Transportation of Dangerous Goods

General Policy Advisory Council (GPAC)

Working Group (WG) On:

Means of Containment (DOT 111 tank cars)

Recommendations to the Federal Minister of Transport

Honourable Lisa Raitt
Minister of Transport

January 31, 2014

Minister,

On behalf the TDG General Policy Advisory Council working group regarding *Means of Containment (DOT 111 railway tank cars)*, I respectfully submit to you, our report and recommendations.

Respectfully,

J.A. (Andy) Ash,

Director, Dangerous Goods
Railway Association of Canada

(Working Group Leader)

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Section 1: List of Working Group Members (no specific order)

Association/Company

Association of American Railroads (AAR)

Canadian Fertilizer Institute (CFI)

Federation of Canadian Municipalities (FCM)

Procor Ltd.

Railway Association of Canada (RAC)

CPR

CN

Teamsters Union Canada

Transport Canada

CF Industries

Orica

CAPP

RSI Committee for Tank Cars

Cresent Point Energy (CAPP)

Suncor (CAPP)

Section 2: Terms of Reference

In the Minister's letter of September 2013 to the TDG-GPAC Chair, Louis Laferriere, the Honourable Lisa Raitt stated:

"…I would ask TDG-GPAC members to provide me with advice focused on whether or how regulatory requirements could be enhanced in the following ways:

- DOT 111 tank car standards and reviewing classification issues around oil on rail movements."

And further,

"These themes should address the following two questions:

- What immediate TDG-related actions should be considered?
- Taking into account the ongoing work of the TDG-GPAC, what long-term TDG actions should be considered? "

This working group has been comprised of knowledgeable, experienced persons from a variety of different backgrounds, associations and companies.

Although the focus is mainly on rail means of containment (DOT 111) tank cars, it was mentioned that any other MOC issues that one has may be brought forward and discussed.

The working group is to discuss the issues and concerns of all regarding the transportation of crude oil by rail.

The working group will arrive at recommendations to the Minister either for the short term or long term depending on feasibility.

Any organization that may stand with an opposed recommendation to WG consensus will have those published in this document also.

Note: the WG may also recommend further study of certain issues by means of additional working group, committee, expert or regulator work.

Section 3: Schedule of Working Group Conference Calls and Correspondence

The WG conference call schedule as follows:

Call #1 – Wednesday January 15

Call #2 – Tuesday January 28

Call #3 – Wednesday January 29

Call #4 – Thursday January 30

Note: there are no scheduled conference calls the week of January 20 to allow study and discussion at the AAR Tank Car Executive Committee meetings in Jacksonville, FL.

Throughout this period of WG activity, email correspondence took place within the WG to allow a free flow of technical information and updates.

Section 4: Reference Material Listing

The following documents were used as reference and guidance in the discussions within the WG in order to formulate these recommendations:

- Canadian Transportation of Dangerous Goods Regulations
- CGBS 43.147 Construction, Modification, Qualification, Maintenance, and Selection and Use of Means of Containment for the Handling, Offering for Transport, or Transporting of Dangerous Goods by Rail
- Transport Canada TP-14877 Containers for Transport of Dangerous Goods by Rail, a Transport Canada Standard (Ref. Canada Gazette I)
- Docket NO. PHMSA-2012-0082, Hazardous Materials: Rail Petitions and Recommendations to Improve the Safety of Railroad Tank Car Transportation – Comments of the Association of American Railroads and the American Short Line And Regional Railroad Association
- RSI-AAR Railroad Tank Car Safety Research and Test Project "The DOT-111 Tank Car"
- Canada Gazette I – Proposed Regulations, dated January 11, 2014.
- RSI (Railway Supply Institute) Comment – PHMSA-2012-0082-Final.
- AAR Field Manual of Interchange Rules
- TSB Rail Safety Recommendations (January 23/14)

Section 5: Glossary of Acronyms

AAR – Association of American Railroads

ANPRM – Advance Notice of Proposed Rulemaking (US)

CGSB – Canadian General Standards Board

CPC – Casualty Prevention Circular (AAR document)

CPR – Conditional Probability of Release

DG – Dangerous Goods

DOT – Department of Transport (US)

MOC – Means of Containment

NTSB – National Transportation Safety Board (US)

PHMSA – Pipeline Hazardous Materials Safety Administration

PSI – Pounds per Square Inch

RAC – Railway Association of Canada

RSI – Railway Supply Institute

SCFM – Square Cubic Feet per Minute

TC – Transport Canada

TCC – Tank Car Committee (AAR)

TDG – Transportation of Dangerous Goods

TSB – Transportation Safety Board (Canada)

Section 6: Background

The following is intended to supply information on how the DOT 111 tank car is constructed, how it is designed, maintained, used, regulated, loaded and shipped.

Railway tank cars are designed and built differently depending on the type of product they are required to contain. These can be liquids or compressed gases.

These tank cars are designed, approved and constructed to technical and mechanical standards and regulations that are issued by Transport Canada, US Department of Transportation and industry standards are set by the Association of American Railroads (AAR) Tank Car Committee (TCC).

The AAR TCC is comprised of the AAR, RAC, railways, rail car owners, manufacturers, railway DG customers with participation from Transport Canada, US DOT, NTSB, TSB and PHMSA.

Tank cars are assigned various specifications depending on their design.

The DOT 111 specification is assigned to the railway tank car we have been studying.

There are approximately 228,000 DOT 111 tank cars in service in North America right now, approximately 92,000 of these are in flammable liquid service.

The DOT 111 tank car is considered a low pressure type means of containment that is generally considered to have a test pressure of a maximum of 100 psi.

These tank cars can carry dangerous goods such as flammable liquids such as crude oil, ethanol, gasoline, fuel oil, or corrosives such as sulphuric acid and other types of dangerous goods. Non dangerous goods can also be shipped in the DOT 111 such vegetable oil, corn syrup etc.

All tank cars are made up of a shell which is a long cylindrical part with two tank heads attached (one at each end).

The capacity of the DOT 111 can vary in the range from about 10,000 gallons (45,000 litres) to 34,500 gallons (155,250 litres).

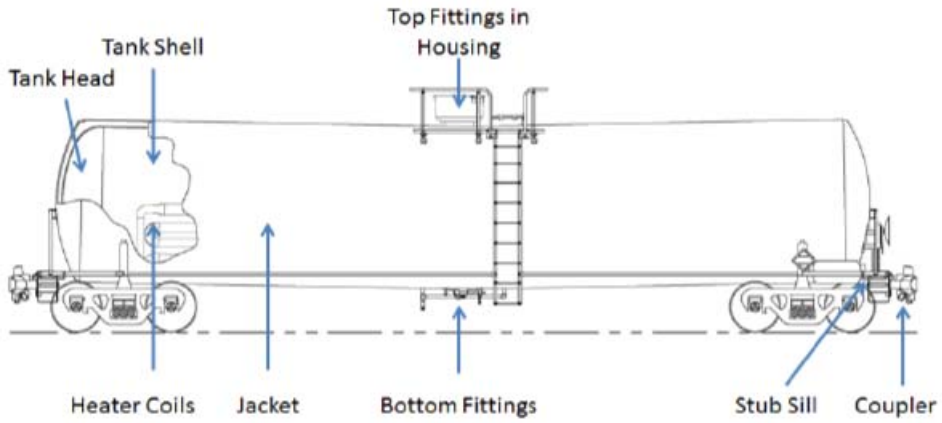
All tank cars have equipment attached to facilitate loading and unloading. There can be valves and fittings located on the top of the tank car and may also have valves or fittings on the bottom of the tank car. These valves and fittings can vary in quantity and type depending on shipper/manufacturer preference.

All tank cars have pressure relief devices designed to relieve in the event of an unplanned pressure buildup in transit or exposure to fire/heat.

Most DOT 111 tank cars in service presently have a minimum tank shell thickness of 7/16", no tank head protection and in some cases, no rollover/fitting protective housing for the top valves and fittings.

