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Where applicable, authorities having jurisdiction should be consulted.

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This program is designed to give the first responder a basic understanding of crude oil that is being transported by rail tank car. The program will discuss the basics of hazard identification, tank car design, and emergency response considerations.
At the end of this program, the participant should be able to:

• Understand the growth of crude oil by rail
• Identify shipping papers used
• Identify the information sources available for identification
• Describe the benefit of the information from rail shipping papers
• Recognize the markings used for identification of rail cars transporting crude oil
• Describe the considerations to be taken during an incident involving crude oil by rail including:
  – Basic firefighting
  – Containing and confinement
Course Outline

- Why crude oil by rail?
- Recognizing the hazards
- Understanding crude oil
- Rail cars that carry crude oil

- Fire response
- Spill response
- Incident command during a rail incident
U.S. Crude Oil Production

* Energy Information Administration estimate          Source: EIA
U.S. Crude Oil on Class 1 Railroads

Car loads of crude oil (tens of thousands)

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2009</th>
<th>2011</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>11</td>
<td>65</td>
<td>407</td>
</tr>
</tbody>
</table>

Commodities by %

- Crude oil, NGLs & petroleum products, 6.5
- Other commodities, 32.5
- Coal, 19.9
- Chemical & allied products, 13.9
- Farm products, 7.2
- Food & kindred products, 7.8

Rail Safety Record

Chapter I
Determine If HAZMAT is Present

- Call the railroad emergency phone number (found here)
- Identify specific hazardous materials
- Find the train crew
Recognizing a HAZMAT Shipment

Placards are on both sides and both ends

Examples of crude oil placards
### Emergency Response Information

**Flammable Liquids (Non-Polar/Water-Immiscible)**

**Guide 128**

#### Potential Hazards

**Fire or Explosion**
- Highly flammable. Will be easily ignited by heat, sparks, or flames.
- Vapors may form explosive mixtures with air.
- Vapors may travel to source of ignition and flash back.
- Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Vapor explosion hazard indoors, outdoors, or in sewers.
- Those substances designated with a (P) may polymerize explosively when heated or involved in a fire.
- Runoff to sewer may create fire or explosion hazard.
- Containers may explode when heated.
- Many liquids are lighter than water.
- Substance may be transported in bulk.
- For lithium-ion batteries, also consult Guide 147.
- If molten aluminum is involved, refer to Guide 169.

**Health**
- Inhalation or contact with material may irritate or burn eyes and skin.
- Fire may produce irritating, corrosive, and/or toxic gases.
- Vapors may cause dizziness or suffocation.
- Runoff from fire control or dilution water may cause pollution.

**Public Safety**
- Call Emergency Response: Telephone number on shipping paper first. If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- At an immediate precautionary measure, testable spill or leak area for at least 50 meters (150 feet) in all directions.
- Keep unauthorized personnel away.
- Stay airborne.
- Keep out of low areas.
- Ventilate closed spaces before entering.

**Protective Clothing**
- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

**Evacuation**
- Large Spill: Consider initial windward evacuation for at least 500 meters (1000 feet).
- Fire: If tank, railcar or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

### Emergency Response

**Fire**
- CAUTION: All these products have a very low flash point. Use of water spray when fighting fire may be inefficient.
- CAUTION: For mixtures containing alcohol or polar solvent, alcohol-resistant foam may be more effective.

**Small Fire**
- Dry chemical, CO₂, water spray or regular foam.

**Large Fire**
- Water spray, fog or regular foam.
- Do not use straight streams.
- Move containers from fire area if you can do it without risk.

**Fire Involving Tanks or Car/Trailer Loads**
- Right fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and set fire burn.

**Spill or Leak**
- Eliminate all ignition sources (no smoking, fires, sparks, or flames in immediate area).
- All equipment used when handling the product must be grounded.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
- A vapor suppressing foam may be used to reduce vapors.
- Absorb or cover with dry earth, sand, or other non-combustible material and transfer to containers.
- Use clean non-sparking tools to collect absorbed material.

