

Hazardous Materials Technician State Test Review

*Presented by:
Florida Association of Hazmat
Responders*

Regulations

- Department of Transportation
- Occupational Health and Safety Administration
- Environmental Protection Agency

Department of Transportation

- **Regulates the transportation of hazardous materials and hazardous wastes**
- **Requires employers to provide hazardous materials training for employees**
- **Publishes Performance-Oriented Packaging Standards (POPS)**
- **Publishes the Hazardous Materials Table (49 CFR 172.101)**
- **Designates hazard classes**
- **Regulates placarding and labeling standards**
- **Publishes chemical segregation table**

49 CFR 172.101 Hazardous Materials Table

S y m b o l s	Hazardous Materials Shipping Names	Hazard Class or Division	UN/NA ID Numbers	Packing Groups	Labels Required (unless excepted)	Special Provisions	Packaging Authorization 173.***			Quantity Limitations	
							8	9	10	11	12
1	2	3	4	5	6	7	Excep- tions	Non- Bulk	Bulk	P.A and R.C.	Cargo. Aircraft
	Acetone	3	UN 1090	II	Flammable Liquid	T8	150	202	242	5 L	60 L
	Corrosive Liquid, N.O.S.	8	UN 1760	I	Corrosive	A7,B10, 242	None	201	243	.5 L	2.5 L
				II		B2,T14	154	202	242	1 L	30 L
				III		T7	154	203	241	5 L	60 L
	Methylhydrazine	6.1	UN 1244	I	Poison, Flammable Liquid, Corrosive	1,B9,B14,B3 0,B72, B77,N34, T38,T43, T44	None	226	244	Forbid	Forbid
+	Nitric Acid, Red Fuming	8	UN 2032	I	Corrosive, Oxidizer, Poison	2,B9,B32, B74,T38, T43,T45	None	227	244	Forbid	Forbid
	Sulfuric Acid with more than 51 % acid	8	UN 1830	II	Corrosive	A3,A7,B3, B83,B84,N34, T9 T27	154	202	242	Forbid	30 L

Note: Column 10, which provides limitations on shipment by water is not included in this table.

Column 1 Symbols

- “A”= Aircraft restrictions
- “W”= Vessel restrictions
- “D”= Domestic transportation only
- “I”= Internationals transportation only
- “+”=Fixes the proper shipping name, hazard class, and packing group for that entry without regard to whether the materials meets the definition of that class or packing group or any other class definition.

Column 2

- Hazardous Materials Description and Shipping Name
- Information in *italics* are not part of the name/ description.

Column 3

- Hazard Class or division
- May have a “forbidden” notation

Column 4

- UN/NA
 - United Nations and North American
- Can be shipped internationally
- 4 digit number which refers to the North American Emergency Response Guidebook.

Column 5

- Packing Group
 - I (Great Danger)
 - II (Moderate Danger)
 - III (Minor Danger)
- Always in Roman numerals
- Class 2,7, and ORM do not have groups.

Column 6

- Required Labels
- First label is the primary hazard.
- Other labels are subsidiary labels and must not carry a number in the lower corner.

Column 7

- Special provisions under 172.102
- “A”= Aircraft
- “B”= Bulk
- “H”= Highway
- “N”= Non-bulk less than 119 gallons or a net mass of 400 kg.
- “R”= Railways
- “T”= Portable Tanks
- “W”= Water

Column 8

- Packaging Authorizations
- “8A”= exceptions
- “8B”= Bulk containers
- “8C”= Non-bulk containers

Column 9

- Quantity Limitation
- “9A”= Transportation by passenger vehicles
- “9B”= Transportation by cargo vehicles
- “Forbidden” may be noted
- Quantities are net unless otherwise noted.

Column 10

- Stowage requirements aboard waterborne vehicles.

HAZARD CLASSES

Hazard Class	Hazard Class Description	Hazard Class/ Division	Hazard Division Description
1	Explosives	1.1 1.2 1.3 1.4 1.5 1.6	Mass Explosion Hazard Projection Hazard Fire Hazard No Blast Hazard Insensitive Explosive Extremely Insensitive Explosive
2	Compressed Gases	2.1 2.2 2.3	Flammable Non-Flammable and Non-Poisonous Poisonous
3	Flammable Liquid	NO DIVISIONS	
4	Flammable Solid	4.1 4.2 4.3	Flammable Solids Spontaneously Combustible Dangerous When Wet
5	Oxidizers	5.1 5.2	Oxidizers Organic Peroxides
6	Poisons	6.1 6.2	Poisons Etiologic Agents
7	Radioactive	NO DIVISIONS	
8	Corrosives	NO DIVISIONS	
9	Misc. Hazards	NO DIVISIONS	

Table 1 Materials

- Always require placarding regardless of quantity.
- Class 1.1, 1.2., 1.3
- Class 2.3
- Class 4.3
- Class 7
- Class 6.1, PG1, PIH Zone A and B
- Organic Peroxides, 5.2, Type B, liquid or solid, temperature controlled

Table 2 Materials

- All other hazard classes and materials not in Table 1.
- Aggregate gross weight of 1,001 lbs. or more of hazardous materials.
- Table 2 material in a package meeting the definition of a bulk package (See Section 171.8).
- Those materials requiring a subsidiary placard (See Section 172.505).

Labels

- When chemicals have multiple hazards in Column 6, then multiple labels should be used.
- Primary labels are to the above or to the left of subsidiary labels.
- Placed within 6 inches of the product or waste label.
- Subsidiary labels do not have numbers.

Occupation Health and Safety Administration

- **Regulates the handling of hazardous materials and hazardous waste at facility sites**
- **Develops standards covering worker health and safety**
- **Publishes the Hazard Communication Standard (29 CFR 1910.1200)**
- **Publishes HAZWOPER (29 CFR 1910.120) covering hazardous waste operations and emergency response**
- **Publishes other standards covering various issues (e.g., confined spaces, bloodborne pathogens, respiratory protection)**

Standards Promulgated by OSHA

- Legally enforceable standards in:
 - General Industry
 - Maritime
 - Construction
 - Agriculture
- OSHA Standards apply to all workplaces.

Environmental Protection Agency

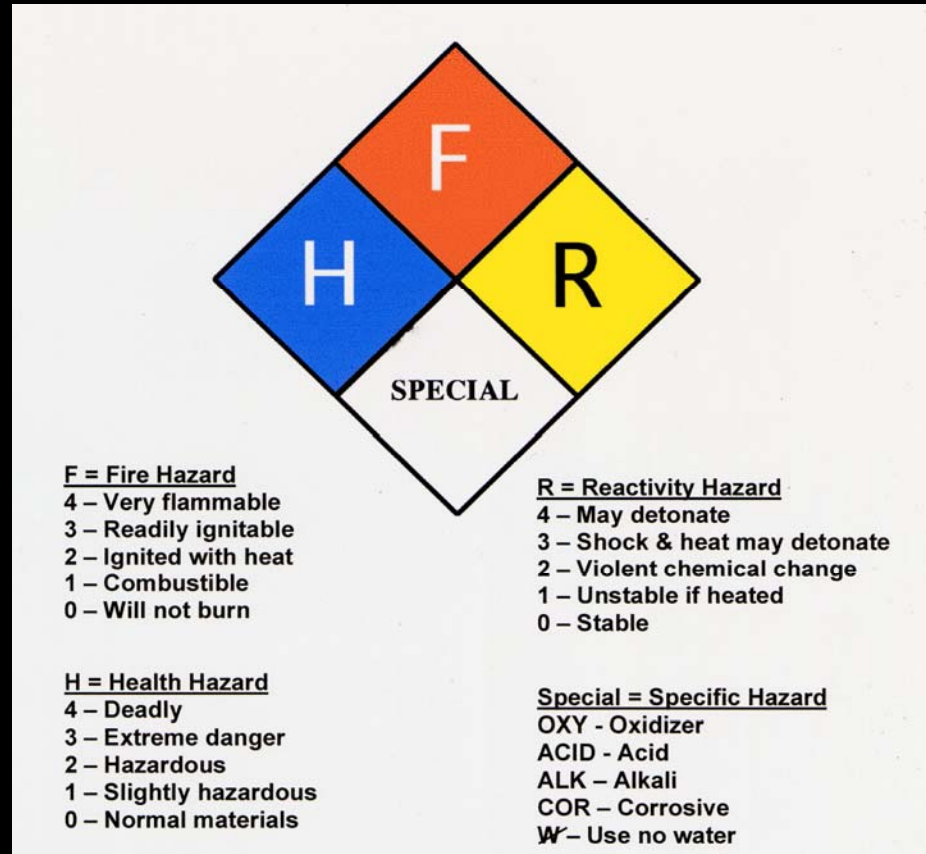
- **Regulates the Federal system of hazardous waste management**
- **Establishes environmental regulations**
- **Enforces:**
 - **Resource Conservation and Recovery Act (RCRA)**
 - **Comprehensive Environmental Responsibility Compensation and Liability Act (CERCLA)**
 - **Superfund Amendment and Reauthorization Act (SARA)**
 - **Toxic Substance Control Act (TSCA)**
 - **Clean Air Act (CAA)**

Superfund Amendment & Reauthorization Act

- Emergency Planning and Community Right to Know Act established in Oct. 17, 1986.
- Emergency Planning
- Emergency Release Notifications
- Reporting Requirements
- Toxic Chemical Inventory Forms

NFPA 704 Diamond

- National Fire Protection Agency
- Blue= Health
- Red= Fire
- Yellow= Reactivity
- White= Special Hazards



Hazardous Materials Identification System

- National Paint and Coating System
- Blue= Health
- Red= Fire
- Yellow= Reactivity
- White= Personal Protective Equipment



Health Hazard

- 4 – Deadly
- 3 – Extreme danger
- 2 – Hazardous
- 1 – Slightly Hazardous
- 0 – Normal materials
- * – Chronic hazard

Reactivity Hazard

- 4 – May detonate
- 3 – Shock & heat may detonate
- 2 – Violent chemical change
- 1 – Unstable if heated
- 0 – Stable

Fire Hazard

- 4 – Very flammable
- 3 – Readily ignitable
- 2 – Ignited with heat
- 1 – Combustible
- 0 – Will not burn

PPE

Personal Protective Equipment recommendations

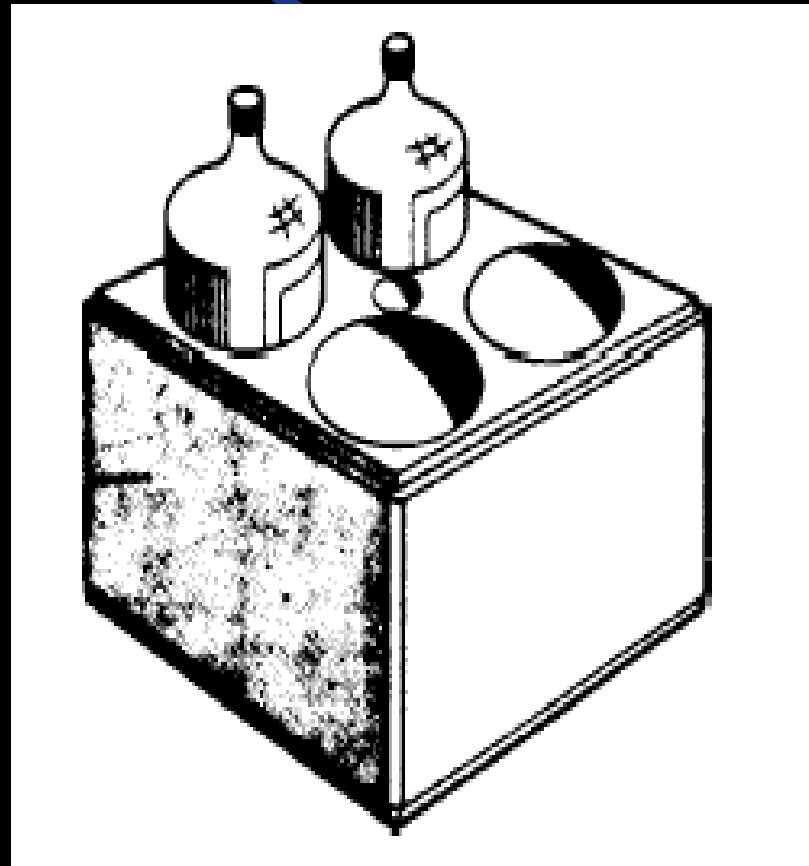
Recognition and Identification

Emergency Centers

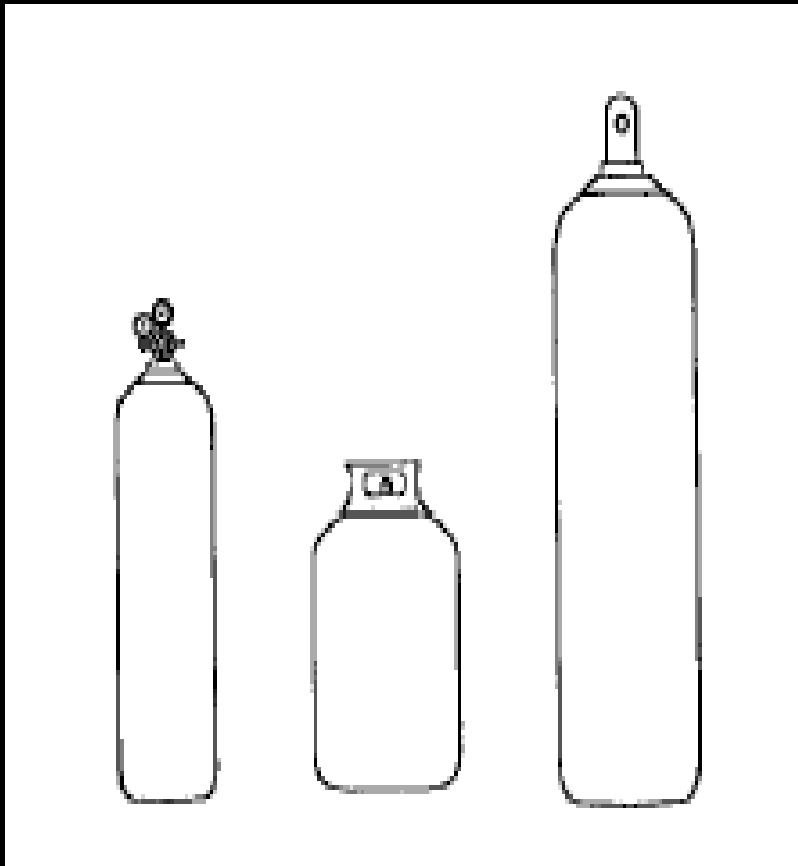
- Important resources providing immediate technical assistance to responders.
 - CHEMTREC
 - CHEM-TEL, INC.
 - INFOTRAC
 - 3E COMPANY
 - National Response Center

