TERMINAL OBJECTIVE
Given examples of various highway, rail, portable and fixed containers, the participant will be able to identify the key characteristics of the container and possible materials that they would be used to transport or store.
EDUCATIONAL OBJECTIVES

CONTAINERS
Given examples of the following tank cars, identify each tank car by type, as follows:
- Cryogenic liquid tank cars
- Non-pressure tank cars (general service or low pressure cars)
- Pressure tank cars (1.1.1.1)

Given examples of the following intermodal tanks, identify each intermodal tank by type, as follows:
- Non-pressure intermodal tanks
- Pressure intermodal tanks
- Specialized intermodal tanks, including the following:
  - Cryogenic intermodal tanks
  - Tube modules (1.1.1.2)

Given examples of the following cargo tanks, identify each cargo tank by type, as follows:
- Compressed gas tube trailers
- Corrosive liquid tanks
- Cryogenic liquid tanks
- Dry bulk cargo tanks
- High pressure tanks (1.1.1.3)

Given examples of the following storage tanks, identify each tank by type, as follows:
- Cryogenic liquid tank
- Non-pressure tank
- Pressure tank (1.1.1.4)

Given examples of the following non-bulk packaging, identify each package by type, as follows:
- Bags
- Carboys
- Cylinders
- Drums
- Dewar flask (cryogenic liquids) (1.1.1.5)

Given examples of the following radioactive material packages, identify the characteristics of each container/package by type, as follows:
- Excepted
- Industrial
- Type A
- Type B
- Type C (1.1.1.6)

Identify the general testing requirements for “Type A”, “Type B”, and “Special Form” packaging used for radioactive material transportation. (1.3.5)

**MARKINGS AND PAPERS**
Given examples of containers, identify the markings that differentiate one container from another.

Given examples of the following marked transport vehicles and their corresponding shipping papers, identify the following vehicle or tank identification marking:
- Highway transport vehicles, including cargo tanks
- Intermodal equipment including tank containers
- Rail transport vehicles, including tank cars (1.1.2.1)

Given examples of facility containers, identify the markings indicating container size, product contained, and/or site identification numbers. (1.1.2.2)

Identify the following information on a pipeline marker:
- Emergency telephone number
- Owner
- Product (1.1.3.1)

Given a pesticide label, identify each of the following pieces of information, then match the piece of information to its significance in surveying hazardous materials incidents:
- Active ingredient
- Hazard statement
- Name of pesticide
- Pest control product (PCP) number (in Canada)
- Precautionary statement
- Signal word (1.1.3.2)

Given a label for a radioactive material, identify the type or category of label, contents, activity, transport index, and criticality safety index as applicable. (1.1.3.3)

Give examples of ways to verify information obtained from the survey of a hazardous materials/WMD incident. (1.1.5)

Identify at least three additional hazards that could be associated with an incident involving terrorist or criminal activities. (1.1.6)

**DAMAGE ASSESSMENT**
Identify three types of stress that could cause a container system to release its contents. (1.3.2)
Identify five ways in which containers can breach. (1.3.3)

Identify four ways in which containers can release their contents. (1.3.4)

Define a BLEVE and describe its impacts.

Demonstrate an understanding of the need for container damage assessment.
UNIT TIMELINE

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3 hrs 5 mins. TOTAL

REQUIRED MATERIALS

- Visuals for Unit 2.4
- Video “Containers”
- Video “Damage Assessment” (optional)
- Video Case study of the Waverly or Memphis, Tennessee MC 330 LPG tank failure (optional)

ATTITUDES TO FOSTER
I) UNIT OBJECTIVES (5 MINUTES)

A) Unit goal

1) Given examples of various highway, rail, portable and fixed containers, the participant will be able to identify the key characteristics of the container and possible materials that they would be used to transport or store.

B) Educational objectives

1) Identify key characteristics of containers
2) Recognize and identify the various types of highway, rail and portable transportation containers
3) Identify the various types of fixed facility containers
4) Identify potential emergency control devices
5) Identify the importance of insuring that a proper container damage assessment is performed

II) KEY CHARACTERISTICS OF CONTAINERS (15 MINUTES)

A) All containers have important key characteristics based upon the commodity they are intended to hold.

