ACCREDITING AGENCY
California Unified Program Annual Training Conference
www.calcupa.org

FIRE DOG
HAZMAT & EMERGENCY TRAINING SPECIALIST

HAZWOPER Refresher Training

Presented by

FireDog Haz Mat & Emergency Training Specialist

February 3rd & 4th

23Rd Annual California CUPA Training Conference
February 2 thru March 18, 2021
Virtual Conference

CALIFORNIA CUPA FORUM

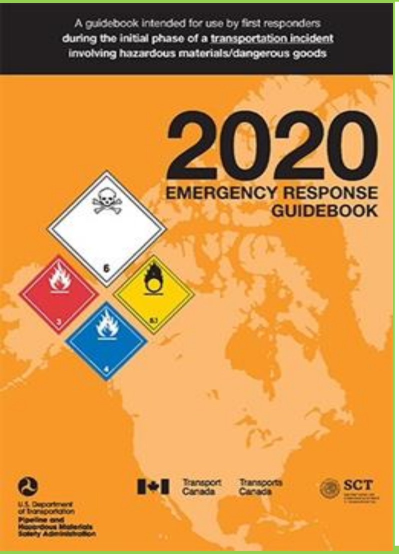
www.calcupa.org

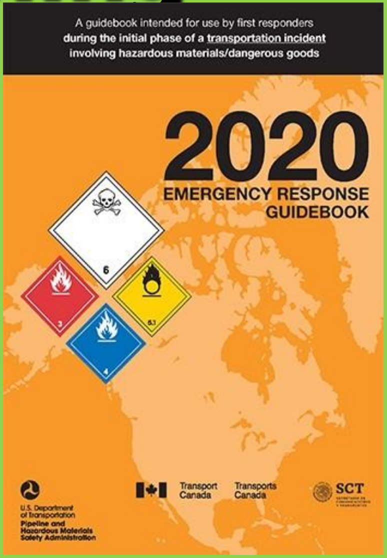
FIRE DOG

HAZMAT & EMERGENCY TRAINING SPECIALIST

Presents

HAZWOPER Refresher Training





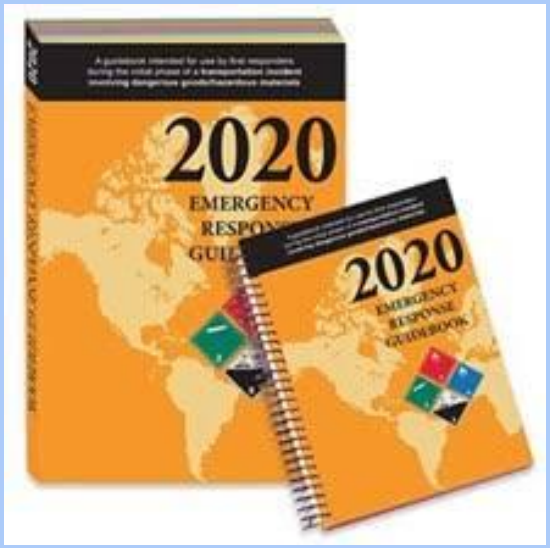
Greg Coon
FIREDOG Haz Mat Training
760-964-1279
firedogtraining.com

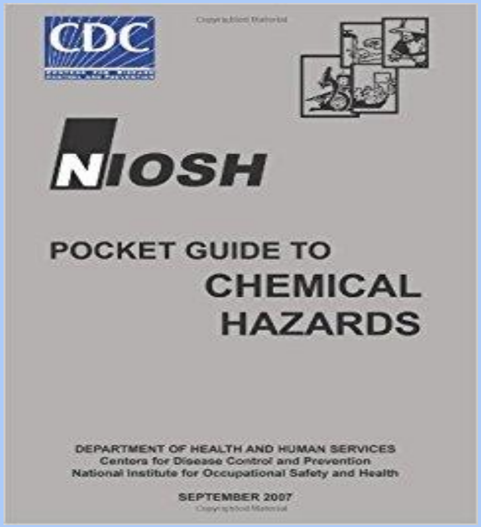
Please Turn your Cell Phone To Vibrate

Intro & Welcome

Why do we need Training

Put these Apps on your Phone





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)

CUPA 3

Immediate Reporting of a Release or Threatened Release

- ***<u>The immediate reporting requirements are not based on the quantity of the material.</u>***

<u>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.</u>

#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

EVERYDAY CALIFORNIA

EVERYDAY CALIFORNIA

JUST Google It!

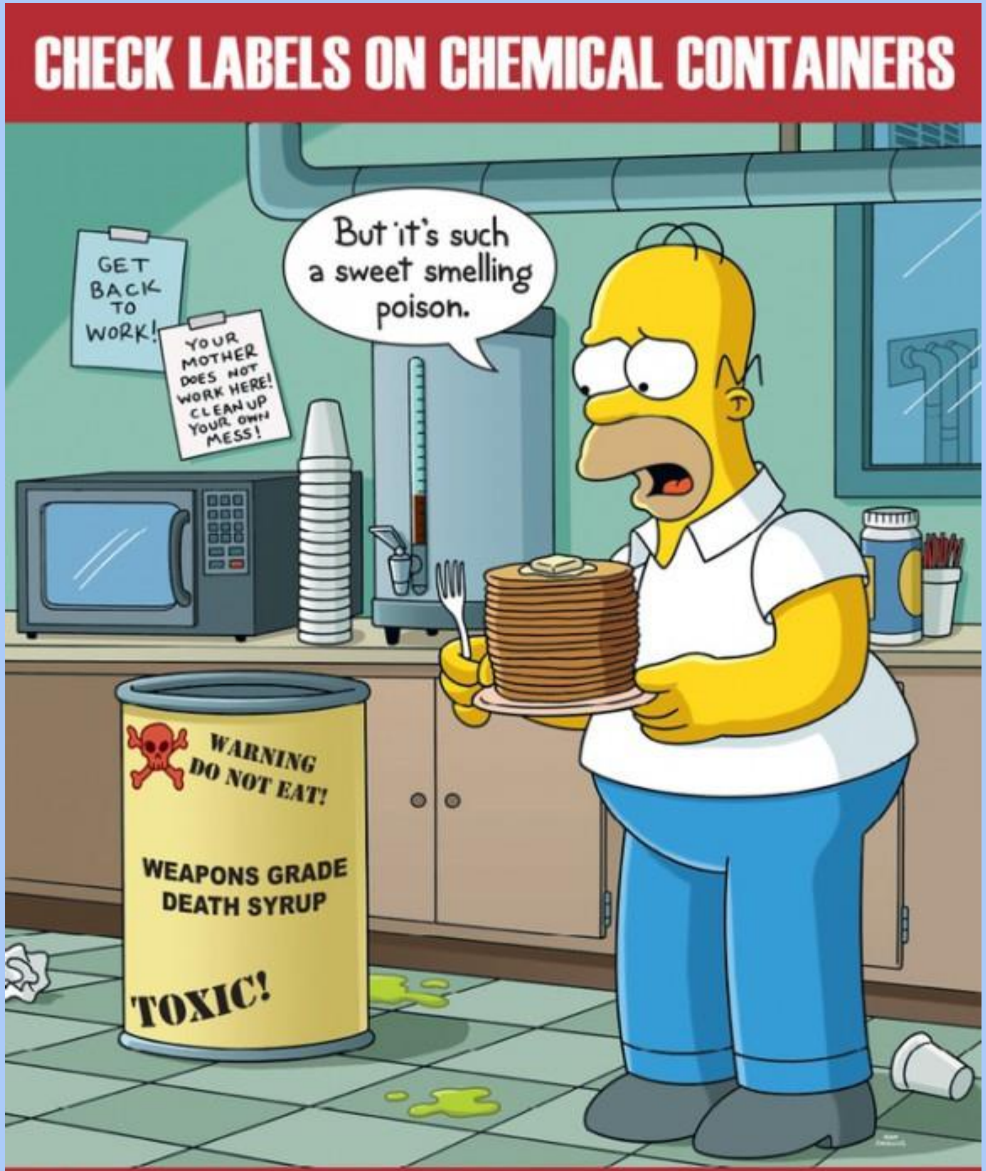
Federal Reporting Requirements

4

JUST Google It!

- 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 ?



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**

Patriot Environmental Services

CleanHarbors

Who needs HAZWOPER training ?[5]

- **<u>The key word when applying HAZWOPER training is</u>**
<u>"uncontrolled".</u>
- 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:**

- Uncontrolled hazardous waste site operators
- Treatment, storage and disposal facility (TSDF) personnel
- Emergency responders

In general terms, HAZWOPER training is needed if workers are to be: [7]

- Exposed to high concentrations of poisonous substances
- Exposed to chemical conditions that pose a fire or explosion hazard
- Entering sites with atmospheres at or above IDLH levels
- Exposed to oxygen deficient atmospheres (less than 19.5% oxygen)
- Leading evacuations due to chemical atmospheres or oxygen deficient conditions
- Performing confined space entry
- Supervising workers exposed to any of the above dangers

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]

- **<u>An incidental release</u>** 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 Incidents

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.**

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.

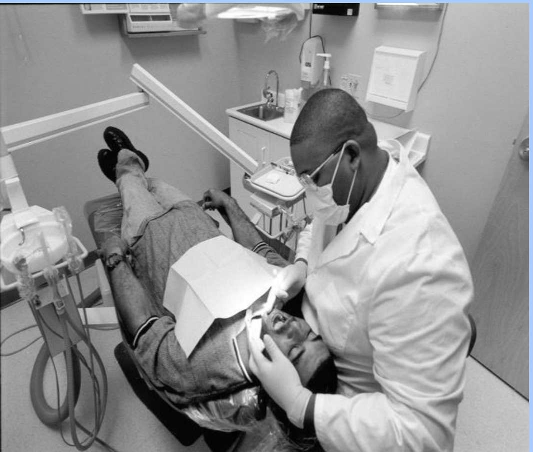
- The employee should take the next available refresher training course. "There should be a record in the employee's file indicating why the training has been delayed and when the training will be completed.

- <u>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.</u> 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.

END

Fact 1

Hazardous Materials
Are Everywhere -
And They Are Always Hazardous



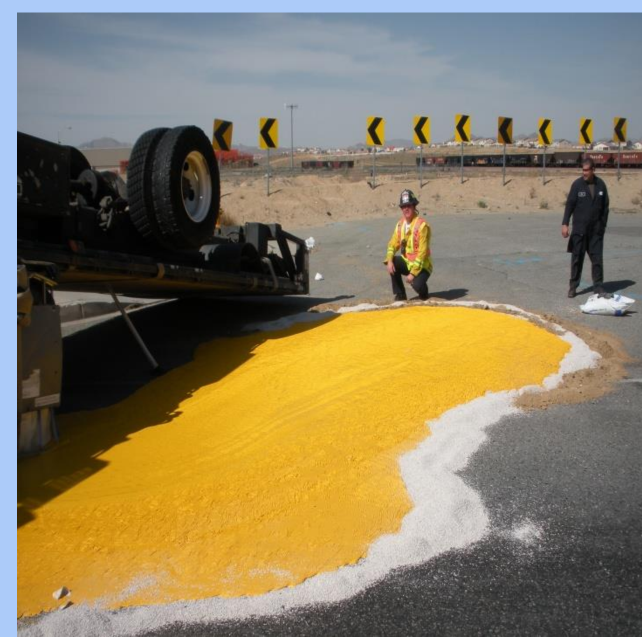
Hazardous Materials Exist in Only Two States

Normal

"Controlled States"

Emergency

"Uncontrolled States"



Normal

Production & Storage

Normal

Transportation

Normal

End Use


Emergency
FIRE

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

- **<u>In An Emergency -</u>**

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

Don’t Rush In!!!

Think ..Think .. Think!!

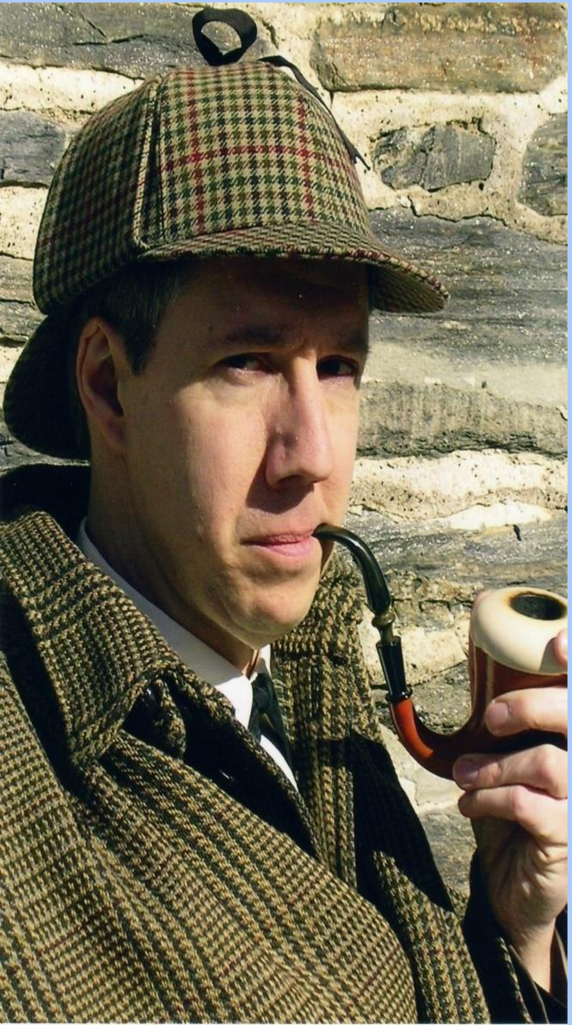
If You Don’t Know..
Don’t Go..


Fact: 6

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


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

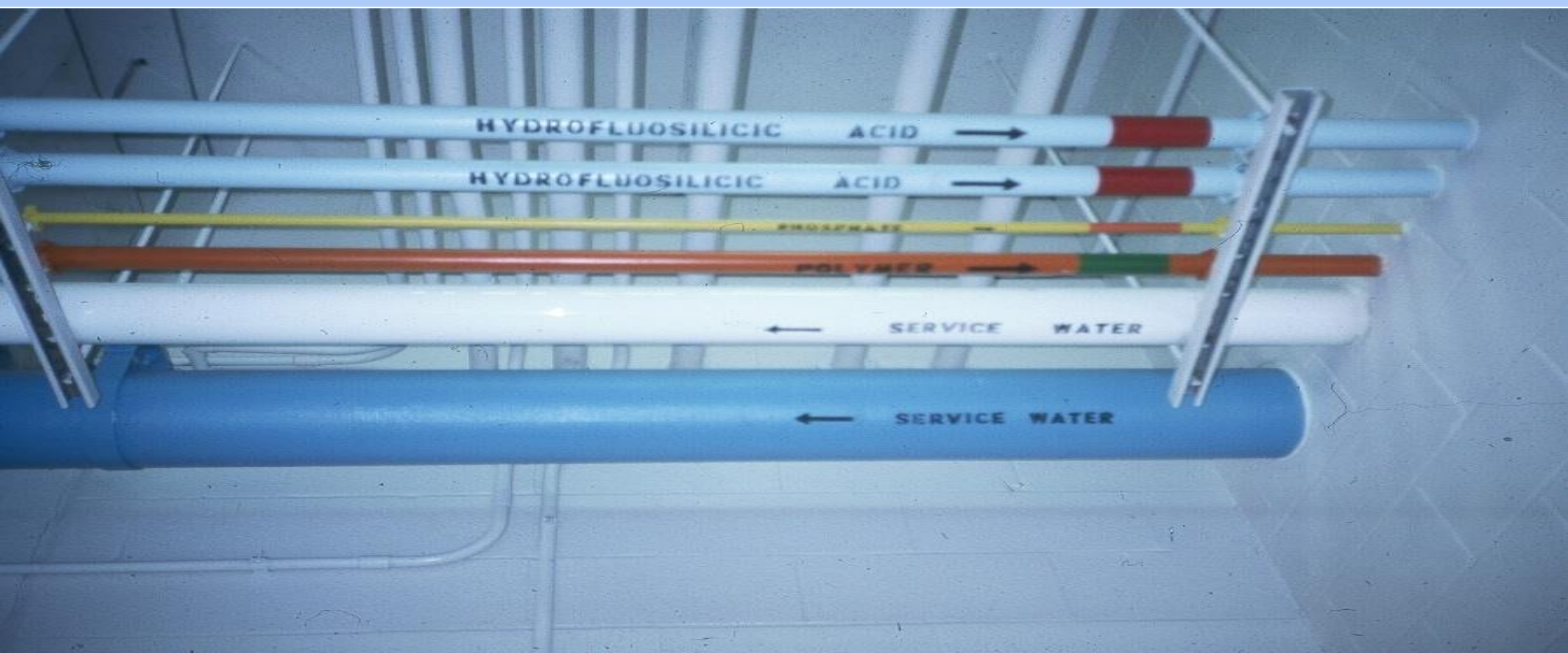
- Occupancy and Location

Identification Clues

- Container Shapes & Sizes

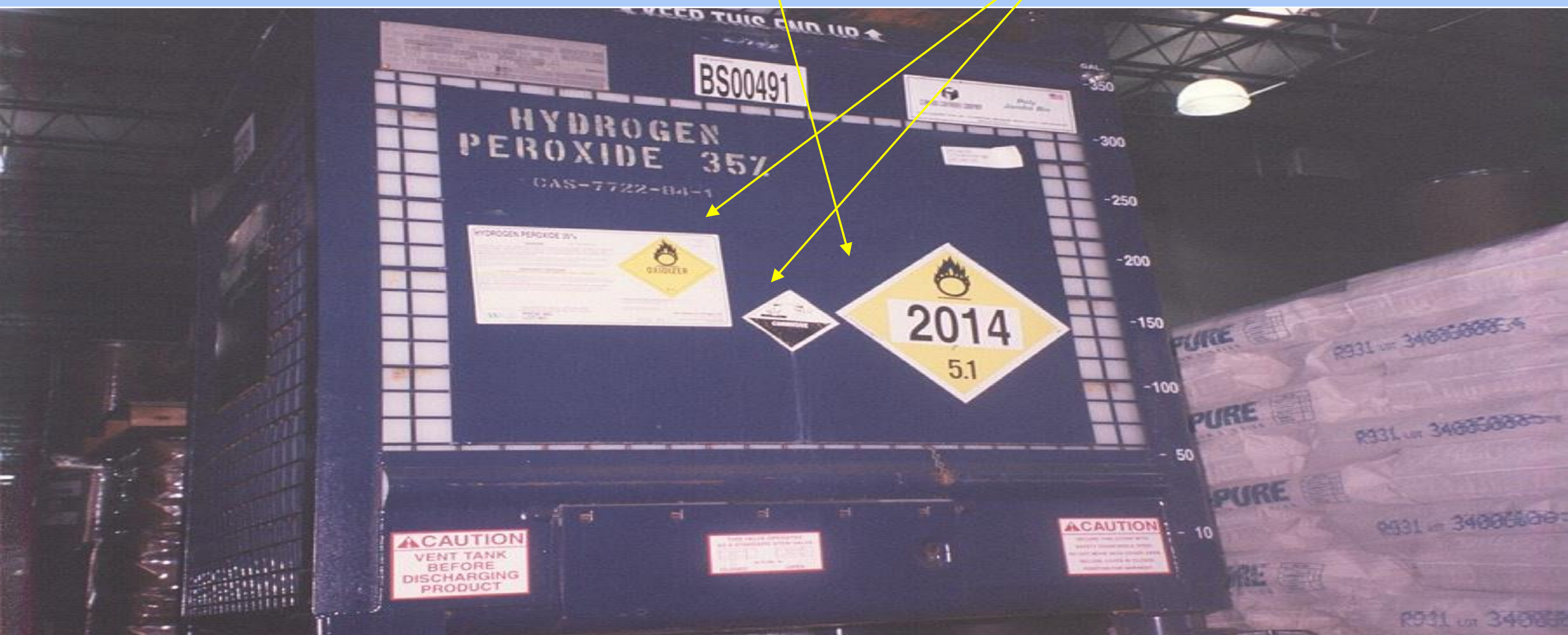
Identification Clues

- Markings & Colors



Identification Clues 1

- Placards & Labels

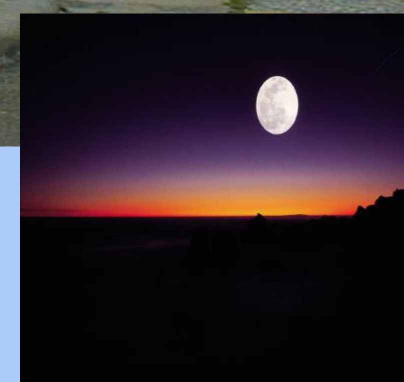


Variables & Hazard Assessment

- **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

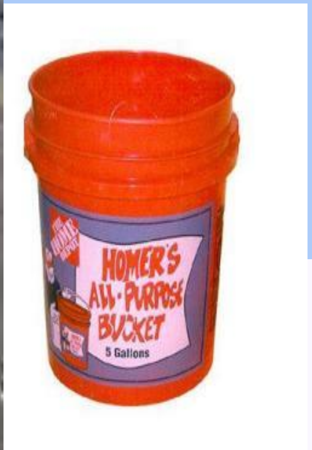
- **<u>Dynamic or Static</u>**
  - (short vs. long duration release)
  - Long Term Clean up

Variables & Hazard Assessment

- Type, condition & behavior of container

Variables & Hazard Assessment

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



Predicted Behavior

- 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?

