



HAZWOPER 8 Hour Refresher

Brian Otter

Otter Training and Consulting Services

M-K₁

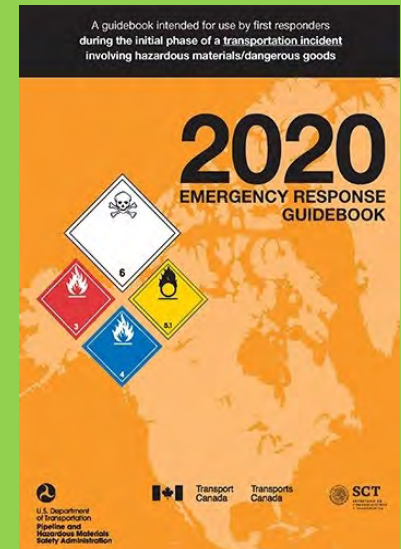
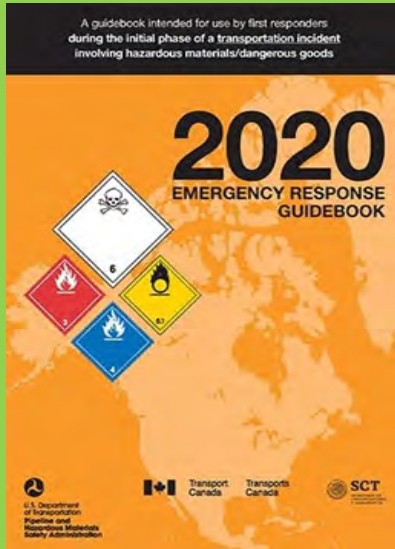
March 20, 2023



25th California Unified Program
Annual Training Conference
March 20 – 23, 2023

Otter Training and Consulting Services

Presents HAZWOPER Refresher Training

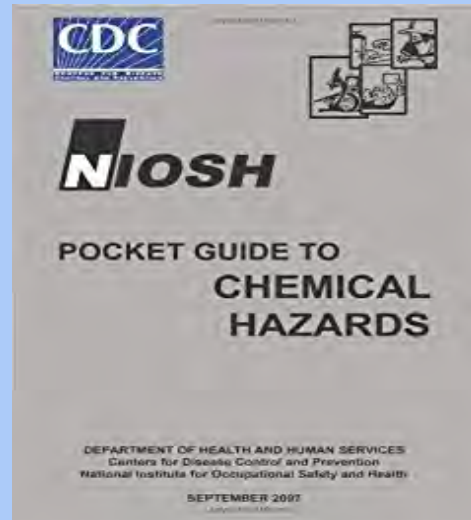
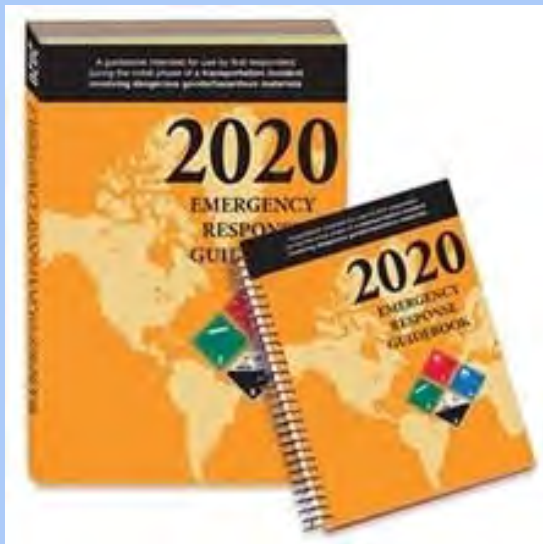


Brian Otter
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Why do we need Training? Haz Mats Are Everywhere!

EDUCATIONAL
FILMS
Presents

Put these Apps on your Phone



Intro to Wiser



Course Goals & Objectives ³

- To provide ***you*** with the necessary awareness of safe and competent Haz-Mat response actions, within the typical resource and capability limits at the 1st. Responder Operational & HAZWOPER level.
- Meet the OSHA HAZCOM training standard within [29 CFR 1910.1200](#) & [Cal OSHA Title 8 CCR 5194](#)
- Meet the OSHA requirement for qualifications as a first responder within the [29 CFR 1910.120](#) & [Cal-OSHA Title 8 CCR 5192](#)

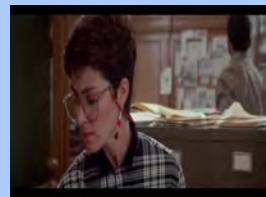


Enforcement & State Response Agencies



- **EPA** - Federal – State
- **DTSC** - Department of toxic substance control
- **SWRCB** – State water resources control board
- **CDFW**– Calif. Dept. of Fish & Wildlife
- **CHP/Cal Trans**
- **OES**
- **Cal Fire**
- **OSHA**-Federal – State
- **Other Agencies**
- **Air Quality Management** Districts
- Local D.A. Environmental crimes unit

- CUPAs ///PAs.....Reporting Requirements



Know who your CUPA or PA is so you can make the proper notifications



Title 19, California Code of Regulations (CCR), §2703-

A person shall provide an immediate, verbal report of any release or threatened release of a hazardous material to the administering agency (CUPA or PA, and OES (800-852-7550)



CUPA³

Immediate Reporting of a Release or Threatened Release



- The immediate reporting requirements are not based on the quantity of the material.**

They are based on the hazardous material's potential to cause harm to human health and safety, property, or the environment — regardless of the quantity.

#Reasonable Belief #Reasonable Belief #Reasonable Belief #Reasonable Belief





What is a Non-Significant Release ¹



*During planned maintenance at a fixed facility, small drips are to be expected and **may** be considered “**not significant,**” and thus **may** not be reportable.*





What is a Significant Release ⁷



Any release of a hazardous material that results in a fatality, chemical exposure, or other injury, to an employee or member of the public.

If any part of a release, including airborne releases, extends outside of the facility boundaries.

Any release or threatened release of a hazardous material that results in an evacuation.

Any release that cannot be immediately mitigated by qualified facility personnel (e.g., spill requires contacting a hazardous waste clean-up contractor for proper remediation).

Any release that requires the use of respiratory protection for mitigation and/or abatement.

Any release or threatened release where emergency response personnel are called.

Any release of a Regulated Substance (CCR Title 19), Extremely Hazardous Waste (CCR Title 22), Extremely Hazardous Substance (EPCRA Section 302) or Acutely Hazardous Material (40 CFR)

Calif. Haz- Mat Spill / Release Notification

To get a OES control number call:
(800) 852 - 7550 or (916) 845 - 8911



Federal Reporting Requirements

4

- If the release poses a significant threat to persons outside the facility you must also report the incident to the National Response Center (NRC)
- A report to the NRC is required if there is a release at a facility of a Extremely Hazardous Substance exceeding the **Reportable Quantity (RQ)**
- **RQs** are listed in pounds, and any release amount must be converted into pounds to determine if the **RQ** was exceeded.
- The phone number to the **NRC is (800) 424-8802.**
- **Example: The reportable quantity (RQ) for anhydrous ammonia is 100 pounds or approximately 18 gallons.**

WHICH HAZWOPER COURSE SHOULD YOU TAKE ?

CHECK LABELS ON CHEMICAL CONTAINERS



29CFR1910.120(q)
levels of responder training
required for hazmat
emergency response.

FRA

FRO

TECH

Spec

IC

40/24 Hour HAZWOPER

HAZWOPER

Hazardous Waste Site Operator Emergency Response

- HAZWOPER has training requirements for different kinds of haz-waste workers. Training can range from **24 to 40 hours**. Supervisors and managers must have the same training as the workers they supervise, plus eight hours of additional training in management of haz- waste sites. **8 hour per year refresher training**



Who needs HAZWOPER training ?⁵

- The key word when applying HAZWOPER training is “uncontrolled”.

- When a chemical emergency occurs, or a site with a potential chemical legacy is discovered, these may be identified as uncontrolled sites by a government body if the “accumulation of hazardous substances creates a threat to the health and safety of individuals or the environment or both.”
- **HAZWOPER is designed to reduce the risks of chemical exposure to workers employed in one of three very specific activities:**



What are the HAZWOPER training requirements for on-site workers who are not directly involved in cleanup activities? ³

- Workers, such as utility workers, who must perform duties at a hazardous waste site that has not yet been characterized but where contamination is expected, do fall under the scope of 29 CFR 1910.120.
- These workers must work under the direction of an on-site supervisor and a site-specific safety and health plan, and must be fully trained and protected pursuant to the HAZWOPER standard.
- When additional information becomes available through site characterization which verifies that there is minimal or no risk of employee exposure to hazardous substances, a lesser degree of PPE and worker training may be acceptable.

What training do I need to clean up a Spill ³

- **An incidental release** is a release of a hazardous substance which does not pose a significant safety or health hazard to employees in the immediate vicinity or to the employee cleaning it up, nor does it have the potential to become an emergency within a short time frame.
- Incidental releases are limited in quantity, exposure potential, or toxicity and present minor safety or health hazards to employees in the immediate work area or those assigned to clean them up.
 - **An incidental spill may be safely cleaned up by employees who are familiar with the hazards of the chemicals with which they are working.**

Incident Commander

Haz-Mat I.Cs are trained to manage Haz-Mat emergencies beyond that of the 1st.Responder. Upon arrival to the scene, they formally assume command from the 1st.responder, who should have already established a working ICS and would be the interim I.C.

OSHA requires Hazardous Materials Incident Commanders to be trained in accordance with section (q) of the HAZWOPER regulation.



FEMA

Take FREE, online courses in emergency management from the Federal Emergency Management Agency!



The Independent Study Program (ISP) is a distance learning program offered free of charge to the American public.

- How to Get Started The fastest way to begin taking courses is to visit there website. You can learn about each course, study materials, and submit your final exams all from the convenience of your home or office.
- 1. Obtain a FEMA student ID number at: cdp.dhs.gov/femasid
- 2. Go to the Independent Study Program Website
training.fema.gov/IS/
- 3. Click on “IS Course List” toward the left side of the page.
- 4. Choose a course, and click on it.

ICS-100.C: Introduction to the Incident Command System

ICS-200: ICS for Single Resources and Initial Action Incidents²⁰

Site Safety Officer



HAZWOPER Standard 29 CFR 1910.120(q)(3)(vii)

States that “The individual in charge of the Incident Command System shall designate a Safety Officer, who is knowledgeable in the operations being implemented at the emergency response site, with specific responsibility to identify and evaluate hazards and to provide direction with respect to the safety of operations for the emergency at hand.”

Simply stated, a designated Safety Officer is required to be in place at a hazmat incident. If the incident requires response at the hazmat technician level or above, the Safety Officer should be certified to at least the technician level in order for them to be cognizant of the unique hazards presented

Is computer-based training acceptable for refresher training?

- Computer-based training may meet some refresher training requirements, provided that it covers topics relevant to workers' assigned duties. It must be supplemented by the opportunity to ask questions of a qualified trainer and by an assessment of hands-on performance of work tasks. **40 Hr. online training still requires you to suit up.**

I THINK... I MAY...

HAVE SAT AT THIS COMPUTER FOR TOO LONG....

memegenerator.net





What if refresher training isn't received in 12 months?₃



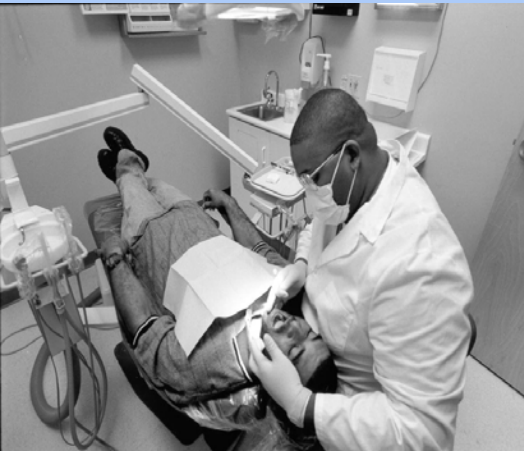
- If the date for refresher training has lapsed, the need to repeat initial training must be determined based on the employee's familiarity with safety and health procedures used on site.
- The employee should take the next available refresher training course. "There should be a record in the employee's file indicating why the training has been delayed and when the training will be completed.
- It is up to the employer to decide if the employee still possesses the requisite knowledge and skills to safely and effectively perform their job. Although OSHA typically allows a short grace period, refresher courses must be completed on or before the anniversary date of the employee's initial training.



Fact



Hazardous Materials
Are Everywhere -
And They Are Always Hazardous



Hazardous Materials Exist in ² Only Two States

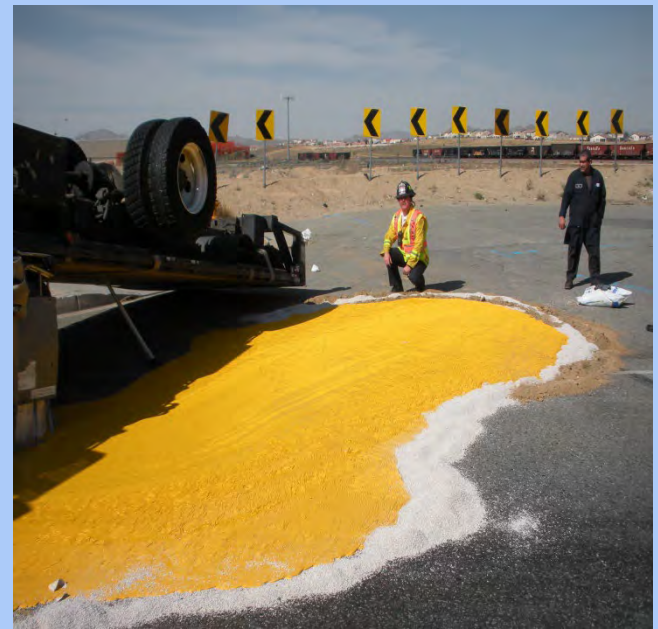
Normal

*“Controlled
States”*



Emergency

*“Uncontrolled
States”*



Normal

Production & Storage



Normal

Transportation



Normal

End Use

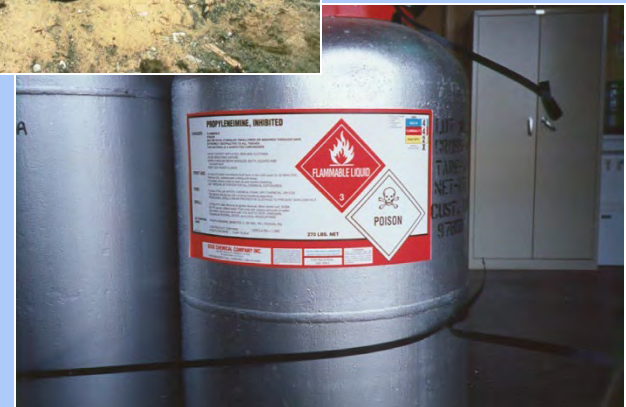




Emergency



Emergency Issues



Timing of the Release

Size of the Release

Length of Exposure

Lethal or Harm of the Release

Fact:

2

In an Emergency -
Always Focus On The Outcome

Direct

Fatalities / Injuries
Property Damage
Environmental
Damage

Indirect

Damaged Reputation
Critical System Disruption
Residual Fear



Fact:

3

Hazardous Materials Are The Great
Equalizers -
They Hurt Anyone and Everyone



Fact: 4

Where You Stand Directly Influences Your Perception of The Event

- **Safe** No harmful effects from chemicals exist at the present time.
- **Unsafe** Atmospheres or concentrations that will cause harm if you are exposed to them for a prolonged period of time.
- **Dangerous** Situations or conditions that are an immediate threat to life and health. Such atmospheres could be deadly and result in catastrophic events.



Fact:

5

- In An Emergency -

What You Do In The First Five Minutes
Affects Can Affect You Rest The Of Your Life



Don't Rush In!!!

Think ..Think .. Think!!

If You Don't Know.. Don't Go..



Fact:



In Every Emergency Your First Job is to
Recognize and Identify
In Order To Stay Alive



BOMB SQUAD



**IF YOU SEE US RUNNING,
TRY TO KEEP UP**

Hazard Recognition Clues

1

- **Must First Know How to Recognize Haz Mat Incidents**



The most important action we can perform as first responders is to identify that a hazardous material is present, determine what the material is and evaluate the threats the material poses.

Identification Clues

- Occupancy and Location



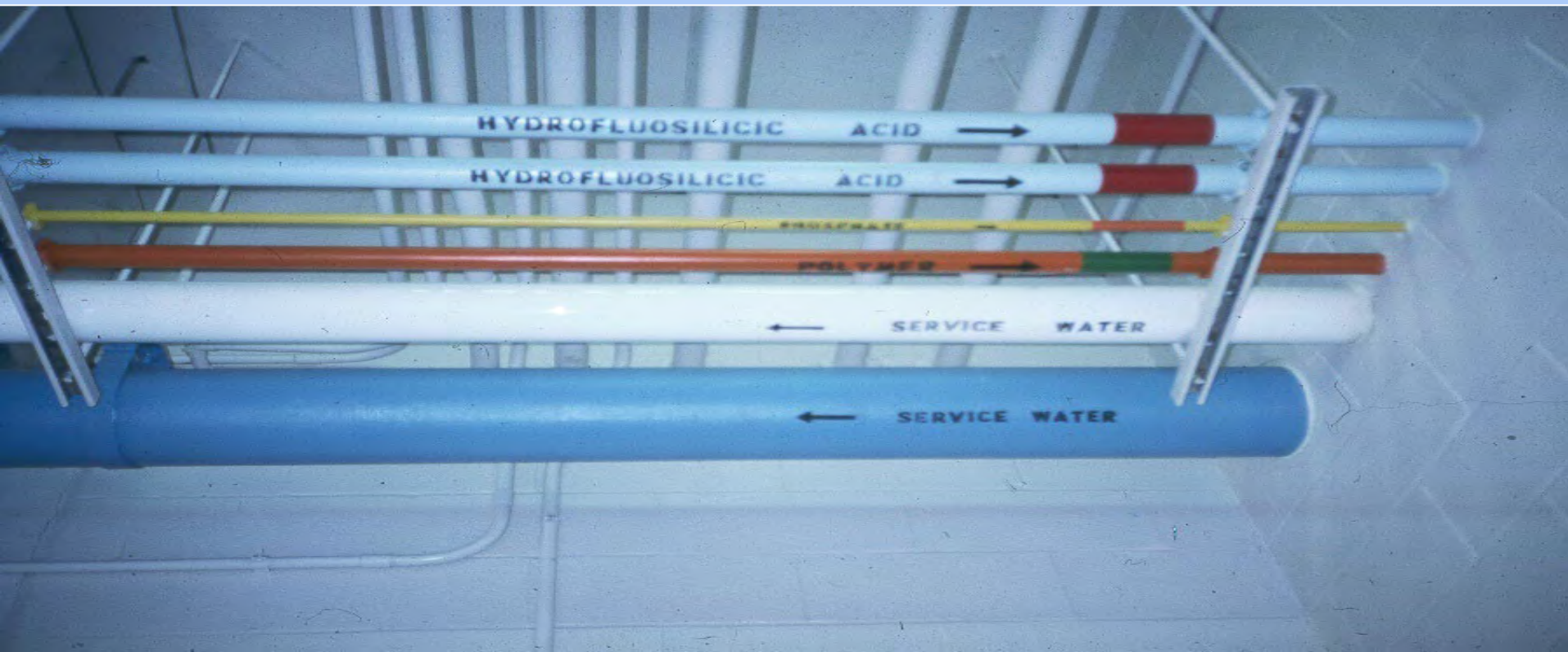
Identification Clues

- Container Shapes & Sizes



Identification Clues

- Markings & Colors



Identification Clues ¹

- Placards & Labels



Variables & Hazard Assessment ²



- **Location can influence dispersion**
 - **Stuff goes downhill**
 - **Buildings can trap and/or redirect airborne contaminants**

Variables & Hazard Assessment ²

- Weather and Time of day can affect:
 - Gases/vapors will usually go downwind
 - Vapor clouds can take longer to disperse in cold weather



Variables & Hazard Assessment



• Stage of incident

- Dynamic or Static
 - (short vs. long duration release)
 - Long Term Clean up

Variables & Hazard Assessment

- Type, condition & behavior of container



Variables & Hazard Assessment



- Size of problem
- (5 gallon vs. 500 gallon)



Predicted Behavior ⁶

- Before intervention
- Try to predict behavior of release
 - What will it do?
 - Where will it go?
 - What will it hurt ?
- Outcome of natural stabilization?
- Favorable impact intervention will make?



Captain Hindsight



ALL NEW



Container Stress & Behavior₃

- Haz-mats are released when container fails
 - Failure can be minor or catastrophic
 - Nature of failure determines potential harm



Types of Container Stress



Type of stress ?

When/How will container weaken & fail ?

What material will be released ?

Who much & how fast ?

What & who will be in harms way ?