Some cars also have an insulation system protected by a metal jacket to retain warmth during the heating process related to off loading of more viscous commodities.

DOT111 Tank Car with jacket:



Age Limits of the DOT 111 tank car:

AAR Interchange rules state cars built after July 1, 1974 have a 50 year life span in interchange between railways

DOT 111 Safety Improvements:

In August of 2011 the AAR implemented a new standard for new builds of the DOT 111 tank car that will be used in Crude Oil and Ethanol, Packing Groups I and II service.

The standard was published in a Circular Letter CPC-1232 and was supported by the RAC, RSI, American Petroleum Institute, Renewable Fuels Association, American Chemistry Council and the Chlorine Institute.

This standard included:

- Tank shell steel must be normalized TC-128 Grade B or normalized A516-70 steel
- Thicker tank shell – for tanks constructed of TC-128 Grade B steel shell thickness must be ½" for non-jacketed tanks and 7/16" for jacketed tanks. For tanks constructed of A516-70 steel, tank shell thickness must be 9/16" for non-jacketed tanks and ½" for jacketed tanks.
- Half height head shields – ½" head shields
- Top fitting protection – provide fitting protection for the tallest fittings in use.

Currently, there are approximately 26,000 of these newer style tank cars in service since 2011.

Note: the AAR petitioned PHMSA to adopt these standards in Petition 1577.

Half Head Shield:

Top Fitting Protection:

A Further Call for Additional Safety Improvements:

In November of 2013, the AAR commented to PHMSA regarding HM-251 to require all tank cars in flammable liquid service to be build to an even higher standard.

The requested change in Standards:

- Tank cars be equipped with jackets and thermal protection
- Tank cars must have FULL head shields
- Installation of high flow capacity safety relief valves (minimum 27,000 scfm)
- Bottom outlet valve handles be configured to prevent the bottom outlet valves from being opened in an accident

In addition, the AAR also asked PHMSA to consider a new tank car specification to differentiate between the baseline DOT 111 and the new design.

The AAR/RSI also addressed what to do with the older DOT 111's in service with the following potentials:

- Aggressively phase out older model tank cars
- Reassign to a non-dangerous service
- Conduct a retrofit program

Note: none of the DOT 111 tank cars in the Lac Megantic disaster were of the CPC-1232 design; however there were some DOT 111 tank cars that did have top fitting protection.

The TSB has stated in their Recommendations of January 23, 2014 that roughly half of the tank cars involved in the Lac Megantic derailment had top fitting protection. 18% of those cars released product from damage. The remaining cars that did not have top fitting protection, 66% of which released product from damage.

Section 7: Recommendations

WG Statement: The Working Group wishes to state that the recommendations listed below, deal with the rail transport of crude oil or other flammable liquids in DOT 111 tank cars. This is what has been agreed to at this point in time and with the information available at this time.

Notations:

- Canadian Association of Petroleum Producers (CAPP) wish only to provide feedback on Recommendations #3 and #4, thus abstain from all other recommendations.

- At this time, RSI does not support an expansion of CPC-1232 beyond flammable liquids.

- The railways indicate that further study is ongoing and the railway position may change.

Short Term:

1. a. The working group (WG) agrees presently with the proposed regulatory text of TP-14877, a revised standard, and certain selection and use of tank cars published in Canada Gazette Part I on January 11, 2014. These TP-14877 Standards harmonize with the AAR CPC-1232 circular but goes further to include all dangerous goods in Packing Group I and Packing Group II.
   b. It is recommended that this should be placed into regulation by Gazette II without any significant change.

   c. Justification: DOT 111 tank cars ordered after Oct 1, 2011 for ethanol and crude oil are currently being built to the AAR industry standard (CPC-1232). These cars built to the higher standard have a significant improvement in the Conditional Probability of Release (CPR) in an accident relative to cars ordered prior to this date.

   See Appendix 2.

   RSI advises of the quantity of new cars in service, will be:

   2013 – 26,200 tank cars

   2014 – 44,700 tank cars

   2015 – 52,500 tank cars

2. With the words of Recommendation #1 in mind, the WG feels that regulators, industry, car builders and shippers can go further.

   The TP-14877 standard Section 10.5.3 speaks about all Dangerous Goods in Packing Groups I and II.

   The WG recommends a standard such as this should also include all new tank cars in Flammable Liquid (Class 3) service for Packing Groups I, II and III.

   Furthermore, this recommendation should be implemented into the TP-14877 as written in Canada Gazette I for inclusion in Canada Gazette II.

3. The WG recommends that Transport Canada require the appropriate means of containment as may result from the TDG GPAC Classification Working Group's analysis of the characteristics of all crude oil.

4. **Interim Recommendation:** The WG recommends that a Working Group be formed as part of the Advisory Council to further study Classification and required Means of Containment and coordinate their efforts with the AAR Tank Car Committee.

5. Harmonization – The WG recommends that if there are regulatory requirement changes of a means of containment for crude oil, including timing, as changes are written, consideration be given to a solution that is a North American solution and does not interfere with transborder transportation.

6. The WG recommends that Transport Canada review train operations involving the shipments of Crude Oil in relation to the current MOC.

Longer Term:

7. The WG recommends that the TP-14877 standard, Section 10.5.3 should be reviewed to correspond with the AAR comments to the PHMSA ANPRM requiring an even higher standard of design safety of the DOT 111 new build tank cars.

   It is recommended that the TP-14877 Committee work with the AAR Tank Car Committee to form a consensus of government, industry and railway stakeholders.

8. The WG is recommending that the pre-CPC-1232 DOT 111tank cars in flammable liquid (Class 3) service be looked at for retirement, reassignment or retrofit.

   Regarding retrofitting; the WG recommends that a feasibility study, perhaps through TC, AAR TCC and RSI, be conducted on how a retrofit could be performed. This study should provide a timeframe that is as expedient as practicable.

   See Appendix 1.

9. **Interim Recommendation:** Prioritizing of retrofitting or retirement may be placed for the existing cars with an emphasis on pre- CPC-1232 compliant tank cars in a Crude Oil service.

End - Recommendations.

Section 8: Appendix 1

RAILWAY SUPPLY INSTITUTE
Support, Connection, Advocacy
425 Third Street, SW | Suite 920 | Washington, DC 20024 | phone (202) 347-4664 | fax (202) 347-0047 | www.rsiweb.org

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RE: PHMSA-2012-0082 (HM-251), Hazardous Materials: Rail Petitions and Recommendations to Improve the Safety of Railroad Tank Car Transportation

Dear Sir or Madam:

The Railway Supply Institute Committee on Tank Cars ("RSICTC") submits the attached comments in response to the Department of Transportation, Pipeline and Hazardous Materials Safety Administration's ("PHMSA") request for comments on the Advanced Notice of Proposed Rulemaking in Docket No. PHMSA-2012-00082, regarding improvements to the regulations applicable to the transportation of hazardous materials by rail, which was published by PHMSA in the federal register on September 6, 2013 (78 Fed. Reg. 54849).

Thank you for your consideration of the attached comments.

Respectfully submitted,

Thomas D. Simpson, President

Docket No. PHMSA-2012-0082, Hazardous Materials: Rail Petitions and Recommendations to Improve the Safety of Railroad Tank Car Transportation (RRR)

Comments of the Railway Supply Institute
Committee on Tank Cars

Introduction and Scope

The Railway Supply Institute Committee on Tank Cars ("RSICTC") submits the following comments in response to the Department of Transportation ("DOT"), Pipeline and Hazardous Materials Safety Administration's ("PHMSA") request for comments on the Advanced Notice of Proposed Rulemaking ("ANPRM") regarding improvements to the regulations applicable to the transportation of hazardous materials by rail, which was published by PHMSA in the federal register on September 6, 2013 (78 Fed. Reg. 54,849-61). The membership of the RSICTC includes American Railcar Industries; American Railcar Leasing; CIT Rail; GATX Corporation; General Electric Railcar Services Corporation; The Greenbrier Companies; Trinity Rail Group, LLC; and Union Tank Car Company. These companies build more than 95 percent of all new railroad tank cars and own and provide for lease over 70% of railroad tank cars operating in North America. The RSI is the international trade association of the railway supply industry. Its members provide all types of goods and services to our nation's freight and passenger railroads, rail shippers and freight car lessors.

