State of Tank Car Safety

Association of Car Accounting & Service Officers

May 8, 2014

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Thank you for inviting me to speak to you today on the state of tank car safety. Recent train accidents and federal enforcement findings have set in motion a series of federal government emergency orders, protective directions, prohibition orders, safety advisories, and rulemaking initiatives. Although the tank car standards are in a state of flux, this presentation provides a summary of the current challenges before us. Sources at DOT suggest that a NPRM on tank car standards will occur towards the end of this year. Transport Canada published its proposed rulemaking on January 11, 2014, and is likely to issue a final rulemaking mid-summer. Although it is difficult to predict the final outcome, I hope that this presentation will provide some insight towards the current administrative actions at both DOT and Transport Canada.

North America's industrial machine is at the renaissance of growth and skilled and professional labor has grown to the demands of crude oil drilling, gas exploration, and on-shoring of industries that have come to realize cheaper means of energy.

Despite our vital economic growth, the safe transportation of crude oil, ethanol, and other flammable liquids have become politically challenged as a series of catastrophic train accidents manifest shortcomings in our engineering systems to ensure public safety.

The Lac-Mégantic derailment occurred at approximately 01:15 am on July 6, 2013, when an unattended 74-car freight train carrying Bakken formation crude oil ran away and derailed, resulting in the fire and explosion of multiple tank cars. Forty-two people were confirmed dead with 5 more missing and presumed dead. More than 30 buildings in the town's center, roughly half of the downtown area, were destroyed.

Thermal rupture of a tank car at the Casselton, North Dakota derailment. To put the size of the fire ball in perspective, look at the rail cars at the bottom of the screen. At this point in time, the fire ball is over 1,000 feet high and nearly 800 feet wide.

Casselton, North Dakota.

On April 30, 2014, in the city of Lynchburg, Virginia, a CSXT train derailed near the James River. Preliminary findings suggest track washout. The train was en route from Chicago to Virginia when 17 cars of crude oil derailed, resulting in the release of one car, 30,000 gallons, into the James River.

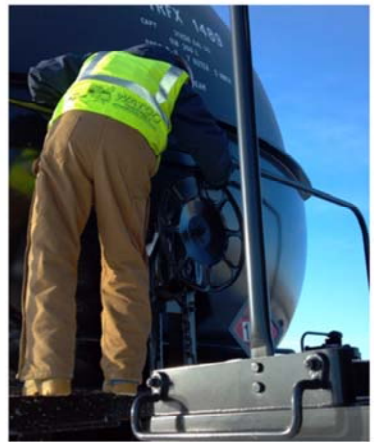
Incident	Date	# Cars derailed	Speed at derailment	Unit train	Product Loss (gal)	Cause of Derailment
New Brighton, PA	2006	23	37	Yes	485,278	Rail
Painesville, OH	2007	6	48	No	76,153	Rail
Luther, OK	2008	5		Yes	243,000	Cross level
Rockford, IL	2009	19	34	No	232,963	Washout/Rail
Arcadia, OH	2011	31	46	Yes	834,840	Rail
Tiskilwa, IL	2011	10	34	No	143,534	NTSB Investigation
Columbus, OH	2012	3	23	No	53,347	NTSB Investigation
Plevna, MT	2012	17	25	No	245,336	Undetermined
Lac Megantic	2012	63	43	Yes	1,500,000	Securement
Aliceville, AL	2013	26	39	Yes	700,000	Rail
Casselton, ND	2013	13	43	Yes	400,000	Broken Axle on an Adjacent Train
Lynchburg, VA	2014	17	24	Y	30,000	NTSB Investigation

As noted in this slide, there have been several catastrophic railroad accidents involving loss of life and substantial property damage. Rockford, Illinois, Lac Megantic, Quebec, Casselton, North Dakota, and Lynchburg, Virginia provide critical reminders of our need to ensure that we establish safe operating practices and engineering systems to detect defects in track and equipment. As explained later, the railroads have taken voluntary actions to address human factor caused accidents and the detection of defects in track structures and rail equipment. In addition to railroad operating and maintenance initiatives is the need to ensure for the proper classification of crude oil, and to consider changes in tank car design, so that if an accident does occur, the likelihood of a release is minimized.

Without addressing the holistic system (railroad operations and maintenance, tank car design, and the hazards of the product), railroads face ruinous liability if an accident occurs in an undesired location. Lac Megantic provides an example as the cost of that derailment is estimated in the billions.