Complications in Hazard Assessment

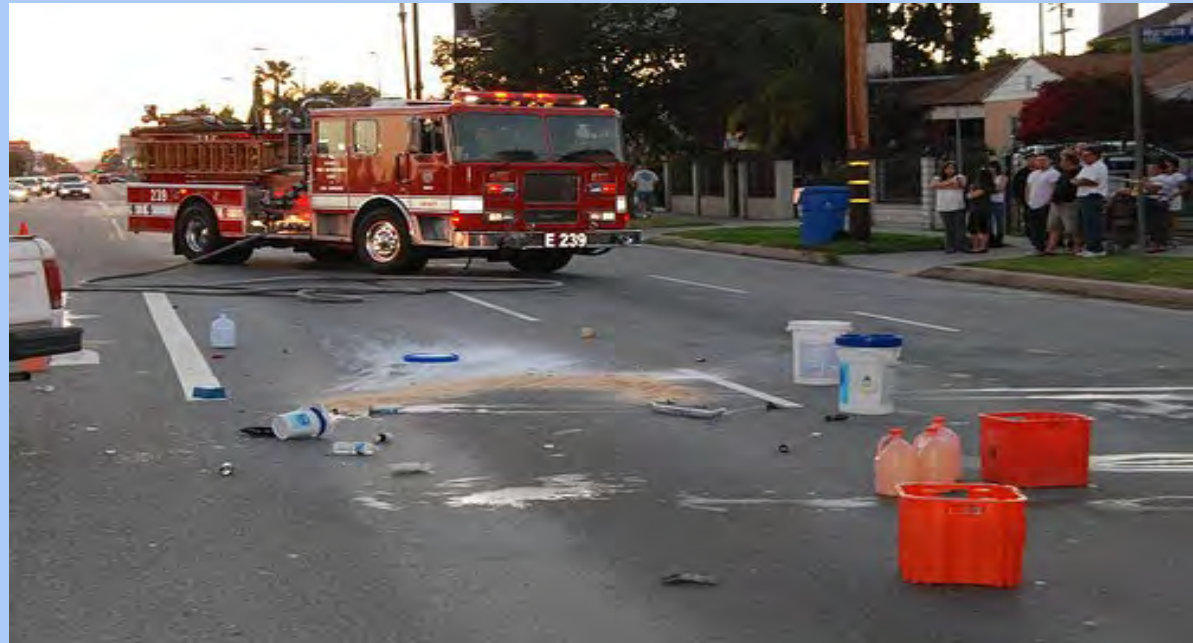
- Multiple Haz Mats or “Mixed Bag” problem
 - May need chemist or Haz Mat team to aid in IDHA & action planning



Low Risk



- Small quantities
- Inert solid materials
- Undamaged container



Moderate Risk



- **Smaller quantities**
- **Low vapor-pressure liquid materials**
- **Undamaged/slightly damaged container**

High Risk



- Large quantities/multiple containers
- Low vapor-pressure liquids or gases
- Slightly/moderately damaged container

Unacceptable Haz-mat Risk₃

- Larger quantities and/or gas cylinders involved
- High vapor-pressure liquids, gases, explosives and/or reactive materials
- Visibly stressed container and/or flame impingement on a gas cylinder



Fact: **7**

Information is Important - But Information Management is Critical To Survival



Information - The Big Three 3

- ◆ Quality of The Information
- ◆ Time To Acquire The Information
- ◆ Ability To Use The Information



Location

Name of person reporting

Substance released

Nature of problem

Quantity released

Other potential hazards

Safe approach route & or Staging area



Hazard Identification



CHEMTREC
 The 24-hour HAZMAT Communications Center
1-800-262-8200
 FOR INFO OR REGISTRATION

CAMEO Chemicals

Chemical Database

Search Chemicals

Chemical Identifiers

CAS Number	UN/NA Number	DOT Hazard Label	SPCS CHRIS
7782-50-5	502	Flammable Gas	CL2
		Oxidizer	
		Corrosive	

NTPA FDS

Classified	Hazard	Value	Description
	Health	4	Eye Irritant



WISER
 Wireless Information System
 for Emergency Responders



A guidebook intended for use by first responders during the initial phase of a transportation incident involving hazardous materials/dangerous goods

2020
 EMERGENCY RESPONSE
 GUIDEBOOK

U.S. Department of Transportation
 Transport Canada
 SCT



Take Inventory of Your Chemicals⁴

- Safe storage begins with an up-to-date inventory of hazardous chemicals.
- An accurate inventory is also necessary if emergency responders are to respond effectively to a fire or chemical release.
- Your business can be fined if it does not provide an inventory to the CUPA or PA.
- Unified information required to be submitted and reported electronically to CERS includes, but is not limited to facility data regarding hazardous material regulatory activities (such as, hazardous materials business plans, site maps, and chemical inventories), underground and aboveground storage tanks, hazardous waste generation, and inspection, compliance and enforcement actions.



What Is GHS ?

5

The Globally Harmonized System of Classification and Labelling of Chemicals is an internationally agreed-upon standard managed by the United Nations that was set up to replace the assortment of hazardous material classification and labelling schemes previously used around the world.

What is GHS?



The Globally Harmonized System of Classification and Labeling of Chemicals

MSDS vs. SDS



MSDS have 9 information points:

- 1 Product Information: product identifier (name), manufacturer and suppliers names, addresses, and emergency phone numbers
- 2 Hazardous Ingredients
- 3 Physical Data
- 4 Fire or Explosion Hazard Data
- 5 Reactivity Data: information on the chemical instability of a product and the substances it may react with
- 6 Toxicological Properties: health effects
- 7 Preventive Measures
- 8 First Aid Measures
- 9 Preparation Information: who is responsible for preparation and date of preparation of MSDS

SDS have 16 information points:

- 1 Identification
- 2 Hazard(s) identification
- 3 Composition/information on ingredients
- 4 First-aid measures
- 5 Fire-fighting 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

GHS



GHS Pictograms

Carcinogen Respiratory Sensitizer Reproductive Toxicity Target Organ Toxicity Mutagenicity Aspiration Hazard		Acute Toxicity (severe)		Flammables Self-Reactive Pyrophorics Self-Heating Emits Flammable Gas	
Environmental Toxicity		Irritant Derma/Skin Sensitizers Acute Toxicity (Harmful) Transient Target Organ Effects (narcotic or respiratory)		Oxidizers Organic Peroxides	
Corrosives		Gases under Pressure		Explosive Self-Reactive Organic Peroxides	

DOT Labels/Placards

You can look at their colors and know what they are...



DOT chemical families:



- DOT Class 1: Explosives
- DOT Class 2: Gases
- DOT Class 3: Flammable combustible liquids
- DOT Class 4: Flammable solids, spontaneously combustible materials; and dangerous when wet materials/water-reactive substances
- DOT Class 5: Oxidizing substances and organic peroxides
- DOT Class 6: Toxic and infectious substances
- DOT Class 7: Radioactive materials
- DOT Class 8: Corrosive substances
- DOT Class 9: Miscellaneous



Label Your Chemicals⁹



- All hazardous chemicals must be clearly labeled for the benefit of current users, emergency personnel, and future users.
- Unknown chemicals can be expensive to dispose of.
- Make sure all labels are legible and in good condition.
- Repair or replace damaged or missing labels.
- **Manufacturers' Labels** Cal/OSHA requires that manufacturers provide **labels with the following information:**
 - Contents of the container
 - Physical and health hazard information
 - Name, address, and emergency phone number of the manufacturer or other responsible party
 - **Original manufacturers' labels must not be removed or defaced.**⁶⁶

Your Own Labels 4

- Hazardous chemicals that are not in the manufacturer's original container must at a minimum,
- Be labeled with the contents of the container.
- If the contents are hazardous, attach a label indicating the hazard to warn individuals in the work area.
- It is not necessary to label containers that will be used temporarily (during one work shift) and are under your immediate control.



Acetone
ACETONE

ENGLISH H220: Unstable/explosive – H221: Flammable gas – H250: In contact with water releases flammable gases which may ignite spontaneously.
P101: If medical advice is needed, have product container or label at hand. – P220: Keep away from combustion materials. – P223: Keep away from any possible contact with water, because of violent reaction and possible flashing.

FRANCAIS H200: Explosif instable – H201: Gaz inflammable – H250: Dégage au contact de l'eau des gaz inflammables qui peuvent s'enflammer spontanément.
P101: En cas de consultation d'un médecin, gardez à disposition le récipient ou l'étiquette. – P220: Tenir à l'écart des matières combustibles. – P223: Éviter tout contact avec l'eau, à cause de risque de réaction violente et d'inflammation spontanée.

DANGER 2022-202-202-2 202-202-202-2
DANGER 2022-202-202-2 202-202-202-2

Brady Corporation
6005 West Good Hope Road
Milwaukee, WI 53223
202-202-202-2

250L



Multiple Hazard Classes ₂

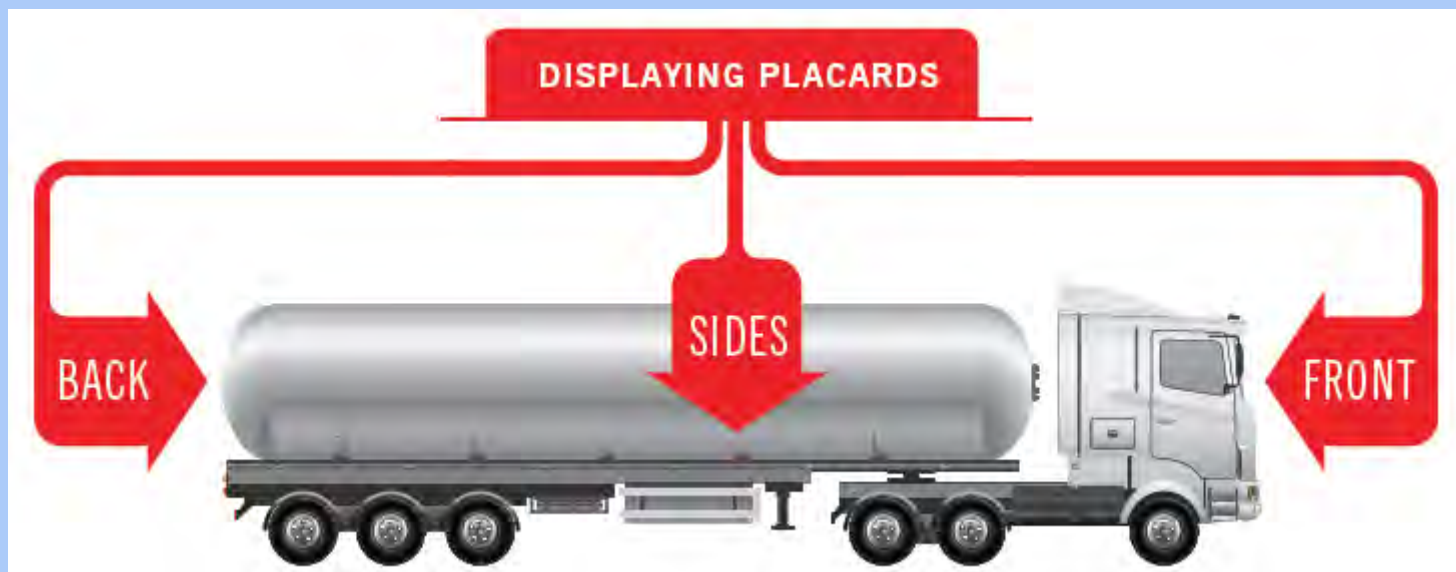
- Many chemicals belong to more than one chemical family or hazard class. In such cases, all storage rules must be strictly observed.
- Acetic acid is both a corrosive acid and a combustible liquid. It must be stored away from corrosive bases, such as sodium hydroxide, and also from oxidizing acids, such as nitric acid.



Transportation Marking System

- **Placards**

- Placed on all four sides of vehicles
- Identify a broad hazard class



Transportation Marking System

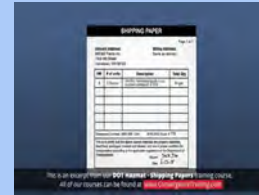
- Not all chemical shipments are marked.
- You may also identify hazardous materials in transport from:
 - The bill of lading or freight bill
 - The waybill or consist



https://app.finales... x https://app.finales... x
https://app.finalesinventory.com/demofw/aisp/shipment/billoflading/L2R0W99mdy9HcCvC2tpqC10wCjMTAwM0F=5hipmemskL%2010001.pdf

Date: 10/3/2013		BILL OF LADING		Page 1 of 1	
SHIP FROM		Shipper's number: 10001-1			
Big Productions 123 Main St Redwood City, CA 91021		Carrier name: Big Productions LLC			
		Carrier's number: US DOT #982123			
		Hazmat reg. number: 132142 194 821AU			
		24 Hr. Emergency Contact Tel. No.: 1-800-515-1234			
		Contract: AZA-123-09122			
SHIP TO					
City of Orange 7891 Cassiopeia Way Lancaster, CA 90812					
No. of Units & Container Type	HM	BASIC DESCRIPTION Identification Number, Proper Shipping Name, Hazard Class, Packing Group	Total Quantity mass, vol, or activity	Weight	
X	UN0335	Fireworks, 1.3G, PGII EX Numbers: 2011011319, 2011013602, 2011013661, 2011015464, 2011015979, 2011016170, 2011016348, 2011020368, 2011020845, 2011023163, 2011024115, 2011024408, 2011026226, 2011027218, 2011036216, 2011036364, 2011037259, 2011037478, 2011040388, 2011042030, 2011042108, 2011044551, 2011049519	99 lb Net Explosive Mass	247 lb	
X	UN0336	Fireworks, 1.4G, PGII EX Numbers: 2011027382, 2011031709, 2011034488, 2011049220	12 lb Net Explosive Mass	30 lb	
TOTAL				277 lb	

SHIPPING PAPERS 7



- Shipping paper must:

- Contain the name of the shipper
- Indicate multiple pages, for example “page 1 of 4”.
- Show emergency response number
- Contain Shipper’s Certification
- Include the total quantity of material
- Accompany the shipment (give to the driver)
- Be readily available in driver’s compartment

Emergency Response Information ⁶



- Shippers use SDS, ERG, forms. Information must include:

Basic Description of the hazardous material

- Immediate hazards to health
- Risks of fire or explosion
- Immediate precautions in case of an accident
- Procedures in case of fire
- Methods for handling spills and leaks
- Preliminary first aid

Determining the Physical Hazard



So How do I determine the Physical Hazard of a material?

This should be your first choice

Section 9: Physical and Chemical Properties

Section 9 - Physical & Chemical Properties

Appearance:	Yellow liquid	Odor:	Solvent odor
Physical State:	liquid	pH:	Not determined
Vapor Pressure:	185 mm Hg	Vapor Density:	>1
Boiling Point:	56.1°C/133°F @ 76 mm Hg	Melting Point:	Not available
Solubility (H ₂ O):	Negligible	Specific Gravity:	0.872 @ 77°F
Evaporation Rate:	Slower than ethyl ether	Viscosity:	Not determined
Bulk Density:	7.26 lbs/gal (liquid density)	Percent Volatile:	73-77
VOC:	659g/L (5.5 lbs/gal) EPA protocol 24		



PHYSICAL HAZARDS ⁵



Flame Over Circle – oxidizers

Flame – flammables, pyrophorics, self-heating, emits flammable gas, self-reactives, organic peroxides

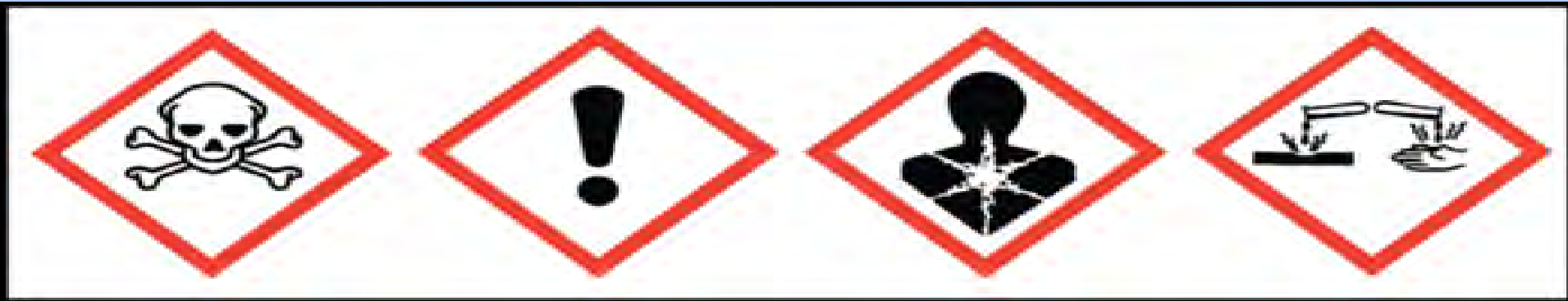
Exploding bomb – explosives, self-reactives, organic peroxides

Corrosion – corrosive to metals

Gas cylinder – gases under pressure

HEALTH HAZARDS

4



Skull and Crossbones – acute toxicity (fatal or toxic)

Exclamation Mark – irritant (skin and eye), skin sensitizer, acute toxicity (harmful), narcotic effects, respiratory tract irritant

Health Hazard – carcinogen, mutagenicity, reproductive toxicity, respiratory sensitizer, target organ toxicity, aspiration toxicity

Corrosion – skin corrosives, burns, eye damage

Transportation Info System



How CHEMTREC® Helps
First Responders

• CHEMTREC

- Operates a 24-hour telephone line
- An extensive database of chemical information
- Must have information ready when calling

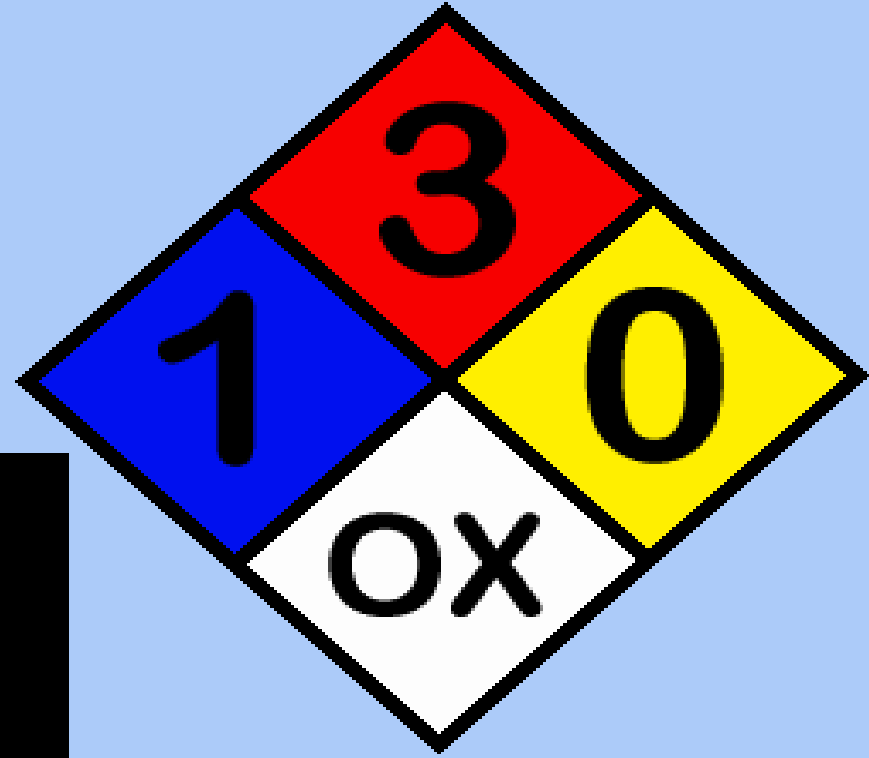
1-800-262-8200

NFPA 704 LABEL

*


FIVE NFPA HAZARD LEVELS

- 4 EXTREME
- 3 HIGH
- 2 MODERATE
- 1 SLIGHT
- 0 INSIGNIFICANT



HAZMAT STORAGE – 101


GET YOURS! ONLY \$3!



**HAZMAT
STORAGE 101
FOR
DUMMIES**

**EASY HAZMAT
STORAGE TIPS
EVEN YOU CAN
UNDERSTAND!
GUARANTEED
TO MAKE YOU
SMARTER!**

**THIS BOOK
CHANGED MY
LIFE!**



www.txt2pic.com

The safe storage of hazardous chemicals is an essential part of an environmental, health, and safety program. Chemical storage facilities must meet certain minimum standards to satisfy diverse regulations, such as those of Cal/OSHA, the local CUPA, and the California Fire Code.

Improper Storage



Improper Storage



Improper Storage



Improper Storage



Improper Cylinder Storage



Improper.....Everything !!!!



Segregate Incompatibles 4

- Each Chemical Hazard class should be separated from all other chemical classes by an approved non-combustible partition or by a distance of twenty feet.
- Ideally, each hazard class would be kept in a cabinet or on a shelf segregated from other hazard classes.
- **Incompatible chemicals within the same hazard class should also be separated from one another.**
- *For example, both nitric and perchloric acids are incompatible with organic acids (such as acetic acid) and should not be stored together.*



Segregate Incompatibles ³



- Materials should always be segregated and stored according to their chemical family or hazard classification. **Do not store chemicals alphabetically unless they are compatible!**
- Accidental contact between incompatible chemicals can result in a fire, an explosion, the formation of highly toxic and/or flammable substances, or other potentially harmful reactions:
- Oxidizers mixed with flammable solvents can cause a fire. Acids mixed with metal dust can produce flammable hydrogen gas.



Segregate Incompatibles 5



- Store flammable liquids in approved safety containers in flammable storage cabinets. Do not store anything but flammable or combustible liquids in these cabinets.
- Segregate acids from bases.
- Segregate most organic acids from oxidizing mineral acids.
- Keep oxidizers away from other chemicals, especially flammables, combustibles, and toxic materials.
- Keep corrosives away from substances that they may react with and release corrosive, toxic, or flammable vapors.



Common Incompatibles

Chemical

- Acetylene
- Acetic Acid
- Acetone
- Chlorine
- Hydrogen Sulfide
- Sodium Peroxide
- Mercury

Incompatible with

Copper, silver, mercury

Chromic acid, Nitric acid, Ethylene glycol

Concentrated sulfuric or nitric acid

Ammonia, acetylene, benzene hydrogen

Nitric acid, Oxidizing gases

Any oxidizable substances

Acetylene, Ammonia, Lithium



Storage Area Requirements⁷



- ✓ Label storage areas according to the type of chemical class or hazard classification found there.
- ✓ Inspect storage areas as warranted and **Waste areas weekly**.
- ✓ Keep aisles, hallways, doorways, exits, and entryways clear.
- ✓ Keep storage areas well lit, appropriately ventilated, and at a consistent, cool temperature.
- ✓ Eliminate ignition sources such as open flames, heat sources, or direct sunlight.
- ✓ Keep emergency equipment such as fire extinguishers handy and in good working order.
- ✓ Confine chemical storage areas so that leaks or spills are controlled. Prevent chemicals from running down sink, floor, or storm water drains. Clean up spills and drips immediately



Flammables & Combustibles

Flammability is determined by measuring a substance's

FLASH POINT





Flammables & Combustibles₃



- Most common hazard

- Several agencies define and classify flammable & combustible liquids

- NFPA <100 >100
- DOT <140 >141
- GHS <199.6 >199.6





Flammables & Combustibles

Bottom Line The Fire Dept Says:

Any material having a flash point

Below 100°F are called **FLAMMABLES**

Above 100°F are called **COMBUSTIBLES**



Just don't forget the DOT & GHS versions



Dusts can be Explosive!!

