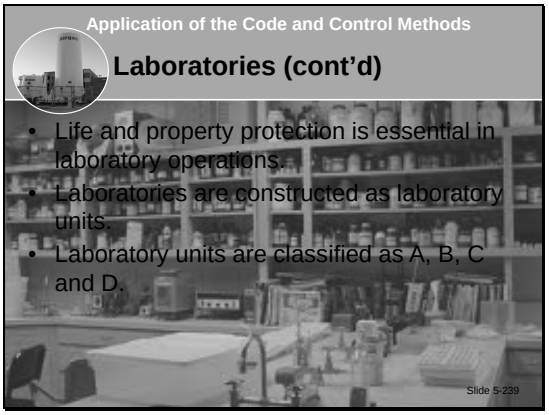
4. What recommendations would you have to implement control measures for this facility?

5. What documentation would you expect for this facility?

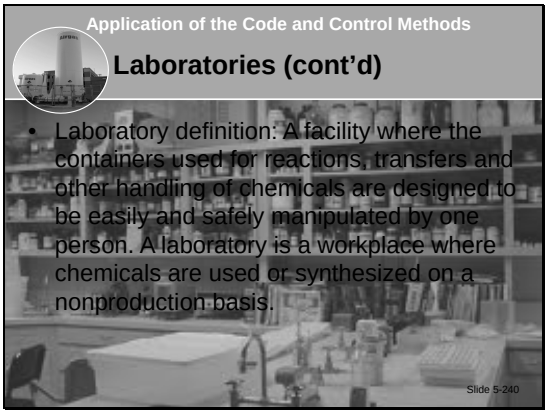
NOTE-TAKING GUIDE (cont'd)

Slide 5-238

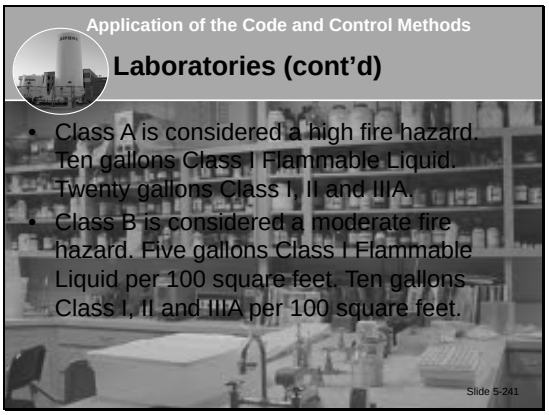
Slide 5-239



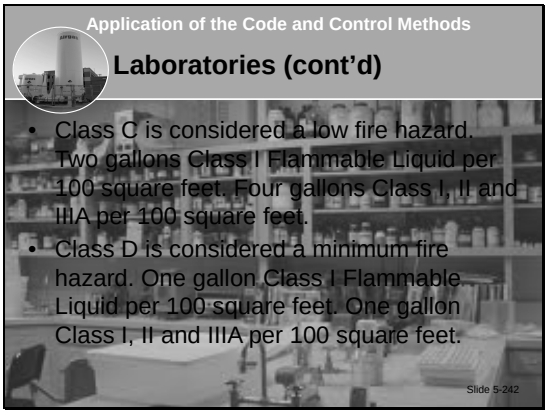
Slide 5-240



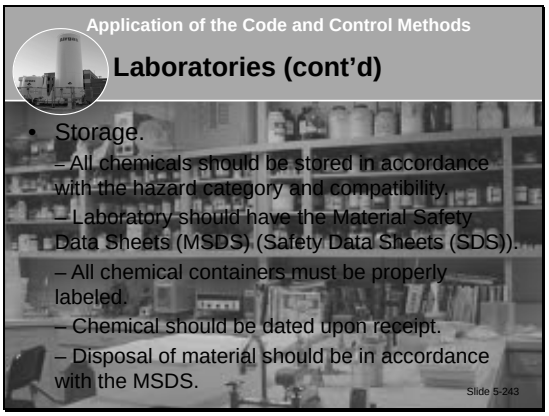
Slide 5-241



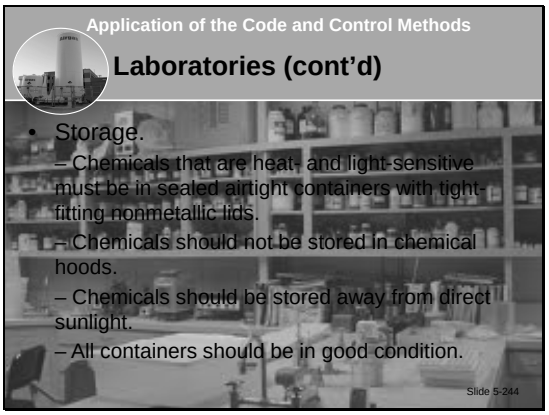
Slide 5-242



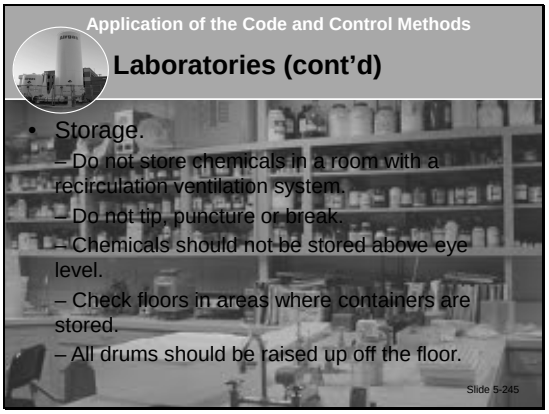
Slide 5-243



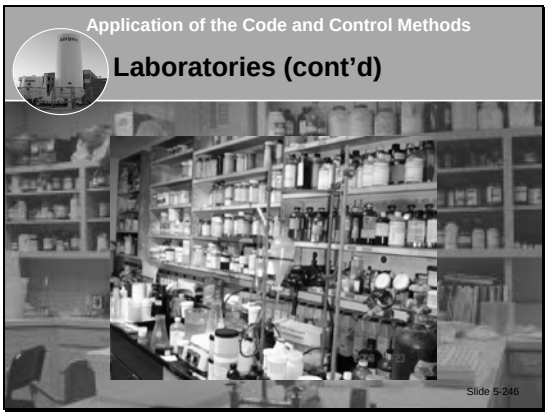
Slide 5-244



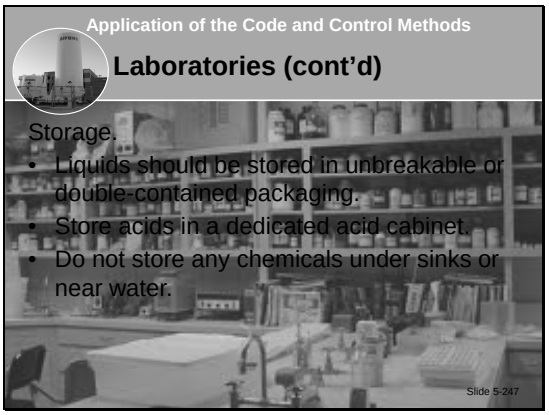
Slide 5-245



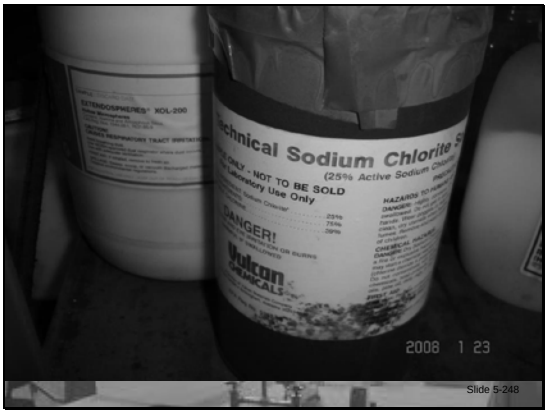
Slide 5-246



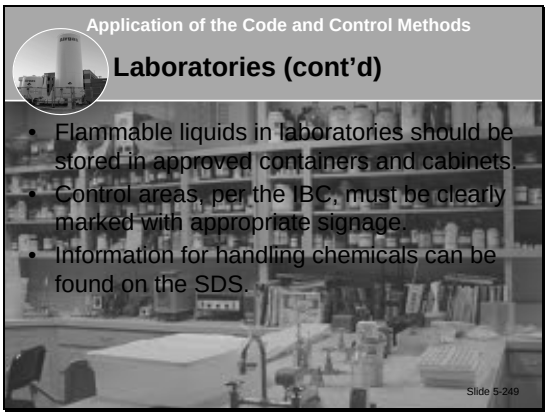
Slide 5-247



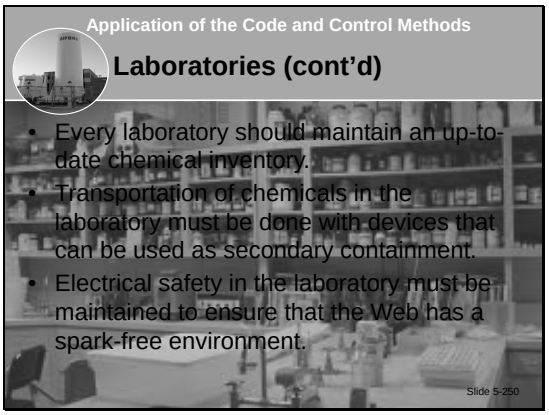
Slide 5-248



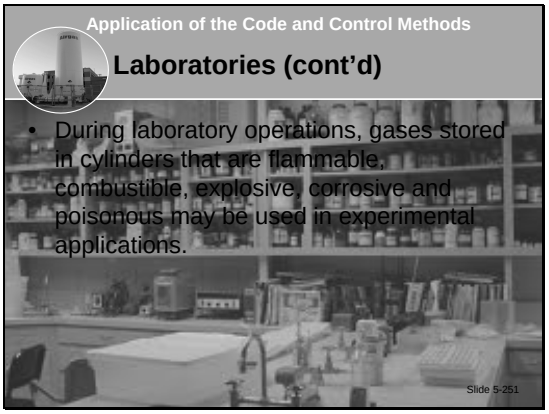
Slide 5-249



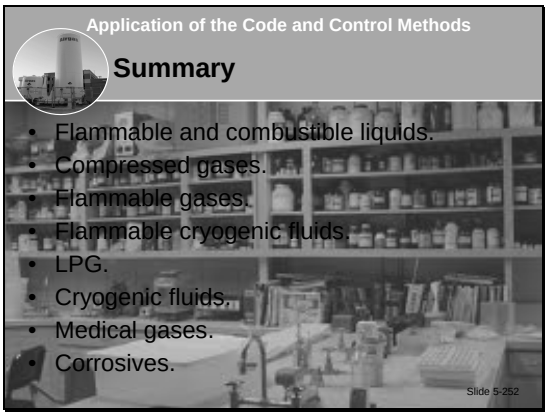
Slide 5-250



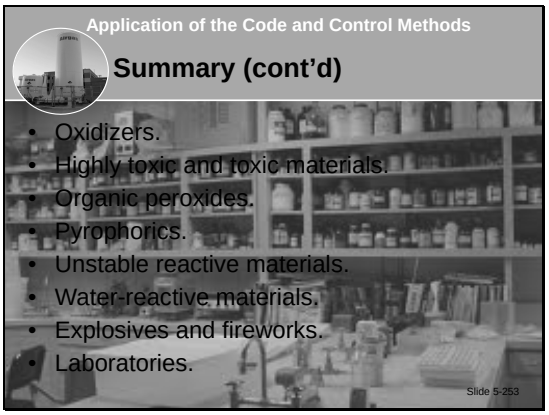
Slide 5-251



Slide 5-252



Slide 5-253


Application of the Code and Control Methods
Summary (cont'd)
• Oxidizers.
• Highly toxic and toxic materials.
• Organic peroxides.
• Pyrophorics.
• Unstable reactive materials.
• Water-reactive materials.
• Explosives and fireworks.
• Laboratories.
Slide 5-253

BACKGROUND TEXT

This page intentionally left blank.

FLAMMABLE AND COMBUSTIBLE LIQUIDS

Flammable and combustible liquids are used in a wide variety of applications throughout the modern world. They are used in applications varying from cosmetics to aviation fuel. The inspector may encounter them in quantities varying from a quart to 500,000 gallons or more.

The potential hazard presented by flammable and combustible liquids will depend on the class, quantity and use of the liquid. The flash point of a flammable combustible liquid is the primary determiner of a flammable or combustible liquid's hazard. Liquids with low flash points present a greater hazard than those with higher flash points. The codes recognize this in the provisions for MAQs in control areas. Liquids with lower flash points have smaller MAQs.

Flammable Liquid Containers and Tanks

Flammable and combustible liquids are stored, transported and used in a variety of containers and tanks.

Containers

Any vessel of 119 gallons (450 Liters) or less capacity used for transporting or storing liquids.

Closed Container

Sealed by a lid or other device that liquid and/or vapor will not escape from at ordinary temperatures.

Intermediate Bulk Container

Any closed vessel having a liquid capacity not exceeding 793 gallons (3,000 liters) and intended for storing and transporting liquids. Rigid plastic intermediate bulk containers limited to Class II and III liquids.

Tanks

Any vessel having a liquid capacity that exceeds 60 gallons (230 liters) is intended for fixed installation, and is not used for processing (NFPA 30, *Flammable and Combustible Liquids Code*, p. 20).

The installation or removal of a flammable or combustible liquid tank requires a construction permit. It is not uncommon, however, for tanks to be installed in a haphazard manner without a

permit. Tanks involve much larger quantities of liquids than containers and, therefore, can pose a greater potential hazard.

Tanks for flammable and combustible liquids are usually of steel construction. However, concrete tanks may be permitted for certain liquids. Other tank materials may also be used, including combustible materials under limited circumstances.

Portable Tank

Any vessel having a liquid capacity over 60 gallons (230 liters) intended for storing liquids and not intended for fixed installation (NFPA 30, p. 20). Portable tanks are limited to Class II and III liquids.

Storage Cabinets

Containers are portable and, therefore, are a convenient means for storing or using (dispensing) flammable and combustible liquids. An inspector will encounter container usage in a variety of occupancies.

It is obvious from the earlier discussion that, once a liquid has been identified and classified, the amount present must be determined. The amount may consist of only a few gallons of fuel for a snowblower or several drums of solvent used in an industrial process.

As was stated earlier, the amount of flammable or combustible liquid present cannot exceed the MAQ for a control area. However, the codes will allow increases beyond the nominal maximum quantity of flammable and combustible liquids when an automatic sprinkler system is present and/or an approved storage cabinet is provided. The codes allow an increase of 100 percent of the MAQs when the liquids are stored in an approved cabinet with a maximum capacity of 120 gallons. Cabinets are required to be self-closing and self-latching. They can be of steel or wood construction. Flammable liquid cabinets are often a practical and economical means of storing limited quantities of liquids.

Storage Rooms

Some occupancies may need container storage beyond the amounts permitted in control areas, even including the allowable increase for automatic sprinklers. In these cases, the code will require that a flammable liquid storage room be provided. This most often occurs in warehouse situations. Flammable liquid warehouses often store containers in groups (or piles) of a hundred or more containers. In these cases, in addition to being classified as an H occupancy, flammable liquid storage rooms will be required.

Flammable liquid storage rooms are required to be separated from other areas by fire barriers of one- or two-hour fire resistance depending on the area of the room.

For example, if the room has an area of less than 150 square feet, one hour would be satisfactory. If the area of the room exceeded 150 square feet, then a two-hour barrier would be required. Flammable liquid storage rooms will also have requirements for their location. A flammable liquid storage room may be required to be located on an exterior wall with an outside door. The room may also be required to face an open area with a specified minimum distance to an interior lot line. Doors in the fire barriers are required to be self-closing fire doors of a specified rating.

Since the accumulation of flammable vapors is a potential danger with flammable and combustible liquids, a mechanical ventilation system may be required. Where the flammable vapors are heavier than air, the exhaust intake is to be located within 12 inches of the floor. Storage rooms containing more than 1,000 gallons of liquid are required to have a means of spill control. This can consist of a liquid-tight recessed or sloped floor, raised sills or dikes, sumps, or other engineered systems. The retention capacity is based on the size of the largest vessel contained.

Flammable and combustible liquid containers can be stored in a variety of ways including rack storage and pallets. The codes will control the maximum height of stored containers. Various types of fire protection can be provided for container storage. The container storage configuration and class of flammable liquid will determine the design of the fire protection system. Aqueous Film Forming Foam (AFFF) systems, for example, may be required in some instances (i.e., where a palletized storage arrangement is used).

Codes allow for the incidental storage and use of flammable and combustible liquids, such as for maintenance. A code may allow for up to 10 gallons to be stored in an approved cabinet for maintenance purposes. Codes also provide for the incidental use of flammable and combustible liquids in Class A, B, E, I and R occupancies for purposes such as maintenance, demonstration, laboratory work, and equipment operation. However, the amount permitted is limited to that permitted in a control area.

Aboveground Tanks

Aboveground tanks are required to have warning placards identifying the liquid contained in the tank.

Flammable and combustible liquid tanks may contain large quantities of liquid which, if ignited, pose a serious threat to surrounding property. Therefore, clearances between tanks and nearby property are provided for in the codes.

The required clearance will depend on several factors. These include:

- The class of liquid.
- Whether or not the liquid is a stable liquid.
- The pressure at which the liquid is being stored.

- The size of the tank.
- The construction of the tank.
- Protection available for exposures.
- Whether or not the tank has a fire protection system.

Codes establish basic separation distances based on the size of a tank and then modify the basic distance depending on the above factors.

Flammable liquids which are unstable or have boil over characteristics may be encountered. The codes have special provisions for the clearances of tanks containing these liquids. The codes also have requirements for minimum separation between adjacent tanks.

Aboveground tanks containing Class I, Class II or Class III are required to have a means of controlling spills or accidental discharges. Controlling spills and discharges from tanks is not only a fire issue but an environmental issue as well. The codes provide for several methods of controlling spills. Surrounding a tank with a dike is a commonly used method. Dikes are required to have a volumetric capacity equal to the capacity of the largest tank within the dike's area. A dike is permitted to be constructed of earth, steel, concrete or masonry, and it must be liquid tight.

Another method of controlling spills is to provide a remote impounding area. The impounding area provides for liquids to be drained away from the immediate area of the tank involved. The volume of the impounding area must be at least equal to the largest tank that drains into it.

Tanks are frequently elevated on supports to facilitate dispensing. When a tank is elevated, its supports are required to have a fire-resistive rating. Tank cars or tank vehicles cannot be used as storage tanks. The area around tanks must be kept clear of weeds and combustible materials.

Outside Storage

Containers and portable tanks of flammable and combustible liquids are often stored outdoors. There are some points, however, to be considered and evaluated with respect to outdoor container and tank storage:

- The class of the liquid.
- Whether containers or portable tanks are being used.
- MAQ determines control area and separation from buildings.
- Site security.

- Accumulation of weeds and debris in the area.
- Clearance to buildings located on the site.
- Clearance to lot lines and public ways.
- Protection from the elements.
- Fire department access.
- Separation between storage and control areas.
- Height of containers.

As an example, if a business needed to store a Class IB flammable liquid in containers, a code might restrict the total amount per pile to 2,200 gallons. If the liquid were stored in portable tanks, the amount per pile could be 4,400 gallons. More than one pile of containers or tanks is permitted at a location. However, a minimum distance between piles is specified in the codes. The minimum distance from a pile to a lot line which could be built upon, in this case, would be 50 feet and 10 feet to a public way. Also the containers could be stacked to a maximum height of 12 feet. If the liquid involved were a Class II liquid, the amounts permitted per pile would be 8,800 and 17,600 gallons for containers and portable tanks respectively.

Protection from the elements is an important consideration with outside storage. Prolonged exposure can result in rusting of steel containers with subsequent container leakage.

Outside container and tank storage is permitted adjacent to a building on the same property and under the same management. However, a code may require that the wall of the building have a specified fire resistance.

Underground Tanks

Tanks for flammable and combustible materials are sometimes placed underground. Gas stations are a common example. Having tanks underground eliminates the need for the clearances discussed with aboveground tanks.

Underground tanks pose some unique problems. One problem is detection of leaks. Since an underground tank is out of sight, a leak is not visible. For this reason, a leak detection system is required.

The placement of tanks requires careful consideration. Tanks must be located so that loads from nearby foundations are not transmitted to the tank. A tank must be located a minimum distance from basements. A tank must be placed on a firm foundation and surrounded with an inert material.

Before being covered, underground tanks are required to be tested for tightness.

Flammable Liquids in Occupancies

The MAQs shall not be exceeded for the following occupancy classifications:

- Assembly.
- Ambulatory health care.
- Business.
- Day care.
- Detention and correctional.
- Education.
- Health care.
- Residential.

The MAQs are as follows:

Liquid Classes	Gallons	Liters
I and II	10	38
IIIA	60	227
IIIB	120	454

Mercantile

Mercantile occupancies are permitted to have larger quantities of flammable and combustible liquids.

For example, for a nonsprinklered mercantile occupancy, the maximum storage amount of a Class IA flammable liquid would be 30 gallons. Quantities can be increased 100 percent for sprinklered occupancies.

Storage of Class II, IIIA and IIIB liquids are limited to 120 gallons with an increase of 100 percent for storage cabinets or sprinklers.

Industrial

Industrial occupancies may have both used and unused flammable and combustible liquids on-site.

MAQ may vary based on control area, type of construction, sprinklers, and other containment systems.

Storage

Storage occupancies may have a limited number of occupants, notification and/or protection systems.

Other hazardous materials or incompatible products may be present within the occupancy.

Bonding and Grounding

Static electricity occurs from the transfer of electrons between dissimilar materials. When the materials are separated, an electrical discharge can occur due to a difference in electrical charge between the materials. The electrical discharge may occur in the form of a spark. The electrical potential of the spark will depend on the insulating properties of the materials. The electrical discharge is often enough to be a source of ignition. This is especially true with flammable gases, low flash point flammable liquids, and flammable dusts.

To eliminate the possibility of a static electric spark, one of two methods can be used: bonding or grounding. In bonding, a conductive path is provided between the two objects or substances involved. This equalizes the charge between the two objects. In grounding, a conductive path is provided to the earth.

The elimination of static electrical discharge is an important fire prevention method in handling hazardous materials, especially in the dispensing of flammable I liquids and the discharge of flammable gases. Flammable dusts can be ignited by a static discharge where they are being conveyed.

Electrical Equipment in Hazardous Locations

Electrical equipment can be a source of ignition in several ways, including heating and arcing. Any combustible material can be ignited by electrical energy of sufficient strength. Many hazardous materials are especially susceptible to ignition by ordinary electrical equipment such as lights, switches, motors, and communications equipment.

To eliminate this danger, electrical equipment is designed to be operated in locations where a hazardous environment exists or may exist due to the use or presence of hazardous materials.

These locations are known as hazardous locations and the electrical equipment is known generally as "explosion proof." Electrical code requires approved hazardous electrical equipment where a hazardous environment can exist. This refers to NFPA 70, *National Electrical Code*®.

Hazardous materials present differing degrees of hazards with respect to electrical equipment. Acetylene presents a different degree of hazard than ammonia because it has a wider explosive range. Hazardous location electrical equipment, therefore, is classified for different environments.

Hazardous location electrical equipment is classified by class, division and group.

- Class I equipment is intended for areas in which flammable gases or vapors may exist.
- Class II equipment is intended for locations in which ignitable dust may be present.
- Class III equipment is intended for locations in which ignitable fibers may be present.

Divisions refer to whether or not the hazardous material is exposed or likely to be exposed under normal operating conditions.

- Division 1 equipment is intended for use where the hazardous material is normally exposed to the atmosphere or may be under abnormal conditions (i.e., an open system).
- Division 2 equipment is intended for locations where the hazardous material is normally confined (i.e., a closed system).

The groups (A through D) refer to specific hazardous materials or groups of hazardous materials.

- Group A:

  Acetylene is an extremely volatile product. Extra precautions must be taken to reduce the potential for fire or explosion.

- Group B:

  Flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor mixed with air that may burn or explode, having either a maximum experimental safe gap (MESG) value less than or equal to 0.45 millimeters or a minimum igniting current (MIC) ratio less than or equal to 0.40.

- Group C:

  Flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor mixed with air that may burn or explode, having either an MESG value greater than 0.45 millimeters and less than or equal to 0.75 millimeters, or an MIC ratio less than or equal to 0.40 and less than or equal to 0.80.

- Group D:

  Flammable gas, flammable liquid-produced vapor, or combustible liquid-produced vapor mixed with air that may burn or explode, having either an MESG value greater than 0.75 millimeters and less than or equal to 0.75 millimeters, or an MIC ratio greater than 0.80.

A common example would be the electrical fixtures in a spray booth. These would be required to be Class I, Division 1, and Group D fixtures since a flammable vapor would normally be in the spray booth environment.

The inspector must be alert for the presence of improper electrical equipment. It is very easy for improper electrical equipment to be installed in a hazardous location such as an ordinary window fan for exhaust in a hazardous area.

COMPRESSED GASES — GENERAL

Compressed gases present two unique hazards. First, they are stored under pressure. Because of this, any leaks will result in a rapid flow rate of the product out of the containing vessel. Any rupture of a container will be violent. Second, they are either in a gaseous state or they will vaporize to a gas upon release. This makes efforts at control or containment of leaks more difficult.

Gases can be stored in a gaseous or liquid state. It is more efficient to store and transport a gas as a liquid. Any gas can be liquefied by compression, refrigeration or a combination of both. For example, carbon dioxide will exist as a liquid at room temperature at a pressure of approximately 838 pounds per square inch gauge (psig). It will also exist as a liquid at 0 degrees F and a pressure of 300 pounds per square inch absolute (psia).

Whether a gas is stored as a gas or a liquid will depend on the amount and the intended use. Oxygen, for example, can be shipped as a gas for smaller portable applications while liquid oxygen is used for bulk transport and industrial applications.

Compressed gases are typically stored at very high pressures. Gaseous oxygen, for example, is stored in cylinders at 2,000 psig. The containers and piping must be designed for high pressure, and the containers must be protected from physical damage.

Compressed gases can be flammable or nonflammable. Although a nonflammable gas does not itself present a fire hazard, the rupture of a container due to overpressure under fire conditions can be destructive. Compressed gas cylinders are required to have pressure relief devices to prevent rupture.

The fire codes do not contain MAQs for inert gases. However, the fire codes contain provisions for proper storage and handling. Cylinders and containers are designed to be stored either horizontally or vertically. They should be stored in their approved position for which they were

designed. Compressed gas containers must be secured to prevent falling. Several methods are provided to prevent falling. These are:

- Securing tanks to a fixed object.
- Securing tanks on a cart.
- Nesting which consists of having the cylinders grouped together in contact with each other or with walls at three points.
- Nesting of cylinders is permitted in warehouses and servicing facilities grouped together.
- Securing to a rack.

Cylinders must also be protected against vehicle impact.

FLAMMABLE GASES

Flammable gases share the same general hazards of all compressed gases (i.e., they are stored under pressure). In addition, since they are flammable, they contribute additional fuel to any fire situation in which they may become involved. A rupture of a container of flammable gas during a fire results in a large increase in thermal energy in addition to the force of a pressure release. Fire codes, therefore, have additional requirements for the storage and handling of flammable compressed gases and requirements for specific gases, such as liquefied petroleum gas (LPG).

Control areas are used with respect to the allowable storage and use of flammable gases. As discussed earlier, the MAQ of gas permitted in a control area can be expressed in a code of pounds or cubic feet at normal temperature and pressure (NTP). NTP is a temperature of 70 F (21 C) at an absolute pressure of 14.7 psia (101.325 kilopascal (kPa)). As with many other hazardous materials, the amount of flammable gas per control area can be increased by 100 percent in a sprinklered building or if a gas cabinet is used for storage.

When a gas cabinet is used to increase the allowable storage, it is required to have steel construction and self-closing doors. It must be constructed of a material compatible with the material being stored, or the cabinet must be coated with a material to protect the steel. A gas cabinet must also be provided with an exhaust system which maintains a negative pressure with respect to the surrounding area.

Flammable gases can be stored in cylinders or tanks. When stored in cylinders with a flat bottom, the cylinders are usually required to be stored in a vertical position. They must also be secured to prevent falling. Cylinders can be secured by several methods, including securing them to a fixed object, securing them to a cart or a rack, or by nesting. Nesting consists of having the cylinders grouped together in contact with each other or with walls at three points. Nesting of cylinders is permitted in servicing and warehouse facilities not open to the public.

In addition to the general limits of MAQs permitted in control areas, codes may prohibit or restrict the storage of flammable compressed gases in occupancy classes such as assembly, educational, institutional, residential or business areas.

Flammable gases are often stored outdoors. The codes contain provision for outdoor control areas. The amount of gas permitted in an outdoor control area is understandably greater than permitted in an indoor control area. If tanks or cylinders are stored outdoors in areas where sunlight may produce extreme temperatures, then overhead covers are provided. Areas where tanks or cylinders are stored must be kept clear of combustible debris and vegetation.

LIQUEFIED PETROLEUM GAS

LPG is a widely used fuel. Inspectors can expect to encounter it in a wide variety of occupancies. Uses include domestic, industrial, commercial, agricultural and motor fuels. LPG is widely used in rural areas for domestic heating and operating farm machinery.

In industry, it can be used for heat treating, annealing, firing kilns, metal cutting and brazing. It is widely used on construction sites for temporary heating. Codes have special and specific provisions for LPG.

Containers

LPG is used with portable containers/tanks or stationary installations. Portable storage containers are designed and constructed to be moved over a highway from one location to another.

If more than 1,000 gallons is contained, then the portable tank must be equipped with protected container appurtenances and permanently mounted skids or runners or be fabricated and installed within a full framework.

Storage containers over 2,000 gallons of individual capacity or with aggregate capacity exceeding 4,000 gallons must be stationary. Container sizes 2 1/2 pounds to 120,000 gallons are limited in congested areas. These limitations are established by local code (business districts).

LPG vapor is heavier than air and can accumulate in low areas. This property affects the safe placement of LPG containers.

LPG Container Location and Clearance — Key Considerations

Examples of aboveground container clearances.

Size in Gallons	Clearance to Buildings or Lot Lines	Separation Between Containers
125-250	10 feet	0 feet
251-500	10 feet	3 feet
501-2,000	25 feet	3 feet
2,001-3,0000	50 feet	5 feet
3,0001-7,0000	75 feet	25 feet or the sum of the diameter of the container

Containers are generally required to be outside of buildings, but there are numerous exceptions.

- Industrial occupancies.
- Limited amounts in educational and institutional occupancies.
- Fifty pounds in E occupancies and 12 pounds in I occupancies.
- Allowed in restaurants for food preparation.
- In buildings not accessible to the public (300-pound maximum).

Industrial forklift trucks are generally to be fueled outdoors, their cylinder size is limited to 45 pounds, and they are restricted in buildings frequented by the public.

Cylinder refilling and exchange are commonly encountered. Cylinder refueling is to be conducted by trained personnel who remain in attendance.

Containers are not to be stored in basements or near means of egress. Cylinders, except 2 1/2 pounds, are not allowed to be stored in buildings accessible to the public. Protection is required against tampering and vehicle impact. Clearance is required for cylinders awaiting exchange from building, exits, liquefied petroleum (LP) dispensing station, combustible materials, and motor fuel dispensing.

Damaged Containers

Containers that show excessive denting or corrosion shall be removed from service. Containers that have been involved in a fire can be returned to service, but they must show no distortion and be prequalified for continued service by a manufacturer or a Department of Transportation (DOT) repair facility. They must be hydrostatically tested and have all appurtenances replaced.

CRYOGENIC FLUIDS

A cryogenic fluid is a refrigerated liquefied gas with a boiling point less than -130 F. Flammable cryogenic fluids include hydrogen and methane. They are used to provide low temperature environments for freezing and chilling applications, such as freezing foods. Cryogenic fluids are stored or transported in portable tanks known as Dewar flasks, which are around a 40-gallon capacity, or larger tanks. Some cryogenic fluids are flammable, such as hydrogen; others are nonflammable, such as nitrogen.

Cryogens expand at a ratio of 1,000-to-1 when heated to ambient temperature. If spilled in a closed space, they can expand and displace the air and cause a flammable atmosphere. For example: Forty gallons of liquid would expand to 5,347 cubic feet of gas or a room with dimensions 8 by 26 by 26 feet.

Hazards are:

- Burns from freezing.
- Asphyxiation.
- Explosion.

The discharge of the pressure relief devices must be to the open air to minimize danger to personnel and equipment. The discharge must also be arranged so that the discharging fluid will not enter other buildings.

Containers and piping for cryogenic fluid systems must be identified with the name of the product. Supports for cryogenic fluid tanks subjected to exposure to temperatures less than -150 F must be protected against the effects of low temperature exposure.

Piping must be suitable for **temperatures and pressures** to which subjected. Tanks must be separated from buildings, lot lines, air intakes, combustible debris, patient areas and places of public assembly.

MEDICAL GASES

Several gases, both flammable and nonflammable, may be encountered in health care facilities. These include oxygen, nitrous oxide, carbon dioxide, and medical air. Medical gases must comply with the general requirements for flammable gases with respect to MAQs. They must be stored in a separate area. Oxidizing gases cannot be stored with any flammable gas or liquid.

Medical gases, if stored indoors, must be in a:

- One-hour exterior room.
- One-hour interior room.
- Gas cabinet.

Exterior rooms must be separated from remainder of building by one-hour assembly. Openings to interior spaces must be protected with self-closing smoke and draft assemblies of one-hour rating.

Two exterior vents of 36 square inches, one within 6 inches of floor and one within 6 inches of ceiling, are required. The room should have a sprinkler “to provide cooling” in case of fire.

Interior rooms have the following requirements:

- One-hour rated room.
- Sprinklered.
- Room shall be exhausted to outside by one-hour rated supply and exhaust ducts flow rate of 1 cubic foot per minute per square foot.

Gas cabinets have a three-cylinder maximum. They must be made of 12 gauge steel with self-closing limited access ports, self-closing doors. Gas cabinets must be connected to an exhaust system with ventilation velocity no less than 200 feet per minute and internally sprinklered.

CORROSIVES

Corrosive materials are widely used in industry and will be encountered by inspectors. They pose a serious **immediate** risk to skin, tissue, eyes and other parts of the body. Most commonly encountered acids are corrosive. However, not all acids are classified as corrosives. Carborane super acid is an example of a noncorrosive acid that does not pose a risk to body tissue.

Some strong bases are corrosives such as sodium hydroxide (NaOH) and potassium hydroxide (KOH). Corrosives may be either acids or bases.

Typical corrosives include:

- Sulfuric acid.
- Nitric acid.
- Sodium hydroxide.

- Potassium hydroxide.
- Hydrochloric acid.
- Sodium hypochlorite.
- Glacial acetic acid.
- Acetic anhydride.

Both acids and bases destroy the skin by catalyzing the hydrolysis of fats. Corrosives can be solids (potassium hydroxide), liquids (sulfuric acid), or gas (chlorine). Corrosives can attack steel and aluminum and will attack adjacent containers if released.

They can pose a threat to firefighters in runoff water.

Control considerations are:

- Segregation.
- Containment.
- Spill control.
- Neutralizing.

Storage of Corrosive Liquids

If individual containers of corrosive liquid exceeding 55 gallons are being stored indoors, or if the aggregate capacity of multiple containers exceeds 1,000 gallons, then spill containment must be provided. Spill control can be accomplished in several ways, including liquid-tight raised or recessed floors or dikes. Sumps and collection systems can also be used. Codes also provide for special engineered systems of spill control. This could include chemical neutralization of an acid.