1) Physical state of the material
2) Operating pressure of the container

Ratings for operating pressures of containers vary widely based upon whether the container is highway, rail or fixed. The following are general pressure ratings that we will use in this program.

(a) Non-pressurized (atmospheric)
- 0 – 5 psi (solid, liquid)

(b) Low pressure
- 5 – 100 psi (liquid)

(c) High pressure
- 100 – 3,000 psi (gas or liquefied gas)

(d) Ultra high pressure
- Over 3,000 psi (gas)

The required pressure rating of a container is determined by the vapor pressure of the product being carried.

3) Container capacity

(a) Bulk or non-bulk

(b) Bulk is defined as
- 120 gallons (1,000 pounds) or greater water capacity (120 gal water x 8.35 lbs/gal = 1000 pounds +/-)
- Carries 882 pounds or more of a solid

(c) Anything carrying less would be considered non-bulk packaging

4) Safety and emergency control devices

5) Container use

(a) Fixed storage container
- Large capacity
- Can be pressurized, non-pressurized
(b) Transportation container

- Highway
  - By far the most common transportation container encountered by emergency responders

- Rail
  - Large quantities can be carried
  - Very common

- Intermodal
  - Movement between modes of transportation
  - Marine, rail, highway
  - Hazards class may not be well marked

- Pipeline
  - May carry a single product or multiple products
  - Various products carried at different times

(c) Portable

- Small non-bulk containers

6) Container construction and shape

(a) Material
• Non-ferrous (low pressure containers when strength is not necessary)

• Ferrous (when high strength is required)

• Alloys (mixtures of ferrous and other metals)

• Aluminum (used when weight, not container strength is important)

• High Strength Low Allow Steel (HSLA)

• Austenite Stainless Steel (SS)
  – Alloy of iron, nickel and chromium
  – Good resistance to corrosives

(b) Shape

• Rounded surfaces are used to more evenly distribute pressure.

7) Standards

(a) Transportation container standards

• Specifications are found near the end or head of all containers used for transport.

• Rail: Stenciled on right side as you face the side of the tank

• Highway: Found on the front end of the container
• Standards are established by the US Department of Transportation (DOT).

Examples of various standards:
(Motor Carrier Standard 306)
DOT 406 (Department of Transportation Standard 406)
DOT 111 A 300 W (Railcar DOT Specification 111)

III) FIXED STORAGE CONTAINERS (20 MINUTES)

Explain to the participants that there is no set standard on container pressures. What in highway would be called low pressure, in rail it is called non-pressure.

A) Non-pressurized

1) Operating from 0 – .5 psi

2) May be bags, boxes, drums or tanks

3) Contain
   (a) Low vapor pressure liquids
   (b) Solids
   (c) Operate under normal conditions (no pressurization)

4) Common types
   (a) Underground storage tanks
   (b) Above ground tanks

   • Dome roof is the most common
   • Open floating roof
   • Closed floating roof
5) Facility papers and markings
   (a) Map of facility
   (b) Stencils
   (c) NFPA 704
   (d) MSDS

Discuss the design considerations of horizontal, open floating and closed floating roof tanks. Reinforce that floating roof tanks have a flexible seal between the floating roof and the side walls. As the level of the product drops, the roof also drops to minimize the vapor space inside the tank. Open floating roofs can be susceptible to “rim” fires particularly from lightning. An open floating roof tank can be identified by the presence of a “wind girder”. This girder provides structural stability from wind effects when the roof is low in the tank.

Discuss the products and their hazards that are found in the community in fixed facility tanks.