In order to achieve the most substantial safety improvements, RSICTC recommends that PHMSA focus this rulemaking on DOT-111s servicing Class 3, Packing Group ("PG") I and II flammable liquid commodities. Modern methods to ship these specific commodities by rail include the use of unit trains, which have contributed to the severity of the post-derailment consequences of recent major derailments. By focusing on Class 3, PG I and II flammable liquids, PHMSA and the industry will be able to apply resources to most effectively improve tank car safety due to the fact that these commodities have been the ones involved in the most severe derailments. To further improve the scope of this rule, RSICTC supports the re-categorization of all grades of crude oil and ethanol to PG I or II under the DOT hazardous materials regulations. This rule need not address properly characterized PG III commodities as these low hazard commodities by their nature have a very low probability of serving as the catalyst for any event resulting in severe post-derailment consequences. RSICTC appreciates the opportunity to provide comments to PHMSA regarding the various petitions and recommendations that have been presented to the agency and is committed to continue working with its industry partners to enhance tank car safety for newly manufactured tank cars as well as the existing tank car fleet.

Tank Car Transportation is Critical to Our National Economy

Each year, tank cars carry nearly 1.4 million shipments of various commodities including over 150 million tons of hazardous materials on the North American rail system. The safe transport of hazardous materials by rail is a multidisciplinary activity involving infrastructure, rail equipment, maintenance, and other human factors related to train operation. Although these commodities are defined as "hazardous" by DOT regulations, many of them are critical commodities which are part of

our everyday lives. These commodities include fuels, fertilizers, lubricants, asphalt, disinfectants, and chemicals that are essential to our economy. Despite the magnitude of these operations, the railroads, shippers, car builders and car owners have an outstanding record of safely delivering hazardous materials to their destination. In fact, more than 99.997% of hazardous material shipments arrive at their destination without a release caused by an accident, making rail the safest way to transport hazardous materials. By way of comparison, while trucks have a smaller average hazardous material spill size, they spill more total quantity of liquid hazmat and spill roughly double the total equivalent hazmat (including gasses, liquids, and solids) than do railroads on either an annual or billion ton mile basis.[1] Notwithstanding the overall safety record of these operations, RSICTC is committed to improving tank car safety.

The DOT-111 Tank Car is an Integral Part of the North American Rail System

Today's North American rail tank car fleet consists of approximately 334,869 tank cars, including pressurized and non-pressurized as well as insulated and non-insulated tank cars. At the core of this fleet is the DOT-111 tank car, which constitutes the majority of the fleet. DOT-111s are non-pressurized tank cars designed to carry a variety of commodities, including hazardous materials and non-hazardous economic staples such as corn syrup or vegetable oil. There are 272,119 cars constructed to a DOT-111/AAR 211 specification that are currently in service, and approximately 63% of these DOT-111s are in hazardous material service.

Each year shippers use DOT-111 tank cars to transport large volumes of a variety of non-flammable hazardous materials, including caustic soda, sulfuric acid, and liquid fertilizers. Flammable liquids, such as crude oil or denatured ethanol, make up one subset of hazardous materials that are shipped in DOT-111s. These flammable liquids are classified as Class 3 materials under DOT's hazardous materials regulations. Approximately one-third of the DOT-111 tank car fleet is dedicated to servicing flammable liquid commodities. Class 3 materials are further broken down by Packing Group ("PG"), with low hazard commodities in PG III and higher hazard commodities in PG I and II. RSICTC believes the most substantial safety improvements can be achieved by focusing on the subset of commodities in PG I and II. Therefore, RSICTC urges PHMSA to focus this rulemaking on DOT-111s servicing Class 3, PG I and II commodities. Additionally, RSICTC shares PHMSA's concerns about shipper classification of crude oil and ethanol. Therefore, as part of our recommendation, we support the re-categorization of all grades of crude oil and ethanol to PG I or II under the DOT hazardous materials regulations.

Table 1 provides an overview of the DOT-111 tank car fleet and includes AAR 211 tank cars in all figures, since these tank cars also transport flammable liquids.[2]

Table 1
DOT-111 Tank Car Fleet Breakdown
(As of the Third Quarter of 2013)

DOT-111 Tank Cars	Total Cars	Percent of the Entire DOT-111 Tank Car Fleet
All DOT-111s	272,119	100.0%
Non-Hazmat DOT-111s	101,360	37.2%
Hazardous Material DOT-111s*	170,759	62.8%
Other Hazardous Materials Service	76,769	28.2%
Flammable Liquids (FL) Service*	94,178	34.6%
CPC-1232 Compliant Tank Car - FL Service (Jacketed and Non-Jacketed)	14,160	5.2%
Jacketed Tank Car - FL Service	14,677	5.4%
Non-Jacketed Tank Car (Existing Base Car) - FL Service *	**65,341**	**24.0%**
Existing Base Car, Ethanol Service	28,970	10.6%
Existing Base Car, Crude Oil Service	21,646	8.0%
Existing Base Car, Other Flammable Liquid Service	25,703	9.4%

* = These figures are not additive of the subcategories because some tank cars carry loads in more than one commodity category.

As an integral part of the North American tank car fleet, the DOT-111 has been operated safely for more than forty years. RSI has long recognized the significance of investing in the research and development of safety improvements for DOT-111s. In 1970, the predecessor to RSI teamed up with the Association of American Railroads (AAR) to create the Railroad Tank Car Safety Research and Test Project ("Tank Car Safety Project"). Since then, over $20 million has been invested in the Tank Car Safety Project yielding vast improvements in safety research, modifications to existing tank cars, construction of new tank cars to meet improved specifications, and reductions in post-derailment consequences. The data collected by the Tank Car Safety Project describing damage to tank cars in train accidents is available to industry researchers to support studies of potential enhancements to tank car construction, designs, and materials. Over time, manufacturers have implemented a variety of safety improvements as a result of advances in technology, the use of data analytics, and the investigation of accidents. These improvements include: tougher tank steels, stronger stub sill designs, head protection, accident protection for top and bottom fittings, fittings designs that prevent leaks during transportation and double shelf couplers.

In 2009, AAR reexamined the tank car regulations and standards for PG I and II materials. On July 23, 2009, AAR's Tank Car Committee (TCC) charged the T87.5 task force with investigating possible risk-reduction options for DOT-111 tank cars carrying PG I and II materials by examining tank car construction standards. By 2011, the TCC had developed and proposed a new standard for

[2] All fleet data in Table 1 was generated by the University of Illinois at Urbana-Champaign, using the AAR waybill and fleet databases. This table includes AAR 211 tank cars in all figures and is current as of November 9, 2013.

tank cars, such as DOT-105 or the DOT-112 cars, due to the fact that pressure tank cars have thicker shells and heads, are typically equipped with metal jackets, and have a different style of protective housing for top fittings. Based on these conclusions, NTSB recommended several safety enhancements to the DOT-111 design that it believed would improve the performance of these tank cars in a derailment.[13] These recommendations included: enhanced tank head and shell puncture-resistance systems and top fittings protection for tank cars transporting denatured fuel ethanol and crude oil in Packing Groups I and II (R-12-5); design improvements to bottom outlet valves on non-pressure tank cars to ensure the valves remain closed during accidents involving impact to the valve and operating handle (R-12-6); and improvements to the stub sill design for tank cars authorized for transportation of hazardous materials (R-12-7).[14]

RSICTC views each derailment as an opportunity to review all dimensions of the overall rail transportation system. While serious derailments are rare, RSICTC recognizes that these incidents can result in serious consequences, particularly where flammable liquids are involved. It should be noted that none of the high profile derailments mentioned above would have been prevented by any of the recommended improvements to tank car designs. The overall safety of hazardous material transportation by rail cannot be achieved by placing the sole burden of that goal on the designs of tank cars. Therefore while the industry supports safety-enhancing improvements to the designs of tank cars, it also supports operational enhancements that will address these root causes.