FRA Emergency Order 28

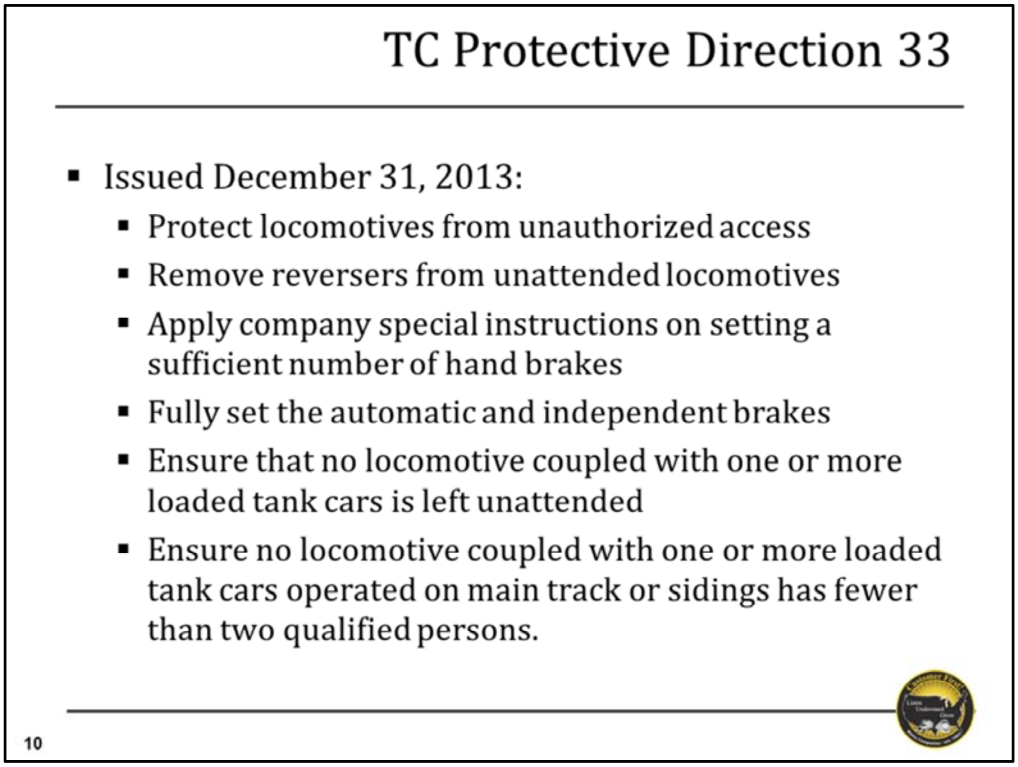
- Issued August 7, 2013:
  - Additional Requirements for Attendance and Securement of Certain Freight Trains and Vehicles on Mainline Track or Mainline Siding Outside of a Yard or Terminal.



9

In response to these accidents, on August 7, 2013, the FRA issued Emergency Order 28 requiring carriers to:

1. Review the circumstances with respect to the Lac Megantic accident with their team members (employees).
2. Review crew staffing practices for over-the-road trains that transport certain quantities of hazmat.
3. Amend their procedures to require removal or securement of the reverser lever of the controlling locomotive to prevent unauthorized movement;
4. Establish practices for the employees responsible for securing a locomotive and to notify the train dispatcher, with acknowledgement from the train dispatcher that the crew met the securement requirements.
5. Review existing procedures with respect to the number of handbrakes set, and implement operating rules with respect to job briefings covering securement.
6. Develop procedures to verify that a train remains secured after an emergency responder has been on, under, or between rolling equipment.
7. Review operational and testing programs related to securement of unattended equipment.
8. Conduct system-wide evaluations to identify particular hazards (e.g., grade, train commodity, trespasser accessibility) which increase securement and other safety risks at crew change locations, including other locations were trains are not attended;
9. Review other human factor requirements such as operator fatigue, the use of derails as a secondary line of defense at high-risk locations, and available personnel to secure a train.



In a similar action, and pursuant to section 33 of the Railway Safety Act, railway companies in Canada were ordered to:

1. Ensure, within 5 days of the issuance of the emergency directive, that all unattended controlling locomotives on main track and sidings are protected from unauthorized entry into the cab of the locomotives;
2. Ensure that reversers are removed from any unattended locomotive on main track and sidings;
3. Ensure that their company's special instructions on hand brakes referred to in Rule 112 of the *Canadian Rail Operating Rules* are applied when any locomotive coupled with one or more cars is left unattended for more than one hour on main track or sidings;
4. Ensure, when any locomotive coupled with one or more cars is left unattended for one hour or less on main track or sidings, that in addition to complying with their company's special instructions on hand brakes referred to in item 3 above, the locomotives have the automatic brake set in full service position and have the independent brake fully applied;
5. Ensure that no locomotive coupled with one or more loaded tank cars transporting "dangerous goods" as this expression is defined in section 2 of the *Transportation of Dangerous Goods Act* (TDGA) is left unattended on main track; and
6. Ensure that no locomotive coupled with one or more loaded tank cars transporting "dangerous goods" as this expression is defined in section 2 of the TDGA is operated on main track or sidings with fewer than two persons qualified under their company's requirements for operating employees.