B) Low pressure
   1) Appearance may be very similar to non-pressurized containers when holding liquids
   2) They operate at a pressure of .5 – 15 psi
   3) Used to store volatile liquids

C) Pressurized
   1) Above 15 psi
   2) Characteristics
      (a) Generally horizontal but can also be seen as spherical in shape
      (b) Characteristically rounded ends
(c) The rounded shape allows for equal distribution of pressure on all interior surfaces

(d) Single wall, non-insulated

(e) Painted white or highly reflective color

(f) Size range from 500 – 30,000 gallons and higher

(g) “Liquefied compressed gas”
   - Liquefied petroleum gases
   - Anhydrous ammonia
   - Butane
   - Numerous other products

D) Special containers

1) Telescoping tanks

   (a) Used to hold natural gas in gaseous state

   (b) Tank walls extend upwards as tank fills

2) Cryogenic

   (a) Used to hold gases that are maintained as a liquid through extremely cold temperatures and have high expansion ratios

   (b) Well insulated tank

      - Internal tank

      - Annular space is a vacuum filled with isolating materials and reflective layers to minimize inward transmission of heat
(c) Found at industrial facilities, hospitals and gas processing facilities

(d) Common materials include:

- Liquid oxygen (LOX)
- Liquid nitrogen
- Liquid hydrogen
- Liquid carbon dioxide

E) Preplanning is essential

1) Identify where the containers are present in your community
2) What do the containers store?
3) What are the container capacities?
4) What are the likely scenarios for a release?
5) Where are the remote emergency shut-offs and how do they operate?
6) Where can you get technical assistance?

IV) TRANSPORTATION CONTAINERS (30 MINUTES)

A) Highway transportation containers

1) Non-pressurized containers DOT 406

   (a) Make up the majority of highway transportation containers for hazardous materials

   (b) 0 – 5 psi

   (c) Commonly contain

   - Materials lighter than water
• Petroleum products (gasoline, diesel and fuel oil)

• Highly volatile

• Some poisonous liquids

(d) Generally have a capacity of 7,000 – 9,000 gallons

(e) Mostly constructed of aluminum to save on weight

(f) May be compartmentalized

2) Low pressure containers — Less than 40 psi

(a) DOT 407

(b) Referred to as the general purpose chemical tanker

(c) Carries

• Material about the weight of water

• Mild corrosives

• Volatile liquids

(d) Construction

• Aluminum, steel or stainless steel (SS) may be used

• Can be insulated or un-insulated

• Capacity generally not greater than 7,000 gallons

• Usually not compartmentalized
(e) DOT 412 corrosives carrier

- Very strong design in order to carry very heavy corrosive liquids (as well as other heavy liquids)

- Weight of product limits capacity

- Many of the products carried can weigh as much as twice the weight of water

- Construction
  - Black iron, SS or aluminum alloys
  - Many are lined with special materials to allow it to carry specific materials
  - No bottom outlet valves. Piping runs through the top of the tank and pressurized air is used for off-load of product
  - Heavy reinforcing rings and roll over protection
  - Small diameter barrel

3) MC 330 and MC 331 high pressure

(a) MC 331 is used to carry liquefied petroleum gases (LPG) and has a working pressure of 250 psi
UNIT 2.4 — CONTAINERS AND DAMAGE ASSESSMENT

(b) MC 330 is used to carry LPG and anhydrous ammonia and has a working pressure of 265 psi

- Ammonia tanks can carry LPG, but not vice versa

(c) Construction

- Generally constructed of high strength low allow steel
- Characteristic rounded ends indicate a pressurized cylinder
- Emergency shut-offs located at front left and right rear

(d) BLEVE potential

- These tanks are susceptible to BLEVE as would be any closed container
- Pressures in this and other containers are controlled with venting devices discussed earlier

Discuss the principles of relief devices.

4) MC 338 cryogenic tankers

(a) A specialized pressure container (only during off-loading)

(b) Gases are maintained as a liquid through extremely cold temperatures

(c) Very similar to the cryogenic tanks discussed during fixed facilities
(d) Construction

- Internal tank
- Annular space
- Outer shell
- Control valves generally located in a cabinet at the rear of the trailer

(e) Unique venting considerations

- No cryogenic tank can provide perfect insulation
- Natural warming of the product does occur
- As the cryogenic liquid is warmed, pressure increases
- Relief must be provided to allow periodic venting (also known as a cool down vent)
- When on the road the relief valve generally activates in the area of 25 psi (depending upon product carried)
- This venting process actually reduces the temperature inside the tank
- Periodic venting must be anticipated
- Application of water to the vent can result in freezing of the relief valve and can worsen the problem
• During off-loading, a high pressure relief valve is activated to allow pressures within the container to approach up to 250 psi