MultiCell Packages

- Non-bulk container
- Polystyrene form filled box or wooden crate
- No more than six bottles and 4 liters

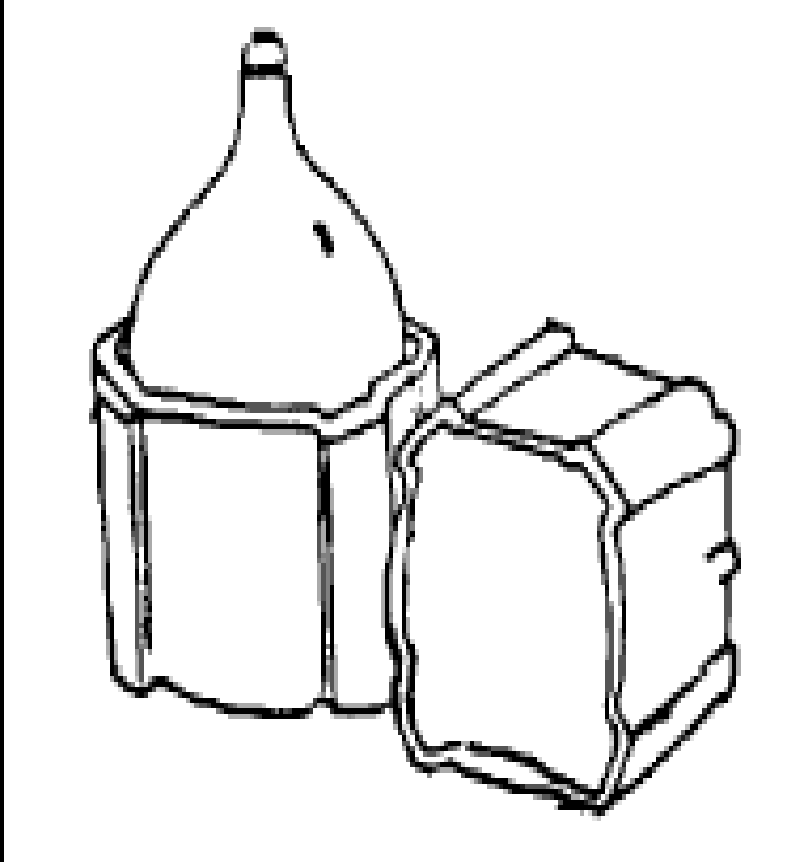


Cylinders



- Contain compressed gas, flammable combustible liquids, radioactive materials, poisons, or corrosives.
- High or low pressure
- Valves
- Safety Relief Valves

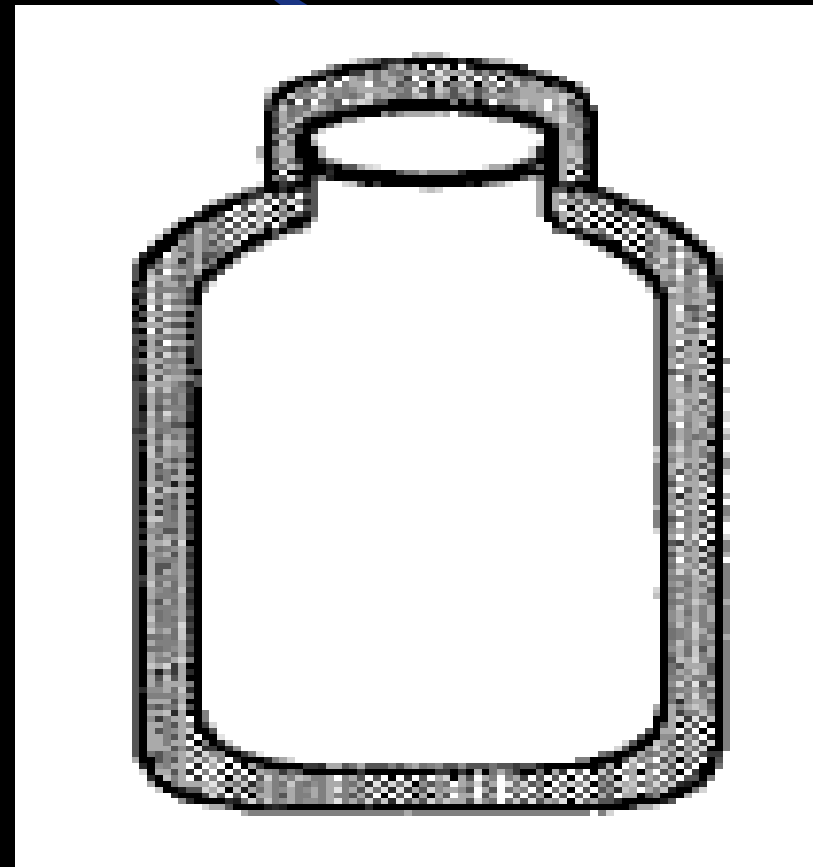
Carboys



- Almost exclusively for hazardous materials
- Glass or plastic
- Encased in specially made boxes of wood or cardboard.
- Non- bulk between 13 and 20 gallons
- Because of construction can be found to carry corrosives

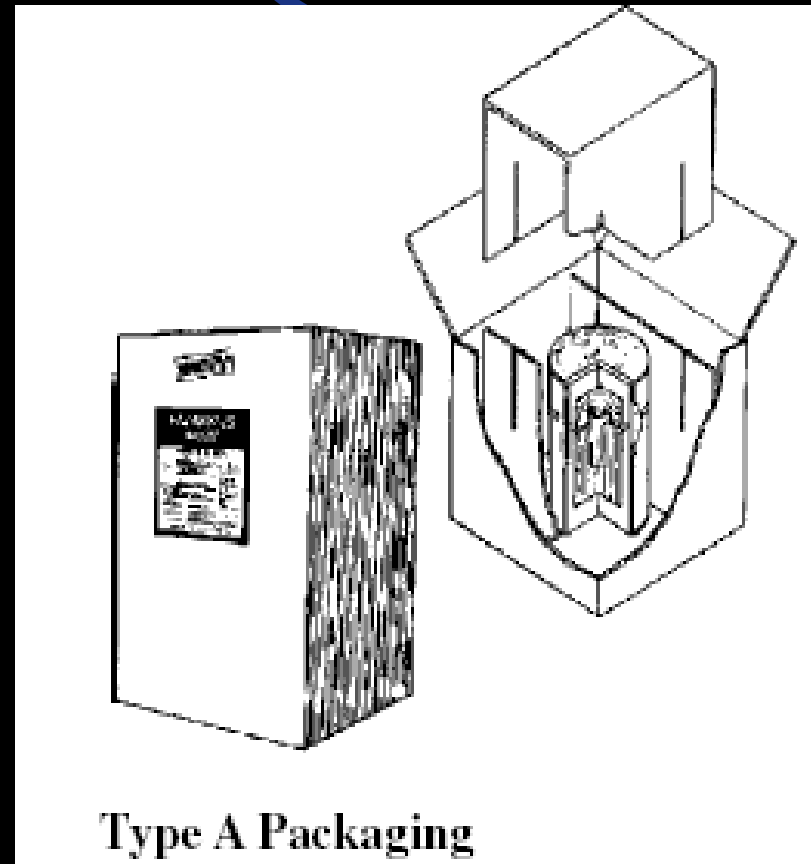
Dewars

- Cryogenic liquid storage
- Glass lined with heavy insulation
- Jacketed-vacuum
- Non-pressure



Radioactive Type A Package

- Low level materials
- Inner package cushioned in a stronger outer package



Material Safety Data Sheets

- Best source of information on a specific hazardous material.
- Not required to be attached to shipping papers.
- Can be received from manufacturer or shipper.
- May be incomplete or inaccurate on data.

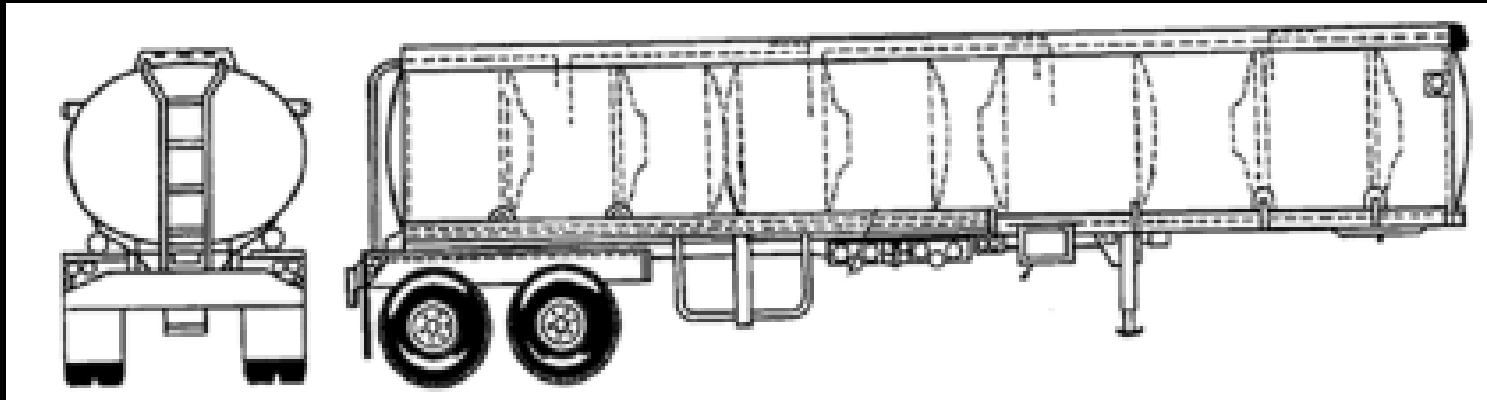
Data Collection

- Shipper's are also a good resource on response information if M.S.D.S. or other resources are not available.
- May be able to identify contents if the truck's identification number can be supplied.

Cargo Tank Truck Design

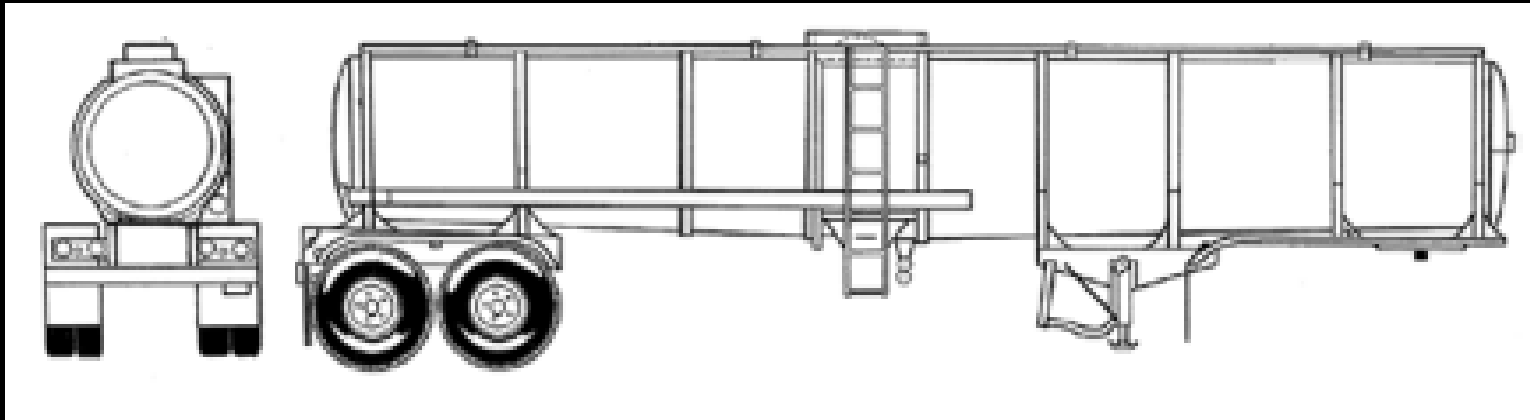
- Recognition of types of cargo tank trucks.
- Physical characteristics.
- Commodities carried.
- Quantities carried.
- Valving and venting.