Safety Alert

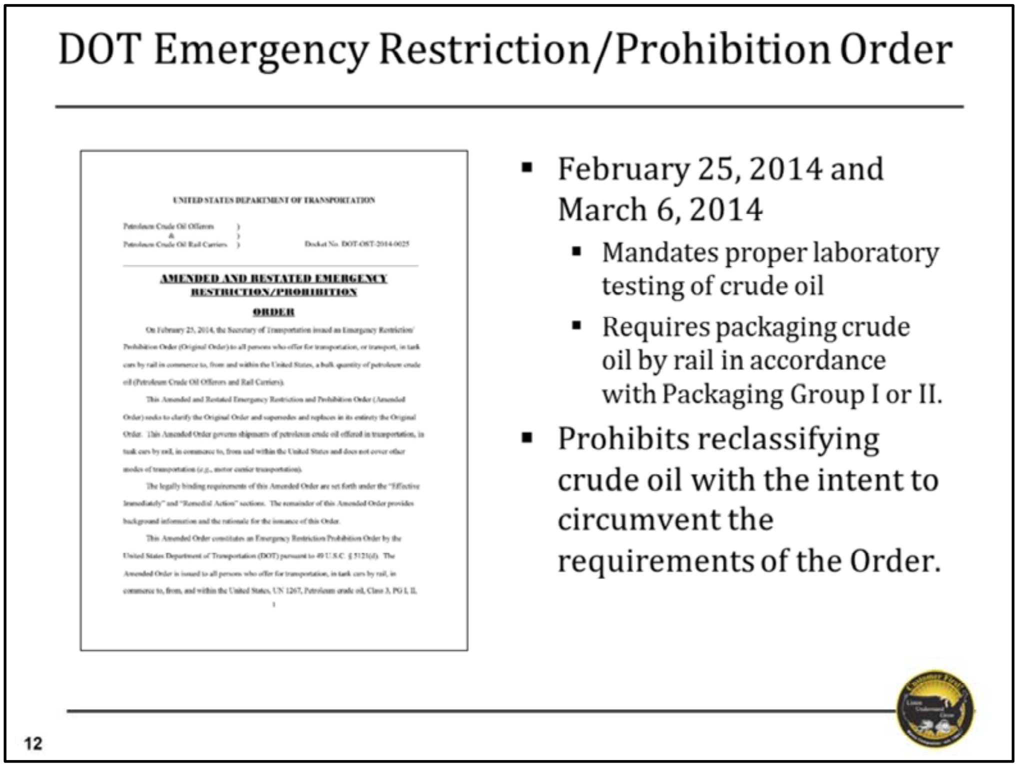
- Issued January 2, 2014:
  - PHMSA reinforced requirements to properly test, characterize, classify, and where appropriate sufficiently degasify hazardous materials prior to transportation.
  - The scope of lab testing must include other factors that affect proper characterization and classification:
    - Reid Vapor Pressure ("RVP");
    - Corrosivity;
    - Hydrogen sulfide content; and
    - Composition/concentration of the entrained gases in the material.

11

In response to a large scale PHMSA/FRA crude oil collection and classification program, on January 2, 2014, PHMSA issued a "Safety Alert" recommending that offerors (shippers):

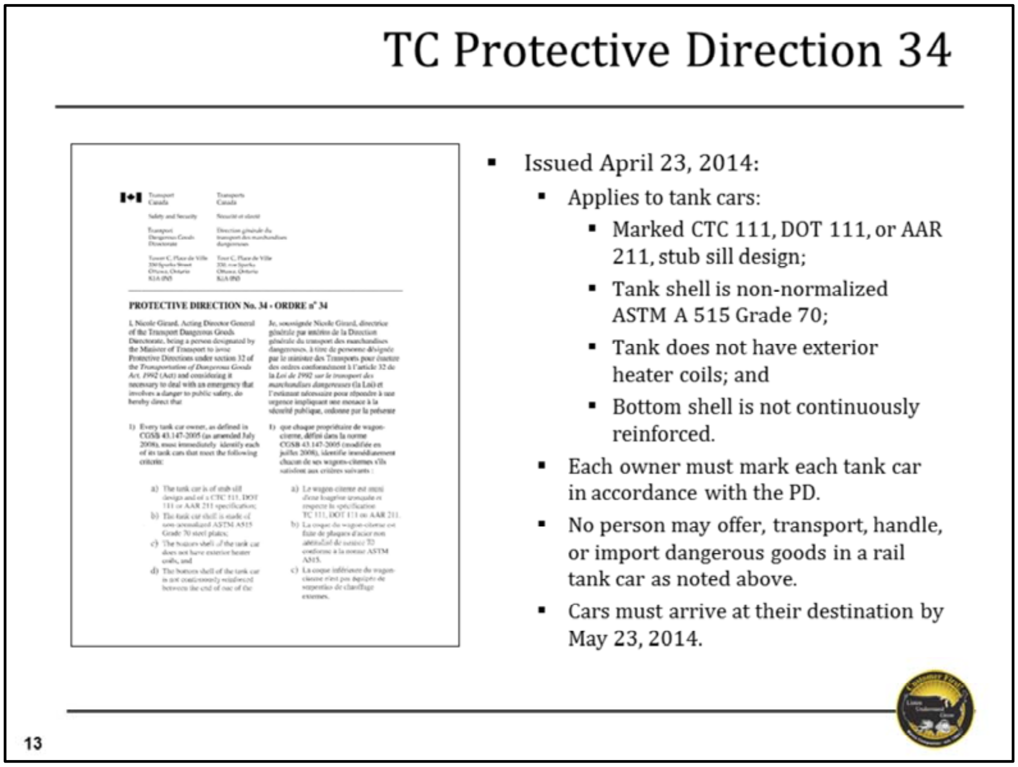
1. Evaluate their internal programs to ensure that the material loaded into a tank car is properly classified and described on a shipping paper. Classification refers to the laboratory process of analyzing a chemical against a series of DOT required tests, and assigning the material, based on those test, to a DOT group – commonly called a "hazard class," such as flammable gas, flammable liquid, and a corrosive material.