**First Aid**
- Move victim to fresh air.
- Call 911 or emergency medical service.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Wash skin with soap and water.
- In case of burns, immediately cool affected skin for as long as possible with cold water.
- Do not remove clothing if adhering to skin.
- Keep victim warm and quiet.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.
Railroad Shipping Papers

Cars listed in order

Box of asterisk identifies HAZMAT car

DOT Proper Shipping Name (PSN) and information

24-Hr emergency contact number for shipper
Verifying Information

020 CBTX 743308
87 FROM HEAD

Platforms: 1

Brakes: 1.0

L T32 CRDOIL TB052 05-840-05 STJAMES, LA ST JAM RAI 60 138 T 60 ft
2,719 T 1,198 ft

1/1c, 201071/LB
UN1267
PETROLEUM CRUDE OIL
3 PG I
TN=(PETROLEUM CRUDE OIL)
SHIPPER CONTACT
CHEMTREC (CCN 681568)
HAZMAT STCC = 4910165

EMERGENCY CONTACT:
8004249300
PETROLEUM CRUDE OIL
CLASS 3 (FLAMMABLE LIQUID)

PETROLEUM CRUDE OIL IS A DARK VISCOUS LIQUID. IT HAS A FLASH POINT OF LESS THAN 141 DEG. F. IT IS LIGHTER THAN WATER AND INSOLUBLE IN WATER. ITS VAPORS ARE HEAVIER THAN AIR.

IF MATERIAL ON FIRE OR INVOLVED IN FIRE
DO NOT EXTINGUISH FIRE UNLESS FLOW CAN BE STOPPED
USE WATER IN FLOODING QUANTITIES AS FOG
SOLID STREAMS OF WATER MAY SPREAD FIRE
COOL ALL AFFECTED CONTAINERS WITH FLOODING QUANTITIES OF WATER
APPLY WATER FROM AS FAR A DISTANCE AS POSSIBLE
USE FOAM, DRY CHEMICAL, OR CARBON DIOXIDE

IF MATERIAL NOT ON FIRE OR NOT INVOLVED IN FIRE
KEEP SPARKS, FLAMES, AND OTHER SOURCES OF IGNITION AWAY
KEEP MATERIAL OUT OF WATER SOURCES AND SEWERS
BUILD DIKES TO CONTAIN FLOW AS NECESSARY
ATTEMPT TO STOP LEAK IF WITHOUT UNDUE PERSONNEL HAZARD
USE WATER SPRAY TO KNOCK-DOWN VAPORS

PERSONNEL PROTECTION
AVOID BREATHING VAPORS
KEEP UPWIND
WEAR APPROPRIATE CHEMICAL PROTECTIVE GLOVES, BOOTS AND GOGGLES
DO NOT HANDLE BROKEN PACKAGES UNLESS WEARING
APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT
**Comparison of Common Flammables**

### Packing Group (PG) and Key Physical Properties of Common Flammable Materials

<table>
<thead>
<tr>
<th></th>
<th>PG I Crude Oil*</th>
<th>PG II Crude Oil*</th>
<th>PG III Crude Oil*</th>
<th>Ethanol (PG II)</th>
<th>Gasoline (PG I or II)</th>
<th>Diesel (PG III)</th>
<th>LPG (Propane)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boiling Point</strong></td>
<td>&lt;95 °F</td>
<td>&gt;95 °F</td>
<td>&gt;95 °F</td>
<td>174 °F</td>
<td>90 to 110 °F</td>
<td>300 °F</td>
<td>-43 °F</td>
</tr>
<tr>
<td><strong>Flashpoint</strong></td>
<td>&lt;73 °F</td>
<td>&lt;73 °F</td>
<td>&gt;73 to &lt;140 °F</td>
<td>55 °F</td>
<td>-36 to -50 °F</td>
<td>125 °F</td>
<td>-156 °F</td>
</tr>
</tbody>
</table>

*No two shipments (even from same well head or mine) will have the exact same chemical and physical composition, flashpoints/boiling points and Packing Groups will vary.

Table provided by BNSF
Crude oil is not a refined product but consists of many constituent products.

**Primary concerns**
- Flammability
- Volatility – similar to gasoline – confined space hazard
- Hydrogen sulfide – headspace as well as open air
- Benzene

**Secondary concerns**
- May contain known or suspected carcinogens

**Combustion byproducts**
- Oxides of carbon, nitrogen, and sulfur
- Various organics – aldehydes, aromatics
- Particulate matter/soot, polycyclic aromatic hydrocarbons

This information is also available in the ERG
## Liquid Viscosity

Viscosity is a measure of how easily a substance flows.

