

Instructor Manual

Module

4

Transportation and Transfer

Module Objective

Upon completion of this module, participants should be able to describe how ethanol-blended fuels are transported and transferred as well as where the most likely points for error in these actions will exist.

Enabling Objectives

1. List common modes of transportation for ethanol-blended fuels.
2. Describe the United Nations/ Department of Transportation (UN/ DOT) placards and markings that will allow responders to identify ethanol-blended fuel transports.
3. Identify national resources available to provide product and mitigation information.
4. Discuss the likelihood and potential locations of incidents involving ethanol-blended fuels.
5. Methods of identifying and confirming presence in transport vehicles will also be discussed.

Instructor Note:

Module Time: 30 minutes/ 45 minutes

Materials:

- *Activity 4.1*
- *Responding to Ethanol Incidents video – (Show the video segment from 6:48 to 9:30)*

Instructor Note:

Show the video Emergency Response Considerations (6:48 to 9:30).

Introduction

Given the increased use of ethanol and ethanol-blended fuel, it is essential that emergency responders be able to quickly and effectively identify their presence at the scene of an incident. It is important to recognize the proper placarding and marking of ethanol-blended fuels. Proper identification of ethanol and ethanol-blended fuels can ensure proper steps are taken so incidents are managed effectively.

Instructor Note:

Ask participants, in their jurisdiction where is the greatest likelihood of an emergency involving Ethanol Flex-Fuels or ethanol transportation?

From Field to Your Vehicle

Most ethanol transported from an ethanol production facility is denatured fuel ethanol with 2-5% hydrocarbon (like natural gasoline). A small quantity of ethanol leaves the production facility undenatured (also known as neat ethanol), for industrial use or export. Less than 1% of gallons shipped from an ethanol production facility are shipped as ethanol flex fuel (51-85% ethanol by volume).

The ultimate destination determines the mode of transport leaving a production facility. Denatured fuel ethanol is delivered to a liquid products terminal, an oil refinery, or directly to a retail fueling station. When shipping to a liquid products terminal or oil refinery, transportation by rail is the most common. However, cargo tank truck transport may be used for short shipping distances. Cargo tank truck transport is used to move product from liquid product terminals to retail fueling stations and, to a lesser extent, from an oil refinery to deliver to retail fueling station.

Transport Placards and Markings

Ethanol and ethanol-blended fuels are identified using DOT placards and markings.

The U.S. Department of Transportation (DOT) requires that vehicles transporting hazardous materials (also known as dangerous goods) must display the appropriate DOT hazard class placard. These placards must be displayed on all sides of the transporting vehicle.

Ethanol-blended fuels and gasoline are transported in various types of containers including cargo tank trucks, rail tank cars, freighter ships or barges, and pipelines.

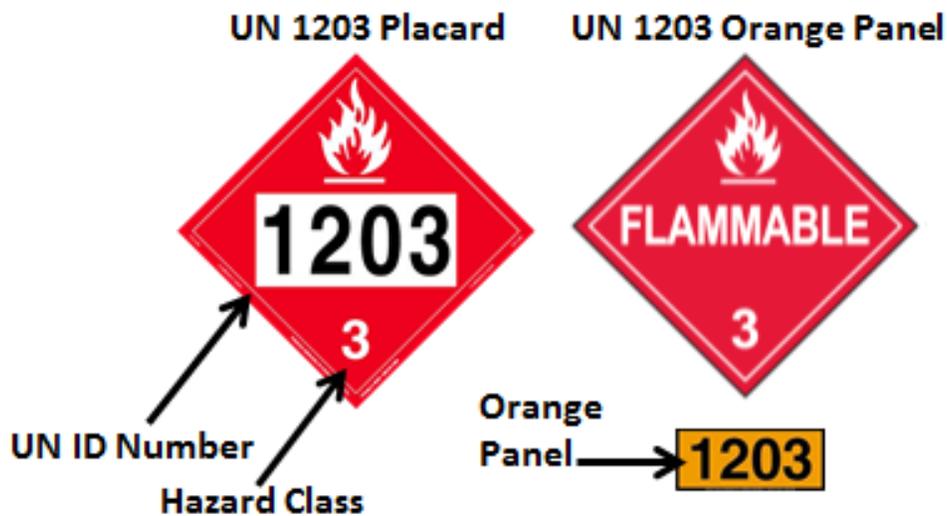
DOT has classified hazardous materials according to their primary hazard and has assigned standardized symbols to identify the classes. Materials are grouped by their major hazardous characteristics; however, many materials will have other hazards as well. Ethanol and ethanol-blended fuels are in the flammable liquids category, or DOT Class 3 hazardous materials. Placards for flammable liquids have a red background with a white flame and a “3” at the bottom

along with their corresponding identification number. The same placarding and marking protocols are used for highway and rail shipments.