3



At very high concentrations and under the right conditions, some dusts can be explosive.

The smaller the particle, the more reactive the dust. As the materials become smaller, they disperse and remain suspended more easily, increasing the potential for ignition and propagation of the reaction.

An example is excess organic material created from dumping corn into a silo or small fibers.





Storage Precautions for Flammables and Combustibles ⁶



Keep flammables away from all ignition sources: open flames, hot surfaces, direct sunlight, spark sources.

Store flammables separate from other hazard classes, especially oxidizers and toxics.

Separate flammable gases from oxidizing gases with an approved non-combustible partition or by a distance of 20 feet.

Store flammable liquids in approved safety containers or cabinets.

In instances where static electricity may accumulate and ignite flammable vapors, ground and bond flammable liquid containers.

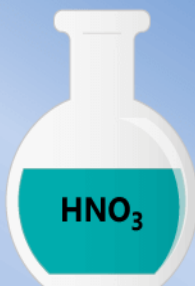
Keep a fire extinguisher (appropriate for the hazard) readily available and make sure anyone who may need to use it is properly trained.



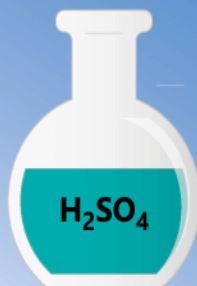
Strong Acids



Hydrochloric
Acid



Nitric
Acid



Sulfuric
Acid



Hydrobromic
Acid



Hydroiodic
Acid

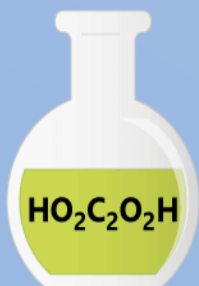


Perchloric
Acid

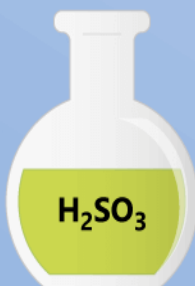


Chloric
Acid

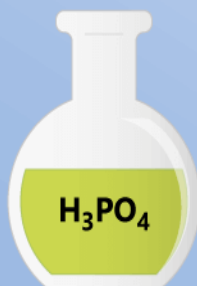
Weak Acids



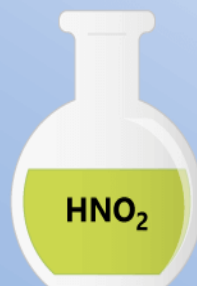
Oxalic
Acid



Sulfurous
Acid



Phosphoric
Acid



Nitrous
Acid



Benzoic
Acid



Acetic
Acid



Formic
Acid



Hazards of Strong Acids ⁴



- Concentrated strong acids can cause severe and painful burns.
- The pain is due in part to the formation of a protein layer, which resists further penetration of the acid.
- In general, inorganic acids are more dangerous than organic acids, although the latter can cause deep-seated burns on extended contact with skin.
- Leakage from containers and residue on the outside of a container following a sloppy transfer can cause corrosion of the shelving.



Inorganic acids ³



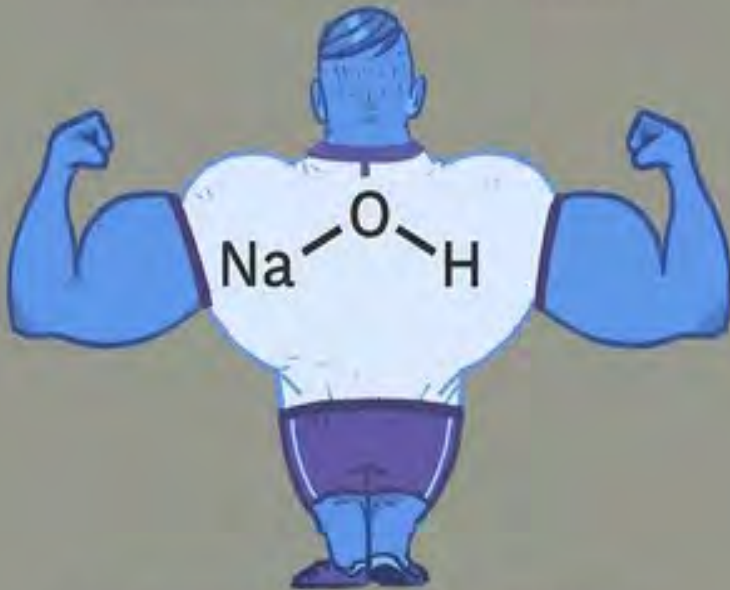
- **Inorganic acids**, also called mineral acids or natural acids, are acids derived from one or more inorganic compounds.
- Inorganic acids are man made.
- These **inorganic acids** are either oxygen-less or oxoacids. ... The **inorganic acids**, especially **sulfuric acid**, **nitric acid**, and **hydrochloric acid**, are manufactured for commercial use in large plants in large quantities.



Examples of Common Strong Bases



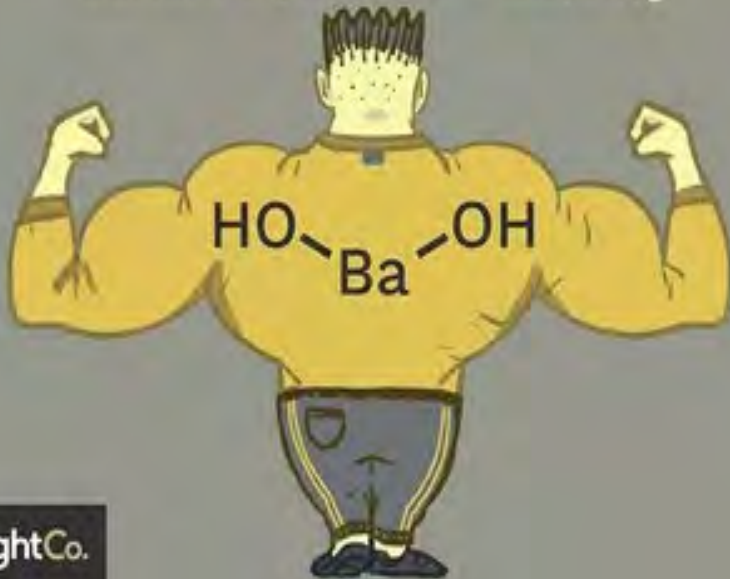
Sodium Hydroxide - NaOH



Potassium Hydroxide - KOH



Barium Hydroxide - Ba(OH)₂



Calcium Hydroxide - Ca(OH)₂





Hazards of Strong Bases ⁴



- Alkali metal hydroxides are very dangerous when allowed to contact tissue.
- Contact with the skin may be less painful than a comparable exposure to acid because the protective protein barrier is not formed.
- Greater damage may occur because the pain is less pronounced.
- Any area exposed to strong alkaline material should be flooded with water for at least 15 minutes. This is particularly important in eyes where exposure can result in global rupture.



Dehydrating Agents ⁵



- Strong dehydrating agents such as

- *Sulfuric acid*
- *Sodium hydroxide*
- *Phosphorous pentoxide*
- *Calcium oxide*
- *Glacial acetic acid*



- Cause severe burns to the eyes because of their strong affinity to water. When added to water too rapidly, violent reactions, accompanied by spattering, can occur.



Storage Precautions for Corrosives ⁷



- Segregate acids from bases. Segregate inorganic oxidizing acids (e.g., *nitric acid*) from organic acids (e.g., *acetic acid*), flammables, and combustibles.
- Segregate acids from chemicals that could generate toxic gases upon contact (e.g., *sodium cyanide* and *iron sulfide*).
- Segregate acids from water reactive metals such as *sodium*, *potassium*, and *magnesium*.
- Use tight-fitting goggles, gloves, and closed-toe shoes while handling corrosives.
- Store solutions of inorganic hydroxides in polyethylene containers.
- Store corrosives on lower shelves, at least below eye level and in compatible secondary containers.
- **Do not store corrosives on metal shelves.** Although ventilation helps, chemicals will still corrode the shelves. Store containers in plastic tubs or trays as secondary containment.



Storage Precautions for Corrosives ⁵



- Corrosive liquids must never be stored under sinks and may not be stored on shelves above eye-level.
- The formation of crystals and residues around the caps of bottles of corrosive-liquids is an indication that the container is not properly sealed. Containers that show these signs of leakage must be discarded as hazardous waste.
- Inorganic Corrosives
- Storage cabinets that are constructed of corrosion-resistant materials are the preferred storage location for most inorganic corrosive liquids. The corrosive vapors that may escape from containers of concentrated acids and bases can damage cabinets, shelves, and brackets.
- Mildly corrosive inorganic liquids such as dilute acids and bases may be stored in open shelving. It is recommended that acids and bases stored in regular cabinets be kept on plastic trays or in plastic bins.



Chemical Toxicity



- Toxicology is the study of the nature and action of poisons. Toxicity is the ability of a chemical molecule or compound to produce injury once it reaches a susceptible site in or on the body.

THE CASE OF JIM JONES AND THE PEOPLES TEMPLE

@JENNYBWRITER



Dose–Response Relationships ²



- The potential toxicity (harmful action) inherent in a substance is manifest only when that substance comes in contact with a living biological system. A chemical normally thought of as "harmless" will evoke a toxic response if added to a biological system in sufficient amount.
- *The toxic potency of a chemical is defined by the relationship between the dose (the amount) of the chemical and the response that is produced in a biological system.*

Exposure Limits

- Permissible Exposure Limit (PEL)
- Threshold Limit Value (TLV)
- Recommended Exposure Limit (REL)
- Time-weighted average (TWA)
- Short-term Exposure Limit (STEL)
- Ceiling (C)
- Immediately Dangerous to Life or Health (IDLH)





Routes of Entry into the Body ⁶



- There are three main routes by which hazardous chemicals enter the body:
- Absorption through the respiratory tract through **inhalation**. This is most important in terms of severity.
- **Absorption** or **Injection** through the skin or eyes.
- Absorption through the digestive tract through **ingestion**. This can occur through eating or smoking with contaminated hands or in contaminated work areas.
- Most exposure standards including **ACGIH Threshold Limit Values (TLVs)** and **OSHA Permissible Exposure Limits (PELs)**, are based on the inhalation route of exposure. *They are normally expressed in terms of either parts per million (ppm) or milligrams per cubic meter (mg/m³) concentration in air.*
- If a significant route of exposure for a substance is through skin contact, the SDS will have a "skin" notation. Examples include: pesticides, carbon disulfide, phenol, carbon tetrachloride, dioxane, mercury, thallium compounds, xylene, hydrogen



Health Effects ³



- **Acute poisoning** is characterized by rapid absorption of the substance and the exposure is sudden and severe. Normally, a single large exposure is involved. Examples: ***carbon monoxide*** or ***cyanide poisoning***.
- **Chronic poisoning** is characterized by prolonged or repeated exposures of a duration measured in days, months or years. Symptoms may not be immediately apparent. Examples: ***lead*** or ***mercury*** poisoning and ***pesticide*** exposure.
- **Local** refers to the site of action of an agent and means the action takes place at the point or area of contact. The site may be skin, mucous membranes, the respiratory tract, gastrointestinal system, eyes, etc. Absorption does not necessarily occur. Examples: strong ***acids or alkalis***.



Health Effects

3



- **Systemic** refers to a site of action other than the point of contact and presupposes absorption has taken place. For example, an inhaled material may act on the liver. Examples: ***arsenic*** affects the blood, nervous system, liver, kidneys and skin; ***benzene*** affects the bone marrow.
- **Cumulative poisons** are characterized by materials that tend to build up in the body as a result of numerous chronic exposures. The effects are not seen until a critical body burden is reached. Examples: ***heavy metals***.
- **Synergistic responses** When two or more hazardous material exposures occur the resulting effect can be greater than the effect of the individual exposures. This is called a synergistic or potentiating effect. Example: exposure to both ***alcohol and chlorinated solvents***.



Other Factors Affecting Toxicity ³



- **Rate of entry and route of exposure**; that is, how fast is the toxic dose delivered and by what means. Age can affect the capacity to repair tissue damage. Previous exposures can lead to tolerance, increased sensitivity or make no difference.
- **State of health, physical condition**, and life style, can affect the toxic response. Preexisting disease can result in increased sensitivity.
- **Environmental factors** such as temperature and pressure may also affect the exposed individual as well as host factors including genetic predisposition and the sex of the exposed individual.



Toxic Chemical Classes



- **Hepatotoxic**

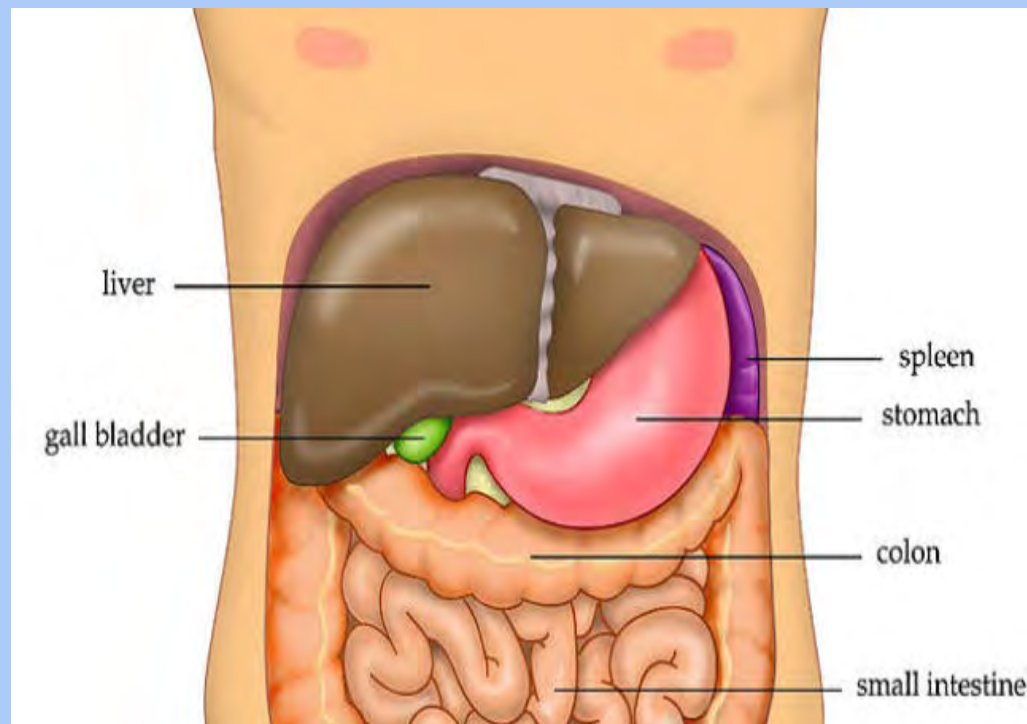
- *Hepatotoxic* agents cause damage to the liver.

- These include:

- carbon tetrachloride

- tetrachloroethane

- nitrosamine



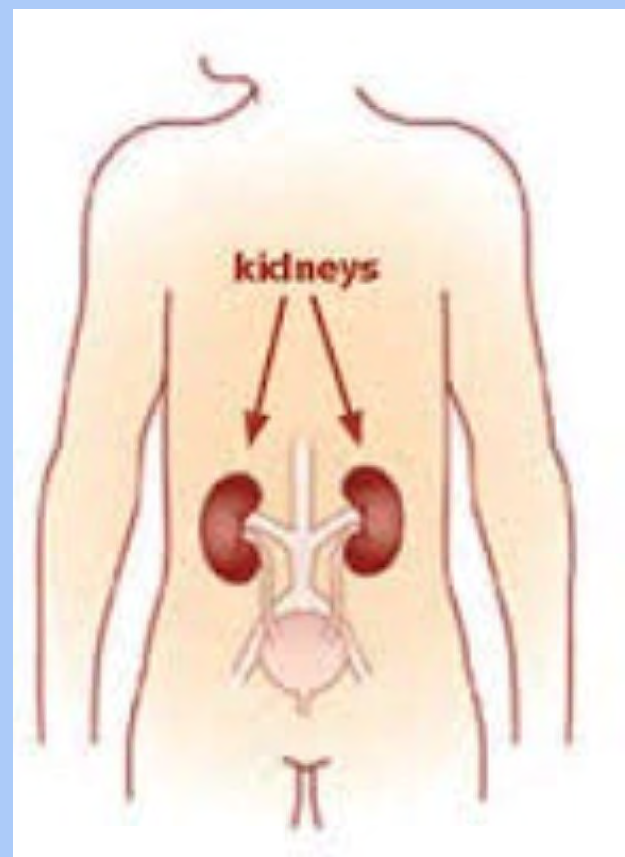


Toxic Chemical Classes



• Nephrotoxins

- *Nephrotoxic agents* damage the kidneys.
- These include:
 - halogenated hydrocarbons
 - uranium compounds



- A **halogenated compound** is one onto which a **halogen** (e.g., fluorine, chlorine, bromine, or iodine) has been attached

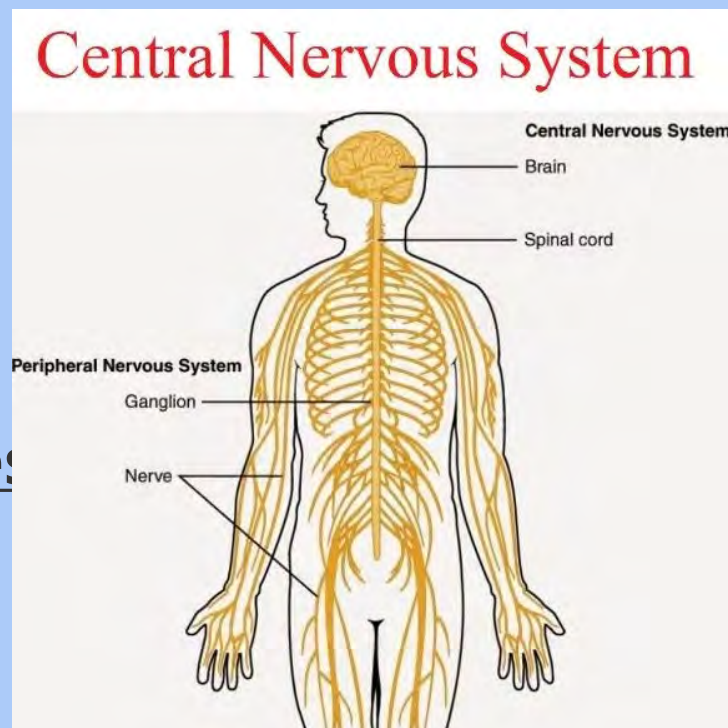


Toxic Chemical Classes



• Neurotoxins

- *Neurotoxic agents* damage the nervous system.
- The nervous system is especially sensitive to organometallic compounds and certain sulfide compounds.
- These include:
 - trialkyl tin compounds
 - tetraethyl lead
 - methyl mercury
 - carbon disulfide
- organic phosphorus insecticides
- manganese
- thallium





Toxic Chemical Classes

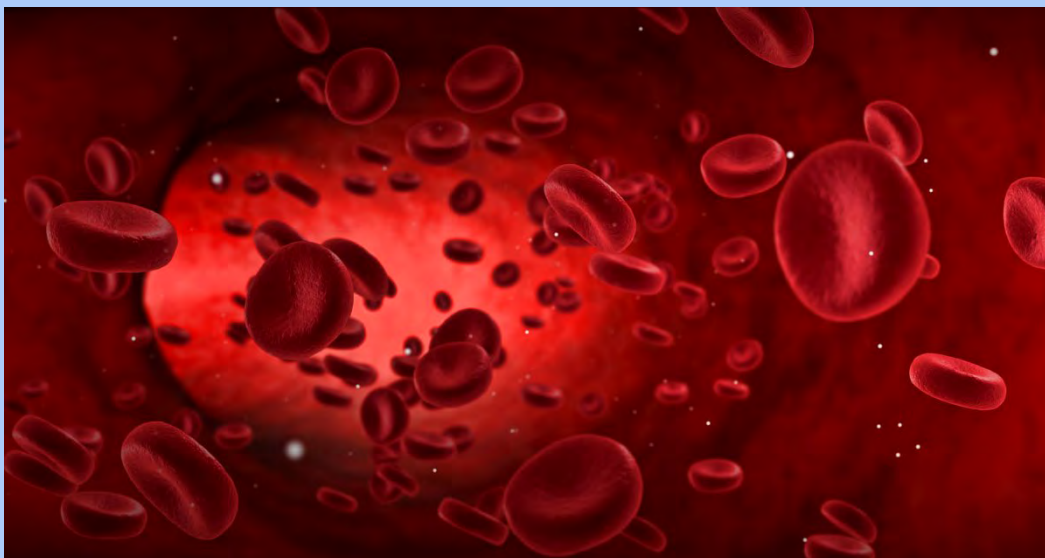


• Hematopoietic Toxins

- Some toxic agents act on the blood or *hematopoietic* system.
- The blood cells can be directly affected or the bone marrow can be damaged.

• These include:

- nitrites
- aniline
- toluidine
- nitrobenzene
- benzene





Storage Precautions for Toxics ⁴



- Segregate toxics from other hazard classes and store in a cool, well ventilated area, away from light and heat.
- Containers should be tightly sealed to minimize exposure to personnel and contamination of other chemicals.
- Maintain the lowest possible quantities of highly toxics.
- Segregate highly toxic chemicals from other hazard classes and store in an area that is cool, well ventilated, and away from light and heat.