<table>
<thead>
<tr>
<th>Liquid @ 68° F</th>
<th>Viscosity (cP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>1</td>
</tr>
<tr>
<td>Crude Oil (sg=0.855)</td>
<td>7.5</td>
</tr>
<tr>
<td>Olive Oil</td>
<td>84</td>
</tr>
<tr>
<td>Light Machine Oil</td>
<td>102</td>
</tr>
<tr>
<td>Pancake Syrup</td>
<td>2,500</td>
</tr>
<tr>
<td>Ketchup</td>
<td>50,000</td>
</tr>
<tr>
<td>Peanut Butter</td>
<td>250,000</td>
</tr>
<tr>
<td>Tar or Pitch</td>
<td>30,000,000,000</td>
</tr>
</tbody>
</table>

Classification by Specific Gravity

“Weight” or Specific Gravity

- Lighter crudes
  - Lower density
  - Low viscosity

- Heavier crudes
  - Higher density
  - Higher viscosity
Non-Pressure Tank Cars
Key Components of a Tank Car

- **Top fittings housings** prevent the top valves from damage in a derailment.
- **Top Fittings**
  - Reduce the pressure inside the car and act as a thermal protection system in case of a derailment and fire.
- **Tank shell** holds the product and thicker tank material improves puncture resistance.
- **Head shields** improve puncture resistance in a derailment.

**Bottom fittings and Bottom outlet protection**

- **Jacketed**
- **Non-Jacketed**
Respiratory protection

• Skin protection
  • Flammability is the major influencer of PPE selection
  • If the potential for flammability exists, PPE choices are limited
  • No flammability – many more options

• Eye protection
  • Splash protection
  ✓ Glasses, goggles, or face shield depending on the job task

• Guidance for PPE
  • Response to these incidents can be found in the NFPA standards, OSHA regulations, and the AHJ SOP/SOG
Provide air monitoring in the community and work areas surrounding the crude oil release.

- **Reasons for air monitoring:**
  - Worker safety
  - Safety of the community near the incident
  - Assessment of potential problems
  - PPE selection
  - Compliance with regulatory standards and guidelines
- Spill fires running and pooled
- Fire impinging on car(s)
- Pressure fire three dimensional fire
- Fire/product release from pressure relief devices
- Breached car with crude inside of car on fire
- Fire duration
DOT 111 tank cars involved with intense pool fires or torch fires are subject to immediate failure.
Site Assessment

Evaluate the risk vs. benefits and the capability to intercede prior to engagement.

- **Potential hazards:**
  - Rail car failure
  - Respiratory hazards
  - Physical site hazards
  - Potential for boil over
  - Slop over/froth over
  - Fire type

This information is also detailed in the ERG, see slide 13
Strategic Objectives

- RECEOS
  - Rescue
  - Exposures
  - Confine/Contain
  - Extinguish
  - Overhaul
  - Salvage
“If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.”
Chapter V – Response Operations

- Defensive Operations
- Offensive Operations
- Non-intervention
Defensive Operations Considerations

- Cooling Tank Cars
  - Is cooling from a distance beneficial?
  - Are all exposures outside the exclusion zone?
  - Can an adequate water supply be maintained?
  - Can the fire water runoff, if used, be contained or diverted to minimize impact to the environment?
Defensive Operations – Concerns

Cooling crude oil rail cars adjacent to the fire can decrease the possibility of car failure such as a heat induced tear.

- **Cooling water should be directed:**
  - At the point of flame impingement first
  - On the vapor space of tank cars adjacent to the fire exposure from radiant heat

- **For extended operations** (long burn times) or when the ability to reach needed areas of the car(s) is limited, remote unstaffed monitors should be considered.
Cool Adjacent Cars

- **DO NOT** spray cooling water directly into a crude oil tank car if breached. This could lead to a slop over/froth over or long term, potentially, a boil over.

- **Continuously evaluate** the effect cooling:
  - Effective cooling is when water is flowing down the sides of the car without evaporating.
  - Lack of effective cooling may result in rising pressure within the tank (increasing sounds may be noted).
Cool Run-Off

- **Evaluate potential** down stream impacts of crude oil on fresh water intakes, sewers, and water bodies
- If **burning** crude oil enters a storm sewer
  - Consider the use of fire fighting foam to extinguish (ref. NFPA 11)
- If **non-burning** crude oil enters a storm sewer
  - Conduct air monitoring to determine the quantity of flammable vapors and $\text{H}_2\text{S}$
  - Evaluate the use of foam in the sewer to reduce flammability
For Offensive Operations

- **Class B foams** are recommended in NFPA 11 as the extinguishing agent of choice on crude oil spill/pool fires (NFPA 11 is the standard for foam application).
- **Dry chemical** is an effective extinguishing agent for crude oil fires.
- **Railroad track structure**, tank car position, and other obstructions as well as weather conditions can impact foam effectiveness.
Additional Key Considerations for Offensive Operations

- Do you have the necessary amount of adequately trained and protected responders available?
- Do you have clarity on the type of fire – spill/pool vs. three dimensional?
- Do you have enough of the correct extinguishing agent, equipment, and trained personnel?
  - Foam concentrate
  - Dry chemical
- Can you maintain a post suppression foam blanket to prevent re-ignition?
- Do you have a large enough sustainable water supply?
Monitoring for Flammable Vapors
- Once the fire is extinguished, monitoring for flammable vapors, which can cause re-ignition, and toxic atmospheres should be conducted even with a foam blanket.

