Module Objective

Upon the completion of this module, participants will be able to describe how ethanol-blended fuels are transported and transferred and 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) 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.
**Introduction**

Given that an increased percentage of all fuel transportation-related incidents are likely to involve ethanol or ethanol-blended fuels, 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.

**Ethanol Transport Placards and Markings**

Ethanol and ethanol-blended fuels are identified using DOT placards. Ethanol-blended fuels and gasoline are transported in various types of containers including tank trucks, rail cars, barges and pipelines.

DOT has classified hazardous materials according to their primary danger 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. Placards for flammable liquids have a red background with a white flame on them along with their corresponding United Nations (UN) or North American (NA) number.

**Figure 3.1: Flammable 1203 Placard**

Rail cars and tankers carrying ethanol and ethanol-blended fuels will generally be placarded with a flammable placard or United Nations (UN) 1203 flammable placard when transporting lower ethanol concentrations up to and including E10 blended fuels. The E85 ethanol blend is included under the designation: UN 3475 identification. The UN 3475 placard covers ethanol blends from E11 to E94. Denatured fuel ethanol will be placarded with a UN or North American (NA) 1987
flammable placard (see Figure 3.7). Ethanol blends from E95 to E99 will be covered under this UN or NA 1987 designation. The UN 1170 placard is for neat ethanol (E100).

Table 3.2: Table for Proper Ethanol Shipping Names and UN Numbers for Rail Cars and Tankers

<table>
<thead>
<tr>
<th>Ethanol Concentration</th>
<th>Preferred Proper Shipping Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1 to E10</td>
<td>Gasoline (UN 1203)</td>
</tr>
<tr>
<td>E11 to E94</td>
<td>Ethanol and gasoline mixture (UN 3475)</td>
</tr>
<tr>
<td>E95 to E99</td>
<td>Denatured alcohol (NA 1987) or Alcohols n.o.s. (UN 1987)</td>
</tr>
<tr>
<td>E100</td>
<td>Ethanol (UN 1170) or Ethyl alcohol (UN 1170)</td>
</tr>
</tbody>
</table>

Figure 3.3: UN 1203 Placards for Gasoline-Blended With up to 10 Percent Ethanol

Emergency Response Guide
The Emergency Response Guidebook, which includes this placarding information, is used as a resource for first responders when attending to an incident involving hazardous materials and dangerous goods.

Facility Marking System
One more marking system of interest to emergency responders is the National Fire Protection Association (NFPA) 704 diamond (see Figures 3.4 and 3.5). The NFPA 704 marking system is based on the “704 diamond” and is the system used for identifying hazardous materials found
within facilities. The NFPA 704 system uses colors, numbers, and special symbols to indicate the presence of hazardous materials. Each colored square indicates the type of hazard, and the higher the number (0-4), 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.

**Figure 3.4: NFPA 704 Diamond**

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

**NFPA 704 for Ethanol**

Ethanol is represented by a 1 in the blue health square, indicating slight to moderate irritation. It is also represented by a 0 for reactivity (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.
Figure 3.5: NFPA Diamond for E100, E95, E85, and Gasoline

Transportation and Placarding
As most emergency response agencies are aware, most incidents involving hazardous materials occur during transportation and transfer operations. Emergency responders should be aware of areas or routes where large 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 (E95, E98) are now commonly seen on some key rail routes leaving from the Midwest and carrying products to various population and distribution centers throughout the country. Most of the Midwest and other ethanol production facilities have access to rail sidings. As a note, some oil refineries are now shipping fuel fully blended.

Transportation of Ethanol via Highway
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 transport of the blended fuels that emergency responders will encounter will be by MC-306 and Department of Transportation (DOT)-406 style road tankers (see Figures 3.6 and 3.7) with 3/8-inch aluminum tanks. These tankers are non-pressurized dual-axle, come in a variety of sizes and configurations, and have a capacity up to 6,000-9,500 gallons depending on where responders are located. The tanker itself may also have up to seven compartments.
Cargo tank trucks are placarded and marked similar to other products. Other characteristics of the cargo tank are pressure and vacuum relief devices. They are typically bottom loaded and unloaded and equipped with a vapor recovery system. Safety devices on these tank trucks consist of emergency shutoffs, breakaway valves for sheer protection, pressure relief devices as well as overfill and collision protection.

**Transportation of Ethanol via Rail**

Denatured fuel ethanol is transported safely by rail every day. In the transportation of ethanol and ethanol-blended fuels, various routes are utilized. Methods include rail to fixed facility, rail directly to truck and rail directly to pipeline. Most of the ethanol transports by rail will be in a non-pressurized (general service) DOT111A100W1 tank car (see Figures 3.8 and 3.9) with no thermal protection. These tank cars have a capacity of approximately 30,000-34,000 gallons and unlike over-the-road cargo tankers, which contain multiple compartments, rail cars are single tanks. Ethanol and ethanol-blended fuels are commonly transported by unit train. A unit train consists of 80-100 rail cars which are all heading for a single destination. Unit trains are stored in or near terminals or transloading facilities. Each rail car should be properly placarded and include a shipping paper stating the identification number, proper shipping name, hazard class or
division number and packing group. Also included is the weight of the filled tank car, emergency contact, shipper contact and Hazmat STCC code.

