

Enhanced Tank Car Standards and Operational Controls for High Hazard Flammable Trains (HM-251)



History

AAR Task Force T87.5

P-1577 – March 9, 2011

CPC-1230 – July 26, 2011

T87.6 – August 17, 2011 (first meeting)

CPC-1232 – August 31, 2011

NPRM – August 1, 2014 (79 FR 45016)

ANPRM – September 6, 2013 (78 FR 54849)

Final Rule – May 8, 2015 (89 FR 26644)



Elements of Rule



Classification



Routing/Notification



Speed Restrictions



Braking



Tank Car Specifications

Scope of Rule

- **High Hazard Flammable Train (HHFT)**
 - 20 or more loaded cars in a continuous block
 - 35 loaded cars throughout the train
- **High Hazard Flammable Unit Train (HHFUT)**
 - 70 or more loaded tank cars in a single train



Classification

- **Sampling and testing program for unrefined petroleum products**
 - Frequency of sampling/testing
 - Sample prior to offering/changes
 - Sampling method
 - Test methods
 - Quality control measures
 - Duplicate samples
 - Criteria for modification of program
 - Other methods
- **Certify, document, and make available to DOT**
- **49 CFR Section 173.41**



Routing

- **Risk assessment**

- Routing analysis (27 safety and security factors)
- Select a route based on its findings

- **Notification**

- Contact information for State and/or regional fusion centers and State, local, and tribal officials
- Request information related to the routing of hazardous materials through their jurisdictions
- **May 7, 2014 Emergency Restriction/Prohibition Order remains in effect**
- Subject of future NPRM (HM-251B)

- **49 CFR § 174.310 (1)**



Speed Restriction

- **HHFT**
 - 40 mph in High Threat Urban Area (§ 1580.3)
 - Unless all tank cars meet new standards
 - 50 mph otherwise
 - **49 CFR § 174.310 (2)**



Braking

- **Effective date (HHFT)**
 - Two-way end-of-train device (§ 232.5) or
 - Distributed Power (§ 229.5)
 - Speed > 30 mph
- **January 1, 2021 (HHFUT)**
 - Class 3 PGI material (Bakken Crude oil)
 - Speed > 30 mph
 - Electronically controlled Pneumatic Brakes (49 CFR Part 232, Subpart G)
 - Not buffer cars

Braking

- **January 1, 2023**
 - All HHFUTs (includes denatured alcohol)
- **Buffer cars counted in determine effective and operative brakes (§ 232.609)**
- **Alternate brakes systems may be approved (49 CFR Part 232, Subpart F)**
- **§ 174.310(3)**

Tank Car Specification

- **New cars constructed after October 1, 2015**
 - Specification standard
 - Performance standard
 - DOT 117J
- **Existing car to be retrofitted**
 - Specification standard
 - Performance standard
 - DOT117R
- **Prescribed retrofit schedule**
- **Retrofit reporting**



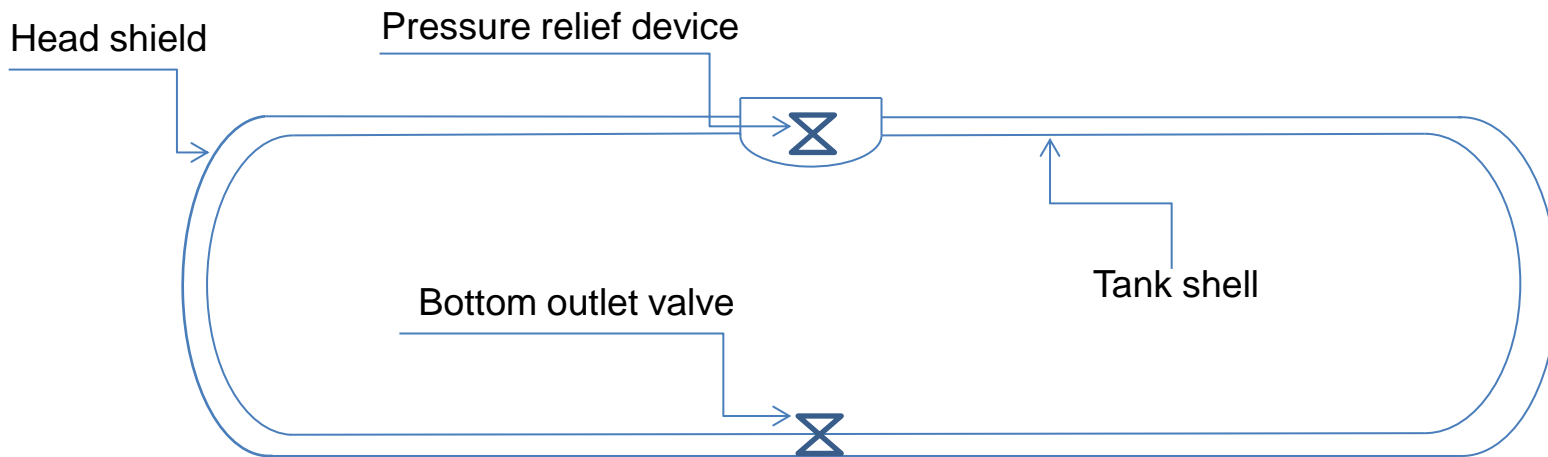
New Tank Cars

- **Specification Standard (DOT117)**
 - TC-128 Minimum shell/head thickness – 9/16”
 - Tank head puncture resistance system – § 179.16(c)
 - Thermal protection system – § 179.18
 - Bottom outlet valve – prevent in intended actuation during a derailment
 - Top fittings protection – AAR’s Tank Car Manual, E 10.2.1)
 - **49 CFR Part 179, Subpart D**