When the amount of corrosive liquid exceeds that permitted for a control area, the floors of the storage area must be liquid tight.

When corrosive liquid tanks are installed out-of-doors exceeding a specific size, secondary containment must be provided. Some codes require this for tanks over 1,000-gallon capacity. Outdoor storage is also required to have clearance to public ways and lot lines.

When corrosives are used or dispensed indoors, mechanical ventilation must be provided because of the injurious nature of corrosive fumes. Acids are used in waste water treatment to neutralize pH.

OXIDIZERS

Oxidizers are used for a wide variety of purposes and will be found in a large number of occupancies. Examples of oxidizers and some of their uses include the following:

- Ammonium nitrate — fertilizer, herbicide, insecticide, explosives.
- Calcium chlorate — photography, pyrotechnics, herbicide.
- Calcium chlorite — corrosion inhibitor, pigment, metal coating.
- Hydrogen peroxide — bleaching of textiles, foam rubber, electroplating, water distillation, refining metals.
- Sodium nitrate — curing foods, fertilizer, dye manufacturing.

The hazard of individual oxidizers depends on their specific chemistry. As was described in Unit 3, oxidizers are classified from Class 4 (most reactive) to Class 1 (least reactive). The class of an oxidizer in some cases will depend on the concentration. For example, perchloric acid solutions less than 50 percent by weight are Class 1 oxidizers. Perchloric acid solutions 50 to 60 percent are Class 2 and solutions 60 to 72 percent are Class 3. Oxidizers are found in low concentrations in household cleaning products.

Storage

Oxidizers are stored in tanks and bins. Tanks are for the storage of bulk liquid oxidizers. Bins are for the storage of bulk solid oxidizers.

Both tanks and bins must meet the following requirements:

- Materials of construction need to be compatible with the oxidizer stored.
- Design and construction must be in accordance with federal, state and local regulations or, as a minimum, in accordance with nationally recognized engineering practices.
- American Society of Mechanical Engineers (ASME).
- American Petroleum Institute (API).

Incompatible materials such as ordinary combustibles, combustible and flammable liquids, greases, other oxidizers, and other materials that have the potential to react with an oxidizer should avoid contact. Solid oxidizers should not be stored below liquid oxidizers.

They should be stored to prevent contact with water. This can affect container integrity and product stability. When flammable and combustible liquids containers are stored with oxidizer containers, they should be separated by at least 25 feet.

The codes will have differing requirements for oxidizers based on their class, as well as restrictions on the amount of oxidizers which can be stored in certain occupancies. Class 4 liquid and solid oxidizers cannot be stored or used in residential occupancies. Class 4 cannot be stored or used in office or retail spaces of business, factory, mercantile or storage occupancies.

A maximum of 200 pounds or 20 gallons of solid or liquid Class 3 oxidizers are permitted in institutional occupancies for maintenance or operational purposes.

Oxidizing gases must also meet requirements of compressed gases, e.g., nitrous oxide, nitrogen dioxide. When amount exceeds the amount permitted in control areas, **detached** buildings are required. A separation distance is required that will depend on the oxidizer class and the quantity. Oxidizers cannot be on or against combustible materials. Code may require smoke detection system unless sprinklered.

HIGHLY TOXIC AND TOXIC MATERIALS

Highly Toxic Material

A material that produces a lethal dose or lethal concentration that falls within any of the following categories:

- A chemical that has a median lethal dose (LD_{50}) of 50 milligrams/kilograms or less of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

- A chemical that has a median lethal dose (LD_{50}) of 200 milligrams/kilograms or less 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 or albino rats weighing 200 and 300 grams each.

- A chemical that has a median lethal concentration (LC_{50}) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 milligrams/liters or less of mist, fume, or dust, when administered by continuous inhalation for one hour, or less if death occurs within one hour, to albino rats weighing between 200 and 300 grams each.

Toxic Material

A chemical that has a median lethal dose of 50 to 500 milligrams per kilogram of body weight administered orally to albino rats weighing between 200 and 300 grams each.

Definitions

- Dose: An amount of a substance taken at one time.
- Concentration: Amount of a component in a volume.
- Containment system: Gas-tight recovery system that can be placed over the top of a leak to stop or control the escape of gas from the leaking cylinder.
- Containment vessel: Gas-tight recovery vessel that can encapsulate a leaking container.
- Excessive flow valve: A valve designed to positively shut off the flow of gas in the event that its predetermined flow is exceeded.
- Reduced flow valve: Restrictive flow orifice valve that is inserted into a compressed gas cylinder to reduce the maximum flow from the valve under full load condition.

Exceptions

Fire codes will contain some exceptions for the storage and use of toxic materials. These include mainly pesticide and agricultural products used for weed abatement and similar application in accordance with manufacturer's instructions, as well as transportation of pesticides in compliance with the federal Hazardous Materials Transportation Act. The codes do not apply to consumer-type products in dwellings and private garages.

MAQs are established for highly toxic and toxic materials. The International Fire Code (IFC) establishes the following MAQs.

Table 2703.1.1(2) — Maximum Allowable Quantity per Control Area of Hazardous Material Posing a Health Hazard

Material	STORAGE			USE-CLOSED SYSTEM			USE-OPEN SYSTEMS	
	Solid pounds	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid pounds	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid pounds	Liquid gallons (pounds)
Highly Toxic	10	(10)	20	10	(10)	20	3	(3)
Toxic	500	(500)	810	500	(500)	810	125	(125)

Indoor Storage

For chemicals that pose a health hazard, indoor storage requires that the floor be liquid tight. For highly toxic solids and liquids:

- Storage shall be in an approved hazardous material storage cabinet.
- Isolated from other material storage by construction according to the International Building Code (IBC).

Indoor methods of liquid transfer.

- Safety cans complying with Underwriters Laboratories (UL) 30.
- Closed piping system.
- From containers or tanks with approved pump system.
- If moved by gravity, must have self-closing or automatic closing valves and secondary containment.
- An approved engineered liquid transfer system.

Indoor storage requires an exhaust ventilation open system, that is, a mechanical exhaust ventilation that provides for capture of gases, fumes, mist or vapors at the point of generation. Mechanical exhaust ventilation must be provided in a closed system only if the closed system will be opened as part of normal operation.

Cylinders and tanks stored in gas cabinets.

- Gas cabinet shall be located within a gas room.
- Exhaust ventilation shall be provided.
- Gas cabinet or exhaust enclosure shall be provided for leaking cylinders.
- Leaking portable cylinders shall be provided with portal ventilation ducts directed to a treatment system.

Piping controls for stationary tanks must include:

- Pressure relief devices that vent to a treatment area.
- Pressure relief valves on outdoor systems that are intended to relieve pressure for fire exposure are not required to be vented.

- Filling and dispensing connections shall have a means of local exhaust and be exhausted to a treatment facility.

- Stationary tanks provided with the means of excess flow control.

Gas Rooms

Gas rooms must be exhausted to an exhaust system that is equipped with an approved sprinkler system. An alternative fire extinguishing system shall not be used. Automatic fire detection must be provided in accordance with Section 907.

- Gas detection system shall be provided.

- Will initiate the local alarm when gas is detected and transmit to a constantly attended control station.

- Gas detection system shall shut off gas automatically at the source.

Treatment systems are utilized to handle accidental releases. They must be capable of diluting, absorbing, containing, neutralizing or burning highly toxic and toxic gases. Maximum discharge of gas to be reduced to one-half of the Immediately Dangerous to Life and Health (IDLH) level. Treatment systems are sized to handle the worst-case scenario. Stationary tanks, portable tanks and cylinders must be labeled with maximum rate of release for compressed gas.

Emergency power standby power must be provided in gas rooms with a valve that will close automatically when gas is detected.

Limitations for Indoor Use and Storage

- Highly toxic compressed gas shall not be stored or used in Group A, E, I and U occupancies. Exception is 20 cubic feet within gas cabinets for fume hoods.

- Group R — highly toxic compressed gas and toxic shall not be stored or used in Group R occupancies.

- Office, retail sales, and classrooms shall not store or use highly toxic or toxic compressed gas. Exception is for classroom with 20 cubic feet or less in gas cabinet or fume hood.

Use of Exhausted Enclosures to Increase MAQ

- Noncombustible construction.

- Ventilation system operated negative pressure.

- Installed in accordance with the International Mechanical Code.

Gas Cabinets

- Construction of 12 gauge steel.
- Self-closing ports in windows.
- Self-closing doors.
- Interior treated with material that is compatible with the hazardous material stored.

Outdoor Storage and Use of Solids and Liquids

Outdoor storage location must be 20 feet from lot lines, public streets, public alleys and public way. A two-hour fire barrier wall 30 inches above and to the sides of the storage may be used in lieu of the 20-foot rule.

Exhaust scrubbers must be provided where spill or accidental release can be expected. Installation is performed according to the International Mechanical Code.

Outdoor Storage Piles

- 2,500 cubic feet per pile.
- Aisle width of 10 feet between piles or one-half the height of the pile.

Weather Protection

- Overhead weather protection with automatic sprinkler system or storage vessel shall be fire resistant.
- Noncombustible construction according to the IBC.
- Outdoor liquid transfer same as indoor.

Outdoor Location of Storage or Use of Gases

The distance to exposures should be 75 feet from the lot line, public street, public way or exit discharge. The location must include a two-hour fire barrier that interrupts a line of sight between storage and exposure and is at least 5 feet from any exposure and does not have more than two sides of approximately 90 degrees.

Openings in exposure building not associated with the manufacture of the toxic gas must be protected with a two-hour fire barrier and/or the building cannot be within 75 feet of storage. Air intakes must not be located within 75 feet of storage.

Leaking cylinders or tanks must have a gas cabinet adjacent to the outside storage area. Portable tanks, piping and controls, and stationary tanks must be in accordance with indoor regulations.

Ozone gas generator rooms must be in accordance with the International Mechanical Code including:

- Six air changes per hour.
- Gas detection.
- Normally not occupied.
- Room access doors are marked properly.

ORGANIC PEROXIDES

Peroxides can be either inorganic or organic. Organic peroxides are unique in the code because of their explosive properties. They are chemically characterized by a weak oxygen-to-oxygen bond in the molecule. Organic peroxides are derived from hydrogen peroxide by chemically replacing the hydrogen atoms with an organic structure. The weak bonding of the oxygen atoms results in a tendency to react and form more chemically stable substances. A violent decomposition of organic peroxide can be initiated by heat, shock, light or sparks. They easily react with strong oxidizing and reducing agents.

Examples of organic peroxides include the following:

- Butyl hydroperoxide.
- Diacetyl peroxide.
- Dibenzoyl peroxide.
- Dicumyl peroxide.
- Diisopropyl peroxydicarbonate.
- Methyl ethyl ketone peroxide.

As with oxidizers, organic peroxides are classified from Class 1 to Class 5 with Class 1 being the most hazardous. Class 1 organic peroxides can react with sufficient force to create a deflagration hazard. Some organic peroxides, known as unclassified detonable, are capable of a detonation

under fire conditions. As in the case of oxidizers, the hazard classification of an organic peroxide can be affected by its concentration. The following chart illustrates the effect of concentration on hazard class for dibenzoyl peroxide:

Concentration	Hazard Class
98 percent	I
78 percent in water	II
75 percent in water	III
70 percent in water	IV
55 percent in plasticizer	III

Appropriately, codes contain restrictions on the storage of organic peroxides. Any amount of Class I organic peroxides and organic peroxides capable of detonation must be stored in a hazardous material cabinet in A, E, I and U occupancies. The MAQ permitted in control areas is small. The MAQ of Class I organic peroxide for example is 1 pound.

Unclassified detonable and Class I organic peroxides shall not be stored or used in R occupancies.

Unclassified detonable and Class I organic peroxides shall not be stored or used in offices or retail sales areas of B, F, M or S occupancies. Unclassified detonable and Class I organic peroxides are permitted in the classrooms in B, F or M occupancies in hazardous materials cabinets.

Unclassified detonable organic peroxides that are capable of detonating in their normal shipping containers, when stored indoors, are stored as explosives. When the amount of organic peroxides stored exceeds the MAQ for detonable and Class I organic peroxides, they must be stored in a **detached** building. Detached buildings can also be required for Class II and III organic peroxides.

Special Requirements for Organic Peroxides

The vast majority of organic peroxides are found at refrigerated temperatures, some at freezing temperatures (below 0 C). If you are looking at organic peroxides, be sure they are not in general refrigerators or coolers; you must have secondary power supplies to keep them cool or else, during a power outage, they may explode.

Rooms for the storage of organic peroxides must have liquid-tight floors. Storage areas for Class I and II organic peroxides must have electrical equipment complying with the requirements for Class I, Division 2 locations. A smoke detection system is required where Class I, II or III are stored. The smoke detectors shall sound a local alarm. Such a system is not required in detached sprinkler systems.

Because of the sensitivity of organic peroxides, special storage arrangements are required. Containers and packages in storage areas are required to be closed. Bulk storage is not permitted in piles or bins. A 2-foot space is required between the storage and a wall that is not insulated. Fifty-five gallon drums cannot be stored more than one high. Class I and II organic peroxides must be stored on the ground floor. Explosion control is required for indoor storage rooms and areas containing unclassified detonable and Class I organic peroxides.

PYROPHORIC MATERIALS

Pyrophoric materials will ignite spontaneously in air at temperatures of or below 130 F (54 C). In addition, they may be toxic, corrosive or water-reactive. This section will demonstrate that they require very special handling procedures.

Examples of pyrophoric materials include:

- Finely divided metals or metal powders.
- Nonmetal hydrides.
- Phosphorus.
- Alkali metals: lithium, sodium, potassium.
- Gases: silane, dichlorosilane, phosphine.

Pyrophoric materials are used for applications, such as spark mechanisms in cigarette lighters and firearms. They are also encountered in semiconductor manufacturing and research laboratories. Pyrophorics can be solid, liquid or gas.

Pyrophoric liquids are handled in bottles with a lined septum. They are also supplied in tanks. The handling procedures for pyrophoric liquids are very precise. The liquid is withdrawn from the bottle using a syringe which is dry and flushed with an inert gas.

Pyrophoric solids are stored in an inert atmosphere or in kerosene. Working with pyrophoric solids requires a glove box with an inert atmosphere. Some pyrophoric solids, such as sodium hydride, can be handled for a short period of time in air depending on the ambient temperature, lower temperatures being safer. However, this is not desirable. Avoid storage near heat and flame, oxidizers and water. All containers should be labeled with the correct chemical name and hazard warning.

Disposal of a small amount of pyrophoric solid can be accomplished by a process known as quenching. The pyrophoric solid is diluted with a nonreactive solvent, such as toluene. The solution can be added to dry ice and then quenched with a mildly reactive substance such as methanol.

Pyrophoric gases must be handled in a closed system and must be used within a purged containment system. Pyrophoric gases must be stored in gas cabinets in an inert atmosphere. Amounts exceeding the MAQ for pyrophoric gases must be in detached storage buildings. Safety clearances are required from the detached buildings depending on the amount stored. For example, 250 cubic feet of gas in a detached building would require a safety clearance of 25 feet from an interior lot line.

The MAQ for pyrophoric materials are listed in the IFC as follows:

Table 2703.1.1(1) — Maximum Allowable Quantity per Control Area of Hazardous Materials Posing a Physical Hazard

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE			USE-CLOSED SYSTEMS			USE-OPEN SYSTEMS	
			Solid Pounds (cubic feet)	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid Pounds (cubic feet)	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid Pounds (cubic feet)	Liquid gallons (pounds)
Pyrophoric	N/A	H-2	4	(4)	50	1	(1)	10	0	0

UNSTABLE REACTIVE MATERIALS

An unstable reactive material is defined as a material, other than an explosive, which, in the pure state or as commercially produced, will vigorously polymerize, decompose, condense, or become self-reactive and undergo other violent chemical changes, including explosion, when exposed to heat, friction, or shock, or in the absence of an inhibitor, or in the presence of contaminants, or in contact with incompatible materials. Examples include acetylene, dry nitrocellulose, and hydrazine.

Unstable reactive materials are divided into four classes for code purposes with Class 4 being the most hazardous and Class 1 the least hazardous.

Class 4

Materials readily capable of detonation, explosive decomposition, or explosive reaction at NTPs. This class includes materials that are sensitive to mechanical or localized thermal shock at NTPs.

Class 3

Materials capable of detonation, explosive decomposition, or explosive reaction but require a strong initiating source or which must be heated under confinement before initiation. This class includes materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.

Class 2

Materials that are normally unstable and readily undergo violent chemical change but do not detonate. This class includes materials that can undergo chemical change with rapid release of energy at NTPs, and materials that can undergo violent chemical change at elevated temperatures and pressures.

Class 1

Materials that are normally stable but can become unstable at elevated temperatures and pressures.

Indoor Storage

Indoor storage of Class 3 and 4 unstable (reactive) materials must meet the requirements of the IBC for explosives. Indoor storage rooms for Class 3 and 4 unstable (reactive) materials must have explosion control. Floors of storage areas must be liquid tight.

Indoor piles of unstable (reactive) materials greater than 500 cubic feet are to be separated into piles of 500 cubic feet with aisle widths equal to the height of the piles or 4 feet, whichever is greater. Unstable (reactive) materials cannot be stored in basements.

Outdoor Storage

Outdoor storage of unstable (reactive) materials Class 4 and 3 (detonable) is required to be separated from exposures in accordance with the requirements for explosives. Outdoor storage of Class 2 and 1 have separation distances of 20 feet. Piles are limited to 1,000 cubic feet. Aisle widths are one-half the pile height or 10 feet, whichever is greater.

Picric Acid

Picric acid is a well-known reactive material. Its history can be traced to the eighteenth century. Its earliest use was for military explosives.

Potential Acute Health Effects

Very hazardous in case of skin contact (irritant) and eye contact (irritant). Hazardous in case of ingestion or inhalation. Slightly hazardous in case of skin contact (permeating). Corrosive to eyes and skin. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastrointestinal or respiratory tract, characterized by burning,

sneezing and coughing. Severe overexposure can produce lung damage, choking, unconsciousness or even death. Inflammation of the eye is characterized by redness, watering and itching. Skin inflammation is characterized by itching, scaling, reddening or occasionally blistering.

Potential Chronic Health Effects

Slightly hazardous in case of skin contact (sensitizer). Carcinogenic effects: not available. Mutagenic effects: mutagenic for bacteria and/or yeast. Teratogenic effects: not available. Developmental toxicity: not available. The substance is toxic to mucous membranes. The substance may be toxic to blood, kidneys and liver. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction or dermatitis. Repeated inhalation of dust can cause lung damage.

Uses

It is also used in electric batteries, as a reagent, and in the analytical chemistry of ores. Dry picric acid is very shock sensitive. Picric acid is stored under water in glass or plastic bottles. If stored in a metal container, picric acid can form metal picrate salts which are more sensitive and hazardous than the acid itself.

Picric acid is sometimes encountered in laboratory store rooms where it may have been abandoned or left unused for some time. In these circumstances, it is often found to have “dried out,” rendering it very hazardous.

Handling Picric Acid

Do not allow picric acid to dry out. Do not let dry picric acid (crystals) form in the container or on the cap threads of a container creating a strong incandescent light. Ground all equipment containing the material. Empty containers may pose a fire risk. Avoid shock and friction. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, metals and alkalis. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label to medical provider(s). Keep away from heat. Keep away from sources of ignition.

Picric Acid Storage

Picric acid should be stored in a segregated area away from oxidizing and organic materials. They should be isolated from organic materials. Do not store in metal containers. Keep the container in a cool, well-ventilated area. Keep wet with a minimum of 30 percent water so that it

doesn't dry out. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition.

WATER-REACTIVE MATERIAL

Water-reactive materials are those that explode; violently react; produce flammable, toxic or other hazardous gases; or evolve enough heat to cause autoignition or ignition of combustibles upon exposure to water or moisture. The concern to firefighters is obvious. Water cannot be used on fires involving water-reactive materials.

Water-reactive materials include aluminum carbide, calcium carbide, lithium, magnesium phosphide and sodium.

As with other hazardous materials, there are varying degrees of hazards which are reflected in how they are treated in the codes. Water-reactive materials are classified as follows:

- Class 3 — materials that react explosively with water without requiring heat or confinement.
- Class 2 — materials that react violently with water or have the ability to boil water. Materials that produce flammable, toxic, or other hazardous gases, or evolve enough heat to cause autoignition or ignition of combustibles upon exposure to water or moisture.
- Class 1 — materials that react with water with some release of energy but not violently.

The MAQs for the water-reactive materials are as follows:

Table 2703.1.1(1) — Maximum Allowable Quantity per Control Area of Hazardous Materials Posing a Physical Hazard

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE			USE-CLOSED SYSTEMS			USE-OPEN SYSTEMS	
			Solid Pounds (cubic feet)	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid Pounds (cubic feet)	Liquid gallons (pounds)	Gas cubic feet at NTP	Solid Pounds (cubic feet)	Liquid gallons (pounds)
Water reactive	3 2 1	H-2 H-3 Not Applicable	5 50 Not Limited	(5) (50) Not Limited	N/A	5 50 Not Limited	(5) (50) Not Limited	N/A	1 10 Not Limited	(1) (10) Not Limited

Calcium Carbide

- Class 2 water-reactive material.
- MAQ is 50 pounds in storage and closed systems; 10 pounds in open systems.

Rooms that are used for the storage of water-reactive solids and liquids are required to be constructed to resist the penetration of water. The only piping carrying water permitted in such rooms is piping for automatic sprinklers. Although the IFC does not prohibit automatic sprinkler systems where water-reactive materials are stored, the IFC does permit omission of sprinklers in rooms where the application of water would create a serious life or fire hazard. This could obviously be applied to water-reactive materials.

Handling

Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe dust.

Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible.

Keep away from incompatibles such as oxidizing agents, acids, alkalis and moisture.

Indoor Storage Exceeding MAQ

Detached storage should be away from occupied structure. Liquid-tight floor. Liquid-tight construction. The room should be waterproof. Piping carrying water for other than approved automatic sprinkler systems shall not be within such rooms or areas.

Indoor storage rooms and areas containing Class 2 or 3 water-reactive solids and liquids are required to have an explosion control system. The explosion control system could be either a system of deflagration venting or an explosion suppression system.

When a Class 3 area is equipped with automatic sprinkler systems, materials are to be in water-tight containers. Note: The IFC permits omission of automatic sprinklers when water would create a fire or life hazard. The codes contain requirements for indoor storage configuration. Solid and liquid indoor storage must be in piles no greater than 500 cubic feet. Aisle widths between piles are to be no less than one-half the height of the pile or 4 feet, whichever is greater.

Outdoor Storage

Outdoor storage of water-reactive solids and liquids shall be within tanks or closed water-tight containers.

Outdoor storage of Class 3 water-reactive solids and liquids shall not be within 75 feet (22,860 millimeters) of buildings, lot lines, public streets, public alleys, public ways, or means of egress.

Outdoor storage of Class 2 water-reactive solids and liquids shall not be within 20 feet (6,096 millimeters) of buildings, lot lines, public streets, public alleys, public ways, or means of egress.

A two-hour fire barrier wall without openings or penetrations, and extending not less than 30 inches (762 millimeters) above and to the sides of the storage area, is allowed in lieu of such distance. The wall shall either be an independent structure or the exterior wall of the building adjacent to the storage area.

Class 3 water-reactive solids and liquids shall be limited to piles no greater than 500 cubic feet (14 cubic meters). Class 2 water-reactive solids and liquids shall be limited to piles not greater than 1,000 cubic feet (28 cubic meters). Aisle widths between piles shall not be less than one-half the height of the pile or 10 feet (3,048 millimeters), whichever is greater.

Secondary containment shall be provided in accordance with the provisions of Section 5004.2.2.4.

EXPLOSIVES AND FIREWORKS

There is a difference between high-explosive and low-explosive materials.

Explosion — the bursting or rupture of an enclosure or a container due to the development of internal pressure from a deflagration (NFPA 1, *Fire Code*).

Explosion — the sudden conversion of potential energy (chemical or mechanical) into kinetic energy with the production and release of gases under pressure, or the release of gas under pressure. These high-pressure gases then do mechanical work such as moving, changing or shattering nearby materials (NFPA 921, *Guide for Fire and Explosion Investigations*).

Explosive material — a chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion.

High-explosive — a material that is capable of sustaining a reaction front that moves through unreacted material at a speed equal to or greater than that of sound in the medium (typically 3,000 feet per second); a material capable of sustaining a detonation (NFPA 921).

Low-explosive — an explosive that has a reaction velocity of less than 3,000 feet per second (NFPA 921).

Fire Inspector's Role

Regulate storage used in normal day-to-day operations of construction blasting, demolition and special uses.

The use of fireworks is a cultural and historic tradition in the United States. Unfortunately, fireworks are hazardous from a fire and personnel safety standpoint. The sale and use of fireworks are controlled by a variety of local laws both on a state and local basis. Fireworks vary from those intended for retail use to those intended for public displays.

There are several government agencies that will have authority over various aspects of explosives and fireworks. These include law enforcement, state agencies, and federal agencies, such as the DOT and the Consumer Product Safety Commission (CPSC).

The Use of Explosives Will Also Vary From Jurisdiction to Jurisdiction

In some areas, the use of explosives is common for construction, demolition or quarrying. In other areas, explosives may be rarely used.

The fire codes contain extensive and fairly complicated regulations for both fireworks and explosives. This is due in part to the technical nature of explosives and fireworks.

The fire inspector will serve in two functions. The first is the controller of the legitimate use of explosives or fireworks through permitting and inspection, such as for a planned fireworks display. The other is locating and identifying unlawful explosives and fireworks in the course of normal inspections.

The location and identification of unlawful explosives has become increasingly important due to the heightened concern for potential acts of terrorism. One problem for the inspector is recognizing explosive packaging. Some explosive packaging simply does not stand out and could be overlooked.

Exceptions

As with hazardous materials in general, fire codes contain several exceptions. Fire codes typically do not apply to:

- Armed forces of the U.S.
- Small arms ammunition when packaged in accordance with DOT packaging requirements.
- Possession, storage and use of no more than 1 pound of sporting black powder, 20 pounds of smokeless black powder, and 10,000 small arms primers for hand loading of small arms ammunition for personal consumption.
- The use of explosive materials by federal, state, and local regulatory, law enforcement, and fire agencies.
- Special industrial explosive devices (like stud drivers) that in the aggregate contain less than 50 pounds of explosive material.
- Possession, storage and use of blank industrial power load cartridges

- Transportation in accordance with DOT 49 Code of Federal Regulations (CFR).
- Items pre-empted by federal regulations.
- Model and high-powered rocketry, which is covered by other NFPA standards.
- Mining and quarry operations are usually regulated by state government mining authorities.
- Transportation of explosive falls under the DOT and state police.

Administrative Oversight of Explosives

Appropriately, codes contain provision for the administrative control of explosives and fireworks. These include establishing minimum qualifications for people in charge of explosives and fireworks; possible supervision by the fire official of operations; notification of the fire official of the establishment of a permanent or temporary storage site; and the authority to seize explosives and fireworks found in violation of the code.

Permits

Fire codes require permits for the manufacture, storage, handling, sale or use of explosives and fireworks. In addition to requiring permits, codes will require a bond or liability insurance policy before blasting or fireworks displays.

Prohibited Explosives

Codes prohibit the possession, use or handling of some explosives including:

- Liquid nitroglycerin.
- Dynamite with more than 60 percent liquid explosive ingredient.
- Dynamite with an absorbent that permits leakage.
- Nitrocellulose in a dry and uncompressed condition in a quantity greater than 10 pounds.
- Fulminate of mercury in a dry condition and fulminate of all other metals in any condition except as a component of manufactured articles not hereinafter forbidden.
- Explosive compositions that ignite spontaneously or undergo marked decomposition, rendering the products of their use.

- More hazardous when subjected for 48 consecutive or less to a temperature of 167 F.
- New explosive materials until approved by DOT.
- Explosive materials condemned by DOT and others listed in the IFC.
- Explosive materials containing an ammonium salt and a chlorate.
- Explosives not packed or marked as required by DOT.

Classes of Explosives

Explosives are classified by DOT as follows:

- **Division 1.1:** Explosives that have a mass explosion hazard. A mass explosion is one that affects almost the entire load.
- **Division 1.2:** Explosives that have a projection hazard but not a mass explosion hazard.
- **Division 1.3:** Explosives that have a fire hazard and either a minor blast or a minor projection hazard or both, but not a mass explosion hazard.
- **Division 1.4:** Explosives that pose a minor explosion hazard. The explosive effects are largely confined to the package, and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause a virtually instantaneous explosion of almost the entire contents of the package.
- **Division 1.5:** Very insensitive explosives. This division is comprised of substances that have a mass explosion hazard but which are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.
- **Division 1.6:** Extremely insensitive articles that do not have a mass explosion hazard. This division is comprised of articles that contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation.

Separation Distances

A key consideration in the safe storage of explosives is the separation distance of the explosive from neighboring property. The safe distance will depend on the amount of explosive and the division of explosive. The codes make use of quantity-distance (Q-D) tables in establishing minimum separations. The tabular separation distances in the codes do not provide absolute safety.

Q-D Tables and Abbreviations

Q-D is the quantity of the explosive material and separation distance relationships providing protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures and are tabulated in the appropriate Q-D tables. The separation distances specified afford less than absolute safety.

Minimum separation distance (D): The minimum separation distance (D) between adjacent buildings occupied in conjunction with the manufacture, transportation, storage or use of explosive materials where one of the buildings contains explosive materials and the other building does not.

Intraline distance (ILD) or intraplant distance (IPD): The distance to be maintained between any two operating buildings on an explosive manufacturing site when at least one contains or is designed to contain explosives, or the distance between a magazine and an inhabited building or site boundary.

Inhabited building distance (IBD): The minimum separation distance between an operating building or magazine containing explosive materials and inhabited building or site boundary.

Intermagazine distance (IMD): The minimum separation distance between magazines.

Public traffic route (PTR):

Handling and Storage

Explosive storage is limited to magazines. A magazine is a structure designed and constructed for storing the explosive materials.

Blasting agents are commonly stored in tractor-trailer trucks that transport them from site to site.

Magazines

Fire codes require that explosives and explosive materials (blasting agents and detonators) be stored in magazines. A magazine is a building, structure or container approved for the storage of explosives.

There are several types of magazines:

- Type 1: A permanent structure, such as a box, bin or other container, constructed as required for Type 2, 4 or 5 magazine in accordance with NFPA 495, *Explosive Materials Code*; NFPA 1124, *Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles;* or DOT 27 CFR so as to be fire resistant and theft resistant.

- Type 2: A portable or mobile structure, such as a box, skid-magazine, trailer or semitrailer, constructed in accordance with the requirements of NFPA 495, NFPA 1124 or DOT 27 CFR that is fire resistant, theft resistant, weather resistant and ventilated. If used outdoors, a Type 2 magazine is also bullet resistant.

- Type 3: A fire-resistant, theft-resistant and weather-resistant "day box" or portable structure constructed in accordance with NFPA 495, NFPA 1124 or DOT 27 CFR used for temporary storage of explosive materials.

- Type 4: A permanent, portable or mobile structure, such as a building, igloo box, semitrailer or other mobile container that is fire resistant, theft resistant and weather resistant and constructed in accordance with NFPA 495, NFPA 1124 or DOT 27 CFR.

- Type 5: A permanent, portable or mobile structure, such as a building, igloo box, bin, tank, semitrailer, bulk trailer, tank trailer, bulk truck, tank truck or other mobile container that is theft resistant, which is constructed in accordance with NFPA 495, NFPA 1124 or DOT 27 CFR.

Magazine Requirements

- Constructed in accordance with NFPA 495, NFPA 1124 or DOT 27 CFR.

- Explosives.

- Explosive materials.

- Division 1.3 G fireworks.

Exceptions

Exceptions exist for the basic requirement for use of magazines. These are fireworks at display sites in "ready boxes" and portable magazines not exceeding 120 square feet. Also storage of fireworks display site.

Indoor Magazines

The codes provide for the use of indoor magazines. Indoor magazines are limited to Group F, H, M or S occupancies and research and development laboratories. Indoor magazines are required to be fire resistant and theft resistant. They are to be painted red. They are to be fitted with wheels to facilitate removal in the event of an emergency. The door is to be labeled "EXPLOSIVES — KEEP FIRE AWAY."

No more than 50 pounds of explosive material are permitted in one magazine. Magazines are to be located on the first floor within 10 feet of an entrance and only at grade access. Indoor magazines cannot be used in a Group R occupancy. No more than two magazines can be located in the same building with 10-foot separation and less than 5,000 detonators.

Outdoor Magazines

- Outdoor magazines are required to be separated from each other by distances which are determined by the explosives division (1.1, 1.2, etc.) and the amount stored. Where there are two or more magazines situated on the same property, they must be separated by a minimum distance, an IMD.
- Shall comply with Table 5604.5.2(2) and Table 5604.5.2(3). (See IFC 2012.)
- If there are two or more storage magazines on the same property, there is a minimum distance from inhabited buildings, public transportation, and operating buildings. They shall be separated from each other by no less than the IMD.
- Grouped magazines are separated by IMD. Groups shall be considered as one magazine and storage quantities as the same.
- Type 3 magazines as specified in Section 5604.5.3 of the IFC (2012).
- Magazine construction shall be in accordance with Section 5604.6 (IFC 2012).
- Magazine shall be secured.
- No open flame or flame-producing devices.
- Brush will be cleared a distance of 25 feet from around the magazine.
- Combustible storage not within 50 feet.
- No packing and repacking of materials within 50 feet of the magazine.
- Compatible grades material shall be stored together and rotated so the oldest stock is used first.
- Magazine shall be maintained.
- Magazine will be inspected every seven days.

Disposal of Explosive Materials

Fire code official shall be notified whenever leaking or deteriorated explosive materials are determined to be dangerous and are to be disposed. Deteriorated materials considered unstable will be disposed of in accordance with the manufacturer's specifications. Only qualified licensed personnel shall dispose of materials.

Explosive material misfire shall be placed back in the magazine until it can be properly disposed of.

Disposal sites will be in accordance with IFC Section 5604.10.5. Approved burning site shall be saturated with water and inspected before materials are burned. Forty-eight hours must be surpassed between burns of materials. Burns shall be observed from a safe distance by qualified personnel. Personnel shall not re-enter the burn site until it has been thoroughly inspected.

Means of Egress

Means of egress in all buildings shall comply with applicable requirements of NFPA 101, *Life Safety Code*. Means of egress in process buildings also shall comply with the following requirements:

- At least two remotely located means of egress shall be provided from every point in every undivided floor area of more than 100 square feet (9 square meters).

- Where process buildings are divided into rooms, means of egress shall be as follows:

  - At least two means of escape shall be provided from each room of more than 100 square feet (9 square meters).

  - Toilet rooms shall be permitted to have only one means of egress, provided that they are located away from or shielded from process areas.

- An unobstructed means of egress shall be located so that every point within the room or undivided floor area is within 25 feet (7.6 meters) of a means of egress.

- Exit doors shall open outward and shall be capable of being pressure actuated from the inside.

LABORATORIES

Laboratories present a challenge to fire inspectors because of their varied nature. Laboratories may be involved in repetitive routine activities, such as quality control testing or exotic research. There are also mechanical or electrical laboratories. This unit deals with laboratories using chemicals.