Many of these operational enhancements have already been evaluated by the T87.6 task force. RSICTC agrees that broken rails are an indisputable factor in the frequency of derailments and support efforts to improve rail integrity throughout the entire North American rail system. A reduction in broken rails must be central to the effort to improve the safety of tank car operations, given that this is one of the leading causes of derailments. RSICTC also supports the work of the task force to examine additional operational enhancements such as the alternative brake signal propagations systems, speed restrictions for "Key Trains"—unit trains containing 20 or more loaded tank cars of PG I and II hazardous materials, enhanced track inspection programs and improvements to the emergency response system. In order to build on the task force committee's examination of each of these aspects of operational enhancements, RSICTC encourages an ongoing discussion within the industry relative to improved operating practices and procedures where appropriate.

Benefits of the P-1577 Enhancements for New Tank Cars

Through its role on the AAR Tank Car Committee and its participation in the T87.6 task force, RSICTC has worked closely with its industry partners to expeditiously address the concerns regarding the documented damage to the tank cars involved in recent derailments, including Cherry Valley. On March 9, 2011, with support from RSI and others in the industry,[15] AAR submitted to PHMSA Petition 1577 ("P-1577" or the "Petition") to amend 49 C.F.R. Part 179 for tank cars used to transport PG I and II hazardous materials. The Petition includes both a jacketed and a non-jacketed option for new tank car construction, which reflects the industry's consensus that both options provide an increased level of tank car safety. RSICTC strongly endorses the P-1577 enhancements

[13] NTSB Safety Recommendation to PHMSA (March 2, 2012).
[14] NTSB Cherry Valley Report at 90-91.
[15] This petition was submitted by the AAR on behalf of itself, its member railroads, and the members of the AAR Tank Car Committee which includes multiple representatives for RSI.

for newly constructed tank cars and recommends that the agency's proposed rule continue to include both the jacketed and non-jacketed construction option.

RSICTC supports a rulemaking that would require the P-1577 design features for newly constructed DOT-111 tank cars transporting Class 3, Packing Group I and II materials. We also support reclassifying denatured ethanol and crude oil grades that are currently classified as PG III, to PG I or II, so that the rule addresses all grades of these two commodities. The key tank car enhancements for newly constructed tank cars included in the Petition include:

- PG I and II material tank cars to be constructed to 286,000 lb Gross Rail Load standards;
- Heads and shells must be constructed of normalized steel;
- New cars must be equipped with at least a ½ inch half-head shields;
- For tank cars constructed of normalized TC128 Grade B steel, head and shell thickness must be ½ inch for non-jacketed cars and 7/16 inch for jacketed cars;
- For tank cars constructed of normalized A516-70 steel, shells of non-jacketed tank cars must be 9/16 inch thick while shells of jacketed tank cars must be ½ inch thick;
- Top fittings must be protected by a protective structure as tall as the tallest fitting;
- Installation of a reclosing pressure relief valve.

The rail industry has long recognized that derailments involve the energy of thousands of tons of moving train mass, traveling at normal track speeds, in widely diverse terrain. As a result, derailments are high-energy, chaotic events. In the absence of the ability to test tank car design features in the variety of circumstances in which derailments can occur, the Tank Car Safety Project developed a Conditional Probability of Release (CPR) metric based on 40 years of rail accident data. This tool provides a means to assess design features for their effectiveness in reducing the probability that the contents of loaded tank cars will be released in an accident based on the history of actual accidents. CPR has been used to evaluate the efficacy of design alternatives in recent years and was used to assess the effectiveness of features during the development of the P-1577 petition tank car requirements. To evaluate the P-1577 enhancements, a non-jacketed, 30,000 gallon tank car with bottom fittings, 7/16 normalized tank heads and shells, and no top fittings protection or head shields, serves as the "base car" for the CPR metric.

A. Non-Jacketed P-1577 Tank Cars

Increasing tank shell thickness and applying head protection will improve the puncture resistance of these tank cars and provide more protection in the event of a derailment. The P-1577 enhancements also include a pressure relief device with a higher exit flow and lower trigger point. These changes to the pressure relief device will improve the potential for this equipment to operate as intended in a fire situation. Additionally, this enhancement is consistent with the T87.6 task force's conclusion that new cars in ethanol or crude oil service should be equipped with a pressure relief device with a higher exit flow and lower trigger point. The improved puncture resistance will result in less product release and therefore smaller fires in the event of a derailment. If any fire exposure should occur, the enhanced pressure relief system will serve to further reduce the probability of a high-energy release event.

Using the data contained in the Tank Car Safety Project Database and the CPR methodology, one can estimate that the various P-1577 risk reduction options for new tank cars will

the construction of new DOT-111s carrying PG I and II materials, which included enhanced end-of-tank protection in the form of head shields, thicker tank steel or jackets, and top fittings protection. The TCC further determined that these standards should apply to the construction of new cars. Consistent with its ongoing commitment to improving tank car safety, AAR and supporting organizations including RSI petitioned PHMSA to use these new standards for newly manufactured tank cars as the basis for a federal rule. AAR then implemented these standards in Casualty Prevention Circular 1232 ("CPC-1232"), making the new standards effective for all new tank cars servicing ethanol and crude oil that were ordered after October 1, 2011.

The data from the AAR-Bureau of Explosives (BOE) Annual Report of Hazardous Materials Transported by Rail (2012)[3] illustrates the results of the industry's robust commitment to tank car safety and underscores the fact that rail remains the safest way to transport hazardous materials. During the ten year period between 2003-2012 a total of 14,229,880 hazardous material tank car shipments were initiated in the US and Canada. Out of over 14 million shipments during this ten year period, 508 individual tank cars experienced damage enroute such that any reportable quantity (which varies by commodity)[4] of hazardous material was released to the environment.

Looking specifically at 2012, there were 1.76 million hazardous material shipments by rail last year. Out of these shipments, there were twenty-six separate events impacting forty-six individual tank cars that resulted in release of hazardous materials during transportation. Twenty of these twenty-six events involved the release of material from a single car. Eleven of these events resulted in the release of materials from flammable liquid carrying cars. Four of the flammable liquid release events involved multi-car releases of material. The frequency of these events has continued to decrease over the years through the collective efforts of tank car manufacturers and tank car owners along with railroads, shippers, regulators and other partners to improve the safe shipment of hazardous materials by rail.

Comparing hazardous material shipment by rail to other modes of transportation further illustrates that rail is the safest way to transport hazardous materials. From 2002-2012, the "spill rate" for railroads was an estimated 2.2 gallons per million crude oil ton-miles generated, while the comparable spill rate for pipelines was approximately 6.3 gallons per million crude ton-miles.[5] Similarly, from 2002-2009, the over-the-road truckers transporting hazardous materials spilled 58% more total liquid hazardous materials and roughly double the total equivalent hazardous materials (including gasses, liquids and solids) than railroads did per year and per billion ton-miles.[6]

Changes in Hazardous Material Transportation

As PHMSA contemplates the standards for its proposed rule, RSICTC notes that tank car safety enhancements should be responsive to changes in traffic flows and operational practices adopted by the industry. The most significant changes to the way hazardous materials are

[3] These statistics are based on the most up-to-date report available, however, RSICTC notes that data compiled for the 2012 AAR-BOE Annual Report does not encompass 2013 and therefore does not account for the derailment in Lac-Megantic, Quebec.
[4] For each hazardous material listed in 49 C.F.R. § 172.101, Appendix A, PHMSA has designated a specific quantity as the "reportable quantity" for the commodity.
[5] Association of American Railroads, Moving Crude Oil by Rail (May 2013).
[6] Association of American Railroads, Just the Facts – Railroads Safely Move Hazardous Materials, Including Crude Oil (July 2013).