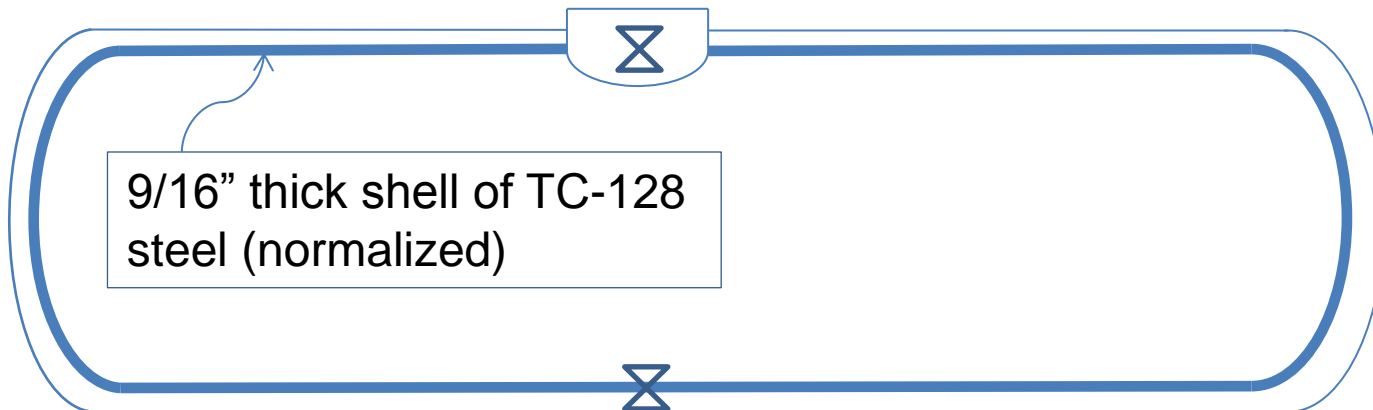
New Tank Cars

- **Performance Standard (DOT117P)**
 - Shell - 12" x 12" indenter: 12 mph
 - Tank head – 18 mph
 - Thermal protection system – § 179.18
 - Bottom outlet valve – prevent in intended actuation during a derailment
 - Top fittings protection – AAR's Tank Car Manual, E 10.2.1)
 - § 179.202-12