Pressure and vacuum relief devices will be the same as those that are currently found on gasoline-style transport tankers. Nearly all of these fuels are bottom loaded and unloaded by the standard 4-inch quick connect or direct connections. Valving is internal to the tanks with breakaway piping and remote shut-off controls. Vapor recovery systems, also known as scully systems, will be the same as those currently found on gasoline tankers (see Figures 3.10 and 3.11).

**Figure 3.8: DOT 111 General Service Tank Car**

![Figure 3.8: DOT 111 General Service Tank Car](image1)

**Figure 3.9: DOT 111 With Placard**

![Figure 3.9: DOT 111 With Placard](image2)
The most common mode of transportation for fuel ethanol leaving an ethanol production facility is via rail transport. It is estimated that near 70% of all ethanol produced today will travel via rail during the path to the marketplace. Commonly referred to as the “virtual pipeline,” rail transport of fuel ethanol has proven to be extremely efficient and more than adequate for moving product to the marketplace. The “virtual pipeline” may contain upwards of 2.5 million gallons of fuel ethanol in single unit train transport, roughly equivalent to the typical load of petroleum introduced to the pipeline. As the industry continues to grow and expand, the “virtual pipeline” will surely grow and become even more efficient, thus assuring the continued leadership of fuel ethanol transport via rail.

Rail transport can play a significant role in the everyday operations of an ethanol production facility. For example, a 100 million gallon plant situated on a rail line can easily expect to receive and ship an average of 36 railcars per day. That entails receiving raw materials and process aides while at the same time shipping fuel ethanol and other co-products to customers. From a production cost perspective, rail transport can represent the third highest internal cost for a biorefinery, following only raw material procurement and direct energy costs.

**Transportation and Placarding**

The majority of the denatured fuel ethanol (E95, E98) is transported from the production facilities to the storage depots by rail. Storage depots that do not have rail access receive fuel-grade ethanol (E95, E98) by road tankers. There is some transfer of fuel-grade ethanol (E95, E98) from rail tanks directly to road tankers called transloading. This is considered to be an interim process until permanent transfer facilities can be provided. Transloading has the greatest potential for transfer problems due to a lack of permanent fixtures or safety equipment. Emergency responders should be aware of this process occurring in their areas. However, many of the bulk storage fuel depots do not have rail sidings. For this reason much of the fuel-grade ethanol (E95, E98) is transloaded to tanker trucks for distribution to bulk storage facilities via highways. There is some denatured fuel ethanol (E95, E98) transported by waterway on board barges or freigher ships. At this time very small amounts of denatured fuel ethanol or ethanol-blended fuel are being experimentally transported by pipeline to evaluate the feasibility of larger-scale pipeline transfers; the concern was corrosiveness to the pipe. Some refineries are now customizing shipments by shipping fuel fully-blended to their customers.

**Additional Resources**

Placards are used to indicate high-concentration ethanol-blended fuels. But the current state of placarding does not provide sufficient information to distinguish between gasoline and E10 gasohol. To the responder, the difference is that E10, as well as all other ethanol-blended fuels, requires Alcohol-Resistant (AR) foam for emergency response. Therefore, localities with mutual aid plans utilizing Airport Rescue Fire Fighting (ARFF) assets must check if these resources carry AR foam. A good resource to assist in preparing for potential transportation-related hazardous materials events is the Transportation Community Awareness and Emergency Response (TRANSCAER) Web site, http://www.transcaer.com. TRANSCAER is a voluntary national outreach effort that focuses on assisting communities prepare for and respond to a possible hazardous material transportation incident. TRANSCAER members consist of representatives from chemical manufacturing, transportation, distribution, emergency response
agencies, and government agencies. A critical element of this is the flow study which is designed to identify shipments of hazardous materials that either originate or are destined to pass through a specific region. By using the data collected, responders will be able to enhance emergency planning capabilities.

**Summary**

There are a variety of sources from which an emergency responder can glean information about chemicals involved in spill or fire incidents. Among them are Safety Data Sheets (SDS) or Material Safety Data Sheets (MSDS), UN numbers, DOT placards, and NFPA 704 placards. Denatured fuel ethanol (E95, E98) has become one of the leading hazardous materials transported by rail. Transfer of this fuel commonly occurs via highways as well.
Activity 3.1: 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 transport truck (see Figure 3.12) delivering fuel to the Gas ‘N Matches retail site is involved in a hit and run accident. The driver advises you that the truck is carrying 3,000 gallons of fuel. There is a leak on 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 3.12: Transport Truck**