Container Stress & Behavior[3]

- 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 ?

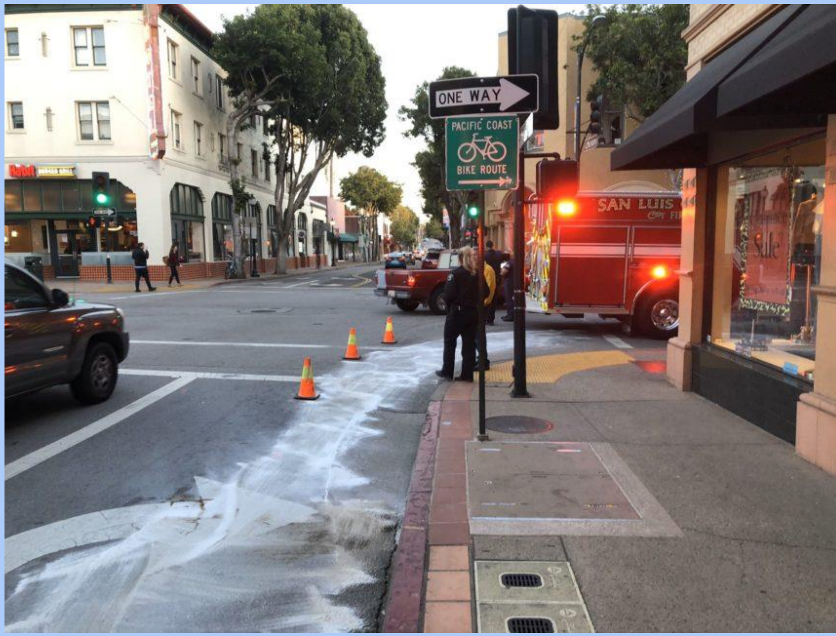
Complications in Hazard Assessment

- 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 Risk[3]

- 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

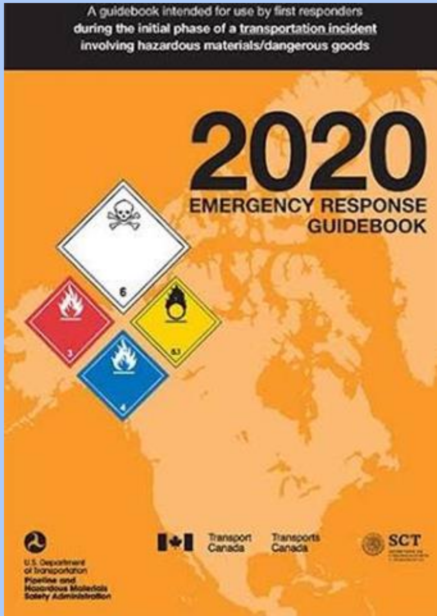
Information is Important - But Information Management is Critical To Survival

Information - The Big Three

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

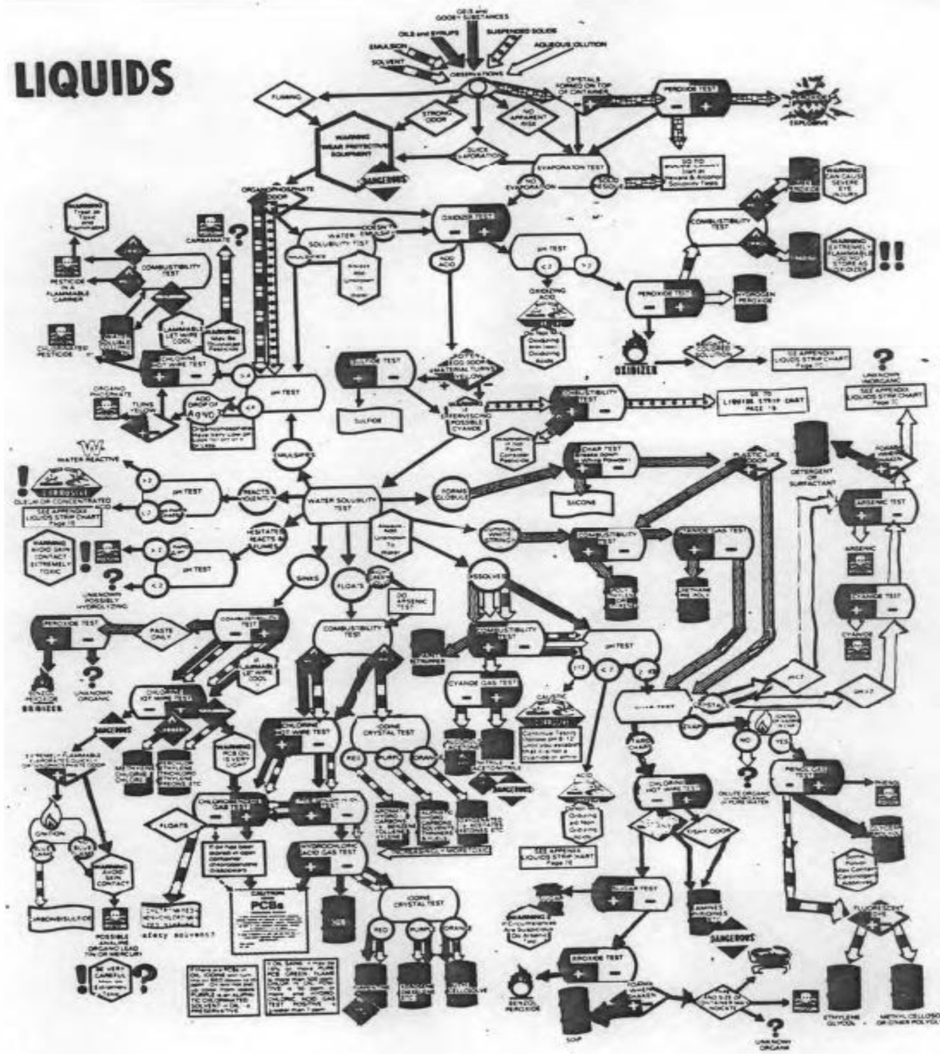
Location
Name of person reporting
Substance released
Nature of problem
Quantity released
Other potential hazards
Safe approach route & or Staging area

Hazard Identification



Hazard Identification

Identification can also be made in the field with sampling and testing kits. **<u>This may or may not be time-consuming</u>**.



Take Inventory of Your Chemicals[4]

- 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.

CERS California Environmental Reporting System

END

What Is GHS ?

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.

MSDS vs. SDS

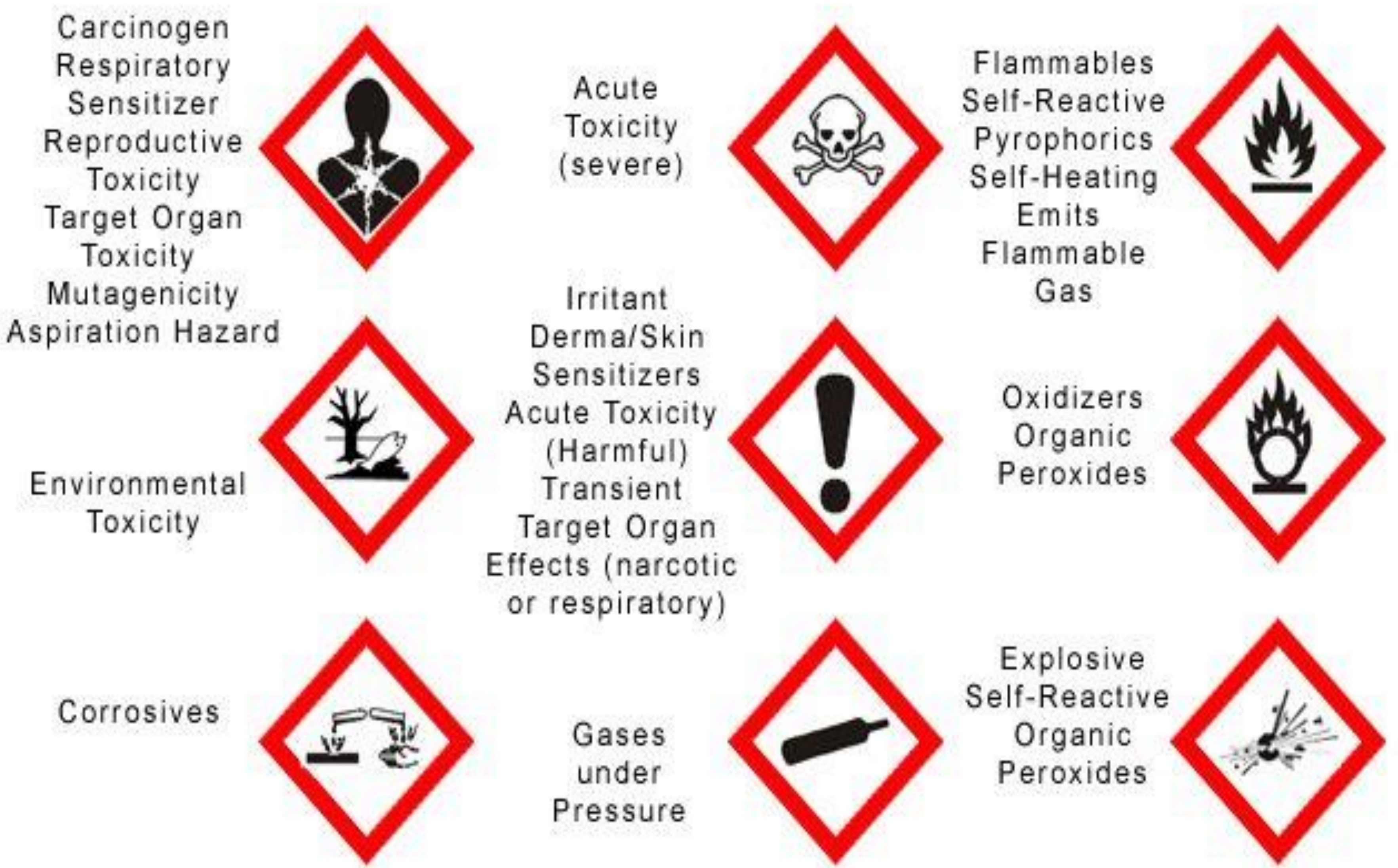
MSDS have 9 information points:

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 Pictograms



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 Chemicals[9]

- 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.***

Your Own Labels

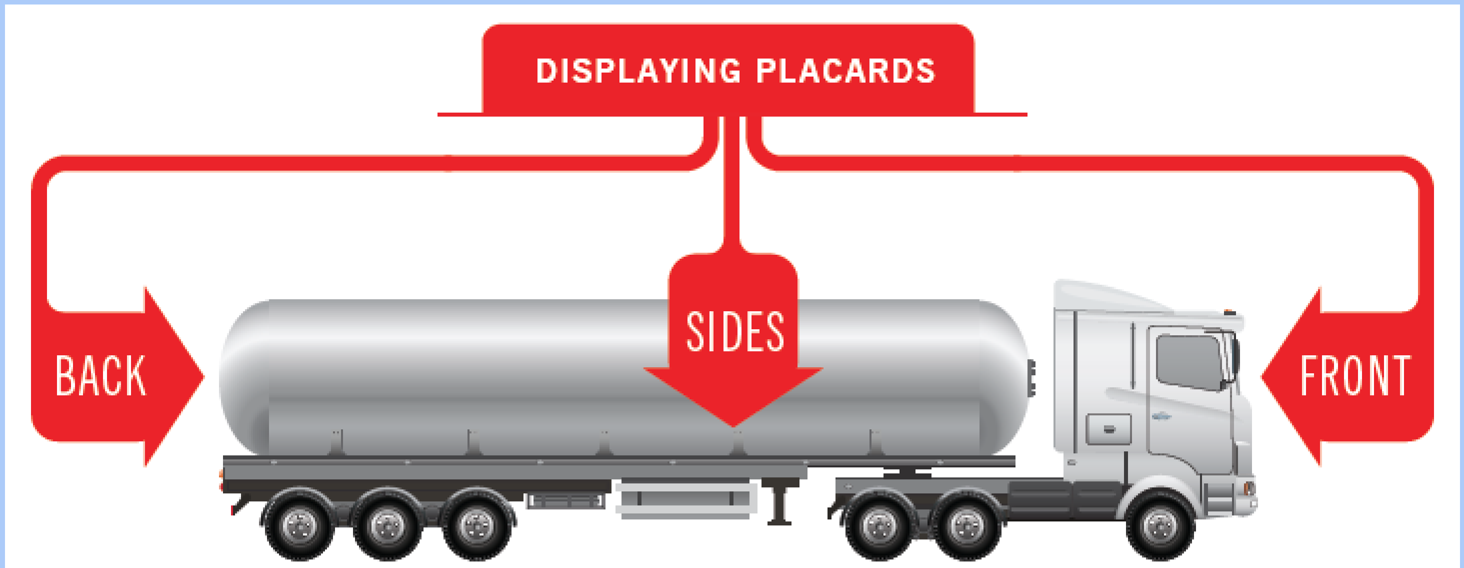
- Hazardous chemicals that are not in the manufacturer’s original container must at a minimum,
- Be labeled with the contents of the container.
- If the contents are hazardous, attach a label indicating the hazard to warn individuals in the work area.
- It is not necessary to label containers that will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

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.

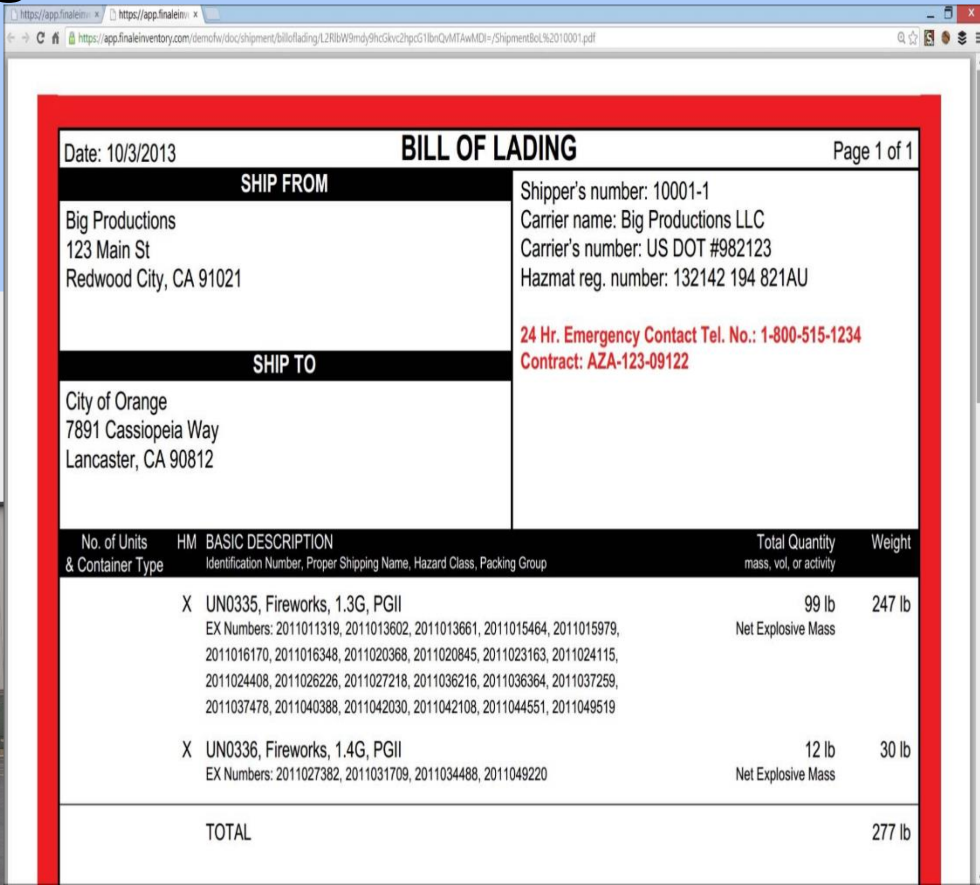
Transportation Marking System

- 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



BILL OF LADING

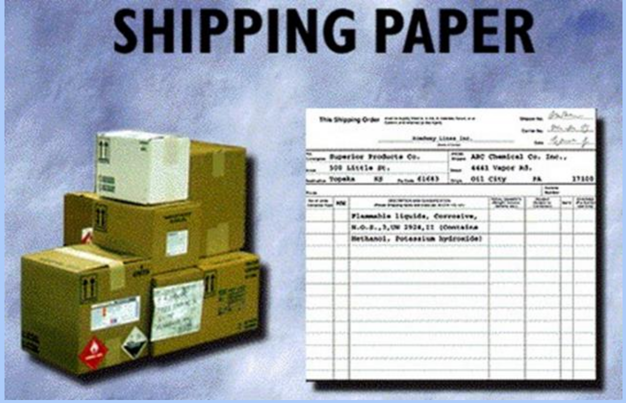
Date: 10/3/2013 — Page 1 of 1

SHIP FROM	
Big Productions 123 Main St Redwood City, CA 91021	Shipper's number: 10001-1 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

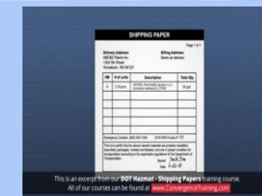
SHIPPING PAPERS

3



- Entry must be legible and in English
- Entry may not contain code numbers or abbreviations
- Each entry for each hazardous material must include the BASIC DESCRIPTION:
  - Proper shipping name (Column 2, Hazmat Table)
  - Hazard class (Column 3, Hazmat Table)
  - Identification Number (Column 4, Hazmat Table)
  - Packing Group (Column 5, Hazmat Table)

SHIPPING PAPERS 7



- <u>Shipping paper must:</u>
  - Contain the name of the shipper
  - Indicate multiple pages, for example “page 1 of 4”.
  - <u>*Show emergency response number*</u>
  - 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:	56.1ºC/133ºF @ 76 mm Hg	Melting Point:	Not available
Solubility (H_2O):	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

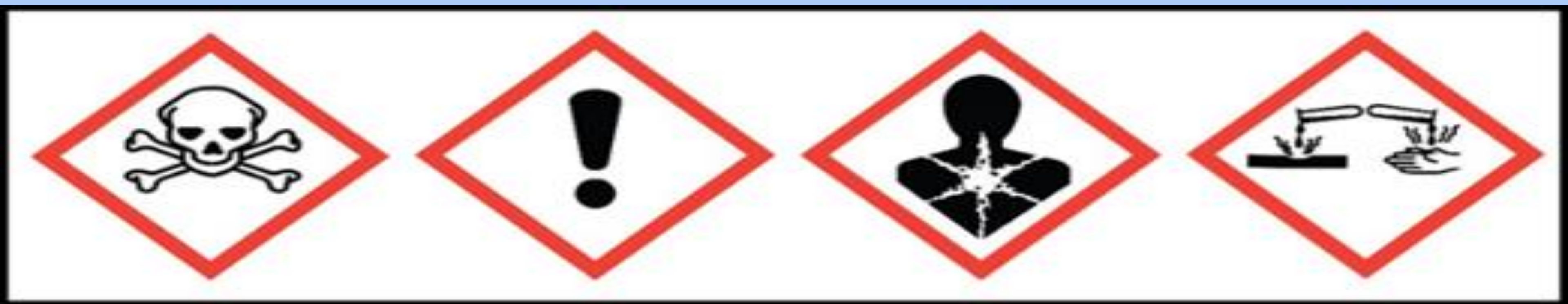
Flame – flammables, pyrophorics, self-heating, emits flammable gas, self-reactives, organic peroxides