tank cars, such as DOT-105 or the DOT-112 cars, due to the fact that pressure tank cars have thicker shells and heads, are typically equipped with metal jackets, and have a different style of protective housing for top fittings. Based on these conclusions, NTSB recommended several safety enhancements to the DOT-111 design that it believed would improve the performance of these tank cars in a derailment.[13] These recommendations included: enhanced tank head and shell puncture-resistance systems and top fittings protection for tank cars transporting denatured fuel ethanol and crude oil in Packing Groups I and II (R-12-5); design improvements to bottom outlet valves on non-pressure tank cars to ensure the valves remain closed during accidents involving impact to the valve and operating handle (R-12-6); and improvements to the stub sill design for tank cars authorized for transportation of hazardous materials (R-12-7).[14]

RSICTC views each derailment as an opportunity to review all dimensions of the overall rail transportation system. While serious derailments are rare, RSICTC recognizes that these incidents can result in serious consequences, particularly where flammable liquids are involved. It should be noted that none of the high profile derailments mentioned above would have been prevented by any of the recommended improvements to tank car designs. The overall safety of hazardous material transportation by rail cannot be achieved by placing the sole burden of that goal on the designs of tank cars. Therefore while the industry supports safety-enhancing improvements to the designs of tank cars, it also supports operational enhancements that will address these root causes.

Many of these operational enhancements have already been evaluated by the T87.6 task force. RSICTC agrees that broken rails are an indisputable factor in the frequency of derailments and support efforts to improve rail integrity throughout the entire North American rail system. A reduction in broken rails must be central to the effort to improve the safety of tank car operations, given that this is one of the leading causes of derailments. RSICTC also supports the work of the task force to examine additional operational enhancements such as the alternative brake signal propagations systems, speed restrictions for "Key Trains"—unit trains containing 20 or more loaded tank cars of PG I and II hazardous materials, enhanced track inspection programs and improvements to the emergency response system. In order to build on the task force committee's examination of each of these aspects of operational enhancements, RSICTC encourages an ongoing discussion within the industry relative to improved operating practices and procedures where appropriate.

Benefits of the P-1577 Enhancements for New Tank Cars

Through its role on the AAR Tank Car Committee and its participation in the T87.6 task force, RSICTC has worked closely with its industry partners to expeditiously address the concerns regarding the documented damage to the tank cars involved in recent derailments, including Cherry Valley. On March 9, 2011, with support from RSI and others in the industry,[15] AAR submitted to PHMSA Petition 1577 ("P-1577" or the "Petition") to amend 49 C.F.R. Part 179 for tank cars used to transport PG I and II hazardous materials. The Petition includes both a jacketed and a non-jacketed option for new tank car construction, which reflects the industry's consensus that both options provide an increased level of tank car safety. RSICTC strongly endorses the P-1577 enhancements

[13] NTSB Safety Recommendation to PHMSA (March 2, 2012).
[14] NTSB Cherry Valley Report at 90-91.
[15] This petition was submitted by the AAR on behalf of itself, its member railroads, and the members of the AAR Tank Car Committee which includes multiple representatives for RSI.

for newly constructed tank cars and recommends that the agency's proposed rule continue to include both the jacketed and non-jacketed construction option.

RSICTC supports a rulemaking that would require the P-1577 design features for newly constructed DOT-111 tank cars transporting Class 3, Packing Group I and II materials. We also support reclassifying denatured ethanol and crude oil grades that are currently classified as PG III, to PG I or II, so that the rule addresses all grades of these two commodities. The key tank car enhancements for newly constructed tank cars included in the Petition include:

- PG I and II material tank cars to be constructed to 286,000 lb Gross Rail Load standards;
- Heads and shells must be constructed of normalized steel;
- New cars must be equipped with at least a ½ inch half-head shields;
- For tank cars constructed of normalized TC128 Grade B steel, head and shell thickness must be ½ inch for non-jacketed cars and 7/16 inch for jacketed cars;
- For tank cars constructed of normalized A516-70 steel, shells of non-jacketed tank cars must be 9/16 inch thick while shells of jacketed tank cars must be ½ inch thick;
- Top fittings must be protected by a protective structure as tall as the tallest fitting;
- Installation of a reclosing pressure relief valve.

The rail industry has long recognized that derailments involve the energy of thousands of tons of moving train mass, traveling at normal track speeds, in widely diverse terrain. As a result, derailments are high-energy, chaotic events. In the absence of the ability to test tank car design features in the variety of circumstances in which derailments can occur, the Tank Car Safety Project developed a Conditional Probability of Release (CPR) metric based on 40 years of rail accident data. This tool provides a means to assess design features for their effectiveness in reducing the probability that the contents of loaded tank cars will be released in an accident based on the history of actual accidents. CPR has been used to evaluate the efficacy of design alternatives in recent years and was used to assess the effectiveness of features during the development of the P-1577 petition tank car requirements. To evaluate the P-1577 enhancements, a non-jacketed, 30,000 gallon tank car with bottom fittings, 7/16 normalized tank heads and shells, and no top fittings protection or head shields, serves as the "base car" for the CPR metric.

A. Non-Jacketed P-1577 Tank Cars

Increasing tank shell thickness and applying head protection will improve the puncture resistance of these tank cars and provide more protection in the event of a derailment. The P-1577 enhancements also include a pressure relief device with a higher exit flow and lower trigger point. These changes to the pressure relief device will improve the potential for this equipment to operate as intended in a fire situation. Additionally, this enhancement is consistent with the T87.6 task force's conclusion that new cars in ethanol or crude oil service should be equipped with a pressure relief device with a higher exit flow and lower trigger point. The improved puncture resistance will result in less product release and therefore smaller fires in the event of a derailment. If any fire exposure should occur, the enhanced pressure relief system will serve to further reduce the probability of a high-energy release event.

Using the data contained in the Tank Car Safety Project Database and the CPR methodology, one can estimate that the various P-1577 risk reduction options for new tank cars will

our everyday lives. These commodities include fuels, fertilizers, lubricants, asphalt, disinfectants, and chemicals that are essential to our economy. Despite the magnitude of these operations, the railroads, shippers, car builders and car owners have an outstanding record of safely delivering hazardous materials to their destination. In fact, more than 99.997% of hazardous material shipments arrive at their destination without a release caused by an accident, making rail the safest way to transport hazardous materials. By way of comparison, while trucks have a smaller average hazardous material spill size, they spill more total quantity of liquid hazmat and spill roughly double the total equivalent hazmat (including gasses, liquids, and solids) than do railroads on either an annual or billion ton mile basis.[1] Notwithstanding the overall safety record of these operations, RSICTC is committed to improving tank car safety.

The DOT-111 Tank Car is an Integral Part of the North American Rail System

Today's North American rail tank car fleet consists of approximately 334,869 tank cars, including pressurized and non-pressurized as well as insulated and non-insulated tank cars. At the core of this fleet is the DOT-111 tank car, which constitutes the majority of the fleet. DOT-111s are non-pressurized tank cars designed to carry a variety of commodities, including hazardous materials and non-hazardous economic staples such as corn syrup or vegetable oil. There are 272,119 cars constructed to a DOT-111/AAR 211 specification that are currently in service, and approximately 63% of these DOT-111s are in hazardous material service.

Each year shippers use DOT-111 tank cars to transport large volumes of a variety of non-flammable hazardous materials, including caustic soda, sulfuric acid, and liquid fertilizers. Flammable liquids, such as crude oil or denatured ethanol, make up one subset of hazardous materials that are shipped in DOT-111s. These flammable liquids are classified as Class 3 materials under DOT's hazardous materials regulations. Approximately one-third of the DOT-111 tank car fleet is dedicated to servicing flammable liquid commodities. Class 3 materials are further broken down by Packing Group ("PG"), with low hazard commodities in PG III and higher hazard commodities in PG I and II. RSICTC believes the most substantial safety improvements can be achieved by focusing on the subset of commodities in PG I and II. Therefore, RSICTC urges PHMSA to focus this rulemaking on DOT-111s servicing Class 3, PG I and II commodities. Additionally, RSICTC shares PHMSA's concerns about shipper classification of crude oil and ethanol. Therefore, as part of our recommendation, we support the re-categorization of all grades of crude oil and ethanol to PG I or II under the DOT hazardous materials regulations.