For code purposes, a laboratory is defined as "a facility where the containers used for reactions, transfers, and other handling of chemicals are designed to be easily and safely manipulated by one person. A laboratory is a workplace where chemicals are used or synthesized on a nonproduction basis."

Codes also define a laboratory unit as "an enclosed space used for experiments or tests. A laboratory unit can include offices, lavatories, and other incidental contiguous rooms maintained for or used by laboratory personnel, and corridors within the unit. It can contain one or more separate laboratory work areas."

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals* is the standard which addresses laboratories using chemicals. NFPA 45 exempts several types of laboratories such as:

- Laboratories with less than one gallon of flammable or combustible liquid.
- Laboratories containing 75 cubic feet of flammable gas.
- Laboratories which are pilot plants.
- Laboratories that only handle chemicals with a hazard rating as defined in NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response* of 0 or 1.
- Laboratories that are primarily manufacturing plants.
- Incidental testing facilities.
- Physical laboratories that use chemicals only for incidental purposes.
- Hazards associated with radioactive materials.
- Laboratories that work only with explosive material as covered by NFPA 495.

Classification of Laboratories

Laboratory units are classified as A, B, C and D according to the quantities of flammable and combustible liquids specified in Table 10.1.1 or 10.1.5 of NFPA 45.

- Class A is considered a high fire hazard. Ten gallons Class I flammable liquid. Twenty gallons Class I, II and IIIA.
- Class B is considered a moderate fire hazard. Five gallons Class I flammable liquid per 100 square feet. Ten gallons Class I, II and IIIA per 100 square feet.

- Class C is considered a low fire hazard. Two gallons Class I flammable liquid per 100 square feet. Four gallons Class I, II and IIIA per 100 square feet.

- Class D is considered a minimum fire hazard. One gallon Class I flammable liquid per 100 square feet. One gallon Class I, II and IIIA per 100 square feet.

Chemical storage and handling.

- All chemicals should be stored in accordance with the hazard category and compatibility.

- Laboratory should have the Material Safety Data Sheets (MSDS) (Safety Data Sheets (SDS)) on hand so that storage requirements can be ascertained for personnel in the laboratory.

- All chemical containers must be properly labeled with full chemical names, hazard warning, and name of the manufacturer.

- Chemical should be dated upon receipt.

- Disposal of material should be in accordance with the MSDS.

- Chemicals that are heat- and light-sensitive must be in sealed airtight containers with tight-fitting nonmetallic lids.

- Chemicals should not be stored in chemical hoods, on the floor, in the aisles, in areas of egress, or on bench tops.

- Chemicals should be stored away from direct sunlight.

- All containers should be in good condition and be able to be sealed properly. A defective container should be removed and disposed of properly.

- Do not store chemicals in a room with a recirculation ventilation system.

- Chemicals should be stored in such a manner that they will not tip, be punctured, or break.

- Chemicals should not be stored above eye level. Safety cans must be used according to manufacturer specifications for any type of flammable solvents.

- Check floors in areas where containers are stored and check for missing labels.

- All drums should be raised up off the floor so they will not sweat or corrode.

- Liquids should be stored in unbreakable or double-contained packaging, or the storage tray should have the capacity to hold the contents if the containers break or leak.

- Store acids in a dedicated acid cabinet, and store highly toxic materials in a locked dedicated poison cabinet.
- Do not store any chemicals under sinks or near water.
- Flammable liquids in laboratories should be stored in approved containers and cabinets.

Control areas, per the IBC, must be clearly marked with appropriate signage. Information for handling chemicals can be found on the SDS. Every laboratory should maintain an up-to-date chemical inventory.

Transportation of chemicals in the laboratory must be done with devices that can be used as secondary containment. Electrical safety in the laboratory must be maintained to ensure that the Web has a spark-free environment. During laboratory operations, gases stored in cylinders that are flammable, combustible, explosive, corrosive and poisonous may be used in experimental applications.

SUMMARY

- Flammable and combustible liquids.
- Compressed gases.
- Flammable gases.
- Flammable cryogenic fluids.
- LPG.
- Cryogenic fluids.
- Medical gases.
- Corrosives.
- Oxidizers.
- Highly toxic and toxic materials.
- Organic peroxides.
- Pyrophorics.
- Unstable reactive materials.

- Water-reactive materials.
- Explosives and fireworks.
- Laboratories.

This page intentionally left blank.

APPENDIX:
SAFETY DATA SHEETS

This page intentionally left blank.

Material Safety Data Sheet

Acetylene

Section 1. Chemical product and company identification

Product name : Acetylene

Supplier : AIRGAS INC., on behalf of its subsidiaries
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Product use : Synthetic/Analytical chemistry.

Synonym : acetylen; acetylene ; ethine; ethyne; narcylen

MSDS # : 001001

Date of Preparation/Revision : **5/11/2011.**

In case of emergency : 1-866-734-3438

Section 2. Hazards identification

Physical state : Gas.

Emergency overview : WARNING!

FLAMMABLE GAS.
MAY CAUSE FLASH FIRE.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CONTENTS UNDER PRESSURE.

Keep away from heat, sparks and flame. Do not puncture or incinerate container. May cause target organ damage, based on animal data. Use only with adequate ventilation. Keep container closed.

Contact with rapidly expanding gases can cause frostbite.

Target organs : May cause damage to the following organs: lungs, upper respiratory tract, central nervous system (CNS).

Routes of entry : Inhalation

Potential acute health effects

Eyes : Contact with rapidly expanding gas may cause burns or frostbite.

Skin : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : Acts as a simple asphyxiant.

Ingestion : Ingestion is not a normal route of exposure for gases

Potential chronic health effects

Chronic effects : May cause target organ damage, based on animal data.

Target organs : May cause damage to the following organs: lungs, upper respiratory tract, central nervous system (CNS).

Medical conditions aggravated by over-exposure : Pre-existing disorders involving any target organs mentioned in this MSDS as being at risk may be aggravated by over-exposure to this product.

See toxicological information (Section 11)

Section 3. Composition, Information on Ingredients

Name	CAS number	% Volume	Exposure limits
Acetylene	74-86-2	100	**NIOSH REL (United States, 6/2009).** CEIL: 2662 mg/m³ CEIL: 2500 ppm

Section 4. First aid measures

No action shall be taken involving any personal risk or without suitable training.If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus.It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Eye contact : Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention 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. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Inhalation : Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion : As this product is a gas, refer to the inhalation section.

Section 5. Fire-fighting measures

Flammability of the product : Flammable.

Auto-ignition temperature : 305°C (581°F)

Flash point : Closed cup: -18.15°C (-0.7°F).

Flammable limits : Lower: 2.5% Upper: 100%

Products of combustion : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Fire hazards in the presence of various substances : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge, heat and oxidizing materials.

Fire-fighting media and instructions : In case of fire, use water spray (fog), foam or dry chemical.

In case of fire, allow gas to burn if flow cannot be shut off immediately. Apply water from a safe distance to cool container and protect surrounding area. If involved in fire, shut off flow immediately if it can be done without risk.

Contains gas under pressure. Flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions : Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment (section 8). Shut off gas supply if this can be done safely. Isolate area until gas has dispersed.

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Methods for cleaning up : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Section 7. Handling and storage

Handling : Use only with adequate ventilation. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. High pressure gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Keep container closed. Keep away from heat, sparks and flame. To avoid fire, eliminate ignition sources. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Storage : Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Segregate from oxidizing materials. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Personal protection

Eyes : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

The applicable standards are (US) 29 CFR 1910.134 and (Canada) Z94.4-93

Hands : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Personal protection in case of a large spill : Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product.

Product name

Ethyne	**NIOSH REL (United States, 6/2009).** CEIL: 2662 mg/m³ CEIL: 2500 ppm

Consult local authorities for acceptable exposure limits.

Section 9. Physical and chemical properties

Molecular weight : 26.04 g/mole

Molecular formula : C2-H2

Melting/freezing point : Sublimation temperature: -81.8°C (-115.2 to °F)

Critical temperature : 35.3°C (95.5°F)

Vapor pressure : 635 (psig)

Vapor density : 0.907 (Air = 1)

Specific Volume (ft ^{3}/lb) : 14.7058

Gas Density (lb/ft ^{3}) : 0.0691 (-80°C / -112 to °F)

Section 10. Stability and reactivity

Stability and reactivity : The product is stable.

Incompatibility with various substances : Extremely reactive or incompatible with the following materials: oxidizing materials.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Toxicity data

Chronic effects on humans : May cause damage to the following organs: lungs, upper respiratory tract, central nervous system (CNS).

Other toxic effects on humans : No specific information is available in our database regarding the other toxic effects of this material to humans.

Specific effects

Carcinogenic effects : No known significant effects or critical hazards.

Mutagenic effects : No known significant effects or critical hazards.

Reproduction toxicity : No known significant effects or critical hazards.

Section 12. Ecological information

Aquatic ecotoxicity

Not available.

Products of degradation : Products of degradation: carbon oxides (CO, CO_2) and water.

Environmental fate : Not available.

Environmental hazards : This product shows a low bioaccumulation potential.

Toxicity to the environment : Not available.

Section 13. Disposal considerations

Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, local regulation.Return cylinders with residual product to Airgas, Inc.Do not dispose of locally.

Section 14. Transport information

Regulatory information	UN number	Proper shipping name	Class	Packing group	Label	Additional information
DOT Classification	UN1001	ACETYLENE, DISSOLVED	2.1	Not applicable (gas).		**Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: 15 kg

Acetylene						
TDG Classification	UN1001	ACETYLENE, DISSOLVED	2.1	Not applicable (gas).		**Explosive Limit and Limited Quantity Index** 0 **Passenger Carrying Ship Index** 75 **Passenger Carrying Road or Rail Index** Forbidden **Special provisions** 38, 42
Mexico Classification	UN1001	ACETYLENE, DISSOLVED	2.1	Not applicable (gas).		-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 15. Regulatory information

United States

U.S. Federal regulations : **TSCA 8(a) IUR**: Partial exemption
United States inventory (TSCA 8b): This material is listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: Ethyne
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: Ethyne: Fire hazard, reactive, Sudden release of pressure, Immediate (acute) health hazard

Clean Air Act (CAA) 112 accidental release prevention - Flammable Substances: Acetylene

Clean Air Act (CAA) 112 regulated flammable substances: Ethyne

State regulations : **Connecticut Carcinogen Reporting**: This material is not listed.
Connecticut Hazardous Material Survey: This material is not listed.
Florida substances: This material is not listed.
Illinois Chemical Safety Act: This material is not listed.
Illinois Toxic Substances Disclosure to Employee Act: This material is not listed.
Louisiana Reporting: This material is not listed.
Louisiana Spill: This material is not listed.
Massachusetts Spill: This material is not listed.
Massachusetts Substances: This material is listed.
Michigan Critical Material: This material is not listed.
Minnesota Hazardous Substances: This material is not listed.
New Jersey Hazardous Substances: This material is listed.
New Jersey Spill: This material is not listed.
New Jersey Toxic Catastrophe Prevention Act: This material is not listed.
New York Acutely Hazardous Substances: This material is not listed.
New York Toxic Chemical Release Reporting: This material is not listed.
Pennsylvania RTK Hazardous Substances: This material is listed.

Rhode Island Hazardous Substances: This material is not listed.

Canada

WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.
Class F: Dangerously reactive material.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

United States

Label requirements : FLAMMABLE GAS.
MAY CAUSE FLASH FIRE.
MAY CAUSE TARGET ORGAN DAMAGE, BASED ON ANIMAL DATA.
CONTENTS UNDER PRESSURE.

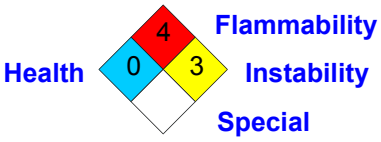
Canada

Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.
Class F: Dangerously reactive material.

Hazardous Material Information System (U.S.A.) :

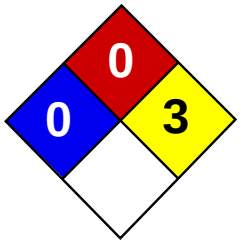
Health	*	1
Flammability		4
Physical hazards		2

National Fire Protection Association (U.S.A.) :



Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.



Health	2
Fire	1
Reactivity	1
Personal Protection	E

Material Safety Data Sheet
Ammonium nitrate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ammonium nitrate

Catalog Codes: SLA3082, SLA4585

CAS#: 6484-52-2

RTECS: BR9050000

TSCA: TSCA 8(b) inventory: Ammonium nitrate

CI#: Not available.

Synonym: Ammonium Saltpeter; Nitric acid, ammonium salt

Chemical Name: Ammonium Nitrate

Chemical Formula: NH4NO3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ammonium nitrate	6484-52-2	100

Toxicological Data on Ingredients: Ammonium nitrate: ORAL (LD50): Acute: 2217 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation (lung irritant). Slightly hazardous in case of skin contact (permeator). Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, mucous membranes. The substance may be toxic to blood, gastrointestinal tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 300°C (572°F)

Flash Points: CLOSED CUP: Higher than 93.3°C (200°F).

Flammable Limits: Not available.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of heat, of combustible materials, of organic materials. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of heat, of combustible materials, of organic materials, of metals.

Fire Fighting Media and Instructions:
Oxidizing material. Do not use water jet. Use flooding quantities of water. Avoid contact with organic materials.

Special Remarks on Fire Hazards:
Caution: Strong Oxidizer. Contact with material may cause a fire. Contact with combustible or organic materials may cause fire.

Special Remarks on Explosion Hazards:
It is an oxidizing agent and can self-ignite/detonate when in contact with powdered metals and some organic materials such as Urea and Acetic Acid.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:

Oxidizing material. Stop leak if without risk. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Keep away from combustible material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (white granular solid. Deliquescent solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 80.05 g/mole

Color: Not available.

pH (1% soln/water): 4.5 - 6.0 @ 25 deg. [Acidic.]

Boiling Point: Decomposition temperature: 210°C (410°F)

Melting Point: 169.6°C (337.3°F)

Critical Temperature: Not available.

Specific Gravity: 1.725 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, acetone.

Solubility:
Easily soluble in cold water, hot water. Soluble in acetone. Partially soluble in methanol. Insoluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with reducing agents, combustible materials, organic materials, metals, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Also incompatible with finely powdered metals (aluminum, copper, chromium, iron, zinc brass, nickel , lead, manganese, magnesium, antimony), acetic acid, ammonium chloride, phosphorus, sodium perchlorate, sulfur, bismuth, cadmium, chlorides, cobalt, potassium and ammonium sulfate, sodium, sodium hypochlorite, sodium-potassium alloy, organic materials and combustible materials (paper, oil, charcoal, etc.)

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 2217 mg/kg [Rat].

Chronic Effects on Humans:
Causes damage to the following organs: lungs, mucous membranes. May cause damage to the following organs: blood, gastrointestinal tract.

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation (lung irritant). Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
Carcinogenic effects: At this time, no studies were found on the possible carcinogenicity of Ammonium Nitrate in humans or experimental animals. However nitrates can be reduced to nitrites in the body, and the formed nitrites can subsequently react with amines to form suspect carcinogens N-nitrosamines. Genetic Effects: No genetic data was found for ammonium. However, in general, nitrates and nitrites are genotoxic. Reproductive Effects: There has been some association between consumption of nitrate-contaminated well water and birth defects, especially neural tube defects. However, these studies would not specifically implicate Ammonium Nitrate.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. It may be absorbed through intact skin. Eyes: Causes eye irritation. Inhalation: Causes respiratory tract (nose, throat), and mucous membrane irritation. Symptoms may include: coughing, severe lung congestion, difficulty breathing. Inhalation of large amounts may cause systemic acidosis, Methemoglobinemia with symptoms similar to acute ingestion. Ingestion: Gastroenteritis with abdominal pain, nausea, vomiting, diarrhea. Exposure to large amounts may affect behavior/central nervous system, and blood and cause Methemoglobinemia, and systemic

acidosis. Symptoms of Methemoglobinemia include cyanosis (blue lips, eyelids, earlobes, and skin), headache, fatigue, weakness, convulsions, dizziness, loss of coordination, nausea, vomiting, dyspnea, and drowsiness. It may also affect the cardiovascular system and cause increased or decreased heart rate, and hypotension. Chronic Potential Health Effects: Ingestion: The toxicity of nitrates is due to in vivo conversion to nitrites. Chronic ingestion of more than 5 mg/kg/day is considered unacceptable. Primary overdose effects include orthostatic hypotension and Methemoglobinemia. Orthostatic hypotension, faintness, fatigue, weakness, depression, mental impairment, dizziness, shortness of breath, and reflex tachycardia are common; headache, nausea and vomiting may also occur. Chronic ingestion may also cause nephritis.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 5.1: Oxidizing material.

Identification: : Ammonium Nitrate UNNA: 1942 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: No products were found. California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: No products were found. Connecticut hazardous material survey.: Ammonium nitrate Rhode Island RTK hazardous substances: Ammonium nitrate Pennsylvania RTK: Ammonium nitrate Massachusetts RTK: Ammonium nitrate Massachusetts spill list: Ammonium nitrate New Jersey: Ammonium nitrate New Jersey spill list: Ammonium nitrate TSCA 8(b) inventory: Ammonium nitrate

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS C: Oxidizing material.

DSCL (EEC):

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 1

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 0

Flammability: 0

Reactivity: 3

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:35 PM

Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

Material Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

CHEVRON REGULAR UNLEADED GASOLINE

Product Number(s): CPS201000 [See Section 16 for Additional Product Numbers]
Synonyms: Calco Regular Unleaded Gasoline

Company Identification
Chevron Products Company
Marketing, MSDS Coordinator
6001 Bollinger Canyon Road
San Ramon, CA 94583
United States of America

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
ChevronTexaco Emergency Information Center: Located in the USA. International collect calls accepted. (800) 231-0623 or (510) 231-0623
Product Information
Technical Information: (510) 242-5357

SPECIAL NOTES: This MSDS applies to: Federal Reformulated Gasoline, California Reformulated Gasoline, Wintertime Oxygenated Gasoline, Low RVP Gasoline and Conventional Gasoline.

SECTION 2 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Gasoline	86290-81-5	100 %volume
Benzene	71-43-2	0.1 - 4.9 %volume
Ethyl benzene	100-41-4	0.1 - 3 %volume
Naphthalene	91-20-3	0.1 - 2 %volume
Ethanol	64-17-5	0 - 10 %volume
Methyl tert-butyl ether (MTBE)	1634-04-4	0 - 15 %volume
Tertiary amyl methyl ether (TAME)	994-05-8	0 - 17 %volume
Ethyl tert-butyl ether (ETBE)	637-92-3	0 - 18 %volume

Motor gasoline is considered a mixture by EPA under the Toxic Substances Control Act (TSCA). The refinery streams used to blend motor gasoline are all on the TSCA Chemical Substances Inventory. The appropriate CAS number for refinery blended motor gasoline is 86290-81-5. The product specifications of motor gasoline sold in your area will depend on applicable Federal and State regulations.

SECTION 3 HAZARDS IDENTIFICATION

****

EMERGENCY OVERVIEW

- EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE
- HARMFUL OR FATAL IF SWALLOWED - MAY CAUSE LUNG DAMAGE IF SWALLOWED
- VAPOR HARMFUL
- CAUSES SKIN IRRITATION
- CAUSES EYE IRRITATION
- LONG-TERM EXPOSURE TO VAPOR HAS CAUSED CANCER IN LABORATORY ANIMALS
- KEEP OUT OF REACH OF CHILDREN
- TOXIC TO AQUATIC ORGANISMS

****

IMMEDIATE HEALTH EFFECTS
Eye: Contact with the eyes causes irritation. Symptoms may include pain, tearing, reddening, swelling and impaired vision.
Skin: Contact with the skin causes irritation. Skin contact may cause drying or defatting of the skin. Symptoms may include pain, itching, discoloration, swelling, and blistering. Contact with the skin is not expected to cause an allergic skin response. Not expected to be harmful to internal organs if absorbed through the skin.
Ingestion: Because of its low viscosity, this material can directly enter the lungs, if swallowed, or if subsequently vomited. Once in the lungs it is very difficult to remove and can cause severe injury or death.
Inhalation: The vapor or fumes from this material may cause respiratory irritation. Symptoms of respiratory irritation may include coughing and difficulty breathing. Breathing this material at concentrations above the recommended exposure limits may cause central nervous system effects. Central nervous system effects may include headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion, or disorientation. At extreme exposures, central nervous system effects may include respiratory depression, tremors or convulsions, loss of consciousness, coma or death.

DELAYED OR OTHER HEALTH EFFECTS:
Reproduction and Birth Defects: This material is not expected to cause birth defects or other harm to the developing fetus based on animal data.
Cancer: Prolonged or repeated exposure to this material may cause cancer. Gasoline has been classified as a Group 2B carcinogen (possibly carcinogenic to humans) by the International Agency for Research on Cancer (IARC).

Contains benzene, which has been classified as a carcinogen by the National Toxicology Program (NTP) and a Group 1 carcinogen (carcinogenic to humans) by the International Agency for Research on Cancer (IARC).
Contains ethylbenzene which has been classified as a Group 2B carcinogen (possibly carcinogenic to humans) by the International Agency for Research on Cancer (IARC).
Contains naphthalene, which has been classified as a Group 2B carcinogen (possibly carcinogenic to humans) by the International Agency for Research on Cancer (IARC).

Whole gasoline exhaust has been classified as a Group 2B carcinogen (possibly carcinogenic to humans) by the International Agency for Research on Cancer (IARC).

Risk depends on duration and level of exposure. See Section 11 for additional information.

SECTION 4 FIRST AID MEASURES

Eye: Flush eyes with water immediately while holding the eyelids open. Remove contact lenses, if worn, after initial flushing, and continue flushing for at least 15 minutes. Get medical attention if irritation persists.
Skin: Wash skin with water immediately and remove contaminated clothing and shoes. Get medical attention if any symptoms develop. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.
Ingestion: If swallowed, get immediate medical attention. Do not induce vomiting. Never give anything by mouth to an unconscious person.
Inhalation: Move the exposed person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if breathing difficulties continue.
Note to Physicians: Ingestion of this product or subsequent vomiting may result in aspiration of light hydrocarbon liquid, which may cause pneumonitis.

SECTION 5 FIRE FIGHTING MEASURES

See Section 7 for proper handling and storage.

FIRE CLASSIFICATION:
OSHA Classification (29 CFR 1910.1200): Flammable liquid.

NFPA RATINGS: Health: 1 Flammability: 3 Reactivity: 0

FLAMMABLE PROPERTIES:
Flashpoint: (Tagliabue Closed Cup) < -45 °C (< -49 °F)
Autoignition: > 280 °C (> 536 °F)
Flammability (Explosive) Limits (% by volume in air): Lower: 1.4 Upper: 7.6

EXTINGUISHING MEDIA: Dry Chemical, CO_2, AFFF Foam or alcohol resistant foam if >15% volume polar solvents (oxygenates).

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: Use water spray to cool fire-exposed containers and to protect personnel. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in the vicinity of the spill or released vapor. If this material is released into the work area, evacuate the area immediately. Monitor area with combustible gas indicator.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. All equipment used when handling the product must be grounded. A vapor suppressing foam may be used to reduce vapors. Use clean non-sparking tools to collect absorbed material. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required. This material is covered by EPA's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Petroleum Exclusion. Therefore, releases to the environment may not be reportable under CERCLA.

SECTION 7 HANDLING AND STORAGE

Precautionary Measures: READ AND OBSERVE ALL PRECAUTIONS ON PRODUCT LABEL. This product presents an extreme fire hazard. Liquid very quickly evaporates, even at low temperatures, and forms vapor (fumes) which can catch fire and burn with explosive violence. Invisible vapor spreads easily and can be set on fire by many sources such as pilot lights, welding equipment, and electrical motors and switches. Never siphon gasoline by mouth.
Use only as a motor fuel. Do not use for cleaning, pressure appliance fuel, or any other such use. Do not store in open or unlabeled containers. Do not get in eyes, on skin, or on clothing. Do not taste or swallow. Do not breathe vapor or fumes. Wash thoroughly after handling. Keep out of the reach of children.
Unusual Handling Hazards: WARNING! Do not use as portable heater or appliance fuel. Toxic fumes may accumulate and cause death.
General Handling Information: Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating an accumulation of electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR 1910.106, 'Flammable and Combustible Liquids', National Fire Protection Association (NFPA 77, 'Recommended Practice on Static Electricity', and/or the American Petroleum Institute (API) Recommended Practice 2003, 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents'. Improper filling of portable gasoline containers creates danger of fire. Only dispense gasoline into approved and properly labeled gasoline containers. Always place portable containers on the ground. Be sure pump nozzle is in contact with the container while filling. Do not use a nozzle's lock-open device. Do not fill portable containers that are inside a vehicle or truck/trailer bed.

General Storage Information: DO NOT USE OR STORE near heat, sparks or open flames. USE AND STORE ONLY IN WELL VENTILATED AREA. Keep container closed when not in use.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to

prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:
Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below the recommended exposure limits.

PERSONAL PROTECTIVE EQUIPMENT
Eye/Face Protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as a good safety practice.
Skin Protection: No special protective clothing is normally required. Where splashing is possible, select protective clothing depending on operations conducted, physical requirements and other substances in the workplace. Suggested materials for protective gloves include: Chlorinated Polyethylene (or Chlorosulfonated Polyethylene), Nitrile Rubber, Polyurethane, Viton.
Respiratory Protection: Determine if airborne concentrations are below the recommended exposure limits. If not, wear an approved respirator that provides adequate protection from measured concentrations of this material, such as: Air-Purifying Respirator for Organic Vapors. When used as a fuel, this material can produce carbon monoxide in the exhaust. Determine if airborne concentrations are below the occupational exposure limit for carbon monoxide. If not, wear an approved positive-pressure air-supplying respirator.
Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.

Occupational Exposure Limits:

Component	Limit	TWA	STEL	Ceiling	Notation
Benzene	ACGIH_TLV	.5 ppm	2.5 ppm		Skin A1
Benzene	OSHA_PEL	1 ppm	5 ppm		
Benzene	OSHA_Z2	10 ppm		25 ppm	
Ethanol	ACGIH_TLV	1000 ppm			A4
Ethanol	OSHA_PEL	1000 ppm			
Ethyl benzene	ACGIH_TLV	100 ppm	125 ppm		A3
Ethyl benzene	OSHA_PEL	100 ppm	125 ppm		
Ethyl tert-butyl ether (ETBE)	ACGIH_TLV	5 ppm			
Gasoline	ACGIH_TLV	300 ppm	500 ppm		A3
Gasoline	OSHA_PEL	300 ppm	500 ppm		
Methyl tert-butyl ether (MTBE)	ACGIH_TLV	50 ppm			A3
Naphthalene	ACGIH_TLV	10 ppm	15 ppm		Skin A4
Naphthalene	OSHA_PEL	10 ppm	15 ppm		
Tertiary amyl methyl ether (TAME)	CHEVRON		50 ppm		

Refer to the OSHA Benzene Standard (29 CFR 1910.1028) and Table Z-2 for detailed training, exposure monitoring, respiratory protection and medical surveillance requirements before using this product.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Colorless to yellow
Physical State: Liquid
Odor: Petroleum odor
pH: NA
Vapor Pressure: 5 psi - 15 psi (Typical) @ 37.8°C (100°F)
Vapor Density (Air = 1): 3 - 4 (Typical)
Boiling Point: 37.8°C (100°F) - 204.4°C (400°F) (Typical)
Solubility: Insoluble in water; miscible with most organic solvents.
Freezing Point: NA
Melting Point: NA
Specific Gravity: 0.7 g/ml - 0.8 g/ml @ 15.6°C (60.1°F)
Viscosity: <1 SUS @ 37.8°C (100°F)

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: May react with strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Hazardous Decomposition Products: None known (None expected)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

IMMEDIATE HEALTH EFFECTS
Eye Irritation: The Draize eye irritation mean score in rabbits for a 24-hour exposure was: 0/110.
Skin Irritation: For a 4-hour exposure, the Primary Irritation Index (PII) in rabbits is: 4.8/8.0.
Skin Sensitization: This material did not cause sensitization reactions in a Modified Buehler guinea pig test.
Acute Dermal Toxicity: 24 hour(s) LD50: >3.75g/kg (rabbit).
Acute Oral Toxicity: LD50: >5 ml/kg (rat)
Acute Inhalation Toxicity: 4 hour(s) LD50: >2000ppm (rat).

ADDITIONAL TOXICOLOGY INFORMATION:
Gasolines are highly volatile and can produce significant concentrations of vapor at ambient temperatures. Gasoline vapor is heavier than air and at high concentrations may accumulate in confined spaces to present both safety and heath hazards. When vapor exposures are low, or short duration and infrequent, such as during refuelling and tanker loading/unloading, neither total hydrocarbon nor components such as benzene are likely to result in any adverse health effects. In situations such as accidents or spills where exposure to gasoline vapor is potentially high, attention should be paid to potential toxic effects of specific components. Information about specific components in gasoline can be found in Sections 2, 8 and 15 of this MSDS. More detailed information on the health hazard of specific gasoline components can be obtained calling the Chevron Emergency Information Center (see Section 1 for phone numbers).

NEUROTOXICITY: Pathological misuse of solvents and gasoline, involving repeated and prolonged exposure to high concentrations of vapor is a significant exposure on which there are many reports in the medical literature. As with other solvents, persistent abuse involving repeated and prolonged exposures to high concentrations of vapor has been reported to result in central nervous system damage and eventually, death. In a study in which ten human volunteers were exposed for 30 minutes to approximately 200, 500 or 1000 ppm concentrations of gasoline vapor, irritation of the eyes was the only significant effect observed, based on both subjective and objective assessments. In an inhalation study, groups of 6 Fischer rats (3 male. 3 female) were exposed to 2056 ppm of wholy vaporized unleaded gasoline for 6 hours perday, 5 day per week for up to 18 months. Histopathology of the peripheral nervous system and spinal cord revealed no distal axonal neuropthy of the type associated with exposure to n-hexane even though gasoline contained 1.9% n-hexane. The authors concluded that gasoline treatment may have amplified the incidence and prominence of some naturally occurring age-related (subclinical) in the nervous system. BIRTH DEFECTS AND REPRODUCTIVE TOXICITY: An inhalation study with rats exposed to 0, 400 and 1600 ppm of wholly vaporized unleaded gasoline, 6 hours per day on day 6 through 16 of gestation, showed no teratogenic effects nor indication of toxicity to either the mother or the fetus. Another inhalation study in rats exposed to 3000, 6000, or 9000 ppm of gasoline vapor, 6 hours per day on day 6 through 20 of gestation, also showed no teratogenic effects nor indications of toxicity to either the mother or the fetus.

CHRONIC TOXICITY/CANCER: Wholly vaporized unleaded gasoline was used in a 3 month inhalation study. Groups of 40 rats (20 males, 20 female) and 8 squirrel monkeys (4 male, 4 female) were exposed 6 hours per day and 5 days per week for 13 weeks to 384 or 1552 ppm gasoline. One group of each species served as unexposed controls. The initial conclusion of this study was that inhalation of gasoline at airborne concentrations of up to 1522 ppm caused no toxicity in rats or monkeys. However, further histopathological examination of male rat kidneys on the highest dose group revealed an increased incidence and severity of regenerative epithelium and dilated tubules containing proteinaceous deposits. Lifetime inhalation of wholly vaporized unleaded gasoline at 2056 ppm has caused increased liver tumors in female mice. The mechanism of this response is still being investigated but it is thought to be an epigenetic process unique to the female mouse.

This exposure also caused kidney damage and eventually kidney cancer in male rats. No other animal model studied has shown these adverse

kidney effects and there is no physiological reason to believe that they would occur in man. EPA has concluded that mechanism by which wholly vaporzied unleaded gasoline causes kidney damage is unque to the male rat. The effects in that species (kidney damage and cancer) should not be used in human risk assesment. In their 1988 review of carcinogenic risk from gasoline, The International Agency for Research on Cancer (IARC) noted that, because published epidemiology studies did not include any exposure data, only occupations where gasoline exposure may have ocurred were reviewed. These included gasoline service station attendants and automobile mechanics. IARC also noted that there was no opportunity to separate effects of combustion products from those of gasoline itself. Although IARC allocated gasoline a final overall classification of Group 2B, i.e. possibly carcinogenic to humans, this was based on limited evidence in experimental animals plus supporting evidence including the presence in gasoline of benzene and 1, 3-butadiene. The actual evidence for carcinogenicity in humans was considered inadequate.

MUTAGENICITY: Gasoline was not mutagenic, with or without activation, in the Ames assay (Salmonella typhimurium), Saccharamyces cerevisesae, or mouse lymphoma assays. In addition, point mutations were not induced in human lymphocytes. Gasoline was not mutagenic when tested in the mouse dominant lethal assay. Administration of gasoline to rats did not cause chomosomal aberrations in their bone marrow cells. EPIDEMIOLOGY: To explore the health effects of workers potentially exposed to gasoline vapors in the marketing and distribution sectors of the petroleum industry, the American Petroleum Institute sponsored a cohort mortality study (Publication 4555), a nested case-control study (Publication 4551), and an exposure assessment study (Publication 4552). Histories of exposure to gasoline were reconstructed for cohort of more than 18,000 employees from four companies for the time period between 1946 and 1985. The results of the cohort mortality study indicated that there was no increased mortality from either kidney cancer or leukemia among marketing and marine distribution employees who were exposed to gasoline in the petroleum industry, when compared to the general population. More importantly, based on internal comparisons, there was no association between mortality from kidney cancer or leukemia and various indices of gasoline exposure. In particular, neither duration of employment, duration of exposure, age at first exposure, year of first exposure, job category, cumulative exposure, frequency of peak exposure, nor average intensity of exposure had any effect on kidney cancer or leukemia mortality. The results of the nested case-control study confirmed the findings of the original cohort study. That is, exposure to gasoline at the levels experienced by this cohort of distribution workers is not a significant risk factor for leukemia (all cell types), acute myeloid leukemia, kidney cancer or multiple myeloma.

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY

The 96 hour(s) LC50 for rainbow trout (Oncorhynchus mykiss) is 2.7 mg/l.
The 48 hour(s) LC50 for water flea (Daphnia magna) is 3.0 mg/l.
The 96 hour(s) LC50 for sheepshead minnow (Cyprinodon variegatus) is 8.3 mg/l.
The 96 hour(s) LC50 for mysid shrimp (Mysidopsis bahia) is 1.8 mg/l.
This material is expected to be toxic to aquatic organisms. Gasoline studies have been conducted in the laboratory under a variety of test conditions with a range of fish and invertebrate species. An even more extensive database is available on the aquatic toxicity of individual aromatic constituents. The majority of published studies do not identify the type of gasoline evaluated, or even provide distinguishing characteristics such as aromatic content or presence of lead alkyls. As a result, comparison of results among studies using open and closed vessels, different ages and species of test animals and different gasoline types, is difficult.

The bulk of the available literature on gasoline relates to the environmental impact of monoaromatic (BTEX) and diaromatic (naphthalene, methylnaphthalenes) constituents. In general, non-oxygenated gasoline exhibits some short-term toxicity to freshwater and marine organisms, especially under closed vessel or flow-through exposure conditions in the laboratory. The components which are the most prominent in the water soluble fraction and cause aquatic toxicity, are also highly volatile and can be readily biodegraded by microorganisms.

ENVIRONMENTAL FATE

This material is expected to be readily biodegradable. Following spillage, the more volatile components of gasoline will be rapidly lost, with concurrent dissolution of these and other constituents into the water. Factors such as local environmental conditions (temperature, wind, mixing or wave action, soil type, etc), photo-oxidation, biodegradation and adsorption onto suspended sediments, can contribute to the weathering of spilled gasoline.