MC 306/ DOT 406



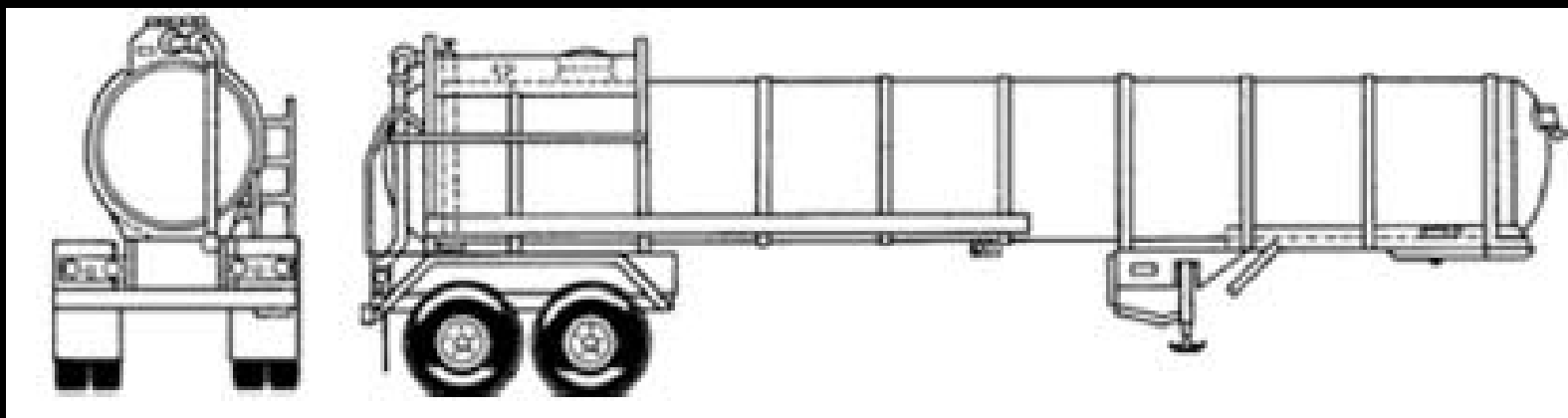
- Carry 1,500 up to 12,000 gallons.
- Primarily carry petroleum, fuel oils. May carry alcohols, class B poisons, or food products
- Elliptical cross sections and flat heads
- Multiple Cells
- Atmospheric pressure container

MC 307/ DOT 407



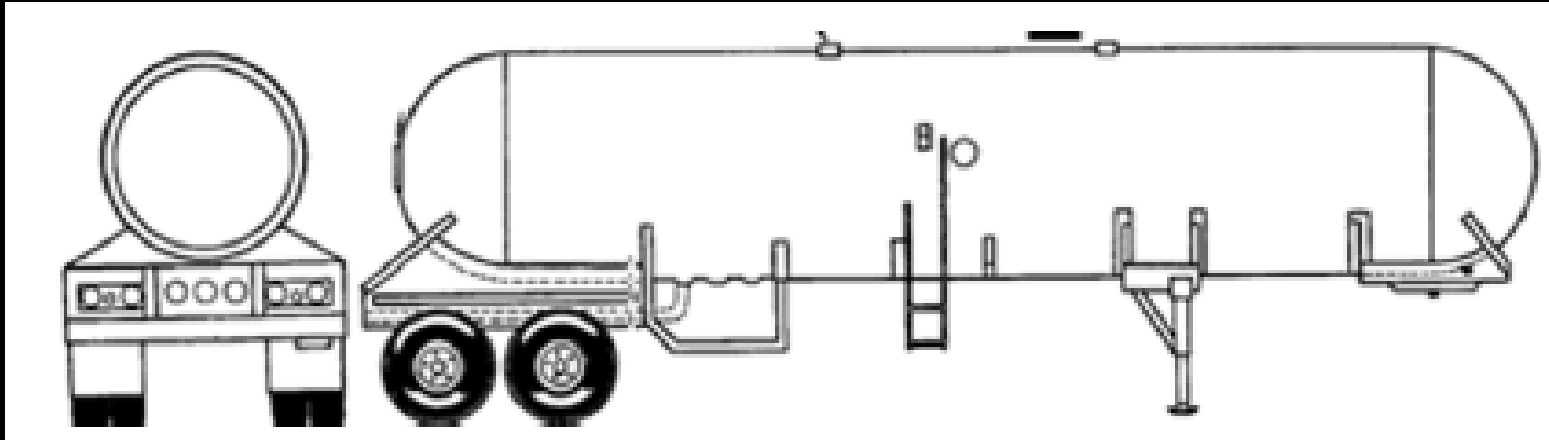
- Low pressure cargo (25 to 35 psig)
- Diameter tapers from front to back
- 5,000 to 8,000 gallons for 307/ up to 9,500 for 407 with cells for different classes.
- Flammables, combustibles, mild corrosives, toxins, and almost all other type of chemicals.

MC 312/ DOT 412



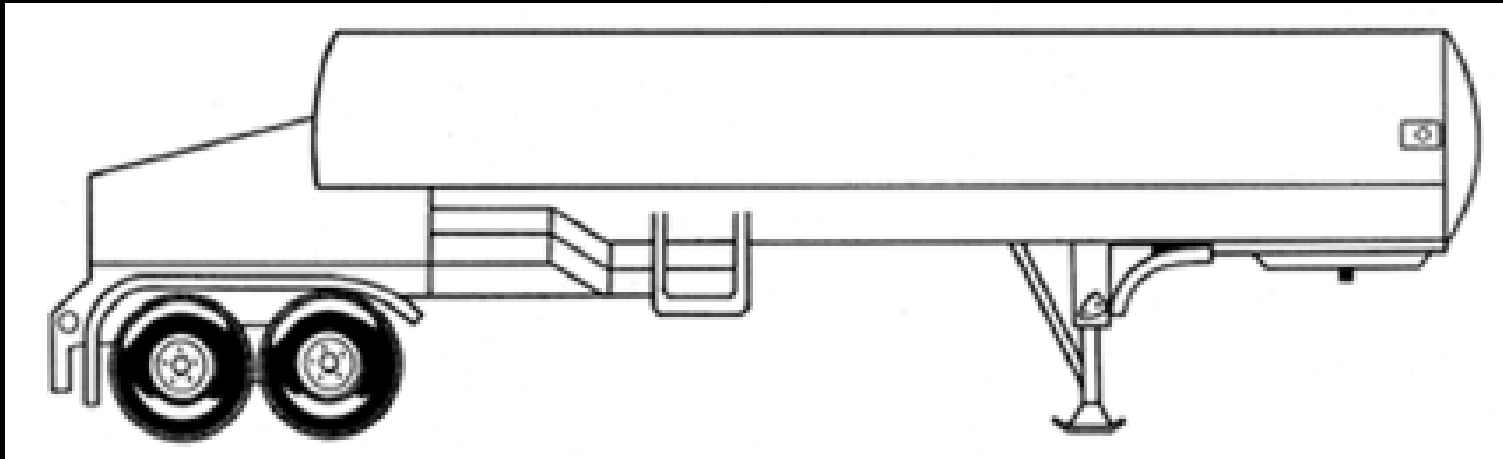
- Low pressure cargo (15 to 50 psig)
- Visible stiffening rings, some may have jacketed insulation hiding rings.
- Smaller diameter.
- 3,000 to 7,000 gallons with some with multiple cells.
- Commonly carry heavy corrosives.

MC 331



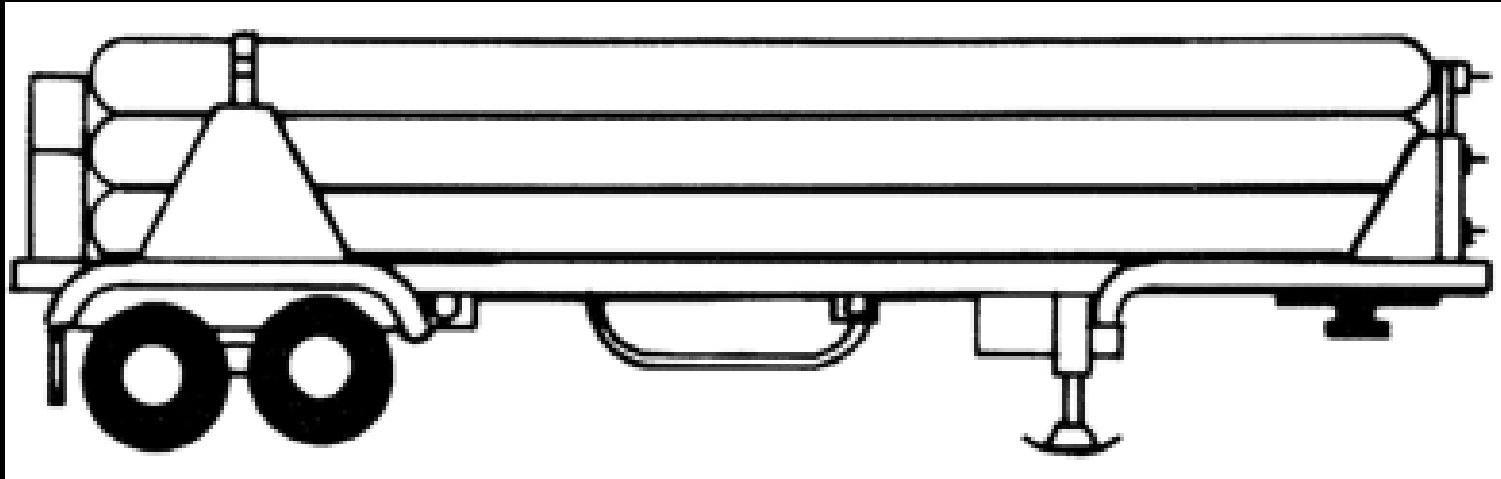
- 100 to 500 psig working pressures, High Pressure
- Rounded heads and painted white or highly reflective.
- Emergency discharge valves at both ends.
- 8,000 to 11,500 gallons.
- Propane, butane, anhydrous ammonia, nitrous oxide, carbon monoxide, chlorine.

MC 338



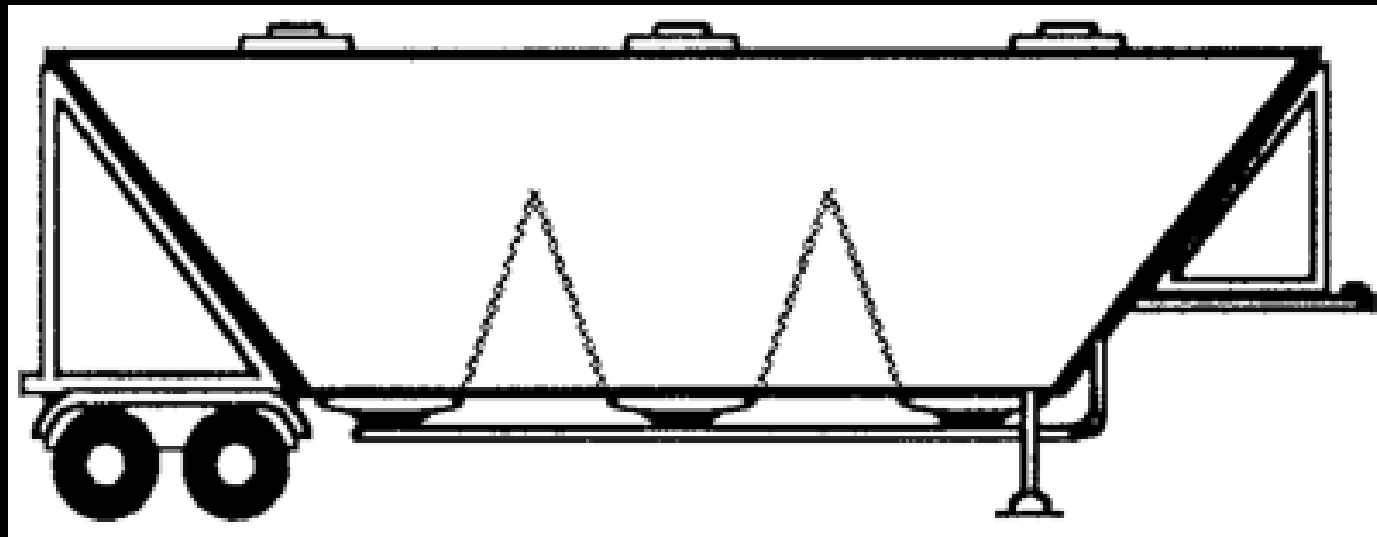
- Cryogenic at -130° F. Commonly vent.
- Circular diameter with flattened heads.
- Highly insulated with valving commonly at the rear.
- 8,000 to 10,000 gallons.
- LOX, Liq. Nitrogen, Liq. Hydrogen, Liq. Helium, Liq. Carbon Dioxide are common.

Tube Trailers



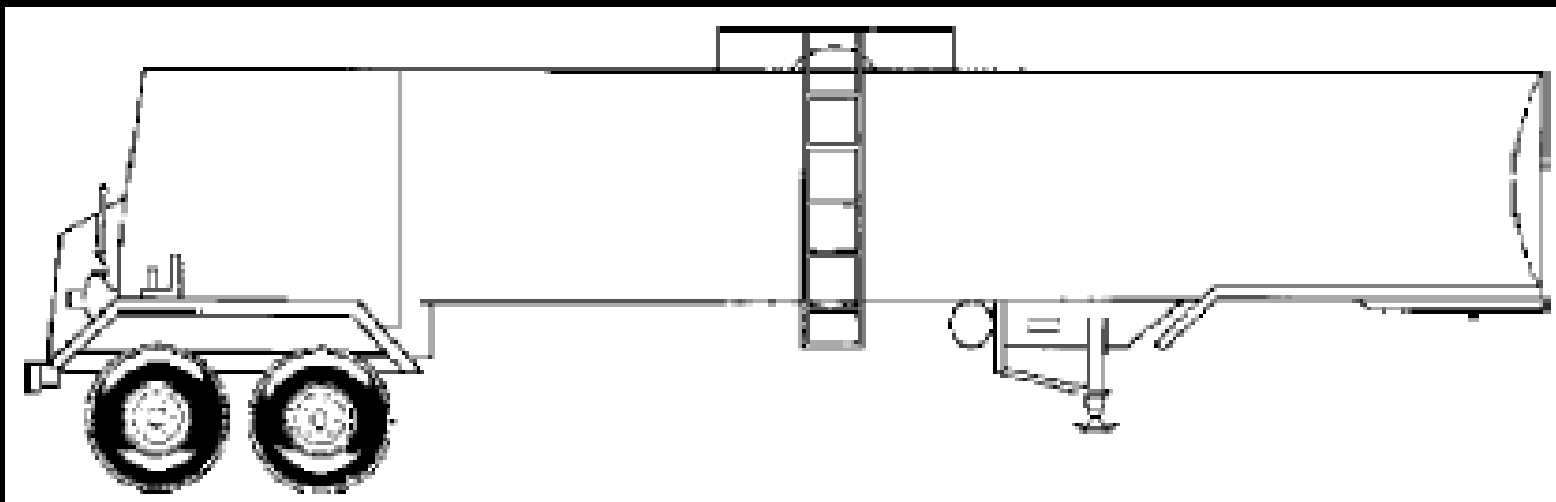
- Compressed Gas Truck
- 2 to 20 long, thin tubes or cylinders.
- 9 to 48" in diameter with pressures up to 5,000 psig.
- Gases are at high pressure, e.g., atmospheric gases, argon, carbon dioxide, helium, hydrogen, oxygen, nitrogen, and refrigerants. Do not carry liquefied gases.