Reaplication of Foam
- Reaplication of foam may be necessary for an extended time during remediation.

Foam-blanketed Area
- NFPA 11 recommends responders not enter a foam-blanketed area, disturbing the intact blanket, unless absolutely necessary. If this is necessary, foam lines should be actively utilized to maintain a robust foam blanket.
Industry follows a set of guiding principles that allows the response community to achieve a rapid, well-managed, and unified response effort:

- Protect the safety & health of people
- Stop the source of a spill as quickly as possible
- Minimize environmental & community impact
- Minimize oil getting into water in onshore scenarios
Oil Spill – Basic Info

- What type of oil was spilled?
- Where was it spilled?
- Where is it going?
- What will it impact?
- When will it impact?
- What should be done about it?
- How much was spilled?

http://www.oilspillprevention.org
Secure the perimeter
• Eliminate ignition sources
• Establish air monitoring

Stop the source of a spill as quickly as possible
• Close valves, plug holes

Minimize environmental and community impact by limiting the amount and the spread of oil that has spilled
• Berms, trenches etc.

Minimize oil getting into the water
• Damming, diking, diverting, or retention

Minimize the spread of oil
Oil Spill on Land

Containment:
Dikes, Berms and Dams

- Embankment structures built from existing terrain used to exclude oil from sensitive areas (e.g. waterways) are most effective before oil arrives.
Oil Spill on Land

Containment: Trenches and Pits

- Constructed with earth moving equipment to collect free flowing product on land
Booming is used to contain product or protect sensitive areas, under certain environmental and operational conditions, with four basic strategies:

- **Containment Booming** – Booming strategy used in little or no current to isolate a spill, control spreading, concentrate the oil, and to facilitate its recovery.

- **Exclusion Booming** – Strategy used to exclude slicks from sensitive shorelines and/or amenities. With the addition of sorbent material, booms can also be used to collect oil.

- **Diversion Booming** – One or more boom strings can be positioned to divert a slick to a shoreline area that’s suitable for recovery.

- **Deflection Booming** – Boom is deployed at an angle to a drifting slick to deflect oil away from sensitive areas or to a collection point.
Preparing for Response

A detailed contingency planning and preparedness process is made up of the following core components:

The preparedness process allows for potential scenarios, enabling a rapid and effective response in the event of an incident.

Preparing for Response

Identify Potential Events

Plan Scenarios

Develop Response Strategies

Provision Resources

Stakeholder Engagement with Governments, Communities, and Industry
Railroad emergency responders are trained in and prepared to operate using NIMS/ICS.

- In the Unified Command, the senior transportation officer or designee will act as the lead railroad official with the lead agency Incident Commander.
The four major organizational components one encounters in a typical railroad ICS structure are:

- Transportation – monitors the network, routes traffic and schedules trains and crews
- Mechanical – in charge of all rolling stock (railcars) and locomotives
- Engineering – in charge of all infrastructure including, track, signals, bridges, tunnels, etc.
- Safety or Risk Management – contains emergency response functions such as police, HAZMAT, Environment, Public Affairs, Claims, etc.
Incident Command System

Public Safety ICS

- Incident Commander
- Safety
  - Operations
- PIO
  - Planning
  - Logistics
  - Finance

Railroad Incident Management

- Senior Transportation Officer
  - Safety
  - PIO
  - Transportation
  - Mechanical
  - Engineering
  - Risk Management

- HAZMAT/ Dangerous Goods Group
- Environmental Group
- Law Enforcement
- Safety & Regulatory Affairs
- Risk Mitigation Group
- Public Affairs Group
- Damage Prevention and Freight Claims
Unified Command

Municipal Fire Chief

Senior Transportation Officer

Joint Safety

Joint PIO

Planning

Logistics

Operations

Finance

Railroad Branch

Fire Branch

Transportation

Fire

Mechanical

Rescue

Engineering

Risk Management
In Summary

Chapter VIII

- Protect the public
- Contact the railroad
- Secure the scene
- Assess the hazards
- Respond accordingly
- Coordinate response actions with the railroad
Resources

- Emergency Response Guidebook

- National Incident Management System (NIMS)

- CHEMTREC®

- TRANSCAER®
  - [http://www.transcaer.com/](http://www.transcaer.com/)


- NFPA 11 – Standard for low-, medium-, and high-expansion foam

- NFPA 1851 - Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting

- OSHA 29 CFR 1910.120-Hazardous waste operations and emergency response