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

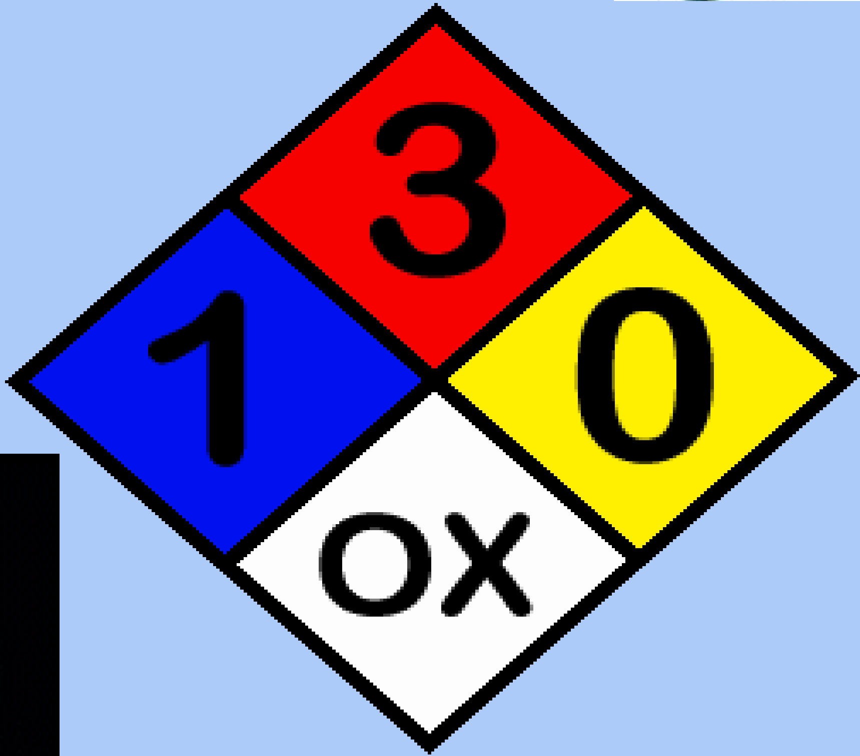
- **<u>CHEMTREC</u>**
  - Operates a 24-hour telephone line
  - An extensive database of chemical information
  - Must have information ready when calling

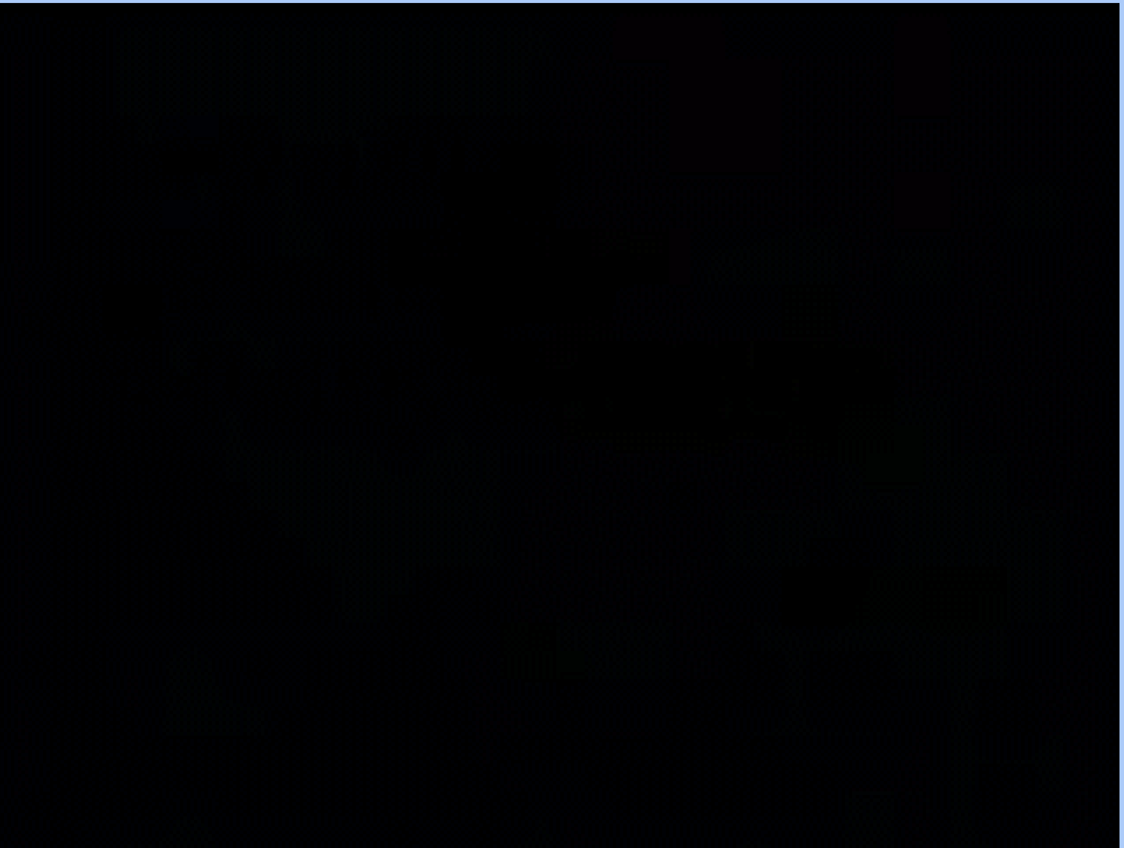
1-800-262-8200

NFPA 704 LABEL

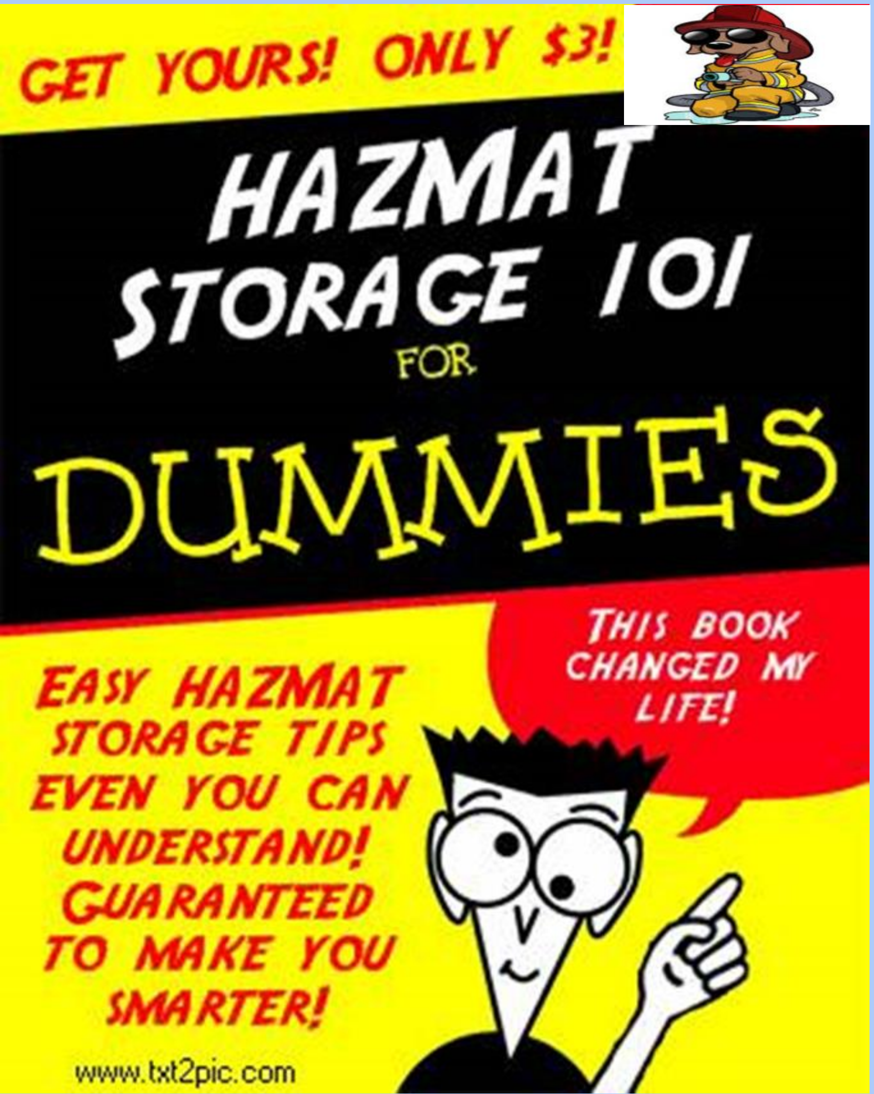
FIVE NFPA HAZARD LEVELS

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





HAZMAT STORAGE – 101



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	Incompatible with
Acetylene	Copper, silver, mercury
Acetic Acid	Chromic acid, Nitric acid, Ethylene glycol
Acetone	Concentrated sulfuric or nitric acid
Chlorine	Ammonia, acetylene, benzene hydrogen
Hydrogen Sulfide	Nitric acid, Oxidizing gases
Sodium Peroxide	Any oxidizable substances
Mercury	Acetylene, Ammonia, Lithium

Storage Area Requirements[7]

- ✔ Label storage areas according to the type of chemical class or hazard classification found there.
- ✔ Inspect storage areas as warranted and **<u>Waste areas weekly</u>**.
- ✔ 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 substances

FLASH POINT

Flammables & Combustibles[3]

- **<u>Most common hazard</u>**
- Several agencies define and classify flammable & combustible liquids
  - **<u>NFPA</u>** <100 >100
  - **<u>DOT</u>** <140 >141
  - **<u>GHS</u>** <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!!

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.

Corrosives

Both **acids** and **alkalines** have the same Corrosive Label

Acid

Alkaline-Base

1 7 14

You must know what type of Corrosive it is BEFORE storing!

Just because they have the same label does not mean they like each other

Strong Acids

HCl	Hydrochloric Acid
HNO_3	Nitric Acid
H_2SO_4	Sulfuric Acid
HBr	Hydrobromic Acid
HI	Hydroiodic Acid
$HClO_4$	Perchloric Acid
$HClO_3$	Chloric Acid

Weak Acids

$HO_2C_2O_2H$	Oxalic Acid
H_2SO_3	Sulfurous Acid
H_3PO_4	Phosphoric Acid
HNO_2	Nitrous Acid
C_6H_5COOH	Benzoic Acid
CH_3COOH	Acetic Acid
HCOOH	Formic Acid

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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

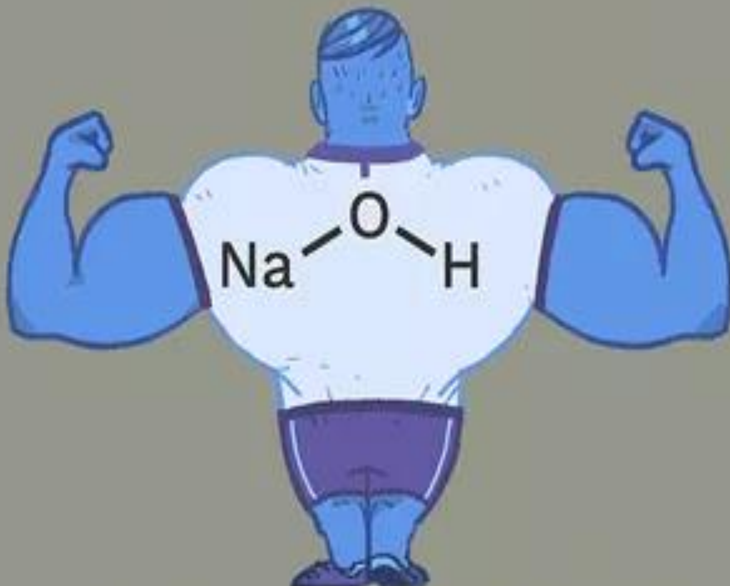
- **Inorganic acids**, also called mineral **acids** or natural **acids**, are acids derived from one or more inorganic compounds.

- 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.

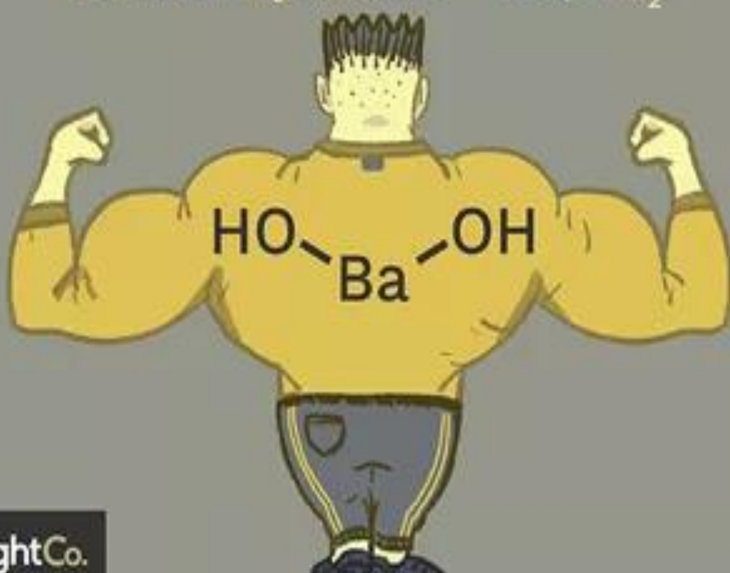
Examples of Common Strong Bases

Sodium Hydroxide - NaOH

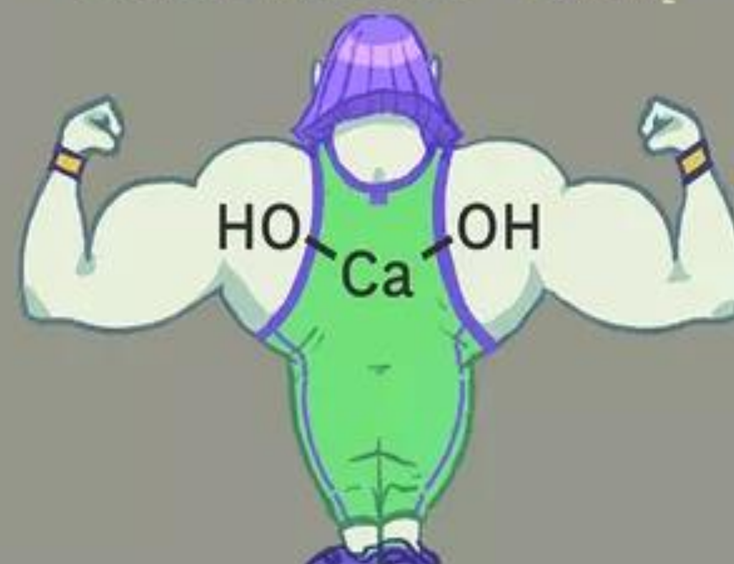


Potassium Hydroxide - KOH

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.

Storage Precautions for Corrosives [3]

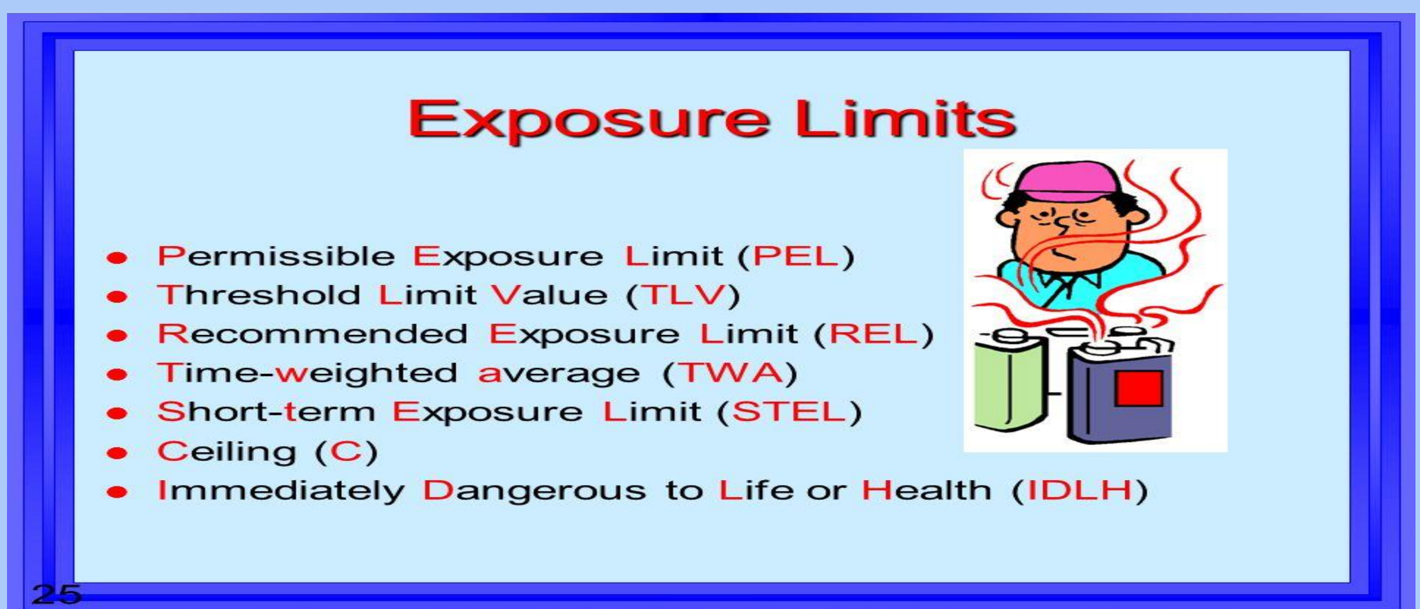
- **<u>Amines</u>** The easiest way to think of amines is as near relatives of ammonia, In amines, the hydrogen atoms in the ammonia have been replaced one at a time by hydrocarbon groups.
- Amines are alkaline compounds that may be corrosive, but are generally weak bases. Amines are also commonly flammable and tend to give off strong odors. Amines do not need to be stored in a corrosion-resistant cabinet. If they are flammable, they should be kept in a flammable-liquids storage cabinet.
- **<u>Organic acids and acid chlorides</u>**
- Non-halogenated organic acids and acid chlorides ***<u>(such as formic acid and acetic acid)</u>*** are corrosive, but they are also flammable. These should be stored in a flammable-liquids storage cabinet. Keep the containers clean and tightly capped to avoid damage to the cabinet due to escaping corrosive vapor.
- **<u>Oxidizing acids</u>**
- Some acids ***<u>(such as nitric, chromic, and sulfuric)</u>*** are strongly oxidizing in addition to being strongly corrosive. These acids must be kept in a corrosion-resistant cabinet and must be stored separately from all reducing agents, organic chemicals, and cellulose containing materials.

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.

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.
- *<u>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.</u>*



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 cyanide.

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

- **<u>Systemic</u>** 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*** <u>affects the blood, nervous system, liver, kidneys and skin</u>; ***benzene*** <u>affects the bone marrow</u>.

- **<u>Cumulative poisons</u>** 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***.

- **<u>Synergistic responses</u>** 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.

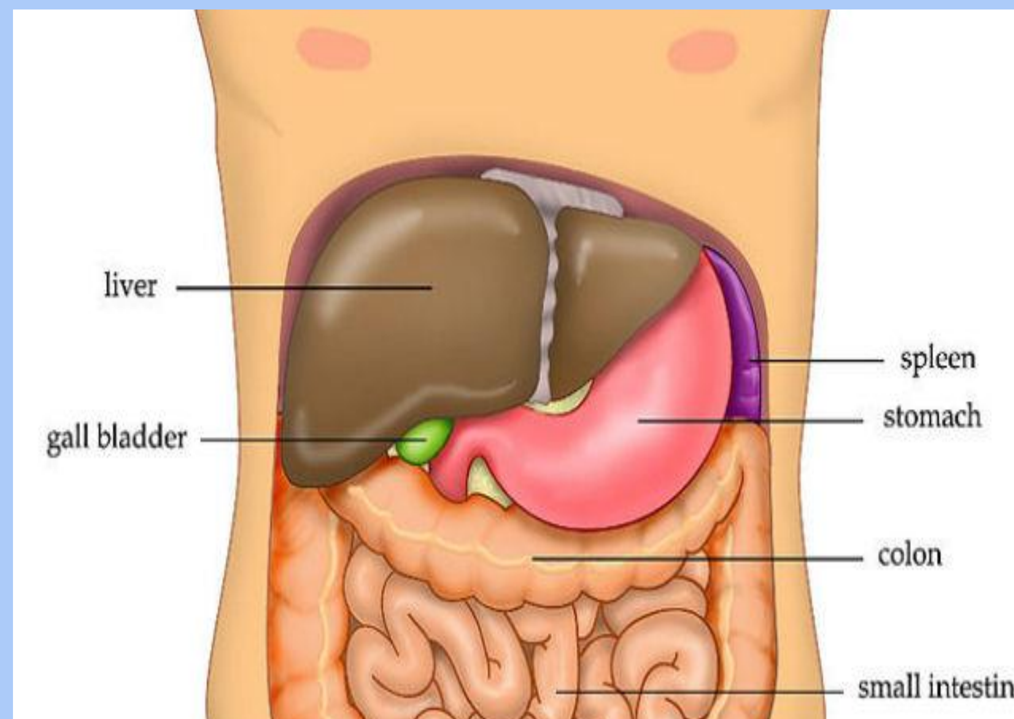
- **State of health, physical condition**, and life style, can affect the toxic response. Preexisting disease can result in increased sensitivity.