Dry Bulk Commodity Carriers



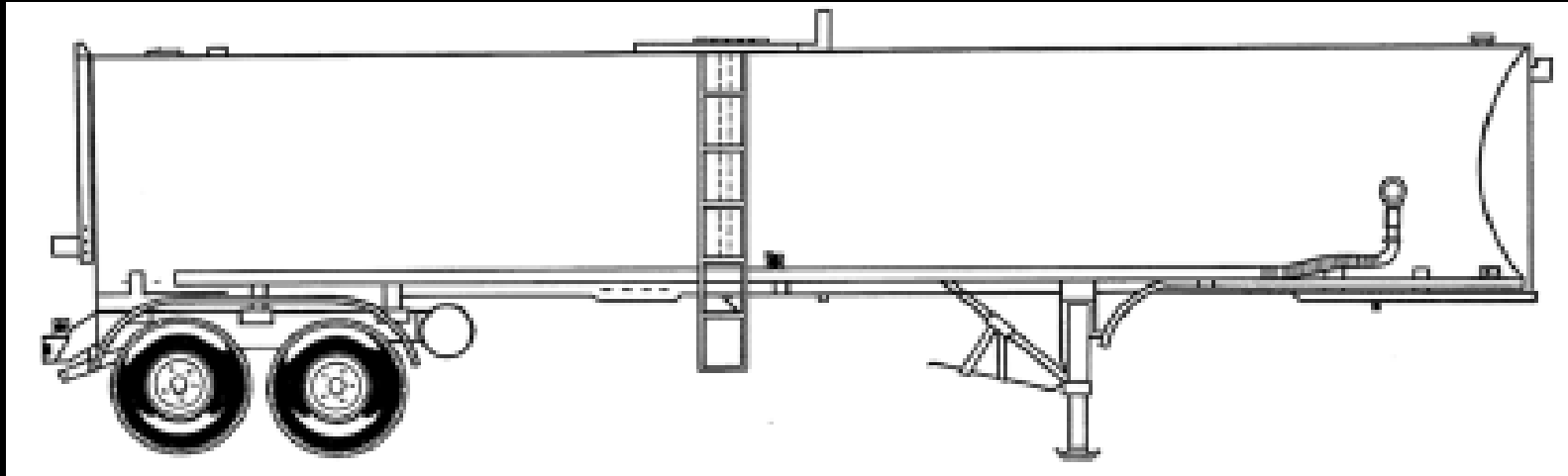
- Large, heavy, sloping V shape unloading compartments.
- Rear mounted air compressors.
- Pneumatically off load hoppers.
- Fertilizers, oxidizers, plastics are common commodities.
- May have water reactive materials.
- Transport hazardous and non-hazardous materials.

Molten Materials Carriers



- Molten materials are not considered hazardous, so not always placarded. High temperatures.
- Usually stenciled product name, e.g., “Molten Sulfur”
- 3,300 to 4,300 gallons of material.
- Large, heavily insulated metal “pots” on flat trailers.

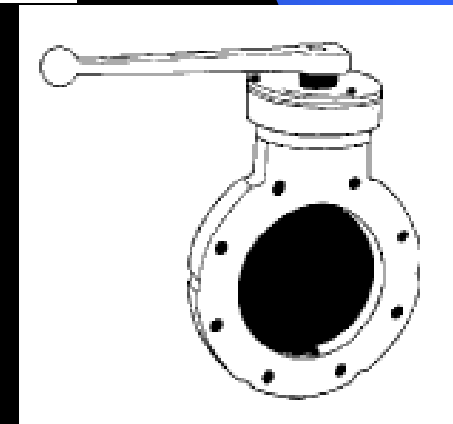
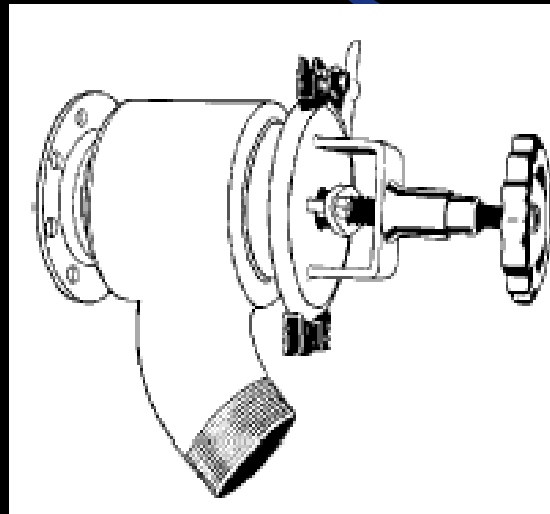
Tar and Asphalt Carriers



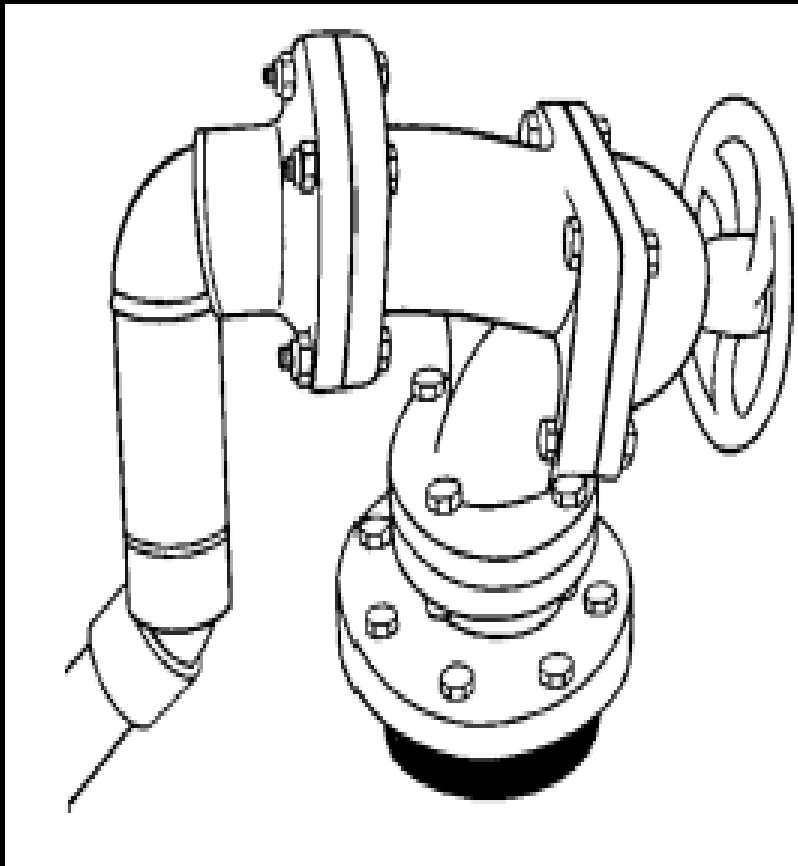
- Used to transport hot asphalt and solvent mixtures for asphalt products.
- Non-pressure tank of steel with an outer jacket.
- 400° to 500° F with propane burners and attached propane tanks.

Discharge Valves

- Y adapter valves
- Hydro let valves
- Ball valves
- Butterfly valves
- Flush valves
- Gate valves
- Globe valves

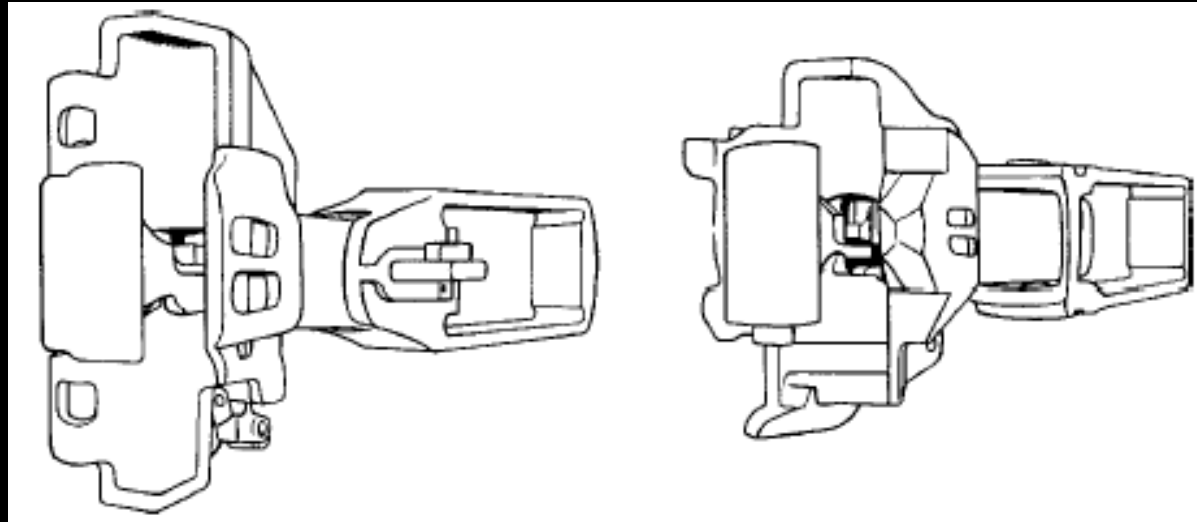


Top Mounted Discharge Valves



Railcar Tanks and Design

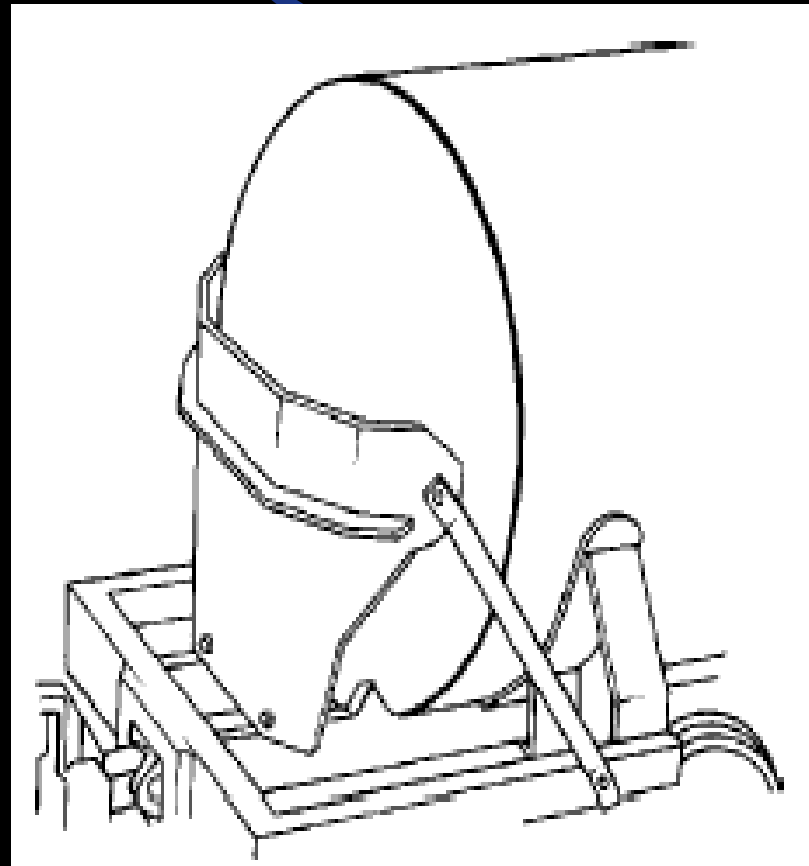
Shelf Couplers



- Required for all tank cars after Nov. 15, 1990 for transportation of materials subject to the hazardous materials regulations.
- Prevent tanks from becoming uncoupled and the tanks colliding during derailment.

Retro-fit Head Shields

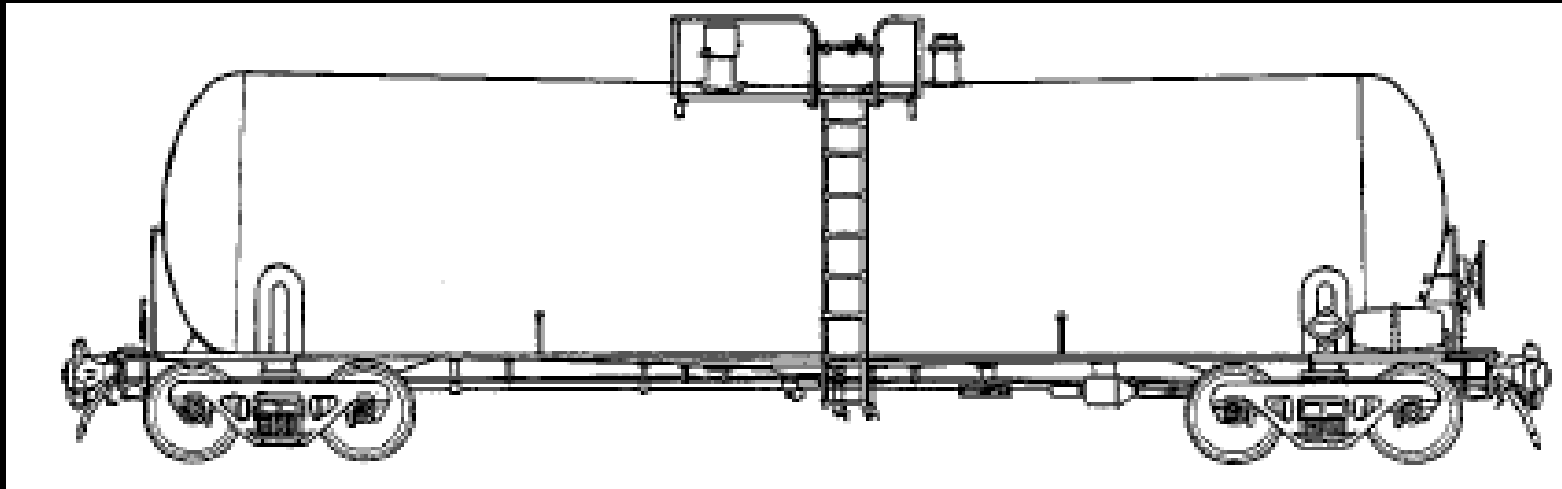
- Retro-fit program to protect ends of tank from damage.
- Built into head of car or “half-head” or “trapezoidal-shaped” on each end of tank car.