2. Review their security plans to address personnel security, unauthorized access to hazardous materials, and en-route security, and adjust those plans if necessary.



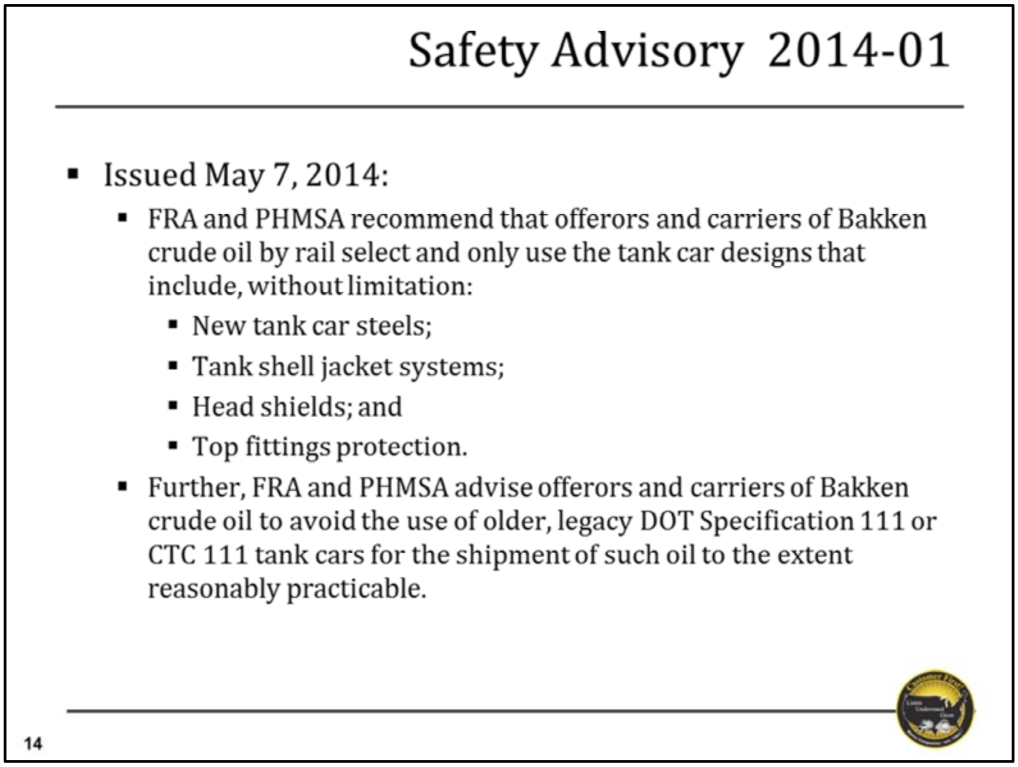
As a result of the PHMSA/DOT classification studies, the Secretary of Transportation issued an Emergency Restriction/Prohibition Order that:

1. Requires mandatory testing of crude oil;
2. Requires packaging crude oil by rail in accordance with the requirements for flammable liquids in Packaging Groups I and II; and
3. Prohibits reclassifying crude oil to circumvent the order.



In unrelated investigations resulting in the catastrophic failure of tank car in normal train operations, but imperative to improve transportation safety, Transport Canada issued Protective Direction 34. The Direction requires the immediate removal of certain tank cars from hazardous materials (dangerous goods) service in Canada:

1. Marked CTC 111, DOT 111, or AAR 211, stub sill design;
2. Tank shell is non-normalized ASTM A 515 Grade 70;
3. Tank does not have exterior heater coils; and
4. Bottom shell is not continuously reinforced.



In response to the Lynchburg, Virginia train derailment, PHMSA and FRA issued Safety Advisory 2014-01. The safety advisory recommends:

1. The use of new tank car steels;
2. Tank shell jacket systems;
3. Head shields; and
4. Top fittings protection.

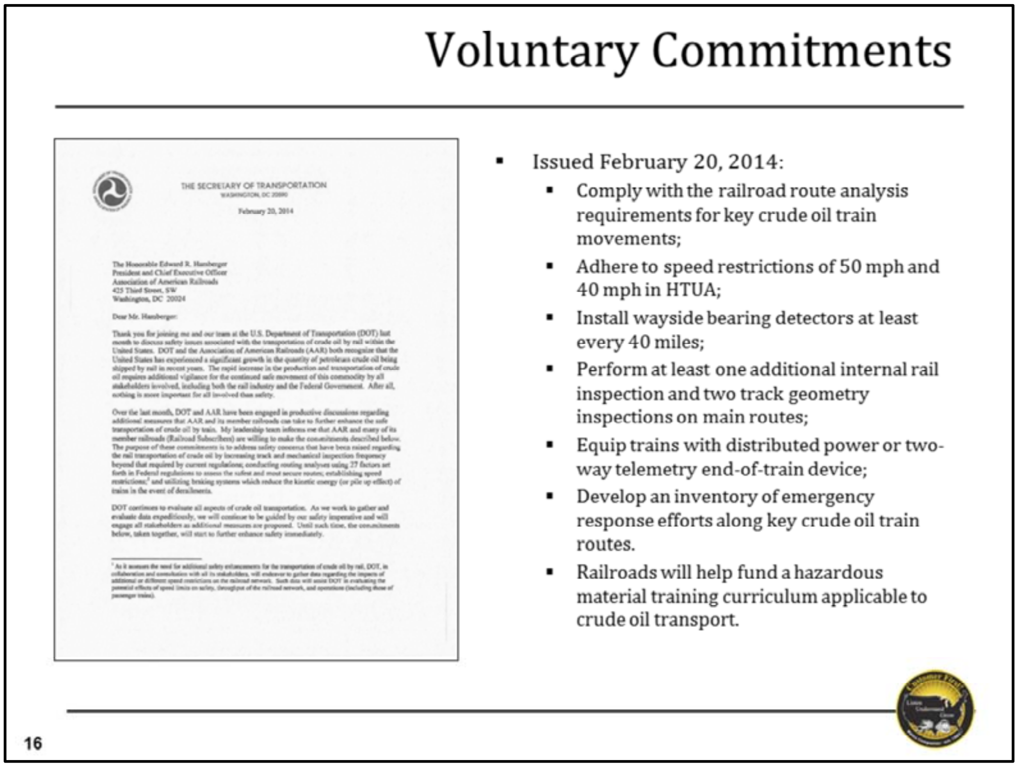
The Safety Advisory provides a precursor to what we can expect from the current DOT rulemaking initiative.

DOT Emergency Restriction/Prohibition Order

- Issued May 7, 2014:
  - Requires railroads that transport 1,000,000 gallons or more of crude oil in a train sourced from the Bakken shale formation to provide a point-of-contact and transportation information to the State Emergency Response Commission (SERC) for each state in which it operates such trains.

15

Also on May 7, 2014, the Secretary of Transportation issued another Emergency Restriction/Prohibition Order. The order requires railroads that transport 1,000,000 gallons or more of crude oil in a train sourced from the Bakken shale formation to provide a point-of-contact and transportation information to the State Emergency Response Commission (SERC) for each state in which it operates such trains.



In addition, DOT and FRA activities, and in cooperation with the railroad association members (AAR and ASLRRA), and the petroleum association members (API), the railroads agreed to a set of voluntarily safety imperatives. These voluntary imperatives were acknowledged in a letter from each carrier to the Secretary of Transportation, Anthony Foxx. Signatories of the agreement have agreed to:

1. Comply with the railroad route analysis requirements for key crude oil train movements. This is consistent with the route analysis of trains transporting a material poisonous by inhalation, and contains 27-risk factors that must be considered;
2. Adhere to key train speed restrictions of 50 mph, and 40 mph in HTUA;
3. Equip trains with distributed power or two-way telemetry end-of-train device;
4. Perform at least one additional internal rail flaw inspection and two track geometry inspections on main routes.
5. Install wayside bearing detectors at least every 40-miles;
6. Develop an inventory of emergency response efforts along key crude oil train routes.
7. Railroads will help fund a hazardous material training curriculum applicable to crude oil transport. The railroads are committed to contribute $5MM to this effort. This is in addition to the current railroad's commitment to train emergency response personnel along the general railroad system of transportation.

Ensuring Tank Car Safety

P-1577

- March 9, 2011
  - AAR petitions PHMSA for a rulemaking to improve the crashworthiness of the existing DOT 111 tank car for flammable liquids in Packing Groups I and II

CPC-1232

- August 31, 2011
  - AAR adopts as a standard the AAR petition car for only crude oil and ethanol shipments.
- January 11, 2014
  - Among other items, TC proposes to amend the Transportation of Dangerous Goods Regulations by adopting Transport Canada Standard TP14877.