(f) Cooling with water streams

• Remember that water from fire streams is extremely hot in comparison to the temperatures of the product inside

• Application of water to a cryogenic tanker not involved in fire can increase the pressure within the tank

• Water should never be directed at relief valve

5) Compressed gas tube trailers

(a) Used to carry compressed (not liquefied) gases

(b) Very similar in operation to a fire department cascade system

• Used for filling air bottles

• Can be found on construction sites

(c) Can be seen with ultra-high pressures up to 5000 psi

(d) Common products include compressed

• Oxygen

• Helium
• Natural gas

• Argon

(e) Heavy steel cylinders secured to a flat bed vehicle

6) Dry bulk carriers

(a) Designed to carry powdered or granular dry bulk materials

(b) Bottom unloading

(c) Many such materials are hazardous while the majority are non-hazardous

B) Intermodal containers

1) Containers that can be used across various modes of transportation

(a) Marine

(b) Highway

(c) Rail

2) General arrangement is a tank within a frame

3) Various pressure ratings

(a) IM 101 is rated 25.4 to 100 psi

(b) IM 102 is rated 14.5 to 25.4 psi

(c) Pressurized tanks 100 to 500 psi

(d) Cryogenic (IMO type 7)

(e) Tube

4) Many of the intermodal containers have the same design considerations as a highway transportation container

(a) Venting devices
UNIT 2.4 — CONTAINERS AND DAMAGE ASSESSMENT

(b) Loading and unloading

5) Frame is designed to allow lifting from one mode of transport to another

Show the Video (10 minutes)

Containers

C) Rail transport containers (15 Minutes)

1) Wide variety of rail transportation containers

2) Box cars

3) Flat cars

4) Gondola cars
   (a) Sides with open tops
   (b) Coil, steel, iron ore, rock

5) Hopper cars
   (a) Can be covered or uncovered
   (b) Can off-load by rotary pump or bottom rapid discharge
   (c) Can carry a wide variety of bulk hazardous materials

6) Tank cars
   (a) In rail transport, tank cars can be classified as low pressure or high pressure
      • Non-pressurized (< 100 psi)

Discuss the considerations for recognizing a non-pressurized tank car (e.g., bottom off-loading valves, appearance of exposed valves on the top of the car).
Remind the participants not to mistake an “expansion dome” for a dome that encloses valves on a pressurized car.

- Pressurized (> 100 psi)

Characteristic round ends (as seen in highway containers) are generally not visible on pressurized rail cars. This is because the inner tank is covered by an outer shell that masks the shape of the inner container. Pressurized cars will be absent of underside valves and plumbing and all valves on top are enclosed in a protective dome.

(b) Can also find the same general types of highway transport containers in the rail setting

- Cryogenic
- Compressed gas tube cars
- These are generally contained within a “box car”

(c) Hazardous material capacities of rail cars range from 6,500 gallons to 31,500 gallons.

(d) Many rail cars are dedicated to carry certain products. Therefore, the name of the product to be carried may be stenciled on the end of the car.

(e) Intermodal

- Container on flat car (COFC)
- Trailer on flat car (TOFC)

V) SHIPPING PAPERS AND PLACARDS (10 MINUTES)
A) The operations responder needs to know how to obtain shipping papers in transport

B) Highway shipping papers

1) Bill of lading or shipping papers
   (a) Located with the driver
   (b) If driver leaves the vehicle, papers must be left on the seat or in the door pocket
   (c) Waybills will be “flagged” if they contain hazardous materials

2) Placards will appear on a highway transportation vehicle depending upon placarding requirements (this was discussed during awareness level training)
   (a) Four digit ID number will appear on the placard if the vehicle and the container are one in the same
   (b) Otherwise, product identification number must be obtained from the shipping papers

C) Rail transportation shipping papers

1) Waybills (one for each car)
   (a) STCC — Numbers starting with 48 or 49 indicate hazardous material

2) Consist list
   (a) Lists what the train consists of
   (b) A car by car summary of what is in the entire train
   (c) Listed in order of appearance
   (d) Referenced to the car number
      ● Large stenciled letters and numbers
• Located on the left as you face the car from the side