Tank Insulation

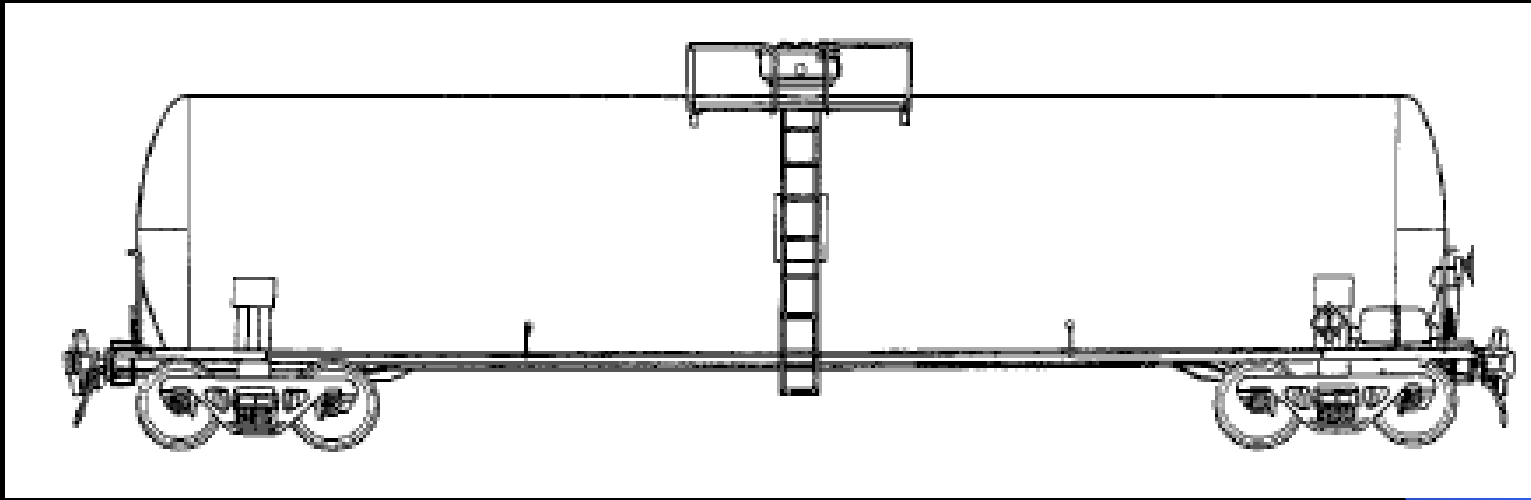
- Used to maintain temperature of product.
- Fiberglass or polyurethane is most common for insulation.
- Cork for certain tanks such as hydrocyanic acid.
- Perlite is most common for refrigerated liquefied gases.
- Metal jacketed to hold insulation in place.

Non-Pressure Tank Cars



- Convex heads, visible valving. One manway or expansion dome.
- 4,000 to 45,000 gallons capacity.
- 35 to 100 psig test pressures.
- Non-pressure carry flammable and combustible liquid and solids, oxidizers, organic peroxides, liquid poisons, corrosives.

Pressurized Tank Car



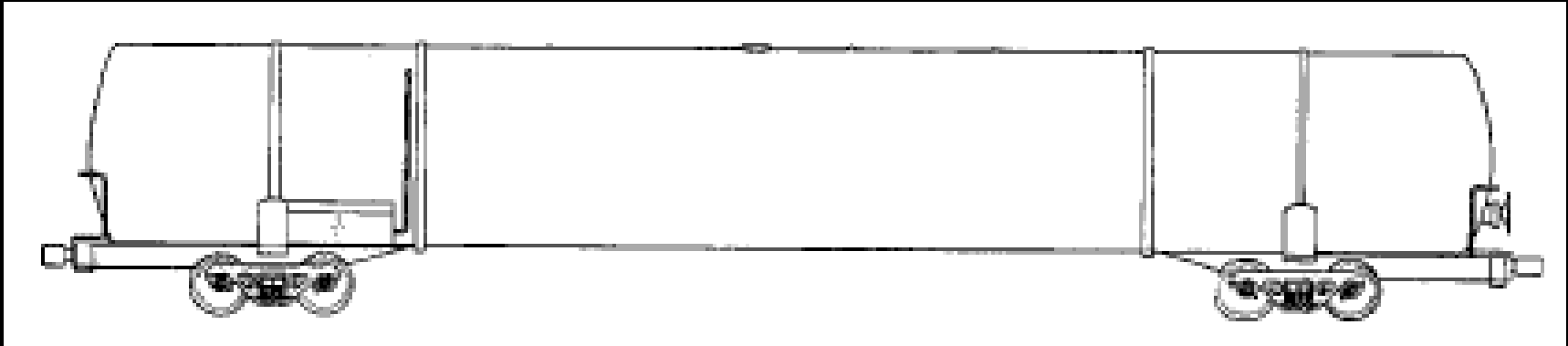
- 100 to 600 psig. Operating pressures.
- 4,000 to 45,000 gallon capacity.
- Enclosed protective housing for valving.
- Flammable and non-flammable compressed gasses and poisonous gases, e.g., chlorine, LPG, anhydrous ammonia, hydrogen fluoride, ethylene oxide,

Hydrogen Cyanide Tank Car

- Pressurized Tank Car
- Painted white with three red strips.
- Very toxic

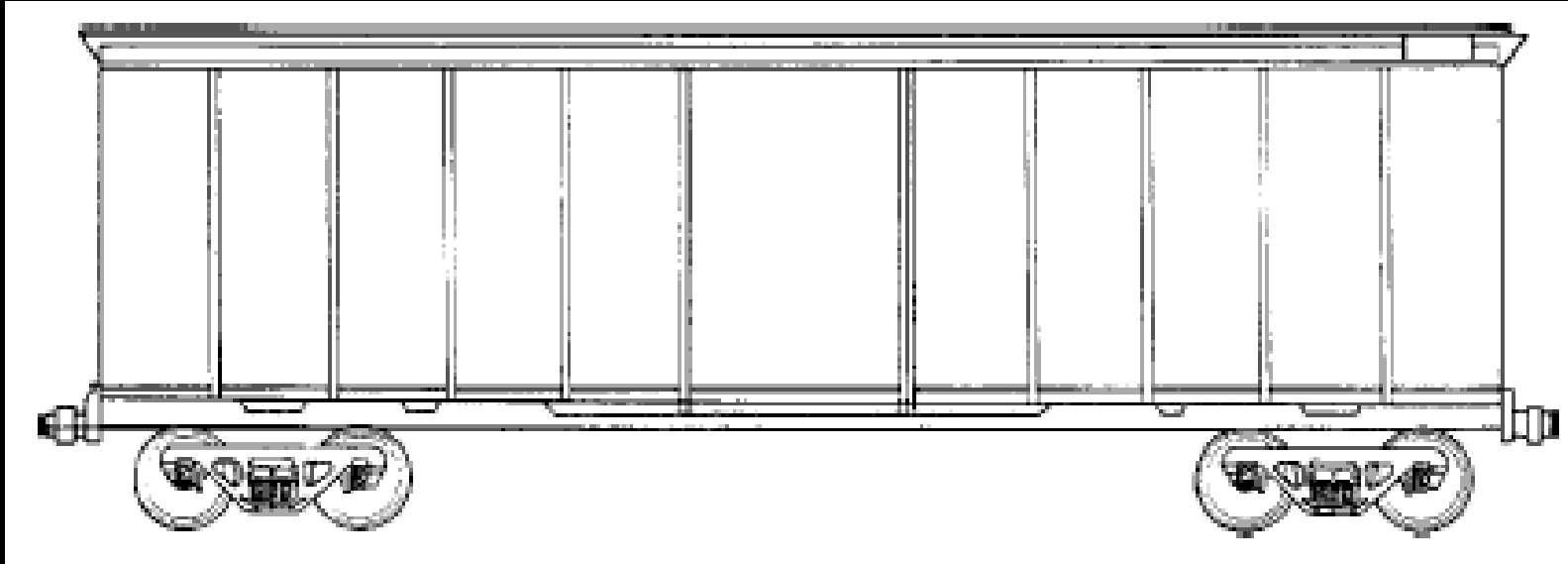


Cryogenic Liquid Car



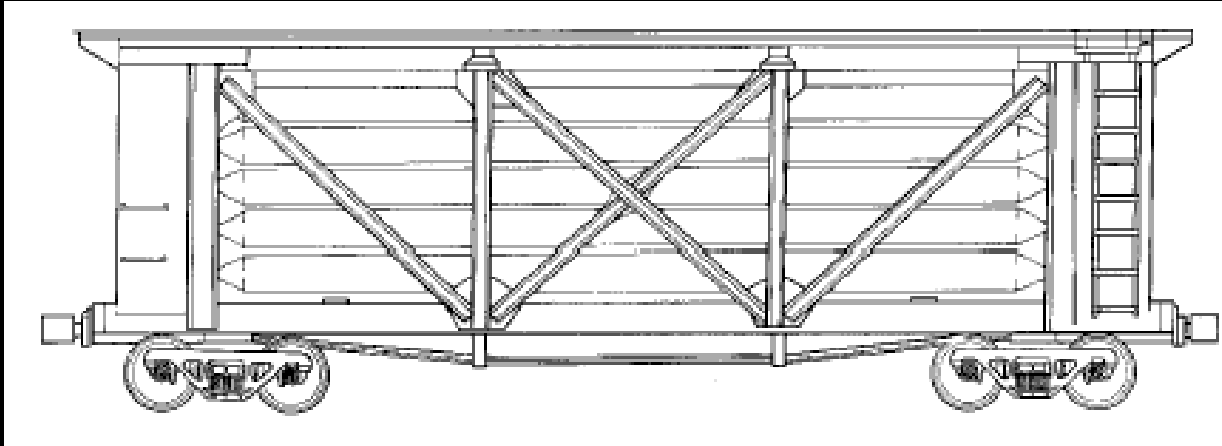
- Liquefied refrigerated gases (-155° F) @ 25 psig.
- Liquefied gases through refrigeration.
- Vacuum liner with insulation filled
- No exposed valving and recessed man way.
- Argon, hydrogen, ethylene, nitrogen, oxygen are common.

Box Cars & Gondola Cars



- Bulk quantities of dry materials.
- Drums, wooden crates, bags, fiber drums, cartons, cases.

High Pressure Tube Car



- 40' long, seamless cylinders enclosed in steel structures.
- Steel head shields on both ends.
- Safety relief valve or safety vent with auto-igniters for flammable gases.
- Oxygen, hydrogen, (most often) helium.

Non-Pressure Intermodal Tank

- Used for both highway and rail transportation.
- 20' in length and 8' in diameter.
- Sea and land units are 35' in length.
- Primarily transport liquids and solids
- Capacity of 5,000 to 6,300 gallons
- IM101/IMO Type I tank
 - Working pressure @ 25.4 to 100psig.
- IM102/IMO Type II tank
 - Working pressure @ 14.5 to 25.4 psig.

Pressurized Intermodal Tank

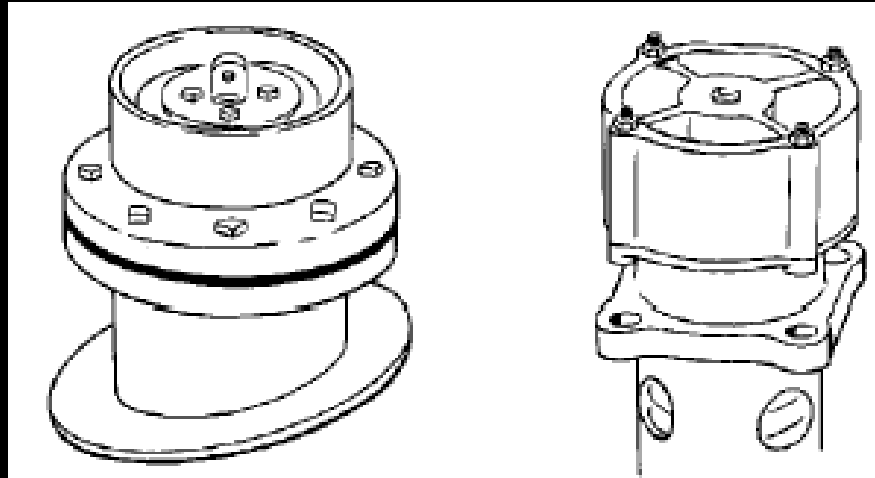


- Used for both highway and rail transportation.
- 20' in length and 8' in diameter.
- Sea and land units are 35' in length.
- Primarily transport LPG and anhydrous ammonia
- Capacity of 1,000 gallons
- DOT51 IMO Type 5 tank
 - Working pressure @ 100 to 500psig.