HM-251

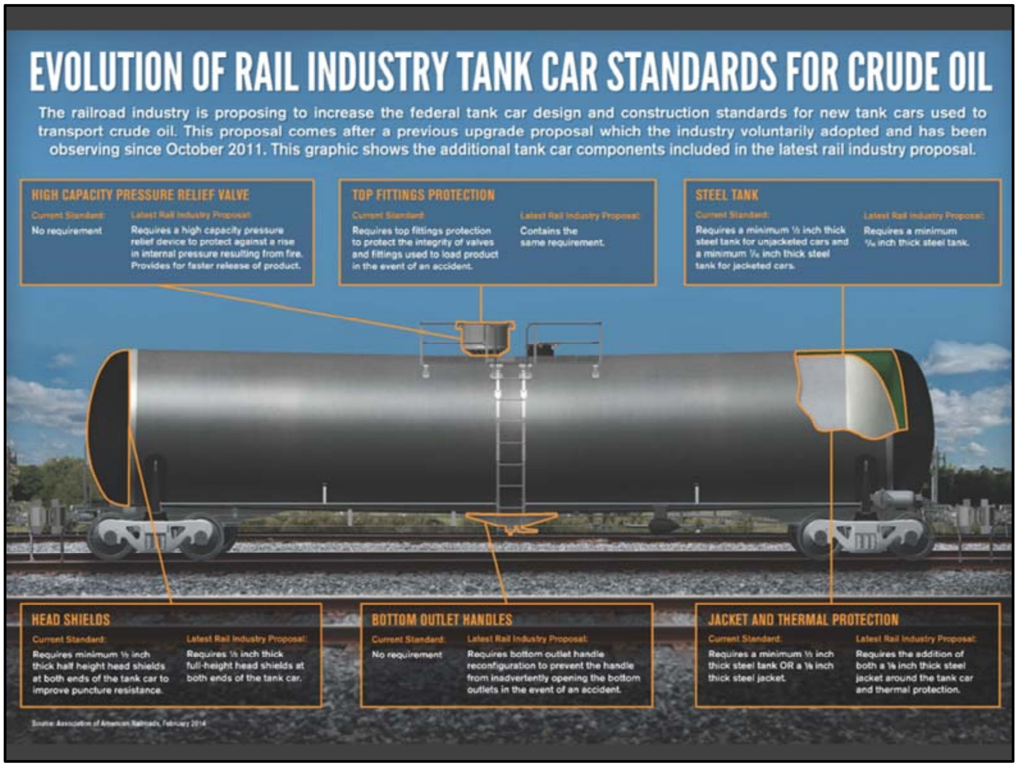
- September 6, 2013
- PHMSA issues a ANPRM to collect additional information on adopting the AAR petition into the federal regulations.
- NPRM at the Office of Management and Budget

With respect to tank car design, there are three common terms currently in use today to describe the proposed tank car specification. These terms are associated with either a DOT petition number, a DOT rulemaking docket number, or an AAR circular letter number.

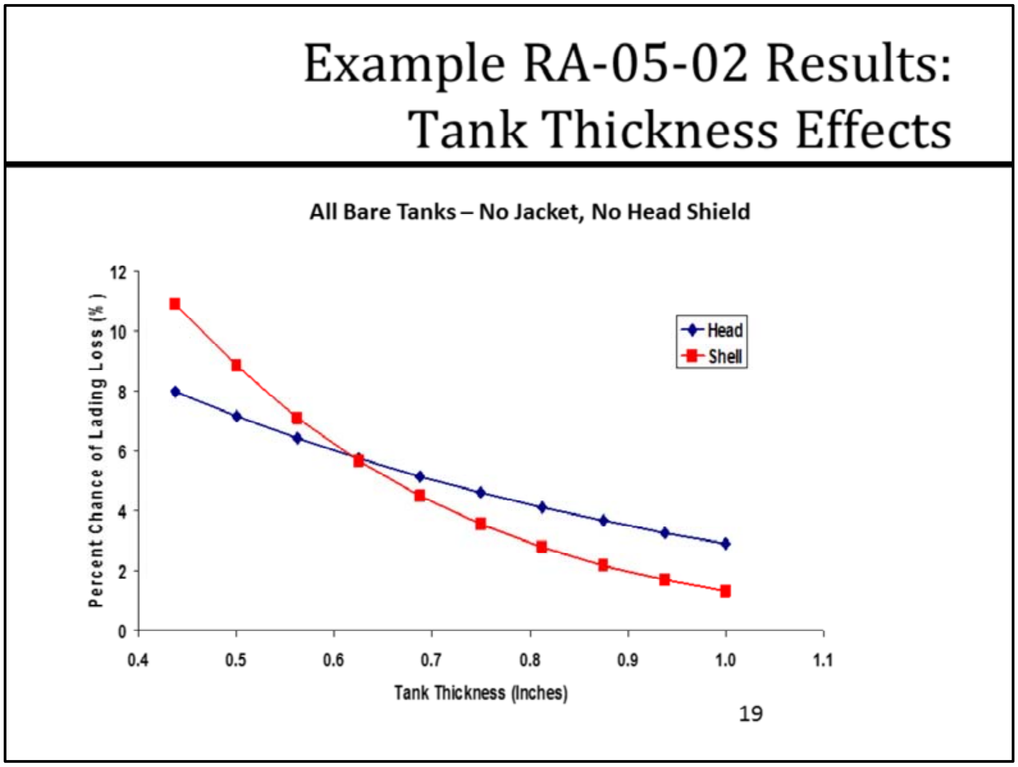
P-1577 is the number assigned by DOT to an industry petition to improve the crashworthiness of tank cars transporting any flammable liquid in Packing Group I or II. The petition: 1) applies to new car construction for any flammable liquid with a flash point generally below 100 degrees Fahrenheit, and 2) applies to cars ordered built after October 1, 2011. <u>It is important to note that all of the major trade associations supported this action</u>.

CPC-1232 is the number assigned by the AAR to require the construction of new tank cars, after October 1, 2011, transporting petroleum crude oil or ethanol. The AAR issued the circular letter because the DOT was not progressing a rulemaking and the impending threat to communities along the general railroad system of transportation. <u>It is important to note that all of the major trade associations supported this action</u>.

HM-251, is the docket number assigned to the DOT rulemaking in response to the industry petition, P-1577 (above). HM means “Hazardous Material” and 251 is simply the next available docket number. DOT issued an “Advanced Notice of Proposed Rulemaking, (ANPRM) to solicit comments on the AAR petition. As of today, it is my understanding the NPRM is at the Office of Management and Budget.