Instructor Note:

Explain that the identification number is a four-digit identification number on the placard or orange panel. By looking up the identification number in the Emergency Response Guidebook (ERG), you can find hazard response information about the material.

Figure 4.1: UN 1203 Placards and Markings for Gasoline-Blended With up to 10 Percent Ethanol



Hazardous Material Description

Ethanol-blended fuels up to and including E10 will display an identification 1203 flammable placard.

Ethanol blends of E15 to E85 are included under the 3475 identification. The 3475 placard covers ethanol blends from E11 to E94.

Denatured fuel ethanol (E95 to E99 blends) will display a 1987 flammable placard.

The 1170 placard is for undenatured or neat ethanol (E100).

Table 4.2: Ethanol Shipping Information

Identification Number	Ethanol Concentration	Preferred Proper Shipping Name	Common Ethanol Blends
UN 1203	1% - 10%	Gasoline	E10
UN 3475	11% - 94%	Ethanol & gasoline mixture	E15-E85
UN 1987	95% - 99%	Alcohols n.o.s.	Denatured Fuel Ethanol, E95 - E98
UN 1170	100%	Ethanol <i>or</i> ethyl alcohol	E100

Emergency Response Information

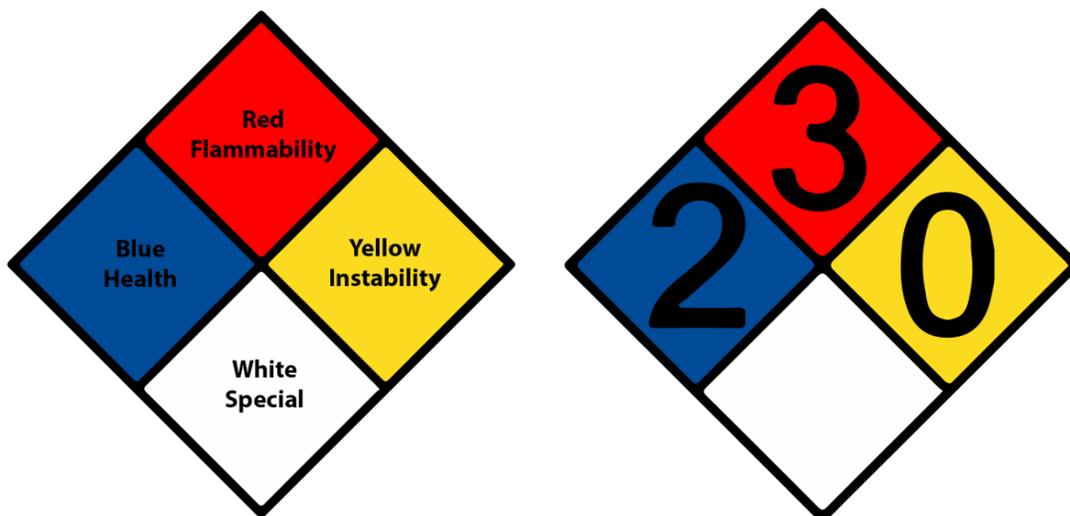
The DOT *Emergency Response Guidebook* (ERG), which includes this placarding information, is used as a resource for emergency responders when attending to an incident involving hazardous materials and dangerous goods. A safety data sheet (SDS) will also provide key safety information and product characteristics.

NFPA 704 for Ethanol

The National Fire Protection Association (NFPA) 704 marking system used for identifying hazardous materials found within facilities is based on the “704 diamond.” First "tentatively adopted as a guide" in 1960, this system is revised regularly and has been adopted by NFPA as a standard.

The NFPA 704 system uses colors, numbers (from 0-4), and special symbols to indicate the presence of hazardous materials. Each colored square indicates the type of hazard and the higher the number, the greater the hazard. For example, the number 4 in the blue health square indicates that a very short exposure could cause death or major residual injury (See figures 4.3 in Participant Guide).