Specialized Intermodal Tank

- IMO 7 (Cryogenic Tank)
 - Refrigerated gases such as argon, oxygen, helium, and nitrogen
- IMO 8 (Tube Tank)
 - Multiple tanks 12” to 48” in diameter
 - Operating pressures of 5,000 psig.
 - Enclosure on one end

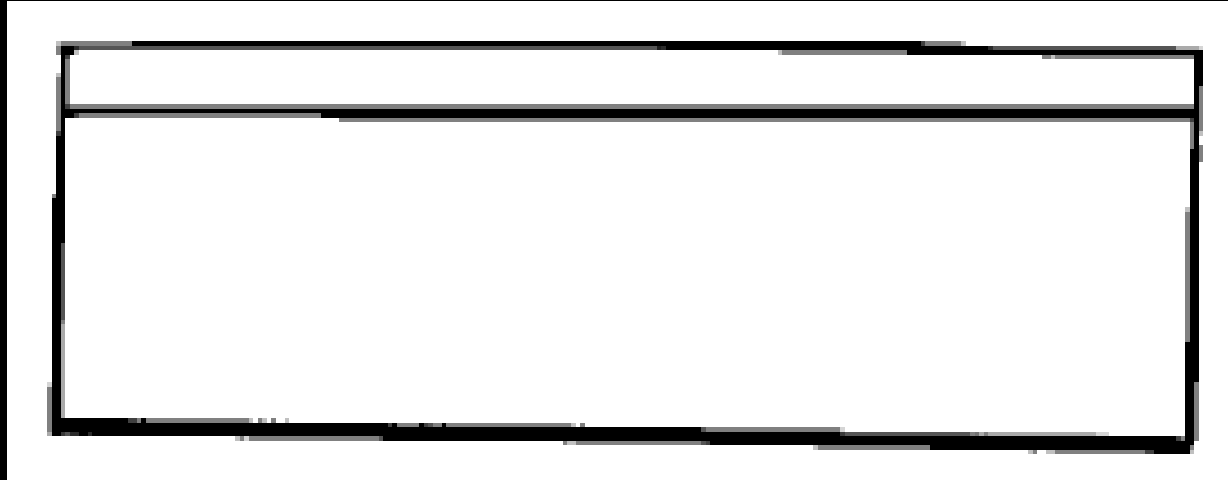
Safety Vents



- Allow for the relief of internal pressure to prevent over pressurization.
- Spring loaded to open and close at set pressure settings.

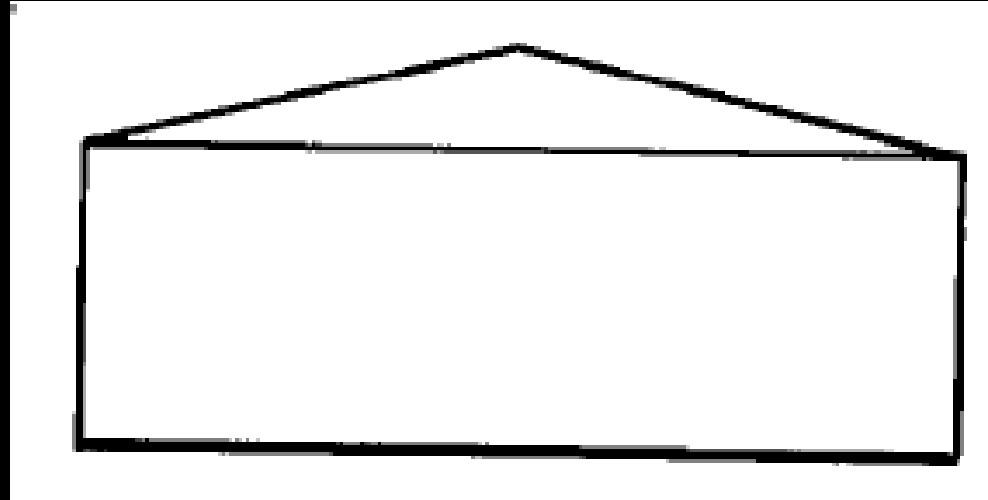
Fixed Facility Storage Tanks

Vertical Flat Roof Tank



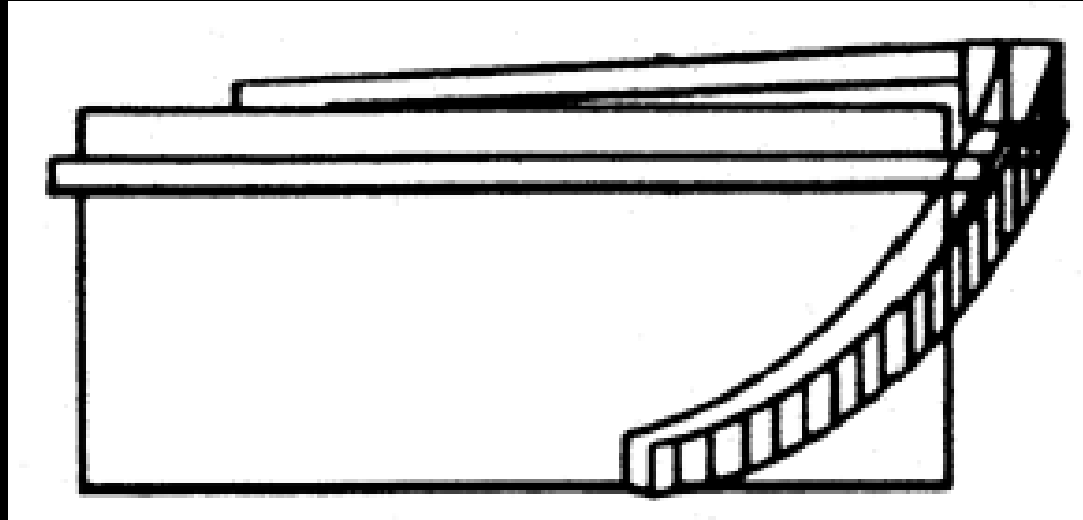
- Wider than tall.
- Diked area surrounding tanks.
- Flat topped roof.
- Large capacity storage for primarily flammables and combustibles.
- May contain corrosives or non-hazmats.

Vertical Cone Roof Tank



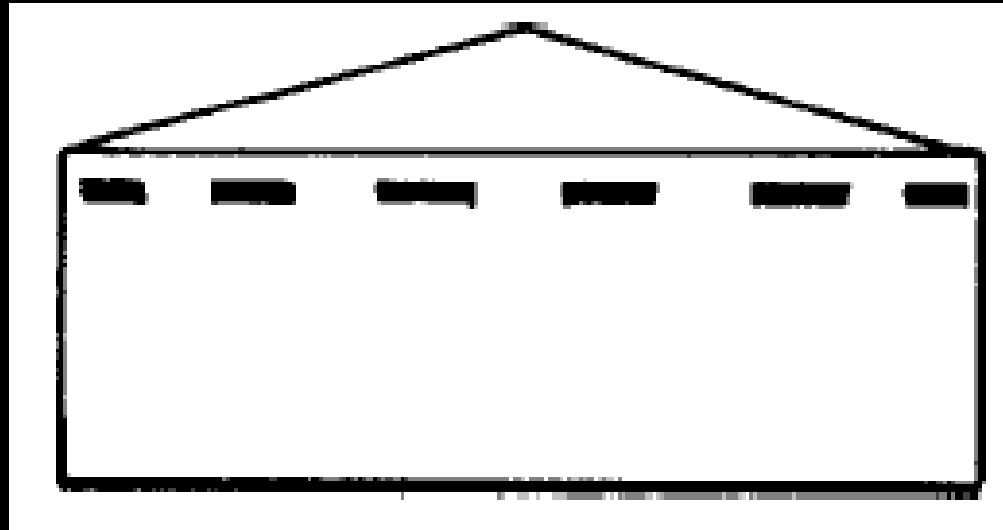
- Slightly pointed, cone shaped roof
- Designed to break apart should internal pressure become too high.
- Flammable, combustibles, corrosives are commonly stored.
- Atmospheric pressure

Open Floating Roof Tank



- Roof floats on top of material to reduce vapor space and vapor production.
- Ladder up side may be seen.
- Usually store flammable and combustibles like gasoline.
- Atmospheric pressure

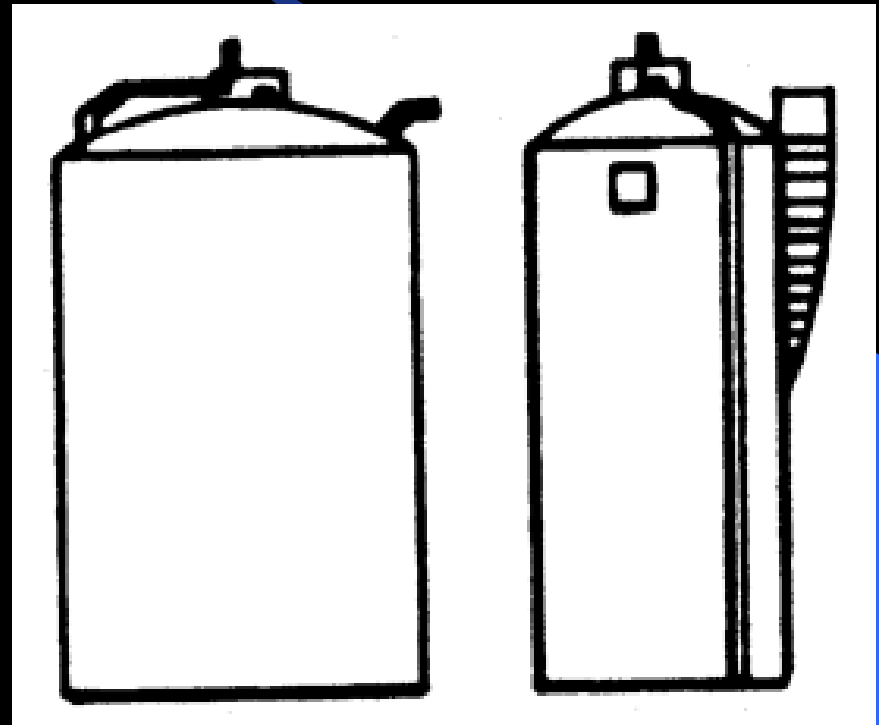
Covered Floating Roof Tank



- Incorporate a fixed cone shaped roof with inner floating roof.
- Differentiated from Vertical Cone Roof tanks by large vents around the roof for vapor release.

Dome Roof Tank

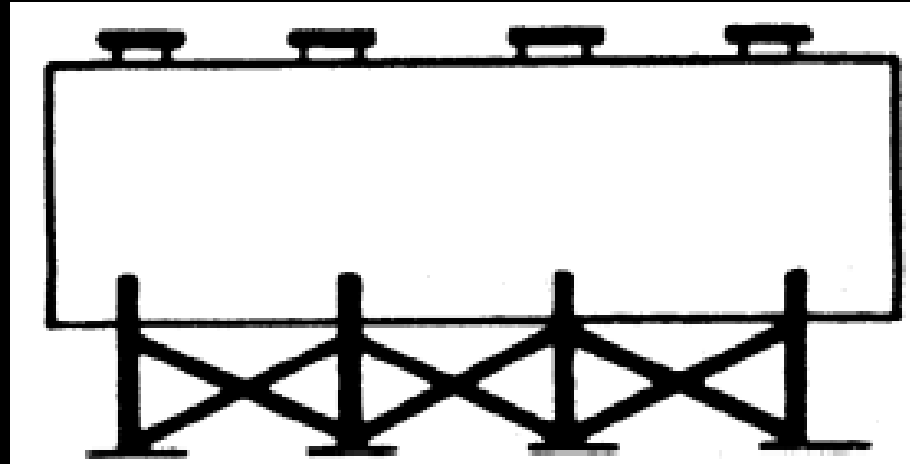
- Taller than wider.
- Dome roof design to accommodate changes in vapor pressure.
- Generally store flammable or combustible liquids.
- Some contain non-hazardous materials.



One Ton Cylinders

- For storage as well as transportation.
- 3' in diameter and 6' in length.
- Concaved ends
- Contents are usually liquefied gases such as Chlorine, anhydrous ammonia, and sulfur dioxide.

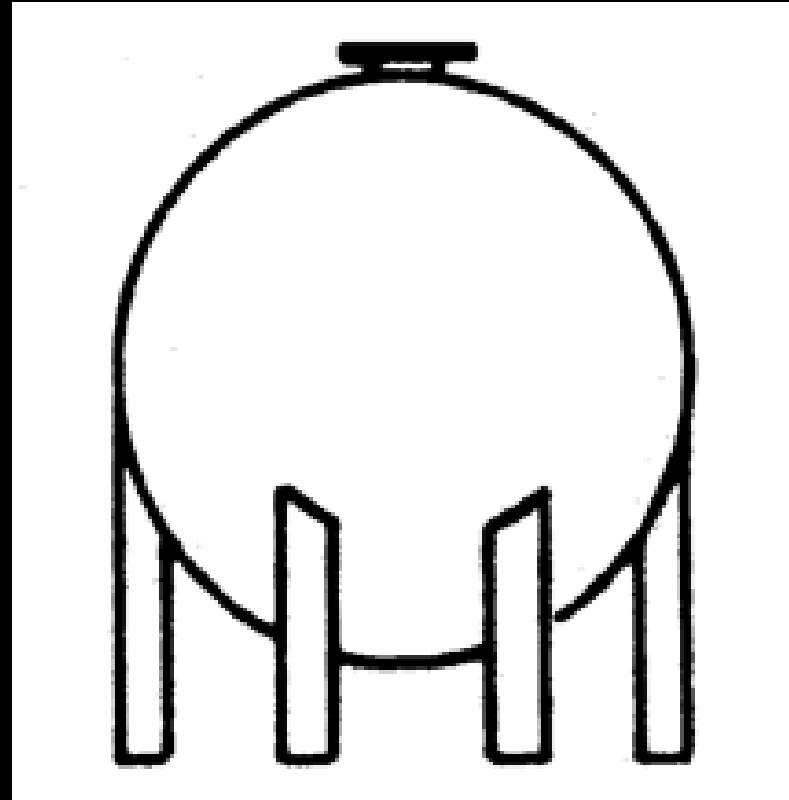
Horizontal Storage Tanks



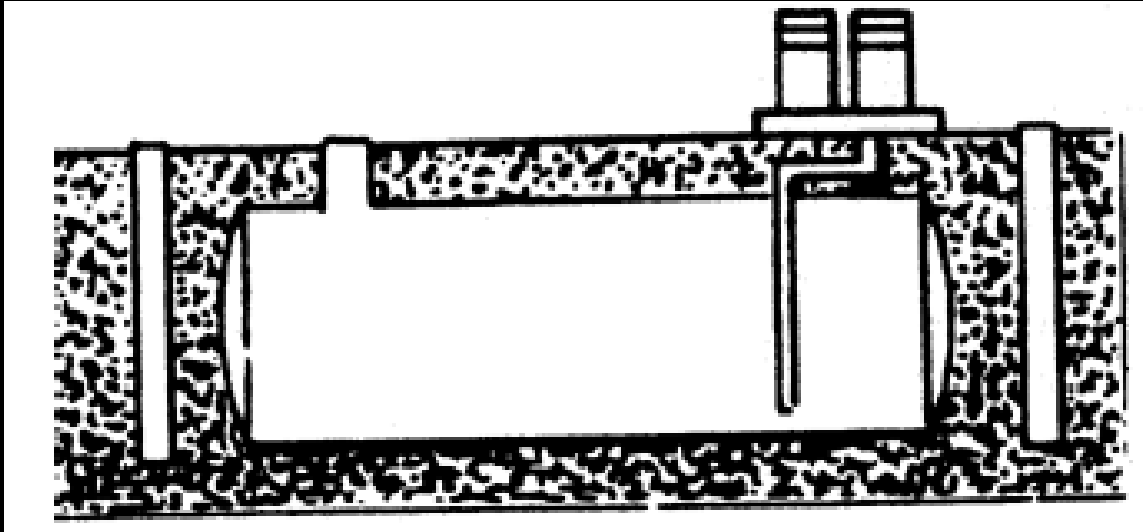
- Non-transportable tank usually on legs or blocks.
- Non-pressure have flat ends
 - Flammable/combustible, corrosives, poisons, solvents
- Pressurized have rounded ends
 - Propane, butane, anhydrous ammonia, chlorine, sulfur dioxide, hydrogen chloride.