Table 2 details the large number of recently constructed existing DOT-111s in hazardous material service that are already CPC-1232 compliant.[19]

Table 2
Existing Tank Car Compliance with CPC-1232
(As of the Third Quarter of 2013)

	Cars with New CPC-1232 Safety Features	Total Cars
Crude Oil 111s	11,549	38,679
Ethanol (Denatured) 111s	476	29,547
All Flammable Liquid 111s	14,160	94,178
All 111s in Hazmat Service	16,165	170,759
Total Hazmat 111s In Service by the End 2015*	55,546	

*Based on cars currently in service and on order.

Moving beyond the CPC-1232 compliant cars manufactured since 2011, RSICTC recognizes that a significant portion of the existing fleet is not equipped with the CPC-1232 safety features. To address this, RSICTC supports the ongoing research of the AAR Tank Car Committee and puts forth the following modification proposal consisting of four elements which are consistent with the findings and conclusions of the committee.

For existing non-jacketed DOT-111s servicing Class 3, PG I and II materials, RSI proposes that PHMSA consider the following safety modifications:

- Trapezoidal or conforming half height head shields;
- Equipping tank cars with a pressure relief valve that is sized properly to protect the tank against over-pressurization, should the T87.6.1 task force determine this is appropriate;
- Reduction in fitting height or some other method of fittings protection as deemed appropriate by the RSI task force; and
- Bottom outlet valve handles that may be removed in transit, or otherwise protected in a way that the T10.7.5 task force determines is appropriate, to assure the handle does not open in derailment.

This set of modifications reduces the CPR from the base tank car value to 12.4%, representing a 37% reduction. Once modified, these cars should be permitted to remain in active service for the duration of their legal life, as permitted by the regulations. For an estimate of the costs associated with these modifications please see the Appendix.

Given that existing jacketed DOT-111s already provide substantial protection in the event of a derailment, only minor modifications are needed to improve the safety of this subset of existing

[19] All fleet data in Table 2 was generated by the Rail Transportation and Engineering Center at the University of Illinois at Urbana-Champaign. This table includes AAR 211 tank cars in all figures and is current as of November 9, 2013.

cars. The Tank Car Safety Project has modeled the survivability of the jacketed tank car in a pool fire using the "Analysis of Fire Effects on Tank Cars" ("AFFTAC") which simulates a survival time of nearly 250 minutes in ethanol service and 480 minutes diesel fuel service.[20] Furthermore, the CPR for this configuration is 8.5%, a 56.6% improvement over the CPR of the base tank car. RSICTC recommends that these cars also be equipped with high capacity pressure relief valves should this modification be deemed necessary by the T87.6.1 task force and a bottom outlet valve handle configuration as determined by the T10.7.5 task force. Should modifications be made to the existing jacketed DOT-111s, we again urge PHMSA to allow these modified cars to remain in active service for the duration of their regulatory life.

RSICTC's modification proposal would provide the industry with an organized and efficient path to improved safety for these cars. However, an orderly process for modification is critical to successful implementation of any rule mandating modifications. At this time, tank car repair facilities are running at full capacity to handle the normal repairs and qualifications of the existing tank car fleet. Given the complexity of the work and the capacity of the repair network, a reasonable timeline must be established for the completion of this work. If all the existing non-jacketed tank cars are mandated to undergo requalification work at the same time to incorporate the proposed modifications, the existing repair network may be overwhelmed by this demand. In order to achieve these modifications in a timely way that will not overwhelm the tank car maintenance and repair system, RSICTC submits that PHMSA adopt a ten-year program allowing compliance to be achieved in phases through modification, re-purposing or retirement of unmodified non CPC-1232 tank cars in Class 3, PG I and II flammable liquid service. RSICTC further recommends that PHMSA permit each owner to submit individual plans to the agency articulating the manner in which it will achieve compliance on or before the end of the ten-year period. This would give individual car owners the flexibility they need to ensure compliance in the most efficient and expeditious manner possible. Without such a timeline, these modifications will exacerbate the existing repair backlog and may exceed the current capacity of repair and supply shops.

To further illustrate the necessity of a ten-year phase-in program, RSICTC urges PHMSA to consider the following. First, RSICTC anticipates the modifications, as proposed by RSICTC, will increase the average annual required tank car maintenance labor hours by 31.8%. This increase in average estimated labor hours represents the additional maintenance capacity needed to implement mandated modifications while still meeting the regular qualification and maintenance demands necessary to keep the fleet compliant with existing regulations. Based on the increased annual labor demand associated with a ten-year program, RSICTC anticipates that any modification period less that the recommended ten-year period will force the early shopping of tank cars which may have the effect of driving up the cost of all cars shopped and may extend out-of-service times. Second, any compliance period must take into account the time needed to design, test, and engineer modification solutions for the existing fleet, once the final rule is determined. These modifications will require substantial planning and utilization of engineering resources that cannot commence in earnest until the full scope of the final rule modification requirements is known. Third, the actual infrastructure needs of the repair shop network cannot be fully assessed until a final rule is issued. Therefore, any

[20] The AFFTAC model estimates tank car survivability by assuming a 1500 °F pool fire, completely engulfing a tank car. The modeling assumes a pressure relief device with a 27000 SCFM flow capacity and a 75 psi STD pressure. It is also based on the assumption that the general purpose insulation has fully degraded and heat conduction is governed by a jacket assembly with an air gap between the jacket and the tank. It is critical that the real world condition of the air gap that develops between the tank and the jacket be taken into account to avoid overly conservative estimates of the tank survival time.

substantial expansion of the repair shop network infrastructure, which requires design, engineering, permitting and construction, will not be immediately available to meet the modification needs. Finally, under the ten-year program, RSICTC anticipates roughly 3,000 cars will be out of service at any given point during the program period. Given the constraints on barge shipments and pipeline capacity, shippers will likely compensate for this decrease in rail transport capacity, by turning to long haul trucking. Assuming that the average tank car carrying 28,000 gallons of a commodity makes two turns per month and 3.5 tank truck shipments are required to equal one tank car, this will result in nearly 252,000 additional long haul truck shipments, which creates substantial additional risk for transporting hazardous materials. A shorter phase-in period will only amplify the added risk of using long haul trucking to compensate for out-of-service tank cars because more tank cars will be out of service at any given time.

Thermal Protection Systems

In direct response to PHMSA's questions regarding the utility of thermal protection systems for newly manufactured and existing tank cars, RSICTC notes that the use of thermal jacketing or spray-on thermal protection would only provide minimal secondary safety benefits in light of the other enhancements proposed. The application of thermal protection systems was carefully reviewed by the T87.6 task force at the time the original CPC-1232 standards were developed—the task force examined both spray-on thermal protection and thermal protection systems including an increased flow capacity pressure relief device. The purpose of thermal insulation is to delay the occurrence of and minimize the consequences from a post-derailment, high energy event induced by pool fire. The proposed enhancements for newly constructed tank cars will have the effect of reducing the likelihood that such an event would occur by using alternative methods. The proposed P-1577 tank cars, and the existing CPC-1232 compliant tank cars, implicitly provide a thermal protection system because the thicker tank materials decrease the likelihood of release in a derailment which in turn decreases the likelihood of a fire. In the event a fire should occur, the high capacity pressure relief valve reduces the potential for a high energy event resulting from pressure build-up during a fire.