The aqueous solubility of non-oxygenated unleaded gasoline, based on analysis of benzene, toluene, ethylbenzene+xylenes and naphthalene, is reported to be 112 mg/l. Solubility data on individual gasoline constituents also available.

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. This material, if it must be discarded, may meet the criteria of a hazardous waste as defined by US EPA under RCRA (40 CFR 261) or other State and local regulations. Measurement of certain physical properties and analysis for regulated components may be necessary to make a correct determination. If this material is classified as a hazardous waste, federal law requires disposal at a licensed hazardous waste disposal facility.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Name: GASOLINE
DOT Hazard Class: 3 (Flammable Liquid)
DOT Identification Number: UN1203
DOT Packing Group: II

SECTION 15 REGULATORY INFORMATION

SARA 311/312 CATEGORIES:
1. Immediate (Acute) Health Effects: YES
2. Delayed (Chronic) Health Effects: YES
3. Fire Hazard: YES
4. Sudden Release of Pressure Hazard: NO
5. Reactivity Hazard: NO

REGULATORY LISTS SEARCHED:

4_I1=IARC Group 1	15=SARA Section 313
4_I2A=IARC Group 2A	16=CA Proposition 65
4_I2B=IARC Group 2B	17=MA RTK
05=NTP Carcinogen	18=NJ RTK
06=OSHA Carcinogen	19=DOT Marine Pollutant
09=TSCA 12(b)	20=PA RTK

The following components of this material are found on the regulatory lists indicated.

Benzene	15, 16, 17, 18, 20, 4_I1, 5, 6
Ethanol	17, 18, 20
Ethyl benzene	15, 17, 18, 20, 4_I2B
Gasoline	17, 18, 20
Methyl tert-butyl ether (MTBE)	15, 17, 18, 20, 9
Naphthalene	15, 16, 17, 18, 20, 4_I2B
Tertiary amyl methyl ether (TAME)	9

CERCLA REPORTABLE QUANTITIES(RQ)/SARA 302 THRESHOLD PLANNING QUANTITIES(TPQ):

Component	Component RQ	Component TPQ	Product RQ
Benzene	10 lbs	None	186 lbs
Ethanol	100 lbs	None	1961 lbs

Ethyl benzene	1000 lbs	None	34964 lbs
Methyl tert-butyl ether (MTBE)	1000 lbs	None	7513 lbs
Naphthalene	100 lbs	None	4000 lbs

CHEMICAL INVENTORIES:
CANADA: All the components of this material are on the Canadian DSL or have been notified under the New Substance Notification Regulations, but have not yet been published in the Canada Gazette.
UNITED STATES: All of the components of this material are on the Toxic Substances Control Act (TSCA) Chemical Inventory.

WHMIS CLASSIFICATION:
Class B, Division 2: Flammable Liquids
Class D, Division 2, Subdivision A: Very Toxic Material - Carcinogenicity
Class D, Division 2, Subdivision B: Toxic Material - Skin or Eye Irritation

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 1 Flammability: 3 Reactivity: 0

(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

Additional Product Number(s): CPS201023, CPS201054, CPS201055, CPS201075, CPS201090, CPS201105, CPS201106, CPS201120, CPS201121, CPS201122, CPS201126, CPS201128, CPS201131, CPS201136, CPS201141, CPS201142, CPS201148, CPS201153, CPS201158, CPS201161, CPS201162, CPS201168, CPS201181, CPS201185, CPS201186, CPS201188, CPS201216, CPS201217, CPS201218, CPS201236, CPS201237, CPS201238, CPS201266, CPS201267, CPS201268, CPS201277, CPS201278, CPS201279, CPS201286, CPS201287, CPS201289, CPS201296, CPS201297, CPS201298, CPS201849, CPS201850, CPS201855, CPS201856, CPS201857, CPS204000, CPS204001, CPS204002, CPS204003, CPS204010, CPS204011, CPS204022, CPS204023, CPS204046, CPS204047, CPS204070, CPS204071, CPS204088, CPS204089, CPS204104, CPS204105, CPS204116, CPS204117, CPS204140, CPS204141, CPS204164, CPS204165, CPS204188, CPS204189, CPS204200, CPS204201, CPS204212, CPS204213, CPS204224, CPS204225, CPS204248, CPS204249, CPS204272, CPS204273, CPS204290, CPS204291, CPS204322, CPS204323, CPS204324, CPS204350, CPS204352, CPS204354, CPS204356, CPS204358, CPS204359, CPS204364, CPS204365, CPS204370, CPS204371, CPS204376, CPS204377, CPS204382, CPS204383, CPS204388, CPS204389, CPS204394, CPS204395, CPS204400, CPS204401, CPS204406, CPS204407, CPS204412, CPS204413, CPS204418, CPS204419, CPS204424, CPS204425, CPS204430, CPS204431, CPS204436, CPS204437, CPS204442, CPS204446, CPS204450, CPS204454, CPS204458, CPS204462, CPS204466, CPS204467, CPS204484, CPS204485, CPS204502, CPS204503, CPS204520, CPS204521, CPS204538, CPS204539, CPS204556, CPS204557, CPS204574, CPS204575, CPS204592, CPS204593, CPS204610, CPS204611, CPS204628, CPS204629, CPS204646, CPS204647, CPS204664, CPS204665, CPS204682, CPS204690, CPS204691, CPS204696, CPS204697, CPS204702, CPS204703, CPS204708, CPS204709, CPS204721, CPS204722, CPS204727, CPS204728, CPS241765

REVISION STATEMENT: This revision updates the following sections of this Material Safety Data Sheet: Section 1 (Product Codes). This Material Safety Data Sheet has been prepared using the ProSteward MSDS system.

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV	-	Threshold Limit Value	TWA	-	Time Weighted Average
STEL	-	Short-term Exposure Limit	PEL	-	Permissible Exposure Limit
			CAS	-	Chemical Abstract Service Number
NDA	-	No Data Available	NA	-	Not Applicable
<=	-	Less Than or Equal To	>=	-	Greater Than or Equal To

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by the ChevronTexaco Energy Research & Technology Company, 100 Chevron Way, Richmond, California 94802.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

This page intentionally left blank.

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

EMERGENCY OVERVIEW
DANGER!
EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD

NFPA 704 (Section 16)

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Contains benzene, which can cause blood disease, including anemia and leukemia.

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-04)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs): **CHEMTREC (800)424-9300**
COMPANY CONTACT (business hours): Corporate Safety (732)750-6000
MSDS Internet Website www.hess.com/about/environ.html

SYNONYMS: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS * (rev. Jan-04)

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Gasoline (86290-81-5)	100
Benzene (71-43-2)	0.1 - 4.9 (0.1 - 1.3 reformulated gasoline)
n-Butane (106-97-8)	< 10
Ethyl Alcohol (Ethanol) (64-17-5)	0 - 10
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Tertiary-amyl methyl ether (TAME) (994-05-8)	0 to 17.2
Toluene (108-88-3)	1 - 25
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 - 15

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol or MTBE and/or TAME). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

3. HAZARDS IDENTIFICATION (rev. Dec-97)

EYES
Moderate irritant. Contact with liquid or vapor may cause irritation.

SKIN
Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION
The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY
Contains benzene, a regulated human carcinogen. Benzene has the potential to cause anemia and other blood diseases, including leukemia, after repeated and prolonged exposure. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with systemic toxicity. See also Section 11 - Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Dec-97)

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES (rev. Dec-97)

FLAMMABLE PROPERTIES:

FLASH POINT:	-45 °F (-43°C)
AUTOIGNITION TEMPERATURE:	highly variable; > 530 °F (>280 °C)
OSHA/NFPA FLAMMABILITY CLASS:	1A (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.4%
UPPER EXPLOSIVE LIMIT (%):	7.6%

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

During certain times of the year and/or in certain geographical locations, gasoline may contain MTBE and/or TAME. Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration - refer to NFPA 11 “Low Expansion Foam - 1994 Edition.”

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Dec-97)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product

vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Dec-97)

HANDLING PRECAUTIONS

******USE ONLY AS A MOTOR FUEL******

******DO NOT SIPHON BY MOUTH******

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Jan-04)

EXPOSURE LIMITS

Component (CAS No.)	Exposure Limits			
	Source	TWA (ppm)	STEL (ppm)	Note
Gasoline (86290-81-5)	ACGIH	300	500	A3
Benzene (71-43-2)	OSHA	1	5	Carcinogen
	ACGIH	0.5	2.5	A1, skin
	USCG	1	5	
n-Butane (106-97-8)	ACGIH	800	--	2003 NOIC: 1000 ppm (TWA) Aliphatic Hydrocarbon Gases Alkane (C1-C4)
Ethyl Alcohol (ethanol) (64-17-5)	OSHA	1000	--	
	ACGIH	1000	--	A4
Ethyl benzene (100-41-4)	OSHA	100	--	
	ACGIH	100	125	A3

Component (CAS No.)	Source	TWA (ppm)	STEL (ppm)	Note
		Exposure Limits		
n-Hexane (110-54-3)	OSHA	500	--	
	ACGIH	50	--	skin
Methyl-tertiary butyl ether [MTBE] (1634-04-4)	ACGIH	50		A3
Tertiary-amyl methyl ether [TAME] (994-05-8)				None established
Toluene (108-88-3)	OSHA	200		Ceiling: 300 ppm; Peak: 500 ppm (10 min.)
	ACGIH	50	--	A4 (skin)
1,2,4- Trimethylbenzene (95-63-6)	ACGIH	25	--	
Xylene, mixed isomers (1330-20-7)	OSHA	100	--	
	ACGIH	100	150	A4

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as that made of of E.I. DuPont Tychem ®, products or equivalent is recommended based on degree of exposure.

Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Jan-04)

APPEARANCE

A translucent, straw-colored or light yellow liquid

ODOR

A strong, characteristic aromatic hydrocarbon odor. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odor and is detectable at a lower concentration than non-oxygenated gasoline.

ODOR THRESHOLD

	Odor Detection	Odor Recognition
Non-oxygenated gasoline:	0.5 - 0.6 ppm	0.8 - 1.1 ppm
Gasoline with 15% MTBE:	0.2 - 0.3 ppm	0.4 - 0.7 ppm
Gasoline with 15% TAME:	0.1 ppm	0.2 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	85 to 437 °F (39 to 200 °C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)
VAPOR DENSITY (air = 1):	AP 3 to 4
SPECIFIC GRAVITY (H_2O = 1):	0.70 – 0.78
EVAPORATION RATE:	10-11 (n-butyl acetate = 1)
PERCENT VOLATILES:	100 %

SOLUBILITY (H_2O): Non-oxygenated gasoline - negligible (< 0.1% @ 77 ^oF). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 ^oF); ethanol is readily soluble in water

10. STABILITY and REACTIVITY (rev. Dec-94)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Dec-97)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 5 ml/kg
Acute Oral LD50 (rat): 18.75 ml/kg
Primary dermal irritation (rabbits): slightly irritating
Draize eye irritation (rabbits): non-irritating
Guinea pig sensitization: negative

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: OSHA: NO IARC: YES - 2B NTP: NO ACGIH: YES (A3)

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

This product may contain methyl tertiary butyl ether (MTBE): animal and human health effects studies indicate that MTBE may cause eye, skin, and respiratory tract irritation, central nervous system depression and neurotoxicity. MTBE is classified as an animal carcinogen (A3) by the ACGIH.

12. ECOLOGICAL INFORMATION (rev. Jan-04)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, oxygenates such as ethers and alcohols will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. The API (www.api.org) provides a number of useful references addressing petroleum and oxygenate contamination of groundwater.

13. DISPOSAL CONSIDERATIONS (rev. Dec-97)

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION (rev. Jan-04)

DOT PROPER SHIPPING NAME:	Gasoline
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1203
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

PLACARD:

15. REGULATORY INFORMATION (rev. Jan-04)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline)
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 to 15

US EPA guidance documents (www.epa.gov/tri) for reporting Persistent Bioaccumulating Toxics (PBTs) indicate this product may contain the following deminimis levels of toxic chemicals subject to Section 313 reporting:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION - Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i) perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)
Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Jan-04)

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
HMIS® HAZARD RATING	HEALTH:	1 *	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
	* CHRONIC		

SUPERSEDES MSDS DATED: 12/30/97

ABBREVIATIONS:

AP = Approximately < = Less than > = Greater than
N/A = Not Applicable N/D = Not Determined ppm = parts per million

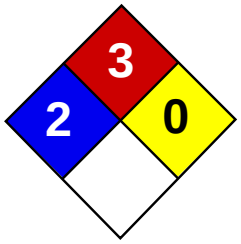
ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212)642-4900
API	American Petroleum Institute (202)682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Workplace Hazardous Materials Information System (Canada)

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.



Health	2
Fire	3
Reactivity	0
Personal Protection	G

Material Safety Data Sheet
Phenylacetylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Phenylacetylene

Catalog Codes: SLP3169

CAS#: 536-74-3

RTECS: DA0780000

TSCA: TSCA 8(b) inventory: Phenylacetylene

CI#: Not available.

Synonym: 1-Phenylethyne; Acetylene, phenyl-; Ethynylbenzene; Phenylacetylide; Phenylethyne

Chemical Name: Benzene, ethynyl-

Chemical Formula: C8-H6

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Phenylacetylene	536-74-3	100

Toxicological Data on Ingredients: Phenylacetylene LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to MAY CONTAIN 1,4 DIOXANE WHICH MAY CAUSE CANCER. The substance may be toxic to blood, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: CLOSED CUP: 31°C (87.8°F).

Flammable Limits: Not available.

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid, insoluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not breathe gas/ fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection: Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 102.14 g/mole

Color: Clear Yellow.

pH (1% soln/water): Not applicable.

Boiling Point: 142°C (287.6°F)

Melting Point: -45°C (-49°F)

Critical Temperature: Not available.

Specific Gravity: 0.93(Water = 1)

Vapor Pressure: 2.3 kPa (@ 20°C)

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, acids.

Corrosivity: Not available.

Special Remarks on Reactivity: Also incompatible with halogens, alkali metals

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
Causes damage to the following organs: MAY CONTAIN 1,4 DIOXANE WHICH MAY CAUSE CANCER. May cause damage to the following organs: blood, upper respiratory tract.

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose/Conc: LDL [Rat] - Route: Oral; Dose: 10 ml/kg

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: May cause skin irritation. Eyes: May cause eye irritation. Inhalation: May cause respiratory tract irritation. Ingestion: May cause digestive tract irritation. May affect respiration (fibrosis, pneumoconiosis, acute pulmonary edema), and blood The toxicological properties of this product have not been fully investigated.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Flammable Liquid, n.o.s. (Phenylacetylene) UNNA: 1993 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: 1,4-Dioxane California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: 1,4-Dioxane TSCA 8(b) inventory: Phenylacetylene

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).

DSCL (EEC):
R10- Flammable. S16- Keep away from sources of ignition - No smoking. S33- Take precautionary measures against static discharges.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Not applicable. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

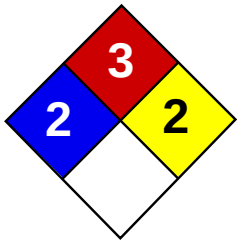
Other Special Considerations: Not available.

Created: 10/10/2005 11:20 AM

Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for

their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Styrene (monomer) MSDS

Section 1: Chemical Product and Company Identification

Product Name: Styrene (monomer)

Catalog Codes: SLS2512, SLU1027

CAS#: 100-42-5

RTECS: WL3675000

TSCA: TSCA 8(b) inventory: Styrene (monomer)

CI#: Not available.

Synonym: Vinylbenzene

Chemical Formula: C8H8

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Styrene (monomer)	100-42-5	100

Toxicological Data on Ingredients: Styrene (monomer): ORAL (LD50): Acute: 2650 mg/kg [Rat]. 316 mg/kg [Mouse]. VAPOR (LC50): Acute: 12000 ppm 4 hour(s) [Rat]. 9500 ppm 4 hour(s) [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant). Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified 2B (Possible for human.) by IARC. A4 (Not classifiable for human or animal.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to the nervous system, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 490°C (914°F)

Flash Points: CLOSED CUP: 31.1°C (88°F). (Cleveland) OPEN CUP: 36.7°C (98.1°F) (TAG).

Flammable Limits: LOWER: 1.1% UPPER: 6.1%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks. Slightly flammable to flammable in presence of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 50 STEL: 100 (ppm) TWA: 213 STEL: 426 (mg/m3) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Clear viscous liquid.)

Odor: Sweetish. Aromatic.

Taste: Not available.

Molecular Weight: 104.14 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 145.2°C (293.4°F)

Melting Point: -30.6°C (-23.1°F)

Critical Temperature: Not available.

Specific Gravity: 0.906 (Water = 1)

Vapor Pressure: 4.5 mm of Hg (@ 20°C)

Vapor Density: 3.59 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.1 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 316 mg/kg [Mouse]. Acute toxicity of the vapor (LC50): 9500 ppm 4 hour(s) [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified 2B (Possible for human.) by IARC. A4 (Not classifiable for human or animal.) by ACGIH. The substance is toxic to the nervous system, upper respiratory tract.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
Animal embryotoxic. Postnatal development injury in animal. Menstrual disorders in human. Human: passes the placental barrier, detected in maternal milk.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Styrene monomer, inhibited : UN2055 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Styrene (monomer) Florida: Styrene (monomer) Minnesota: Styrene (monomer) Massachusetts RTK: Styrene (monomer) New Jersey: Styrene (monomer) TSCA 8(b) inventory: Styrene (monomer) SARA 313 toxic chemical notification and release reporting: Styrene (monomer) CERCLA: Hazardous substances.: Styrene (monomer)

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R10- Flammable. R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

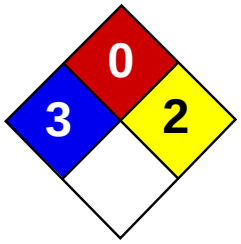
Other Special Considerations: Not available.

Created: 10/09/2005 06:40 PM

Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

This page intentionally left blank.



Health	3
Fire	0
Reactivity	2
Personal Protection	

Material Safety Data Sheet
Sulfuric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sulfuric acid

Catalog Codes: SLS2539, SLS1741, SLS3166, SLS2371, SLS3793

CAS#: 7664-93-9

RTECS: WS5600000

TSCA: TSCA 8(b) inventory: Sulfuric acid

CI#: Not applicable.

Synonym: Oil of Vitriol; Sulfuric Acid

Chemical Name: Hydrogen sulfate

Chemical Formula: H2-SO4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sulfuric acid	7664-93-9	95 - 98

Toxicological Data on Ingredients: Sulfuric acid: ORAL (LD50): Acute: 2140 mg/kg [Rat.]. VAPOR (LC50): Acute: 510 mg/m 2 hours [Rat]. 320 mg/m 2 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, of inhalation. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged

contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention 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. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion:
Products of combustion are not available since material is non-flammable. However, products of decompostion include fumes of oxides of sulfur. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas. Reacts with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Fire Hazards in Presence of Various Substances: Combustible materials

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Metal acetylides (Monocesium and Monorubidium), and carbides ignite with concentrated sulfuric acid. White Phosphorous + boiling Sulfuric acid or its vapor ignites on contact. May ignite other combustible materials. May cause fire when sulfuric acid is mixed with Cyclopentadiene, cyclopentanone oxime, nitroaryl amines, hexalithium disilicide, phorphorous (III) oxide, and oxidizing agents such as chlorates, halogens, permanganates.

Special Remarks on Explosion Hazards:
Mixtures of sulfuric acid and any of the following can explode: p-nitrotoluene, pentasilver trihydroxydiaminophosphate, perchlorates, alcohols with strong hydrogen peroxide, ammonium tetraperoxychromate, mercuric nitrite, potassium chlorate, potassium permanganate with potassium chloride, carbides, nitro compounds, nitrates, carbides, phosphorous, iodides, picratres, fulminats, dienes, alcohols (when heated) Nitramide decomposes explosively on contact with concentrated sulfuric acid. 1,3,5-Trinitrosohexahydro-1,3,5-triazine + sulfuric acid causes explosive decompositon.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:
Hygroscopic. Reacts. violently with water. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 STEL: 3 (mg/m3) [Australia] Inhalation TWA: 1 (mg/m3) from OSHA (PEL) [United States] Inhalation TWA: 1 STEL: 3 (mg/m3) from ACGIH (TLV) [United States] [1999] Inhalation TWA: 1 (mg/m3) from NIOSH [United States] Inhalation TWA: 1 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Thick oily liquid.)

Odor: Odorless, but has a choking odor when hot.

Taste: Marked acid taste. (Strong.)

Molecular Weight: 98.08 g/mole

Color: Colorless.

pH (1% soln/water): Acidic.

Boiling Point:
270°C (518°F) - 340 deg. C Decomposes at 340 deg. C

Melting Point: -35°C (-31°F) to 10.36 deg. C (93% to 100% purity)

Critical Temperature: Not available.

Specific Gravity: 1.84 (Water = 1)

Vapor Pressure: Not available.

Vapor Density: 3.4 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:
Easily soluble in cold water. Sulfuric is soluble in water with liberation of much heat. Soluble in ethyl alcohol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability:
Conditions to Avoid: Incompatible materials, excess heat, combustible material materials, organic materials, exposure to moist air or water, oxidizers, amines, bases. Always add the acid to water, never the reverse.

Incompatibility with various substances:
Reactive with oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(316). Highly corrosive in presence of stainless steel(304). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Hygroscopic. Strong oxidizer. Reacts violently with water and alcohol especially when water is added to the product. Incompatible (can react explosively or dangerously) with the following: ACETIC ACID, ACRYLIC ACID, AMMONIUM HYDROXIDE, CRESOL, CUMENE, DICHLOROETHYL ETHER, ETHYLENE CYANOHYDRIN, ETHYLENEIMINE, NITRIC ACID, 2-NITROPROPANE, PROPYLENE OXIDE, SULFOLANE, VINYLIDENE CHLORIDE, DIETHYLENE GLYCOL MONOMETHYL ETHER, ETHYL ACETATE, ETHYLENE CYANOHYDRIN, ETHYLENE GLYCOL MONOETHYL ETHER ACETATE, GLYOXAL, METHYL ETHYL KETONE, dehydrating agents, organic materials, moisture (water), Acetic anhydride, Acetone, cyanohydrin, Acetone+nitric acid, Acetone + potassium dichromate, Acetonitrile, Acrolein, Acrylonitrile, Acrylonitrile +water, Alcohols + hydrogen peroxide, ally compounds such as Allyl alcohol, and Allyl Chloride, 2-Aminoethanol, Ammonium hydroxide, Ammonium triperchromate, Aniline, Bromate + metals, Bromine pentafluoride, n-Butyraldehyde, Carbides, Cesium acetylene carbide, Chlorates, Cyclopentanone oxime, chlorinates, Chlorates + metals, Chlorine trifluoride, Chlorosulfonic acid, 2-cyano-4-nitrobenzenediazonium hydrogen sulfate, Cuprous nitride, p-chloronitrobenzene, 1,5-Dinitronaphthlene +

sulfur, Diisobutylene, p-dimethylaminobenzaldehyde, 1,3-Diazidobenzene, Dimethylbenzylcarbinol + hydrogen peroxide, Epichlorohydrin, Ethyl alcohol + hydrogen peroxide, Ethylene diamine, Ethylene glycol and other glycols, , Ethylenimine, Fulminates, hydrogen peroxide, Hydrochloric acid, Hydrofluoric acid, Iodine heptafluoride, Indane + nitric acid, Iron, Isoprene, Lithium silicide, Mercuric nitride, Mesityl oxide, Mercury nitride, Metals (powdered), Nitromethane, Nitric acid + glycerides, p-Nitrotoluene, Pentasilver trihydroxydiaminophosphate, Perchlorates, Perchloric acid, Permanganates + benzene, 1-Phenyl-2-methylpropyl alcohol + hydrogen peroxide, Phosphorus, Phosphorus isocyanate, Picrates, Potassium tert-butoxide, Potassium chlorate, Potassium Permanganate and other permanganates, halogens, amines, Potassium Permanganate + Potassium chloride, Potassium Permanganate + water, Propiolactone (beta)-, Pyridine, Rubidium aceteylene carbide, Silver permanganate, Sodium, Sodium carbonate, sodium hydroxide, Steel, styrene monomer, toluene + nitric acid, Vinyl acetate, Thalium (I) azidodithiocarbonate, Zinc chlorate, Zinc Iodide, azides, carbonates, cyanides, sulfides, sulfites, alkali hydrides, carboxylic acid anhydrides, nitriles, olefinic organics, aqueous acids, cyclopentadiene, cyano-alcohols, metal acetylides, Hydrogen gas is generated by the action of the acid on most metals (i.e. lead, copper, tin, zinc, aluminum, etc.). Concentrated sulfuric acid oxidizes, dehydrates, or sulfonates most organic compounds.

Special Remarks on Corrosivity:
Non-corrosive to lead and mild steel, but dillute acid attacks most metals. Attacks many metals releasing hydrogen. Minor corrosive effect on bronze. No corrosion data on brass or zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2140 mg/kg [Rat.]. Acute toxicity of the vapor (LC50): 320 mg/m3 2 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH. May cause damage to the following organs: kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth.

Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
Mutagenicity: Cytogenetic Analysis: Hamster, ovary = 4mmol/L Reproductive effects: May cause adverse reproductive effects based on animal data. Developmental abnormalities (musculoskeletal) in rabbits at a dose of 20 mg/m3 for 7 hrs.(RTECS) Teratogenecity: neither embryotoxic, fetoxic, nor teratogenetic in mice or rabbits at inhaled doses producing some maternal toxicity

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes severe skin irritation and burns. Continued contact can cause tissue necrosis. Eye: Causes severe eye irritation and burns. May cause irreversible eye injury. Ingestion: Harmful if swallowed. May cause permanent damage to the digestive tract. Causes gastrointestial tract burns. May cause perforation of the stomach, GI bleeding, edema of the glottis, necrosis and scarring, and sudden circulatory collapse(similar to acute inhalation). It may also cause systemic toxicity with acidosis. Inhalation: May cause severe irritation of the respiratory tract and mucous membranes with sore throat, coughing, shortness of breath, and delayed lung edema. Causes chemical burns to the repiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Cause corrosive action on mucous membranes. May affect cardiovascular system (hypotension, depressed cardiac output, bradycardia). Circulatory collapse with clammy skin, weak and rapid pulse, shallow respiration, and scanty urine may follow. Circulatory shock is often the immediate cause of death. May also affect teeth(changes in teeth and supporting structures - erosion, discoloration). Chronic Potential Health Effects: Inhalation: Prolonged or repeated inhalation may affect behavior (muscle contraction or spasticity), urinary system (kidney damage), and cardiovascular system, heart (ischemic heart leisons), and respiratory system/lungs(pulmonary edema, lung damage), teeth (dental discoloration, erosion). Skin: Prolonged or repeated skin contact may cause dermatitis, an allergic skin reaction.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 49 mg/l 48 hours [bluegill/sunfish].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Sulfuric acid may be placed in sealed container or absorbed in vermiculite, dry sand, earth, or a similar material. It may also be diluted and neutralized. Be sure to consult with local or regional authorities (waste regulators) prior to any disposal. Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Sulfuric acid UNNA: 1830 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Illinois toxic substances disclosure to employee act: Sulfuric acid New York release reporting list: Sulfuric acid Rhode Island RTK hazardous substances: Sulfuric acid Pennsylvania RTK: Sulfuric acid Minnesota: Sulfuric acid Massachusetts RTK: Sulfuric acid New Jersey: Sulfuric acid California Director's List of Hazardous Substances (8 CCR 339): Sulfuric acid Tennessee RTK: Sulfuric acid TSCA 8(b) inventory: Sulfuric acid SARA 302/304/311/312 extremely hazardous substances: Sulfuric acid SARA 313 toxic chemical notification and release reporting: Sulfuric acid CERCLA: Hazardous substances.: Sulfuric acid: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R35- Causes severe burns. S2- Keep out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S30- Never add water to this product. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 2

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.

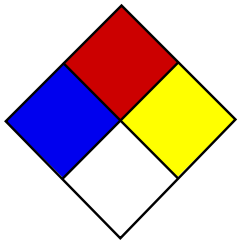
Other Special Considerations: Not available.

Created: 10/09/2005 11:58 PM

Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

This page intentionally left blank.



Material Safety Data Sheet
(Triethylsilyl)acetylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: (Triethylsilyl)acetylene

Catalog Codes: SLT1417

Synonyms: Ethynyltriethylsilane

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
1777-03-3	(Triethylsilyl)acetylene		unlisted

Hazard Symbols: XI F

Risk Phrases: 11 36/37/38

Section 3: Hazards Identification

EMERGENCY OVERVIEW: Not available. Appearance: colorless liquid. Flash Point: 17 deg C. Not available.

Target Organs: Respiratory system, eyes, skin.

Potential Health Effects:

Eye: Causes eye irritation.

Skin: Causes skin irritation. May be harmful if absorbed through the skin.

Ingestion: May cause irritation of the digestive tract. May be harmful if swallowed. Alcohol can intensify the ability of aniline to induce methemoglobinemia.

Inhalation: Causes respiratory tract irritation. May be harmful if inhaled.

Chronic: Not available. Chronic exposure causes hemolysis of the red blood cells, followed by stimulation of the bone marrow.

Section 4: First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion: Get medical aid. Wash mouth out with water.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician: Treat symptomatically and supportively.

Section 5: Fire and Explosion Data

General Information: Vapors can travel to a source of ignition and flash back. Will burn if involved in a fire. Wear appropriate protective clothing to prevent contact with skin and eyes. Wear a self-contained breathing apparatus (SCBA) to prevent contact with thermal decomposition products. Flammable liquid and vapor.

Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or chemical foam.

Flash Point: 17 deg C (62.60 deg F)

Autoignition Temperature: Not available.

Explosion Limits, Lower: Not available.

Upper: Not available.

NFPA Rating: Not published.

Section 6: Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Remove all sources of ignition. Use a spark-proof tool.

Section 7: Handling and Storage

Handling: Use spark-proof tools and explosion proof equipment. Avoid breathing dust, vapor, mist, or gas. Avoid contact with skin and eyes.

Storage: Keep away from heat, sparks, and flame. Store in a cool, dry place. Store in a tightly closed container. Flammables-area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

Exposure Limits:

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
(Triethylsilyl)acetylene	none listed	none listed	none listed

OSHA Vacated PELs: (Triethylsilyl)acetylene: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment:

Eyes: Not available.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9: Physical and Chemical Properties

Physical State: Liquid

Appearance: colorless

Odor: Not available.

pH: Not available.

Vapor Pressure: Not available.

Vapor Density: Not available.

Evaporation Rate: Not available.

Viscosity: Not available.

Boiling Point: Not available.

Freezing/Melting Point: Not available.

Decomposition Temperature: Not available.

Solubility: Not available.

Specific Gravity/Density: 0.783

Molecular Formula: C8H16Si

Molecular Weight: 140.3

Section 10: Stability and Reactivity Data

Chemical Stability: Stable under normal temperatures and pressures.

Conditions to Avoid: Incompatible materials.

Incompatibilities with Other Materials: Strong oxidizing agents.

Hazardous Decomposition Products: Carbon monoxide, carbon dioxide, silicon oxide.

Hazardous Polymerization: Has not been reported

Section 11: Toxicological Information

RTECS#:

CAS#: 1777-03-3 unlisted.

LD50/LC50: Not available.

Carcinogenicity: CAS# 1777-03-3: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

Epidemiology: No data available.

Teratogenicity: No data available.

Reproductive Effects: inh-rat TCL0: 5000 pppm/6H (6-19D preg)inh-mus TCL0: 1800 ppm/6H (6-17D preg)(see RTECS)

Neurotoxicity: No data available.

Mutagenicity: mmo-esc: 1 #mol/l(see RTECS)

Other Studies: See actual entry in RTECS for complete information. The toxicological properties have not been fully inve stigated.

Section 12: Ecological Information

Section 13: Disposal Considerations

RCRA P-Series: None listed.

RCRA U-Series: None listed.

Section 14: Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	No information available.				No information available.
Hazard Class:					
UN Number:					
Packing Group:					

Section 15: Other Regulatory Information

US FEDERAL:

TSCA: CAS# 1777-03-3 is not listed on the TSCA inventory. It is for research and development use only.

Health & Safety Reporting List: None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules: None of the chemicals in this product are under a Chemical Test Rule.

Section 12b: None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule: None of the chemicals in this material have a SNUR under TSCA.

SARA:

CERCLA Hazardous Substances and corresponding RQs: None of the chemicals in this material have an RQ.

SARA Section 302 Extremely Hazardous Substances: None of the chemicals in this product have a TPQ.

Section 313: No chemicals are reportable under Section 313.

Clean Air Act: This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.

Clean Water Act: None of the chemicals in this product are listed as Hazardous Substances under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA: None of the chemicals in this product are considered highly hazardous by OSHA.

STATE: CAS# 1777-03-3 is not present on state lists from CA, PA, MN, MA, FL, or NJ. California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations:

European Labeling in Accordance with EC Directives:

Hazard Symbols: XI F

Risk Phrases: R 11 Highly flammable. R 36/37/38 Irritating to eyes, respiratory system and skin.

Safety Phrases: S 16 Keep away from sources of ignition - No smoking. S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S 36/37/39 Wear suitable protective clothing, gloves and eye/face protection.

WGK (Water Danger/Protection): CAS# 1777-03-3: No information available.

Canada - DSL/NDSL: None of the chemicals in this product are listed on the DSL or NDSL list.

Canada - WHMIS: WHMIS: Not available.

Canadian Ingredient Disclosure List:

Exposure Limits:

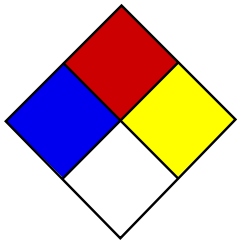
Section 16: Other Information

Created: 02/14/2005 10:16 PM

Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

This page intentionally left blank.



Material Safety Data Sheet
(Triisopropylsilyl)acetylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: (Triisopropylsilyl)acetylene

Catalog Codes: SLT1477

Synonyms: Ethynyltriisopropylsilane

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
89343-06-6	(Triisopropylsilyl)acetylene		unlisted

Hazard Symbols: XI

Risk Phrases: 36/37/38

Section 3: Hazards Identification

EMERGENCY OVERVIEW: Not available. Appearance: colorless liquid. Flash Point: 56 deg C. Not available.

Target Organs: Kidneys, central nervous system, liver, respiratory system, eyes.

Potential Health Effects:

Eye: Causes eye irritation.

Skin: Causes skin irritation. May be harmful if absorbed through the skin.

Ingestion: May cause irritation of the digestive tract. May be harmful if swallowed.

Inhalation: Causes respiratory tract irritation. May be harmful if inhaled.

Chronic: Not available.

Section 4: First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion: Get medical aid. Wash mouth out with water.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician: Treat symptomatically and supportively.

Section 5: Fire and Explosion Data

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Will burn if involved in a fire. Flammable liquid and vapor.

Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or chemical foam.

Flash Point: 56 deg C (132.80 deg F)

Autoignition Temperature: Not available.

Explosion Limits, Lower: Not available.

Upper: Not available.

NFPA Rating: Not published.

Section 6: Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Use water spray to dilute spill to a non-flammable mixture. Remove all sources of ignition.