- **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

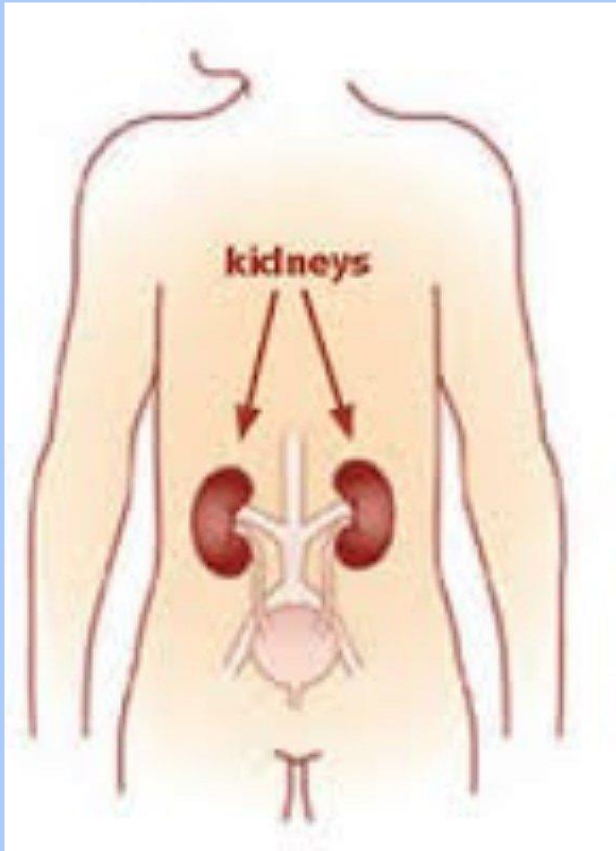
- **Hepatotoxic**
- *Hepatotoxic* agents cause damage to the liver.

- These include:
- carbon tetrachloride
- tetrachloroethane
- nitrosamine



Toxic Chemical Classes

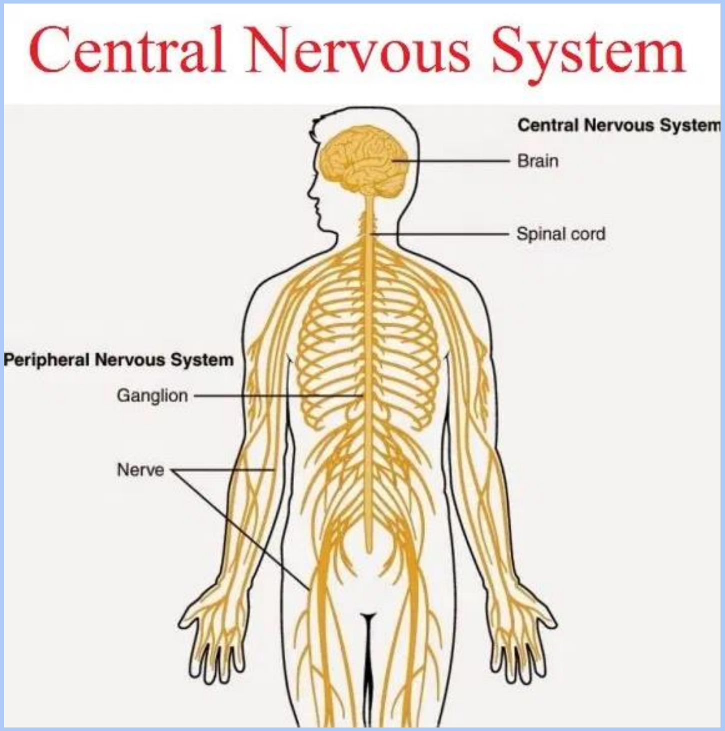
- <u>**Nephrotoxins**</u>
- *Nephrotoxic agents* damage the kidneys.
- These include:
- halogenated hydrocarbons
- uranium compounds



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

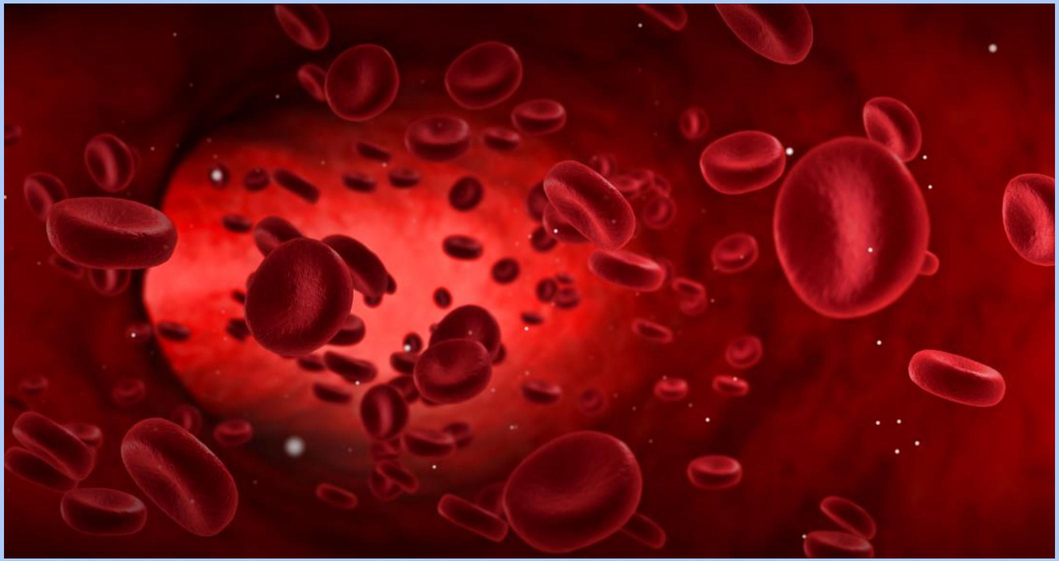
Toxic Chemical Classes

- **<u>Neurotoxins</u>**
- *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
- **<u>organic phosphorus insecticides</u>**
- manganese
- thallium



Toxic Chemical Classes

- <u>**Hematopoietic Toxins**</u>
- 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 [4]

- Chemical irritants are materials that cause reversible inflammation or irritation to a body surface, including eyes, respiratory tract, skin or mucous membranes, upon contact.
- **Primary irritants** exert no systemic toxic action. The degree of irritation depends on the chemical concentration, duration of contact, and personal factors (health status, sensitization).
- Be aware that some irritants are **sensitizers** or have delayed symptoms. Sensitizers are chemicals that can cause an allergic reaction upon repeat low level exposures.
- Breathing chemical irritant gases can also cause the buildup of fluid in the lungs or can interfere with the exchange of oxygen.

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

Irritants [1]

Irritants can also cause changes in the mechanics of respiration and lung function. These include:

- sulfur dioxide
- acetic acid
- formaldehyde
- formic acid
- sulfuric acid
- acrolein
- halogens

Irritants 5

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.

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

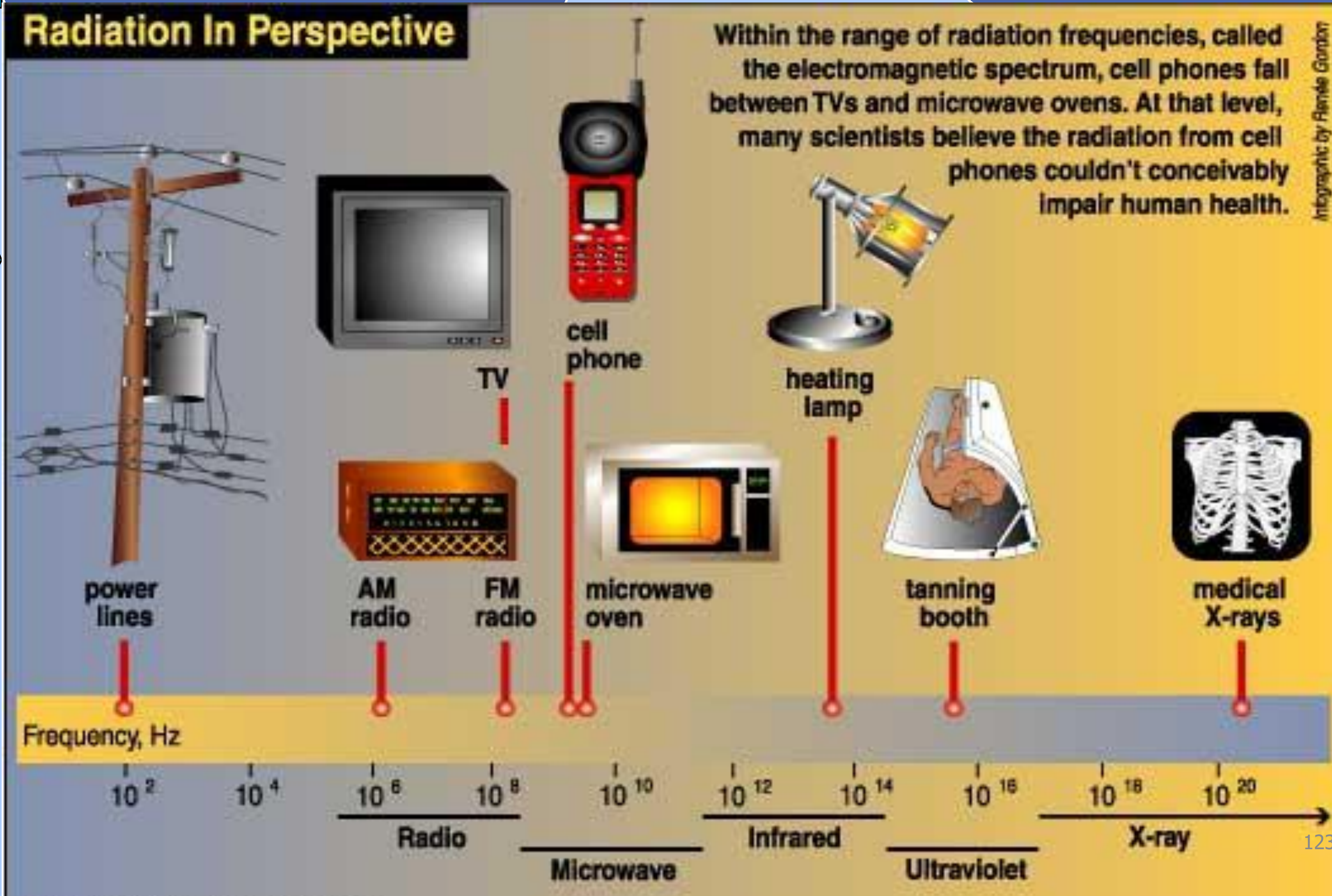
- *Reproductive hazards* are chemicals that affect the reproductive capabilities including chromosomal damage (*mutagens*) and effects on the fetus (*teratogens*).

- 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

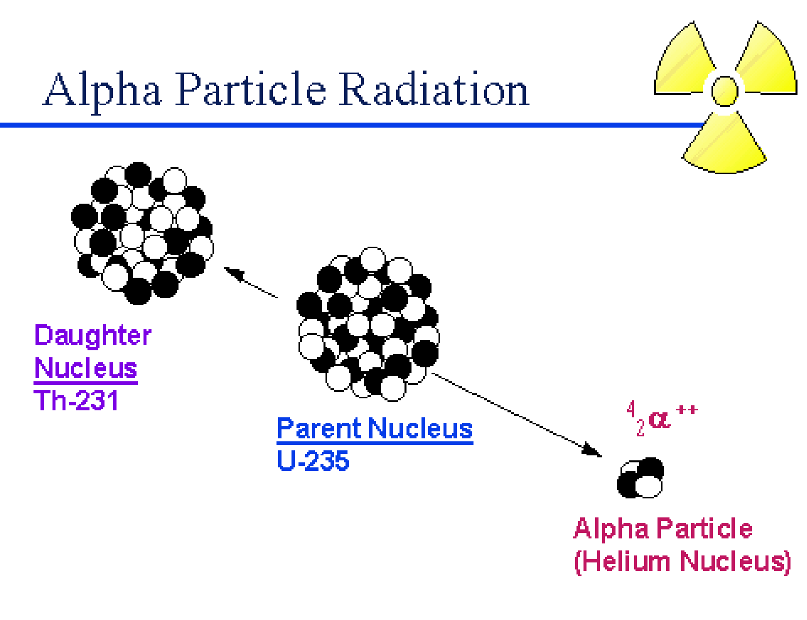
Forms of Radiation

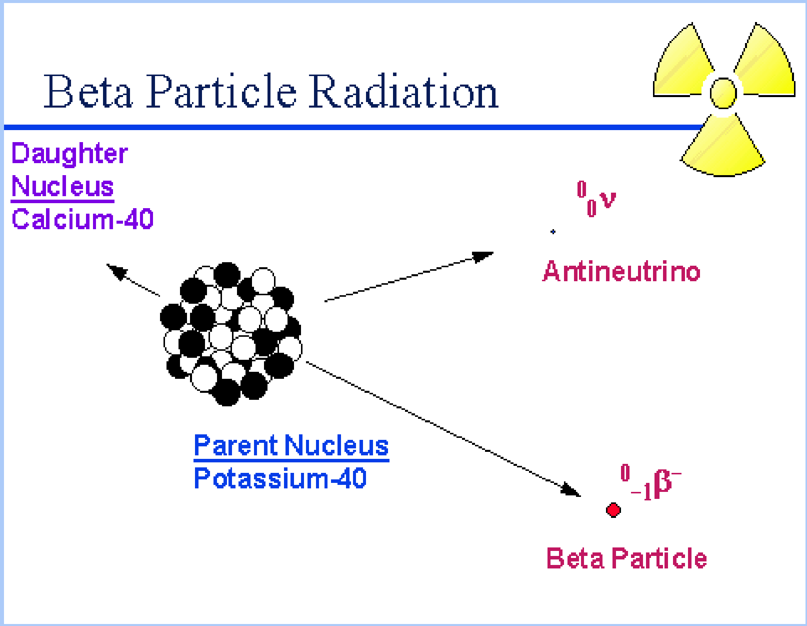
NON-IONIZING

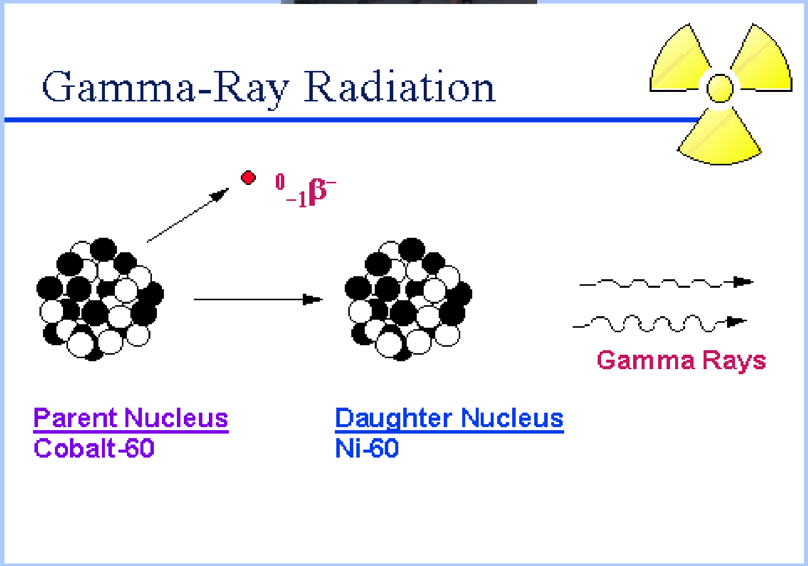
IONIZING

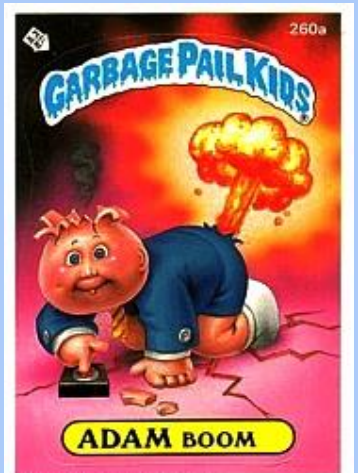


Three Types of Radioactive Decay









Radiation Exposures

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

Coast-to-coast flight 3 mrem

Natural background 150-300 mrem

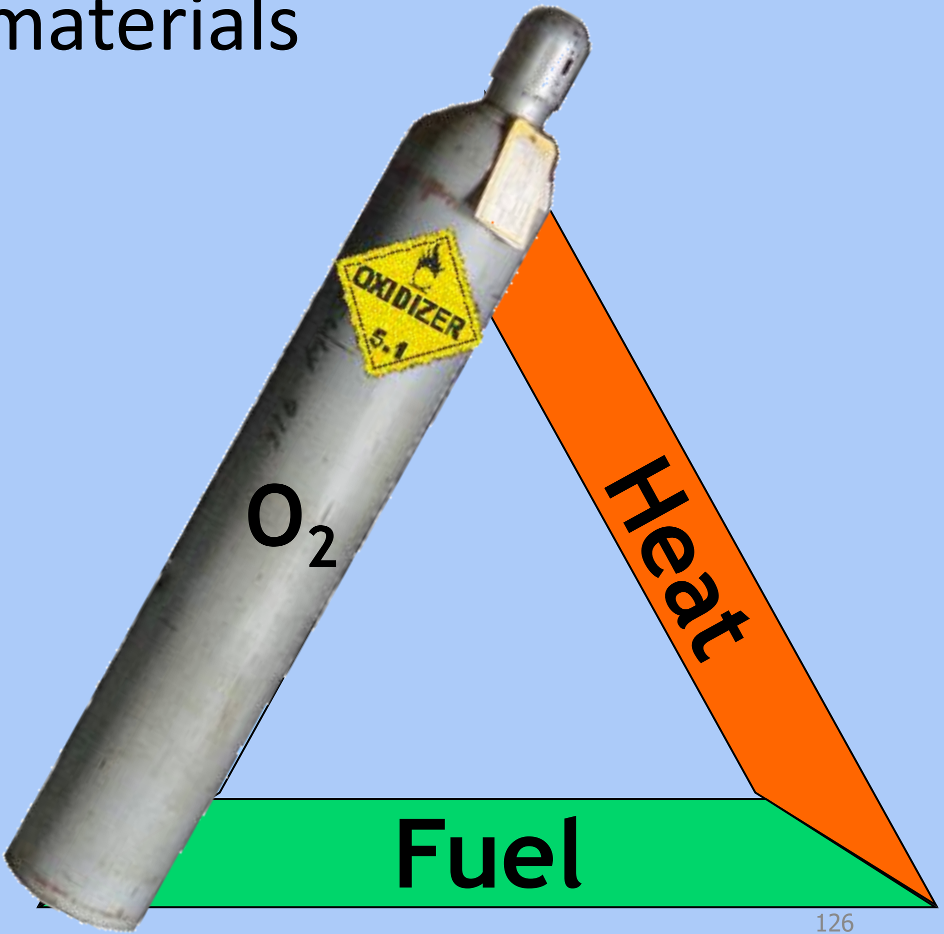
Chest radiograph, A/P
15-25 mrem

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*. ***<u>Strong oxidizers are capable of forming explosive mixtures when mixed with combustible, organic or easily oxidized materials</u>***.

Storage Precautions for Oxidizers

- 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

- 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.

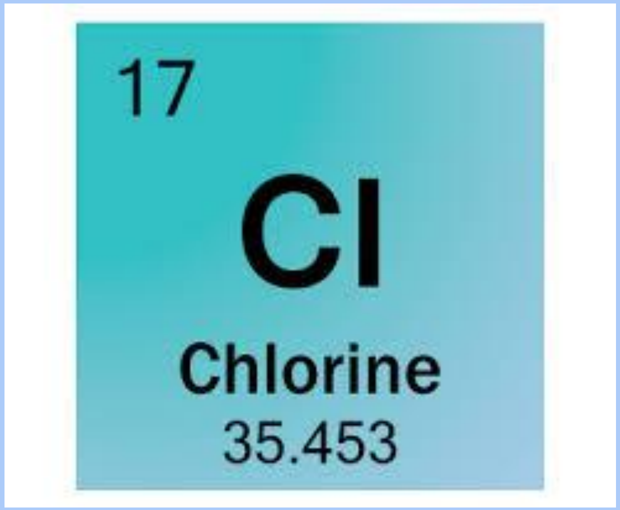
- **Atmospheric pressure** is (14.7 psi). Note that compressed gas cylinder with a pressure gauge reading of 0 psig is not really empty. It still contains gas at atmospheric pressure.