With regard to the alternative of using spray-on thermal insulation without application of a metal jacket, RSICTC considers the methodology without merit. Historically, the use of spray-on thermal insulation has resulted in a variety of problems including cracking, break-down due to UV exposure, loss of adhesion and other issues resulting in tank corrosion. For these reasons, the materials available have not proven themselves as viable in dynamic environments such as railroad rolling stock. What may work for stationary storage applications is not directly transferable to the rail operation environment. Accordingly, PHMSA should discount the thermal protective performance of the application of spray-on insulation as a viable option to modify the existing tank cars.

Turning to metal jackets, RSICTC has several concerns regarding the technical complexity of the application of thermal protection and metal jacket to the existing fleet of non-jacketed 30,000 gallon DOT 111 tank cars. First, RSICTC notes that such a modification mandate may lead to several unintended consequences. It is probable that for certain existing cars, a mandate for metal jackets is technically infeasible due to structural design and railroad clearance requirements. The process of modifying and welding an existing tank car, as would be required to add a metal jacket, can negatively impact the long term integrity of the car in ways that are unknowable today. For example, adding a thermal jacket could cause tank shell defects which are undetectable for many years but may ultimately progress into fatigue cracks over time. Second, it is also likely that for

certain existing cars the additional weight represented by the insulation and metal jacket will impact the load carrying capacity of those individual cars. Such a situation will result in an increase in the number of tank cars needed to ship the same volume of a commodity in order to meet the current economy's commodity demands. A jacket retrofit mandate may also require several tank car owners to retire portions of their existing fleet, effectively amounting to the forced retirement of nearly one fifth of the North American tank car fleet. This additional capacity challenge may lead shippers to turn to less safe modes of transportation for Class 3, PG I and II materials. Finally, RSI is concerned about capacity and capabilities of the current tank car repair network if such a retrofit were mandated. Many repair facilities do not currently have the capabilities needed to undertake such a complex modification requirement. The availability of skilled labor that could be properly trained and certified for the work tasks required will likewise be a major undertaking with uncertain results.

For the reasons outlined above, it is more effective to achieve the benefits associated with a thermal protection system by equipping existing cars and newly constructed cars with the pressure relief device and other enhancements recommended by the RSICTC. Therefore, RSICTC urges PHMSA to adopt the proposed enhancements set forth in the RSICTC's proposal to achieve thermal protection benefits rather than mandate a jacket retrofit or spray-on thermal protection for existing tank cars.

Conclusion

The safety enhancements to tank cars carrying PG I and II flammable liquids must focus on those elements of the transportation system that are most exposed to recent changes in traffic flows and operational practices. RSICTC fully supports a standard for newly manufactured DOT-111 tank cars servicing PG I and II flammable liquids that includes additional protection for top fittings, high flow pressure relief devices, higher strength steel, increased thickness of the non-jacketed tank car, and a mandatory head shield as outlined in the P-1577 petition. While we support certain modifications to the subset of non-jacketed tank cars within the existing DOT-111 fleet that service Class 3, PG I and II flammable liquids, such modifications must be implemented in a way that reflects the complexity of the modifications, the capacity of the repair network, and the technical and economic feasibility of such modifications.

As a key stakeholder in this rulemaking, RSICTC urges PHMSA to resolve the issues raised in the ANPRM as expeditiously as possible within the context of a formal rulemaking, which includes the full notice and comment process. Once RSI member companies can act on the certainty of a final rule, the industry will coordinate required modifications with the qualification schedule for existing tank cars to address existing non-jacketed base cars in crude oil and ethanol service on a priority basis with the least possible disruption to commerce. RSICTC remains committed to improving tank car safety and looks forward to working with PHMSA in the future as it develops a final rule on this issue.

Appendix

Cost of Modifications

The cost figures listed below are an estimate of the average direct cost associated with modifications to existing DOT-111 tank cars. These figures were developed by RSICTC member companies using a common template to assure all pricing was developed using comparable processes. Individual company figures were submitted confidentially to RSI staff and the figures in the table are the average selling prices for those figures submitted. The pressure relief valve and bottom outlet modifications are not yet fully defined by the AAR TCC and therefore are the RSICTC engineers' best representation of modification possibilities. All prices assume that work will be performed in AAR certified shops to AAR engineering and quality standards. RSICTC notes that the overall economic costs of implementing these modifications may actually be higher because these figures don't include the additional cost for moving cars to shops and for the inevitable disruption of service while the cars are undergoing maintenance. These figures represent 2013 dollars and have not been indexed for inflation, which may occur during the life of the program as proposed.

RSICTC respectfully requests that PHMSA consider the estimated costs of these modifications to the existing DOT-111 tank cars in Class 3, PG I and II service to fully evaluate the most effective way for the industry to achieve compliance with a future rule. RSICTC also notes that the out-of-service time reflects the amount of time an individual tank car would be required to be removed from service to undergo the particular modification, but does not account for the timing of a phased in approach to compliance, as recommended by RSICTC.

Average Cost of Safety Enhancements

Modification	Cost to Existing Cars on a Per Car Basis	Out-of-Service Time For Each Car
High Capacity Pressure Relief Valve • If done at Requalification • Not at Requalification	 $2,100 $3,400	 No additional time 5 Weeks
Bottom Outlet Valve Handle Removal	$600 - $3,000	Under Review
Trapezoidal/Conforming Head Shield	$17,500	5 Weeks
Top Fittings Protection • Assuming Existing Nozzle* • Assuming New Nozzle*	 $6,000 $24,500	7 Weeks
Top Fittings Protection – New Nozzle, Jacket, Full Head Shield • Thermal Insulation • Cost of trucks, if upgradable	$63,500 +$3,700 +16,500	12 Weeks **

* Top fittings protection based on AAR Standard Appendix E, Part 10.2. Actual modification used depends on specific tank car design.

** The out of service time reflects the time each individual tank car would be required to be removed from service during the phase-in period of any modification program. For a full discussion of the capacity of the maintenance and repair network and the modification timeline proposed by RSICTC, see the section on RSICTC's modification proposal.

Section 8: Appendix 2

Railway Supply Institute

The DOT-111 Tank Car

1. What is a DOT-111 or TC-111 tank car?

A **tank car** is a rail car specifically designed to carry liquids or compressed gases in a tank that makes up most of the structure of the car. The US Department of Transportation and Transport Canada define various classes of tank cars in their regulations, based upon car features and intended service. **The DOT-111** tank car carries liquids. (Transport Canada defines the TC-111 tank car, which is essentially the same; all references in this paper to DOT-111s refer to both.) To be marked and used as a DOT- 111 or TC-111 car, a tank car must meet all regulatory requirements for the class. Note that many tank cars operate across North American borders.

The DOT-111 tank car should best be considered as a family of railcar designs each optimized for the characteristic of commodities transported. While all tank cars do have certain common design features, not all DOT-111 tank cars are the same. All consist of a **tank**, which is made up of a shell (the long cylindrical part of the tank) and two heads (the ends of the tank). Depending on the density of the commodity carried, a DOT-111 tank can range from about 10,000 gallons to 34,500 gallons in **capacity**.

All DOT-111 cars are equipped with various appurtenances which allow for loading, unloading, internal pressure equalization or relief as well as other shipper-specified items. Collectively these features are referred to as tank car **fittings**. The specific fittings used depend on the commodity carried. Most cars are equipped with bottom fittings to facilitate unloading or cleaning. Many of these cars have bottom outlets which are enclosed in a protective assembly. Tank cars have some combination of fittings on the top of the tank shell (top fittings), which on newer DOT-111 cars are enclosed within a protective housing.

The **stub sills**, one on either end of the tank, support the structure, absorb the forces a railcar experiences as the train moves through the system, and are equipped with the couplers that connect the tank car to other cars in the train.