Section 7: Handling and Storage

Handling: Use spark-proof tools and explosion proof equipment. Avoid breathing dust, vapor, mist, or gas. Avoid contact with skin and eyes.

Storage: Store in a cool, dry place. Store in a tightly closed container.

Section 8: Exposure Controls/Personal Protection

Engineering Controls: Use adequate ventilation to keep airborne concentrations low.

Exposure Limits:

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
(Triisopropylsilyl)acetylene	none listed	none listed	none listed

OSHA Vacated PELs: (Triisopropylsilyl)acetylene: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment:

Eyes: Not available.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9: Physical and Chemical Properties

Physical State: Liquid

Appearance: colorless

Odor: Not available.

pH: Not available.

Vapor Pressure: Not available.

Vapor Density: Not available.

Evaporation Rate: Not available.

Viscosity: Not available.

Boiling Point: 50 - 52 deg C @6mmHg

Freezing/Melting Point: Not available.

Decomposition Temperature: Not available.

Solubility: Not available.

Specific Gravity/Density: 0.813

Molecular Formula: C11H22Si

Molecular Weight: 182.38

Section 10: Stability and Reactivity Data

Chemical Stability: Stable under normal temperatures and pressures.

Conditions to Avoid: Incompatible materials.

Incompatibilities with Other Materials: Strong oxidizing agents.

Hazardous Decomposition Products: Carbon monoxide, carbon dioxide, silicon oxide.

Hazardous Polymerization: Has not been reported

Section 11: Toxicological Information

RTECS#:

CAS#: 89343-06-6 unlisted.

LD50/LC50: Not available.

Carcinogenicity: CAS# 89343-06-6: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.

Epidemiology: No data available.

Teratogenicity: No data available.

Reproductive Effects: No data available.

Neurotoxicity: No data available.

Mutagenicity: No data available.

Other Studies: See actual entry in RTECS for complete information. The toxicological properties have not been fully inve stigated.

Section 12: Ecological Information

Section 13: Disposal Considerations

RCRA P-Series: None listed.

RCRA U-Series: None listed.

Section 14: Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	FLAMMABLE LIQUIDS, N.O.S.				No information available.
Hazard Class:	3				
UN Number:	UN1993				
Packing Group:	III				

Section 15: Other Regulatory Information

US FEDERAL:

TSCA: CAS# 89343-06-6 is not listed on the TSCA inventory. It is for research and development use only.

Health & Safety Reporting List: None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules: None of the chemicals in this product are under a Chemical Test Rule.

Section 12b: None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule: None of the chemicals in this material have a SNUR under TSCA.

SARA:

CERCLA Hazardous Substances and corresponding RQs: None of the chemicals in this material have an RQ.

SARA Section 302 Extremely Hazardous Substances: None of the chemicals in this product have a TPQ.

Section 313: No chemicals are reportable under Section 313.

Clean Air Act: This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.

Clean Water Act: None of the chemicals in this product are listed as Hazardous Substances under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA: None of the chemicals in this product are considered highly hazardous by OSHA.

STATE: CAS# 89343-06-6 is not present on state lists from CA, PA, MN, MA, FL, or NJ. California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations:

European Labeling in Accordance with EC Directives:

Hazard Symbols: XI

Risk Phrases: R 36/37/38 Irritating to eyes, respiratory system and skin.

Safety Phrases: S 16 Keep away from sources of ignition - No smoking. S 26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S 37/39 Wear suitable gloves and eye/face protection.

WGK (Water Danger/Protection): CAS# 89343-06-6: No information available.

Canada - DSL/NDSL: None of the chemicals in this product are listed on the DSL or NDSL list.

Canada - WHMIS: WHMIS: Not available.

Canadian Ingredient Disclosure List:

Exposure Limits:

Section 16: Other Information

Created: 02/14/2005 10:16 PM

Last Updated: 05/21/2013 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

This page intentionally left blank.

Material Safety Data Sheet

MSDS ID NO.: 0121MAR019
Revision date: 12/07/2010

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

Product name: Marathon K-1 Kerosene 400 ppm Sulfur Max
Synonym: 1-K Kerosine 400 ppm Sulfur Max; 1-K Kerosene 400 ppm Sulfur Max; Kerosine K-1 400 ppm Sulfur Max; Kerosene K-1 400 ppm Sulfur Max; Kerosene K-1; K-1 Kerosene; K-1 Kerosene, Non-Road Use, Undyed
Chemical Family: Petroleum Hydrocarbon
Formula: Mixture

Manufacturer:
Marathon Petroleum Company LP
539 South Main Street
Findlay OH 45840

Other information: 419-421-3070
Emergency telephone number: 877-627-5463

2. COMPOSITION / INFORMATION ON INGREDIENTS

1-K Kerosine is a complex mixture of paraffins, cycloparaffins, olefins and aromatic hydrocarbons having hydrocarbon chain lengths predominantly in the range of C9 through C16. May contain a trace amount of benzene (<0.01%). Contains a trace amount of sulfur (15-400 ppm).

Product information:

Name	CAS Number	Weight %	ACGIH Exposure Limits:	OSHA - Vacated PELs - Time Weighted Ave	Other:
Marathon K-1 Kerosene	8008-20-6	100	Skin - potential significant contribution to overall exposure by the cutaneous route 200 mg/m^3 TWA		

Component Information:

Name	CAS Number	Weight %	ACGIH Exposure Limits:	OSHA - Vacated PELs - Time Weighted Ave	Other:
Saturated Hydrocarbons	Mixture	70-80			
Aromatic Hydrocarbons	Mixture	17-25			
Unsaturated Hydrocarbons	Mixture	3-6			
Naphthalene	91-20-3	0.01-0.5	Skin - potential significant contribution to overall exposure by the cutaneous route 10 ppm TWA 15 ppm STEL	= 10 ppm TWA = 50 mg/m^3 TWA = 15 ppm STEL = 75 mg/m^3 STEL	

Notes: The manufacturer has voluntarily elected to reflect exposure limits contained in OSHA's 1989 air contaminants standard in its MSDS's, even though certain of those exposure limits were vacated in 1992.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

CAUTION!

VAPORS, FUMES, OR MISTS MAY CAUSE RESPIRATORY TRACT IRRITATION
MAY BE HARMFUL OR FATAL IF SWALLOWED
MAY CAUSE LUNG DAMAGE
OVEREXPOSURE MAY CAUSE CNS DEPRESSION
SEE TOXICOLOGICAL INFORMATION SECTION FOR MORE INFORMATION

COMBUSTIBLE LIQUID AND VAPOR
VAPOR MAY CAUSE FLASH FIRE
MATERIAL MAY ACCUMULATE STATIC CHARGE

STABLE

Inhalation:

Breathing high concentrations may be harmful.
May cause central nervous system depression or effects. Symptoms may include headache, excitation, euphoria, dizziness, incoordination, drowsiness, light-headedness, blurred vision, fatigue, tremors, convulsions, loss of consciousness, coma, respiratory arrest and death, depending on the concentration and duration of exposure.

Ingestion:

Swallowing this material may be harmful.
May cause irritation of the mouth, throat and gastrointestinal tract. Symptoms may include salivation, pain, nausea, vomiting and diarrhea. Exposure may also cause central nervous system symptoms similar to those listed under "Inhalation" (see Inhalation section).
Aspiration into lungs may cause chemical pneumonia and lung damage.

Skin contact:

Contact may cause reddening, itching and inflammation. Effects may become more serious with repeated or prolonged contact. Skin contact may cause harmful effects in other parts of the body.

Eye contact:

Contact may cause pain and severe reddening and inflammation of the conjunctiva. Effects may become more serious with repeated or prolonged contact.

Carcinogenic Evaluation:

Product information:

Name	IARC Carcinogens:	NTP Carcinogens:	ACGIH - Carcinogens:	OSHA - Select Carcinogens:
Marathon K-1 Kerosene 8008-20-6	NE	male mice-no evidence; female mice-no evidence	A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans	

Notes:

The International Agency for Research on Cancer (IARC) has determined that there is inadequate evidence for the carcinogenicity of diesel fuel/fuel oil in humans. IARC determined that there was limited evidence for the carcinogenicity of marine diesel fuel in animals. Distillate (light) diesel fuels were not classifiable as to their carcinogenicity to humans (Group 3A).

IARC has determined that there is sufficient evidence for the carcinogenicity in experimental animals of diesel engine exhaust and extracts of diesel engine exhaust particles. IARC determined that there is only limited evidence for the carcinogenicity in humans of diesel engine exhaust. However, IARC's overall evaluation has resulted in the IARC designation of diesel engine exhaust as probably carcinogenic to humans (Group 2A) because of the presence of certain engine exhaust components.

Component Information:

Name	IARC Carcinogens:	NTP Carcinogens:	ACGIH - Carcinogens:	OSHA - Select Carcinogens:
Naphthalene 91-20-3	Monograph 82 [2002]	Reasonably Anticipated To Be A Human Carcinogen male rat-clear evidence; female rat-clear evidence; male mice-no evidence; female mice-some evidence	A4 - Not Classifiable as a Human Carcinogen	Present

Notes:

The International Agency for Research on Cancer (IARC) and the Environmental Protection Agency (EPA) have determined that naphthalene is a possible human carcinogen.

4. FIRST AID MEASURES

Eye Contact:

Flush immediately with large amounts of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. GET IMMEDIATE MEDICAL ATTENTION.

Skin Contact:

Immediately wash exposed skin with plenty of soap and water while removing contaminated clothing and shoes. Get medical attention if irritation persists. Place contaminated clothing in closed container until cleaned or discarded. If clothing is to be laundered, inform the person performing the operation of contaminant's hazardous properties.

Ingestion:

Do not induce vomiting. If spontaneous vomiting is about to occur, place victim's head below knees. If victim is drowsy or unconscious, place on the left side with head down. Never give anything by mouth to an unconscious person. Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

Inhalation:

Remove to fresh air. If not breathing, institute rescue breathing. If breathing is difficult, ensure airway is clear and give oxygen. If heart has stopped, immediately begin cardiopulmonary resuscitation (CPR). Keep affected person warm and at rest. GET IMMEDIATE MEDICAL ATTENTION.

NOTES TO PHYSICIAN:

INGESTION: If ingested this material represents a significant aspiration and chemical pneumonitis hazard. Induction of emesis is not recommended.

Medical Conditions Aggravated By Exposure:

skin,

5. FIRE FIGHTING MEASURES

Suitable extinguishing media:

For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Fire fighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Specific hazards:

This product has been determined to be a combustible liquid per the OSHA Hazard Communication Standard and should be handled accordingly. For additional fire related information, see NFPA 30 or the North American Emergency Response Guide 128.

Special protective equipment for firefighters:

Avoid using straight water streams. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Avoid excessive water spray application. Keep surrounding area cool with water spray from a distance and prevent further ignition of combustible material. Keep run-off water out of sewers and water sources.

Flash point: 120-190 F
Autoignition temperature: 489 F
Flammable limits in air - lower (%): 0.7

5. FIRE FIGHTING MEASURES

Flammable limits in air - upper (%): 5.0

NFPA rating:
Health: 1
Flammability: 2
Instability: 0
Other: -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate. Contain liquid with sand or soil. Recover and return free product to proper containers. Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids.

7. HANDLING AND STORAGE

Handling:

Comply with all applicable EPA, OSHA, NFPA and consistent state and local requirements. Use appropriate grounding and bonding practices. Store in properly closed containers that are appropriately labeled and in a cool well-ventilated area. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Do not cut, drill, grind or weld on empty containers since they may contain explosive residues.

Avoid repeated and prolonged skin contact. Never siphon this product by mouth. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

PERSONAL PROTECTIVE EQUIPMENT

Engineering measures: Local or general exhaust required when using at elevated temperatures that generate vapors or mists.

Respiratory protection: Use approved organic vapor chemical cartridge or supplied air respirators when material produces vapors that exceed permissible limits or excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Skin and body protection: Neoprene, nitrile, polyvinyl alcohol (PVA), polyvinyl chloride and polyurethane gloves to prevent skin contact.

Eye protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields.

Hygiene measures: No special protective clothing is normally required. Select protective clothing depending on industrial operations. Use mechanical ventilation equipment that is explosion-proof.

9. PHYSICAL AND CHEMICAL PROPERTIES:

Appearance: Clear to Amber Liquid

9. PHYSICAL AND CHEMICAL PROPERTIES:

Physical state (Solid/Liquid/Gas):	Liquid
Substance type (Pure/Mixture):	Mixture
Color:	Clear or Amber
Odor:	Slight Hydrocarbon
Molecular weight:	180
pH:	Neutral
Boiling point/range (5-95%):	360-550 F
Melting point/range:	Not determined.
Decomposition temperature:	Not applicable.
Specific gravity:	C.A. 0.8
Density:	6.76 lbs/gal
Bulk density:	No data available.
Vapor density:	4-5
Vapor pressure:	1-10 mm Hg @ 100 F
Evaporation rate:	No data available.
Solubility:	Negligible
Solubility in other solvents:	No data available.
Partition coefficient (n-octanol/water):	No data available.
VOC content(%):	10%
Viscosity:	1.3-2.1 @ 50 C

10. STABILITY AND REACTIVITY

Stability:	The material is stable at 70 F, 760 mm pressure.
Polymerization:	Will not occur.
Hazardous decomposition products:	Combustion produces carbon monoxide, aldehydes, aromatic and other hydrocarbons.
Materials to avoid:	Strong oxidizers such as nitrates, perchlorates, chlorine, fluorine.
Conditions to avoid:	Excessive heat, sources of ignition and open flames.

11. TOXICOLOGICAL INFORMATION

Acute toxicity:

Product information:

Name	CAS Number	Inhalation:	Dermal:	Oral:
Marathon K-1 Kerosene	8008-20-6	>2 mg/l for 4 hr [Rat]	>5 ml/kg [Rabbit]	9-16 ml/kg [Rat]

Toxicology Information:

MIDDLE DISTILLATES, PETROLEUM: Long-term repeated (lifetime) skin exposure to similar materials has been reported to result in an increase in skin tumors in laboratory rodents. The relevance of these findings to humans is not clear at this time.

ISOPARAFFINS: Studies in laboratory animals have shown that long-term exposure to similar materials (isoparaffins) can cause kidney damage and kidney cancer in male laboratory rats. However, in-depth research indicates that these findings are unique to the male rat, and that these effects are not relevant to humans.

NAPHTHALENE: Severe jaundice, neurotoxicity (kernicterus) and fatalities have been reported in young children and infants as a result of hemolytic anemia from overexposure to naphthalene. Persons with Glucose 6-phosphate dehydrogenase (G6PD) deficiency are more prone to the hemolytic effects of naphthalene. Adverse effects on the kidney have been reported in persons overexposed to naphthalene but these effects are believed to be a consequence of hemolytic anemia, and not a direct effect. Hemolytic anemia has been observed in laboratory animals exposed to naphthalene. Laboratory rodents exposed to naphthalene vapor for 2 years (lifetime studies) developed non-neoplastic and neoplastic tumors and inflammatory lesions of the nasal and respiratory tract. Cataracts and other adverse effects on the eye have been observed in laboratory animals exposed to high levels of naphthalene. Findings from a large number of bacterial and mammalian cell mutation assays have been negative. A few studies have shown chromosomal effects (elevated levels of Sister Chromatid Exchange or chromosomal aberrations) in vitro. Naphthalene has been classified as Possibly Carcinogenic to Humans (2B) by IARC, based on findings from studies in laboratory animals.

DIESEL EXHAUST: Chronic inhalation studies of whole diesel engine exhaust in mice and rats produced a significant increase in lung tumors. Combustion of kerosine and/or diesel fuels produces gases and particulates which include carbon monoxide, carbon dioxide, oxides of nitrogen and/or sulfur and hydrocarbons. Significant exposure to carbon monoxide vapors decreases the oxygen carrying capacity of the blood and may cause tissue hypoxia via formation of carboxyhemoglobin.

Altered mental state, drowsiness, peripheral motor neuropathy, irreversible brain damage (so-called Petrol Sniffers Encephalopathy), delirium, seizures, and sudden death have been reported from repeated overexposure to some hydrocarbon solvents, naphthas, and gasoline.

TARGET ORGANS: central nervous system, skin, lungs, respiratory system, kidney, liver,

12. ECOTOXICOLOGICAL INFORMATION

Mobility:

May partition into air, soil and water.

Ecotoxicity:

Toxic to aquatic organisms.

Bioaccummulation:

Not expected to bioaccumulate in aquatic organisms.

Persistance/Biodegradation:

Readily biodegradable in the environment.

13. DISPOSAL CONSIDERATIONS

Cleanup Considerations: This product as produced is not specifically listed as an EPA RCRA hazardous waste according to federal regulations (40 CFR 261). However, when discarded or disposed of, it may meet the criteria of an "characteristic" hazardous waste. This material could become a hazardous waste if mixed or contaminated with a hazardous waste or other substance(s). It is the responsibility of the user to determine if disposal material is hazardous according to federal, state and local regulations.

14. TRANSPORT INFORMATION

49 CFR 172.101:

DOT:

Transport Information: This material when transported via US commerce would be regulated by DOT Regulations.

Proper shipping name: Kerosene
UN/Identification No: UN 1223
Hazard Class: 3
Packing group: III
DOT reportable quantity (lbs): Not applicable.

Proper shipping name: Kerosene
UN/Identification No: UN 1223
Hazard Class: 3
Packing group: III

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

OSHA Hazard Communication Standard: This product has been evaluated and determined to be hazardous as defined in OSHA's Hazard Communication Standard.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product contains the following component(s) that have been listed on EPA's Extremely Hazardous Substance (EHS) List:

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Saturated Hydrocarbons	NA
Aromatic Hydrocarbons	NA
Unsaturated Hydrocarbons	NA
Naphthalene	NA

SARA Section 304: This product contains the following component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	CERCLA/SARA - Hazardous Substances and their Reportable Quantities
Saturated Hydrocarbons	NA
Aromatic Hydrocarbons	NA
Unsaturated Hydrocarbons	NA
Naphthalene	= 100 lb final RQ = 45.4 kg final RQ

SARA Section 311/312 The following EPA hazard categories apply to this product:

Acute Health Hazard
Fire Hazard
Chronic Health Hazard

SARA Section 313: This product contains the following component(s) that may be subject to reporting on the Toxic Release Inventory (TRI) From R:

Name	CERCLA/SARA 313 Emission reporting:
Saturated Hydrocarbons	None
Aromatic Hydrocarbons	None
Unsaturated Hydrocarbons	None
Naphthalene	= 0.1 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Saturated Hydrocarbons

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Aromatic Hydrocarbons

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.

Saturated Hydrocarbons

Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Unsaturated Hydrocarbons

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Naphthalene

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	carcinogen, initial date 4/19/02
New Jersey Right-To-Know:	sn 1322
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	carcinogen

Saturated Hydrocarbons

New Jersey - Environmental Hazardous Substances List:	SN 1322 TPQ 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	= 1 lb RQ land/water = 100 lb RQ air

Canadian Regulatory Information:

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Naphthalene	B4, D2A	1 %

NOTE: Not Applicable.

16. OTHER INFORMATION

Additional Information: No data available.

Prepared by: Mark S. Swanson, Manager, Toxicology and Product Safety

The information and recommendations contained herein are based upon tests believed to be reliable. However, Marathon Petroleum Company LP (MPC) does not guarantee their accuracy or completeness nor shall any of this information constitute a warranty, whether expressed or implied, as to the safety of the goods, the merchantability of the goods, or the fitness of the goods for a particular purpose. Adjustment to conform to actual conditions of usage maybe required. MPC assumes no responsibility for results obtained or for incidental or consequential damages, including lost profits arising from the use of these data. No warranty against infringement of any patent, copyright or trademark is made or implied.

End of Safety Data Sheet

This page intentionally left blank.

Material Safety Data Sheet
Diesel Low Sulfur (LSD) and Ultra Low Sulfur Diesel (ULSD)

NFPA:

HMIS III:

HEALTH	1
FLAMMABILITY	2
PHYSICAL	0

0 = Insignificant, 1 = Slight, 2 = Moderate, 3 = High, 4 = Extreme

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	Diesel Low Sulfur (LSD) and Ultra Low Sulfur Diesel (ULSD)			
Synonyms	:	CARB Diesel, 888100004478			
MSDS Number	:	888100004478	**Version**	:	2.19
Product Use Description	:	Fuel			
Company	:	For: Tesoro Refining & Marketing Co. 19100 Ridgewood Parkway, San Antonio, TX 78259			
Tesoro Call Center	:	(877) 783-7676	**Chemtrec (Emergency Contact)**	:	(800) 424-9300

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Regulatory status : This material is considered hazardous by the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (29 CFR 1910.1200).

Signal Word : WARNING

Hazard Summary : Toxic. Combustible Liquid

Potential Health Effects

Eyes : Eye irritation may result from contact with liquid, mists, and/or vapors.

Inhalation : Vapors or mists from this material can irritate the nose, throat, and lungs, and can cause signs and symptoms of central nervous system depression, depending on the concentration and duration of exposure.

Skin : Skin irritation leading to dermatitis may occur upon prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed. Long-term, repeated skin contact may cause skin cancer

Ingestion : Harmful or fatal if swallowed. Do NOT induce vomiting. This material can irritate the mouth, throat, stomach, and cause nausea, vomiting, diarrhea and restlessness Aspiration hazard if liquid is inhaled into lungs, particularly from vomiting after ingestion. Aspiration may result in chemical pneumonia, severe lung damage, respiratory failure and even death.

Target Organs : Central nervous system, Eyes, Skin, Kidney, Liver

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Weight %
Fuels, diesel, No 2; Gasoil - unspecified	68476-34-6	100%
Nonane	111-84-2	0 - 5%
Naphthalene	91-20-3	0 - 1%
1,2,4-Trimethylbenzene	95-63-6	0 - 2%
Xylene	1330-20-7	0 - 2%
Sulfur	7704-34-9	15 ppm maximum

SECTION 4. FIRST AID MEASURES

Inhalation : Move to fresh air. Give oxygen. If breathing is irregular or stopped, administer artificial respiration. Seek medical attention immediately.

Skin contact : Take off all contaminated clothing immediately. Wash off immediately with soap and plenty of water. Wash contaminated clothing before re-use. If skin irritation persists, seek medical attention immediately.

Eye contact : Remove contact lenses. Rinse thoroughly with plenty of water for at least 15 minutes. If symptoms persist, seek medical attention.

Ingestion : Do not induce vomiting without medical advice. If a person vomits when lying on his back, place him in the recovery position. Seek medical attention immediately.

Notes to physician : Symptoms: Dizziness, Discomfort, Headache, Nausea, Disorder, Vomiting, Lung edema, Aspiration may cause pulmonary edema and pneumonitis, Liver disorders, Kidney disorders.

SECTION 5. FIRE-FIGHTING MEASURES

Form : Liquid

Flash point : 38℃ Minimum for #1 Diesel, 52℃ Minimum for #2 Diesel

Auto Ignition temperature : 257 ℃ (495 ℉)

Lower explosive limit : 0.6 %(V)

Upper explosive limit : 4.7 %(V)

Suitable extinguishing media : Carbon dioxide (CO_2), Water spray, Dry chemical, Foam, Keep containers and surroundings cool with water spray.

Specific hazards during fire fighting : Fire Hazard Do not use a solid water stream as it may scatter and spread fire. Cool closed containers exposed to fire with water spray.

Special protective equipment for fire-fighters : Wear self-contained breathing apparatus and protective suit. Use personal protective equipment.

Further information : Exposure to decomposition products may be a hazard to health. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions : Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to contain spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact. Ensure adequate ventilation. Use personal protective equipment.

Environmental precautions : Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection. Discharge into the environment must be avoided. If the product contaminates rivers and lakes or drains inform respective authorities.

Methods for cleaning up : Take up with sand or oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

SECTION 7. HANDLING AND STORAGE

Handling : Keep away from fire, sparks and heated surfaces. No smoking near areas where material is stored or handled. The product should only be stored and handled in areas with intrinsically safe electrical classification.

Advice on protection against fire and explosion : Hydrocarbon liquids including this product can act as a non-conductive flammable liquid (or static accumulators), and may form ignitable vapor-air mixtures in storage tanks or other containers. Precautions to prevent static-initated fire or explosion during transfer, storage or handling, include but are not limited to these examples:

(1) Ground and bond containers during product transfers. Grounding and bonding may not be adequate protection to prevent ignition or explosion of hydrocarbon liquids and vapors that are static accumulators.
(2) Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil or diesel) is loaded into tanks previously containing low flash point products (such gasoline or naphtha).
(3) Storage tank level floats must be effectively bonded.

For more information on precautions to prevent static-initated fire or explosion, see NFPA 77, Recommended Practice on Static Electricity (2007), and API

Recommended Practice 2003, Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents (2008).

Dust explosion class : Not applicable

Requirements for storage areas and containers : Keep away from flame, sparks, excessive temperatures and open flame. Use approved containers. Keep containers closed and clearly labeled. Empty or partially full product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose containers to sources of ignition. Store in a well-ventilated area. The storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

Other data : Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure.

Advice on common storage Keep away from food, drink and animal feed. Incompatible with oxidizing agents. Incompatible with acids.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines

List	Components	CAS-No.	Type:	Value
OSHA Z1	Xylene	1330-20-7	PEL	100 ppm 435 mg/m3
	Naphthalene	91-20-3	PEL	10 ppm 50 mg/m3
ACGIH	Diesel Fuel	68476-30-2	TWA	100 mg/m3
	Xylene	1330-20-7	TWA	100 ppm
		1330-20-7	STEL	150 ppm
	Naphthalene	91-20-3	TWA	10 ppm
		91-20-3	STEL	15 ppm
	Nonane	111-84-2	TWA	200 ppm

Engineering measures : Use adequate ventilation to keep gas and vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Use only intrinsically safe electrical equipment approved for use in classified areas.

Eye protection : Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

Hand protection : Gloves constructed of nitrile, neoprene, or PVC are recommended. Consult manufacturer specifications for further information.

Skin and body protection : If needed to prevent skin contact, chemical protective clothing such as of DuPont

		TyChem®, Saranex or equivalent recommended based on degree of exposure. The resistance of specific material may vary from product to product as well as with degree of exposure.
Respiratory protection	:	A NIOSH/ MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, ANSI Z88.2-1992, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection. Use a NIOSH/ MSHA-approved positive-pressure supplied-air respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.
Work / Hygiene practices	:	Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Form	:	Liquid
Appearance	:	Clear, straw colored
Odor	:	Characteristic petroleum (kerosene) odor
Flash point - typical	:	38℃ Minimum for #1 Diesel, 52℃ Minimum for #2 Diesel
Auto Ignition temperature	:	257 ℃ (495 ℉)
Thermal decomposition	:	No decomposition if stored and applied as directed.
Lower explosive limit	:	0.6 %(V)
Upper explosive limit	:	4.7 %(V)
pH	:	Not applicable
Freezing point	:	No data available
Boiling point	:	154 - 372 ℃(310° - 702 ℉)
Vapor Pressure	:	< 2 mm Hg at 20 ℃
Density	:	**0.86** g/cm3
Water solubility	:	Negligible
Viscosity, dynamic	:	1.7 - 40 mPa.s at 37.8 ℃ (100.0 ℉)

Percent Volatiles	:	100 %
Conductivity (conductivity can be reduced by environmental factors such as a decrease in temperature		Diesel Fuel Oils at terminal load rack: At least 25 pS/m Ultra Low Sulfur Diesel (ULSD) without conductivity additive: 0 pS/m to 5 pS/m ULSD at terminal load rack with conductivity additive: At least 50 pS/m but conductivity may decrease from environmental factors such as temperature drop. JP-8 at terminal load rack: 150 pS/m to 600 pS/m

SECTION 10. STABILITY AND REACTIVITY

Conditions to avoid	:	Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources. Keep away from strong oxidizers. Viton ® ; Fluorel ®
Materials to avoid	:	Strong oxidizing agents. Peroxides
Hazardous decomposition products	:	Carbon monoxide, carbon dioxide and noncombusted hydrocarbons (smoke). Diesel exhaust particulates may be a lung hazard - see Section 11.
Thermal decomposition	:	No decomposition if stored and applied as directed.
Hazardous reactions	:	Keep away from oxidizing agents, and acidic or alkaline products.

SECTION 11. TOXICOLOGICAL INFORMATION

Carcinogenicity

NTP	:	Naphthalene (CAS-No.: 91-20-3)
IARC	:	Naphthalene (CAS-No.: 91-20-3)
OSHA	:	No component of this product which is present at levels greater than or equal to 0.1 % is identified as a carcinogen or potential carcinogen by OSHA.
CA Prop 65	:	WARNING! This product contains a chemical known to the State of California to cause cancer. naphthalene (CAS-No.: 91-20-3)
Skin irritation	:	Irritating to skin.
Eye irritation	:	Irritating to eyes.
Further information	:	Studies have shown that similar products produce skin cancer or skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation. Positive mutagenicity results have been reported. Repeated over-exposure may cause liver and kidney injury IARC classifies whole diesel fuel exhaust particulates as probably carcinogenic to humans (Group 2A). NIOSH regards whole diesel fuel exhaust particulates as a potential cause of occupational lung cancer based on animal studies and limited evidence in humans.

Component:

Fuels, diesel, No 2; Gasoil - unspecified	68476-34-6	Acute oral toxicity: LD50 rat Dose: 5,001 mg/kg Acute dermal toxicity: LD50 rabbit

		Dose: 2,001 mg/kg Acute inhalation toxicity: LC50 rat Dose: 7.64 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Severe skin irritation Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation
Nonane	111-84-2	Acute oral toxicity: LD50 mouse Dose: 218 mg/kg Acute inhalation toxicity: LC50 rat Exposure time: 4 h
Naphthalene	91-20-3	Acute oral toxicity: LD50 rat Dose: 2,001 mg/kg Acute dermal toxicity: LD50 rat Dose: 2,501 mg/kg Acute inhalation toxicity: LC50 rat Dose: 101 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation Carcinogenicity: N11.00422130
1,2,4-Trimethylbenzene	95-63-6	Acute inhalation toxicity: LC50 rat Dose: 18 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Skin irritation Eye irritation: Classification: Irritating to eyes. Result: Eye irritation
Xylene	1330-20-7	Acute oral toxicity: LD50 rat Dose: 2,840 mg/kg Acute dermal toxicity: LD50 rabbit Dose: ca. 4,500 mg/kg Acute inhalation toxicity: LC50 rat Dose: 6,350 mg/l Exposure time: 4 h Skin irritation: Classification: Irritating to skin. Result: Mild skin irritation Repeated or prolonged exposure may cause skin irritation and dermatitis, due to degreasing properties of the product. Eye irritation: Classification: Irritating to eyes. Result: Mild eye irritation

SECTION 12. ECOLOGICAL INFORMATION

Additional ecological : Keep out of sewers, drainage areas, and waterways. Report spills and releases, as

information applicable, under Federal and State regulations.

Component:

Naphthalene	91-20-3	Toxicity to algae: EC50 Species: Dose: 33 mg/l Exposure time: 24 h
1,2,4-Trimethylbenzene	95-63-6	Toxicity to fish: LC50 Species: Pimephales promelas (fathead minnow) Dose: 7.72 mg/l Exposure time: 96 h Acute and prolonged toxicity for aquatic invertebrates: EC50 Species: Daphnia Dose: 3.6 mg/l Exposure time: 48 h

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal : In accordance with local and national regulations.

SECTION 14. TRANSPORT INFORMATION

CFR

Proper shipping name	: DIESEL FUEL
UN-No.	: UN1202 (NA 1993)
Class	: 3
Packing group	: III

TDG

Proper shipping name	: DIESEL FUEL
UN-No.	: UN1202 (NA 1993)
Class	: 3
Packing group	: III

IATA Cargo Transport

UN UN-No.	: UN1202 (NA 1993)
Description of the goods	: DIESEL FUEL
Class	: 3
Packaging group	: III
ICAO-Labels	: 3
Packing instruction (cargo aircraft)	: 366
Packing instruction (cargo aircraft)	: Y344

IATA Passenger Transport

UN UN-No.	: UN1202 (NA 1993)
Description of the goods	: DIESEL FUEL
Class	: 3
Packaging group	: III

ICAO-Labels	:	3
Packing instruction (passenger aircraft)	:	355
Packing instruction (passenger aircraft)	:	Y344

IMDG-Code

UN-No.	:	UN 1202 (NA 1993)
Description of the goods	:	DIESEL FUEL
Class	:	3
Packaging group	:	III
IMDG-Labels	:	3
EmS Number	:	F-E S-E
Marine pollutant	:	No

SECTION 15. REGULATORY INFORMATION

OSHA Hazards : Combustible Liquid
Moderate skin irritant
Moderate eye irritant
Toxic by ingestion
POSSIBLE CANCER HAZARD

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIROMENT)
The CERCLA definition of hazardous substances contains a "petroleum exclusion" clause which exempts crude oil. Fractions of crude oil, and products (both finished and intermediate) from the crude oil refining process and any indigenous components of such from the CERCLA Section 103 reporting requirements. However, other federal reporting requirements, including SARA Section 304, as well as the Clean Water Act may still apply.

TSCA Status : On TSCA Inventory

DSL Status : All components of this product are on the Canadian DSL list.

SARA 311/312 Hazards : Fire Hazard
Acute Health Hazard
Chronic Health Hazard

SARA III US. EPA Emergency Planning and Community Right-To-Know Act (EPCRA) SARA Title III Section 313 Toxic Chemicals (40 CFR 372.65) - Supplier Notification Required

Components	CAS-No.
Xylene	1330-20-7
1,2,4-Trimethylbenzene	95-63-6
Naphthalene	91-20-3

PENN RTK US. Pennsylvania Worker and Community Right-to-Know Law (34 Pa. Code Chap. 301-323)

Components	CAS-No.
Nonane	111-84-2

Naphthalene	91-20-3
1,2,4-Trimethylbenzene	95-63-6
xylene	1330-20-7
Fuels, diesel, No 2; Gasoil - unspecified	68476-34-6

MASS RTK — US. Massachusetts Commonwealth's Right-to-Know Law (Appendix A to 105 Code of Massachusetts Regulations Section 670.000)

Components	CAS-No.
Xylene	1330-20-7
1,2,4-Trimethylbenzene	95-63-6
Naphthalene	91-20-3
Nonane	111-84-2

NJ RTK — US. New Jersey Worker and Community Right-to-Know Act (New Jersey Statute Annotated Section 34:5A-5)

Components	CAS-No.
Nonane	111-84-2
Naphthalene	91-20-3
1,2,4-Trimethylbenzene	95-63-6
Xylene	1330-20-7
Fuels, diesel, No 2; Gasoil - unspecified	68476-34-6

California Prop. 65 : WARNING! This product contains a chemical known to the State of California to cause cancer.

Naphthalene 91-20-3

SECTION 16. OTHER INFORMATION

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Template Prepared by : GWU mbH
Birlenbacher Str. 18
D-57078 Siegen

Germany

Telephone: +49-(0)271-88072-0

12/01/2011

1153, 1250, 1443, 1454, 1814, 1815, 1866, 1925

MSDS
Definition of terms

Material Safety Data Sheet for #2 Diesel

1. Chemical Product

MSDS Number: U7770

MSDS Date: 01-31-99

Product Name: #2 Diesel Fuel

24 Hour Emergency Phone: (210) 979-8346
Transportation Emergencies: Call Chemtrec at 1-800-424-9300
MSDS Assistance: (210) 592-4593

Distributors Name and Address:
T.W. Brown Oil Co., Inc.
1857 Knoll Drive
Ventura, California 93003

Chemical Name: #2 Diesel Fuel **Cas Number:** 68476-34-6

Synonyms/Common Names: This Material Safety Data Sheet applies to the following product descriptions for Hazard Communication purposes only. Technical specifications vary greatly depending on the product, and are not reflected in this document. Consult specification sheets for technical information.