Liquefied Gases

- 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

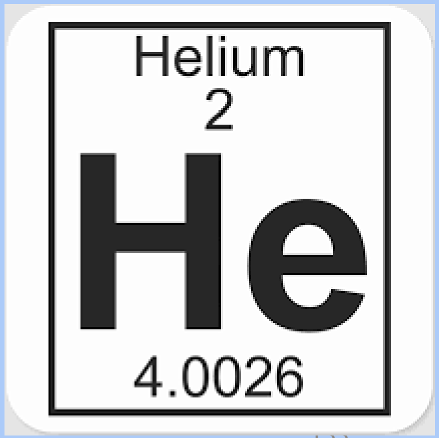


Non-Liquefied Gases

- 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.

- <u>**Common examples of these are**</u>

- 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

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[6]

- 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

- **<u>Exothermic</u>**
  - Releases heat

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

- **<u>Endothermic</u>**
  - Absorbs heat

<u>Ammonium nitrate</u> 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 Pyrophorics[7]

- 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

<u>Storage Precautions for Water Reactives</u>

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 Solids 4

- **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

- **<u>Polymerization:</u>** is a chemical reaction in which many small molecules (monomers) join together to form a large molecule (polymer). **<u>Often the reaction produces heat and pressure</u>**. 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.

- <u>**Vigorous Polymerization:** is potentially hazardous because the reaction may get out of control</u>. Once started, the reaction is accelerated by the heat that it produces. **<u>The uncontrolled buildup of heat and pressure can cause a fire or an explosion, or can rupture closed containers</u>**. 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]

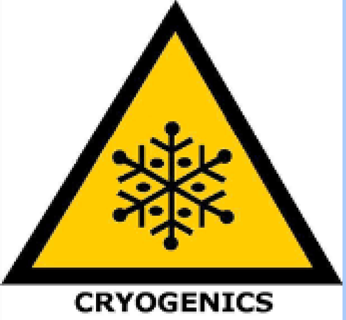
- An inhibitor is a chemical that is added to a material to slow down or prevent an unwanted reaction such as polymerization. Inhibitors are added to many materials that can polymerize easily when they are pure.

- 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.



Cryogen[3]

- ***<u>A liquid cryogen is a liquefied gas with a boiling point typically below (- 238°F).</u>***

- 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

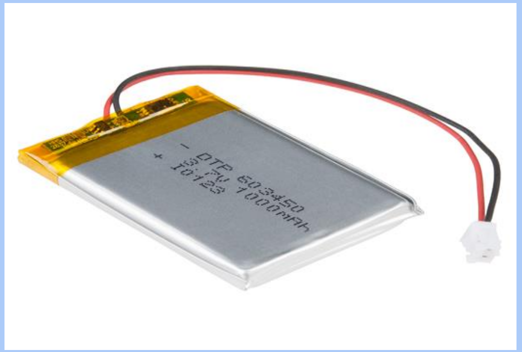
Cryogen3

- **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

- 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.

Lets Review

Secondary Storage Considerations:

Chemical Segregation [3]

- Within each primary storage location (shelf, cabinet, etc.) incompatible materials may not be stored together without appropriate segregation.
- Do not segregate chemical classes into separate rooms unless they will only be used in that room.
- Segregation that disrupts normal work flow or requires more frequent transport of chemicals between work areas will increase the probability of a chemical spill.

Lets Review

Secondary Storage Considerations: 5

Chemical Segregation

- Incompatible materials should be stored in separate cabinets whenever possible.
- For example: Acids and bases would be kept in separate corrosive liquids storage cabinets.
- However, when that is not possible, secondary containment bins can be used to segregate the incompatible materials.
- The secondary containment must be large enough to accommodate the volume of the largest container stored within.
- Once separated into hazard classes, chemicals may be stored alphabetically or by other systems such as by carbon number.

Lets Review

Secondary Storage Considerations: 5

Chemical Segregation

- **Segregation of Solids**

- Segregate solid chemicals from liquid chemicals.
- Keep the following classes of solid chemicals segregated from each other in separate cabinets or secondary containers.
- oxidizing solids
- flammable solids
- water reactive solids

Lets Review

Secondary Storage Considerations: 7

Chemical Segregation

- **Segregation of Liquids**

- Segregate liquid chemicals from solid chemicals.
- Keep the following classes of liquid chemicals segregated from each other in separate cabinets or secondary containers.
- acid liquids
- alkaline liquids high ph
- oxidizing liquids
- flammable or combustible liquids
- pyrophoric & water-reactive liquids

Lets Review

Secondary Storage Considerations:[4]

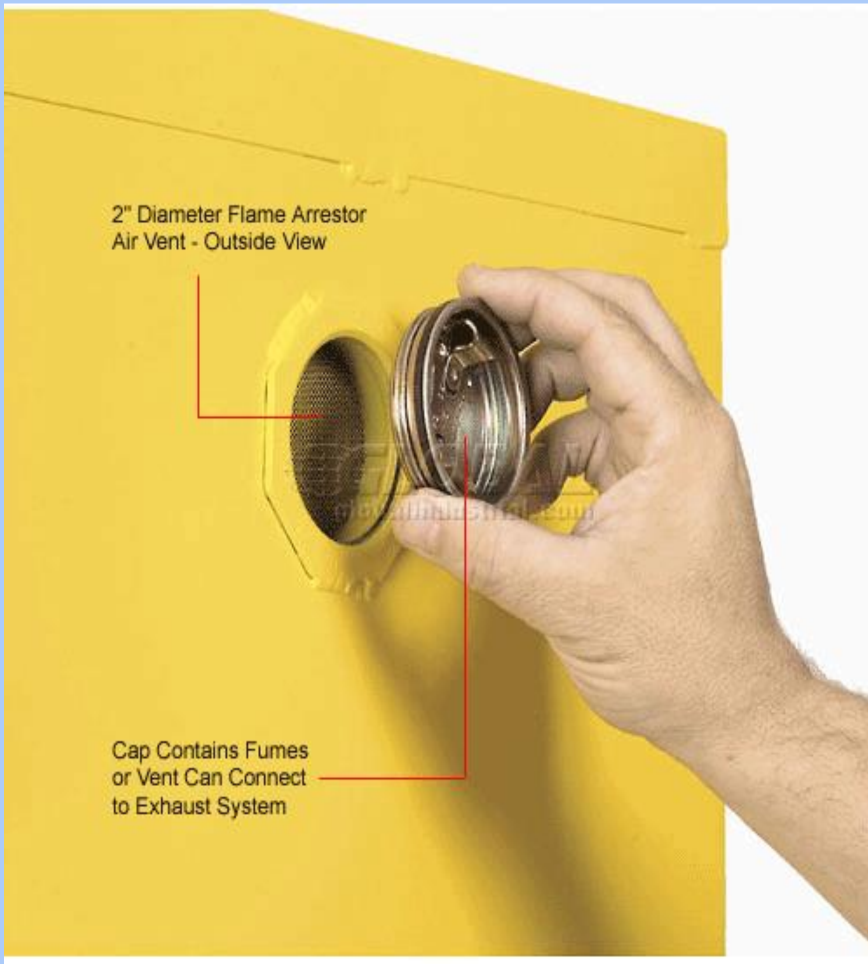
Chemical Segregation

- **Segregation of Compressed Gases**

- The following compressed gas types must be stored separately from each other:
- Toxic gases
- Flammable gases
- Oxidizing gases*
- Empty cylinders must be stored separately from full or partially-full cylinders
- *Oxidizing gas must be separated by a distance of at least 20 feet from fuel gas cylinders or a highly combustible material such as, but not limited to, oil, grease, flammable gas or a source of ignition, or be separated from the material by a noncombustible wall, not less than five feet high, having a fire resistance rating of one hour. All cylinders shall be stored away from heat in excess of 125° Fahrenheit.*

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

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

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

<u>Goals of spill response are to:</u>

1. Eliminate additional loss.

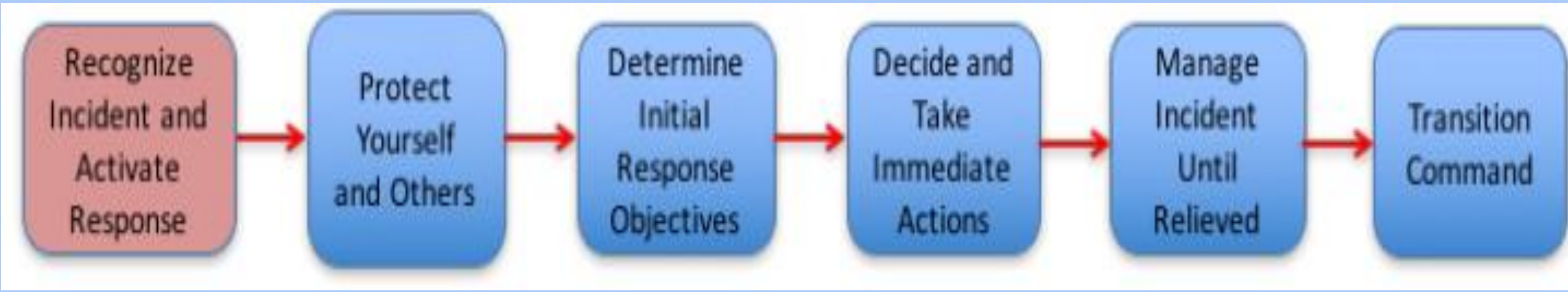
2. Prevent further contamination.

3. Avoid unnecessary exposure of workers.

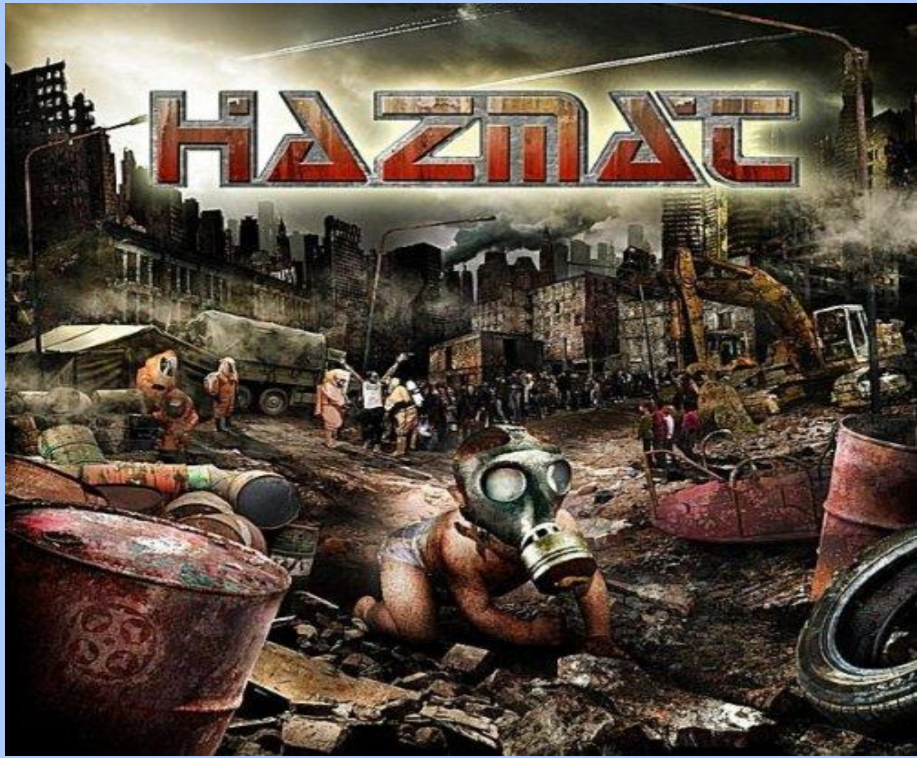
4. Prevent contact with other chemicals.

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:

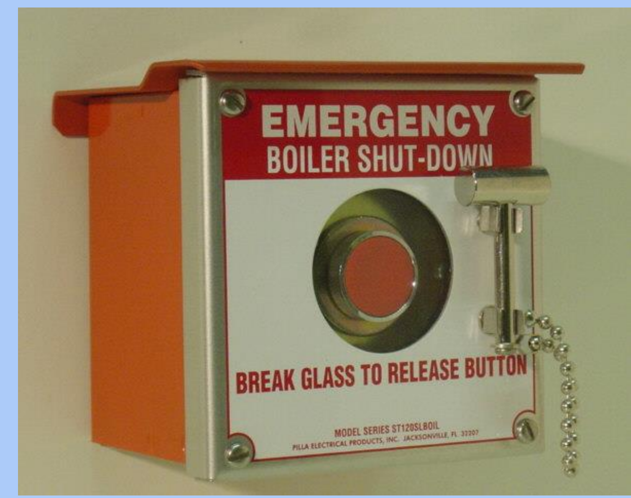
Mixing an acid with a basic material or base with an acid to return their pH levels toward a reading of 7 (neutral).

Physical Control

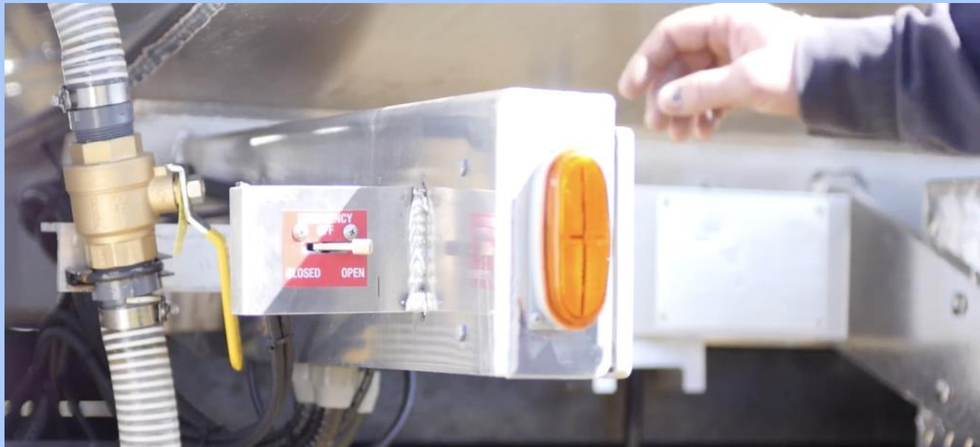
1. Remote shut-offs
2. Vapor suppression fog covering, cooling cylinders
3. Absorbents
4. Damming
5. Diking
6. Diverting
7. Transferring
8. Transfilling
9. Plugging and patching
10. Booming and damming on waterways.

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



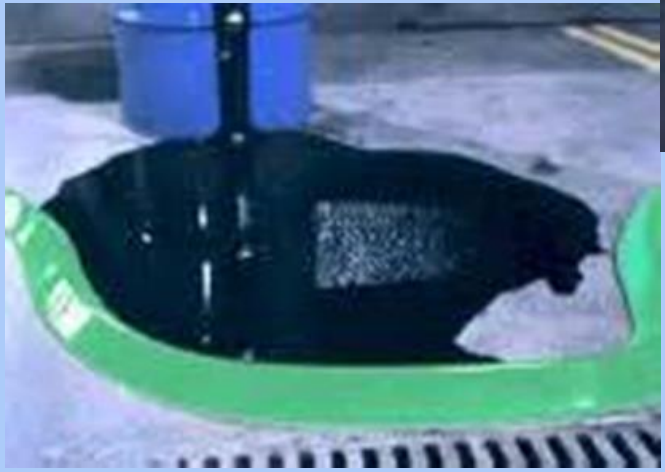
Vapor Suppression

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. <u>Remember they need to be retrieved and disposed of as hazardous waste</u>.

Damming-Damming-Diverting



Protecting Drains

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

Transferring

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 breeched piping.
- Transportation industry may use the following:

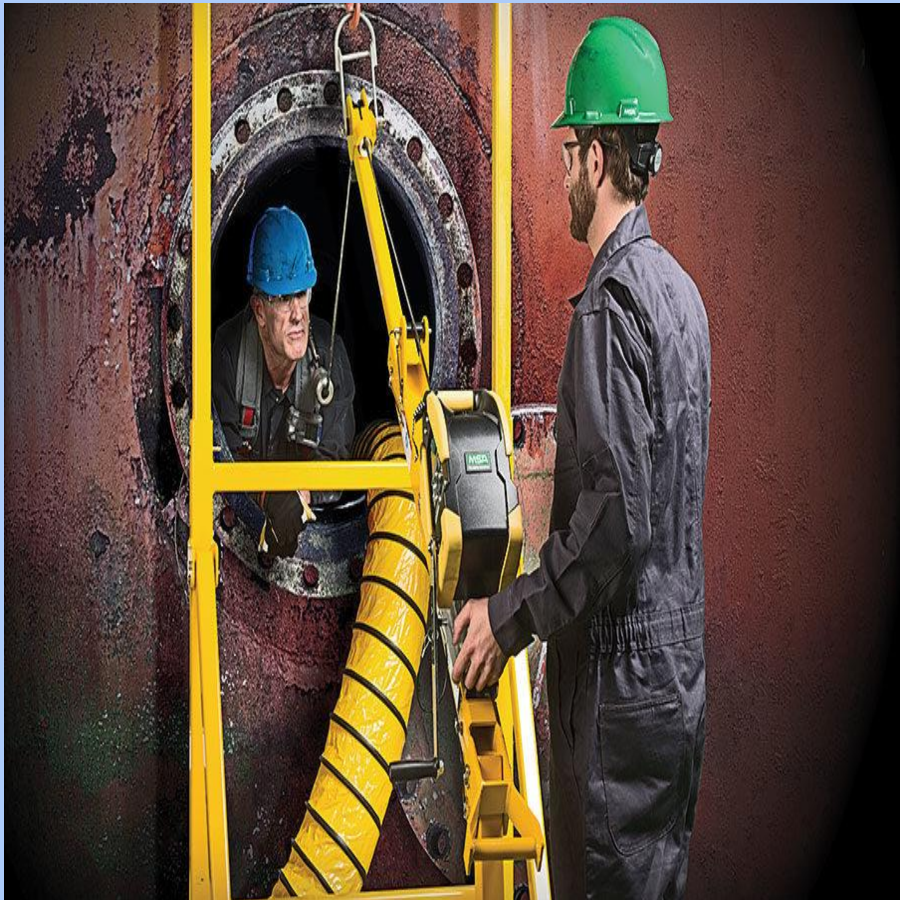
Overpacking

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

END

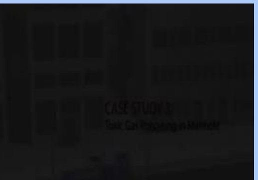
Dangers of Confined Spaces

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

- **<u>Underestimating the Environment:</u>** Many of the hazards associated with confined spaces cannot be seen. Workers will often underestimate the confine space environment and are injured by hidden hazards.

- **<u>Routine Operation Syndrome:</u>** Thinking that the space is safe today because it has not resulted in injuries during previous entries.