Figure 4.3: NFPA 704 Diamond



- Health: Blue
- Flammability: Red
- Instability: Yellow
- Special: White (special notice)

Ethanol, is represented by a 2 in the blue health square, indicating slight to moderate irritation. It is also represented by a 0 for instability (yellow) and a 3 for flammability (red) indicating high flammability with ignition likely under most conditions. There is no commonly accepted special character (white) for ethanol, though one may be appropriate.

Hazard Rating

The U.S. Department of Labor Occupational Safety and Health Administration (OSHA) has adopted hazardous chemical labeling requirements as a part of its revision of the Hazard Communication Standard, 29 CFR 1910.1200, bringing it into alignment with the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS). Implementation affects chemical manufacturers, importers, distributors, and employers.

NFPA's rating goes from 0, which is least hazardous, to 4, which is most hazardous. The OSHA classification system, on the other hand, is numbered 1-4 with 1 being the most severe hazard and 4 being the least severe hazard relating to emergency responder and community exposure.

DOT has not adopted GHS, so current DOT placard requirements for packaging and packages remain in effect.

Emergency responders need to be aware that the OSHA numerical marking system is exactly opposite of the NFPA 704 standard marking system, which may cause confusion on an incident scene. Emergency responders arriving on any hazardous materials incident must visually survey the scene from a safe distance, determine what type of hazardous material identification system is visible, properly interpret the marking system, and initiate the appropriate action plan.

Transportation Patterns

Most hazardous materials incidents occur during the transportation and transfer operations. Emergency responders should be aware of areas or routes where shipments of ethanol and ethanol-blended fuels routinely pass. Denatured fuel ethanol (E95-E98) is one of the leading hazardous materials transported by rail. Unit train shipments containing 80-100 cars of denatured fuel ethanol are commonly seen on key rail routes leaving from the Midwest and heading to various population and distribution centers throughout the country. To aid in familiarization of commodity patterns, railroads provide traffic flow information to bona fide emergency response agencies.

The U.S. DOT Pipeline and Hazardous Material Safety Administration (PHMSA) publishes the *Guidebook for Conducting Local Hazardous Materials Commodity Flow Studies*. This Guidebook is designed to support risk assessment, emergency response preparedness, resource allocation and analyses of hazardous commodity flows across jurisdictions.

Transportation via Highway

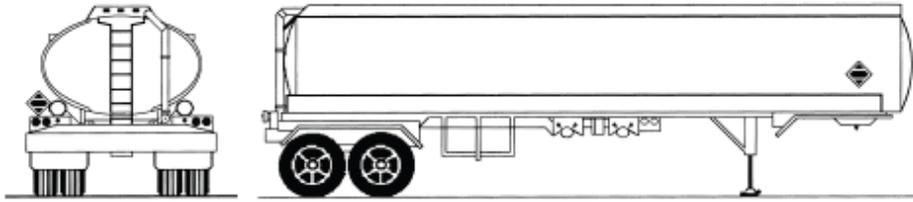
The second most common mode for ethanol leaving a production facility is a MC306/ DOT406 style cargo tank. Since both gasoline and ethanol-blended fuels have very similar physical and chemical characteristics, they will be transported in the same general types of containers and tanks. The most prevalent style of highway transport of the ethanol-blended fuels that emergency responders will encounter will be by the MC306/ DOT406 or MC407/ DOT407 cargo tanks (see Figures 4.4 and 4.5 in the Participant Guide).

The MC306/ DOT406 cargo tanks are non-pressure bulk liquid cargo tanks, that come in a variety of sizes and configurations. The most common MC306/ DOT406 cargo tanks have a capacity between 6,000-9,500 gallons depending on regional factors. The MC306/ DOT406 cargo tank itself can have up to seven compartments and is typically constructed out of aluminum. The MC307/ DOT407 is low-pressure bulk liquid cargo tanks. They come in a variety of sizes and configurations and typically holds between 5,000-7,000 gallons. The MC307/DOT407 can be insulated or uninsulated and contains between 1-4 compartments but some have up to six. The MC307/ DOT407 is typically constructed out of steel.

New single tank chassis (MC306/DOT406) supporting triple axles may have an increased capacity up to 12,000 gallons of ethanol-blended fuel. Many states within the U.S. have also allowed the use of tandem trailers carrying up to 24,000 gallons of ethanol-blended fuels.