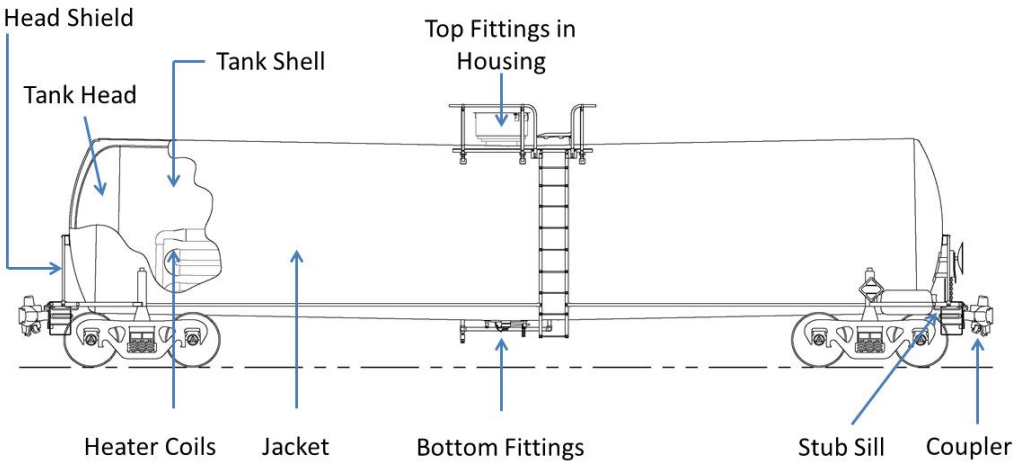
Some cars also have an **insulation** system to maintain the temperature of the lading (i.e., cargo) in transit. This system consists of an insulating blanket against all external surfaces of the tank, held in place by a steel **jacket**.

Although the railroads assemble and operate the trains, and own many of the other freight cars they haul, the **owners** of tank cars (with few exceptions) are either the shipper who manufactures and loads the lading, or a leasing company that provides cars to shippers.

The liquids carried by DOT-111 cars can be **hazardous materials** (known as dangerous goods in Canada) as defined by US and Canadian regulations, including flammable liquids such as crude oil or ethanol, corrosive solutions such as hydrochloric acid, and various other materials. Or, the liquids can be **non-hazardous** materials, also referred to as non-regulated materials, such as corn syrup or vegetable oil. The U.S. and Canadian regulatory agencies, in harmony with international standards, determine the hazard classification of any particular commodity and authorize the use of certain tank car types and configurations by commodity. Shippers have the ultimate responsibility for determining whether their shipments are properly classified, and packaged. All hazardous material tank cars are placarded to identify the commodity class to aid the railroads and emergency responders in case of a product release. The hazards of different materials differ in type and severity, and the safety requirements for the tank cars in those services also vary accordingly.

Figure 1 shows a typical jacketed DOT-111 tank car.

Figure 1
Jacketed DOT-111 Tank Car Components



2. Regulatory oversight of DOT-111 tank cars

The legally binding regulations and industry standards which must be followed by tank car owners and operators are created and enforced principally by two parties:

1) the federal **regulators**: a) the Pipeline and Hazardous Materials Safety Administration (PHMSA) and b) the US Federal Railroad Administration (FRA), both agencies under the US Department of Transportation, and c) Transport Canada, and its Transport Dangerous Goods Directorate (TDG). The DOT regulations on tank cars can be found in 49 CFR Parts 172, 173, 174, 179 and 180. Transport Canada's are in TDG Regulations Parts 4, 5 and 10.

2) the Association of American Railroads (AAR), through its **Tank Car Committee** (TCC). This committee consists of representatives of railroads, tank car builders, tank car owners, and shippers, and establishes requirements for all tank cars that will be used in interchange service, i.e., will be used on multiple railroads. This encompasses virtually all tank cars used in North America. The TCC is also delegated authority by FRA to approve tank car designs. The TCC meets four times per year and is continuously reviewing the performance of tank cars in service. The regulators also attend TCC meetings and contribute where appropriate. AAR's tank car standards are in its Manual of Standards and Recommended Practices, Volume C-III, also known as M-1002.

These organizations all develop safety initiatives, and also receive recommendations from government investigatory agencies: in the US, the National Transportation Safety Board (NTSB), and in Canada, the Transportation Safety Board of Canada (TSB).

An additional source of recommendations and information for the TCC is the RSI-AAR Railroad Tank Car Safety Research and Test Project. The mission of this collaborative research program is to conduct scientific and engineering studies to support continuous improvement in tank car safety. The Project has been collecting information on tank cars damaged in accidents since 1970, and develops quantitative information that the TCC uses to compare the effectiveness of various improvement options.

3. DOT-111 tank car evolution

The DOT-111 tank car has been an integral part of the North American tank car fleet and has been operated safely for more than forty years. Over time, due to the advent of new technologies, and the use of strong data analytics and investigation of accidents, performance and safety improvements have been continually introduced. These improvements were, for the most part, evolutionary in nature and the result of collaboration among the Tank Car Committee, the RSI-AAR Tank Car Safety Project, and the regulatory agencies. They

included tougher tank steels, stronger stub sill designs, accident protection for top and bottom fittings, fittings designs that prevent leaks during transportation, and shelf couplers that hold

together in accidents so that they can't rise up and puncture tank heads. The tank car community remains dedicated to proactive and continual safety improvement.

For example, with the substantial increase in rail transportation of **ethanol and crude oil**, there have been more hazmat trains dedicated to these commodities (**unit trains**). In 2011 the TCC developed a proposed **new standard** for application to new construction of DOT-111 cars to be used for flammable liquids, including crude oil and ethanol. The new standards required end-of-tank protection in the form of an additional outer layer of steel called a head shield, for thicker and more impact-resistant tank steel, and for top fittings protection, all of which help to improve accident performance. TCC interchange standards can be more stringent than federal rules, and this was such a case.

In March 2011, AAR (supported by the Railway Supply Institute, American Petroleum Institute, Renewable Fuels Association, American Chemistry Council, and The Chlorine Institute) petitioned PHMSA to use the new AAR standards as the basis for a federal rule. (Reference **Petition** number P-1577.) The petition was accepted by PHMSA and on September 6, 2013 an Advance Notice of Proposed Rulemaking was published in the Federal Register with a 60-day comment period . Prior to the publication of the ANPRM, the new standards were implemented by AAR in **Circular Letter** CPC-1232, dated August 2011, effective for new cars ordered after October 1, 2011.

4. Fleet statistics

All fleet data in the tables in Section 4 were generated by AAR and the University of Illinois at Urbana-Champaign, using AAR waybill and fleet databases.

Table 1 provides an overview of the DOT-111 tank car fleet.

Table 1
DOT-111 Tank Car Fleet Breakdown
(Third Quarter 2013)

DOT-111 Tank Cars	Cars with Jacket & Insulation	Total Cars	Percent with Jacket & Insulation
All 111 Tank Cars	88,537	228,036	38.8 %
Hazmat 111s	50,678	160,590	31.6 %
Non-Hazmat 111s	37,859	67,446	56.1 %

5. NTSB/TSB recommendations for existing DOT-111 hazmat tank cars

The NTSB and TSB have made certain recommendations for consideration by industry and regulatory agencies to enhance the performance of the DOT-111 tank car in a derailment. The left column of Table 2 below identifies five areas they believe offer potential for improvements. The AAR Tank Car Committee has active task forces that are currently evaluating these recommendations under the open dockets shown in the table. It is anticipated that the task forces will make recommendations to the TCC within six months. Tank Car Committee task forces include representatives of railroads, shippers, tank car builders, tank car owners, regulators and fittings suppliers.

Table 2
NTSB/TSB Recommendations

Recommendation Area	AAR Task Force/Docket
Stub sills	T72.13.1
Bottom outlets	T10.7.5
Top fittings protection	T87.6
Shell protection	T87.6
Head protection	T87.6

6. Industry contacts

Railway Supply Institute	Association of American Railroads
Thomas Simpson	Robert Fronczak
President	AVP Environment and Hazardous Materials
(202) 347-4664	(202) 639-2839
simpson@rsiweb.org	rfronczak@aar.org

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END OF RECOMMENDATION REPORT.