• Car number is like the license plate number

3) Other ways to determine contents of a rail car
   (a) Stenciled product name and capacity
   (b) DOT placards and numbers

4) Operation Respond Emergency Information System (OREIS)
   (a) Web-based access to emergency information and guidance
   (b) UN ID
   (c) Placards
   (d) Chemical database

VI) NON-BULK CONTAINERS (15 MINUTES)

A) Limited quantities
   1) Less than 119 gallons
   2) Less than 1,000 lbs. water capacity

B) Constitutes the vast majority of all hazardous materials shipments
   1) Incident involving non-bulk packages are generally not a major consequence due to limited quantities involved

C) Can be carried by all modes of transport except pipeline

D) Types
   1) Cylinders
   2) Drums
UNIT 2.4 — CONTAINERS AND DAMAGE ASSESSMENT

3) Bags
4) Boxes
5) Totes
6) Carboys
7) Glass or plastic containers within styrofoam or fiberboard boxes

E) As with other larger containers, non-bulk packaging can be found in:
   1) Non-pressurized
   2) Low pressure
   3) High pressure
   4) Cryogenic
   5) Dry products

F) Labeling
   1) Varies with type of container
   2) Pesticide labels
      (a) Pesticide name
      (b) Active ingredient
      (c) Hazard statement
      (d) EPA registration #/ pesticide control product #
      (e) Precautionary statement
      (f) Signal word

G) Pipeline
   1) Pipelines can be dedicated to carry a specific product or they may carry a variety of products
2) Considerations for multiple product pipelines

(a) Products might be separated by a “pig” (an inflatable plug that moves with the product in the line).

(b) Many times, no separates are used at all.

- If the product's specific gravities vary significantly, just the weight of the product can be used to control flow.

- When pumping millions of gallons of a product at a time, a few hundred to a thousand gallons of cross contaminated product is of little consequence.

(c) May make it difficult to determine what is leaking

- Only the pipeline company can estimate what is at “your” location at any given time

- They have to calculate what was placed into the pipe, at what time and how much to calculate what is at any given location

3) Pipeline markers

(a) Must be used any time a pipeline crosses another mode of transportation

(b) Marker must state:
• What is in the line (or general product type, e.g., petroleum)

• Pipeline owner

• Emergency contact information

4) Safety features

(a) Cathodic protection

• Prevents degradation of the pipe through rusting due to naturally occurring electrical charges

(b) Pressure sensors

• Identifies to the pipeline sudden or unexplained loss of pressure

(c) Limited access

• Underground

• Enclosed and secured when they come above ground

• Protected against vandalism with fences or locks

(d) Stress casings

• Used when placed under changing load conditions (e.g., under highways or rail)

• Essentially a pipe within a pipe

• The external pipe absorbs the force
• The external pipe is then vented to each end of the casing

The instructor should use a marker board or easel pad to draw the basic concept of stress casings and vent pipes

VII) RADIOLOGICAL PACKAGES (10 MINUTES)

A) Special form packaging

1) Material may present a direct radiation hazard if released

2) Material presents little hazard of contamination however due to its special form (e.g., a solid chunk that will not break apart and disperse)

B) Expected

1) Solids, liquids or gases that do not meet the definition of special form

2) Extremely low levels of radiation
   (a) Fiber board, wooden or steel crates
   (b) Not identified on shipping papers or package markings

C) Industrial

1) Low concentrations of radioactive materials
   (a) Present limited risk
   (b) Must meet performance standards
   (c) Not identified on shipping papers or labeling

D) Type A packaging
1) Carry higher concentrations of radioactive materials

2) Must, under normal shipping conditions, prevent the loss of the product and maintain shielding capabilities

   (a) Two inches of rain in an hour
   (b) Free drop from 4 feet
   (c) Stacking or compression equal to weight of package for 24 hours
   (d) Vibration for 1 hour
   (e) Penetration of 13.2 pounds dropped from 40 inches
   (f) Fiber board or wood boxes
   (g) Drums

3) Many times these containers have inner containment vessels of glass, plastic or metal which are then packaged inside styrofoam, rubber, vermiculite or other material

