EXHIBIT-A
EXAMPLES OF DOT-111 AND CPC-1232 TANK CAR DAMAGE AND TYPES OF FAILURES EXPERIENCED IN ACTUAL DERALMENTS

Mechanical Damage

Tank car breaching may occur from initial head punctures but may also occur due to damaged fittings, or heat induced tears. Head punctures on ethanol cars usually result in an immediate loss of volume and a fire of great intensity (see **Figure-1**).

Figure-1. Head punctures can be caused by impact from another rail car's coupler or by a puncture caused by another object like a broken rail. This incident occurred on December 30, 2013 at Casselton, North Dakota. 20 tank cars derailed and 18 crude oil cars breached resulting in a fire. The derailment released 436,437 gallons of product. The train was traveling at 42 miles per hour when it derailed. Photo Credit: NTSB.

Fitting and Attachment Damage

DOT-111 and CPC-1232 tank cars are equipped with fittings and attachments for loading and unloading of the flammable liquid. These can fail during either low or high-speed derailments due to impact with another object. (see **Figures 2, 3, and 4**).

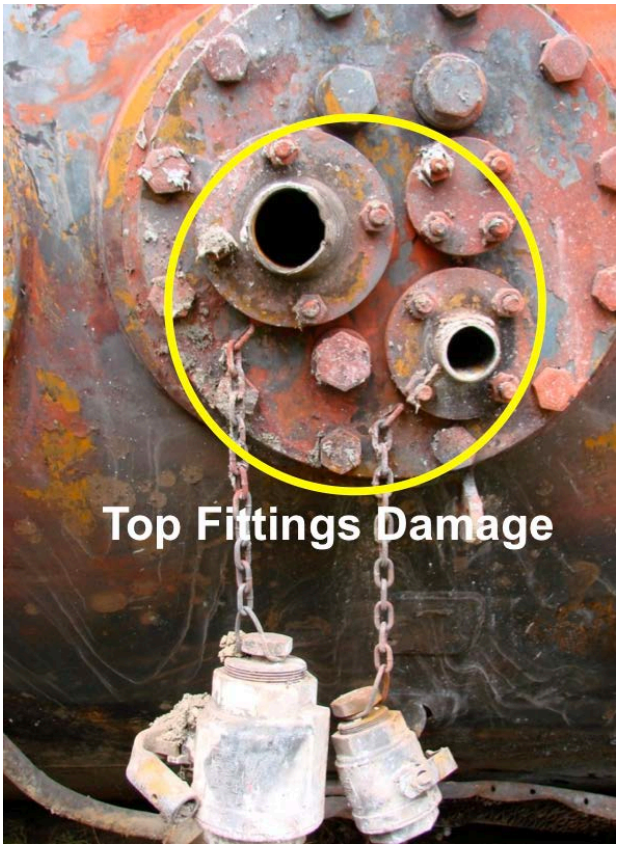

Figure-2. This photo shows top fittings damage from a tank car involved in the June 19, 2011 Cherry Valley, Illinois derailment. 19 tank cars derailed and 15 breached releasing 323,963 gallons of ethanol. Photo Credit: NTSB.

Figure-3. This photo shows fittings that are not properly protected and resulted in failure at the December 30, 2013 Casselton, North Dakota derailment. Photo Credit: NTSB.