Spherical Tanks

- Ball like appearance with support legs.
- White or highly reflective.
- Pressurized commodities, e.g. methane, propane, or other gases
- If no relief valve, then cryogenic such as H_2 , O_2 , N_2 .



Underground Storage Tanks



- May contain liquids or gases.
- Most common contents are liquefied petroleum gases, fuel oils, and gasoline.
- Unable to see gauges or valves.
- Vents are usually visible.

Hazardous Materials and Their Effects on the Body

Classes of Chemical

- Asphyxiants
- Corrosives
- Irritants
- Sensitizers
- Carcinogens
- Neurotoxins
- Mutagens
- Teratogens
- Biological agents

Asphyxiants

- Deprive the body of oxygen
- Simple
 - Displace oxygen and cause hypoxic atmospheres.
 - Carbon Dioxide, helium, hydrogen, nitrogen
- Chemical
 - Inhibit the body's ability to use oxygen.
 - Carbon monoxide, hydrogen sulfide, chlorine

Corrosives

Type	Examples	Effects
Acids	Hydrochloric Acid Sulfuric Acid Nitric Acid	Irritation Pain Burning
Base	Sodium Hydroxide Calcium Carbonate Hydrogen Fluoride	Tissue damage (may be painless at first)

Irritants

Examples	Effects
Ammonia Chlorine Hydrogen Chloride Benzene	Severe inflammation of eyes, skin, respiratory tract Itching, Redness Coughing Difficulty Breathing Over stimulate CNS

Sensitizers

Examples	Effects
Formaldehyde Mercury Toluene diisocyanate	Asthma-like reaction in short term Repeated exposures lead to allergic type reactions Permanent lung disease over longer term

Carcinogens

Examples	Effects
Benzene	Leukemia
Vinyl Chloride	Liver Cancer
Asbestos	Asbestosis
Cigarette Smoke	Lung Cancer

Neurotoxins

Examples	Effects
Toluene Gasoline Benzene	Dizziness Euphoria Impaired Judgment
Malathion Tetraethyl Phosphate Parathion	Wheezing Muscle tremors GI disorders
Dieldrin Phenol Carbon Disulfide	Convulsions

Mutagens

Examples	Effects
Ionizing Radiation Ethylene Oxide Hydrogen Peroxide Benzene	Genetic damage in reproductive organs

Teratogens

Examples	Effects
Anesthetic Gases Organic Mercury Ionizing Radiation German Measles	Fetal malformations

Infectious Agents

Type	Examples	Effects
Virus	Hepatitis A,B,C HIV Herpes	Varied
Bacteria	Tuberculosis Streptococcus	Varied
Fungi	Oral Thrush Athlete's Foot	Irritation or inflammation
Parasites	Larvae insects	Varied, often GI
Rickettsia	Deer Ticks	Varied

Duration of Effects

Acute	Chronic
Short term usually at relatively high concentrations	Long-term effects at relatively low concentrations

Toxins

- To be considered, the material must:
 - Have physical and chemical properties capable of causing harm.
 - Be present in sufficient amounts to do harm.
 - Be present for a sufficient time to do harm.
 - Have a route of entry into the body and reach a susceptible body organ or tissue.

Guidelines for Toxic Exposures

Limit	Exposure Duration
TLV	8 hours/day up to 40 hours per week
PEL	8 hours per day up to 40 hours per week
STEL	15 minutes with a 60 minute interval (max 4 exposures)
IDLH	30 minutes before a threat of injury or death occurs
REL-TWA	Up to 10 hrs/day during 40 hour work week

Routes of Exposure

- Absorption
- Inhalation
 - Most common route for firefighter's exposure.
 - Lungs are the primary “transfer point” for exposures.
- Injection and Puncture
- Ingestion

Factors Affecting Effects

- Rate and depth of respirations
- Duration and the exposure
- Nature and concentration of the exposure
- Route of entry
- Site of deposition
 - Scalp, underarm, genital, and jaw allow for greater rate of absorption.

Record Keeping

- All exposures must be maintained in accordance with OSHA guidelines and NFPA 1500.
- Records are to be maintained and accessible for 30 years after the last date of employment.

Pre-Incident Planning

Pre-Incident Plans

- Need to be site specific for each facility.
- First Step
 - Determine what materials are stored or handled at the site.
- Transportation routes as well as fixed sites should be identified.
- Small generators may be exempt from federal reporting.

Pre-Incident Planning

- Hazard Assessment
 - focus on information gathering.
- Hazard Analysis
 - Identify the potential for an accident
 - Identify vulnerable zones
 - Analyze your potential risks.
- Site visits are required to to complete a pre-incident plan.

Practical Chemistry

Chemical Properties

Term	Description
Vapor Pressure	Measures the ability of a liquid to change to a vapor
Boiling point	The temperature at which a liquid changes to a vapor increasing pressure inside a closed container.
Vapor density	The measure of a chemical's tendency to sink or float. Air= 1 or 29 MW
Flash point	Minimal temperature at which a liquid produces sufficient vapors to form and ignitable mixture.

Chemical Properties

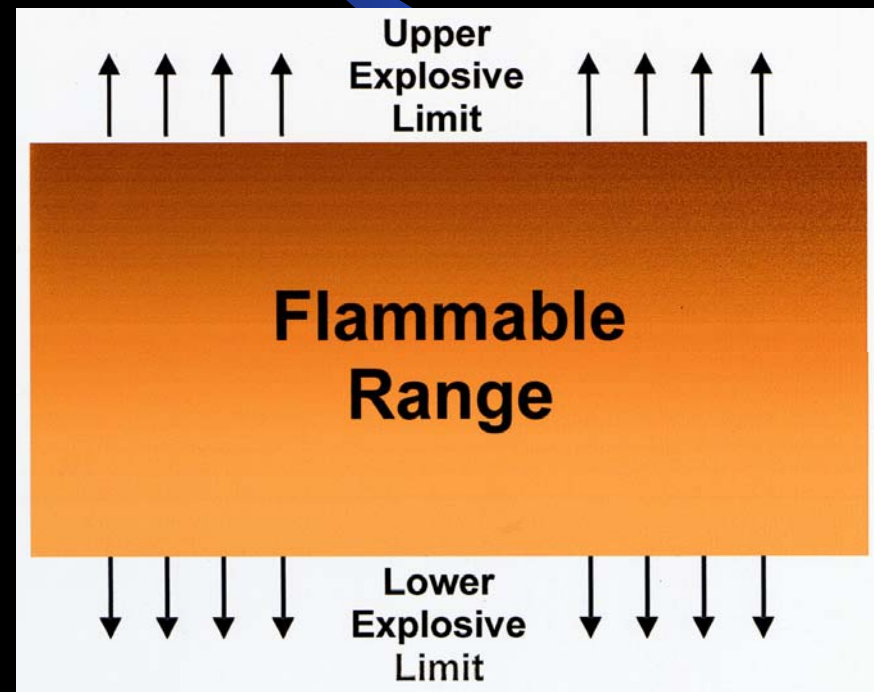
Term	Description
Specific Gravity	Weight of a material compared to the weight of a reference substance, usually water. Water=1.
Pyrophoric	Liquid or solid that spontaneously ignites in air at or below 130° F
Miscible	A material that is infinitely soluble in water.
Polar	Substances with an uneven distribution of (+) and (-) molecules, usually miscible.

Chemical Properties

Term	Description
Ignition temperature	Temperature at which a material burns without a flame.
Gases	All gases have a vapor pressure greater than 760 mmHg.

Flammable Ranges

- Ranges vary for each chemical
- Combustible gas indicators display reading is % of LEL.
- Require oxygen to work.
- 1% = 10000 ppm by volume.

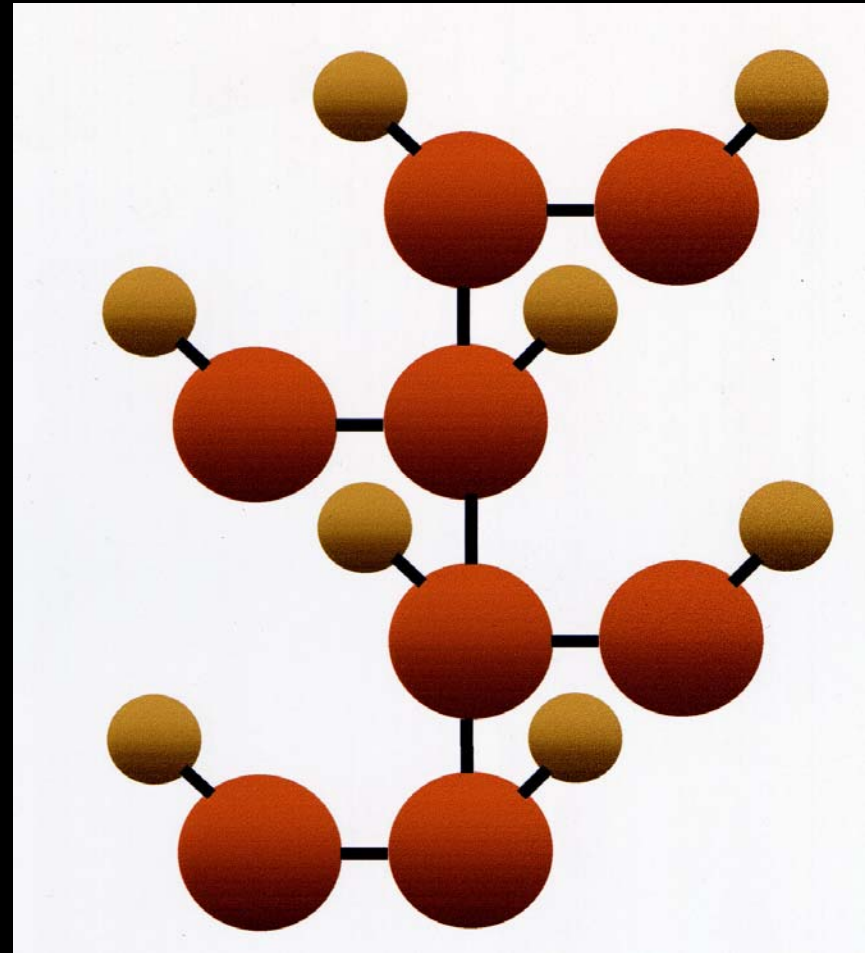


Oxidizers and Peroxides

Oxidizers	Materials that provide their own oxidizing capabilities and usually need no air to burn. Non flammable in but accelerate combustion.
Inorganic peroxides	Act as both oxidizers and corrosives. Capable of supporting combustion, even explosive, in absence of air.
Organic peroxides	Contain an oxidizer and fuel molecule. Only require small amount of heat. DOT Category A to G.

Polymerization

- The combining of single chemical units called monomers.
- Form larger chain called polymer.
- Exothermic reaction which may be explosive.
- Controlled by inhibitors.

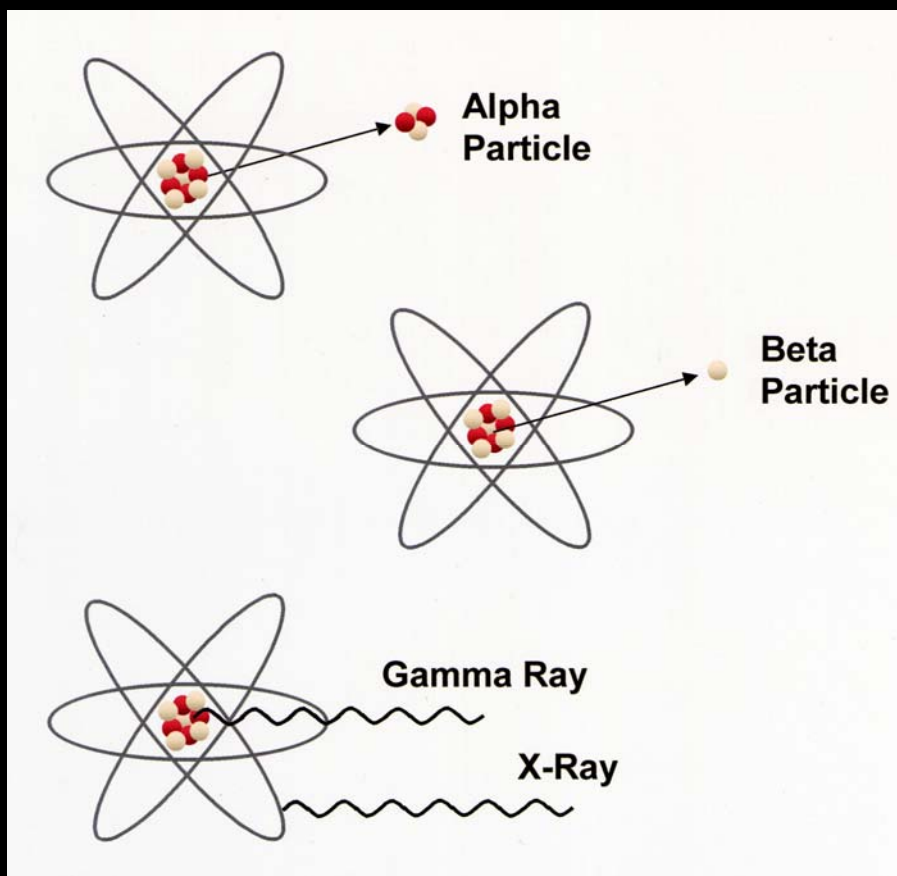


Compressed Gases

Defined by DOT by having an absolute pressure exceeding 40 psi @70° F.