E) Type B packaging

1) Highly radioactive material — Spent fuel

   (a) In addition to meeting the requirements of Type A packaging, Type B packaging must withstand serious accident damage by:

      • Surviving a 30 foot drop
      • Passing a puncture test
      • Passing a thermal exposure test
      • Passing a water immersion test
• Being identified by shipping papers and markings

F) Type C packaging

1) Highest radiological hazard

2) Container construction and shape

G) Labeling of radioactive materials

(a) Contents — Name of the radionuclide

(b) Activity — Expressed in curies, millicuries or microcuries (the strength)

(c) Activity levels

• Identifies the maximum radiation level in millirems/hour at 1 meter (39 inches) from the surface of the container

• Radioactive I (white label) no more than 0.5 millirem/hr at the package surface

• Radioactive II (yellow label) maximum 50 mrem/hr at the surface and 1 mrem/hr at 1 meter

• Radioactive III (yellow label) 200 mrem/hr at the surface and 10 mrem at 1 meter (these shipments are required to be placarded)

If a package failure was to occur, it could be easily be detected with instruments commonly available to the fire service.
VIII) ASSESSING THE CONTAINER (20 MINUTES)

The purpose of this unit is to instill within the participants the understanding of why a thorough container damage assessment must be performed. It is NOT intended to recommend that operations level responders conduct a close up damage assessment, but rather, to make defensive observations of container conditions.

Once the type of container is known and the product involved determined, the container needs to be assessed for the possibility of failure.

A) Types of container stresses

1) Thermal — Weakens the container through thermal decomposition, degradation and softening
   (a) Extreme heat
   (b) Extreme cold

2) Chemical
   (a) Contents that are incompatible with the container
   (b) Heat and gases produced by a reaction inside the container
       • Over pressurization
       • Remember that the rate of reaction increases with pressure

Again, discuss the fact that just because a container was made to carry a corrosive, it does not mean the product will not damage the container if it comes into contact with the outside of it. These containers have special linings to protect them from the corrosive material inside. However, leakage of the product to the outside of the container may result in external degradation.
3) Mechanical

(a) Type of force acting on the container
   - Shock
   - Pressure
   - Impact
   - Punctures

(b) Causes
   - Accidental
   - Negligence
   - Intentional

Describe the types of damage caused from a container sliding on its side or hitting an object. Discuss the expected weakening effects of the container.

B) Types of failures

1) When a container fails, it is called a breach or leak

2) Ways containers breach

   (a) Disintegration
      - Definition
      - Causes
      - Stresses involved

   (b) Run-away cracking
      - Definition: A crack in the container wall develops and, due to internal pressure, the crack
continues in a run-away fashion.

- Causes: Overpressurization with or without external stressor
- Stresses involved

(c) Closure openings

- A manufactured closure (e.g., valve opens or fails to close appropriately)

(d) Punctures

- Caused by an external force
- Example: A forklift puncture

(e) Splits and tears

- Generally caused by an external force
- Depending upon internal pressure, a split or tear can result in run-away cracking

C) Types of Releases (10 minutes)

1) Detonation

(a) Rapid container failure where contents oxidize rapidly

(b) Usually associated with container disintegration or run-away cracking

2) Violent rupture

(a) Massive container failure where contents are spilled rapidly; ignition may follow
(b) Run-away cracking or disintegration

(c) BLEVE — Boiling Liquid Expanding Vapor Explosion

Take several minutes to explain the concepts of BLEVE. Reinforce that BLEVE will not occur in the case of gasoline tankers with aluminum walls because the aluminum will readily melt.

3) Rapid relief

(a) Over-pressurization causes container failure of relief valve operation

4) Spill or leak

(a) From puncture or tears and splits

(b) May be a gradual flow or rapid release

D) Damage assessment

1) Damage assessment is very risky

2) Close-up damage assessment is NOT an operations level responsibility

(a) Hazardous materials technicians or other persons specifically trained to conduct damage assessment should be called upon.

(b) The operations level responder can identify some conditions that might result in a “critical container”.

3) Operations level definition

(a) Damage assessment at the operations level consists of a defensive evaluation of the containers to identify critical containers.
• A critical container is one in which catastrophic failure is possible.