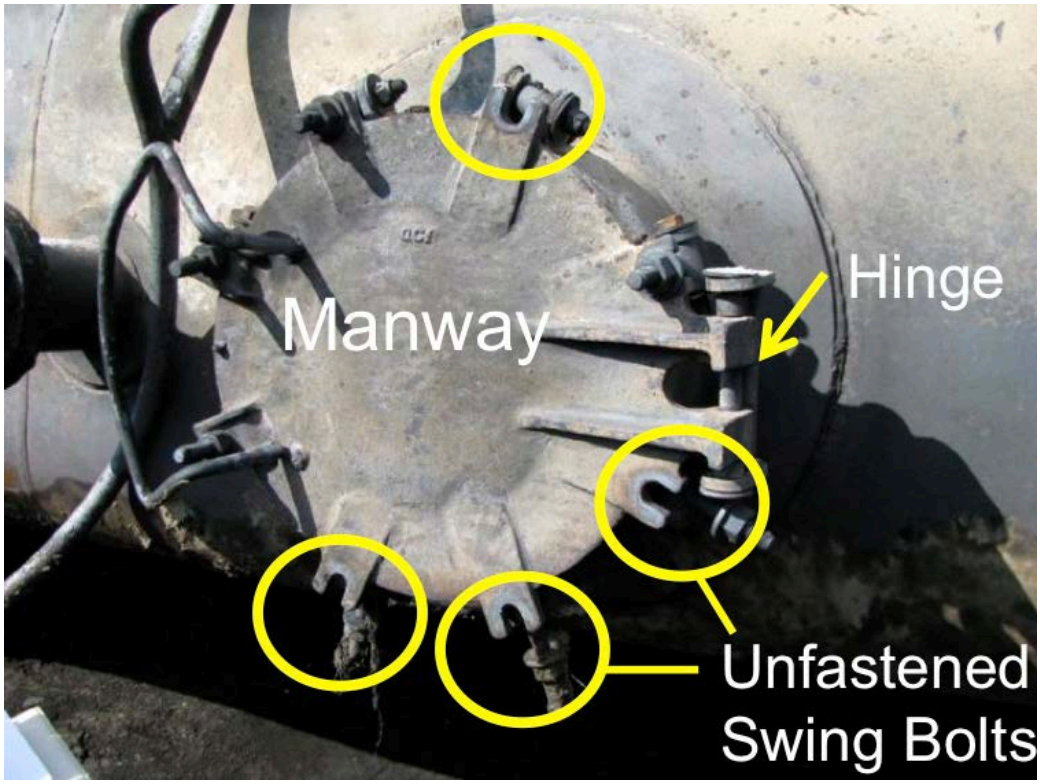

Figure-4. The Manway located on the top of the tank car is susceptible to damage if it collides with another object. Note the unfastened swing bolts. This photo was taken at the July 6, 2013 Lac Megantic, Canada derailment. 63 tank cars derailed and 59 breached releasing 1,580,000 gallons of crude oil. Photo Credit: NTSB.

Thermal Damage

Fire from punctured tank cars can impinge upon adjacent cars and cause thermal failure to the tank shell or cause Pressure Relief Valves to open. Direct flame impingement or radiant heat can cause splits and tears in the tank shell (see **Figure-5**).

Figure-5. Thermal exposure can result in heat induced tearing. This incident occurred on July 11, 2012 at Columbus, Ohio. The tank train derailed going 25 miles per hour. 3 tank cars derailed and breached resulting in a fire. 54,748 gallons of ethanol were released. Photo Credit: NTSB.

Energetic Ruptures

Tank car failure can also be caused by energetic ruptures that result in a rapid release of energy producing a large fireball and separation of the tank car. The sections that separate can travel short distances but do not fragment (see **Figure-6**).

Figure-6. DOT-111 and CPC - 1232 cars are equipped with pressure relief devices but if there is a rapid rise in pressure due to increased temperature, insufficient pressure relief can result in a dynamic failure increasing risk. This incident ocurred February 6, 2011. 31 tank cars derailed and 31 breached releasing 834,849 gallons of ethanol. Photo Credit: NTSB Arcadia, Ohio. Arcadia, Ohio.

Energetic ruptures can produce a fireball 200 meters (656 feet diameter. (see **Figure-7**).

Figure – 7. This photo from the February 6, 2011 derailment at Arcadia, Ohio shows a fireball generated by a dynamic energy release from a DOT-111 tank car. A 30,000 gallon tank car may produce a fireball diameter of approximately 200 meters (656 feet) and a duration of about 10 – 20 seconds. Photo Credit: NTSB.

The Mount Carbon, West Virginia derailment occurred on February 16, 2015. 27 cars derailed carrying crude oil and 20 CPC-1232 cars breached resulting in fire. 378,034 gallons were released. (see **Figure-8**).

Figure-8. This photo shows an energetic release of one rail car.

On March 5, 2015 a derailment occurred at Galena, Illinois. 21 crude oil tank cars derailed and 10 CPC-1232 cars breached and burned. 110,543 gallons of product were released. (see **Figure-9**).

Figure-9. This photo shows an energetic release of one CPC-1232 rail car. Photo Credit: Jacki Witkowsi.