- **<u>Equipment Failure:</u>** 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

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 4

- 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**

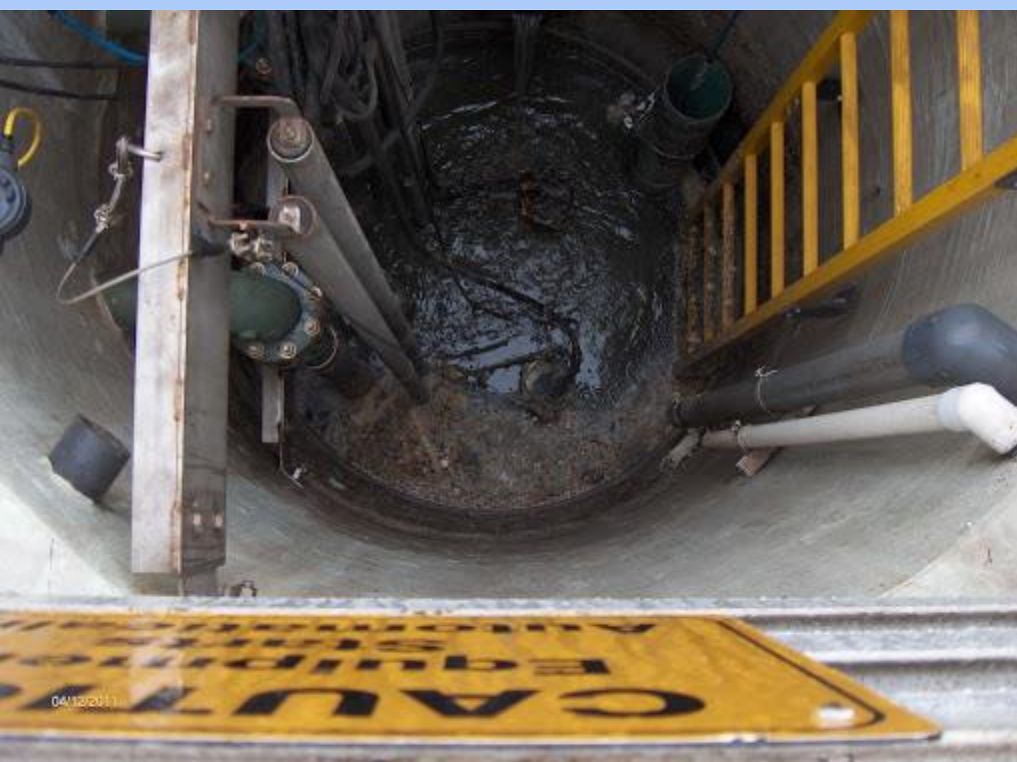
Alternate Entry Spaces 3

- 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

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



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

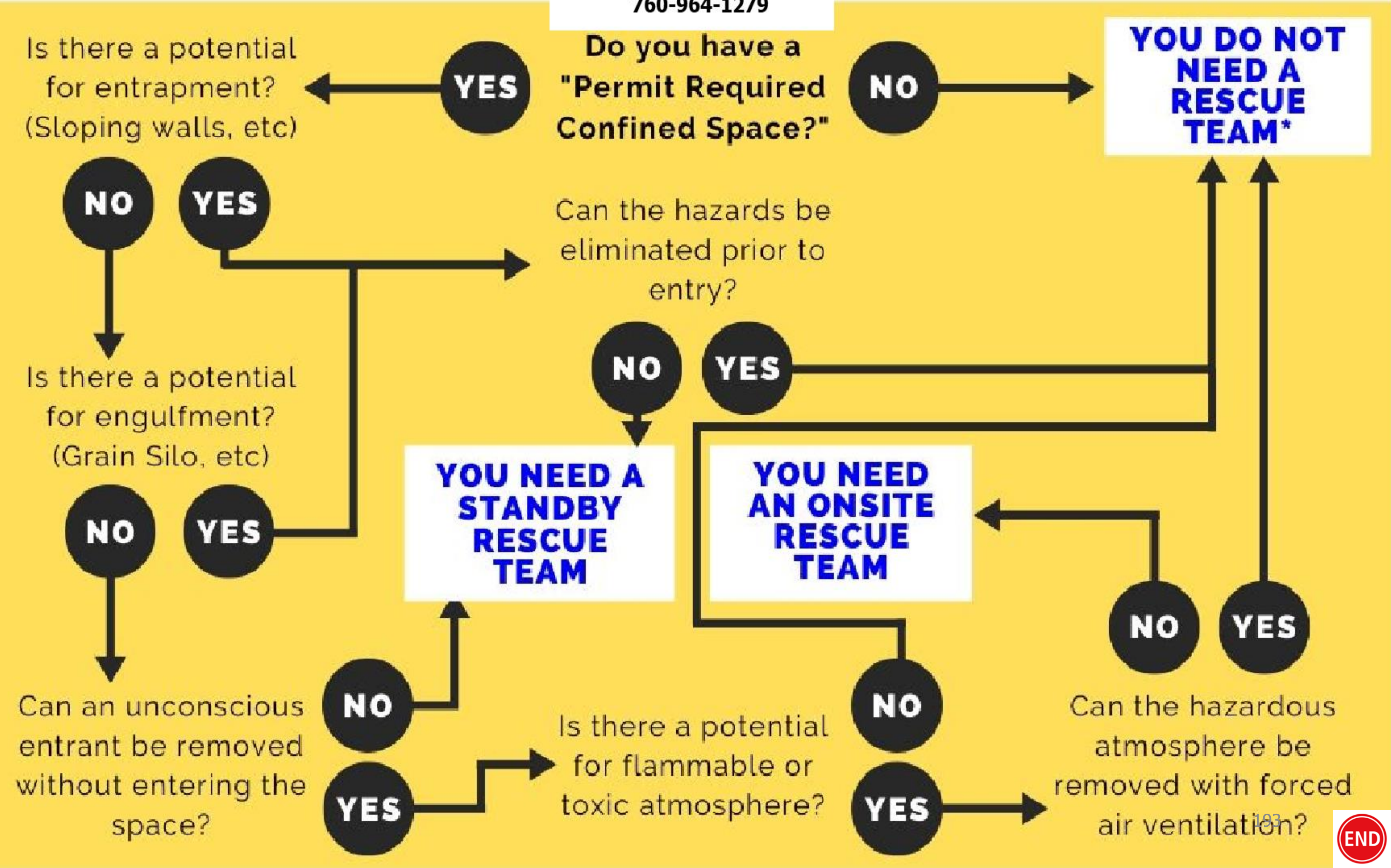
DUTIES OF HOST EMPLOYERS [3]

- 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.

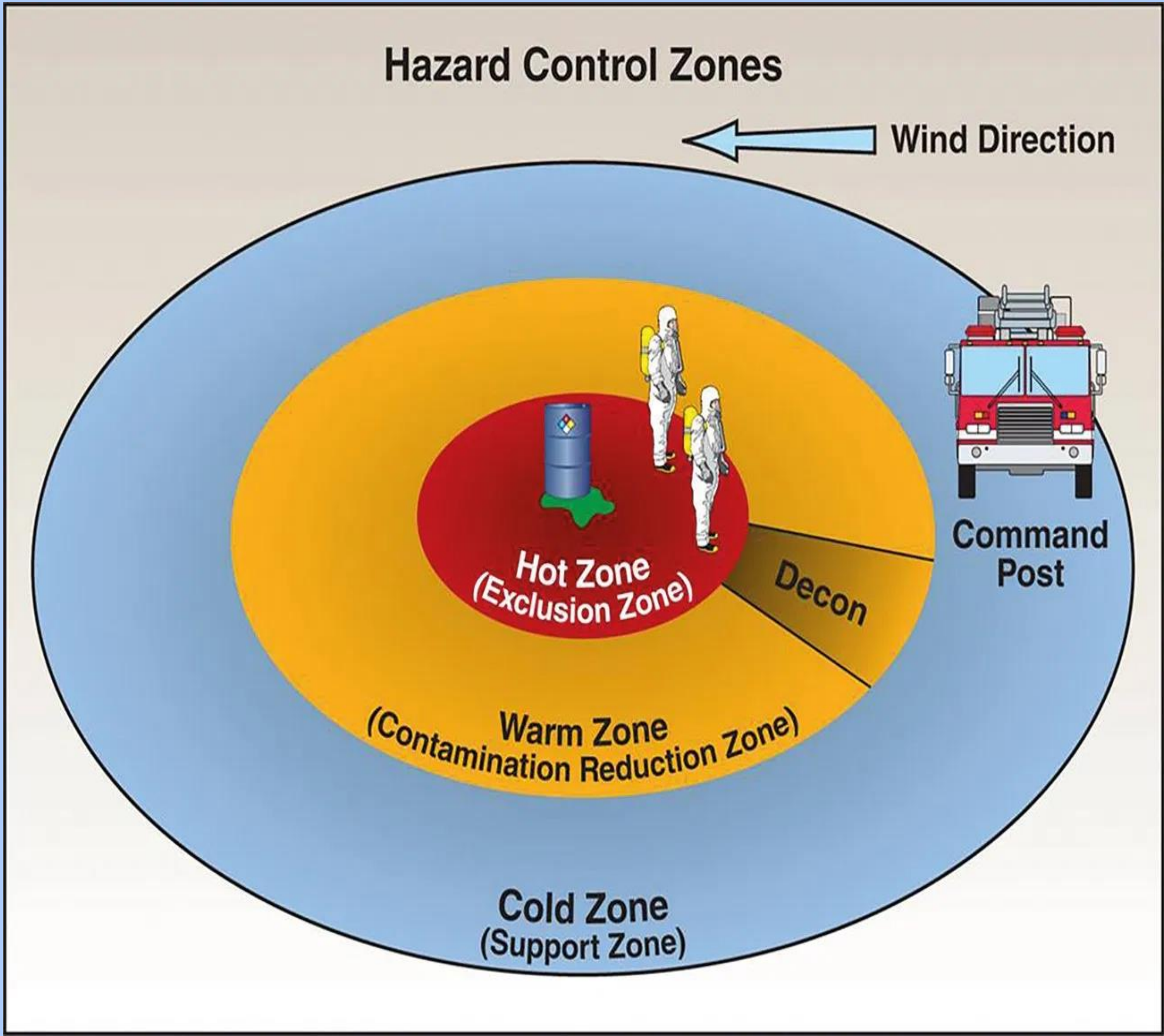
DO YOU NEED A CONFINED SPACE ENTRY RESCUE TEAM?

Greg Coon
FIREDOG Haz Mat Training
760-964-1279



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.

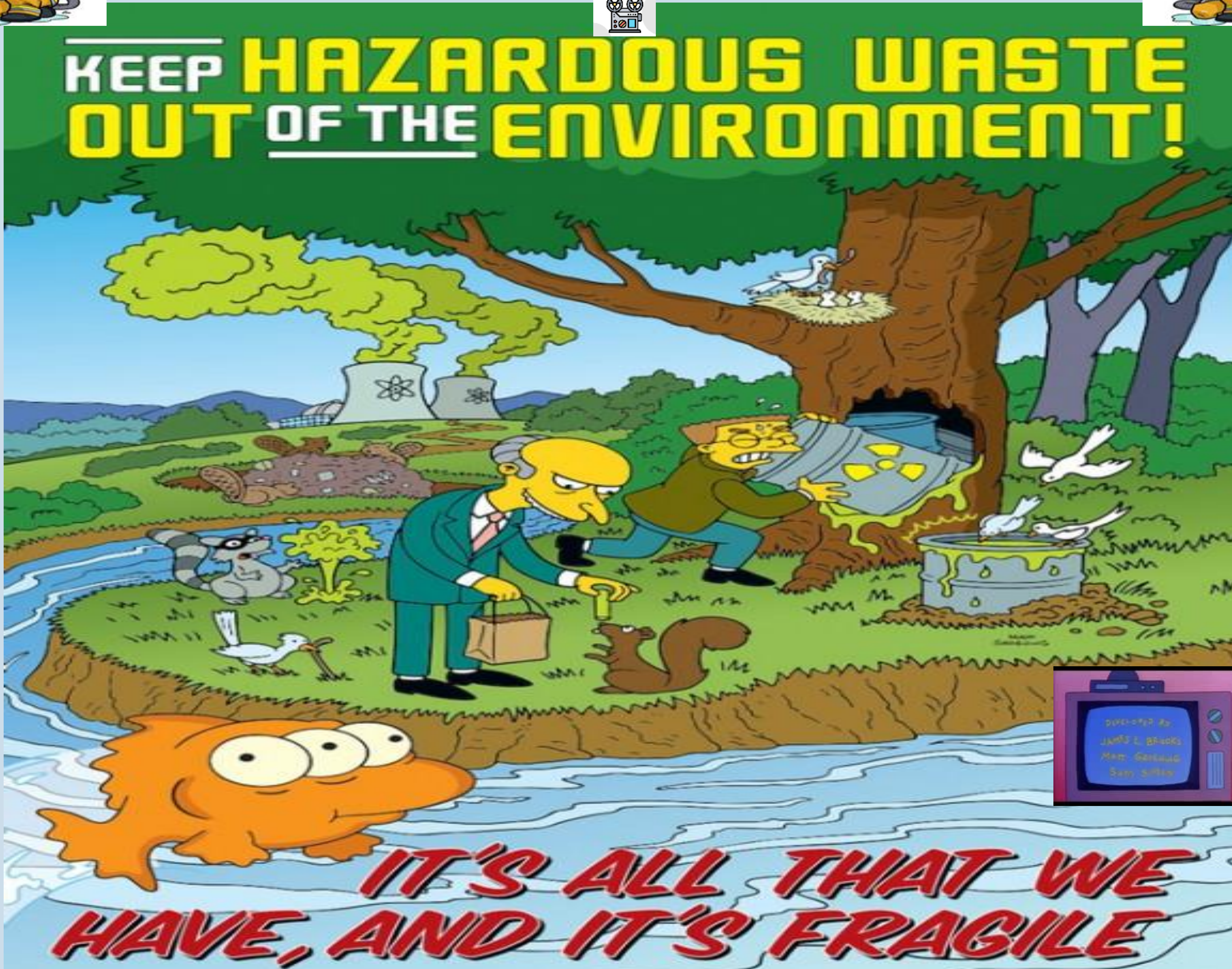
Personnel in this area generally are not required to wear PPE.

Located in this zone:

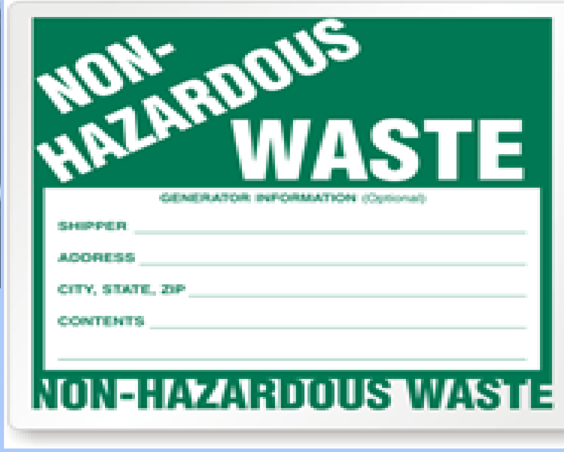
- Command Post and Incident Commander
- Support Services and Agencies
- Staging Area for resources

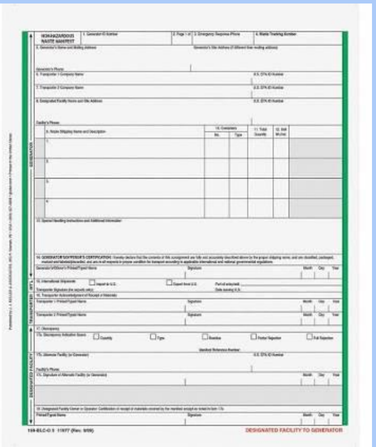
END

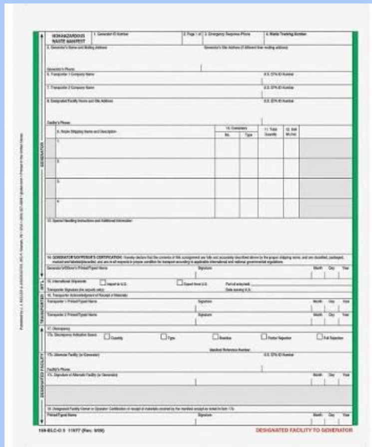
Handling Waste Containers



Hazardous Waste Labels & Manifest







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

- 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.

- **<u>The local Certified Unified Program Agency (CUPA), is responsible for implementing these laws and regulations at the local level.</u>**

ACCREDITING AGENCY CALIFORNIA CUPA FORUM www.calcupa.net

ACCREDITING AGENCY CALIFORNIA CUPA FORUM www.calcupa.net

Hazardous Waste Manifests 4

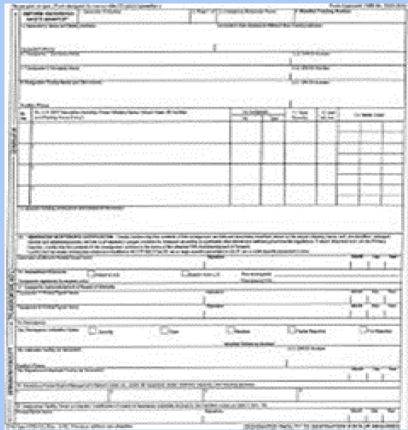
- **Hazardous waste transported for disposal or treatment must be accompanied by a Uniform Hazardous Waste Manifest form:**

- 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.)

Hazardous Waste Manifest System

- 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.**



Hazardous Waste Manifest System

- **<u>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.</u>**
- 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.

- **<u>No, we’re not kidding</u>**

- 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 Violations[6]

- **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

END

Containers 2

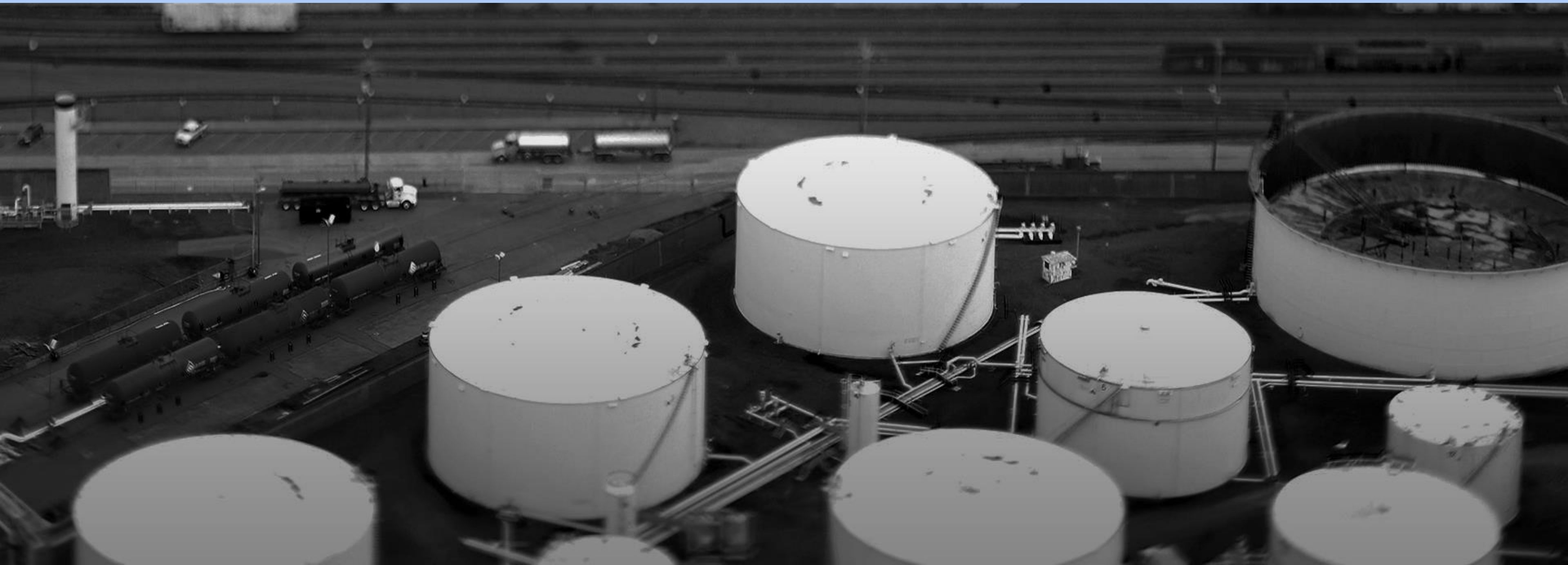
- Vessel or receptacle that holds a material
  - Type, size, and material can provide clues about the nature of the substance inside.
  - Often there is no correlation between the color of the drum and the possible contents.

Bulk Storage Vessels-Tanks

- **Found at facilitys 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
  - **<u>Above-ground storage tanks</u>**
  - **<u>Underground storage tanks</u>**
  - Can hold a few hundred gallons to several million gallons of product



Bulk Storage Vessels

• <u>Totes</u>

- 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 gallons

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

- **<u>Bags……. Small to 1 ton Super Sacks</u>**
  - 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

- **<u>Cylinders</u>**
  - Hold liquids and gases
  - Uninsulated compressed gas cylinders store various substances.
  - Sizes vary.

END

Safety & Health Hazards

Safety

- **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.