California Air Resources Board (Carb) Diesel Fuel- On-road, Off-Road, Tax Exempt blends
Premium Diesel Fuel- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends
#2 Distillate- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends
#2 Diesel Fuel- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends
#2 Fuel Oil- Low-Sulfur, High-sulfur, On-Road, Off-Road, Tax Exempt blends

2. Composition, Information On Ingredients

Product Use: This product is intended for use as a fuel in engines and heaters designed for diesel fuels, and for use in engineered processes. Use in other applicatiions may result in higher exposures and require additional controls, such as local exhaust ventilation and personal protective equipment.

Description: #2 Diesel is a complex mixture of hydrocarbons from a variety of chemical processes blended to meet standardized product specifications. Composition varies greatly and includes C9 to C20 hydrocarbons with a boiling range of about 325-675 degrees F. The following is a non-exhaustive list of common components, typical percentage ranges in product, and occupational exposure limits for each.

Component or Material Name	%	CAS Number	ACGIH Limits TLV -- STEL -- Units	OSHA Exposure Limits PEL -- STEL -- C/P -- Units
Cat cracked distillate, light	0-100	64741-59-9	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A
Hydrotreated distillate, middle	0-100	64742-46-7	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A

Hydrotreated distillate, light	0-100	64742-47-8	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A
Gas oil, light	0-100	64741-44-2	100 -- NA -- mg/m3	N/A -- N/A -- N/A -- N/A

3. Hazards Identification

Health Hazard Data:

1. The major effect of exposure to this product is giddiness, headache, central nervous system depression; possible irritation of eyes, nose, and lungs; and dermal irritation. Signs of kidney and liver damage may be delayed. Pulmonary irritation secondary to exhalation fo solvent.

2. NIOSH recommends that whole diesel engine exhaust be regarded as a potential occupational carcinogen. Follow OSHA and NSHA rules where diesel engine exhaust fumes may be generated.

3. A life time skin painting study by the American Petroleum Institute has shown that similar naphtha products with a boiling range of 350-700 degrees F usually produce skin tumors and/ or skin cancers in laboratory mice. Only a weak to moderate response occurred. The effect to humans has not been determined.

4. Positive results at 2.0 ml/kg and 6.0 ml/kg noted in mutagenesis studies via in-vivo bone marrow cytogenetics assay in rats.

5. Kerosene is classified as a severe skin irritant. Mutation data has been reported for kerosene products. Hydrotreated kerosene is listed as being probably carcinogenic to humans with limited evidence in humans and sufficient evidence in experimental animals.

Hazards of Combustion Products: Carbon monoxide and carbon dioxide can be found in the combustion products of this product and other forms of hydrocarbon combustion. Carbon monoxide in moderate concentrations can cause symptoms of headache, nausea, vomiting, increased cardiac output, and confusion. Exposure to higher concentrations of carbon monoxide can cause loss of consciousness, heart damage, brain damage, and/or death. Exposure to high concentrations of carbon dioxide can cause simple asphyxiation by displacing available oxygen. Combustion of this and other similar materials should only be carried out in well ventilated areas.

< Home | Next >

MSDS
Definition of terms

Material Safety Data Sheet #2 Diesel

Medical Condition Generally Aggravated By Exposure: Medical conditions which have the same symptoms and effects as those outlined under the health hazard information section can be aggraved by exposure to this product.

Medical Limitation: N/A

Routes Of Exposure

Inhalation: Irritation of the upper respiratory tract and eyes, with possible euphoria, dizziness, headache, discoordination, ringing in the ears, convulsions, coma, and respiratory arrest.

Skin Contact: Defatting of the skin may occur with continued and prolonged contact. Irritation and burning sensation may occur on exposure to the liquid or mists.

Skin Absorption: Not significant.

Eye Contact: Severe burning sensation with temporary irritation and swelling of lids.

Ingestion: Irritation of the mucous membranes of throat, esophagus and stomach which may result in nausea and vomiting; central nervous system depression may occur, if absorbed (see inhalation symptoms above). If aspirated, chemical pneumonitis may occur with potentially fatal results. Possible kidney and liver damage may be delayed. (See Notes to Physician in Section 5)

Carcinogenicity Statement: #2 Diesel is not listed as carcinogenic by NTP, OSHA, and ACGIH. IARC has listed kerosene and light catalytic cracked distillates as a probable human carcinogen. Light paraffinic hydrotreated petroleum distillates are listed as confirmed human carcinogens by IARC.

4. First Aid Measures

Eyes: Immediately flush eyes with large amount of water for at least 15 minutes holding lids apart to ensure flushing of the entire eye surface. **SEEK IMMEDIATE MEDICAL ATTENTION.**

Skin: Wash contaminated areas with plenty of soap and water. A soothing ointment may be applied to irritated skin after thoroughly cleansing. Remove contaminated clothing and footwear. **SEEK IMMEDIATE MEDICAL ATTENTION.**

Inhalation: Get person out of contaminated area to fresh air. If breathing has stopped resuscitate and administer oxygen if readily available. **SEEK MEDICAL ATTENTION IMMEDIATELY.**

INGESTION: Never give anything by mouth to an unconscious person. If swallowed, do not induce vomiting. If vomiting occurs spontaneously, keep airway clear. **SEEK MEDICAL ATTENTION IMMEDIATELY.**

Note to Physician: Do not induce vomiting, use gastric lavage only. Aspiration of liquid into the lungs could result in Chemical pneumonitis. Use of adrenaline is not advised. Treat symptomatically.

< Back | Next >

MSDS
Definition of terms

Material Safety Data Sheet for #2 Diesel

5. Fire and Explosion Data

Flash Point: 100 degrees F PM (minimum)
Autoignition Temperature: 494 degrees F
Flammable Limits In Air: UEL: 5% - LEL: 0.7%

Extinguishing Media: Use dry chemical, carbon dioxide, foam or water spray. Water may be ineffective in fighting fires of liquids with low flash points, but water should be used to keep fire exposed containers cool. If a leak or spill has not ignited, use water spray to disperse the vapors and to protect persons attempting to stop a leak.

Special Fire Fighting Procedures: Pressure-demand, self contained, breathing apparatus should be provided for fire fighters in buildings or confined areas where product is stored.

Unusual Fire And Explosion Hazard: Vapor accumulation is possible, and flashback can occur with explosive force if vapors are ignited.

6. Accidental Release Measures

If material is spilled, steps should be taken to contain liquid and prevent discharges to streams or sewer systems and control or stop the loss of volatile materials to the atmosphere. Spills or releases should be reported, if required to the appropriate local, state and federal regulatory agencies.

Small Spills: Remove ignition sources. Absorb spilled material with non-combustible materials such as cat litter, dirt, sand, or petroleum sorbent pads/pillows. Do not use combustible materials like rags, wood chips, or saw dust. Remove contaminated materials to an appropriate disposal container.

Large Spills: Remove ignition sources. Dike spill area with sand or dirt to contain material and cover sewers/drains. Remain upwind and keep unnecessary people away. Contact trained emergency response team for cleanup. Remove liquid using grounded suction pumps, isolate hazard area and deny entry.

7. Handling and Storage Information

Store only in approved containers. Protect containers against physical damage. Outside or detached storage is preferred. Separate from oxidizing materials. Store in cool, well ventilated area of non-combustible construction away from possible sources of ignition. Keep away from incompatible materials and follow OSHA 29 CFR 1910.106 and NFPA 30 for storage requirements.

Product Use: This product is intended for use as a fuel in engines and heaters designed for kerosene or diesel fuels, and for use in engineered processes. Use in other applications may result in higher exposures and require additional controls, such as local exhaust ventilation and personal protective equipment.

8. Exposure Controls/Personal Protection

Ventilation Requirements: Work in well ventilated areas using good engineering practices to process, transfer and store. Special ventilation in not required unless

product is sprayed or heated. High volume use may require engineering controls.

Specific Personal Protective Equipment

Respiratory: Respiratory protection is not required unless product is sprayed or heated. Use NIOSH approved respiratory protection following manufacture's recommendations where spray, mists, or vapors may be generated. Supplied air respiratory protection is required for IDLH areas. See 29 CFR 1910.134 for OSHA Respirator Protection regulations.

Eye: Face shield and goggles or chemical goggles should be worn where mist or spray may be generated, and where splashing occurs. Shower and eyewash facilities should be accessible.

Gloves: Impermeable protective gloves such as nitrile gloves should be worn during routine handling of this product. Barrier creams may also be appropriate where tactile sensitivity is required.

Other Clothing and Equipment: Clothing contaminated with this product should be removed and laundered before reuse. Items which can not be laundered should be discarded. Allow contaminated items to air dry or hang in a well ventilated area. Spontaneous combustion or fire may result from contaminated materials being placed together before drying.

Exposure Monitoring

Biological: No applicable procedure, breath analysis for hydrocarbons has been suggested.

Personal/Area: Based on similarity to kerosene, both active and passive monitors employing charcoal adsorption follow by gas chromatography. An average molecular weight of 170 has been suggested as the average value to convert the determined weight of hydrocarbons to ppm. Direct reading colorimetric tubes are available to evaluate short term exposure.

9. Physical and Chemical Properties

Appearance and Odor: Colorless to straw, or red oily liquid with characteristic kerosene-like odor.
Viscosity: Specification dependent, 1.7 - 3.4 cSt @ 140 degrees F
Boiling Range @ 760 mm Hg: 302-644 degrees F
Vapor Density (Air=1): 4.5 (kerosene)
Evaporation Rate (BuAc=1): N/A
Specific Gravity (H2O=1): 0.865
Bulk Density At 60 degrees F: 6.8-7.2 lbs./gal.
Solubility in H2O % by WT.: Insoluble
Freezing Point: -51 degrees F
Vapor Pressure: 0.5 mmHg @ 20 degrees C
% Volatiles By Vol.: N/A
API Gravity: Specification dependent
pH: NA

< Back | Next >

MSDS
Definition of terms

Material Safety Data Sheet for #2 Diesel

10. Stability and Reactivity Information

Conditions Contributing to Instability: Under normal conditions, the material is stable. Avoid sources of ignition such as flames, hot surfaces, sparks, and electrical equipment.

Incompatibility: Avoid contact with strong oxidizers such as chlorine, concentrated oxygen, and sodium hypochlorite or other hypochlorites.

Hazardous Decomposition Products: Thermal decomposition products may include carbon monoxide, carbon dioxide, oxides of sulfur and nitrogen, and other toxic gases

Hazardous Polymerization: Material is not known to polymerize.

11. Toxicological Information

For detailed information, contact MSDS Assistance at (210) 592-4593

12. Ecological Information

For detailed information, contact MSDS Assistance at (210) 592-4593

13. Disposal Considerations

Shipment, storage, disposal, and cleanup actions of waste materials are regulated under local, state and federal rules. Contact the appropriate agencies if uncertain of applicability. Waste product and contaminated material having a flash point below 140 degrees F is considered a hazardous waste. DOT Hazardous Waste Number D001 applies. Consult 40 CFR 262 for EPA disposal requirements.

14. Transport Information

DOT Proper Shipping Name	Combustible Liquid, n.o.s	Diesel Fuel
DOT Hazard Class*	Combustible Liquid	3*
DOT Packing Group (PG)	III	III
I.D. Number	UN 1993	NA 1993
Required Labeling	None	Flammable Liquid

* Since this product has a flash point >100 degrees F and no other hazard class applies, it may be reclassed as Combustible Liquid and NA 1993 substituted for the product specific I.D.

Number above. Consult 49 CFR 173.120 for specific details.

15. Regulatory Information

TSCA (Toxic Substance Control Act) Inventory

Gasoline is listed in the TSCA inventory.

SARA (Superfund Amendments and Reauthorization Act) TITLE III

This product is reportable under SARA Title III, Sections 311 & 312 as a hazardous substance.

Hazard Categories Applicable under 40 DFR 370.2 (SARA Section 311):

Acute Health	Chronic Health	Pressure	Fire	Reactive
Yes	Yes	No	Yes	No

Components Listed under 40 CFR 372.65 (SARA Section 313):

This product does not contain chemicals identified as toxic by EPA under CFR part 372 and is not subject to the reporting requirements of this section.

State Regulations:

California Proposition 65: This product does not contain chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

16. Other Information

NFPA (National Fire Protection Association) Hazard Ratings Codes*

Fire	Health	Reactivity	Other
2	1	0	Blank

*Based on Standard System for the Identification of the Fire Hazards of Materials, NFPA No. 704 M

This material safety data sheet was prepared by T. W. Brown Oil Co., Inc. in accordance with 29 CFR 1910.1200. All information, recommendations and suggestions appearing herein concerning this product are based upon tests and data believed to be reliable, however, it is the user's responsibility to determine the safety, toxicity and suitability for his own use of the product described herein. Since the actual use by others is beyond our control, no guarantee expressed or implied is made by T. W. Brown Oil Co., Inc. as to the effects of such use, the results to be obtained or the safety and toxicity of the product nor does T. W. Brown Oil Co., Inc. assume any liability arising out of use by others of the product referred to herein. Nor is the information herein to be construed as absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable

MATERIAL SAFETY DATA SHEET

DECEMBER 2012

Llame 1-888-223-0029 para la información sobre los avisos de seguridad en español

Suburban Propane, L.P. P.O. Box 206 Whippany, NJ 07981-0206

TRANSPORTATION EMERGENCY RESPONSE : CHEMTREC (800) 424-9300	GENERAL ADDITIONAL INFORMATION: SAFETY SERVICES (973) 887-5300

SECTION 1 –PRODUCT IDENTIFICATION

Product Name: Commercial Odorized Propane
Chemical Name: Propane
Chemical Family: Petroleum Hydrocarbon
Common Names: Liquefied Petroleum Gas, LP-Gas, LPG, Bottle Gas

SECTION 2 – PHYSICAL AND CHEMICAL CHARACTERISTICS

BOILING POINT: - 44° F	FLASH POINT: -156° F	BULK DENSITY: 4.20 lbs. /gal.
SPECIFIC GRAVITY:	LIQUID: 0.504	VAPOR: 1.50

GAS VOLUME @ ATM. PRESSURE & 60° F (Cu. Ft. gas/gal. Liquid): 36.38

VAPOR PRESSURE: 208 psig @ 100° F (ASTM) SPECIFIC HEAT of LIQUID: .630 BTU/LB. & 60° F
FLAMMABILITY LIMITS (% BY VOLUME IN AIR): L.E.L.: 2.1 U.E.L.: 9.5

EXPANSION RATIO OF LIQUID TO GAS @ 14.7psia : 1 to 270

LIQUID BOIL-OFF TO PROPANE VAPOR ABOVE – 44 F°: 100%

COMPONENTS	*CAS NO.*	
PROPANE	74-98-6	*
PROPYLENE	115-07-1	*
BUTANES	106-97-8	2.5%
SULPHUR	7704-34-9	185 ppmw with no discoloration of Lead Acetate paper**
RESIDUAL MATTER		0.05 ml after boil off of 100 ml liquid sample **
ODORANT(S)	Various	Odor concentration detectable in air of not over one-fifth of the lower limit of flammability per NFPA 58.
CORROSIVES		Not to exceed #1 grade copper strip test**

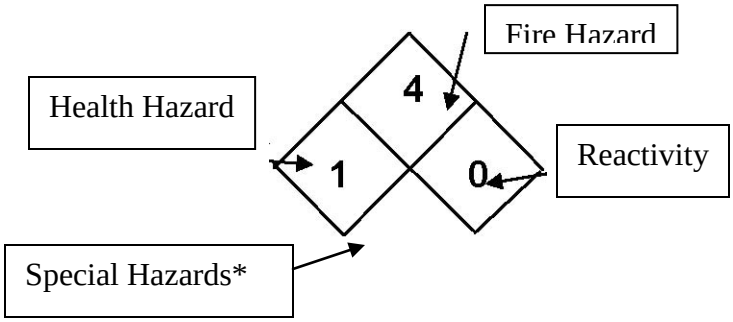
PROPANE IS COLORLESS AND ODORLESS.
PROPANE IS VERY STABLE.
POLYMERIZATION WILL NOT OCCUR.
AN ADDED ODORANT GIVES PROPANE A STRONG UNPLEASANT SMELL. Information regarding the effectiveness or intensity of odorants, is set forth in Section 9 below.

* *Combined constituents comprise a minimum 97.45 % of the total weight under Gas Processors Association (GPA) Standard 2140-97.*
** *Based on American Society of Testing and Materials (ASTM) Standard D1835-91.*

SECTION 3 –PHYSICAL HAZARD DATA

NFPA CLASSES:

4 - Severe
3 – Serious
2 – Moderate
1 – Slight
0 – Minimal
*Ref. NFPA 704



Item No. 1519278 SAF 5152 1212

PROPANE IS FLAMMABLE. PROPANE IS A SIMPLE ASPHYXIANT.
Flammable Gas under pressure – Keep away from sources of ignition such as heat, sparks or flame. Vapor is heavier than air and may collect in low-lying areas.

WHAT IS PROPANE?

Propane (also called LPG-Liquefied Petroleum Gas or LP-Gas) is a liquid fuel stored under pressure. In most systems, propane is vaporized to a gas before it leaves the tank. Propane is highly flammable when mixed with air (oxygen) and can be ignited by many sources, including open flames, smoking materials, electrical sparks, and static electricity. Severe "freeze burn" or frostbite can result if propane liquid comes in contact with your skin.

SECTION 4 – HEALTH HAZARD DATA

Propane is a simple asphyxiant and care must be taken to provide adequate ventilation. Vapors can displace available oxygen for breathing in confined spaces. Odor may not provide adequate warning of potentially hazardous concentrations. Propane is heavier than air and may collect in low-lying areas in the absence of wind or ventilation. Liquid propane can cause freeze burns when brought into direct contact with body parts.

SECTION 5 – PRIMARY ROUTES OF ENTRY

Eye: Although propane vapor is generally non-irritating, pressurized gas may inflict mechanical injury to the eye. Direct contact with liquid propane can cause freeze burns and resultant swelling of the eye.
Skin: Contact with liquid propane can cause freeze burns similar to frostbite.
Ingestion: Deemed unlikely.
Inhalation: Simple asphyxiant. Extreme over exposure may cause dizziness, headache, disorientation, excitability, fatigue, coughing, vomiting, anesthesia, unconsciousness and death.

SECTION 6 – EXPOSURE LIMITS

COMPONENT	THRESHOLD LIMIT VALUE (TLV)	PERMISSABLE EXPOSURE LIMIT (PEL)
PROPANE	NE	1000 ppm
PROPYLENE	NE	NE
BUTANES	NE	800 ppm

PROPANE CAN DISPLACE OXYGEN REQUIRED FOR NORMAL RESPIRATION AND CARE SHOULD BE TAKEN TO PROVIDE ADEQUATE VENTILATION, ESPECIALLY IN CONFINED SPACES AND IN THE ABSENCE OF WIND.

SECTION 7 – TOXICOLOGICAL INFORMATION

Propane is not listed in the latest edition of the National Toxicology Program Annual Report on Carcinogens, has not been found to be a potential carcinogen in the latest edition of the International Agency for Research on Cancer Monographs, and has not been identified as a carcinogen by OSHA.

Upon review of USC Title 15 Chapter 23 Section 2601 commonly known as Toxic Substance Control Act (TSCA), Propane has not been found to be a chemical whose manufacture, processing, distribution in commerce, use, or disposal to present an unreasonable risk of injury to health or the environment.

Propane does not contain any Class 1 or Class 2 ozone-depleting chemicals. Propane is not a listed marine pollutant.

The Food and Drug Administration (FDA) has said propane is GRAS (generally recognized as safe) as a direct human food ingredient when used as a propellant, aerating agent and gas.

Normal combustion products of propane are carbon dioxide, nitrogen and water vapor. Incomplete combustion of propane can produce carbon monoxide (CO), a toxic gas, and various aldehydes; an eye and nose irritant. These can be produced both by gas appliances and internal combustion engines.

SECTION 8 – SAFE HANDLING AND USE

Propane systems must be tested and proven leak free prior to use. Refer to National Fire Protection Association (NFPA) 54 National Fuel Gas Code for further instructions.

Keep away from all sources of ignition, including heat, sparks and open flames. Never check for leaks with a lit match or flame. Use an approved leak detector solution or electronic leak detector.

All piping and equipment used for the handling, storage and use of propane must be specifically designed for that purpose. Refer to NFPA 54 National Fuel Gas Code and NFPA 58 Liquefied Petroleum Gas Code.

OSHA 29 CFR 1910.110, DOT 49 CFR 172.700 and NFPA 58 all require that persons handling LP gases be specially trained in proper handling and operating procedures, which must be documented by the employer. Only qualified persons should transport, operate, service and/or install propane systems and containers.

Propane vapor is heavier than air and can collect in low-lying areas, especially in the absence of wind or ventilation. Propane is a simple asphyxiant.

Liquid propane can cause freeze burns, and appropriate personal protective equipment should be used whenever handling this product.

Propane cylinders should always be stored in an approved location with relief valves in direct communication with the vapor space, and with service valves closed and plugged when not in use. Refer to NFPA 58 for details of specific storage requirements.

Empty propane containers retain residue and should be treated as if full. Never drop or damage containers. Damaged or corroded and leaking containers should not be utilized. Contact your local Suburban Customer Service Center immediately to report any problems. If container service valve fails to operate properly, discontinue use. Never insert any object into the pressure relief valve. Return unused propane to supplier for proper disposal.

SECTION 9 – EXPOSURE CONTROLS

Propane is Odorized: Propane smells like rotten eggs, a skunk's spray, or a dead animal. Some people may have difficulty smelling propane due to their age (older people may have a less sensitive sense of smell); a medical condition; or the effects of medication, alcohol, tobacco, or drugs.

Odor Fade: Odor fade is an unintended reduction in the concentration of the odor of propane, making it more difficult to smell. Although rare, several situations can cause odor fade:

- The presence of air, water, or rust in a propane tank or cylinder;

- The passage of leaking propane through soil;
- The exposure to building materials, masonry or fabrics.

Since there is a possibility of odor fade or problems with your sense of smell, you should respond immediately to even a faint odor of gas.

To learn what propane smells like, customers unfamiliar with that smell should call Suburban's Safety Information Request Center at 1-888-223-0029 and order the pamphlets called "Important Propane Safety Information for You and Your Family" and/or an expansive "Propane Safety" booklet to obtain a Scratch and Sniff Test, provided free of charge. Pamphlets can also be purchased through Propane Education & Research Council (PERC) at 1-866-905-1075 or www.propanecatalog.com.

Propane Gas Detectors are Recommended: Propane gas detectors sound an alarm if propane is detected in the air. Suburban recommends the installation of UL-listed propane gas detectors in basements and where recommended by the manufacturer to provide an additional warning of the presence of propane. They can provide an additional measure of security in structures with little-used areas and for individuals who have difficulty smelling propane.

Guidelines regarding propane gas detectors:
- Buy only units that are listed by Underwriters Laboratories (UL).
- Follow the manufacturer's instructions regarding installation and maintenance.
- Never ignore the smell of propane, even if no detector is sounding an alarm.

Engineering Controls: Provide ventilation in enclosed areas where accumulation of vapors may provide a flammable mixture. Where flammable mixtures may be present, specially designed electrical systems must be used in accordance with NFPA 70 National Electric Code.

Respiratory Protection: For general use no protection is required. Under emergency conditions, concentrations may be high enough to warrant supplied-air or self-contained breathing apparatus. Under these conditions, a flammable atmosphere is likely and precautions should be taken to avoid ignition.

Eye Protection: Approved safety glasses should be used whenever filling and handling propane containers.

Protective Clothing: To avoid skin contact with liquid propane, approved gloves that are impervious to propane should be worn along with clothing that will provide protection from liquid propane for the expected duration- of exposure.

Other Protective Equipment: Safety shoes are recommended when handling cylinders.

SECTION 10 – EMERGENCY AND FIRST AID PROCEDURES

Contact with liquid propane can cause freeze burns similar to frostbite. Remove saturated clothing, shoes and jewelry immediately. Affected body parts should be gently flushed with or immersed in lukewarm water for 15 minutes. Seek medical attention.

If respiratory symptoms occur, get victim away from source and into fresh air. If breathing difficulties develop, qualified personnel may administer oxygen. If breathing or heartbeat cease, artificial respiration or cardiopulmonary resuscitation should be started immediately. Contact emergency medical responders at once.

IF YOU SMELL, HEAR OR SEE GAS

1. **NO FLAMES OR SPARKS**! Immediately put out all smoking materials and other open flames. Do not operate lights, appliances, telephones, or cell phones. Flames or sparks from these sources can trigger an explosion or fire.
2. **LEAVE THE AREA IMMEDIATELY**! Get everyone out of the building or area where you suspect gas is leaking.
3. **SHUT OFF THE GAS**. Turn off the main gas supply valve on your propane tank if it is safe to do so. To close the valve, turn it to the right (clockwise).
4. **REPORT THE LEAK**. From a neighbor's home or other nearby building away from the gas leak, call your propane retailer right away. If you can't reach your propane retailer, call 911 or your local fire department.
5. **DO NOT RETURN TO THE BUILDING OR AREA** until your propane retailer determines that it is safe to do so.
6. **GET YOUR SYSTEM CHECKED**. Before you attempt to use any of your propane appliances, your propane retailer or a qualified service technician must check your entire system to ensure it is leak-free.

LIGHTING PILOT LIGHTS

IF A PILOT LIGHT REPEATEDLY GOES OUT or is very difficult to light, there may be a safety problem. DO NOT try to fix the problem yourself. It is strongly recommended that only a QUALIFIED SERVICE TECHNICIAN light any pilot light that has gone out.

YOU ARE TAKING THE RISK of starting a fire or an explosion if you light a pilot light yourself. Carefully follow all of the manufacturer's instructions and warnings concerning the appliance before attempting to light the pilot.

APPLIANCE AND SYSTEM MAINTENANCE

LEAVE IT TO THE EXPERTS. Only a qualified service technician should connect, disconnect, install, inspect, service, maintain and/or repair your propane equipment and piping. Have your appliances and propane system inspected just before the start of each heating season.

HELP YOUR APPLIANCES "BREATHE" Check the vents of your appliances to be sure that flue gases can flow easily to the outdoors; clear away any insect or bird nests or other debris. Also, clear the area around your appliances so plenty of air can reach the burner for proper combustion.

DO NOT TRY TO MODIFY OR REPAIR valves, regulators, connectors, controls, or other appliance and cylinder/tank parts. Doing so creates the risk of a gas leak that can result in property damage, serious injury, or death.

HAVE OLDER APPLIANCE CONNECTORS INSPECTED. Certain older appliance connectors may crack or break, causing a gas leak. If you have an appliance that is more than 20 years old, have a qualified service technician inspect the connector. Do not do this yourself, as movement of the appliance might damage the connector and cause a leak.

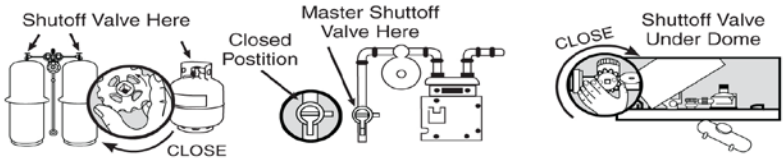
FLAMMABLE VAPORS ARE A SAFETY HAZARD. The pilot light on your propane appliance can ignite vapors from gasoline, paint thinners, and other flammable liquids. Be sure to store flammable liquids outdoors.

DON'T RISK IT! If you cannot operate any part of your propane system, or if you think an appliance or other device is not working right, call your propane retailer or a qualified service technician for assistance.

RUNNING OUT OF GAS
DON'T RUN OUT OF GAS. SERIOUS SAFETY HAZARDS, INCLUDING FIRE OR EXPLOSION, CAN RESULT.

- If an appliance valve or gas line is left open, a leak could occur when the system is recharged with propane.
- If your propane tank runs out of gas, any pilot lights on your appliances will go out. This can be extremely dangerous.
- A LEAK CHECK IS REQUIRED. In many states, a propane retailer or a qualified service technician must perform a leak check of your system before turning on the gas.

EQUIPMENT AWARENESS
KNOW HOW TO SHUT OFF YOUR GAS SUPPLY. Know where the gas supply shutoff valve to your premises valve is located. Tank and cylinder valves must be turned to the right (in a clockwise direction) to stop the flow of gas.



MANUFACTURER'S INSTRUCTIONS. All new appliances will come with an owner's manual and manufacturer's instructions. Keep and consult them for correct operating and maintenance procedures. Contact the appliance manufacturer for replacement instructions, if needed.

KNOW WHERE UNDERGROUND GAS LINES AND TANKS ARE LOCATED to avoid damaging them when digging or working on your premises.

DO NOT STORE PROPANE CYLINDERS OR CONTAINERS INSIDE BUILDINGS.

MAKE SURE REGULATOR REMAINS PROTECTED so operation will not be affected by the elements (rain, sleet, snow, ice, mud, debris). Regulator vent should be pointed down and checked regularly.

MAKE SURE BUILDING OPENINGS ARE NOT CREATED AND SOURCES OF IGNITION ARE NOT SITUATED WITHIN THE AREA OF PROPANE TANKS, REGULATORS, METERS AND OTHER PROPANE EQUIPMENT IN THE SYSTEM.

BE PREPARED FOR WEATHER-RELATED EMERGENCIES

FLOODING – If a flood is predicted for your area or your gas-fired appliance(s) or equipment has been submerged due to flooding:

- Turn off the gas valve at the container or cylinder.
- DO NOT turn the gas back on until a qualified service technician has checked the system.

HEAVY SNOW OR ICE – Heavy accumulations of snow or ice falling from roof eaves on regulators, piping, tubing and valves may cause damage that could result in a gas leak. Regulator vents must remain clear of snow and ice to operate properly. Check the regulator vents on the propane system to be sure they are free of condensation, which if frozen, could cause a malfunction. If a regulator vent is clogged with ice or snow, contact your local Suburban Customer Service Center immediately. Appliance vents, chimneys and flues must be kept clear of snow and ice so appliances may vent properly, especially on roofs of mobile homes. For installations in areas of heavy snowfall, arrange for the protection of piping, regulators, meters and other equipment installed in the piping system from the forces of accumulated

snow or ice. A protective cover or structure may be an appropriate form of protection in some circumstances, and is required in some jurisdictions. Contact your local building or fire official for guidance.

When removing snow:

- Use care around tanks, piping, tubing, valves, regulators and other equipment to prevent damage
- Use a broom instead of a shovel.
- Do not shovel snow from roofs onto propane equipment or piping. The weight of the snow could damage the propane system causing a leak.

SAFE ACCESS

Provide structurally sound access to propane equipment free from snow, ice, debris or other obstructions.

In the event of an accidental release or spill out of doors, these actions should be taken: Evacuate immediate area. Eliminate all possible sources of ignition including heat, sparks and open flame. Provide maximum ventilation and shut off source(s) of leak if possible to do so safely. If cylinder or container is leaking, contact the nearest Suburban Propane supplier or local fire department. Never enter a vapor (white) cloud.

Release without fire: Use a "fogging" hose stream of water to break up and dissipate propane into the atmosphere. Stay uphill and upwind of release at all times.

Release with fire: Apply a direct stream of water to container in order to prevent overheating. Do not attempt to extinguish flame until source of leak is shut off. Water spray or "fog" should be used for adjacent areas and to dissipate liquid propane to atmosphere.

Extinguishing Media: Class B fire-extinguishing media such as Halon, C02, or dry chemical can be used. Water spray or fog is appropriate for surrounding areas. Do not extinguish flame until source of gas is shut off. Only those with specialized training should attempt fire fighting. For further information, refer to NPGA "Propane Emergencies" Text #7220.

SECTION 11 – OTHER INFORMATION

Propane-fired equipment may emit carbon monoxide in its flue gasses.

CARBON MONOXIDE AND YOUR SAFETY

WHAT IS CARBON MONOXIDE (CO)? You can't taste or smell CO, but it is a very dangerous gas, produced when any fuel burns. High levels of CO can come from appliances that are not operating correctly or from a venting system or chimney that is blocked.

CO CAN BE DEADLY! High levels of CO can make you dizzy or sick (see below). In extreme cases, CO can cause brain damage or death.

- Headache
- Dizziness
- Fatigue
- Shortness of breath
- Nausea

IF YOU SUSPECT CO IS PRESENT, ACT IMMEDIATELY!

1. If you or a family member shows physical symptoms of CO poisoning, get everyone out of the building and call 911 or your local fire department.

2. If it is safe to do so, open windows to allow entry of fresh air, and turn off any appliances you suspect may be releasing CO.
3. If no one has symptoms, but you suspect that CO is present, call your propane retailer or a qualified service technician to check CO levels and your propane equipment.

TO HELP REDUCE THE RISK OF CO POISONING:

- Have a qualified service technician check your propane system appliances and related venting systems annually, preferably before heating season begins.
- Install and maintain UL-listed CO detectors in accordance with manufacturer's instructions.
- Never use a gas oven or range-top burners to provide space heating.
- Never use portable heaters indoors unless they are designed and approved for indoor use.
- Never use a barbecue grill (propane or charcoal) indoors for cooking or heating.
- Regularly check your appliance exhaust vents for blockage.

SIGNS OF IMPROPER APPLIANCE OPERATION THAT CAN GENERATE HIGH CO LEVELS:

- Sooting, especially on appliances and vents.
- Unfamiliar or burning odor.
- Increased moisture inside of windows.

FURTHER CONSUMER SAFETY INFORMATION

We urge you to visit www.suburbanpropane.com for Consumer Safety Information prepared by the Propane Education & Research Council (PERC). Pamphlets called "Important Propane Safety information for You and Your Family," "Important Propane Safety Information for Users of Small Cylinders" (including cylinder transportation, storage and inspection procedures), an expansive "Propane Safety" booklet, weather/natural disaster information, and Suburban's Material Safety Data Sheet (MSDS) may be read and downloaded online. These documents are also available free of charge by calling Suburban at 1-888-223-0029 and PERC pamphlets containing a Scratch and Sniff Test of propane odor can be purchased at 1-866-905-1075 or www.propanecatalog.com.

SECTION 12 –CONTACT INFORMATION

This Material Safety Data Sheet, issued December 2012, supersedes all earlier versions.

For further information write to:
SUBURBAN PROPANE, L.P.
Safety Services
240 Route 10 West
P.O. Box 206
Whippany, NJ 07981-0206
Or call: (973) 887 – 5300

DISCLAIMER: The information contained in this document is believed to be correct at the time of writing. **SUBURBAN MAKES NO REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, AND SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE CONCERNING PROPANE, THE USE OF PROPANE AND/OR THE EXPECTED RESULTS TO BE OBTAINED.** This information and any propane furnished by Suburban are provided in reliance upon and on condition that the person receiving them shall make his/her own determination as to the suitability of the propane for any specific purpose and that he/she assumes all risks associated with its storage and use.

UNIT 6: INFORMATION SHARING

TERMINAL OBJECTIVE

The students will be able to describe the protocol for sharing information about the presence of and risk and mitigation strategies pertinent to the hazardous materials that are stored and/or utilized in their local community.