Irritants ⁵



Chemical irritants are materials that cause reversible inflammation or irritation to a body surface, including eyes, respiratory tract, skin or mucous membranes, upon contact.

Long term exposure to irritants can result in increased mucous secretions and chronic bronchitis.

- A **primary irritant** exerts no systemic toxic action, either because the products formed on the tissue of the respiratory tract are non-toxic or because the irritant action is more severe than any systemic toxic action. Example: hydrogen chloride.
- A **secondary irritant's** effect on mucous membranes is overshadowed by a systemic effect resulting from absorption. These include:
 - hydrogen sulfide
 - aromatic hydrocarbons
- Exposure to a secondary irritant can result in pulmonary edema, hemorrhage and tissue necrosis.



Irritants ¹



Common irritants include substances such as:

- ammonia
- alkaline dusts and mists
- hydrogen chloride
- hydrogen fluoride
- halogens
- ozone
- phosgene
- nitrogen dioxide
- phosphorus chloride
- arsenic trichloride





Carcinogens ¹



- *The term carcinogen describes any agent that can initiate or speed the development of malignant or potentially malignant tumors, malignant neoplastic proliferation of cells, or cells that possess such material.*

A select carcinogen is any substance that meets one of the following criteria:

- It is regulated by OSHA as a carcinogen
- It is listed under the category, "known to be carcinogens" in the National Toxicology Program (NTP)
- It is listed by the International Agency for Research on Cancer Monographs (IARC)



Reproductive Hazards ²



- *Reproductive hazards* are chemicals that affect the reproductive capabilities including chromosomal damage (*mutagens*) and effects on the fetus (*teratogens*).

- A **mutagen** affects the chromosome chains of exposed cells. The effect is hereditary and becomes part of the genetic pool passed on to future generation.
- A **teratogen** (embryotoxic or fetotoxic agent) is an agent that interferes with normal embryonic development and may lead to birth defects or even death. Effects are not hereditary

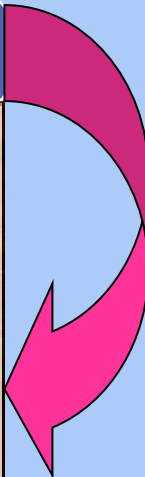
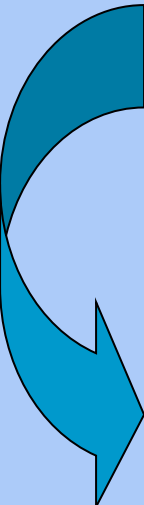
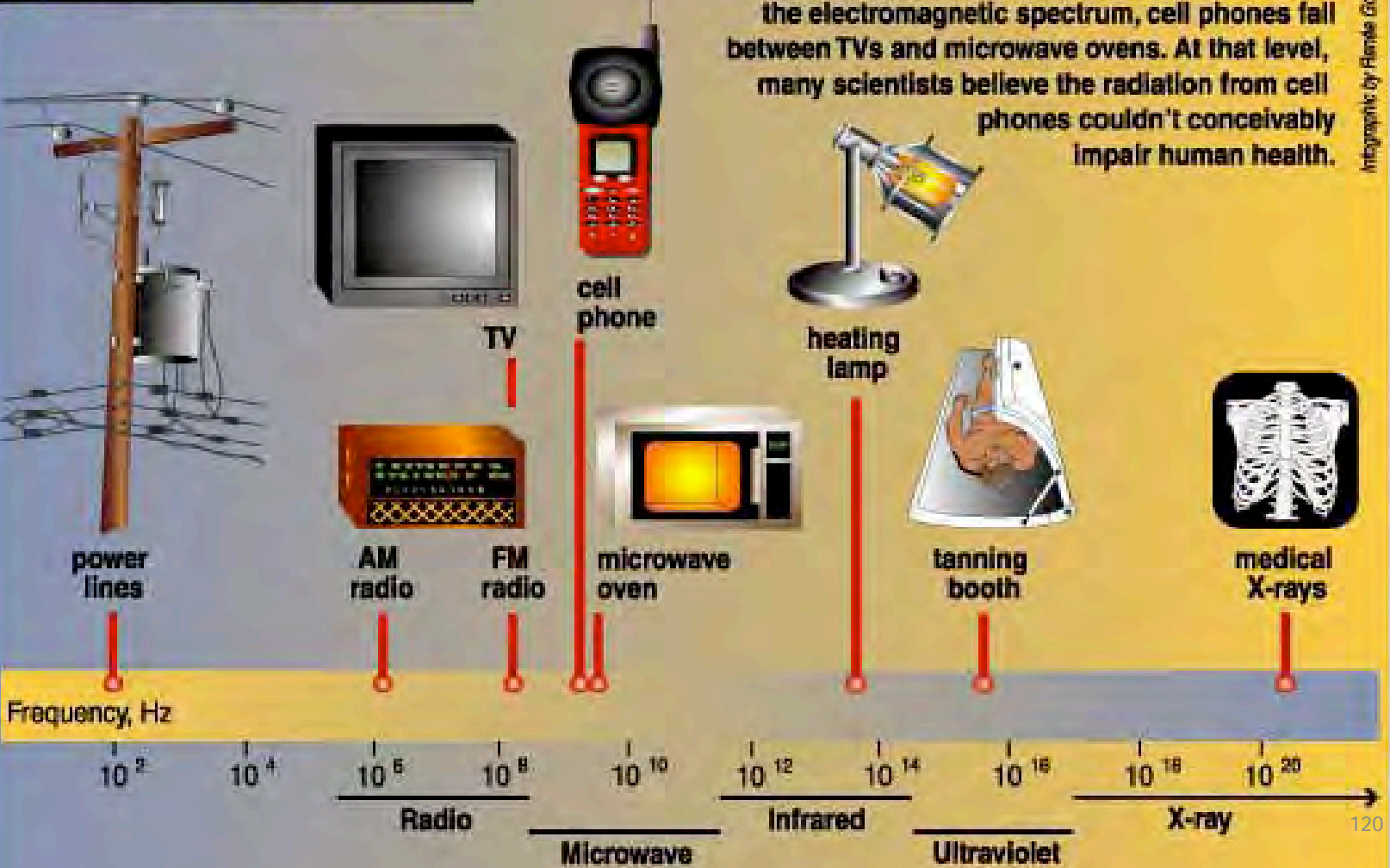


Forms of Radiation

NON-IONIZING

IONIZING

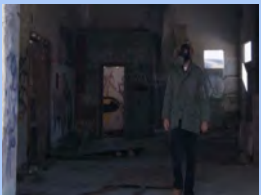
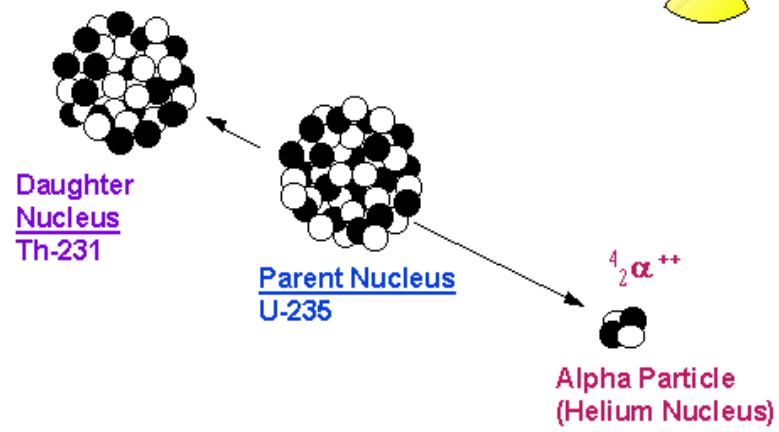
Radiation In Perspective



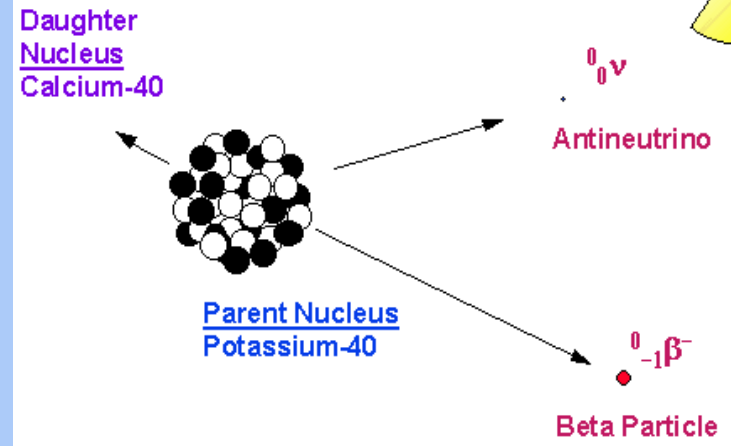


Three Types of Radioactive Decay

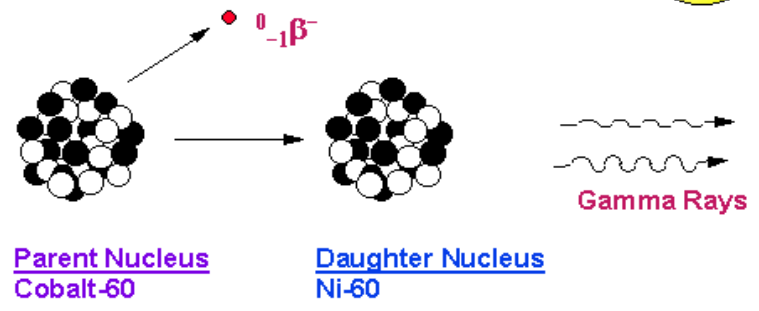
Alpha Particle Radiation



Beta Particle Radiation



Gamma-Ray Radiation





Radiation Exposures

1 REM =
1,000 mREMs
PEL= 5 REM's/Year

Coast-to-coast
flight 3 mrem

Natural
background 150-
300 mrem

Chest radiograph,
A/P
15-25 mrem

Chest radiograph,
lateral
50-65 mrem

Computerized
tomography
2000-6000 mrem

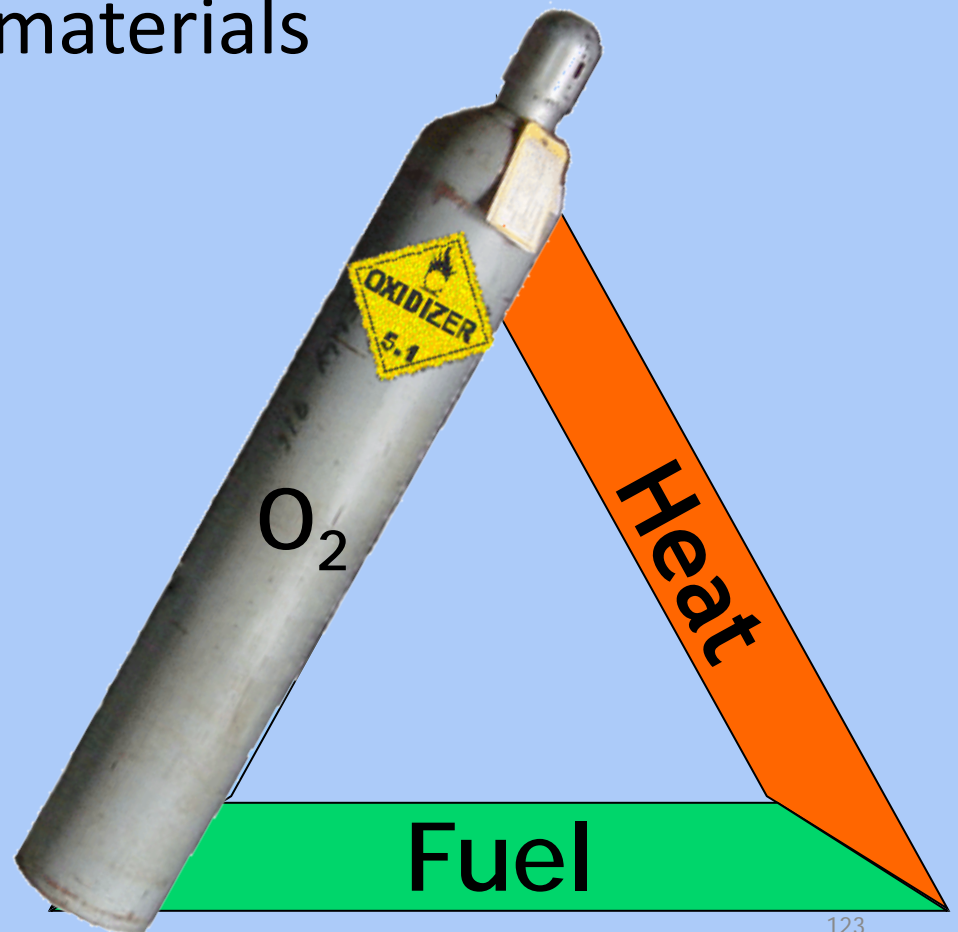




Oxidizers ¹



- The primary hazard lies in their ability to act as an oxygen source, and thus to readily stimulate the combustion of organic materials

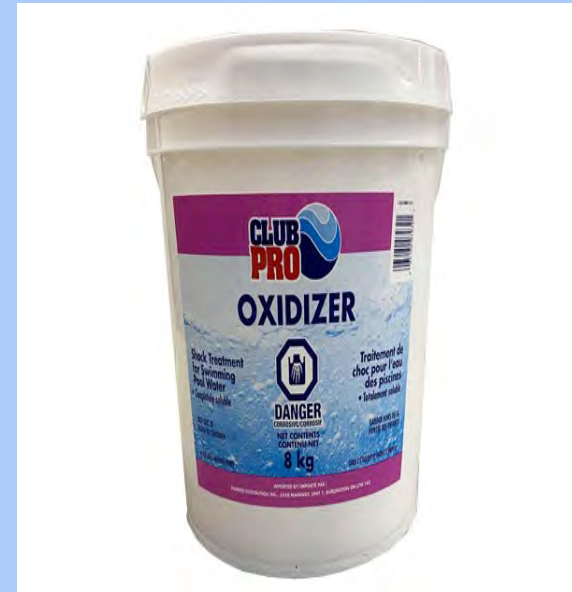




Oxidizers ²



- Oxidizing chemicals are materials that spontaneously evolve oxygen at room temperature or with slight heating or promote combustion.
- This class of chemicals includes *peroxides, chlorates, perchlorates, nitrates, and permanganates*. **Strong oxidizers are capable of forming explosive mixtures when mixed with combustible, organic or easily oxidized materials.**





Storage Precautions for Oxidizers

5



- Segregate oxidizers from flammable and combustible materials (paper, wood).
- Segregate oxidizers from reducing agents (zinc, alkaline metals, formic acid).
- Segregate inorganic oxidizers from organic peroxides.
- Take care not to contaminate oxidizers. Some oxidizers, such as *perchloric acid*, can become explosive mixtures if contaminated with trace amounts of organic materials or metals.
- Store in a cool, dry place.





Peroxide Forming Chemicals ⁶



- Peroxide-forming chemicals are a class of materials that have the ability to form shock-sensitive and explosive peroxide crystals. When triggered by friction or shock the peroxides will explode. Peroxide forming chemicals include ***solids, liquids and gases***. These chemicals may also be flammable.³
- **Peroxides form after exposure to air.** The rate of peroxide formation is dependent on the specific chemical, the amount of air exposure and whether the chemical contains and inhibitor to retard peroxide formation.

Class A Peroxide-Forming Chemicals-Expire 3 months after opening

Class B Peroxide-Forming Chemicals-Expire 1 year after opening

Class C Peroxide-Forming Chemicals-Expire 1 year after opening

“Unopened from manufacturer-Expire after 18 months”

Compressed Gases





Types of Compressed Gas Cylinders ³



- There are three major groups of compressed gases stored in cylinders: **liquefied, non-liquefied and dissolved gases**. In each case, the pressure of the gas in the cylinder is commonly given in pounds per square inch gauge (psig).
- **Gauge pressure** = Total gas pressure inside cylinder - atmospheric pressure.
- **Atmospheric pressure** is (14.7 psi). Note that compressed gas cylinder with a pressure gauge reading of 0 psig is not really empty. It still contains gas at atmospheric pressure.





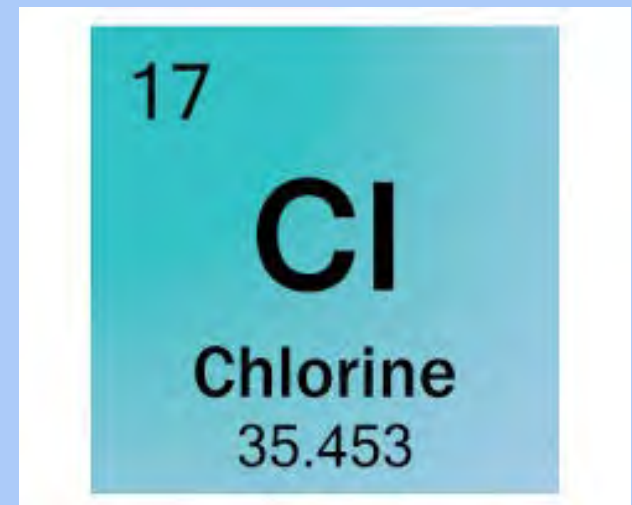
Liquefied Gases 6



- Liquefied gases are gases which can become liquids at normal temperatures when they are inside cylinders under pressure.

The following are Liquefied Gases

- Anhydrous ammonia
- Chlorine
- Propane
- Nitrous oxide
- Carbon dioxide



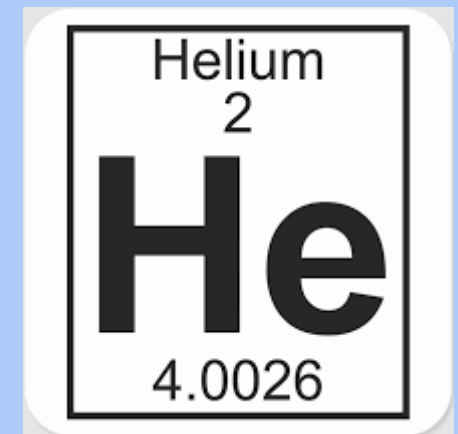
Non-Liquefied Gases 5



- Non-liquefied gases are also known as compressed, pressurized or permanent gases. These gases do not become liquid when they are compressed at normal temperatures, even at very high pressures.

- Common examples of these are

- Oxygen
- Nitrogen
- Helium
- Argon





Dissolved Gases ²



- Acetylene is the only common dissolved gas. Acetylene is chemically very unstable. Even at atmospheric pressure, acetylene gas can explode. Nevertheless, acetylene is routinely stored and used safely in cylinders at high pressures (up to 250 psig at 70°F).
- This is possible because acetylene cylinders are fully packed with an inert, porous filler. The filler is saturated with acetone or other suitable solvent. When acetylene gas is added to the cylinder, the gas dissolves in the acetone. Acetylene in solution is stable



✓ Acetylene
Cylinders are filled
with Calcium
Silicate





Other Gases ⁵



- **Toxic Gas**

- A gas with a (LC50) in air of more than 200 ppm, but not more than 2,000 ppm by volume of gas.

- **Highly Toxic Gas**

- A gas with a (LC50) in air of 200 ppm or less.

- **Corrosive Gases**

- Corrosive gases cause visible destruction of or irreversible alterations in living tissue by chemical action at the site of contact

- **Pyrophoric Gases**

- Are gases with an auto-ignition temperature in air at or below 130°F. These gases are so reactive that they can ignite spontaneously in air.

- **Oxidizing Gases**

- Oxidizing gases include any gases containing oxygen at higher than atmospheric concentrations (above 23-25 percent), nitrogen oxides, and halogen gases such as chlorine and fluorine.



Storage Precautions for Compressed Gases



- Segregate incompatible gases as you would other incompatible chemicals.
- Limit the quantity of compressed gas cylinders on site to what will be used within a reasonable period of time.
- Store cylinders upright
- An acceptable means includes using two non-combustible restraints, such as chains, one restraint located approximately one-third of the cylinder length from the top, and the other restraint one-third from the bottom.
- Keep cylinders away from heat and open flames. Leave the valve protection cap on the cylinder unless it is in use.
- If you suspect that a cylinder is leaking, do not attempt to sniff the leak out. Apply a soap solution to the cylinder and locate the leak by noting where the bubbles appear.



Chemical Reactivity



- **Exothermic**

- Releases heat

Oleum (concentrated sulfuric acid) will bubble, fume & heat to over 300 ° F when water is applied

- **Endothermic**

- Absorbs heat

Ammonium nitrate mixed with water reacts by absorbing heat (for example in a cold pack making the pack as cold as 32° F)

Caution: neutralizing a corrosive spill with water creates a chemical reaction – usually exothermic and is best left to

Hazmat Technicians



Pyrophorics Chemicals ³



Pyrophoric chemicals are liquids, solids, and gases that will ignite spontaneously in air at or below 130 °F.

Oxidation of the compound by oxygen or moisture in air proceeds so rapidly that ignition occurs.

Many finely divided metals are pyrophoric, and their degree of reactivity depends on particle size, as well as factors such as the presence of moisture and the thermodynamics of metal oxide or metal nitride formation.





Storage Precautions for Pyrophorics⁷



- Store in a cool, dry place. Prevent contact with air.
- Take extreme care to prevent containers of pyrophorics from leaking or breaking. The use of corrosion- and shatter resistant secondary containers for storage and transportation of pyrophoric reagent bottles is encouraged.
- Many pyrophoric chemicals are also water reactives

Storage Precautions for Water Reactives

Store in a cool, dry place.

Keep away from water. In case of fire, do not use water.

Use a dry chemical extinguisher.