Recently the U.S. is experiencing the use of “Road Trains” which are triple tankers with triple axles transporting up to 36,000 gallons of ethanol-blended fuels.

Figure 4.4: MC-306/ DOT-406 Cargo Tank



Instructor Note:

On the drawing, Figure 4.4 in the Participant Guide, there are outlets on the underside of the tank for on- and off-loading the product. Depending on the types of product being carried, the MC306 is divided into compartments.

In addition to the outlets and piping on the bottom, you can see vents and caps on the top side of the tank which can fail or leak as a result of rollover accidents. Placards should be visible on all four sides making identification of the product easier.

Figure 4.5: Overtuned MC-306/ DOT-406 Cargo Tank



Ethanol transported in cargo tank trucks are placarded and marked in the same manner as all other hazardous materials. Other characteristics of the cargo tank trucks are pressure and vacuum relief devices. They are typically bottom loaded and unloaded and equipped with a vapor recovery system.

Safety devices on these cargo tank consist of emergency shutoffs, breakaway valves for sheer protection, pressure relief devices as well as overfill and collision protection. It is strongly encouraged that emergency response organizations review these devices and engage in hands-on and functional exercises to refresh and/or enhance their technical knowledge of these transportation vehicles.

Transportation via Rail

Denatured fuel ethanol is regularly transported safely by rail every day. In the transportation of ethanol and ethanol-blended fuels, various routes are utilized: rail to fixed facility, rail directly to cargo tank truck, and rail directly to pipeline.

The most common mode of transport for denatured fuel ethanol leaving a production facility is rail transport that displays a 1987 flammable placard. Rail transportation of ethanol and ethanol-blended fuels is used to move product to fixed facilities, cargo tank truck transfer terminals or pipeline facilities.

Some of the ethanol transported by rail will be in non-pressurized DOT111A100W1 rail tank cars with no insulation or thermal protection. These rail tank cars are also referred to as a “general service” or “low-pressure” rail car (see Figures 4.6 and 4.7 in the Participant Guide).

These rail tank cars have a capacity of approximately 30,000-34,000 gallons. Unlike tractor trailer cargo tanks that contain multiple compartments, rail tank cars usually have only one compartment.

Figure 4.6: DOT 111 General Service Rail Tank Car

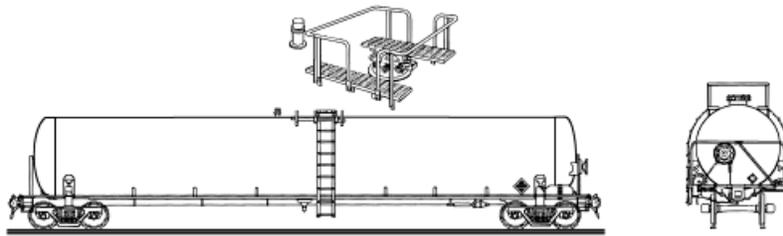


Figure 4.7: DOT 111 With Placard



New regulations for rail tank cars construction were published in 2015. New rail tank cars constructed after October 1, 2015 are required to meet enhanced DOT Specification 117 design or performance criteria. Existing rail tank cars must be retrofitted by 2023 in accordance with the DOT-prescribed retrofit design or performance standard.

Safety enhancements of DOT Specification 117 rail tank car:

- Full-height 1/2 inch thick head shield
- Tank shell thickness increased to 9/16 inch minimum TC-128 Grade B, normalized steel
- Thermal protection
- Minimum 11-gauge jacket
- Top fittings protection
- Enhanced bottom outlet handle design to prevent unintended actuation during a train accident

Rail Tank Car 101 Walk-Around Video and PPT can be downloaded and/ or viewed at www.EthanolResponse.com/resources/.

Ethanol and ethanol-blended fuels are commonly transported by unit train. A unit train consists of 80-100 plus rail tank cars that are all heading for a single destination and carrying the same commodity. For the sake of this training discussion, we are referring to denatured fuel ethanol displaying a DOT 1987 placard. Shippers use the same placarding and marking protocols for both highway and railway transport. They are placarded on both sides and both ends.