ENABLING OBJECTIVES

The students will:

1. *Explain the rationale for sharing information on hazardous materials among organizations and the community at large.*

2. *Define the types of information about hazardous materials that should be shared.*

3. *Suggest mediums for information sharing.*

4. *Discuss emerging requirements pertinent to global harmonization that will impact how information is recorded and shared.*

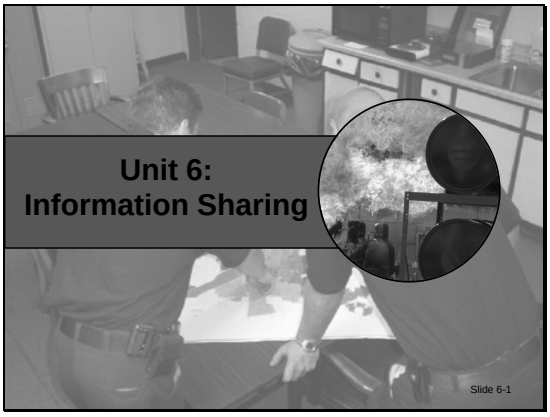
This page intentionally left blank.

NOTE-TAKING GUIDE AND ACTIVITY

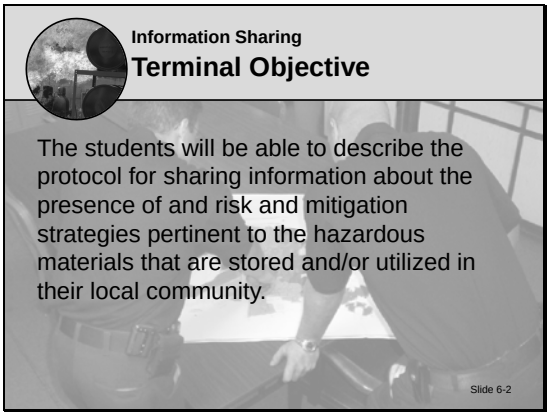
This page intentionally left blank.

NOTE-TAKING GUIDE

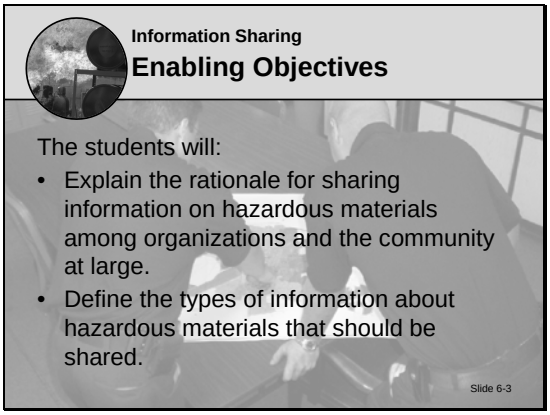
Slide 6-1



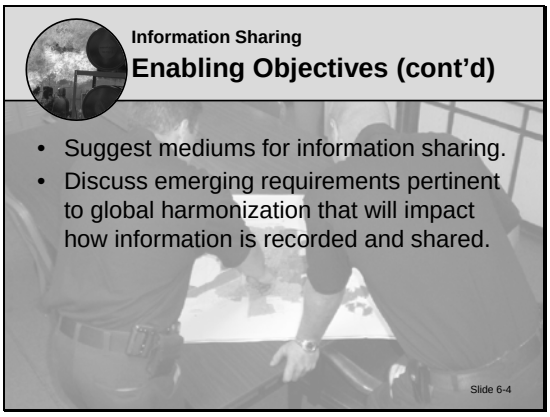
Slide 6-2



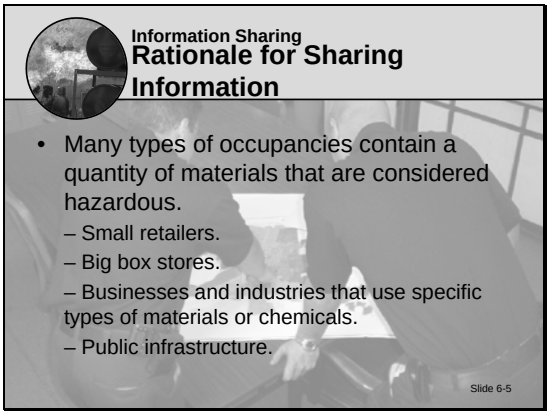
Slide 6-3



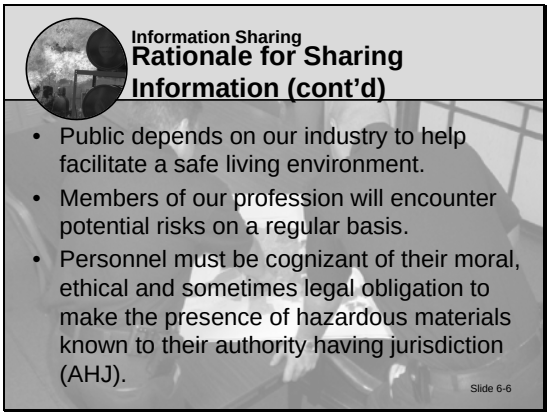
Slide 6-4



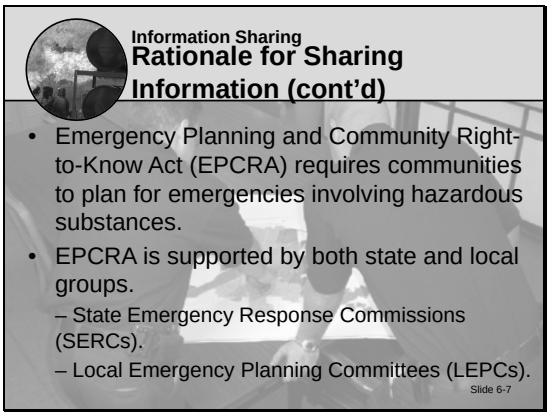
Slide 6-5



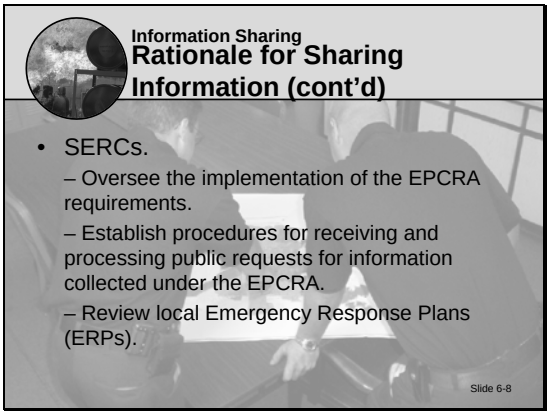
Slide 6-6



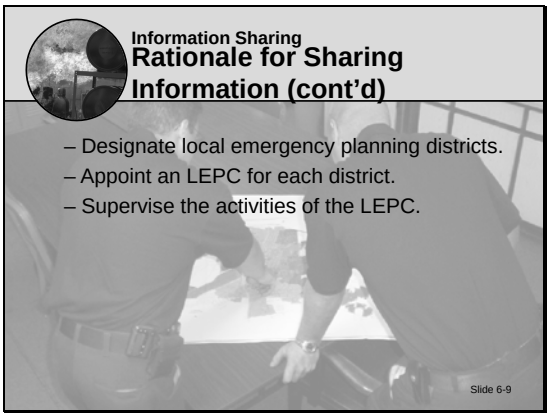
Slide 6-7



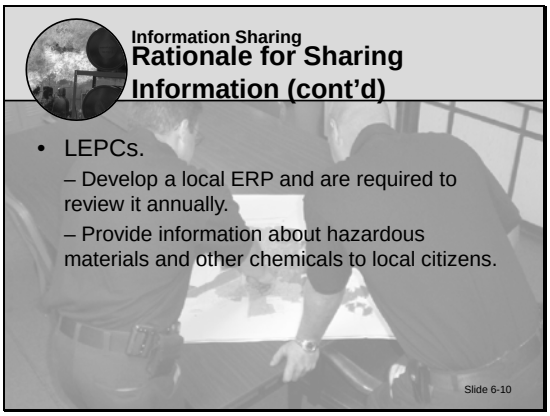
Slide 6-8



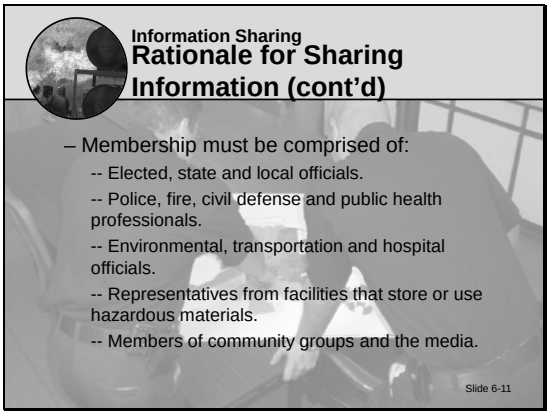
Slide 6-9



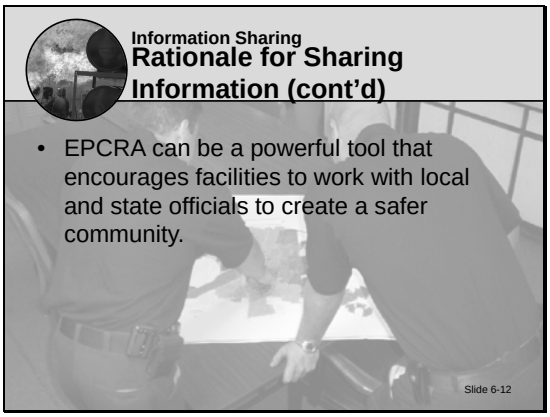
Slide 6-10



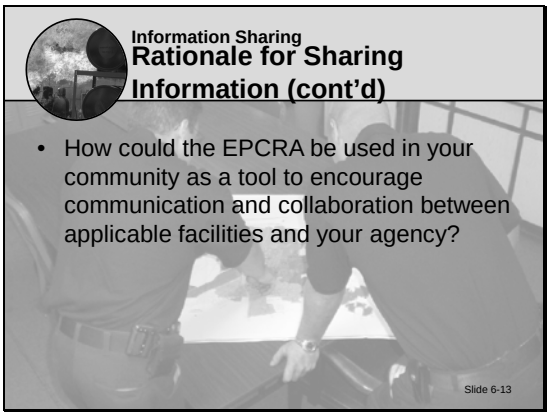
Slide 6-11



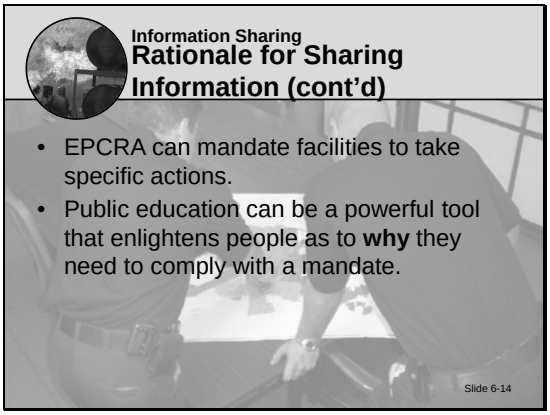
Slide 6-12



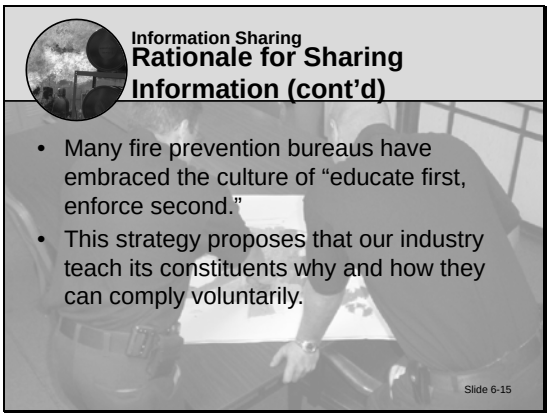
Slide 6-13



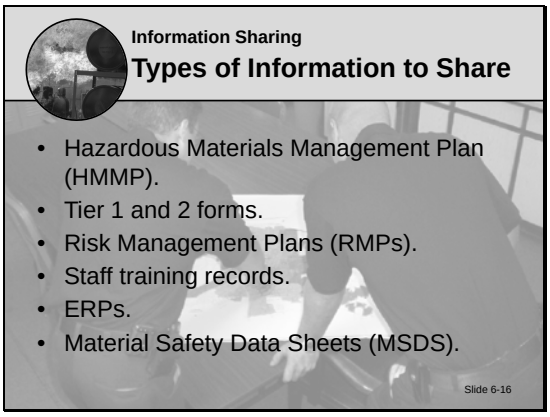
Slide 6-14



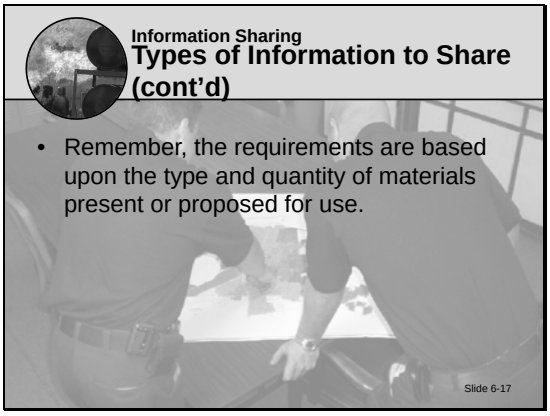
Slide 6-15



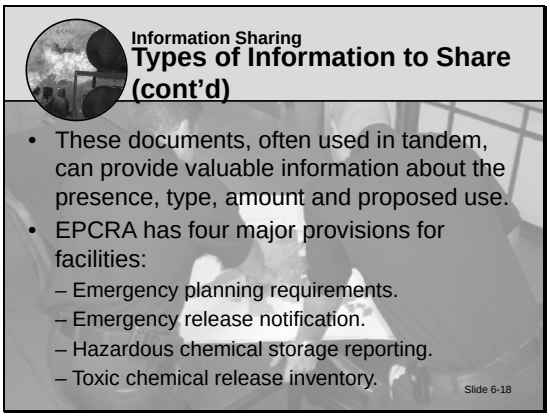
Slide 6-16



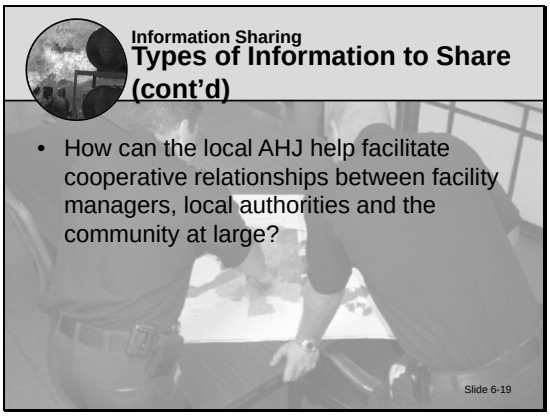
Slide 6-17



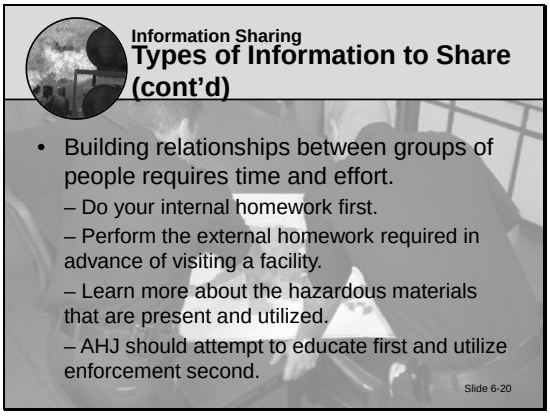
Slide 6-18



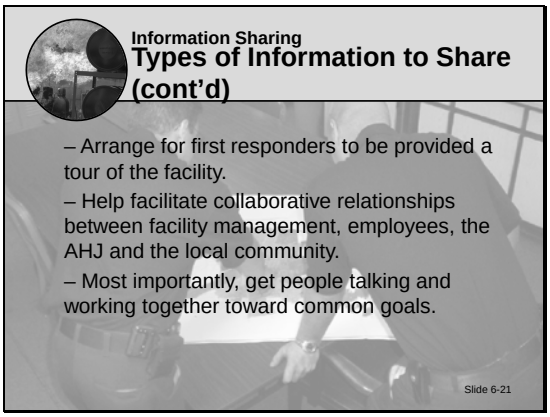
Slide 6-19



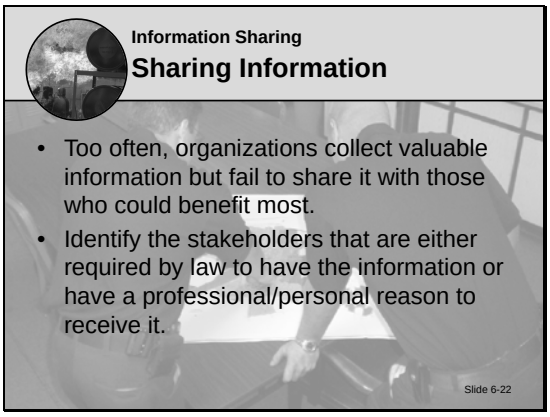
Slide 6-20



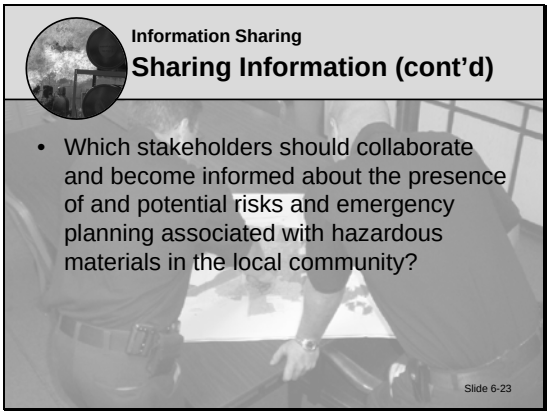
Slide 6-21



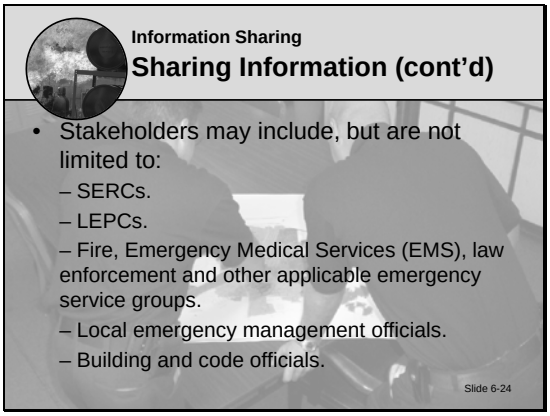
Slide 6-22



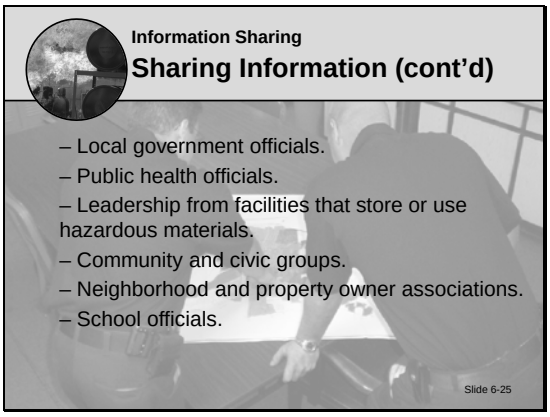
Slide 6-23



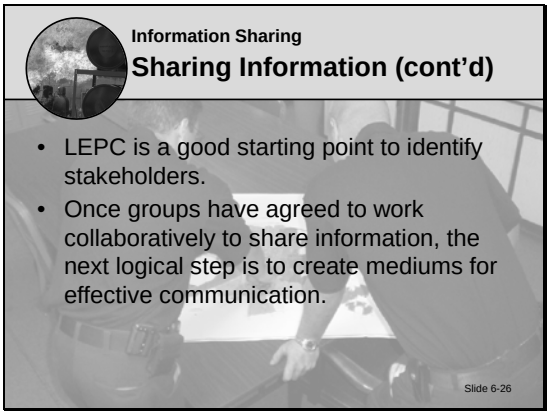
Slide 6-24



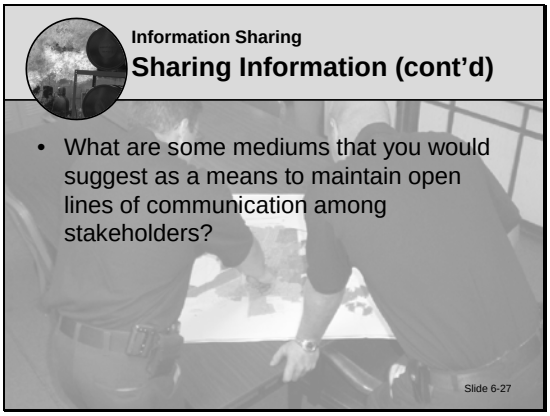
Slide 6-25



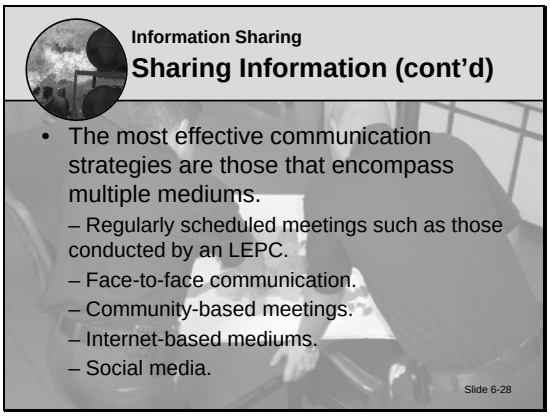
Slide 6-26



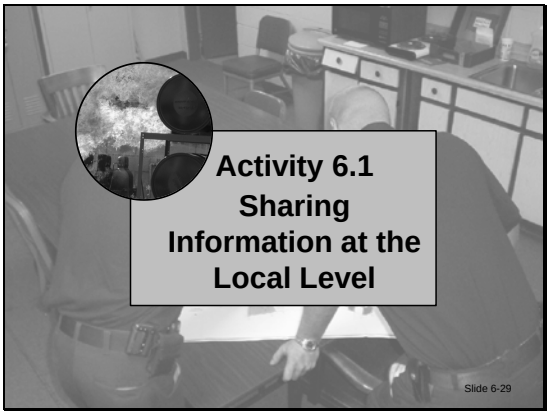
Slide 6-27



Slide 6-28



Slide 6-29



Activity 6.1

Sharing Information at the Local Level

Purpose

To describe the protocol for sharing information about the presence of and risk and mitigation strategies pertinent to the hazardous materials that are stored and/or utilized in your local community.

Directions

1. Using the space provided on the Student Activity Worksheet (SAW), respond individually to the following directives:

   a. Describe the protocol for sharing information about the presence of and risk and mitigation strategies pertinent to the hazardous materials that are stored and/or utilized in your local community.

   _____

   _____

   _____

   _____

   _____

   b. If a protocol does not exist, suggest stakeholders that should be engaged to help develop one.

   _____

   _____

   _____

   _____

   _____

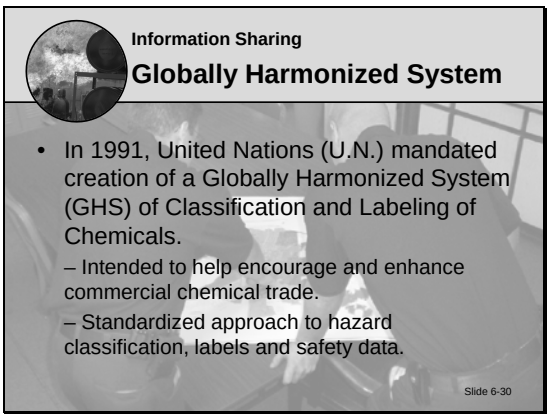
   There are 10 minutes allotted for this task.

2. Next, working in your table groups, compare and contrast your responses with peers.

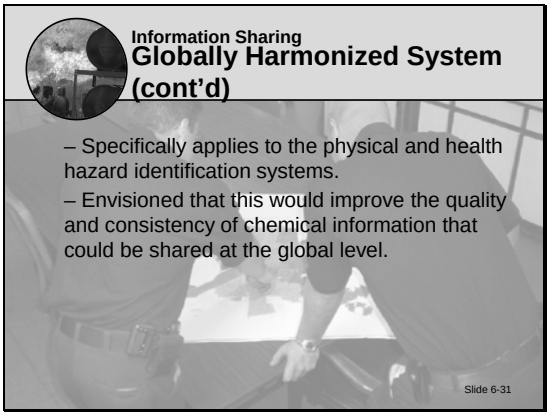
   There are 10 minutes allotted for this task.

NOTE-TAKING GUIDE (cont'd)

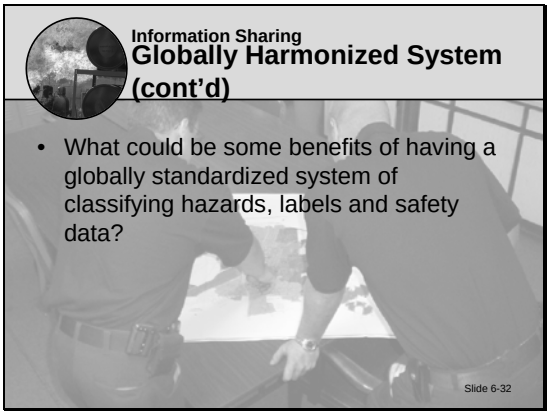
Slide 6-30



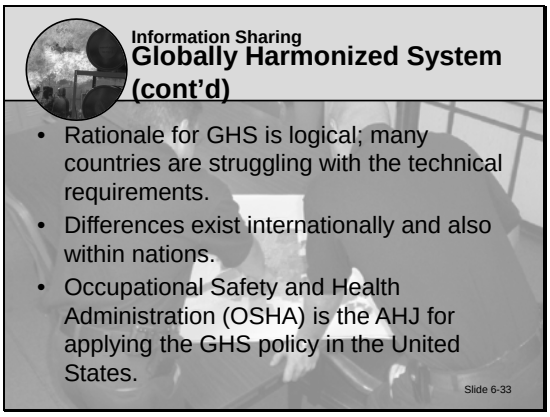
Slide 6-31



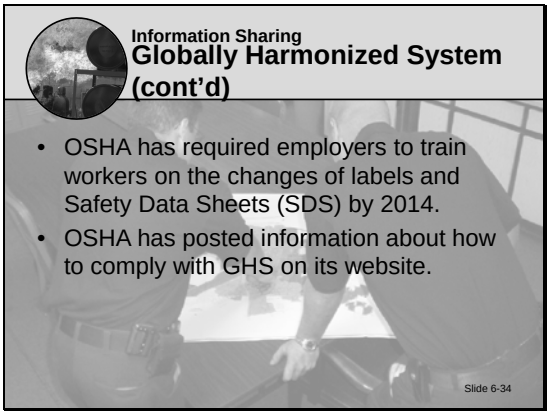
Slide 6-32



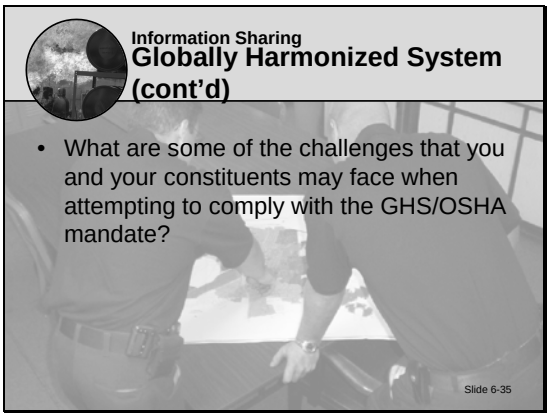
Slide 6-33



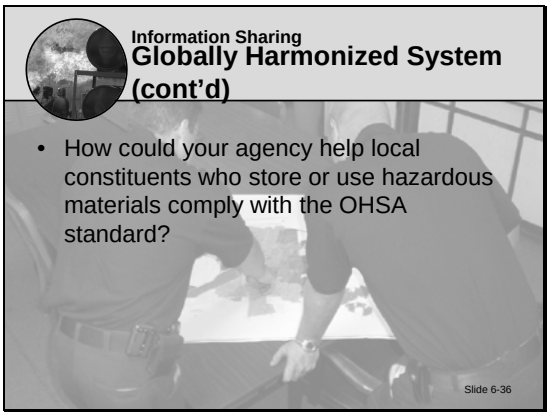
Slide 6-34



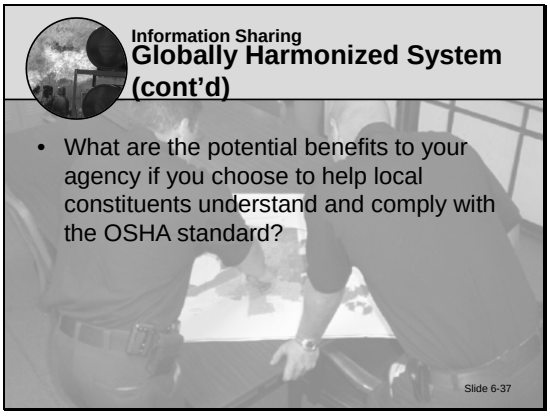
Slide 6-35



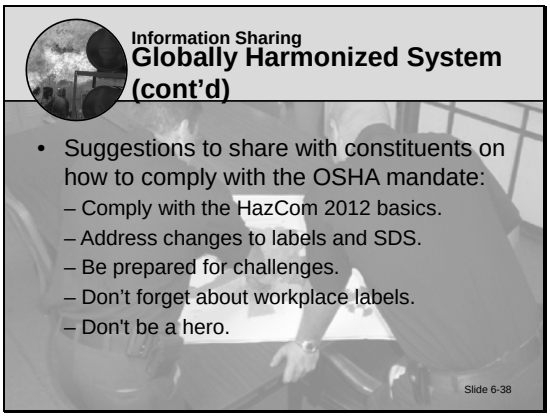
Slide 6-36



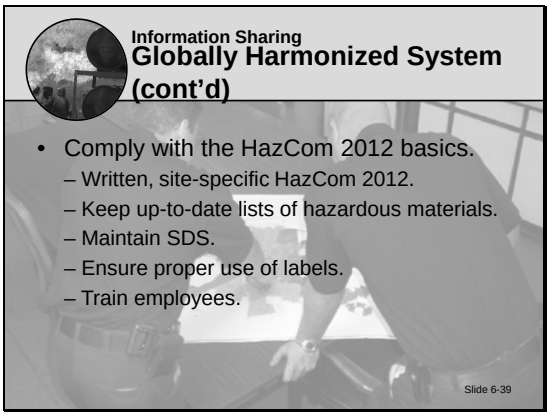
Slide 6-37



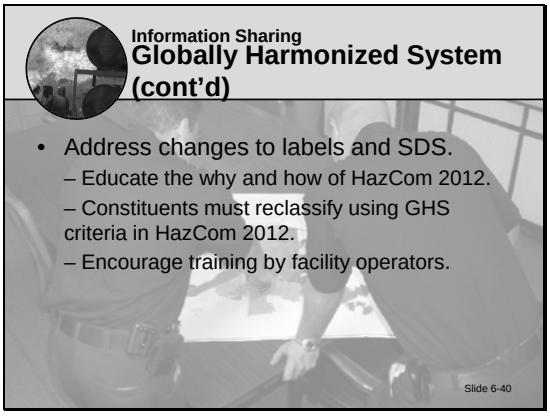
Slide 6-38



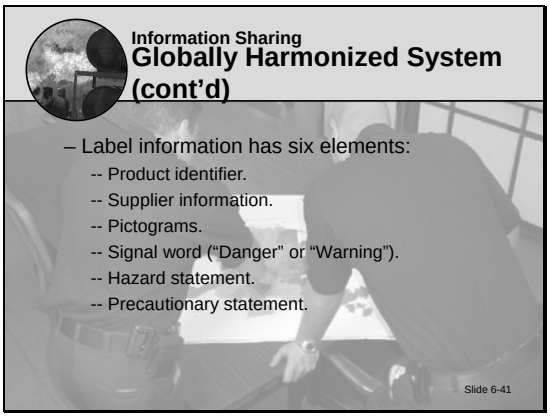
Slide 6-39



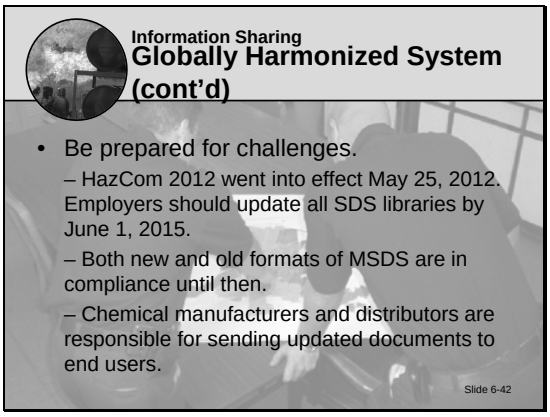
Slide 6-40



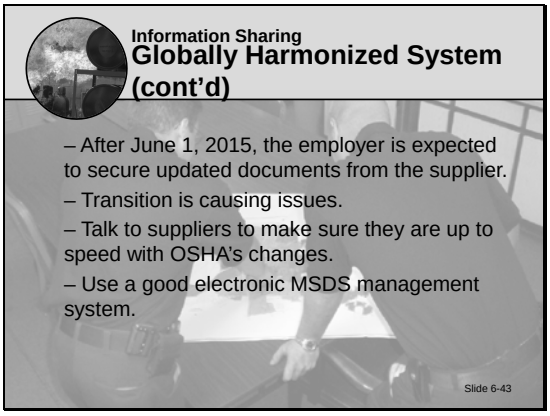
Slide 6-41



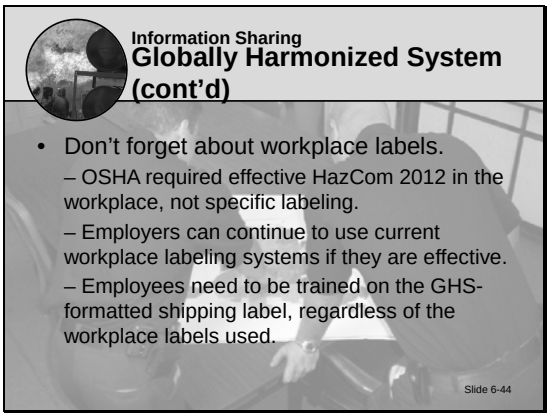
Slide 6-42



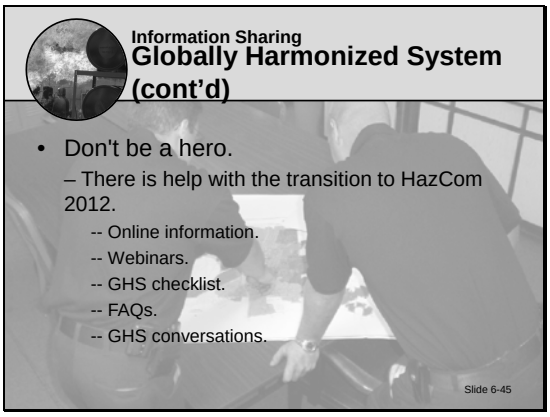
Slide 6-43



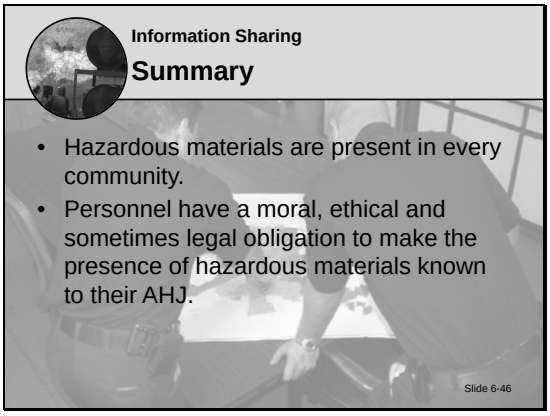
Slide 6-44



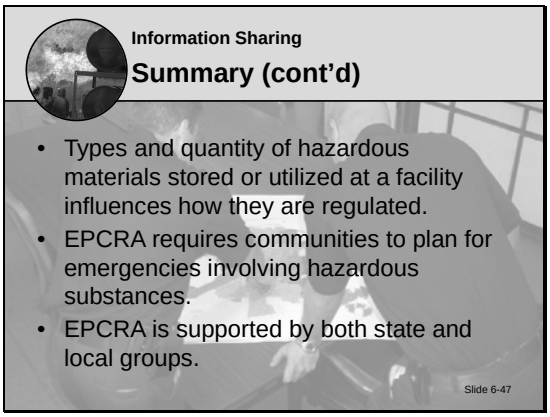
Slide 6-45



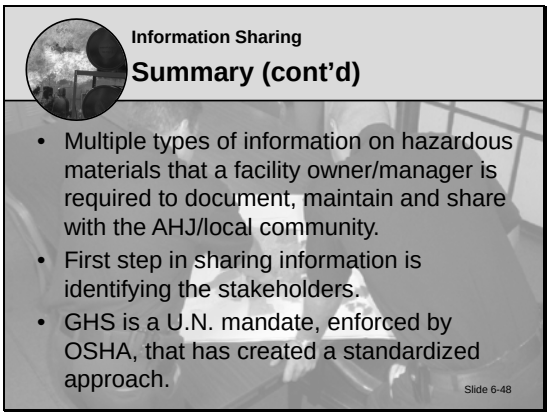
Slide 6-46



Slide 6-47



Slide 6-48


Information Sharing
Summary (cont'd)
• Multiple types of information on hazardous materials that a facility owner/manager is required to document, maintain and share with the AHJ/local community.
• First step in sharing information is identifying the stakeholders.
• GHS is a U.N. mandate, enforced by OSHA, that has created a standardized approach.
Slide 6-48

This page intentionally left blank.