Courtesy of the AAR.

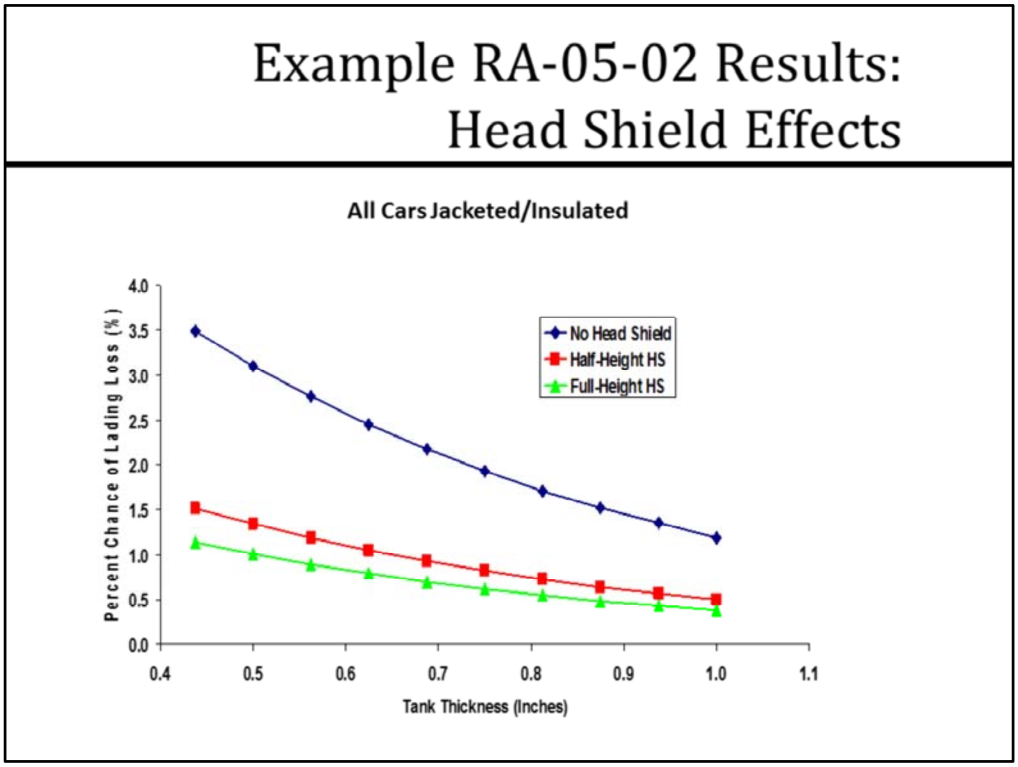


In 2005, the Safety Project issued a report that illustrated the effectiveness of certain tank car enhancements. As shown in the graph, and for a bare tank with no head shield, there is a direct relationship with respect to tank thickness and puncture resistance. The thicker the tank, the less prone the tank is to puncture.

Full-and Half-Height Head Shield

20

These photos show a car with full height and half-height head protection. Head shields protect the tank head in case of tank rollover and impact into other structures.



In 2005, the Safety Project issued a report that illustrated the effectiveness of certain tank car enhancements. As shown in the graph, and cars equipped with a head shield, there is a direct relationship with respect to a head shield and puncture resistance. Cars with a head shield are the less prone to puncture.

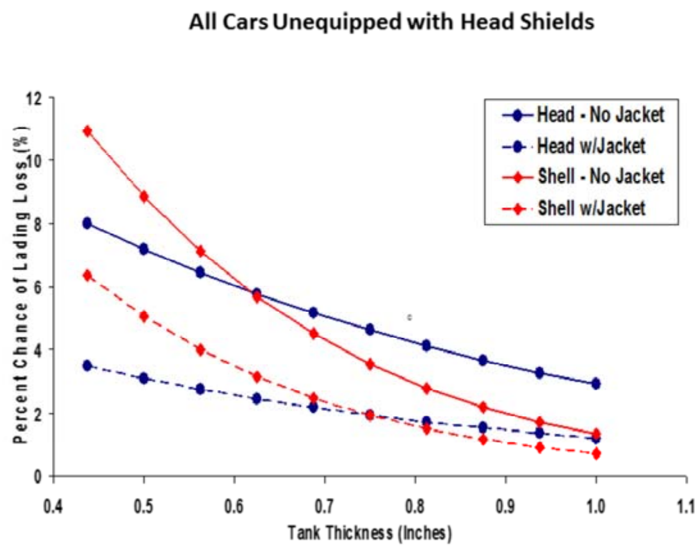
Metal Tank Jacket

- Metal jackets:
  - Protect the insulation or thermal protection material, and
  - Adds puncture resistance to the tank shell and heads.
- Typically the jacket consists of an 11-gauge rolled sheet.

22

This photo simply shows the application of an 11-gauge jacket to a tank. An 11-gauge jacket is about 1/8-inch. Statistically, the metal jacket provides a substantial amount of puncture resistance should the tank become involved in an impact. The federal regulations require a metal jacket to 1) protect tank insulation material or thermal protection material from the weather; and 2) to provide puncture resistance for certain high-risk hazardous materials.