Rail tank car pressure relief devices prevent internal pressure build-up above a specified setting. They open to release pressure and then close once the internal pressure has reduced below the pre-engineered setting of the relief device. (See Figures 4.8 and 4.9 in the Participant Guide. Figures 4.8 and 4.9 show typical arrangements for rail tank car components. Not all components may be present on rail tank cars used for transporting ethanol-related products)

The most common mode of transportation for denatured fuel ethanol leaving an ethanol production facility is via rail transport. It is estimated that nearly 70% of all ethanol produced today will travel by rail during the path to its ultimate destination in the retail marketplace.

Rail transport can play a significant role in the everyday operations of an ethanol production facility. For example, a 100-million-gallon plant geographically co-located next to a rail line can easily expect to receive and ship an average of 36 rail tank cars per day. That entails receiving raw materials and process aides while at the same time shipping fuel ethanol and other co-products to customers.

Figures 4.8 and 4.9 show typical arrangements for rail tank car components. Not all components may be present rail tank cars used for transporting ethanol-related products. Rail tank car components function similarly to those found on cargo tank trucks.

Figure 4.8: Top Fittings Arrangement—Valves

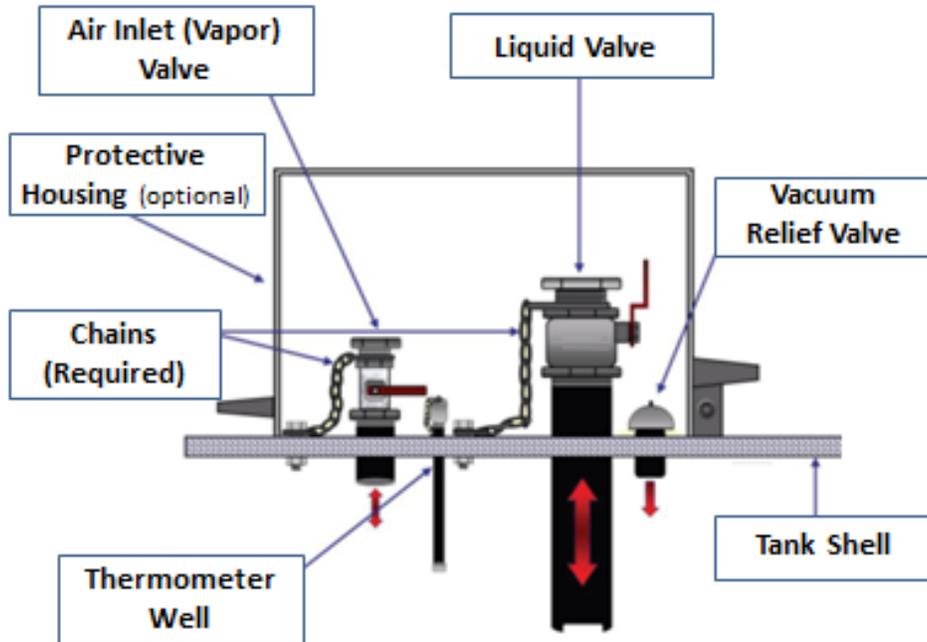
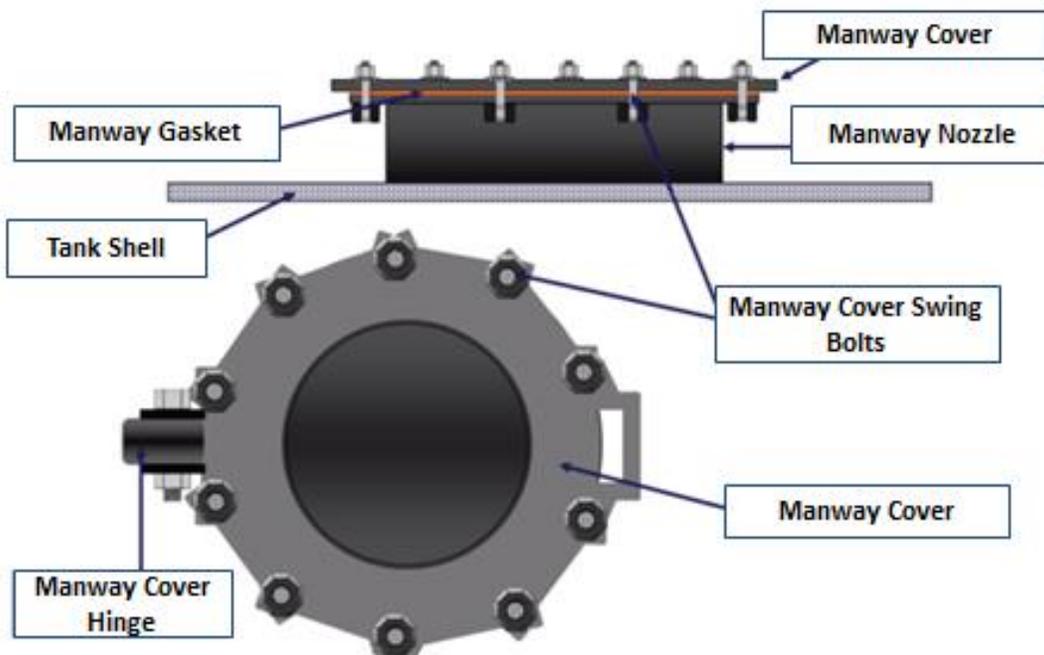