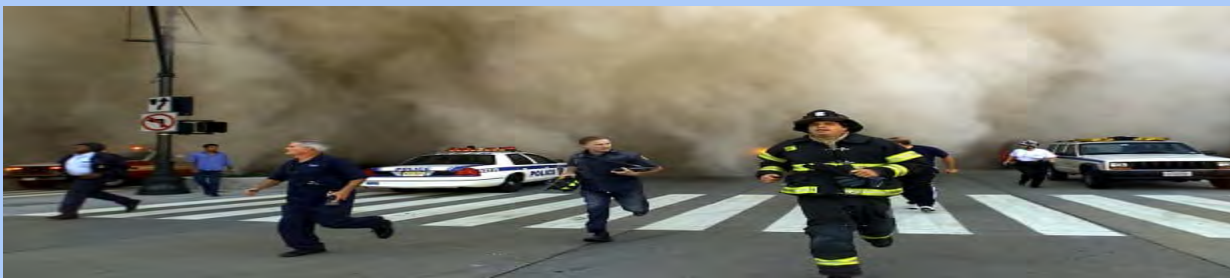
Dangerously Reactive Liquids and Solids⁴



• What are dangerously reactive liquids and solids ?

- Undergo vigorous polymerization, condensation or decomposition
- Become self-reactive under conditions of shock or increase in pressure or temperature
- React vigorously with water to release a lethal gas

Haz Mat Responders don't like anything that Polymerizes





Vigorous Polymerization ²



- **Polymerization**: is a chemical reaction in which many small molecules (monomers) join together to form a large molecule (polymer). **Often the reaction produces heat and pressure.** Industry carries out these processes under closely monitored conditions. Other chemicals (catalysts and initiators) and controlled amounts of heat, light and pressure are often involved.
- **Vigorous Polymerization: is potentially hazardous because the reaction may get out of control.** Once started, the reaction is accelerated by the heat that it produces. **The uncontrolled buildup of heat and pressure can cause a fire or an explosion, or can rupture closed containers.** Depending on the material, temperature increases, sunlight, ultraviolet (UV) radiation, X-rays or contact with incompatible chemicals can trigger such reactions
- **Check for this on your SDS**



Vigorous Condensation

3



- Condensation is a chemical reaction in which two or more molecules join together to form a new substance. Water or some other simple substance may be given off as a by-product. Some polymers, such as nylon, can be formed by condensation reactions.
- Vigorous condensation can produce more energy than the surroundings can safely carry away. This could cause a fire or explosion, or rupture closed containers.
- Some commercial products sold to be mixed for specialized applications may undergo vigorous condensation if they are not stored, handled and used as directed by the chemical supplier.



Vigorous Decomposition ⁴



- Decomposition is a chemical change in which a molecule breaks down into simpler molecules.
- Vigorous decomposition is potentially hazardous because large amounts of energy can be released very quickly. This could result in a fire or explosion, or rupture a closed container causing the release of dangerous decomposition products.
- Some pure materials are so chemically unstable that they vigorously decompose at room temperature by themselves.
- For example, some organics are relatively safe only when refrigerated or diluted.



Inhibitors 4



- An inhibitor is a chemical that is added to a material to slow down or prevent an unwanted reaction such as polymerization. Inhibitors are added to many materials that can polymerize easily when they are pure.
- Inhibitor levels in materials may gradually decrease during storage even at recommended temperatures.
- At storage temperatures higher than recommended, inhibitor levels can decrease at a much faster rate.
- At temperatures lower than recommended, the inhibitors may separate out. This action can result in some part of the material having little or no inhibitor



Inhibitors ³



• There are three common classes of inhibitors:

- **Corrosion inhibitor**: A corrosion inhibitor decreases the rate of oxidation of metal.
- **Enzyme inhibitor**: In chemistry and biology, an enzyme inhibitor binds to an enzyme, lessening its activity. Enzyme inhibitors may be reversible or irreversible.
- **Reaction inhibitor**: A reaction inhibitor is any substance that decreases the rate of a chemical reaction. Corrosion inhibitors and enzyme inhibitors are both types of reaction inhibitors. Reaction inhibitors are classified by their potency as strong, moderate, or weak.

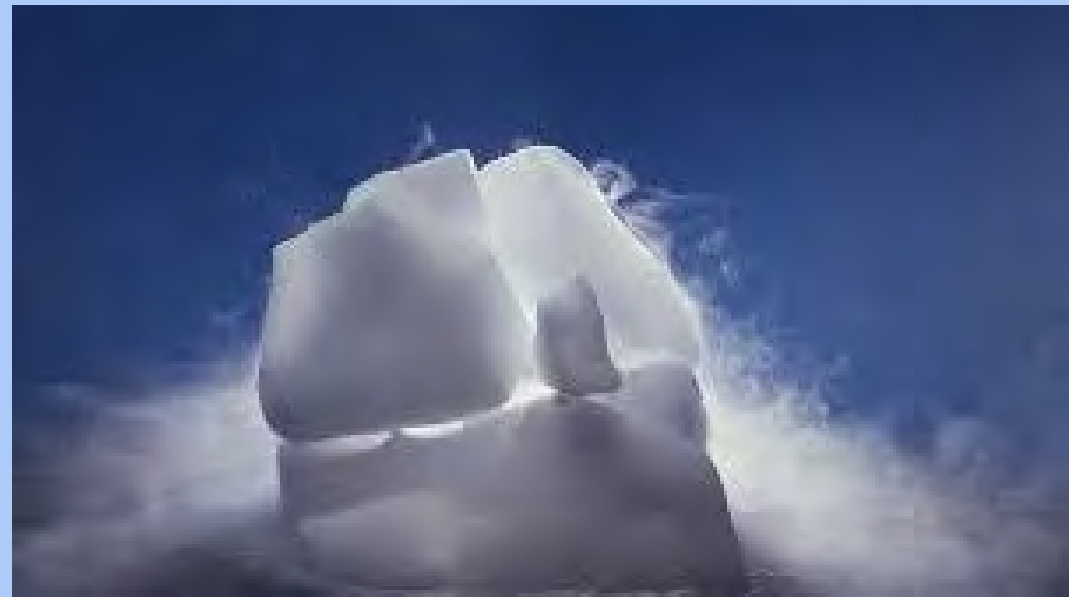


Cryogen₃



• A liquid cryogen is a liquefied gas with a boiling point typically below (- 238°F).

- The following hazards are associated with the storage, handling, and transport of cryogenic liquids and dry ice.
- Burns
- Asphyxiation
- Fire hazards
- Formation of liquid oxygen
- Pressure hazards





Cryogen₃



- Burns

- Even brief skin contact with a cryogen, dry ice or non-insulated equipment parts can cause cold burn and frostbite. Prolonged contact can result in blood clots. Eye contact with a cryogen or dry ice can cause permanent damage.

- Asphyxiation

- Although the gases created by the evaporation of most cryogenic liquids and dry ice are non-toxic and non-reactive, they will displace oxygen in the room and create an oxygen deficient atmosphere, which may result in death.

- Remember:

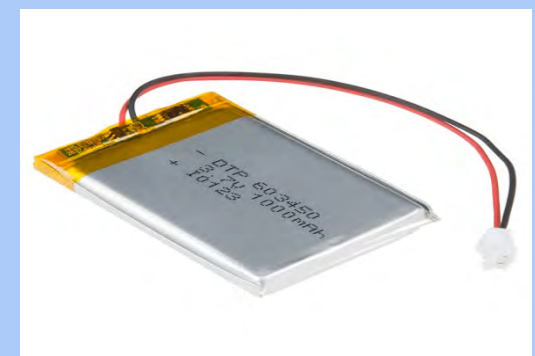
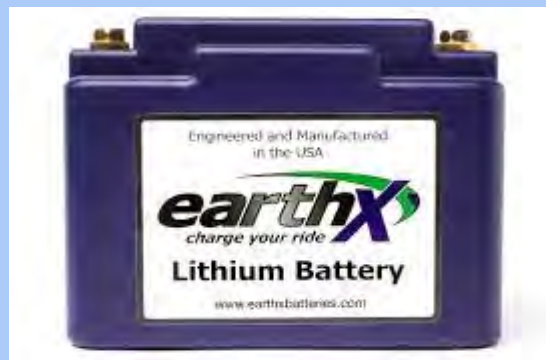
- You cannot detect an oxygen deficiency or over-exposure to carbon dioxide unless there is an oxygen-monitoring device installed in the room. The inert gases are odorless and colorless. By the time you realize you are being deprived of oxygen, it may be too late!



Lithium-Based Batteries ²



- Lithium-based batteries, especially **lithium-ion** and **lithium-polymer** rechargeable batteries have become highly popular due to their favorable power to weight ratio and the fact that lithium-polymer batteries can be configured in various shapes and sizes.
- **The most important safety consideration for lithium-ion and lithium-polymer batteries is to treat the battery as if it will ignite at any time.** Even though the odds are remote, if each battery is segregated from combustible materials during storage, charging and in use, in the rare possibility that a fire does occur, the odds are better that it will be limited to the battery itself.





Lithium-Based Batteries ²



Batteries are classified into two categories:



Primary and Secondary



Primary batteries are not rechargeable. Examples of lithium-based primary batteries are button cells and camera/smoke detector batteries. Primary batteries contain metallic lithium which reacts violently with moisture.. Water is not an effective extinguishing material for primary lithium battery fires.

Secondary batteries are rechargeable. Unlike primary lithium batteries, secondary lithium batteries do not contain metallic lithium. Fires involving secondary lithium-ion or lithium-polymer secondary batteries can be extinguished with a traditional ABC- type fire extinguisher or smothered with a material such as sand.



Lithium-Based Batteries 6



- All lithium batteries must be stored in a dedicated area clear of combustible materials.
- When more than a few lithium batteries must be kept within a given area, they should be stored in a vented metal flammable liquids or metal acid storage cabinet that is strictly dedicated to the storage of lithium batteries.
- No other hazardous or combustible materials shall be stored in or on the cabinet.
- The cabinet should help to contain a battery fire within the cabinet and prevent spread to the building or contents.
- The cabinet vents must be kept open to allow fire-generated gasses to escape.
- Label the outside of the cabinet to indicate that it contains lithium batteries.



Lithium-Based Batteries ⁷



- Inspect all batteries at least weekly. Any batteries with damaged or swollen casings must be segregated from other batteries and combustible materials and placed in a safe location.
- Never charge batteries unattended.
- Never charge batteries inside vehicles.
- Charge batteries individually. Do not charge in parallel.
- Place LiPo batteries in a lithium battery safety bag/container while charging.
- Designate a charging area. The area must be free of combustible materials and preferably located under a sprinkler head. This also applies where charging takes place while traveling or otherwise away from the laboratory.
- Maintain as much space as possible between charging batteries to avoid fire propagation between batteries.

To Vent or not to Vent ?

- Not required but..
- If vented – vent to outdoors.....IF ALLOWED
- If not vented – leave bungs IN



Secure the Cabinet as Warranted



Spill Control and Containment

Hazardous Waste Operations and Emergency Response

29 CFR 1910.120(q)



Containment: Defined ⁴

Act or process of containing and/or preventing the expansion of a substance.

Purpose:

- Prevent contaminating surrounding areas
- Prevent material entering sewers or waterways
- Reduce contamination of adjacent chemicals
- Reduce extent of hazard to human life



Loss of Containment ⁴

Factors contributing to the loss of containment include:

- Mechanical damage,
- Thermal damage,
- Chemical reactions in the container.

Loss of containment requires proper response!



Proper Response Steps ⁹

- Identify spilled material
- Size-up incident severity
- Determine mitigation methods
- Implement methods



Precautions taken to minimize exposure:

Proper size-up of situation

Proper PPE

Understanding hazards of materials involved

Physical state of release and resulting complications.

Response Actions ⁴

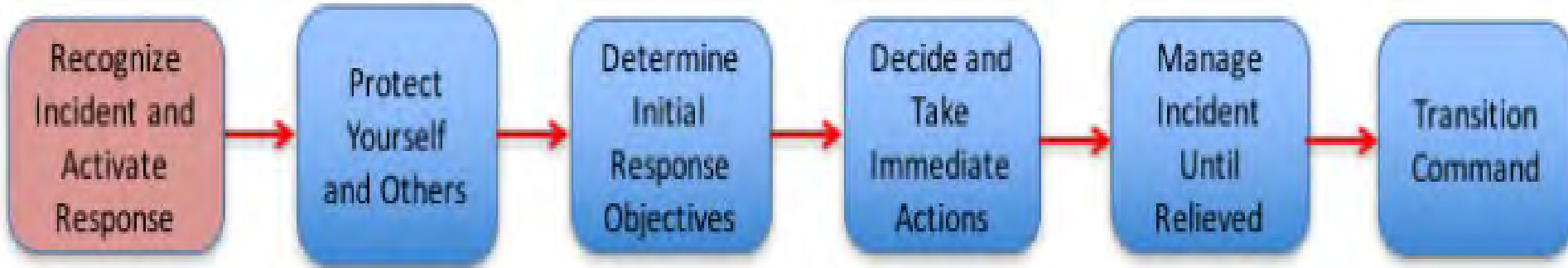
Goals of spill response are to:

1. Eliminate additional loss.
2. Prevent further contamination.
3. Avoid unnecessary exposure of workers.
4. Prevent contact with other chemicals.

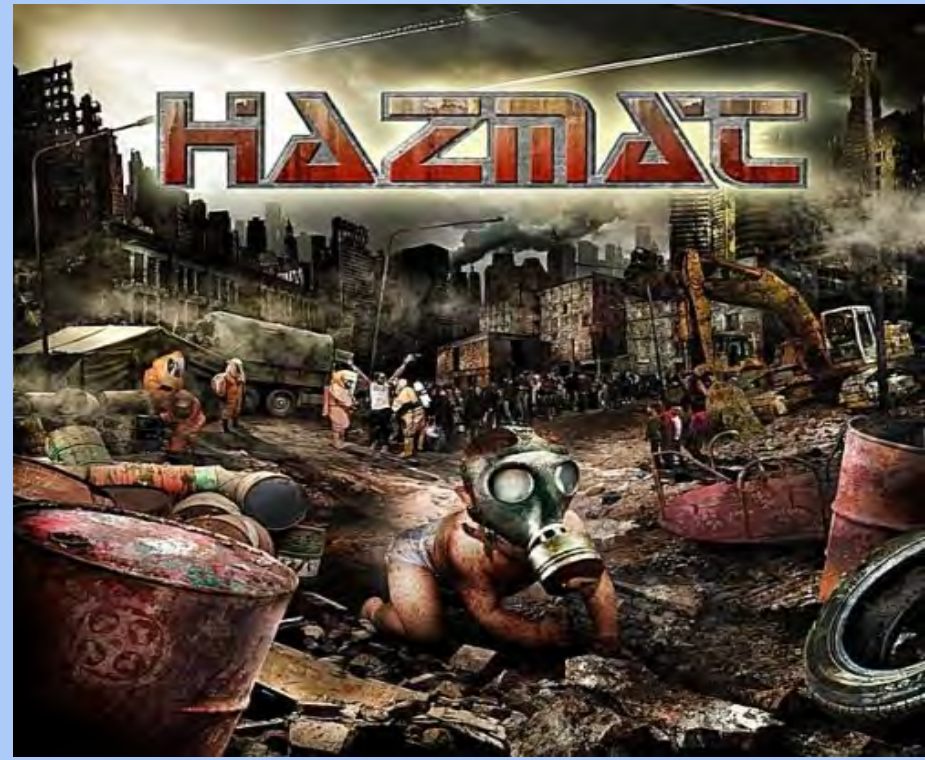


Proper Response Steps

- Always follow your employers Standard Operating Procedures



- S Safety for yourself and others
- I Isolate and deny entry
- N Make proper Notifications



Solid Release ²

- Solid materials are easy to recover if kept dry and air movement is minimized. Once wet or damp, adverse reactions may complicate containment.
- Cover with compatible material to minimize spread.



Liquid Release ³

- Complicated by amount of spilled material and inherent characteristics.
- Vapors on surfaces or confined areas may form flammable-explosive-toxic levels and displace O₂.
- Terrain may aid spread; liquids follow the path of least resistance to storm drains, sewers or waterways.



Gas Release

Often compartments can not be tightly sealed. In engineered facilities, this attempt to “seal” the location is achieved to some degree by shutting-down ventilation and air exchange systems.



Mitigation Techniques ²

The method by which a substance, once released, is controlled by entry personnel. These are:

1. **Chemical Control** and or **Physical Control**
2. Sometimes you can just tighten the cap on the container.



Chemical Control

Neutralization:

Mixing an acid with a basic material or base with an acid to return their pH levels toward a reading of 7 (neutral).



Physical Control

1. Remote shut-offs
2. Vapor suppression fog covering, cooling cylinders
3. Absorbents
4. Damming
5. Diking
6. Diverting
7. Transferring
8. Transfilling
9. Plugging and patching
10. Booming and damming on waterways.



Remote Shut-Offs



These exist to shut down processes or pipe-runs to secure product flow. Use flow diagrams in your pre-plan and know the location of these shut-offs prior to an emergency.

Be aware of critical shutdown procedures



Vapor Suppression

Cooling Cylinders.



Absorbents-Booms-Pads

Materials in a solid or granular form which can absorb a certain volume of a spill on a pound-per-pound basis. Remember they need to be retrieved and disposed of as hazardous waste.



Damming-Diking-Diverting



Protecting Drains

Control/removal considerations can be as particular as using sand in plastic bags for diking material rather than loose sand.



Transferring ⁵

Removal of product from its damaged containment to another containment or container. Possible hazards:

- Characteristics of the material being transferred
- Possibility of spillage
- Vapor production
- Electrical ignition hazard
- Bonding and Grounding



Plugging and Patching

Plugging and patching is the use of compatible materials applied to the container to result in either a temporary or permanent seal at the point of damage.



Other Mitigation Methods

- These can be specific by industry. There are also pipe sleeves which can be used for breached piping.
- Transportation industry may use the following:



Overpacking

- Placing leaking or repaired container into a larger vessel
- Overpacks may be made of steel or plastic.



Dangers of Confined Spaces

And Why Hazardous Materials Are A Big Concern





Research reveals interesting facts regarding the causes of deaths in confined spaces

- 65% hazardous atmospheres
- 13% engulfment
- 7% struck by falling objects
- 6% heat stress/exposure
- 4% other



COMMON CAUSES OF CONFINED SPACE ACCIDENTS ¹⁻² ₄

- **Financial Motivation:** Time is money and money is time. Supervisors and their employees will often cut corners on safety in order to save time.
- **Assessment Deficit:** Not performing or inadequately performing a hazard assessment.
- **Inadequate PPE:** Not using proper personal protective equipment.
- **Lack of Training:** Uninformed and uneducated workers will make poor decisions that can cause accidents.

COMMON CAUSES OF CONFINED SPACE ACCIDENTS 2-2 3

- **Underestimating the Environment:** Many of the hazards associated with confined spaces cannot be seen. Workers will often underestimate the confined space environment and are injured by hidden hazards.
- **Routine Operation Syndrome:** Thinking that the space is safe today because it has not resulted in injuries during previous entries.
- **Equipment Failure:** Improper maintenance, abuse, lack of back-ups, and equipment use that has not been mastered can all lead to accidents.

What is a Confined Space?

3



- Large enough that an employee can enter and perform assigned work.

- Has limited or restricted means for entry or exit.

- Not designed for continuous employee occupancy.



Two Types of Confined Spaces

There are basically two types of confined spaces:

- Non-Permit Confined Spaces
- Permit-Required Confined Spaces



DANGER

A rectangular warning sign with a black border. At the top, the word "DANGER" is written in white, bold, sans-serif capital letters inside a red oval with a white border. Below the oval, the text "NON-PERMIT CONFINED SPACE" is written in black, bold, sans-serif capital letters. Underneath that, "AUTHORIZED PERSONNEL ONLY" is written in black, sans-serif capital letters.

**NON-PERMIT
CONFINED SPACE
AUTHORIZED
PERSONNEL ONLY**



DANGER

A rectangular warning sign with a black border. At the top, the word "DANGER" is written in white, bold, sans-serif capital letters inside a red oval with a white border. Below the oval, the text "PERMIT REQUIRED CONFINED SPACE" is written in black, bold, sans-serif capital letters. Underneath that, "DO NOT ENTER" is written in black, sans-serif capital letters.

**PERMIT REQUIRED
CONFINED SPACE
DO NOT ENTER**

Non-Permit Confined Spaces

Non-Permit Required:

“Does not contain or with respect to atmospheric hazards, have the potential to contain a hazard capable of causing death or physical harm.”



Permit-Required Confined Space



- Contains or has the potential to contain a hazardous atmosphere
- Contains a material that has the potential for engulfing an entrant
- Internal configuration that might cause entrant to be trapped or asphyxiated by inwardly converging walls or floor that slopes downward and tapers to a smaller cross section
- Contains any other recognized serious safety or health hazard

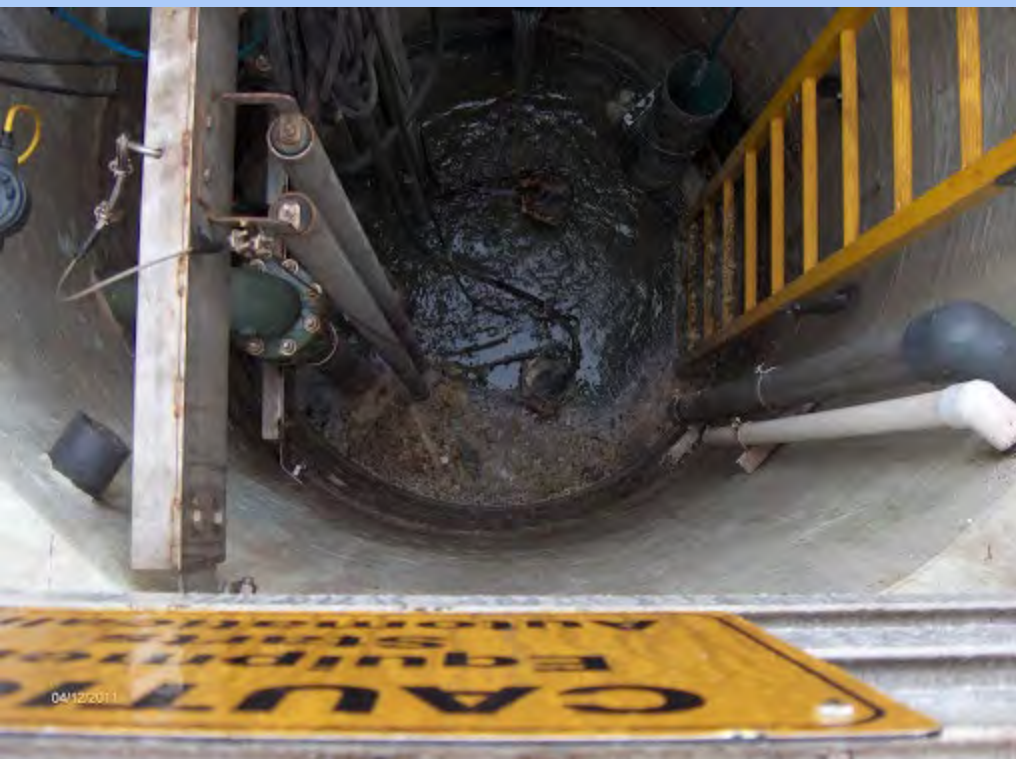
Alternate Entry Spaces ³

- Regulations allow permit-required confined spaces to be re-classified as a alternate confined space
- *If the only hazard is a hazardous atmosphere that can be eliminated or controlled by use of a ventilation fan.*
- If the space has been re-classified then you can use an alternate entry procedure.