BACKGROUND TEXT

This page intentionally left blank.

RATIONALE FOR SHARING INFORMATION

Hazardous materials are present in every community.

There are many types of occupancies that typically contain a quantity of materials that are considered hazardous.

Examples include, but are not limited to:

- Small retailers, like local hardware stores, lawn and garden specialty shops, and places that sell limited amounts of spa/pool supplies.
- Big box stores with a large and broad variety of inventory.
- Businesses and industries that use specific types of materials or chemicals as part of their production process.
- Public infrastructure, such as water and sewage treatment facilities that rely on chemical additives to create a safe living environment.

Members of the emergency services hold positions of public trust. The public depends on our industry to help facilitate a safe living environment that promotes community vitality.

As part of this charge, our members are obligated to act with due diligence to help ensure that potential local risks are either prevented or mitigated if an adverse incident occurs.

Because the presence of hazardous materials is a reality for every community, members of our profession will encounter potential risks on a regular basis.

Emergency service personnel must be cognizant of their moral, ethical and sometimes legal obligation to make the presence of hazardous materials known to their authority having jurisdiction (AHJ).

As learned earlier in the course, the types and quantity of hazardous materials stored or utilized at a facility influences how they are regulated.

Recall from Unit 2 that the Emergency Planning and Community Right-to-Know Act (EPCRA) requires communities to plan for emergencies involving hazardous substances. To accomplish this directive, the EPCRA is supported by both state and local groups.

These groups include the following:

State Emergency Response Commissions

State Emergency Response Commissions (SERCs) perform the following actions:

- Oversee the implementation of the EPCRA requirements for each state.
- Establish procedures for receiving and processing public requests for information collected under the EPCRA.
- Review local Emergency Response Plans (ERPs).
- Designate local emergency planning districts.
- Appoint a Local Emergency Planning Committee (LEPC) for each district.
- Supervise the activities of the LEPC.

Local Emergency Planning Committees

LEPCs perform the following actions at the **local, community-based level:**

- With stakeholder participation, LEPCs develop a local ERP and are required to review it annually.
- They provide information about hazardous materials and other chemicals to local citizens.
- LEPC membership must be comprised of:
  - Elected, state and local officials.
  - Police, fire, civil defense and public health professionals.
  - Environmental, transportation and hospital officials.
  - Representatives from facilities that store or use hazardous materials.
  - Members of community groups and the media.

The goal of the EPCRA is to help increase the public's knowledge about hazardous materials that are present at local facilities, identify the materials' uses, and understand their potential risks to the community. The act also requires facilities to report any releases of hazardous substances into the environment.

When applied as intended, the EPCRA can be a powerful tool that encourages facilities to work with local and state officials to create a safer community.

The EPCRA can mandate facilities to take specific actions; however, when used appropriately, public education can be a powerful tool that enlightens people as to **why** they need to comply with a mandate.

Many fire prevention bureaus have embraced the culture of "educate first, enforce second." This strategy proposes that our industry teach its constituents why and how they can comply voluntarily with federal, state and local public policies in a manner that creates the least amount of financial burden to the corporation.

Obtaining voluntary compliance to a mandated policy provides strong evidence that a corporation is willing to work collaboratively toward the goal of a safer community and environment. However, if voluntary compliance is purposely refuted, or rules are blatantly violated, then enforcement of public policy becomes an alternative (and sometimes necessary) method of intervention.

It should be noted when dealing with hazardous materials that the AHJ may be a federal regulatory agency, such as the Occupational Safety and Health Administration (OSHA).

TYPES OF INFORMATION TO SHARE

Unit 2 provided a summary of the types of information on hazardous materials that a facility owner/manager is required to document, maintain and share with the AHJ/local community.

Examples include:

- Hazardous Materials Management Plan (HMMP).
- Tier 1 and 2 forms.
- Risk Management Plans (RMPs).
- Staff training records.
- ERPs.
- Material Safety Data Sheets (MSDS).

Remember, the requirements are based upon the type and quantity of materials present or proposed for use.

These documents, often utilized in tandem, can provide valuable information about the presence, type, amount and proposed use of a hazardous material in the local community.

Recall that the EPCRA has four major provisions for facilities that meet specific criteria regarding the storage and use of hazardous materials.

These provisions include:

- Emergency planning requirements.

  The facility must have a hazardous materials emergency action plan and provide training to employees on how to prevent and mitigate incidents.

- Emergency release notification.

  A plan must be in place to notify authorities and the community in the event of a hazardous materials release.

- Hazardous chemical storage reporting.

  The facility must maintain current documentation of the hazardous materials inventory it has (or proposes to have) on its premises.

- Toxic chemical release inventory.

  The facility must document and make public all hazardous materials releases that have taken place.

Current regulation on hazardous materials provides a multitude of formats to collect information on what is present in the local community.

The information to be shared with the community is sometimes mandated by law; in other cases (where smaller quantities or less hazardous materials are the focus), sharing may be voluntary.

The salient point to remember is that as the level of risk rises, so does the amount of information that needs to be shared.

Again, the point needs to be emphasized about building relationships between the management of facilities that store or use hazardous materials, the AHJ, and the community.

Authority Having Jurisdiction

- Building relationships between groups of people requires time and effort.

- Suggestions for the AHJ on how to build relationships with facility management (and the community) include:

- Do your internal homework first. Establish a culture whereby the following people/groups work together (and communicate regularly) about the presence of hazardous materials in the community:

  - Inspectors.

  - Code enforcement specialists.

  - Law enforcement.

  - Building department officials.

  - Plan reviewers.

  - Fire marshals.

  - Company Officers (COs).

  - Command Staff.

  - Public education and information officers.

  - Line staff.

- Next, perform the external homework required in advance of visiting a facility that stores or utilizes hazardous materials. Take time to learn about the mission of the facility that is storing or using hazardous materials. As part of the inspection process, allow facility management to provide a tour of the location, including how the hazardous materials are stored or utilized.

- As time allows, attempt to learn more about the hazardous materials that are present and utilized in **your** community.

- When applying public policy such as the EPCRA, the AHJ (regardless of who it is) should attempt to educate the decision-makers first and utilize enforcement of public policy second. Arrange for first responders to be provided a tour of the facility by its management and employees who work with hazardous materials.

- Help facilitate collaborative relationships between facility management, employees, the AHJ and the local community. Most importantly, get people talking and working together toward common goals.

SHARING INFORMATION

Too often, organizations collect valuable information about the presence of and potential risks associated with hazardous materials in the local community but fail to share it with those who could benefit most.

An important first step in sharing information is identifying the stakeholders that are either required by law to have the information or have a professional/personal reason to receive it.

Stakeholders

There can be a vast number of stakeholders that should be working together so a community-based approach to hazardous materials risk prevention and mitigation is facilitated. Stakeholders may include, but are not limited to:

- SERCs.
- LEPCs.
- Fire, Emergency Medical Services (EMS), law enforcement and other applicable emergency service groups.
- Local emergency management officials.
- Building and code officials.
- Local government officials.
- Public health officials.
- Leadership from facilities that store or use hazardous materials.
- Community and civic groups.
- Neighborhood and property owner associations.
- School officials.

The LEPC is a good starting point to identify stakeholders because of the breadth of representation that it encompasses. Once pertinent agencies, corporations and groups have agreed to work collaboratively to share information, the next logical step is to create mediums for effective communication.

Mediums

Rapidly expanding communication mediums continue to create ways to share information. The most effective communication strategies are those that encompass multiple mediums. These include but are not limited to:

- Regularly scheduled meetings, such as those conducted by an LEPC.

- Face-to-face communication.
- Community-based meetings.
- Internet-based mediums.
- Social media.

GLOBALLY HARMONIZED SYSTEM

In 1991, the United Nations (U.N.) mandated the creation of a Globally Harmonized System (GHS) of Classification and Labeling of Chemicals. The mandate was intended to help encourage and enhance commercial chemical trade. It called for the creation of a standardized approach to hazard classification, labels and safety data. The mandate specifically applies to the physical and health hazard identification systems for hazardous materials.

U.N. officials envisioned that standardization would improve the quality and consistency of chemical information that could be shared at the global level by:

- Defining the health, physical and environmental hazards of chemicals.
- Creating classification processes that use available data on chemicals for comparison with the defined hazard criteria.
- Communicating hazard information and protective measures on labels and Safety Data Sheets (SDS).

While the rationale for GHS is logical, many countries are struggling with the technical requirements associated with classifying hazards.

Differences exist internationally and also within nations. For instance, in the United States, the following agencies have different systems and definitions:

- Consumer Product Safety Commission (CPSC).
- Department of Transportation (DOT).
- Environmental Protection Agency (EPA).
- OSHA.

OSHA is the AHJ for applying the GHS policy in the U.S.

The mandate is identified as OSHA Hazardous Communication Standard (29 Code of Federal Regulations (CFR) 1910.1200). The standard is also known as HazCom 2012.

As part of an ongoing process to adopt the standard, OSHA has required that (by 2014) employers must train workers exposed to hazardous materials on the changes that will soon apply to labels and SDS.

Some of the questions that safety professionals responsible for storing or using hazardous materials are asking include:

- Do manufacturers have to send me new SDS, or am I required to get them myself?
- What if my chemical supplier does not know about HazCom 2012 (or GHS in general) and the mandated changes for SDS?
- What exactly do I have to put on my workplace labels?

OSHA has posted information about how to comply with GHS on its website, in the "Federal Register," and in an ongoing series of public briefs.

Even with this information available, finding answers to critical questions can be overwhelming to busy facility managers and inspectors alike.

The following are suggestions to share with constituents on how to comply with the OSHA mandate:

Comply With the HazCom 2012 Basics

Have a written, site-specific hazard communication program. Keep an up-to-date list of hazardous materials that are present at the facility. Maintain SDS for all hazardous materials and provide Right-to-Know access to employees. Ensure proper use of labels and warning signs in the workplace. Train employees on HazCom 2012 and specific workplace hazardous materials.

Note: If a workplace is not in compliance with the above, begin by working with constituents to accomplish the tasks listed.

Facilities must have a current hazardous materials inventory and ensure that there is an SDS for every hazardous substance in the workplace.

Address Changes to Labels and SDS

Promote understanding of why and how HazCom 2012 is standardizing SDS and labels on shipped containers. Educate constituents that by June 2015, hazardous materials manufacturers and distributors must reclassify their materials using GHS criteria as directed by HazCom 2012.

SDS and labels must comply with the applicable formats. Encourage facility operators to conduct training in a timely manner, as changes to labels may occur at any time prior to a June 2015 deadline.

Communicate to constituents that the label information prescribed by OSHA under HazCom 2012 has six standardized elements:

- Product identifier — this is the same product identifier as found on SDS.
- Supplier information — should include the name, address, phone and other contact information of responsible party.
- Pictogram(s) — this is a black hazard symbol on a white background that includes a red diamond border.
- Signal word — must use either the word "Danger" or "Warning," depending upon hazards.
- Hazard statement(s) — declarative statement regarding nature or degree of hazard.
- Precautionary statement(s) — descriptions of appropriate prevention, storage, response and spill measures.

  Note: From the inspector's perspective, employees should know these six elements, how they work together, and how the information provides guidance on product handling and emergency response.

Be Prepared for Challenges

HazCom 2012 went into effect on May 25, 2012.

Between now and June 1, 2015, employers should expect that almost their entire SDS library will be updated.

This is causing some safety professionals to ask whether they have to keep two sets of MSDS books until all of the updates are made. **The answer is no**.

During the transition, OSHA says employers can be in compliance with the old standard, the new standard, or a combination of the two.

For example, employers will likely find their MSDS library contains SDS in both the new format as well as the myriad formats that were allowed under HazCom 1994.

Still, even though two sets of books are not required, employers will need to pay special attention to MSDS as they enter the workplace to see exactly what updates, if any, have been made. They should especially be on the lookout for chemicals that have newly identified hazards listed on the SDS.

Other MSDS questions that many employers have are about the timing of the updates and who has to do what. Some employers may worry that they must ask the chemical manufacturers for

the updated documents or even update the manufacturer SDS themselves. This is not the case (unless they happen to be the originator of the chemical).

Chemical manufacturers and distributors are responsible for sending the updated documents to the end users of their chemicals with the first shipment or the next shipment after a change has been made. This means employers can realistically update their libraries only as quickly as manufacturers and distributors update their own SDS. Manufacturers are not required to proactively send updated SDS to past customers independent of a new shipment.

If an employer receives a chemical shipment after the June 1, 2015, deadline, OSHA does expect the employer to make a good-faith effort to secure an updated document from the supplier.

Exacerbating the SDS issue is the fact that many manufactures seem to be making the move to GHS SDS in stages. For instance, it is not uncommon now to find 16-section SDS with GHS-required elements in the wrong places or SDS with more or less than 16 sections that also contain GHS pictograms and other HazCom 2012 information.

Given these challenges, how will employers know if the SDS they receive are HazCom 2012 compliant?

The best way is for employers to talk with their suppliers and make sure they are up to speed on OSHA's changes (too many chemical manufacturers and distributors are not) and to train their employees well on HazCom 2012. A good electronic MSDS management system also can help to identify SDS that include GHS elements.

If you are still managing MSDS using paper-based filing systems, this may be a good time to start evaluating an electronic solution.

Don't Forget About Workplace Labels

Questions about workplace labels tend to outpace other HazCom 2012 questions by a large margin.

Common questions are, "Can we still use National Fire Protection Association (NFPA) and Hazardous Materials Inventory Statement (HMIS) labels?"

"Do we have to use pictograms, and if so, must they have red borders as on the shipped label?"

Under HazCom 2012, workplace labels are still performance-based — meaning OSHA doesn't tell employers exactly what has to go on secondary container labels; it judges workplace label compliance by how well it does its job of effectively communicating hazards.

OSHA says explicitly in the final rule on HazCom 2012, and elsewhere, that employers can continue to use their current workplace labeling systems, so long as they effectively communicate to employees the hazards of the chemicals to which the workers are exposed.

A recent OSHA brief, "Hazard Communication Standard: Labels and Pictograms," says employers can "either provide all of the required information that is on the label from the chemical manufacturer or, the product identifier and words, pictures, symbols or a combination thereof, which in combination with other information immediately available to employees, provide specific information regarding the hazards of the chemicals."

The standard goes on to say that if employers have their own in-plant system or use HMIS or NFPA systems, they can continue to do so, so long as the system, in conjunction with other information available to employees, provides workers with all of the health and physical hazards of the chemical. If employers choose to employ GHS elements, like pictograms, on the workplace label, then the pictogram borders may have a black border rather than red, as required on the shipped label.

Keep in mind, under HazCom 2012, employees going forward will need to be trained on the GHS-formatted shipping label. Any deviation from that style on the workplace label will also need to be addressed via training.

For instance, employers using the NFPA system for workplace labels will need to ensure that employees are trained on both HazCom 2012 labels and the NFPA system.

Don't Be a Hero

There is no reason for safety professionals to go through the transition to HazCom 2012 alone. There is a wealth of information online, including free GHS webinars, a GHS checklist, and many GHS-related conversations and FAQs.

Additionally, the acceleration of mobile, cloud-based environmental health and safety solutions has made MSDS and chemical management, as well as online training solutions, affordable to even small and midsize employers.

The best-of-breed solutions can help with the influx of SDS, create GHS-formatted workplace labels with the click of a button, and give safety professionals a fast track on regulatory reporting.

HazCom 2012 is here. By following the simple tips listed above — and getting the necessary help — safety professionals should be able to keep their employees safe and employers on the right side of compliance throughout the GHS transition.

SUMMARY

Hazardous materials are present in every community.

Emergency service personnel have a moral, ethical and sometimes legal obligation to make the presence of hazardous materials known to their AHJ.

The types and quantity of hazardous materials stored or utilized at a facility influences how they are regulated.

The EPCRA requires communities to plan for emergencies involving hazardous substances.

The EPCRA is supported by both state and local groups.

- SERCs.
- LEPCs.

There are multiple types of information on hazardous materials that a facility owner/manager is required to document, maintain and share with the AHJ/local community.

An important first step in sharing information is identifying the stakeholders that are either required by law to have the information or have a professional/personal reason to receive it.

GHS is a U.N. mandate, enforced by OSHA, that has created a standardized approach to hazard classification, labels and safety data.

APPENDIX:
FIVE TIPS FOR MANAGING THE MESSY TRANSITION TO GLOBALLY HARMONIZED SYSTEM

This page intentionally left blank.

OH&S
OCCUPATIONAL HEALTH & SAFETY

Exclusively Online

5 Tips for Managing the Messy Transition to GHS

Safety professionals are finding that the more time they spend with the revised standard looking at training, the more questions they have about GHS adoption in general.

By Chuck Haling ***Apr 24, 2013***

OSHA revised the Hazard Communication Standard last year and by Dec. 1, 2013, employers must train workers exposed to hazardous chemicals on big changes the update brings to labels and safety data sheets. OSHA's goal in revising the HazCom Standard was to align it with GHS, the model hazard communication system developed by the United Nations.

Many safety professionals are digging into OSHA's new standard -- called "HazCom 2012" -- to try to understand their training obligations. What those professionals are finding is that the more time they spend with the revised standard looking at training, the more questions they have about GHS adoption in general. Some of the more common questions include:

- Do manufacturers have to send me new safety data sheets, or am I required to get them myself?
- What if my chemical supplier does not know about HazCom 2012 or GHS and the changes to safety data sheets?
- What exactly do I have to put on my workplace labels?

OSHA has provided compliance information on its website, in the *Federal Register*, and in a series of recently published briefs. Yet, for the uninitiated, finding answers to important questions can be overwhelming.

MSDSonline has been tracking and reporting on GHS for nearly five years. We've taken all of the available information and synthesized it into easy action items safety professionals can use in their day-to-day HazCom program. Following are five tips for you to keep in mind as your organization makes the transition to HazCom 2012. Keep in mind, these tips are not a substitute for the very real requirements outlined in OSHA's new standard, which every covered employer must work to understand and comply with.

Tip 1: Comply with HazCom Basics
According to Jennifer Silk and Maureen Ruskin, two HazCom experts who were instrumental in leading OSHA's adoption of GHS, one of the biggest HazCom 2012 transition issues is that employers were not compliant with the old HazCom Standard, which OSHA is now calling "HazCom 1994." The five key responsibilities employers had under HazCom 1994 are the same key responsibilities you will have under HazCom 2012:

I. Have a written site-specific hazard communication program
II. Keep a list of hazardous chemicals present in the workplace
III. Maintain safety data sheets for all hazardous chemicals and provide Right-To-Know access to employees
IV. Ensure proper use of labels and warning signs in the workplace
V. Train employees on HazCom and specific workplace chemical hazards

If your workplace is not in compliance with items I-V, this is the place to start your HazCom 2012 compliance activities. Having an up-to-date chemical inventory and ensuring there is a safety data sheet for every chemical in the workplace is an especially critical component of managing the transition to HazCom 2012, as discussed below.

Tip 2: Tackle Changes to Labels and Safety Data Sheets
HazCom 2012 standardizes safety data sheets and labels on shipped containers. By June 1, 2015, chemical manufacturers and distributors must reclassify their chemicals using GHS criteria spelled out in HazCom 2012 and then revise their safety data sheets and labels in the formats covered below.

Training your employees on these changes is what the Dec. 1, 2013 deadline is all about. OSHA wants employees trained on the format changes to labels and safety data sheets sooner rather than later because manufacturers and distributors can make the changes any time before their June 1, 2015 deadline. In fact, updated labels and safety data sheets already have entered the marketplace.

Changes to Labels
Labels under HazCom 1994 were performance-based, meaning chemical manufacturers and distributors had discretion as to what to put on the label. OSHA would then determine whether the label was compliant based on how well it performed in the workplace.

Under HazCom 2012, label information is prescribed by OSHA and has six standardized elements:

1. Product Identifier -- Same product identifier as found on safety data sheet
2. Supplier Information -- Including name, address, and phone number of responsible party
3. Pictogram(s) -- Black hazard symbol on white background with red diamond border
4. Signal Word -- Must use either "Danger" or "Warning," depending upon hazards
5. Hazard Statement(s) -- Declarative statement regarding nature or degree of hazard
6. Precautionary Statement(s) -- Descriptions of appropriate prevention, storage, response, and spill measures

For training purposes, employees should know these six elements, how they work together, how the information provides guidance on product handling and emergency response. According to a recent OSHA brief, employers are not expected to update labels on shipped containers, even if labeled with HazCom 1994-styled labels. They are, however, expected to update workplace labels as necessary, as discussed later in Tip 4.

Changes to MSDSs
Safety data sheets get a refresh under HazCom 2012 that includes organizing information into 16 mandatory sections with a strict ordering. To meet training requirements, employer should train employees on the 16 sections and their order, pointing out how Sections 1 and 2 correspond to the information found on the new shipped label and how the document is structured so that emergency response information is up front and the more technical information is in the back.

Another change under HazCom 2012 is that safety data sheets are called SDSs, dropping the M from MSDS. Nonetheless, their role in OSHA's new standard is largely unchanged. If anything, the new 16 section format makes safety data sheets even more central to HazCom compliance because information found on the documents -- especially if they are managed electronically -- can be used as a resource for hazard communication planning, inventorying, labeling, and training.

Tip 3: Be Prepared to Get Messy
HazCom 2012 went into effect on May 25, 2012. Between now and June 1, 2015, employers should expect that almost their entire safety data sheet library will be updated. This is causing some safety professionals to ask whether they have to keep two sets of MSDS books until all of the updates are made. The answer is no. During the transition, OSHA says employers can be in compliance with the old standard or the new standard or a combination of the two.

For example, employers will likely find their MSDS library contains safety data sheets in both the new format as well as the myriad of formats that were allowed under HazCom 1994. Still, even though two sets of books are not required, employers will need to pay special attention to MSDSs as they enter the workplace to see exactly what updates, if any, have been made.

They should especially be on the lookout for chemicals that have newly identified hazards listed on the safety data sheet.

Other MSDS questions many employers have are over the timing of the updates and who has to do what. Some employers worry they must ask the chemical manufacturers for the updated documents or even update the manufacturer safety data sheets themselves. This is not the case (unless they happen to be the originator of the chemical).

Chemical manufacturers and distributors are responsible for sending the updated documents to the end users of their chemicals with the first shipment or the next shipment after a change has been made. This means employers can realistically update their libraries only as quickly as manufacturers and distributors update their own safety data sheets. Manufacturers are not required to proactively send updated safety data sheets to past customers independent of a new shipment.

Now, if an employer receives a chemical shipment after the June 1, 2015 deadline, OSHA does

expect the employer to make a good-faith effort to secure an updated document from the supplier.

Exacerbating the safety data sheet issue is the fact that many manufactures seem to be making the move to GHS safety data sheets in stages. For instance, it is not uncommon now to find 16-section safety data sheets with GHS require elements in the wrong places or non-16-section safety data sheets that also contain GHS pictograms and other HazCom 2012 information.

Given this mess, how will employers know if the safety data sheets they receive are HazCom 2012 compliant? The best way is talk with their suppliers and make sure they are up to speed on OSHA's changes (too many chemical manufacturers and distributors are not) and to train their employees well on HazCom 2012.

A good electronic MSDS management system also can help to identify safety data sheets that include GHS elements. If you are still managing MSDS using paper-base filing systems, this may be a good time to start evaluating an electronic solution.

Tip 4: Don't Forget about Workplace Labels
Questions about workplace labels tend to outpace other HazCom 2012 questions by a large margin. Common questions are, "Can we still use NFPA and HMIS labels? Do we have to use pictograms, and if so, must they have red borders as on the shipped label?"

Under HazCom 2012, workplace labels are still performance based -- meaning OSHA doesn't tell employers exactly what has to go on secondary container labels, it judges workplace label compliance by how well it does its job: effectively communicating hazards.

OSHA says explicitly in the final rule on HazCom 2012, and elsewhere, that employers can continue to use their current workplace labeling systems so long as they effectively communicate to employees the hazards of the chemicals to which the workers are exposed.

A recent OSHA brief, "Hazard Communication Standard: Labels and Pictograms," says employers can "Either provide all of the required information that is on the label from the chemical manufacturer or, the product identifier and words, pictures, symbols or a combination thereof, which in combination with other information immediately available to employees, provide specific information regarding the hazards of the chemicals."

The standard goes on to say that if employers have their own in-plant system or uses HMIS or NFPA systems, it can continue to do so, so long as the system, in conjunction with other information available to employees, provides workers with all of the health and physical hazards of the chemical. If employers choose to employ GHS elements like pictograms on the workplace label, the pictogram borders may have a black border rather than red as required on the shipped label.

Keep in mind, under HazCom 2012, employees going forward will need to be trained on the GHS formatted shipping label. Any deviation from that style on the workplace label will also need to be addressed via training. For instance, employers using the NFPA system for workplace labels will need to ensure employees are trained on both HazCom 2012 labels and the NFPA system.

Tip 5: Don't be a Hero
Okay, be a hero if you want to, but there is no reason for safety professionals to go through the transition to HazCom 2012 alone. There is a wealth of information online, including free GHS webinars, a GHS checklist, and many GHS related conversations and FAQs.

Additionally, the acceleration of mobile, cloud-based environmental health and safety solutions has made MSDS and chemical management, and online training solutions affordable to even small and mid-size employers. The best-of-breed solutions can help with the influx of safety data sheets, create GHS formatted workplace labels with the click of a button, and give safety professionals a fast track on regulatory reporting.

HazCom 2012 is here. By following the simple tips listed above -- and getting the necessary help -- safety professionals should be able to keep their employees safe and employers on the right side of compliance throughout the GHS transition.

About the Author

Chuck Haling is the VP of Sales at MSDSonline, a leading provider of sustainable cloud-based compliance solutions that help businesses of all sizes cost-effectively manage a variety of global environmental, health and safety (EH&S) regulatory requirements. For more information, visit

MSDSonline at www.msdsonline.com or call 888-362-2007. GHS webinars and checklists are also available at www.msdsonline.com/blog.

Copyright 2010 1105 Media Inc.

GLOSSARY/ACRONYMS

This page intentionally left blank.

GLOSSARY

Blast area — The area including the blast site and the immediate adjacent area within the influence of flying rock, missiles and concussion.

Blast site — The area in which explosive materials are being or have been loaded, including all holes loaded or to be loaded for the same blast, and a distance of 50 feet (15,240 millimeter) in all directions.

Blaster — A person qualified in accordance with the code to be in charge of and responsible for the loading and firing of a blast.

Blasting agent — A material or mixture consisting of fuel and oxidizer intended for blasting, provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 test detonator when unconfined. Blasting agents are labeled and placarded as Class 1.5 material by the Department of Transportation.

Closed system use — Use of a solid or liquid material in a closed vessel or system that remains closed during normal operations, where vapors emitted by the product are not liberated outside of the system and the product is not exposed to the atmosphere.

Concentration — Amount of a component in a volume.

Containment — The actions taken to keep a material in its container (e.g., stop a release of the material or reduce the amount being released).

Containment system — Gas-tight recovery system that can be placed over the top of a leak to stop or control the escape of gas from the leaking cylinder.

Containment vessel — Gas-tight recovery vessel that can encapsulate a leaking container.

Control area — Space in a building where certain quantities of hazardous materials are stored, used or handled. The aggregate amount is used in determining amount in storage.

Dose — An amount of a substance taken at one time.

Excessive flow valve — A valve designed to positively shut off the flow of gas in the event that its predetermined flow is exceeded.

Flash point	The minimum temperature in degrees Fahrenheit at which a liquid will give off sufficient vapors to form an ignitable mixture with air.
H-1	Detonable pyrophoric materials, detonable organic peroxides, explosives, Class 4 oxidizers, and unstable materials Class 3 and 4.
H-2	Flammable and combustible liquids in open systems, flammable cryogenic fluids, flammable gases, Class 1 organic peroxides, Class 3 oxidizers, and others.
H-3	Flammable and combustible liquids in closed containers, consumer fireworks, oxidizing cryogenic fluids, Class II and III organic peroxides, Class 2 oxidizers, oxidizing gases, and others.
H-4	Materials that present a health hazard, such as corrosives and highly toxic substances.
H-5	Semiconductor fabrication facilities and similar research operations in which hazardous production materials are used.
Hazard	Potential threat.
HazCom 2012	Reference to the OSHA Hazardous Communication Standard (29 CFR 1910.1200).
Inhabited building distance	The minimum separation distance between an operating building or magazine containing explosive materials and inhabited building or site boundary.
Intermagazine distance	The minimum separation distance between magazines.
Intraline distance or intraplant distance	The distance to be maintained between any two operating buildings on an explosive manufacturing site when at least one contains or is designed to contain explosives, or the distance between a magazine and an inhabited building or site boundary.
LC_{50}	Lethal concentration 50 percent of solution.
LD_{50}	Lethal dose 50 percent of solution.
Level 1 aerosol products	Those with a total chemical heat of combustion that is less than or equal to 8,600 British thermal units per pound (Btu/lb) (20 kilojoules per gallon (kJ/g)).

Level 2 aerosol products	Those with a total chemical heat of combustion that is greater than 8,600 Btu/lb (20 kJ/g) but less than or equal to 13,000 Btu/lb (30 kJ/g).
Level 3 aerosol products	Those with a total chemical heat of combustion that is greater than 13,000 Btu/lb (30 kJ/g).
Minimum separation distance	The minimum separation distance between adjacent buildings occupied in conjunction with the manufacture, transportation, storage or use of explosive materials where one of the buildings contains explosive materials and the other building does not.
Neutralizing	To add an acid to a basic solution or a base to an acidic solution until the resulting solution is chemically neutral (pH = 7).
NFPA 400	*Hazardous Materials Code*, 2013 Edition.
Open system use	The use of a solid or liquid in a system that is continuously open to the atmosphere during normal operations, so the product is exposed to the atmosphere.
Quantity-distance	The quantity of the explosive material and separation distance relationships providing protection.
Reduced flow valve	Restrictive flow orifice valve that is inserted into a compressed gas cylinder to reduce the maximum flow from the valve under full load condition.
Risk	Probability of hazard occurrence.
Segregation	Storage located in the same room or inside area that is physically separated by distance from incompatible materials.
Spill control	Procedures and practices implemented to prevent and control spills in a manner that minimizes or prevents the discharge of spilled material.
Vulnerability	Exposure and susceptibility to losses.

This page intentionally left blank.

ACRONYMS

ACC	American Chemistry Council
AHJ	authority having jurisdiction
API	American Petroleum Institute
ASME	American Society of Chemical Engineers
ASTM	American Society for Testing and Materials
AST	aboveground storage tank
ATF	Bureau of Alcohol, Tobacco, Firearms and Explosives
CAA	Clean Air Act of 1990
CAMEO	Computer-Aided Management of Emergency Operations
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CO	Company Officer
CPSC	Consumer Product Safety Commission
CWA	Clean Water Act of 1970
D	minimum separation distance
DHS	Department of Homeland Security
DOL	Department of Labor
DOT	Department of Transportation
EHS	extremely hazardous substance
EMS	Emergency Medical Services

EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act of 1986 (42 U.S.C. § 11011-11050)
ERP	Emergency Response Plan
FAQ	frequently asked question
GHS	Globally Harmonized System
H	high hazard
HAZCOM	hazard communication
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCS	Hazard Communication Standard
HMEP	Hazardous Materials Emergency Preparedness
HMIS	Hazardous Materials Inventory Statement
HMMP	Hazardous Materials Management Plan
HMTA	Hazardous Material Transportation Act of 1975
HMTUSA	Hazardous Materials Transportation Uniform Safety Act of 1990
HPM	hazardous production material
IBC	International Building Code
IBD	inhabited building distance
ICC	International Code Council
IFC	International Fire Codes
IG	Instructor Guide
ILD	intraline distance
IMD	intermagazine distance
IME	Institute of Makers of Explosives

IPD	intraplant distance
KOH	potassium hydroxide
kPa	kilopascal
LEL	lower explosive limit
LEPC	Local Emergency Planning Committee
LFL	lower flammable limit
LP	liquefied petroleum
LPG	liquefied petroleum gas
LRC	Learning Resource Center
MAQ	maximum allowable quantity
MESG	maximum experimental safe gap
MIC	minimum igniting current
MSDS	Material Safety Data Sheets
NaOH	sodium hydroxide
NETC	National Emergency Training Center
NFA	National Fire Academy
NFDC	National Fire Data Center
NFP	National Fire Programs
NFPA	National Fire Protection Association
NTG	Note-taking Guide
NTP	normal temperature and pressure
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit

PPE	personal protective equipment
ppm	parts per million
psi	pounds per square inch
psia	pounds per square inch absolute
psig	pounds per square inch gauge
PSM	Process Safety Management
PSMP	Process Safety Management Program
PTR	public traffic route
Q-D	quantity-distance
RCRA	Resource Conservation and Recovery Act of 1976
RMP	Risk Management Plan
RQ	reportable quantity
SARA	Superfund Amendments and Reauthorization Act of 1986
SERC	State Emergency Response Commission
SDS	Safety Data Sheet(s)
SM	Student Manual
SPCC	Spill Prevention Control and Countermeasure
SPI	Society of the Plastics Industry
STP	standard temperature and pressure
TPQ	threshold planning quantity
TQ	threshold quantity
UEL	upper explosive limit
UFL	upper flammable limit

UL	Underwriters Laboratories
U.N.	United Nations
USFA	U.S. Fire Administration
UST	underground storage tank

This page intentionally left blank.