Figure 4.9: Top Fittings Arrangement—Manway



Contacts and Apps

In 2017 the railroad industry started a safety initiative to place Emergency Notification System (ENS) signs at each public intersection where the rail crosses a public road throughout the USA. In 2018 this same initiative was to take place for all private road crossings.

These signs are typically located within 100' of and on both sides intersection. Each intersection is blue and white in color and has a telephone number and unique intersection identification number. The telephone number gives you direct access to the railroad dispatcher controlling that specific section of rail.

The AskRail mobile app (downloadable at <http://askrail.us/>) is a collaborative effort among the emergency response community and all North American Class I railroads. The app provides emergency responders with immediate access to accurate, timely data about what type of hazardous materials a rail car is carrying so they can make an informed decision about how to respond to a rail emergency. AskRail is a backup resource if information from the train conductor or train consist is not available. For security reasons, only qualified emergency responders can download the app.

Some of the basic features of the program are:

- Railroad emergency contacts
- Links to ERG
- Real time graphic map location with evacuation diameter capabilities
- Data base in real time to determine owner, location and content of rail car based on ID number
- Ability to re-invent the entire consist of the rail car at an incident scene
- A scenario-based exercise to familiarize new users with all capabilities of the app

TRANSCAER Seconds Count video – Contacts & Apps for the Emergency Responder
<https://vimeo.com/403812176>

Shipping Papers

Shippers of hazardous materials via highway and rail must comply with U.S. Department of Transportation regulations to ensure that emergency responders have an accurate description of transported hazardous materials.

For both modes, the required shipping paper entries for ethanol-related products include the amount shipped, the identification number, the proper shipping name, the hazard class, and emergency contact name and phone number.

For rail shipments, a Hazardous Material Response Code (HMRC), or Standard Transportation Commodity Code (STCC) number, will also be present and may aid researching emergency response information.

Remember that the contact number will provide 24-7 access to a person knowledgeable about the commodity and detailed information about the product. One of the most frequently seen emergency response contacts is CHEMTREC® (which can be reached at 1-800-424-9300).

For highway transport, shipping papers will be in the cab near the driver. Rail transport requires that a crew member be in possession of the shipping papers. They will usually be carried by the conductor, engineer, or foreman. They can also be obtained from each railroad by contacting their emergency phone number.

Transportation Logistics

Most of the denatured fuel ethanol placarded with identification number 1987 is transported from the production facilities to liquid product terminals by rail. Liquid product terminals that do not have rail access receive denatured fuel ethanol by cargo tank truck, freighter ship/barge or pipeline.

There is some transfer of denatured fuel ethanol from rail tank cars directly to cargo tank trucks called transloading.

Increasingly, liquid product terminals have added rail access to their facility. There is some denatured fuel ethanol transported by waterway via freighter ships or barges.

At this time small amounts of denatured fuel ethanol or ethanol-blended fuel are being transported by pipeline. Ethanol shipments via pipeline may increase with greater experience.

Emergency responders should be aware of the various modes of transport occurring in their areas.

Loading/ Unloading Operation

The images (Module 4, Slide 22) show a cargo tank truck terminal loading rack and a rail transloading facility. If your responsibilities include rail tank car loading and/or unloading operations, suggestions for best practices are available from the Association of American Railroads *Pamphlet 34 - Recommended Methods for the Safe Loading and Unloading of Non-Pressure (General Service) and Pressure Tank Cars*. *Pamphlet 34* and other related resources can be view and downloaded at www.EthanolResponse.com/resources/.