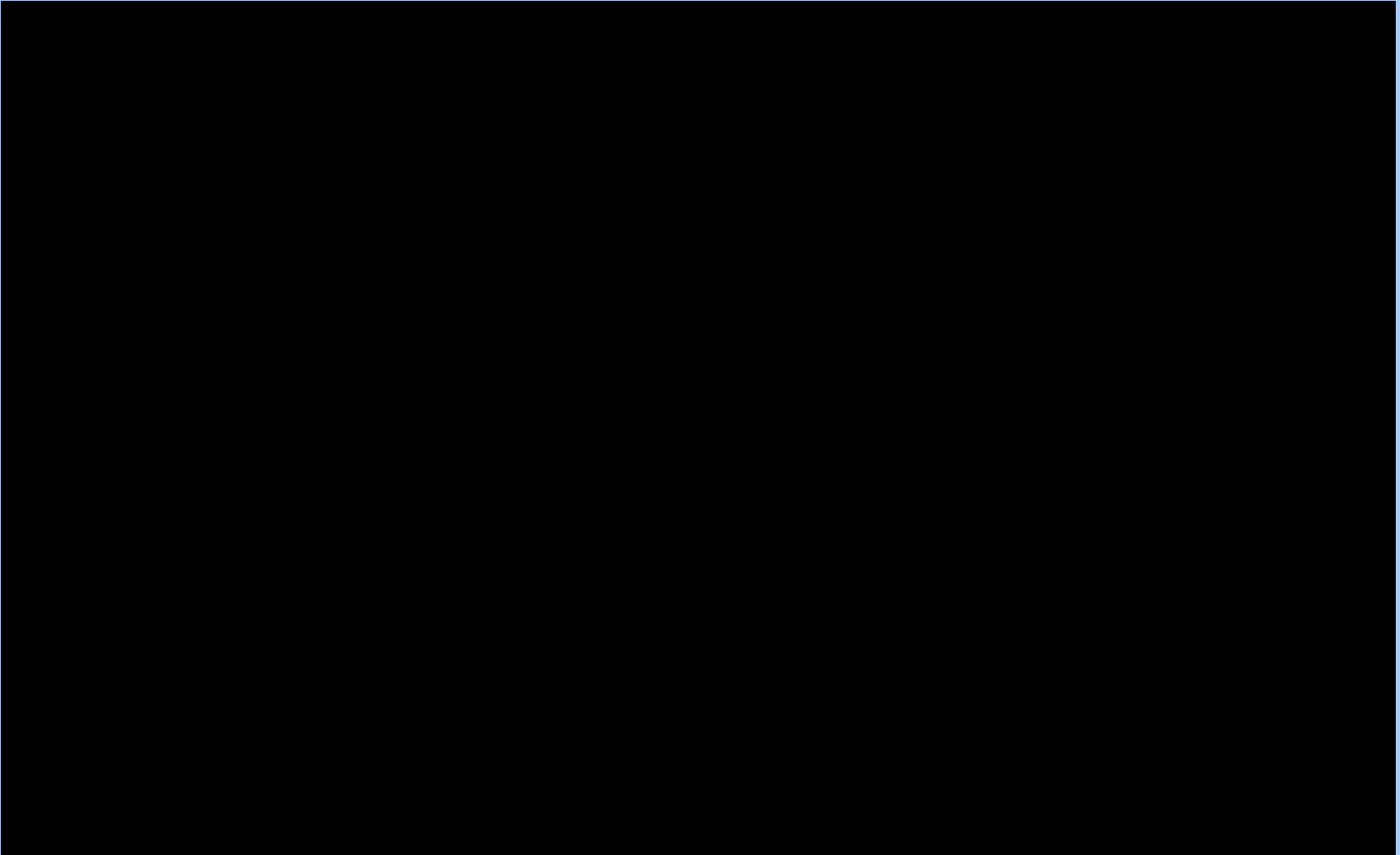


Fatality Statistics 2

•60% of the workers who perish in confined space accidents are rescuers who lack the necessary training & equipment.



Precious Time



Rescue

DUTIES OF HOST EMPLOYERS ³

- ***An employer who designates rescue and emergency services, has several responsibilities. These include:***
- Evaluate a prospective rescuer's ability to respond to a rescue call in a timely manner
- Evaluate the rescue service's ability to perform the tasks associated with rescuing employees from permit spaces
- Select a rescue team that can reach the victim(s) in a time frame that is appropriate to the hazards present

Rescue

DUTIES OF HOST EMPLOYERS ⁴

- If the employer decides to use an in-house rescue service, the following requirements have to be met.
- Provide employees with personal protective equipment and train them in how to use the equipment
- Train employees to perform assigned rescue duties
- Train employees in basic first aid and CPR
- Ensure that employees practice making permit space rescues at least once every 12 months from the types of spaces that are present at the facility

Rescue

DUTIES OF HOST EMPLOYERS ³

- If the employer decides to use an off-site rescue service, arrangements must be made in advance. In other words, *the host employer cannot assume that a fire department will automatically provide the service.*
- The agreement does not have to be in writing.
- Unfortunately, many employers may assume that they can rely on the fire department for assistance without contacting them in advance. This assumption can lead to trouble if the fire department is not prepared to respond to confined space rescues.



DO YOU NEED A CONFINED SPACE ENTRY RESCUE TEAM?



Greg Coon
FIREDOG Haz Mat Training
760-964-1279

Is there a potential for entrapment?
(Sloping walls, etc)

YES

Do you have a "Permit Required Confined Space?"

NO

YOU DO NOT NEED A RESCUE TEAM*

NO

YES

Can the hazards be eliminated prior to entry?

NO

YES

Is there a potential for engulfment?
(Grain Silo, etc)

NO

YES

YOU NEED A STANDBY RESCUE TEAM

YOU NEED AN ONSITE RESCUE TEAM

Can an unconscious entrant be removed without entering the space?

NO

YES

Is there a potential for flammable or toxic atmosphere?

NO

YES

Can the hazardous atmosphere be removed with forced air ventilation?

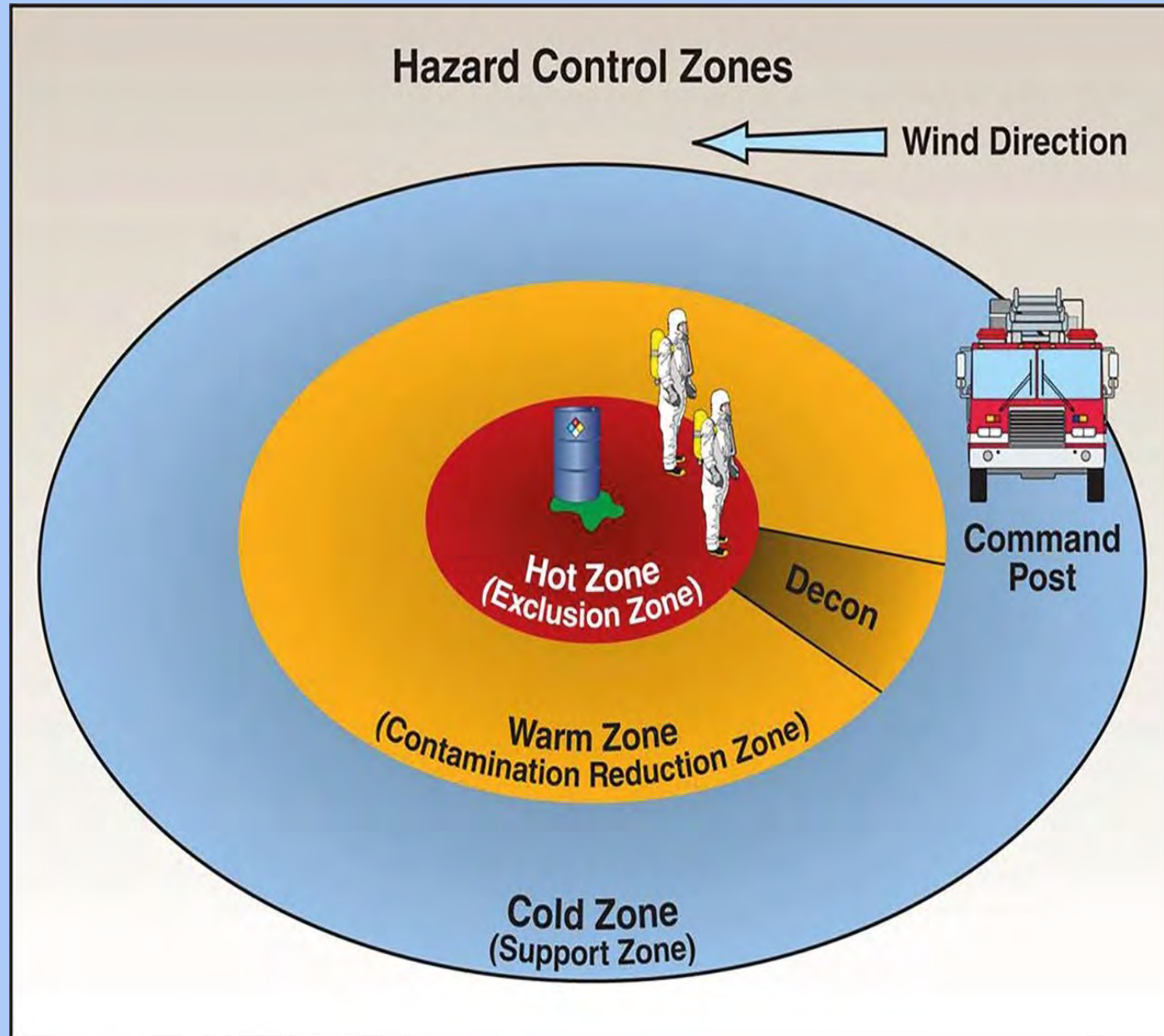
NO

YES

END

Emergency Response Zones

- Hot Zone
- Warm Zone
- Cold Zone



Hot Zone ⁴

Area immediately surrounding and including the contaminated area. Greatest hazard to life and/or property is located here.

When identifying this zone, view:

- Wind direction and speed
- Topography of land
- Ventilation systems
- Potential for release increasing



Warm Zone

Area immediately surrounding the hot zone. This is the area where decon is performed.



Cold Zone ⁴

Immediately surrounds the Warm Zone. This is also a buffer zone to insure a safe barrier is maintained around the release.

Personnel in this area generally are not required to wear PPE.

Located in this zone:

- Command Post and Incident Commander
- Support Services and Agencies
- Staging Area for resources



Handling Waste Containers

**KEEP HAZARDOUS WASTE
OUT OF THE ENVIRONMENT!**



***IT'S ALL THAT WE
HAVE, AND IT'S FRAGILE***

Hazardous Waste Labels & Manifest



HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.
IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY
AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OR THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCE CONTROL.

GENERATOR INFORMATION:

NAME _____ PHONE _____
 ADDRESS _____
 CITY _____ STATE _____ ZIP _____
 EPA / MANIFEST ID NO. / TRACKING NO. _____
 WASTE NO. _____ CA WASTE NO. _____ ACCUMULATION START DATE _____

CONTENTS COMPOSITION _____

PHYSICAL STATE HAZARDOUS PROPERTIES FLAMMABLE TOXIC
 SOLID LIQUID CORROSIVE REACTIVITY OTHER _____

 D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

NON-HAZARDOUS WASTE

GENERATOR INFORMATION (Optional)

SHIPPER _____
 ADDRESS _____
 CITY, STATE, ZIP _____
 CONTENTS _____

NON-HAZARDOUS WASTE

UNIVERSAL WASTE

GENERATOR INFORMATION (Optional)

SHIPPER _____
 ADDRESS _____
 CITY, STATE, ZIP _____
 CONTENTS _____

ACCUMULATION START DATE _____

UNIVERSAL WASTE

TOP 12 HAZARDOUS WASTE GENERATOR VIOLATIONS ⁶

- Separate incompatibles
- Training
- Open Container Violations
- Satellite Collection Storage Area Accumulation Date Violations
- 90 day Violations
- Universal Waste Management



TOP 12 HAZARDOUS WASTE GENERATOR VIOLATIONS

6

- Failure to Make a Waste Determination
- Adequate Aisle Space
- Failure to Perform Weekly Inspections of Hazardous Waste Storage Areas
- Contingency Planning Violations.....CERS
- Marking and Labeling of Containers
- Not having, or having inadequate, hazardous waste manifests



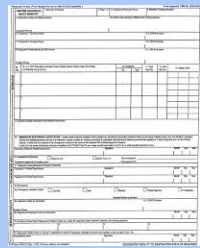
Hazardous Waste Management ³

- If your business has been identified as a generator of hazardous waste and/or universal waste, you must follow federal and state hazardous waste laws.
 - The intent of these laws is to ensure that hazardous waste is properly managed to protect public health and the environment.
- The local Certified Unified Program Agency (CUPA), is responsible for implementing these laws and regulations at the local level.**



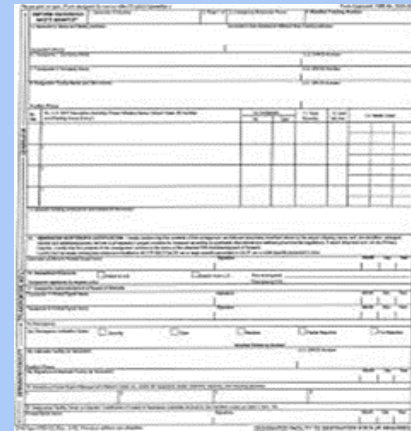
Hazardous Waste Manifests ⁴

- Hazardous waste transported for disposal or treatment must be accompanied by a Uniform Hazardous Waste Manifest form:
- The Federal Uniform Hazardous Waste manifest consists of 6 white pages.
- The Federal manifest does not include a generator copy for submission to the State Department of Toxic Substances Control (DTSC).
- A generator must make a legible photocopy of the manifest and mail it to DTSC within 30 days of shipping the waste.
- (The top page will make a clearer copy than the bottom page, so consider making a copy before the transporter leaves with the manifest.)

A small thumbnail image of a Uniform Hazardous Waste Manifest form, showing various fields for generator, transporter, and waste information.

Hazardous Waste Manifest System ²

- When completed, the form contains information on the type and quantity of the waste being transported, instructions for handling the waste, and signature lines for all parties involved in the disposal process. Each party that handles the waste signs the manifest and retains a copy for themselves
- This ensures critical accountability in the transportation and disposal processes. Once the waste reaches its destination, the receiving facility returns a signed copy of the manifest to the generator, confirming that the waste has been received by the designated facility.



The image shows a sample of a hazardous waste manifest form. It is a complex document with multiple sections and fields. At the top, there are fields for 'Manifest Number' and 'Date'. Below that, there are sections for 'Generator Information', 'Transporter Information', and 'Receiving Facility Information'. A large table in the middle is used for listing the waste, with columns for 'Quantity', 'Hazardous Waste Code', and 'Description'. At the bottom, there are signature lines for the generator, transporter, and receiving facility, along with checkboxes for 'Received' and 'Not Received'.

Hazardous Waste Manifest System

- Any person who transports hazardous waste in a vehicle must have a valid registration issued by DTSC in his or her possession while transporting the hazardous waste.
- The registration certificate must be shown upon demand to any representative of DTSC, any representative of a Certified Unified Program Agency (CUPA), officer of the Department of the California Highway Patrol (CHP), any local health officer, or any public officer designated by DTSC.



Uniform Hazardous Waste Manifests Violations₂

- While thinking “out of the box” metaphorically might be good for your entrepreneurial endeavors, it can get you literally into trouble with the EPA. For example, failing to stay within the lines while filling in those little boxes on a Uniform Hazardous Waste Manifest can cost you.

- **No, we’re not kidding**

- Inspectors are task to enforce rules.. So if you enter a perfectly correct number, but it isn’t positioned just so, you can get a \$25 fine per instance.

10. Containers		11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes		
No.	Type					
3	DM	1.00	G	D001	214	
1	CF	3.00	P		352	
5	DM	5.00	P		214	

Believe it or not.
This out-of-alignment entry is
good for 2 counts of a \$25 fine.

Uniform Hazardous Waste Manifests Violations⁶

- **Expired EPA ID.** One of the most frustrating gaffes is finding out that your EPA ID has expired, which can happen if you fail to complete the required EPA Biennial Waste Report.
- **Inaccurate container and quantity counts.** Inaccuracies will likely bring you bureaucratic scrutiny
- **Erroneous waste codes.** It might just be a bookkeeping error to you, but to the EPA it's the mislabeling (and thereby misidentifying) of a hazardous waste.
- **Wrong units of measure.** Use of decimals or fractions when listing total weights in Item 11 is a no-no, which is why the offending entry would merit two fines @ \$25 each—not just one.
- **Unauthorized signatures.** The person who signs your manifest must be qualified to do so.
- **Mismatched dates, transporter names, and/or EPA IDs.** Dates specific to a shipment of hazardous waste must be consistent across all paperwork.

What's Your Responsibility When Signing The Manifest ²

- When you sign a hazardous waste manifest, you certify that the materials listed on the manifest are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the DOT.
- Therefore, because the person that signs the manifest is responsible for its accuracy, that person is classified as a ***hazardous material employee*** by the DOT. Hazardous material employees, including those participating in pre-transportation functions, must be trained per [49 CFR 172 Subpart H](#)



Containers ₂

- Vessel or receptacle that holds a material
 - Type, size, and material can provide clues about the nature of the substance inside.
 - Often there is no correlation between the color of the drum and the possible contents.



Bulk Storage Vessels-Tanks

- ▶ Found at facilities that rely on and need to store a large amount of a particular chemical
- ▶ Secondary containment is a method to control spills.



Bulk Storage Vessels

- Large volume horizontal tanks
 - Above-ground storage tanks
 - Underground storage tanks
- Can hold a few hundred gallons to several million gallons of product



Bulk Storage Vessels

• Totes

- Hold 119 to 703 gallons
- Portable plastic tanks surrounded by metal cage or made from stainless steel/aluminum
- Can contain most types of chemicals



Bulk Storage Vessels

• Intermodal tanks

- Hold 5,000 to 6,000 gallons
- Pressurized or non-pressurized
- Usually shipped, stored, and returned to the shipper



Drums



Although oil is sometimes shipped in 55 US gallon drums, the measurement of oil in **barrels** is based on the 42 US gallons²⁰⁸

Nonbulk Storage Vessels

• Drums

- Barrel-like containers
- Store a variety of substances
- The nature of the chemical dictates the construction of the drum.



Drum Facts ⁴

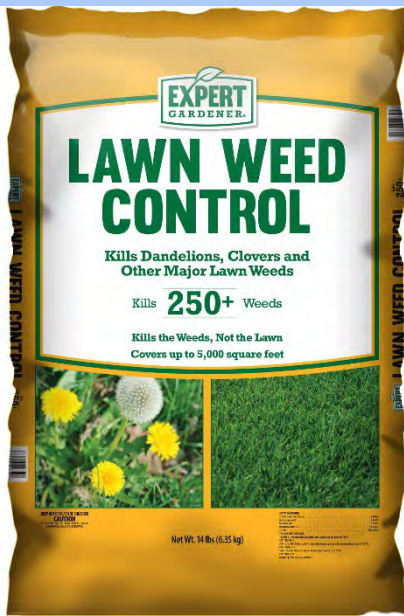
- England uses a 44-gallon drum.
- Iron Clad Manufacturing Company of New York, received two patents in December 1905 that would lead to the modern 55-gallon steel barrel.
- Use of 55 gal drums became widespread in [World War II](#)
- The measurement of oil in [barrels](#) is based on the 42 gal [whiskey](#) barrels of the 1870s



Nonbulk Storage Vessels

• Bags..... Small to 1 ton Super Sacks

- Used to store solids and powders
- Constructed out of plastic, paper, or plastic lined paper.
- Pesticide bags must be labeled with specific information.



Nonbulk Storage Vessels

• Carboys

- Transports and stores corrosives and other chemicals
- Holds 5–15 gallons



Nonbulk Storage Vessels

• Cylinders

- Hold liquids and gases
- Uninsulated compressed gas cylinders store various substances.
- Sizes vary.



Safety & Health Hazards



SEE A HAZARD:



REPORT IT

Safety ³



- **Safety** is the condition of being secure from personal injury and property damage. *Safety is when there are no accidents.*
- **Accident** is an undesirable, unplanned event that may result in personal physical harm or *death*. Damage to property, or disruption to business.
- **Near Miss** incidents where no property was damaged and no personal injury sustained, but where, given a slight shift in time or position, damage and/or injury easily could have occurred.