Pressurized	Compressed.
Liquefied	Made into a liquid to reduce volume. Expansion ratios.
Cryogenic	Cooled to become a liquid.

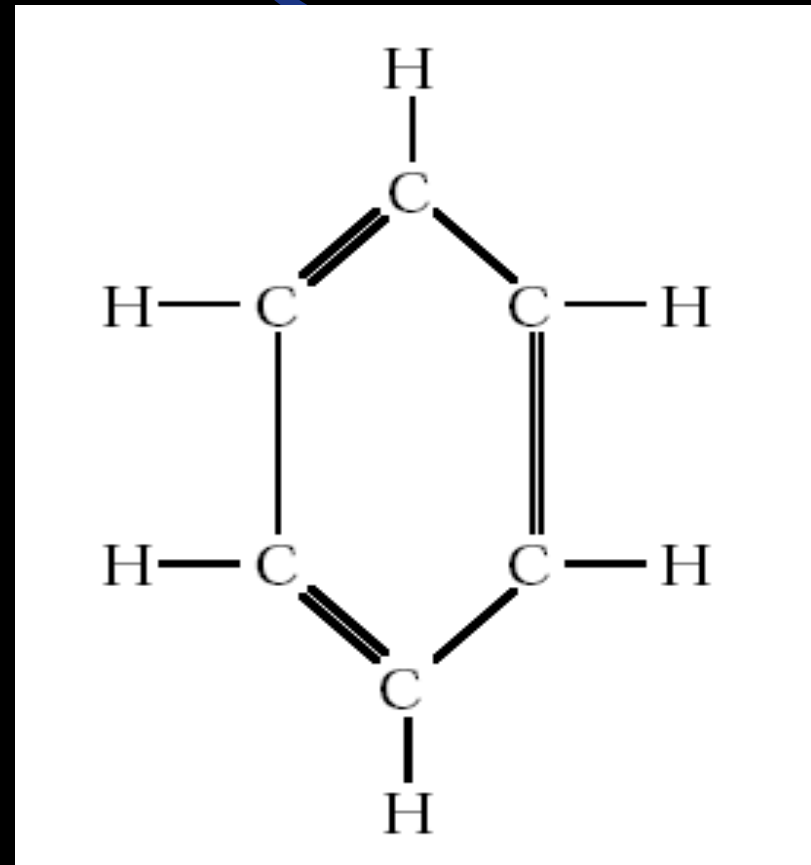
Radiation



- Alpha are large particles with low energy.
 - 4 inch of travel
- Beta are smaller with higher energy.
 - 30 feet of travel
- Gamma are electromagnetic waves with high energy.

Aromatic Hydrocarbons

- Have alternating single and double bonds to form a ring.
- Resonant bond is very stable and therefore produces a sooty smoke.



Detection Devices

Instrument Factors

- Proper equipment operation
- Instrument calibration and checks
- Detection Range
- Relative response
- Response time
- Inherent safety (UL or FM approved)
- Reliability of power source

Relative Response

- Conversion factors or relative response curves that can be used to convert the instrument's reading to a true concentration of the known gas or vapor.
- Meter Reading x factor = True LEL
 - Example $20\% \times 1.25 = 25\%$

Interpreting Readings

- The LEL readings of the CGI can be used to determine the % of gas by volume present in the environment by multiplying the reading by the % of LEL by volume.
- A displacement of 5% air will effect the oxygen levels by 1%.

Detector Tubes



- Useful in measuring the concentration of known vapor or gas contaminants in air.
- Only indicate a chemical is present.
- High error ratios may exist in readings.

Radiological Meters

- Alpha and Beta meters usually display readings in counts per minute.
- Gamma detectors usually utilize millirems per hour.
- Dosimeters are used to measure total exposure.



Photo ionization meters



- Used to measure organic and some inorganic materials at low concentrations.
- Do not identify agents.
- Ionization potential is bulb dependant.
- Can survey higher concentrations.

Flame Ionization Detector

- General survey or qualitative measurement.
- Not restricted by ionization potentials
- Detection of organics.
- Use hydrogen flame to burn the sample.



Personal Protective Equipment

Self Contained Breathing Apparatus

- Positive pressured SCBA offers highest level of respiratory protection.
- Limited air supply
- Added weight and stress on responder
- Minimal level of protection until air monitoring is complete.



Supplied Air Respirator



- Provides positive pressure SCBA protection
- Less weight and stress on responder.
- Up to 300' air line.
- Longer operation time.

Level A Ensemble

- NFPA 1991 Standard
- Highest level of skin protection
- Limited mobility and work times
- Highest in chemical protection.



Splash Protection



- NFPA 1992 Standard
- Offers limited splash protection
- Used with SCBA for Level B protection
- Used with APR for Level C protection

Stress from CPC

- Heat Related Stress
 - High humidity and temperature
 - Suit inhibits evaporation
- Symptoms
 - Heat Cramps
 - Heat Exhaustion
 - Heat Stroke

Chemical Resistance

Term	Action
Penetration	Movement through existing opening
Degradation	Actual observable or measurable change in material cause by contact with another agent.
Permeation	Movement of a chemical through a material on the molecular level.

Doffing Procedures

- Completed after decontamination processes have been checked for effectiveness.
- Suits should be contained for further testing and decontamination.
- SCBAs should be the last thing removed.

Decontamination

Goals

- To prevent the further spread of contamination from the initial area of contamination.
- Prevent the secondary contamination of people, equipment, and the environment outside of the hot zone.
- Reduce levels of exposure to victims and prevent medical workers from exposure.

Establishment of Decon

- Established prior to entry into a hot zone where the potential of chemical exposure may occur.
- Provides a safe haven for personnel to retreat to for immediate care.
- May be established by any means that will effectively remove contaminants prior to it leaving the warm zone.

Means of Decontamination

Means	Action
Emulsification	Use of soap and water for non-soluble products.
Dilution	Use of copious amounts of water to render safe.
Neutralization	Reducing pH to neutral.
Sterilization	Destroying potentially infectious agents.
Physical removal	Physically taking contamination off.
Disposal	Appropriate disposal of contaminated items. Required for Carcinogens.

Emergency Decontamination

- The means of rapidly reducing the levels of contamination without the establishment of a definitive decontamination system.

Control Techniques

Control Options

- Offensive
 - Requiring potential contact with the material to stop the further release.
 - Plugging, patching, and over packing.
- Defensive
 - Techniques of limiting the spread without contact with the material. (containment)
 - Damming, diking, and diverting

Chlorine Kits

Kit	Usage
“A” Kit	100 or 150 lbs. cylinders
“B” Kit	One ton cylinders
“C” Kit	Railcars

Incident Management

Hazard Identification

A thorough evaluation to assess all factors that will affect the incident

It should include:

- Chemical identities, quantities, handling considerations.
- Location of the hazardous material.
- Means of materials spread.
- Hazards most likely to accompany the spill or release.

Vulnerability Analysis

Should include:

- Extent of vulnerable area.
- Number and types of individuals that could be within the vulnerable area.
- Public and private property that may be damaged, including essential support systems and transportation corridors
- Other parts of the environment that may be affected.

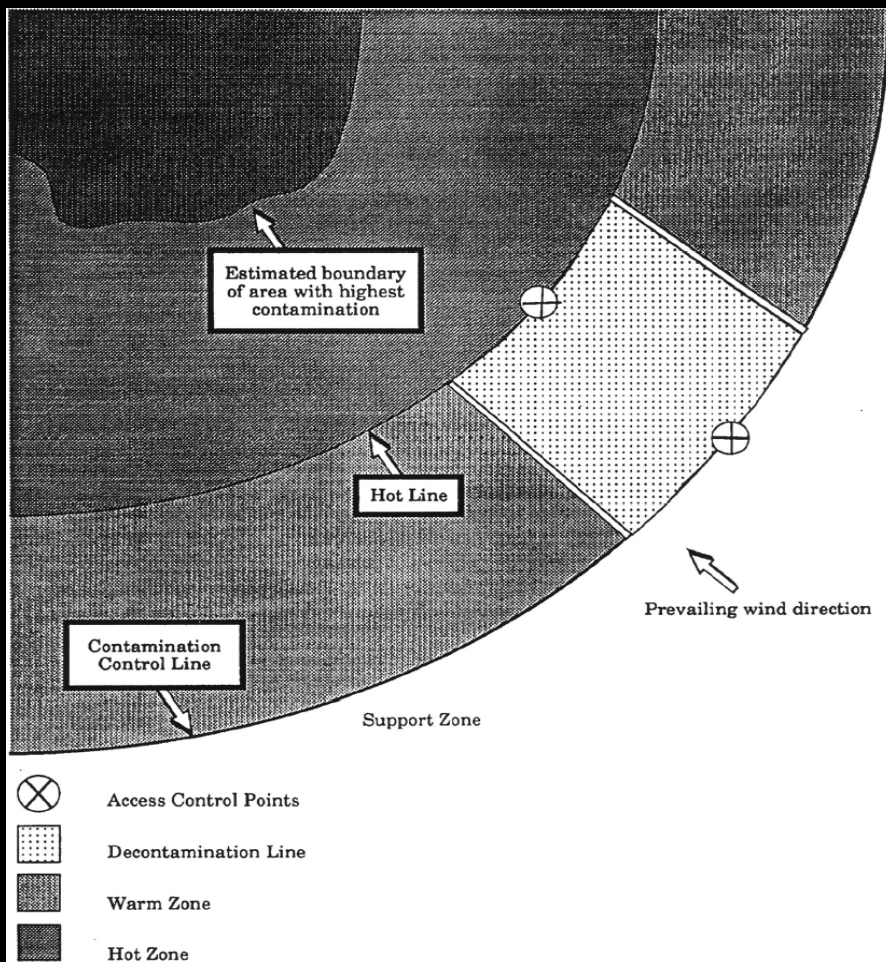
Hazmat Tasks & Staffing Requirements

- Hazmat Sectors/ Group combines many tasks in one functional area.
 - Site Control
 - Safety
 - Research
 - Entry
 - Decontamination
- Manning or 8 to 12 is common.

Incident Command Structure

- Due to complexity and hazards involved in responding to an incident involving a release, two command structures must be utilized:
 - Incident Commander
 - Safety Officer

Control Zones



- Hot Zone
 - Area where contamination does or could occur.
- Warm Zone
 - Decontamination Reduction Corridor
- Cold Zone
 - Clean Area

Site Control Function

- Site control is necessary when the movement of people and equipment in and around the hazard site presents a problem.
- This is the responsibility of the Hazard Sector Officer/Group Supervisor until assigned to an individual or team.

Reducing Contamination

- Decontamination should be a organized process of utilizing chemical and physical removal of contaminants.
- All personnel, equipment, and victims should be decontaminated prior to being removed from the warm zone.
- Testing should be done to ensure the effectiveness of decontamination.

Medical Testing and Monitoring

- The OSHA standard *Hazardous Waste Operations and Emergency Response* (29 CFR 1910.120) specifies that members of hazardous materials teams must participate in a medical surveillance program along with *any* emergency responder who has signs or symptoms of an injury or illness that may be due to an exposure to hazardous materials at an incident.

Medical Testing and Monitoring

- NFPA 1500, recommend that all fire department members participate in a comprehensive medical surveillance program.
- Exposure to a firefighter at or above set exposure limit for 30 or more days.

Terrorism

Types of Harm

- Biological
- Nuclear
- Incendiary
- Chemical
- Explosive

Biological Agents

Category	Example
Bacteria	Anthrax, VEE
Viruses	Smallpox
Toxins	Ricin, Staphylococcal enterotoxin
Best dispersed at night with wind speeds less than 10 mph.	

Chemical Agents

Category	Example
Nerve Agents	Sarin, Soman, VX
Blister Agents	Mustard, Lewsite
Choking Agents	Chlorine, phosgene (prevent the body from being able to use oxygen)
Blood Agents	Cyanide (high risk of secondary contamination)

Properties of Chemical Agents

Category	Definition
Persistence	Rate at which evaporation occurs. They do not want to vaporize.
Vapor Density	Greater than 1.

Explosives

- Most commonly used weapon by terrorist.

Etiological Agents

Etiological agents are also biological in nature. However, etiological agents are defined as substances that are capable of causing disease; not all biological agents result in disease. Examples of etiological agents are hepatitis viruses, hemorrhagic fever, and HIV.

Patient Support

Secondary Contamination

- Even though a victim has been removed from an environment, they may still be contaminated and be a risk to others outside of the hot zone.
- All patients should be decontaminated to reduce the risk that they present to medical care workers.

Medical Conditions

Condition	Definition
Methemoglobinemia	Cause by nitrates. Cause red blood cells not to be able to carry oxygen.
Carboxyhemoglobinemia	When carbon monoxide inhibits the ability of the blood to transport oxygen.
hypocalcemia	Cause the depletion of calcium in the blood stream

Organophosphates

Signs and symptoms:

- Diarrhea
- Urination
- Miosis (pinpoint pupils)
- Bronchospasm (wheezing)
- Emesis (vomiting)
- Lacrimation (tearing in the eyes)
- Salivation

Examples:

- Diazinon
- Malathion

Heat Stress Emergencies in the Hot Zone

- Emergencies may include:
 - Heat cramps, exhaustion, or stroke
- Care should be given to immediately perform emergency decontamination to remove contaminants and then remove excessive clothing. Treat the patient appropriately and confirm decontamination.