Safety Hazards

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

- **T**oxic, **R**eactive, **I**gnitable, **C**orrosive

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
  - <u>Animal bites/stings</u>
  - Toxic plants
  - Microbial

Safety Hazards 1

- *Excavations*, each year more then 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 then 50 kilovolts. Remember to call dig alert and always have utility crews on-hand when performing emergency excavations

Safety Hazards

- ***<u>Electricity</u>***

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. *<u>OSHA requires an assured grounding program or Ground Fault Circuit Interrupter.</u>*

Preventing Electrocution

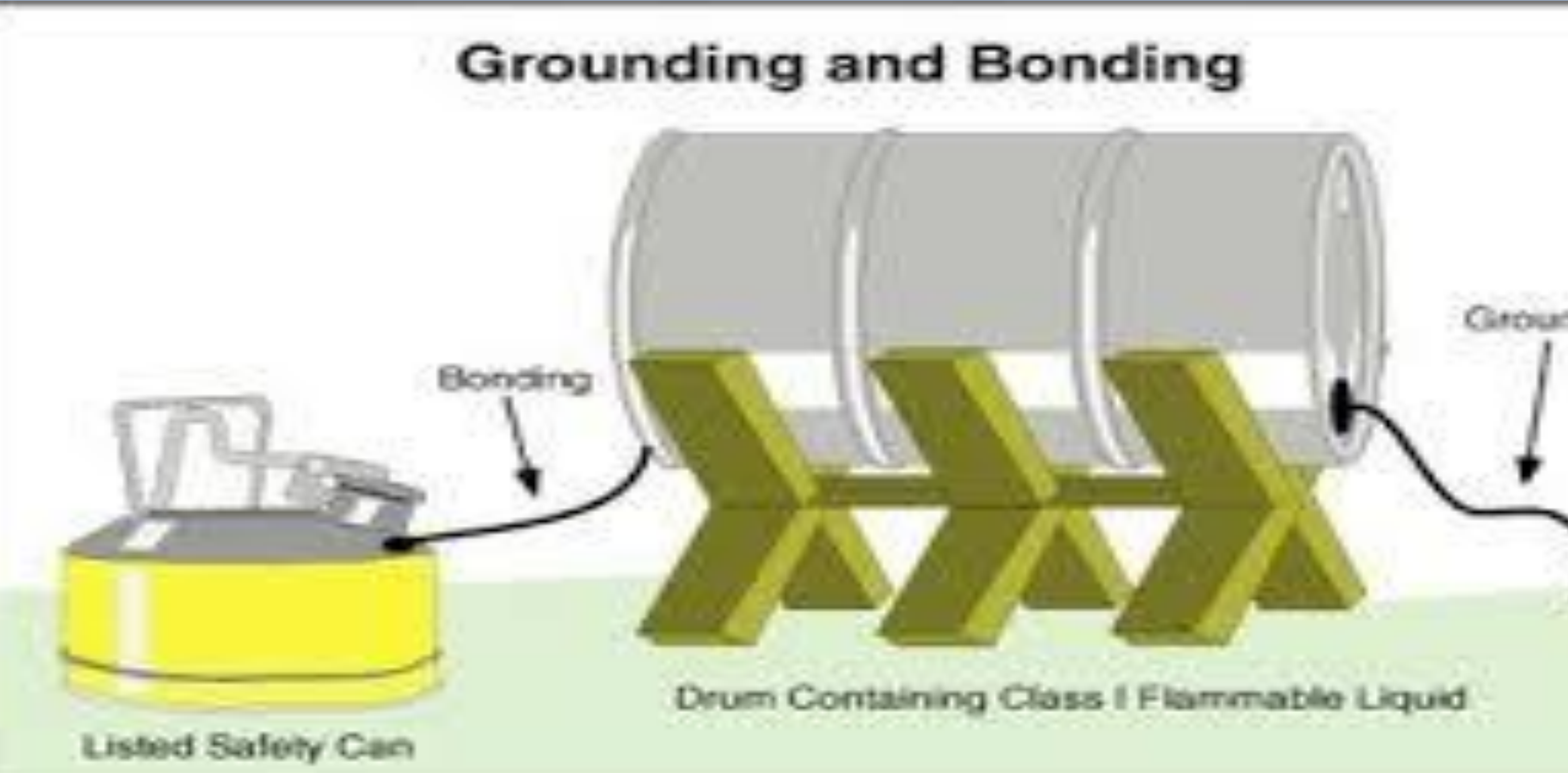
- Lock-out/Tag-out (LOTO)
- De-energize circuit
- Clearly identify and isolate circuit and equipment
- Visual inspection and test to assure de-energizing
- Remove tags and locks by designated worker only

Bonding

Equalizes differences in static potential

Grounding

Eliminates all static potential



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

- 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 quit 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

Heavy Equipment

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

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






Always use Safe Work Practices[4]

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 tour 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.

CPC Fabric Properties

3

<u>Permeation:</u> chemical attacks and immediately breaks through

<u>Degradation:</u> chemical attacks and eventually breaks through

<u>Penetration:</u> chemical seeps in through rips, tears, holes, and seams

CPC Fabric Properties

<u>Chemical resistance:</u> withstands the chemical

<u>Durability:</u> lasts the zone stay-time

<u>Flexibility:</u> does not break down

Temperature extremes:

- Suitable for the climate
- Permeation increases with temperature

Level A Protection

- SCBA or Airline with escape bottle
- Totally encapsulating suit
- Inner gloves
- Steel toe & shank boots
- 2-way radio

Level B Protection

- SCBA or Airline with escape bottle
- Splash suit
- Inner & outer gloves
- Steel toe & shank boots
- Hard hat
- 2-way radio

Level C Protection

- Half or full face APR
- Splash suit
- Inner & outer gloves
- Steel toe & shank boots
- Hard hat
- 2-way radio

Modified Level D Protection 5

Modified Level D Ensemble:

- Chemical resistant coveralls
- Gloves
- Chemical boots or shoes with steel shanks and toes
- Safety glasses or splash goggles
- Hard hat

Level D Protection 2

Level D Ensemble:

- No chemical or respiratory protection
- Protection against safety hazards only

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 ups 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

- **<u>Avoiding cross-contamination</u>**
- Soiled gloves can contaminate objects and surfaces, later exposing you to chemical hazards. When this occurs, you can unknowingly be exposed to chemical hazards.

- **<u>Reduce the likelihood of cross contamination by:</u>**
- Changing gloves immediately when contaminated and after each chemical-handling task
- Discarding gloves immediately after use. Never reuse disposable nitrile gloves!
- Establishing designated ***<u>glove-only vs. no-glove</u>*** 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 | Aqueous/Inorganic

Cyclohexane | 37% Formaldehyde

Nitrile has good general resistance to:

- Oils

Nitrile: Short-term splash protection	
Organics	**Aqueous/Inorganic**
Cyclohexane	37% Formaldehyde
Glutaraldehyde	10% Hydrochloric acid
Heptane	37% Hydrochloric acid
Mineral spirits	30% Hydrogen peroxide
Pentane	10% Nitric acid
Propylene glycol	50% Potassium hydroxide
Naphtha	85% Phosphoric acid
Octane	50% Sodium hydroxide
Octanol	10 - 13% Bleach
Hexane	47% Sulfuric acid
Heptane	Ethidium bromide
	Mercury (metallic)

Nitrile has good general resistance to:

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

Hexane | 47% Sulfuric acid

Heptane | Ethidium bromide

Mercury (metallic)

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

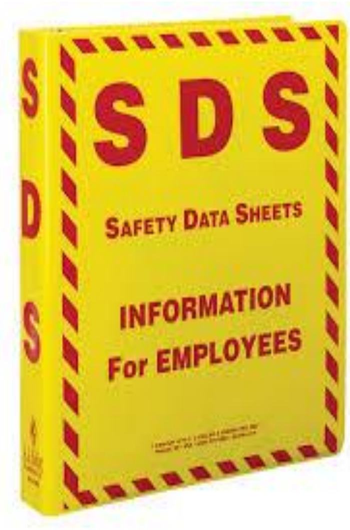
The chemicals listed in red are able to penetrate the skin, contributing to systemic toxic effects of exposure to the chemical. (ACGIH, Skin notation)

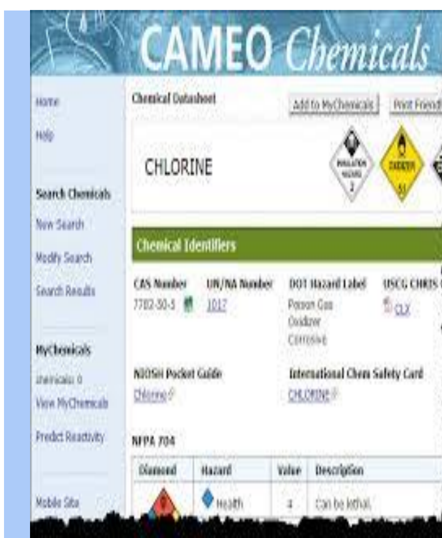
Do Not Use Disposable, One-Time Use, Nitrile Gloves with these chemicals.

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

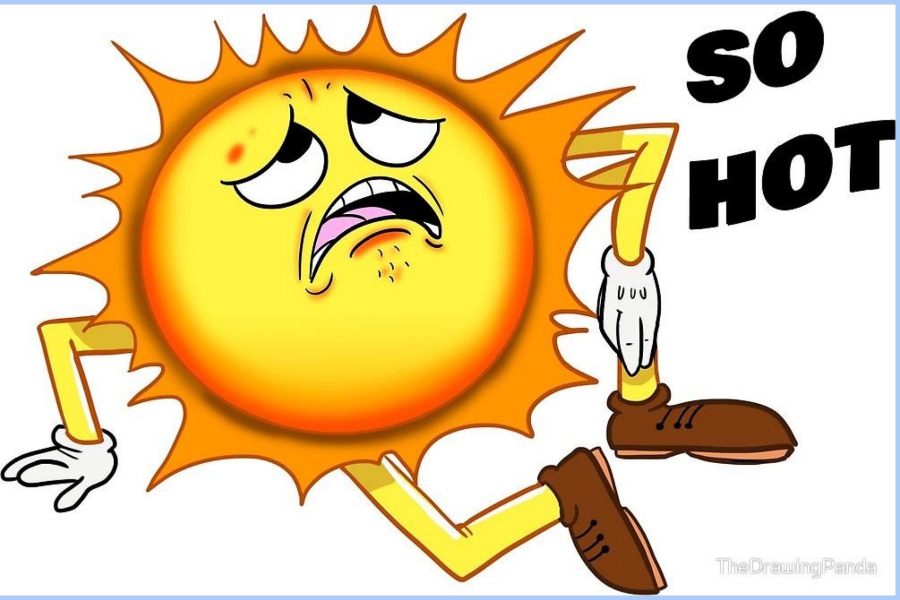
Concentrated acetic acid	70% Nitric acid
30% Ammonium hydroxide	95% Sulfuric acid
88% Formic acid	*Hydrofluoric acid (HF)

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





Wearing PPE & CPC can quickly lead to heat related problems



Heat Related illnesses[5]

Heat Rash:

- Occurs in hot humid environments
- Caused by:
  - Sweat not removed from skin
  - Sweat ducts plug, resulting in skin rash
- **Signs and Symptoms:**
  - Rash aggravated by heat and contact often with infection

Prevention

Remove suit
Leave hot/humid work environment
Allow skin to dry
Bathe regularly

Heat Cramps 5

<u>Causes of Heat Cramps:</u>

- Dehydration
- Depletion of electrolytes (chemical salts)
- Signs and Symptoms include:
  - Painful muscle spasms in:
    - Extremities
    - Abdomen
  - Often after work hours

<u>Treatments:</u>

- Massage cramping muscles
- Gently stretch cramping muscles
- Fluid and electrolyte replacement

Heat Syncope (Fainting) 4

Causes of Heat Syncope:

- Workers not accustomed to hot envi
- Maintaining one work posture
- Also referred to as Heat Fainting

Prevention includes:

- Sitting with head between legs
- Lying down
- Flexing leg muscles before moving
- Standing up slowly
- Sitting up slowly

HEAT EXHAUSTION OR HEAT STROKE

HEAT EXHAUSTION SYMPTOMS:

1. Headache, dizziness, fainting
2. Weakness
3. Irritability or confusion
4. Thirst, nausea, or vomiting
5. Muscle cramps

How to Treat:

1. Move to a cooler location
2. Drink Water
3. Take a cool shower or use a cold compress

HEAT STROKE SYMPTOMS:

1. Throbbing headache
2. No sweating
3. Nausea, vomiting
4. Rapid, strong pulse
5. May lose consciousness

How to Treat:

1. Get emergency help
2. Move to cool area
3. Keep cool until treated
4. Fan and mist person

General Health

Observe Co-workers:

- General physical appearance
- Personality and emotions
- Learn skin color changes for employees with different complexions
- Identify workers ill now or yesterday

Preventing Heat Related Illness[3]

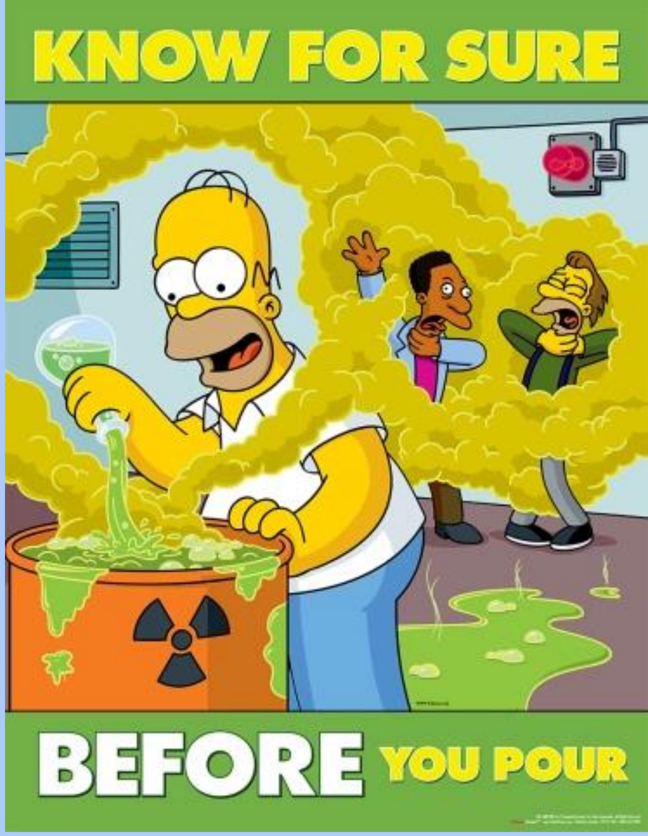
- Stay hydrated
- Replace lost fluids (water, juices)
- Avoid caffeine and alcohol (diuretic)
- Replace electrolytes (sports drinks, fruits, vegetables)

Street Smart Chemistry

Street Smart
Size Up
Physical Properties

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

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

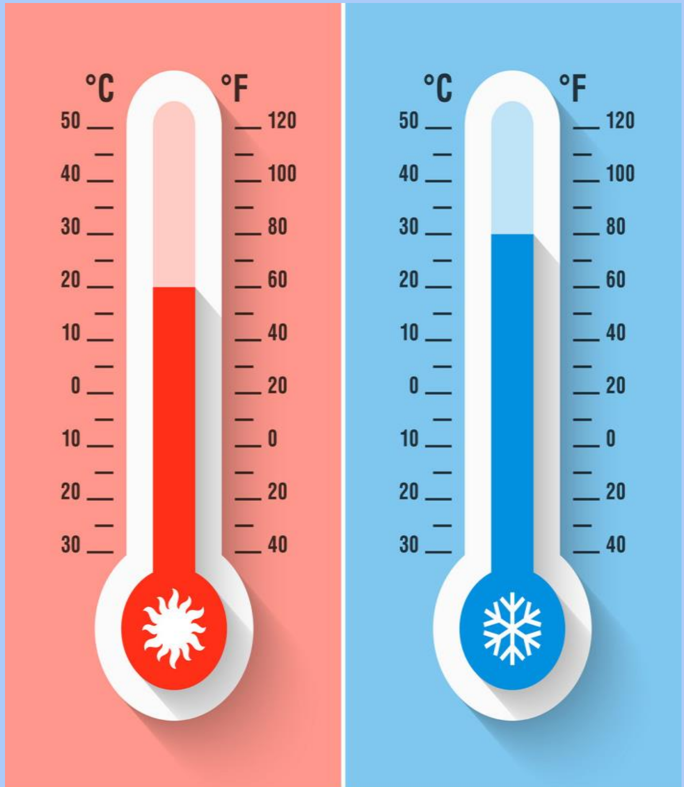
- **Lets convert Fahrenheit to Celsius**

Take 80 degrees Fahrenheit

Minus 30 then divide by 2

This equals 25 Celsius

- Add 273 to equal Kelvin & 457 for Fahrenheit



Vapor Density

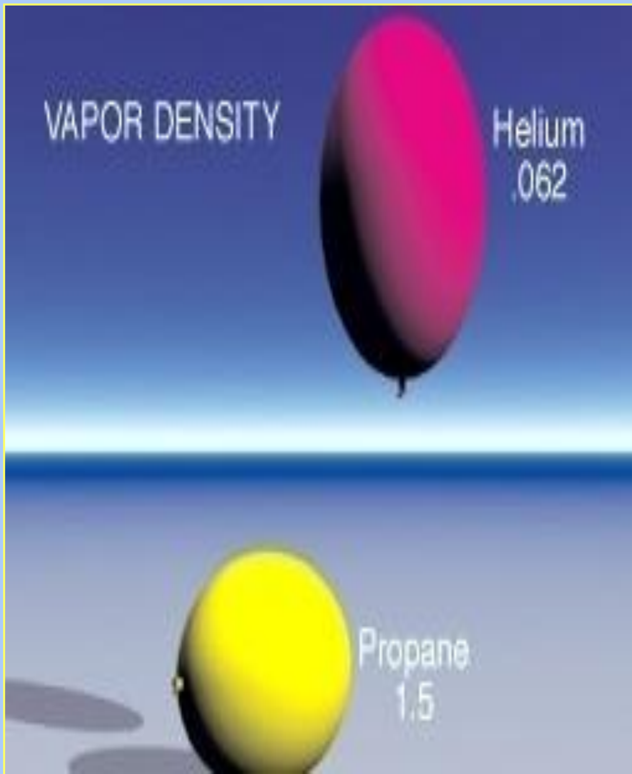
- The weight of a given volume of vapor or gas compared to the weight of an equal volume of dry air at the same temperature and pressure.

- 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.

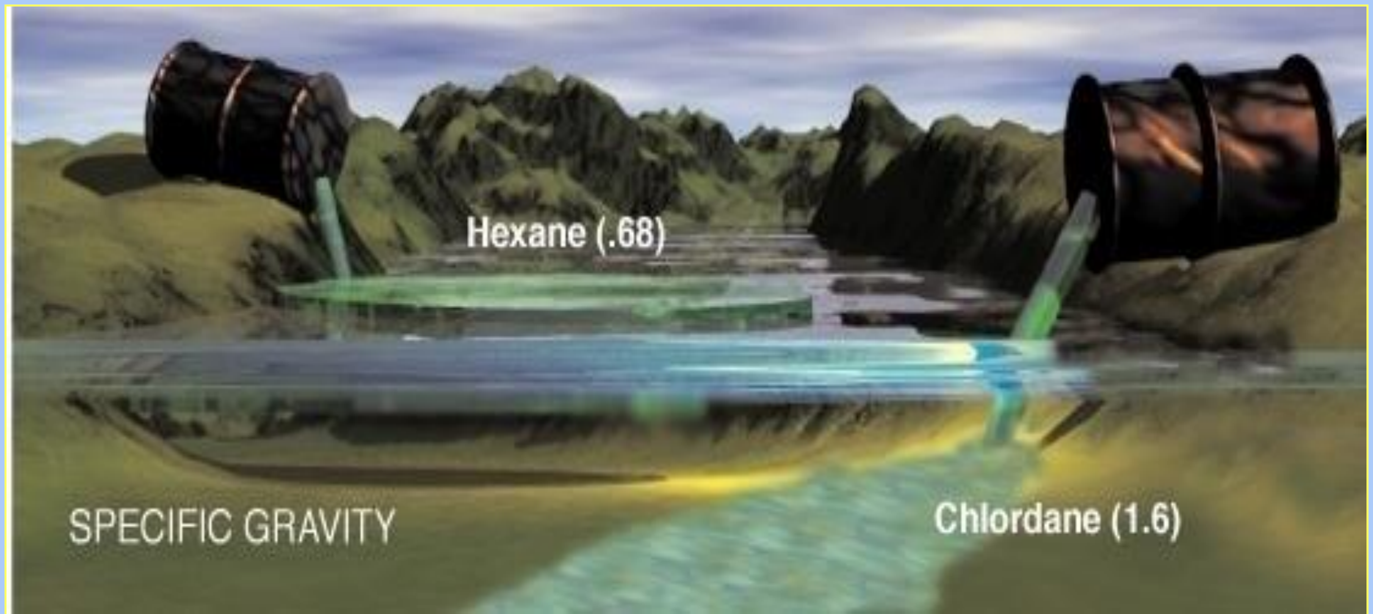
Vapor Densities greater than one will indicate a vapor or gas will settle or sink.

Illuminating Gases “Nat Gas”
Neon
Fluoride
Carbon monoxide
Ammonia
Nitrogen
Methane
Ethylene
Acetylene
Methllithium
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.