Pizza Party



Safety Hazards

5

Vehicles and heavy equipment create hazards for all emergency response personal and on-site workers.

- # Be seen ,wear visible clothing.
- # Listen for back up alarms.
- # Beware of slopes and excavations.
- # Block wheels and set brakes.
- # Watch for rotating equipment.



Types of Hazards ³

Kinetic (Mechanical)

- Striking or struck-by (heavy equipment)
- Caught or caught-by (machine guarding or pinch points)

Thermal

- Fires or explosions
- Hot / Cold environments

Electrical

- Faulty wiring or downed poles



Types of Hazards

3

Chemical

- Toxic, Reactive, Ignitable, Corrosive

Biological

- Poisonous plants and animals
- Disease producing organisms

Radioactive

- Ionizing or non-ionizing



General Safety Issues

2

Tailgate/Toolbox safety meetings are held to keep employees alert to work-related hazards and prevent injuries.

Tailgate or **Toolbox meetings** must address the specific hazards and **safe** work practices for the work tasks that employees are actually performing



Personal Safety Issues ⁵

- 1.Be Aware of Your Surroundings:** Know the particular hazards of the workspace to avoid potentially hazardous situations.
- 2.Keep Correct Posture To Protect Your Back:** If you work at a desk, keep your shoulders in line with your hips to avoid back problems. Lift properly, avoiding stooping and twisting.
- 3.Take Regular Breaks:** Many work-related injuries occur because a worker is tired, burned out and not alert to their surroundings. Regular breaks help you stay fresh on the job. One trick to staying alert is to schedule the most difficult tasks when your concentration is best, like first thing in the morning.
- 4.Use Tools And Machines Properly:** Take the proper precautions when using tools and never take shortcuts, which is a leading cause of workplace injury.
- 5.Keep Emergency Exits and Equipment Shut-offs Easily Accessible:** In case of an emergency, you'll need quick, easy access.

Personal Safety Issues ⁵

6. Report Unsafe Conditions To Your Supervisor: Your supervisor needs to be informed about any workplace safety hazards or risks so they can take steps to make them safe for you and your coworkers. Report all near-miss situations.

7. Use Mechanical Aids Whenever Possible: Instead of attempting to carry or lift something that's really heavy to save time, take the extra minute to use a hand truck, cart, hoist or forklift.

8. Stay Sober: Around three percent of workplace fatalities occur due to alcohol and drugs.

9. Reduce Workplace Stress: Stress can lead to depression and concentration problems, so work to reduce its creation.

10. Wear the Correct Personal Protective Equipment (PPE): PPE like hard hats, safety goggles, gloves or a full-face shield greatly reduce the risk of workplace injury

General Safety Hazards 8

- Travel open/flat terrain
- NO running or jumping
- Communicate - Line-of-sight or radio
- Carefully examine/move things or debris for biological hazards:
 - Dangerous wildlife
 - Animal bites/stings
 - Toxic plants
 - Microbial



Safety Hazards ¹



- *Excavations*, each year more than 25 workers die in excavations . Digging may be necessary to get buried drums, or to remove contaminated soil.
- The most dangerous excavation is the trench, OSHA requires shoring or sloping for trenches more than five feet deep.



Excavations

8

Excavation = man-made

Trench = deeper than wide

Excavation evaluation(s)

- By CP (Competent Person)
- Every day
- After hazardous event
- After weather event (rainstorm)
- Loose soil requires restraining
- Avoid edges of potentially unstable ground
- Quick exit access every 25 feet in trenches more than 4 feet deep
- Eliminate vibrations (Trucks - equipment – roadways)



Safety Hazards

- *Overhead & Underground Utilities*

Cranes and other equipment must maintain a sufficient clearance from overhead power lines. The minimum distance is ten feet. A greater distance is required for lines carrying more than 50 kilovolts.

Remember to call dig alert and always have utility crews on-hand when performing emergency excavations

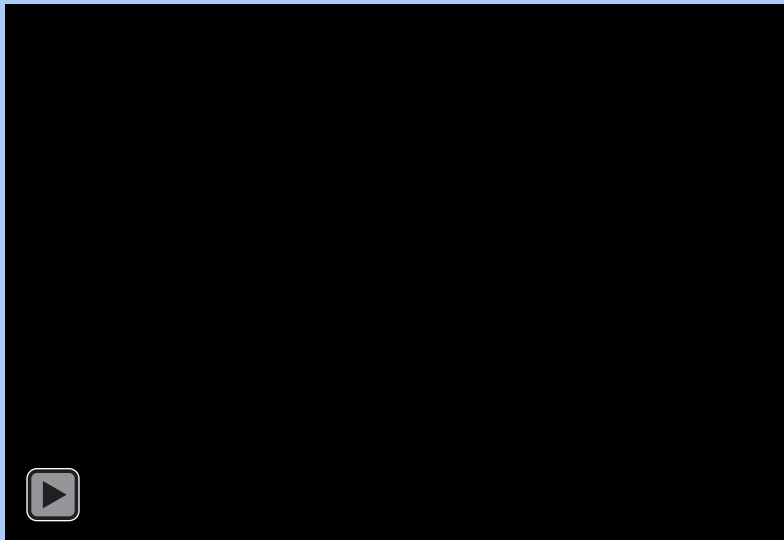


Safety Hazards



- **Electricity**

Breakers and fuses protect equipment and property, but do not necessarily protect you from shock or electrocution. Most of the current will take the path of least resistance, but a little bit might still past through your body. *OSHA requires an assured grounding program or Ground Fault Circuit Interrupter.*



LOTO⁵

- Lock-out/Tag-out (LOTO)
- De-energize circuit
- Clearly identify and isolate circuit and equipment
- Visual inspection and test to assure de-energizing
- Remove tags and locks by designated worker only



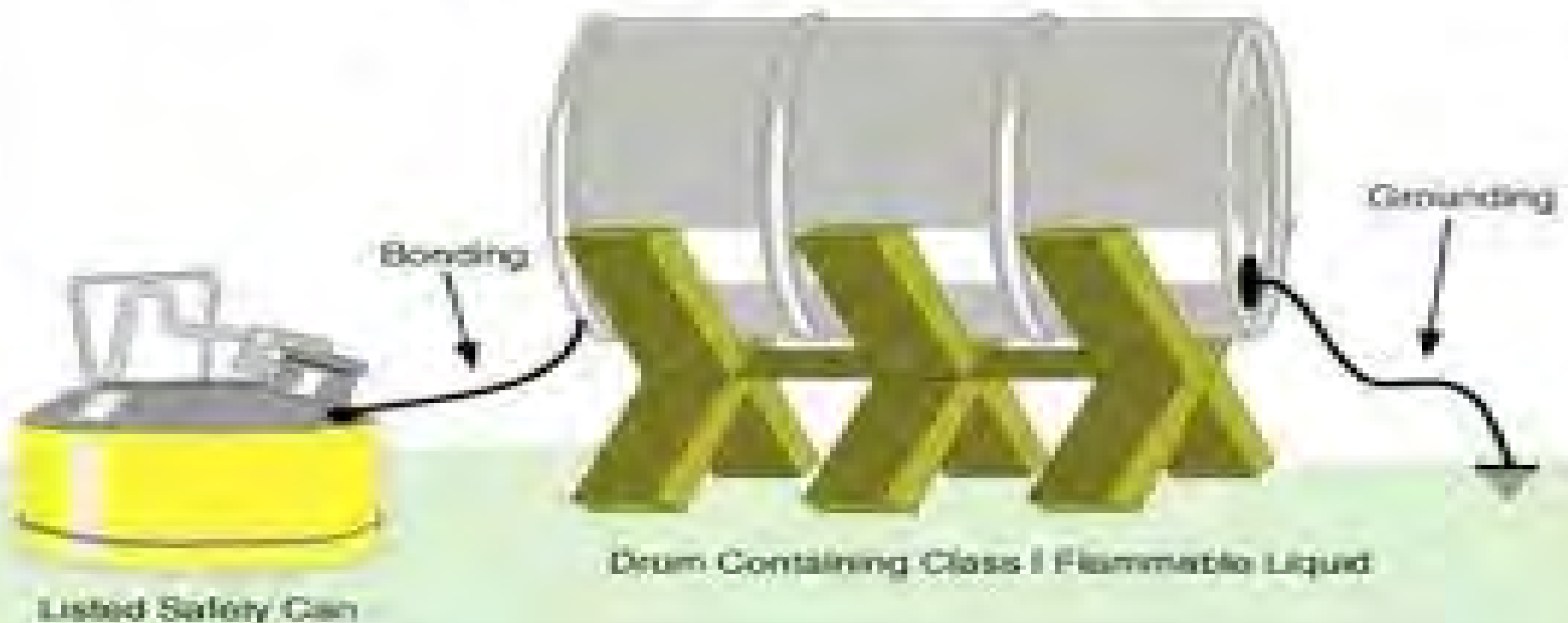
Bonding

Equalizes differences in static potential

Grounding

Eliminates all static potential

Grounding and Bonding



Ladder Safety

10



- Keep in good condition
- Periodic inspection
- No improvised repairs
- Moveable parts should move
- Face ladder in use
- Keep rungs clean
- Secure ladder
- Intended purpose only
- Wood or fiberglass near electrical hazards
- 3 points of contact always



Measuring Noise



4

- Noise is unwanted or unpleasant sound that may have a negative effect on hearing, depending on loudness and frequency and the duration of the exposure.



- Noise is measured with a sound level meter which reads in decibels “dBA”. The “A” means that OSHA requires a certain type of sound level meter, an “A scale “ meter. A conversation in a quiet room makes about 60 dBA.
- *Decibels are different than ordinary numbers. According to OSHA, every time the sound level goes up 5 dBA, it’s twice as loud! So, 95 dBA is twice as loud as 90 dBA. 100 dBA is four times as loud as 90 dBA.*
- **If daily exposure is 90 dBA or above, OSHA requires hearing protection.**



Noise Exposure

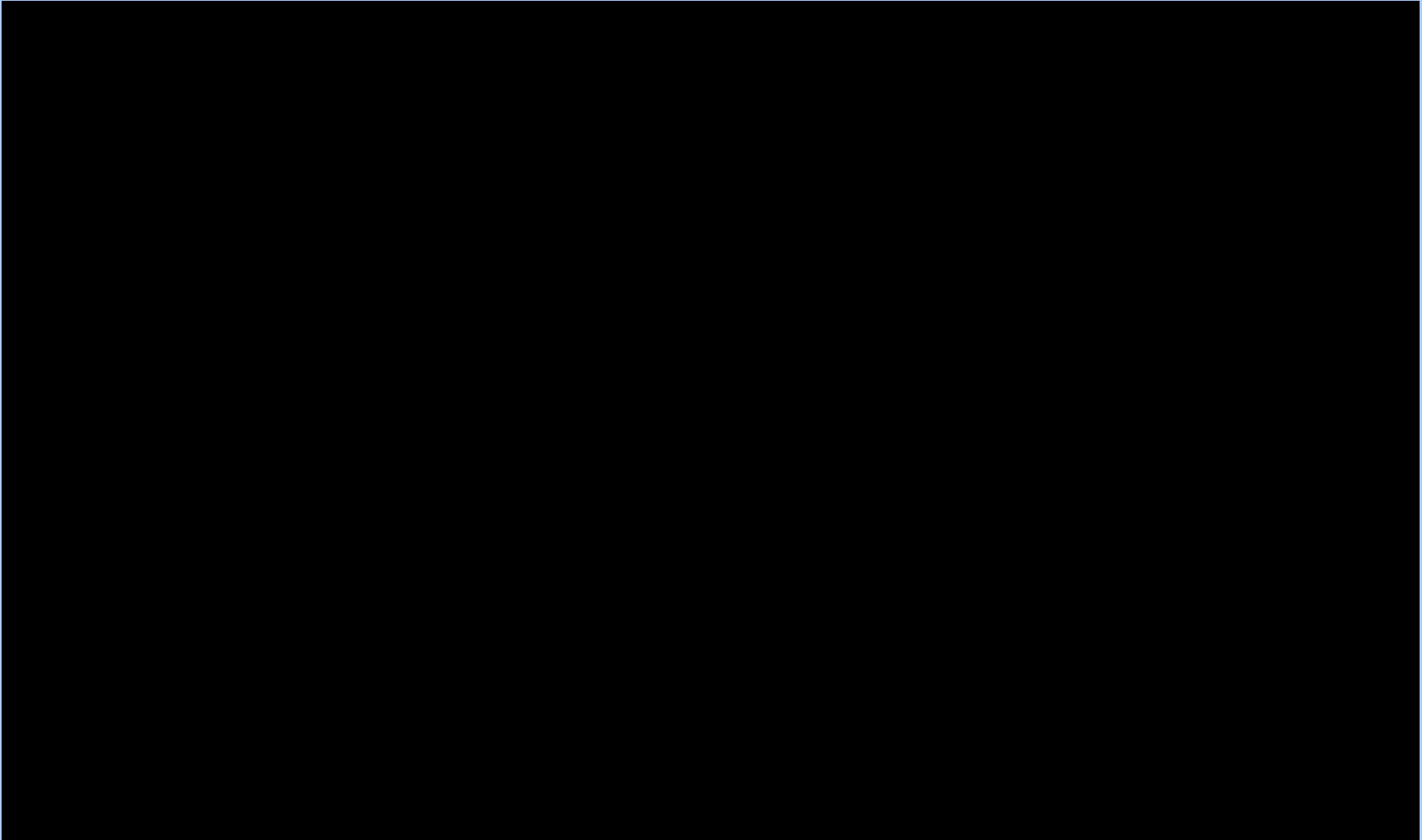
6

Six adverse health effects (in addition to hearing loss):

- Increased pulse rate
- Tensed muscles
- Sleeplessness
- Nervousness
- Increased blood pressure
- Irritability



Say What!



Heavy Equipment 9

- Avoid equipment working up-slope
- Do not get behind equipment
- High noise levels interfere with voice and hearing
- PPE hampers vision and hearing

- **Make yourself known to operators**
- Maintain line-of-sight with operator
- Keep equipment in sight and/or
 - Use a “spotter”
 - Use traffic control plan - flaggers



Always use Safe Work Practices⁴

Use these safe work practices when handling chemicals:

- Do not spill, splash, or drop them
- Keep flammable and combustibles away from open flames, sparks, and other sources of heat
- Do not eat or smoke in your work area
- Wash your hands before going on break or eating



Personal Protective Equipment



Personal Protective Equipment (PPE) is the barrier between you and the hazardous material you are working with. There are many factors to consider when choosing the proper PPE.

For example:

Type of PPE

Material PPE should consist of

Durability

Care of PPE

Availability of the PPE

Expense



Check the SDS

The Safety Data Sheet (SDS) is where you can find out which PPE is right for the particular chemical. This is why it is important to know the location of the SDS.



The screenshot shows the CAMEO Chemicals website interface. The main heading is 'CAMEO Chemicals'. Below it, the chemical name 'SODIUM ALUMINATE, SOLUTION' is displayed. The page includes sections for 'Chemical Identifiers' with a table of identifiers, 'General Description', 'Reactivity Alerts', and 'Air & Water Reactions'. The table of identifiers is as follows:

UN/NA Number	CAS Number	CHDS Code	DOT Hazard Label
3333	13130-99-1	3333	CORROSIVE

Response Levels

Level A



Level B



Level C



Level D



Choose the Proper Glove

PPE is used to protect you from injury to your

eyes, hands, feet, face, skin and head.

To prevent skin absorption you must wear personal protective equipment made of the proper material. Choosing the right gloves is especially important to protect the hands.

Look on to see the importance of glove use



Nitrile Gloves ⁶

- Disposable nitrile gloves are the most common gloves used in Haz Mat; but these thin nitrile rubber provides only limited chemical protection.
- These gloves are intended to be used only as a physical barrier against brief contact with chemicals, and they need to be removed and discarded immediately after they become contaminated.
 - Glove materials are evaluated by there.
- Breakthrough time: This is how long it takes to detect a substance inside the glove when the outside is exposed to a chemical. A glove that holds up for greater than eight hours is considered excellent.
- Degradation: This refers to the physical changes in the material such as swelling, cracking, softening or shrinking, which occur when it comes in contact with a chemical. A glove can exhibit chemical breakthrough even if it doesn't show signs of degradation.
- Permeation rate: This is the rate at which a substance passes through a glove material once breakthrough takes place. This rate includes absorption on the surface, diffusion through the material, and desorption on the inside surface

Nitrile Gloves ²



Selecting the right thickness

- Glove thickness is usually given in the unit mils, which is equal to one one-thousandth of an inch; therefore, a glove that is 10 mil, is 0.010 inches thick. **A thicker gauge glove will provide more protection than a thinner glove of the same material, but often at the expense of touch-sensitivity and dexterity.**
- **Double-gloving can be used to increase the total breakthrough time of a particular glove,** but this increases hand fatigue and overheating and is recommended only for short-duration tasks.

Nitrile Gloves ⁶



- **Avoiding cross-contamination**

- Soiled gloves can contaminate objects and surfaces, later exposing you to chemical hazards. When this occurs, you can unknowingly be exposed to chemical hazards.

- **Reduce the likelihood of cross contamination by:**

- Changing gloves immediately when contaminated and after each chemical-handling task
- Discarding gloves immediately after use. Never reuse disposable nitrile gloves!
- Establishing designated ***glove-only vs. no-glove*** items such as pens, keyboards, instruments, drawers, door handles, refrigerators, and work spaces
- Do not wear gloves in hallways, offices, break rooms, elevators, restrooms, or any other public areas

Nitrile: Short-term splash protection

Organics

Cyclohexane

Aqueous/Inorganic

37% Formaldehyde

Nitrile has good general resistance to:

- Oils

Nitrile: Short-term splash protection

Organics

Cyclohexane

Glutaraldehyde

Heptane

Mineral spirits

Pentane

Propylene glycol

Naphtha

Octane

Octanol

Hexane

Heptane

Hexane

Heptane

Aqueous/Inorganic

37% Formaldehyde

10% Hydrochloric acid

37% Hydrochloric acid

30% Hydrogen peroxide

10% Nitric acid

50% Potassium hydroxide

85% Phosphoric acid

50% Sodium hydroxide

10 - 13% Bleach

47% Sulfuric acid

Ethidium bromide

Mercury (metallic)

47% Sulfuric acid

Ethidium bromide

Mercury (metallic)

Nitrile has good general resistance to:

- Oils
- Fuels
- Some organic solvents
- Weak acids
- Weak caustics

Nitrile: Poor protection (<1 minute) Organics

Acetone	Ethanol
1,4-Dioxane	Ethyl acetate
Acetonitrile	Methanol
Acrylonitrile	n-Butanol
Benzene	Nitrobenzene
Carbon disulfide	o-Xylene
Chloroform	Phenol
Dichloromethane	Pyridine
Diethyl ether	Tetrahydrofuran
Dimethylformamide (DMF)	Toluene

Nitrile has poor resistance to:

- Alcohols
- Ketones
- Halogenated hydrocarbons
- Aromatic hydrocarbons
- Esters
- Ethers
- Amines
- Concentrated acids

The chemicals listed in red are able to penetrate the skin, contributing to systemic toxic effects of exposure to the chemical.

(ACGIH, Skin notation)

Do Not Use Disposable, One-Time Use, Nitrile Gloves with these chemicals.

**Poor resistance (<1-minute breakthrough)
+ Skin corrosion hazard and/or high toxicity**

Concentrated acetic acid 70% Nitric acid
30% Ammonium hydroxide 95% Sulfuric acid
88% Formic acid *Hydrofluoric acid (HF)

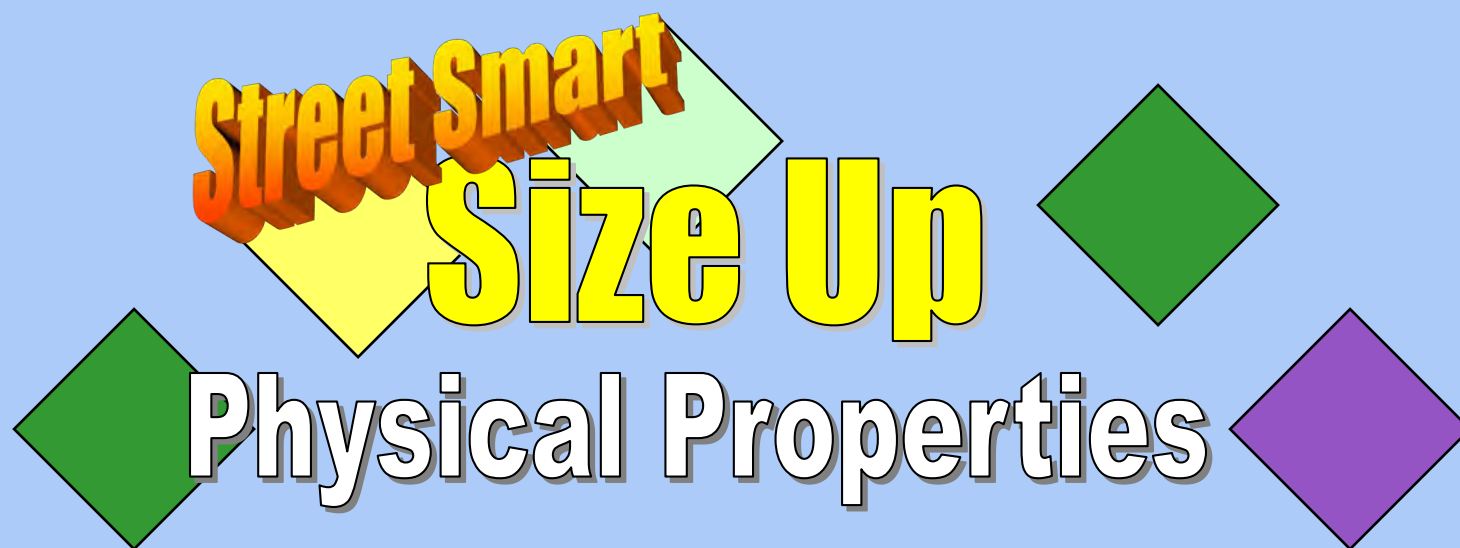
These are just a few examples. This is not a complete list.