Example RA-05-02 Results: Jacket/Insulation Effects



In 2005, the Safety Project issued a report that illustrated the effectiveness of certain tank car enhancements. As shown in the graph, for a tank with a metal jacket and no head shields, there is a direct relationship with respect to adding a jacket and puncture resistance. Cars equipped with a jacket are the less prone to puncture.

Thermal Protection

- Thermal protection is used to retard heat flow into the tank/product resulting from heat impingement on the tank surface.
- The design of thermal protection systems help ensure against tank failure within a 100 minute pool fire / 30 minute torch fire.

24

This photo simply shows the application of a ceramic fiber blanket to the tank. The ceramic fiber retards heat flow into the tank, which would heat the product and increase vapor pressure. If the vapor pressure in the tank exceeds the residual strength of the tank shell (after heating), the car will rupture. Federal standards require modeling the fire effects to a tank car using an FRA and industry sponsored fire modeling program with applied thermal protection. The standard requires the car to survive a 100-minute pool fire and a 30-minute torch fire. In both cases, thermal protection <u>is not designed</u> to prevent rupture, but rather to delay rupture; thereby, allow the evacuation of the local community and to reduce the amount of vapor pressure remaining in the tank should the tank fail (i.e., stored energy within the tank).

High Capacity Pressure Relief Device

- Start-to-discharge 75 psig
- 27,000, plus, SCFM
- The pressure relief device industry is working on a dual-system device capable of lowering the start-to-discharge pressure in fire environments.

25

This photo simply shows a high flow rate pressure relief device. A pressure relief device is designed to open when the vapor pressure in the tank reaches a predetermined start-to-discharge pressure. In addition to the opening pressure, the flow rate out of the valve is a critical element. The flow rate is dependent on many factors, but most predominately the size of the hole from which the material will pass.

The AAR is currently working on a circular to require a pressure relief device that has a high-flow rate, greater than 27,000 standard cubic feet per minute. I should point out that the AAR and the industry believe that this valve is "directionally correct," and may not represent the optimal valve. The AAR and the valve manufacturers are working on new prototypes that would have a greater flow rate, and have a dual start-to-discharge pressure. For example, the valve would open at 75 pounds per square inch during normal operations and 35 pounds per square inch in fire conditions. In general, the valve would encompass a fusible element that would fail under heat allowing the valve to open sooner.

Top Fitting Protection

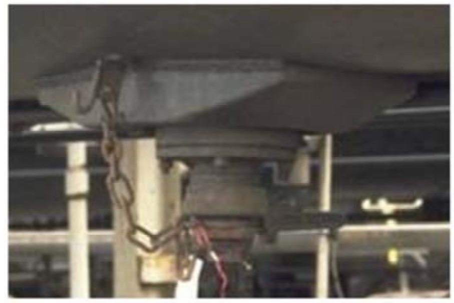
- All pressure tank cars have top fitting protection.
- New general service tank cars conforming to CPC-1232 have top fitting protection.
- Tank cars designed to carry a gross weight on rail greater than 263,000 pounds commonly have top fitting protection.

26

This photo simply shows an example of protective housing around the valves and fittings. The housing is typically ¾-inch steel.   The design has been in use for decades and had been very effective in preventing damage to valves and fittings during rollover accidents.

Bottom Fitting Handle Protection

- With certain and limited exceptions, tank cars must have bottom fitting protection.
  - For example, molten sulfur and elevated temperature materials do not require such protection.
- The AAR is currently developing standards to require disengagement or a break-away handle to prevent the valve from opening as a result of a derailment.



27

This photo simply shows a “skid” to protect the bottom outlet operating mechanisms. Most cars built since about 1979 require bottom outlet protection, generally in the form of a skid. The operable parts of the valve are above the skid, so that in a derailment, should the nozzle and bottom outlet become sheared off, the operable parts of the valve are protected and the valve will maintain product within the tank.

As a note, in several derailments, the long valve handle that operates the valve (open and close) rotated after hitting the ground, which caused the valve to open and the tank to lose its contents. The AAR is currently working on a standard that will require disengagement of the handle prior to transportation, or a break-away handle, for all tank cars. The circular more than likely will require retrofit of the existing fleet.

Coupler Vertical Restraint

- All tank cars must have couplers designed to prevent vertical disengagement (*i.e.*, shelf couplers).

28

The photo simply shows an F (left) and E (right) coupler with top and bottom shelves to prevent vertical disengagement. Without these "shelf couplers," the coupler from one car could override the coupler of another car and puncture the tank head. All tank cars today have shelf couplers.

Current Regulatory Predictions:

1. Tank cars in flammable liquid service will require the use of a tank car having a tank shell thickness of at least ½-inch, possible 9/16-inch, with head protection, top fitting protection, thermal protection, a metal jacket, and bottom outlet valve handle protection.
2. Tank cars in flammable liquid service will require modifications to the pressure relief device and bottom outlet valve handle.
3. Existing tank cars in flammable liquid service will be phased out, unless modified to provide an equivalent level of safety with respect to the notes above cars.