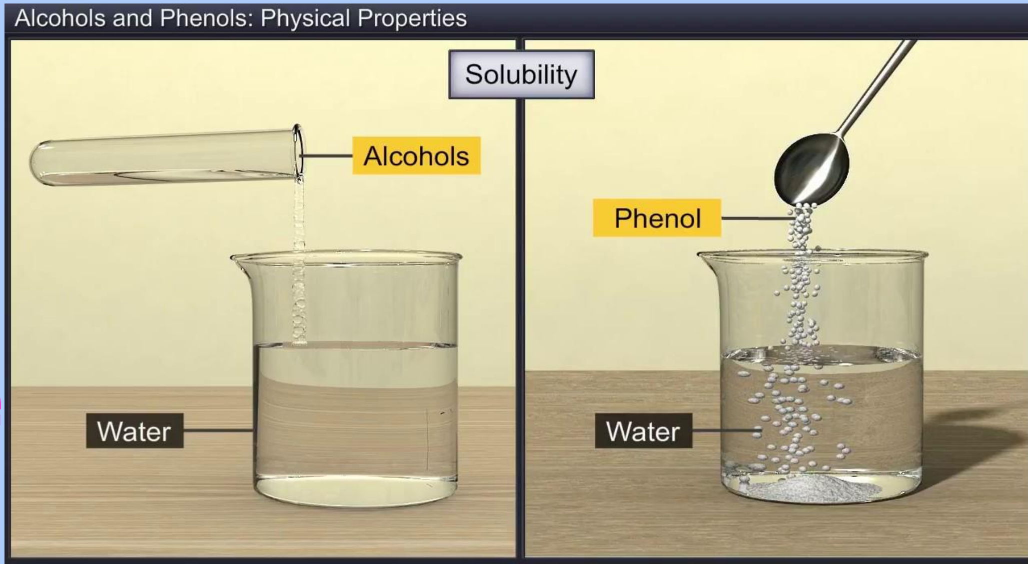
Solubility---Miscibility---Miscible

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**

Vapor Pressure

- 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.

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

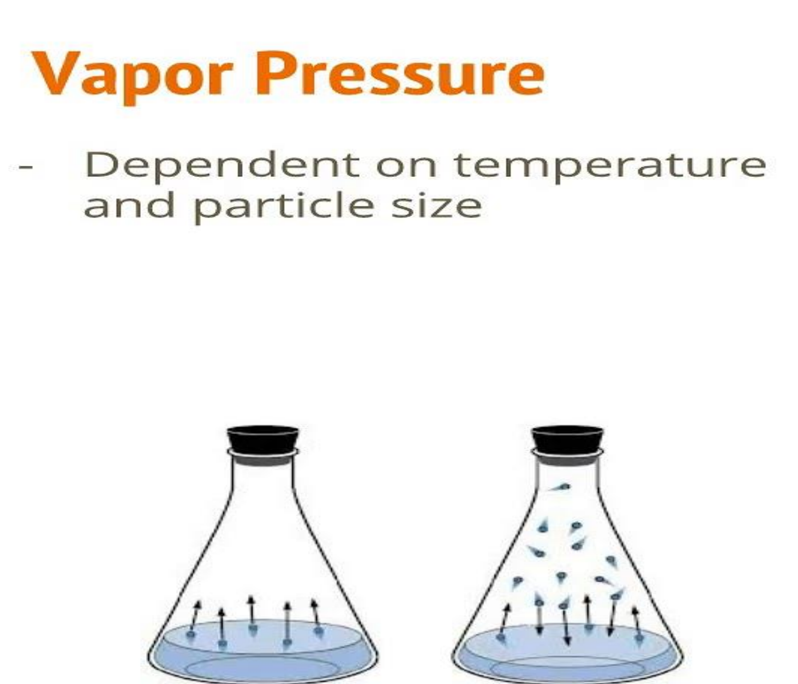
mm Hg "millimetre of mercury"

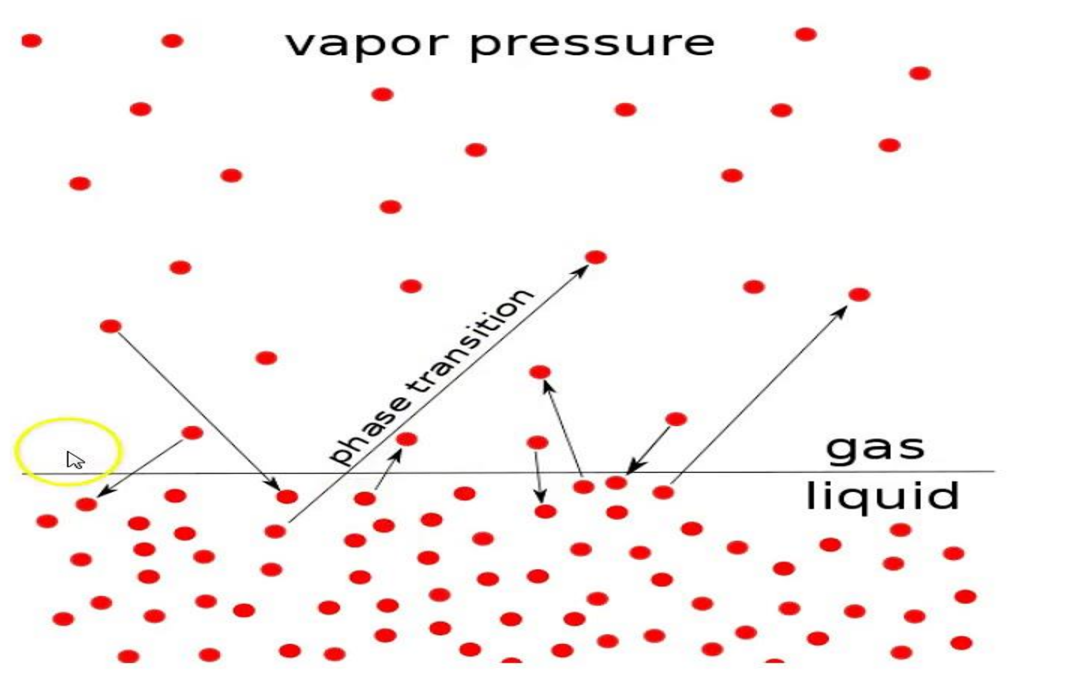
kPa "kilopascal"

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

Common Vapor Pressures

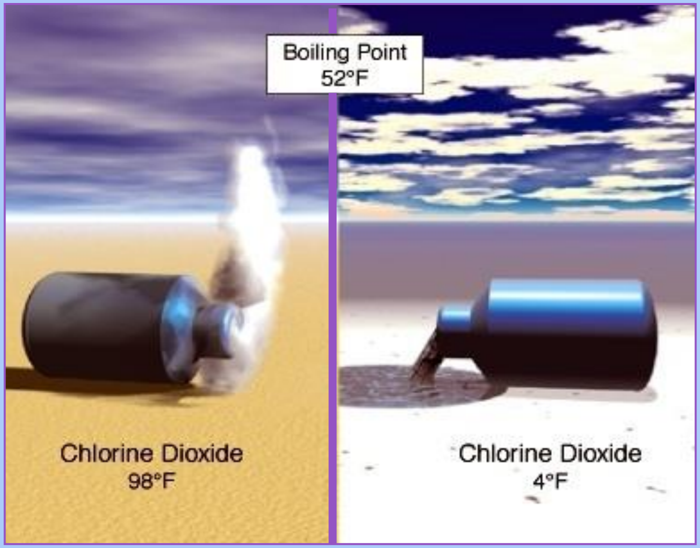
- **<u>Water – 17 mm Hg</u>**
- Acetone – 180 mm Hg
- Gasoline – 300 mm Hg
- Ethyl ether – 440 mm Hg
- Methyl alcohol – 100 mm Hg
- Diesel fuel – 5 mm Hg
- Sodium hydroxide – 1 mm Hg @ 2534º F
- Sulfuric acid – 0.001 mm Hg





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

- 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.

NH_3 Expansion Ratio 1 to 850

Cryogenics

- The cryogenic temperature range has been defined as from −150 °C (−238 °F) to absolute zero (−273 °C or −460 °F)

- Their physical temperature can cause thermal harm.

- Severe harm can occur in contact with the products.

- These products will also expand rapidly creating vapor clouds.

FLASH POINT

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

Chemical	Flash Point
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.

Chemical	LEL	UEL
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

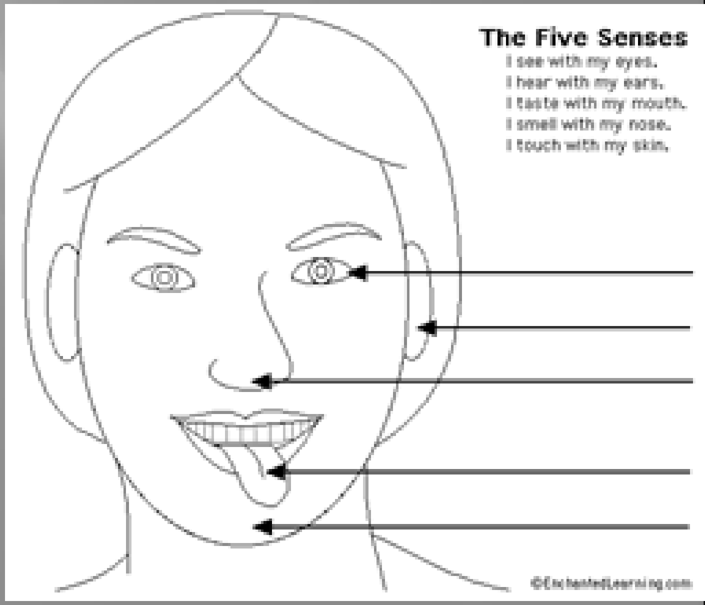
- Does my chemical float or sink in air ????

Monitoring for Hazardous Atmospheres

Why is Detection Important?

3

- Our 5 senses miss many dangerous environments
- Too little or too much oxygen
- Flammable levels of methane in air
- Carbon monoxide



Types of Monitoring Instruments

- pH paper
- Oxygen Meters
- Flammable Gas Detectors
- Toxic Gas Sensors
- PID and FID
- Colorimetric Sampling
- Radiation Detection
- Infrared spectrometry
- Haz-Cat Kit
- Thermal Imager
- Donut

Why is Detection Important?

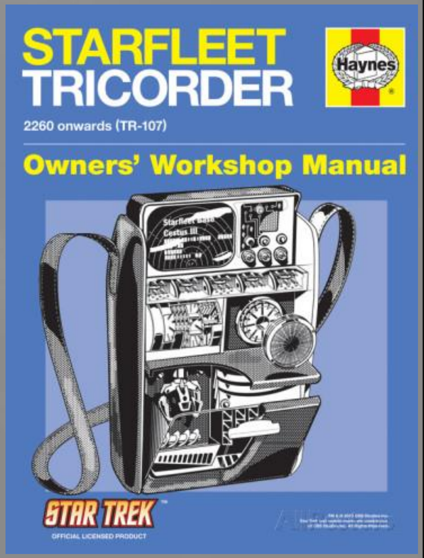
Humans cannot rely on their senses for decision making

- Without effectively knowing how to use detection techniques we are unable to:
- Identify threats
- Make Personal Protective Equipment (PPE) decisions that are appropriate to the actual hazard.
- **Detection technologies supplement our senses when making decisions in potentially hazardous environments:** ***they become our eyes and ears.***

You need to learn how to fully use and trust these detectors

Why is Detection Important?

- Many detectors are essentially dumb devices that take readings and output a number
- They depend upon person using this device to interpret numbers and make an educated assumption on what it means
- Even on ***Star Trek***, they still gave the Tricorder to the smartest person on the Enterprise!



Detectors need Detectives to come to the right conclusion

Where do I find gases and vapors? [3]

<u>People often ask "how far does my gas detector need to be from something to measure it?"</u>

The answer is that the detector needs to be in the cloud to measure "it"

Gas isn't like radiation, radiation diminishes with the inverse square law, so radiation reliably falls off logarithmically from its source

It can be less than a foot of difference from being in a gas cloud to being out of a gas cloud

Does the Chemical Want to be a Gas/Vapor?

From the perspective of gas/vapor detection, one of the most important considerations is, does the chemical even want to be a gas/vapor.

There are two “numbers” that help us make this determination.

- ***Boiling Point***
- ***Vapor Pressure***
- Why is this important?

<u>Because heavy sticky vapors are harder to detect than light gases.</u>

There is no Antidote for Lack of Oxygen

According to 1910.146, air is oxygen deficient whenever concentration is less than 19.5%

Causes:

Displacement: another gas/vapor replaces air reducing oxygen content.

Microbial action: oxygen is consumed by metabolic activity.

Oxidation: the combination of a chemical substance with oxygen to form another chemical.

Combustion: oxygen consumed by fire.

Absorption/Adsorption: oxygen dissolves into a substance or bonds to the surface of a substance.

Oxygen Enrichment 3

29 CFR 1910.146 Specifies 23.5 % is oxygen enriched

High levels of oxygen can increase the rate of many chemical reactions.

Can cause ordinary combustible materials to become flammable or explosive.

The Apollo 1 command module fire in 1967 was caused by Velcro becoming explosively combustible in an oxygen enriched environment.

Flammability is the 2nd most important atmospheric parameter [4]

After oxygen, the detection of ***combustible gases and vapors*** is the next most important atmospheric parameter to measure.

While in some cases humans can smell and even taste some flammable gases and vapors, we are not calibrated to know when we have reached a concentration that is potentially flammable.

When we smell gasoline we can't tell if there is a flammable concentration or not.

Because we can't measure flammability we need to use and understand detection technologies that will provide us with the information we need to make decisions.

pH

- We will start with pH because that's what you should test for first.

- Strong Acid
  - Bright Red
- Strong Base
  - Dark Blue

Combustible Gas Indicator

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- Used to determine if there is a flammable gas present.
- Measures the % of LEL
- Never work in areas with greater than a reading of 10% "it's the law"
- Limitations:
  - Does not tell you what gas or vapor is in the air
  - Gives different readings with different gases.
  - Reads low in oxygen deficiency
  - **Takes at least 20 seconds for meter to respond *"Response Time"***

What is a Correction Factor?

- A Correction Factor (CF) is a measure of the sensitivity of the LEL sensor to a particular gas or vapor
- Manufacturers challenge their sensors with a known concentration of a flammable gas and measure the sensors response to create correction factors
- A low CF means that the LEL sensor is very sensitive to a gas or vapor
- A high CF means that the LEL sensor does not have as good sensitivity to a gas or vapors
- Corrections factors are scaling factors, they do not make a LEL sensor specific to a chemical, they only correct the scale to that chemical.

What it looks like

GAS BEING SAMPLED	LEL (% vol)	CALIBRATION GAS: Butane	Hexane	* Hydrogen	* Methane	* Pentane	* Propane
Acetone	2.5%	1.06	0.70	1.70	1.70	0.90	1.10
Acetylene	2.5%	0.74	0.60	1.30	1.30	0.70	0.80
Benzene	1.2%	1.16	0.80	1.90	1.90	1.00	1.20
Butane	1.8%	1.00	0.55	1.69	1.58	0.79	0.98
Ethane	3.0%	0.84	0.60	1.30	1.30	0.70	0.80
Ethanol	3.3%	0.94	0.52	1.59	1.49	0.74	0.92
Ethylene	2.7%	0.84	0.60	1.40	1.30	0.70	0.90
Hexane	1.1%	1.81	1.00	3.04	2.86	1.42	1.77
Hydrogen	4.0%	0.59	0.33	1.00	0.94	0.47	0.58
Isopropanol	2.0%	1.16	0.90	2.00	1.90	1.00	1.20
Methane	5.0%	0.63	0.35	1.06	1.00	0.50	0.62
Methanol	6.0%	0.63	0.50	1.10	1.10	0.60	0.70
Nonane	0.8%	2.34	1.30	3.95	3.71	1.84	2.29
Pentane	1.4%	1.28	0.71	2.15	2.02	1.00	1.25
Propane	2.1%	1.02	0.57	1.72	1.62	0.80	1.00
Styrene	0.9%	1.30	1.00	2.20	2.20	1.10	1.40
Toluene	1.1%	1.62	0.89	2.71	2.55	1.26	1.57
Xylene	1.1%	1.58	1.10	2.60	2.50	1.30	1.60
JP-4	—	—	—	—	—	1.20	—
JP-5	—	—	—	—	—	0.90	—
JP-8	—	—	—	—	—	1.50	—

CF Example: Xylene

- **<u>CGI reads 7% of LEL in a Xylene atmosphere.</u>**

- #*Detector is calibrated using Methane gas with a correction factor for Xylene of 2.50*

Then the actual concentration is 17.5% LEL Xylene

2.5 CF* x 7%LEL methane = 17.5%LEL Xylene

Remember 1% LEL equals 10,000 PPM

Substance	Permissible Exposure Limit (PPM)
Carbon Dioxide	5,000
Carbon Monoxide	50
Hydrogen Sulfide	20
Methane	1,000
Nitric Oxide	25
Oxygen diflouride	0.05
Phosgene (carbonyl chloride)	0.1
Sulfur Dioxide	5
Stoddard Solvent	500

Single Gas Air Monitoring

Zero Maintenance
Sensor Range 0-100 ppm
Low Alarm 10 ppm
High Alarm 15 ppm
Operate at Temperatures from -40 to + 122 ºF

- **Calibration not required**
- **Daily testing is required**
- **Must be bump tested monthly**
- **Batteries last for 24 to 36 months depending on the manufacturer**

Photoionization Detector (PID)

Ultra-violet lamp measures <u>energy</u>

Removes electron from molecule

Called “Ionization Potential” or “electron-volt potential” (eV)

Limitations:

- Lamps operate at 9.0 - 12.0 eV
- Reads up to lamp’s eV potential only
- Blind to substances with smaller molecules
- High humidity and dust limit its capabilities

- PIDs don’t like, Common toxics (Carbon Monoxide, Hydrogen cyanide, Sulfur Dioxide) Natural gas (methane and ethane) Acid gases, Non volatiles (PCB’s, grease, etc.)

Flame Ionization Detector (FID)

Measures:

- Total Organics
- Reads in ppm
- Hydrogen flame ionizes sample

Limitations:

- Uses Hydrogen Gas
- More complex than PID
- Sensitive to methane

Toxic(s) Meters (Sensors)

- Read in ppm
- Measure specific chemicals such as:
  - Hydrogen Sulfide
  - Chlorine
  - Ammonia

Colorimetric Detectors

Colorimetric detectors draw air through a sample tube

- #Piston type
- #Bellows Type
- # Chips

Limitations:

- Cross sensitivities
- Temperature extremes
- Stain length
- Pump leaks
- Tube shelf life
- Accuracy of ± - 35%

Calibration & Maintenance

- Field calibration should be done in a clean air environment.
- Never test your meter by blowing into it or sticking it into a gas tank.
- Make extra copies of the instruction sheets for each team member.
- Re-calibration as per manufactures recommendations.

Limitations

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No results are 100%

Conditions change.

Confined space entry requires continuous monitoring.

It's not a Tri-corder, it only measures for 4 things.

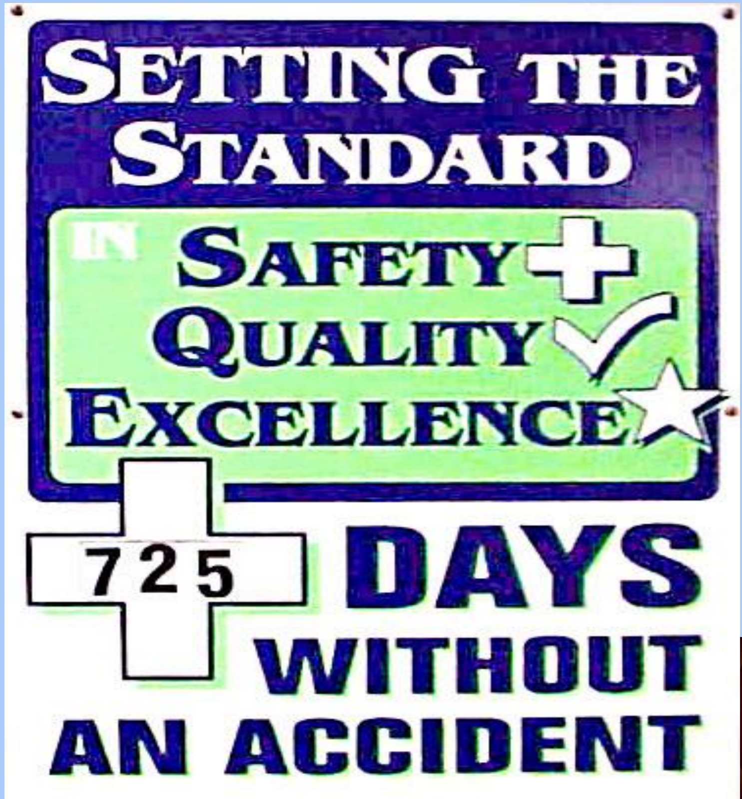
Many things affect your monitors performance.

Your monitor must be calibrated to the same contaminates that are being measured.

Batteries wear out and sensors have a shelf life.

Remember!

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



Any Questions???

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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!

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