In order to reinforce the importance of damage assessment, the instructor should discuss the Waverly Tennessee incident. The instructor can find information concerning the incident in virtually any hazardous materials textbook.

On February 24, 1978 a single tank car carrying 27,000 gallons of LPG violently released its contents and ignited. Prior to the failure, the train had derailed and sustained a dent on the underside of the tank. This dent, in combination with warming temperatures, resulted in a runaway crack in the container some two days later while railroad workers were righting the car.

4) Three items to consider

(a) Pressure within the container

• Vapor pressure of the product

• Chemical reactions inside the closed container

• Thermal — Vapor pressure increases with temperature

Obviously, internal pressure plays a major role in the criticality of the container. The higher the internal pressure, the greater the potential for failure.

(b) Material used to make the container

• Heavy steels (e.g., those used in pressurized tanks) are very susceptible to dents

• Softer metals like aluminum and mild steel, tolerate dents better, but
are susceptible to tears and punctures

(c) Type of stressor

- Thermal stressors can weaken the strength of steel (e.g., HSLA).

- Chemical stressors (e.g., corrosives) can affect the tank strength by degrading the metal or by increasing internal pressures through reactions.

- Mechanical stressors (e.g., dents, gouges, scores) have various effects on different types of metals

5) Critical pressurized tanks

(a) Critical pressurized containers are the greatest concern.

- Is the pressure a result of the product’s normal volatility?

- Is the pressure being generated by another cause (e.g., fire or chemical reaction)?

(b) Mechanical failures — Heavy steel used in pressurized containers can catastrophically fail as a result of tight radius dents.

- Tight dents cause a stretching of the metal which results in the development of internal fractures.
If pressures are allowed to increase, these fractures can result in runaway cracking of the container.

At the operations level, any pressurized container with a tight radius dent must be considered critical.

Major goal is to reduce the pressure. This might be achieved through the defensive application of water.

Remind the participants that this tactic would NOT apply to cryogenic containers.

6) Thermal impacts (BLEVE)

(a) A BLEVE can occur from any closed container involved in fire.

(b) The liquid is heated and boils (boiling liquid).

(c) As a result of the boiling, internal vapors are increased and so is pressure (expanding vapor).

- Normally these vapors are released by built in pressure relief devices.
- Many closed containers that hold only liquids do not have relief devices, or
• These relief devices may not be sufficient enough to release the tremendous vapors generated.

• Therefore, the relief valve will activate and not reset. Changes in pitch may be heard.

  (d) Over-pressurization can occur

  (e) In addition, if the flame is impinging on the metal above the level of the liquid inside the tank, severe metal fatigue can occur.

Optional Videos:
The instructor may wish to utilize one of two videos. “Container Damage Assessment” from the National Fire Academy Hazardous Materials Operating Site Practices program or, the case study of the Waverly, Tennessee or Memphis, Tennessee MC330 LPG tank failure.

IX) DISPERSE AFTER RELEASE (5 MIN)

A) Dispersion types

  1) Hemisphere

  2) Cloud

  3) Plume

  4) Cone

  5) Stream

  6) Pool

  7) Irregular

Discuss that there are several computer modeling programs that can be used to predict dispersion patterns.
after the release. CAMEO’s ALOHA modeling system is one of the most commonly used.

B) Time frame for potential exposure

1) Short term
2) Medium term
3) Long term
4) All dependent on material, leak, dispersion pattern and environmental conditions

X) SUMMARY (5 MINUTES)

A) Numerous types of containers can be found

B) General classifications are:

1) Non-pressurized (atmospheric)
2) Low pressure
3) High and ultra High pressure
4) Special use (e.g., dry bulk, cryogenic)

C) Container used is largely dependent upon product vapor pressure

D) Acquisition of shipping papers is essential to the operations level responder if this can be done safely

E) Radioactive materials are shipped in either Type A or Type B packaging

F) Assessing container damage

ACTIVITY 2.4 (30 Minutes)

Container Recognition
Given images of containers, the participants will identify the type of container and, if present, the type and extent of damage incurred by the container.

This activity is designed to be a reinforcement of container information as well as a learning activity for the vulnerability assessment portion which occurs next in the program.