Diamond	Hazard	Value	Description
		4	CPN for 100%



Street Smart Chemistry



Everything you need to know is in
section 9 of your SDS

Physical and Chemical
Properties

Physical State Liquid

Appearance Colorless

Odor sweet

Odor Threshold 19.8 ppm

pH 7

Melting Point/Range -95 °C / -139 °F

Boiling Point/Range 56 °C / 132.8 °F

Flash Point -20 °C / -4 °F Method - Closed cup

Evaporation Rate 5.6 (Butyl Acetate = 1.0)

Flammability (solid,gas) Not applicable

Flammability or explosive limits Upper 12.8 Lower 2.5 vol

Vapor Pressure 247 mmHg @ 20 °C

Vapor Density 2.0

Specific Gravity 0.790



Lets Learn CELSIUS ⁸

Only three countries do not use the metric system: the United States, Liberia and Burma

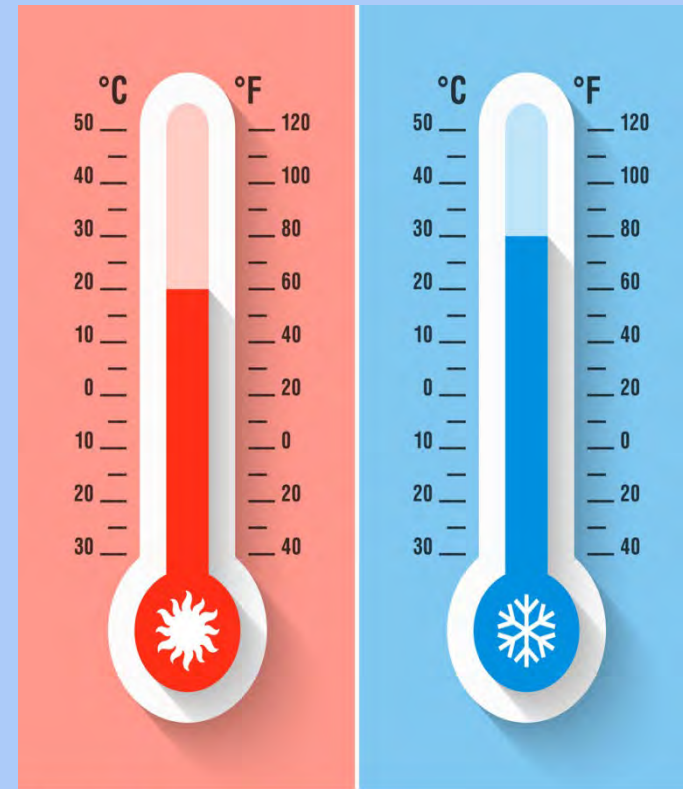
• Easy way to give a rough number

• Lets convert Celsius to Fahrenheit

- Take 10 degrees Celsius
- X 2 plus 30
- This equals 50 degrees Fahrenheit

• Lets convert Fahrenheit to Celsius

- # Take 80 degrees Fahrenheit
- # Minus 30 then divide by 2
- # This equals 25 Celsius
- Add 273 to equal Kelvin & 457 for Fahrenheit



Vapor Density

- The weight of a given volume of vapor or gas compared to the weight of an equal volume of dry air at the same temperature and pressure.

- Air = 1

- MW = 29

- RD same as VD

Numeric values for chemicals that are less than 1 indicate that the specific chemical gas will rise.

Vapor Densities greater than one will indicate a vapor or gas will settle or sink.

illuminating Gases "Nat Gas"

Neon

Fluoride

Carbon monoxide

Ammonia

Nitrogen

Methane

Ethylene

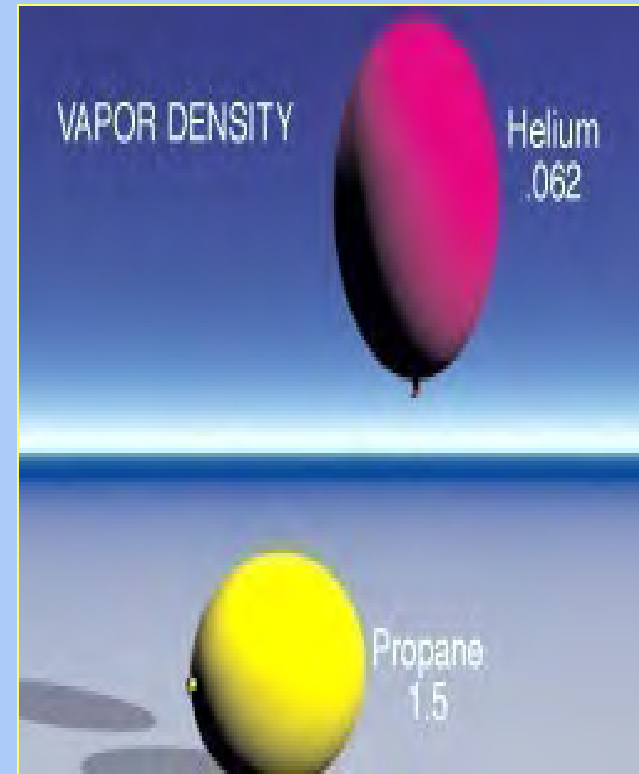
Acetylene

Methylithium

Diborane

Helium

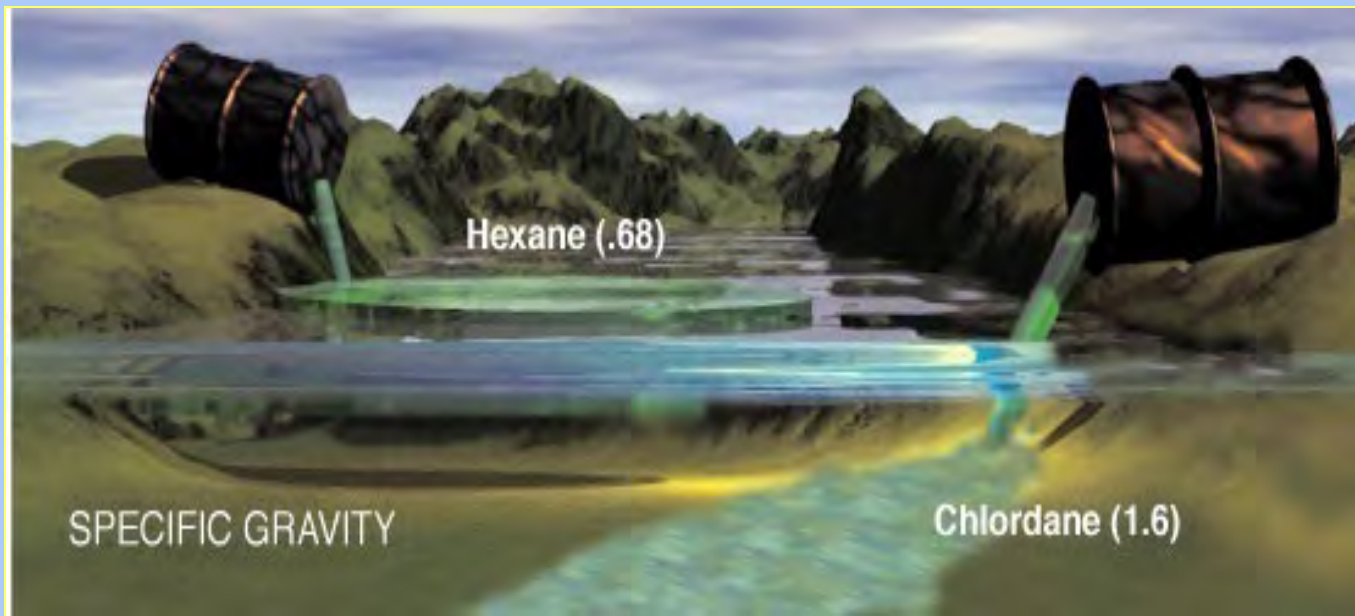
Hydrogen



Specific Gravity

2

- The Weight of a Substance Compared to the Weight of an Equal Amount of Water.
- Water Is 1.
- Numbers Less Than One - Float
- Greater Than One Sink in Water.



Solubility---Miscibility---Miscible

Solubility refers to the degree in which a substance will dissolve in water

Miscibility is the ability of a liquid to dissolve in water

Miscible means that it will totally dissolve in water

Polar compounds, which have slight electrical charges, dissolve in water and non-polar compounds do not mix with water.

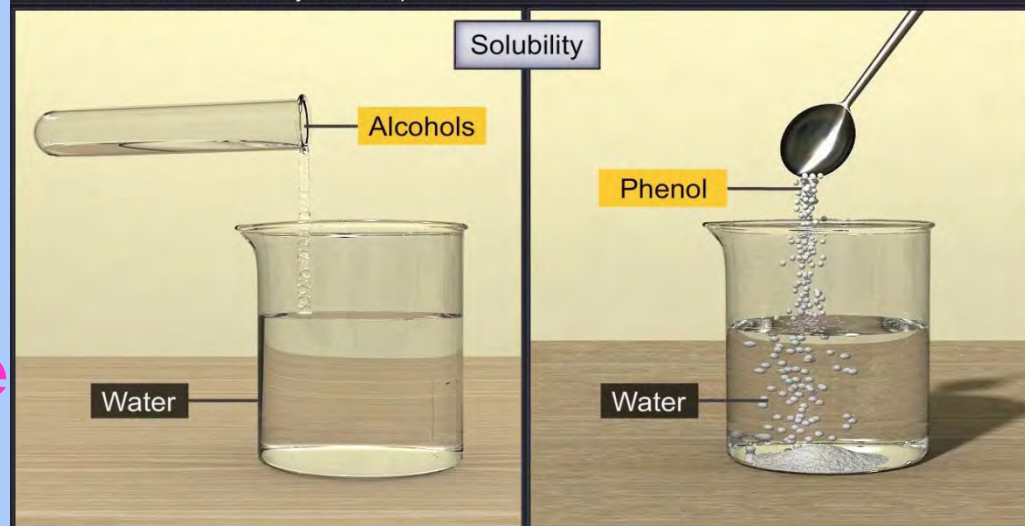
Examples;

Acetone - **miscible**

Ethylene Oxide - **miscible**

Sulfuric Acid - **miscible**

Alcohols and Phenols: Physical Properties



Vapor Pressure

3

- Vapor Pressure is the pressure exerted by the vapor that is in equilibrium with the liquid at a given temperature.
- It is a measure of a liquids ability to evaporate or give off vapors.
 - **JUST REMEMBER THE HIGHER THE VP THE MORE DANGEROUS THE CHEMICAL IS TO YOU.**



I Must Destroy You



Vapor Pressure ³

- Amount of force pushing vapors from a liquid measured as the force of the vapors
- The higher the force – the more vapors produced
- Vapor pressure is an indicator of a material's volatility

Water is 17 mm Hg

>50 mm Hg = Inhalation Hazard

You may see VP in measurements of

mm Hg

"millimetre of mercury"

kPa

"kilopascal"

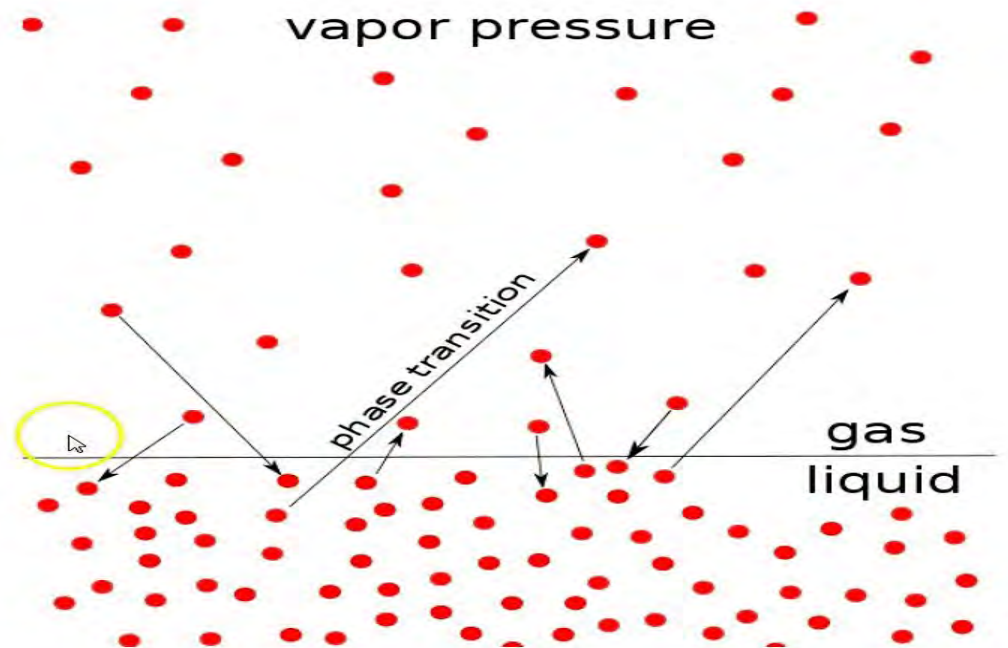
atm VP > 760 mm HG = 1 ATM = 14.7 psi are usually a gas

Common Vapor Pressures

- Water – 17 mm Hg
- Acetone – 180 mm Hg
- Gasoline – 300 mm Hg
- Ethyl ether – 440 mm Hg
- Methyl alcohol – 100 mm Hg
- Diesel fuel – 5 mm Hg
- Sodium hydroxide – 1 mm Hg @ 2534° F
- Sulfuric acid – 0.001 mm Hg

Vapor Pressure

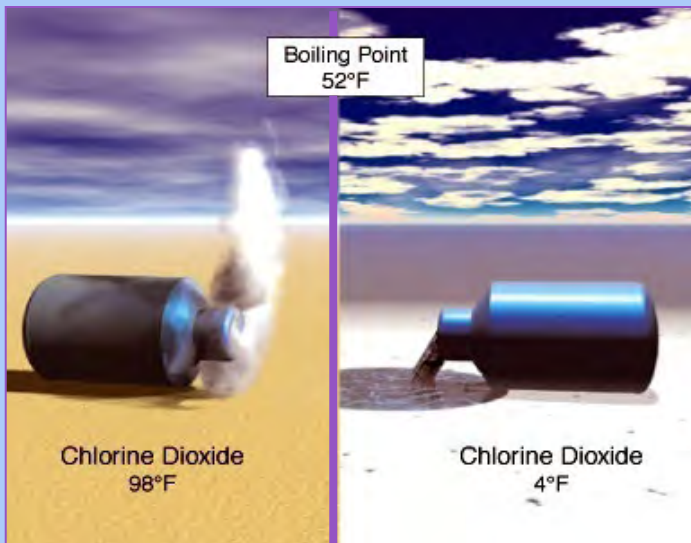
- Dependent on temperature and particle size



Boiling Point



- ▣ The **boiling point** of a substance is the temperature at which the **vapor pressure** of the liquid equals the environmental pressure surrounding the liquid.



Chemical	Boiling Point
Water	212 F
Gasoline	105 F
Butane	31 F
Propane	- 41 F
Oxygen	- 297 F
Hydrogen	- 423 F

- ▣ The Lower the Boiling Point the Higher the Vapor Pressure
- ▣ The Higher the Boiling Point the Lower the Vapor Pressure

Expansion Ratios

3

- The amount of vapor that is produced from the liquid or liquefied product.
- Many product give off vapors.
- The amount is usually given in the form of a ratio.

Nitrogen 1 to 696

liquid helium 1 to 757

argon 1 to 847

liquid hydrogen 1 to 851

liquid oxygen 1 to 860

Neon has the highest expansion ratio with 1 to 1438.

NH₃ Expansion Ratio 1 to 850



FLASH POINT

- The minimum temperature at which a liquid gives off vapors to form an ignitable mixture at with air near the liquids surface.

<u>Chemical</u>	<u>Flash Point</u>
Gasoline	- 45° F
Carbon Disulfide	- 22° F
Fuel Oil	105° F



The Lower the FP the more dangerous the chemical is to you

Flammable/Explosive Range

- The range or limit (high and low) that the vapors will be mixed sufficiently in air to ignite.

<u>Chemical</u>	<u>LEL</u>	<u>UEL</u>
Jet Fuel	0.7%	5.0%
Acetone	2.6%	12.6%
Ethylene Oxide	3%	100%

The Wider the Range the More Dangerous it is in terms of Flammability

Lets practice some chemistry

- Your chemical has a
 - Vapor pressure of 24 mm Hg
 - Flash point of 420 degrees
 - IDLH of 5 ppm
-
- Which is the greatest hazard ???



Lets practice some chemistry

- Your chemical has a
 - Flammable range of 3 to 90
 - Vapor pressure of 330 mm Hg
 - IDLH of 30,000 ppm
-
- Which is the greatest hazard ???



Lets practice some chemistry

- Your chemical has a
- Specific gravity 3.5
- Does this float or sink in water



Lets practice some chemistry

- Your chemical has a
 - Vapor pressure of 6650 mm Hg
 - Flash point of 1800 degrees
 - IDLH of 15 ppm
-
- What is my biggest hazard ?? Do I Evacuate or shelter in place ??



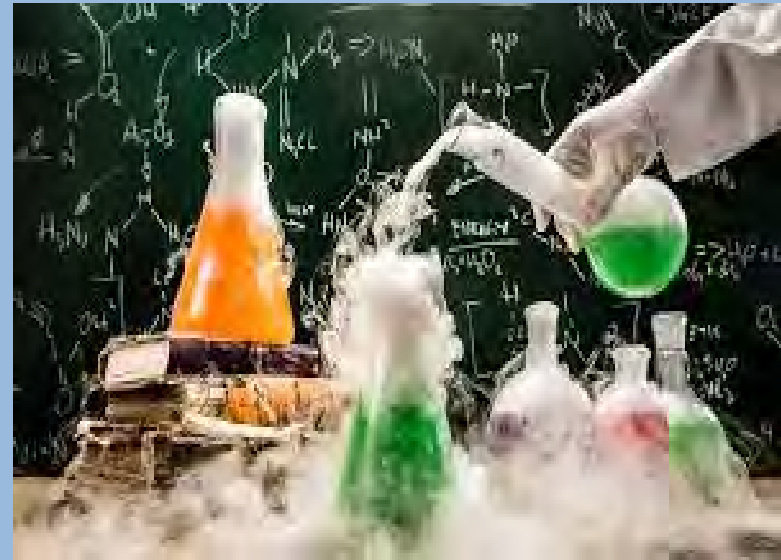
Lets practice some chemistry

- Your chemical has a Ph of 1 and is fuming
- Level A
- Level C
- Firefighter turnouts
- What PPE do I wear ???



Lets practice some chemistry

- Your chemical has a
 - Boiling point of 85 degrees
 - Flash point of -45
 - IDLH of 25 ppm
-
- What is my biggest hazard ???



Lets practice some chemistry

- My chemical has a
- CGI reading of 14% LEL

- What PPE do I wear ??
- Can I make entry ??



Lets practice some chemistry

- My Chemical has a
- CGI reading of 1 LEL
- Flash point is 3000 degrees
- Ph of 13



- What PPE do I wear ???



Lets practice some chemistry

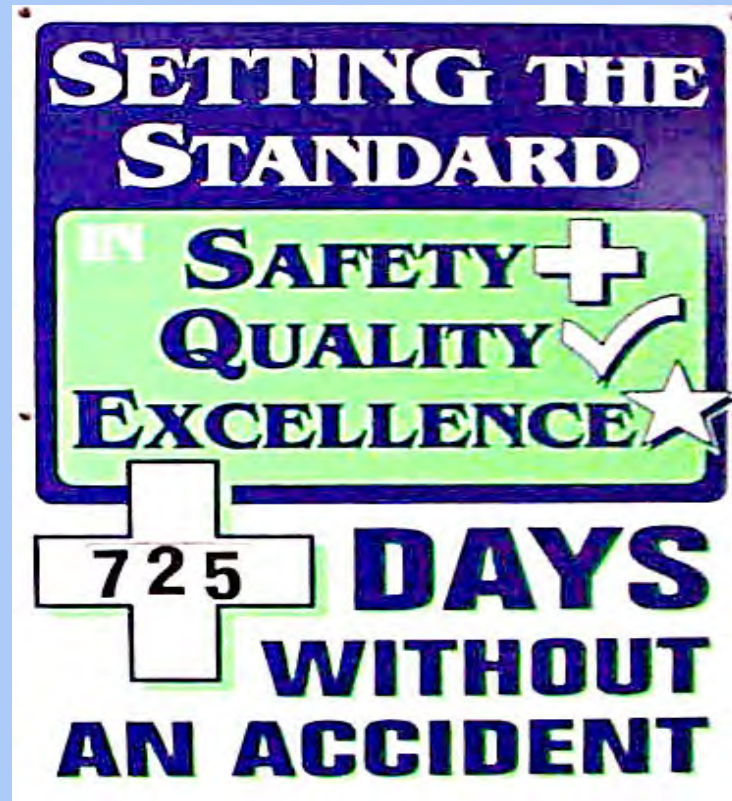
- My Chemical has a
- Vapor pressure of .5



- Does my chemical float or sink in air ????

Remember!

- First Operational Thought = **Safety!**
- First Operational Priority = **Isolate, Deny Entry**
- Be A Sinner = **Safety = Isolation = Notification**



That's all Folks!



Concluding Remarks



- ▣ Make a positive difference!
- ▣ Be part of the solution — Not part of the problem!
 - ▣ **And don't forget:**
 - ▣ **Let's be careful & competent out there!**

Brian Otter

Otter Training and Consulting
Services

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Coon
Dog