A transload facility conducts product transfers from mobile tank to mobile tank. In this slide the image titled “transloading facility” is an example of a rail tank car product transfer to cargo tank truck transload operation. As shown, a portable pump system is in use. This gives the operators flexibility in the unloading process as it can occur at any location within the facility.

The images (Module 4, Slide 23) show a loading racks facility with fixed fire protection. The transfer pumping system is contained within a concrete cistern to contain any product spill due to a malfunction.

The rail tank cars can be simultaneously unloaded to several cargo tank trucks positioned at the loading rack. This increases productivity and efficiency in transporting the ethanol-blended fuel to a bulk liquid storage terminal or retail market.

Additional Resources

A good resource to assist in preparing for potential transportation-related hazardous materials incidents is the Transportation Community Awareness and Emergency Response (TRANSCAER) website, <http://www.transcaer.com>.

TRANSCAER is a voluntary national outreach organization that focuses on assisting communities to prepare for and respond to a possible hazardous materials transportation incident.

TRANSCAER members consist of representatives from chemical manufacturing, transportation, distribution, emergency response agencies, and government agencies.

Summary

There are a variety of sources from which an emergency responder can gather information about chemicals involved in spill or fire incidents.

Among them are Safety Data Sheets (SDS), DOT identification numbers and placards, the NFPA 704 labeling system, and shipping papers.

Denatured fuel ethanol (E95-E98) is one of the leading hazardous materials shipped by rail. Transportation of this fuel commonly occurs via highways as well.

Instructor Note:

Ask participants:

- What are the most likely types of ethanol emergencies you can see occurring in your jurisdiction (retail fueling station incidents, production incidents, rail incidents, cargo tank truck transportation incidents, etc.)?
- Have there been recent ethanol emergencies in your jurisdiction?
- What occurred and what were the actions and impact to the community?

Instructor Note:

Time: 15 minutes

Materials: Figure 4.10

Instructor Directions:

1. Allow the participants to work in groups of two to three for this activity.
2. Participants should read the scenario and determine the resources available, immediate hazards, and possible actions to take.
3. After 10 minutes call time, and randomly call on groups to provide their answers.
4. Participants should mention the following:
 - What type of vehicle is this?
 - **Answer:** MC306/ DOT406
 - List common placards that you might find on this vehicle.
 - **Answers:**
 - 1203 placard
 - 1987 placard
 - 3475 placard
 - 1203 orange panel with flammable wording
 - What other resources might be helpful to responders in this incident?
 - **Answers:**
 - ERG
 - Safety Data Sheets (SDS)
 - Shipping papers
 - Information centers e.g. CHEMTREC® (1-800-424-9300)
 - What are the immediate concerns and hazards?
 - **Answers:**
 - Potential for fire
 - Environmental issues with runoff or fuel leaching into the soil
 - Potential sources of ignition to trigger a fire such as the welding facility nearby or overhead power lines
 - Trees and vegetation as fuel for possible wildfire
 - What possible actions might you take at this point in the situation?
 - **Answers** will vary depending on the knowledge of the class, but should include:
 - Confirming product identity
 - Determining the amount of the product left in the tank or determining the amount of product released

This last question is to allow participants to begin thinking about mitigation techniques. Remind participants that we are operating at an awareness level. The scene will soon be operating under the National Incident Management System (NIMS) and the incident command structure.

Activity 4.1: Ethanol Product Identification

Purpose

To allow participants to determine the hazards associated with an ethanol emergency.

Participant Directions

For this activity you will work in groups of two to three. Read the following scenario, and answer the questions:

1. What type of vehicle is this?
2. List common placards that you might find on this vehicle.
3. What other resources might be helpful to responders in this incident?
4. What are the immediate concerns and hazards?
5. What possible actions might you take at this point in the situation?

Scenario

A cargo tank truck (see Figure 4.10) delivering fuel to the Gas ‘N Matches retail site is involved in a hit and run accident. The driver advises you that the cargo tank truck is carrying 3,000 gallons of fuel. There is a leak in one of the large pipes on the bottom of the trailer. Fuel is leaking onto the ground and running downhill toward a small welding facility.

Figure 4.10: Cargo Tank Truck