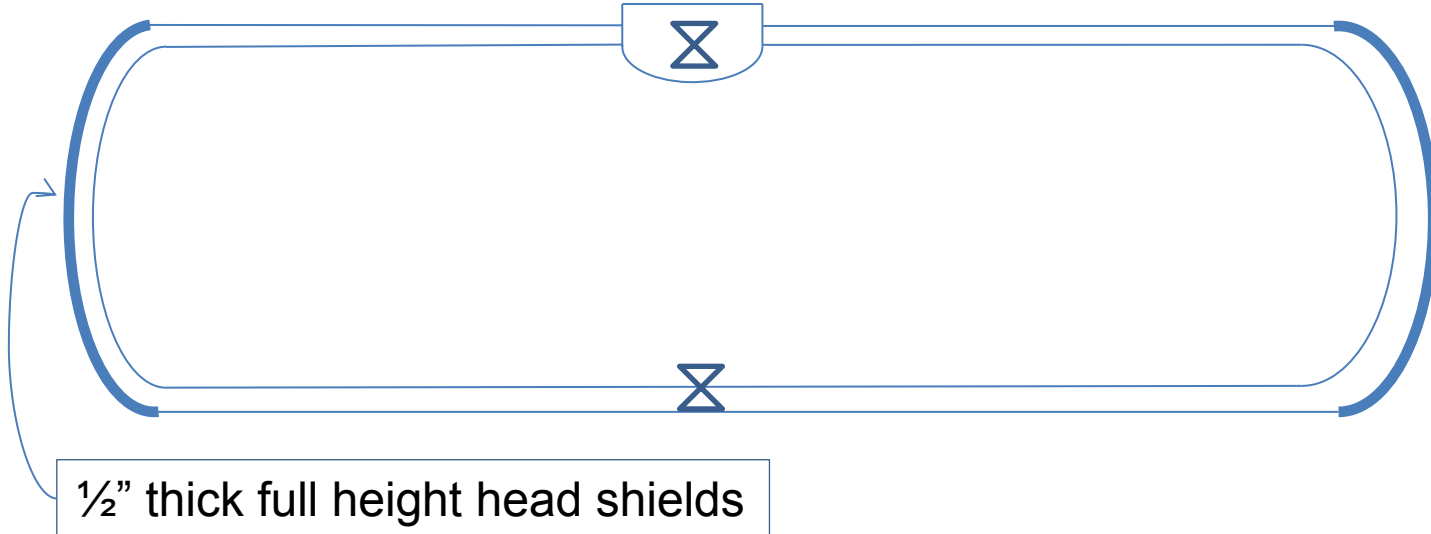
Tank Car Schematic



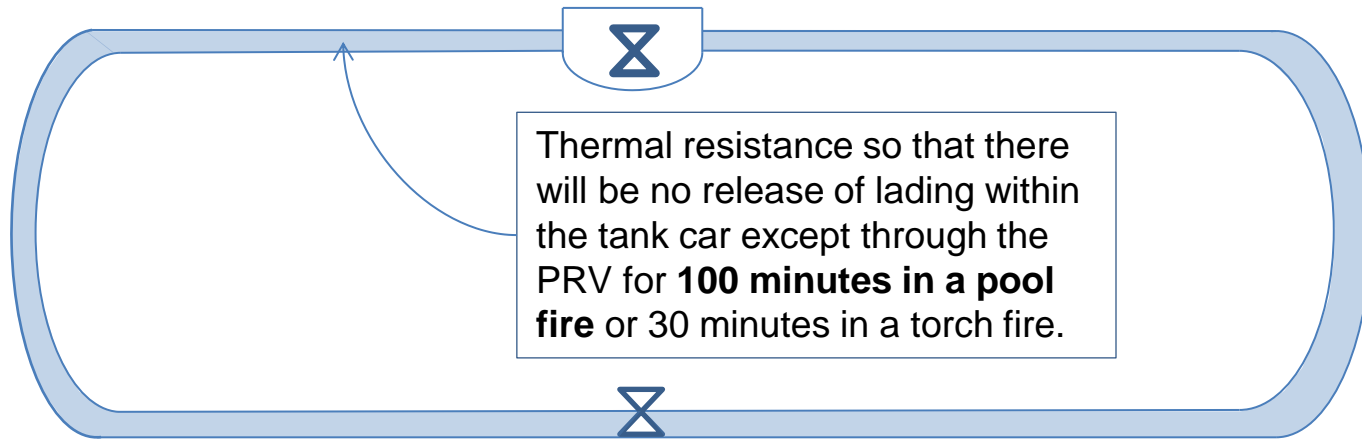
Shell and Head



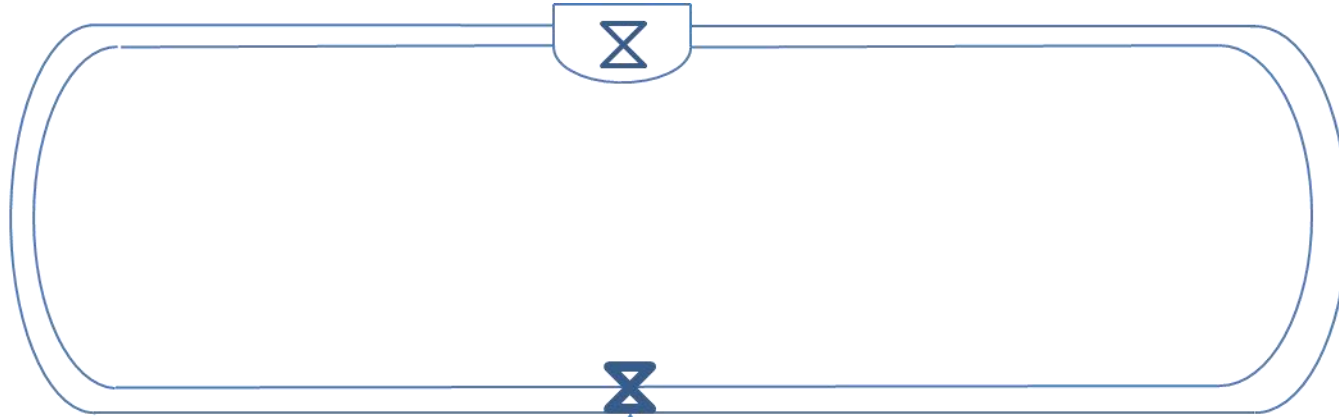
Head Shields



Thermal Protection



Bottom outlet valve



BOV handle must disengage so the valve does not open during derailment



Retrofit Tank Cars

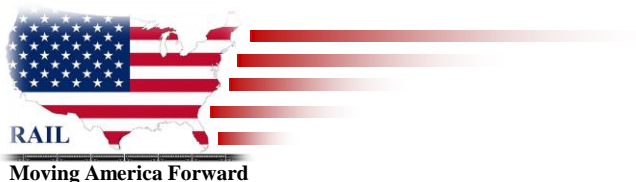
- **Specification Standard (DOT117R)**
 - Minimum shell/head thickness – 7/16”
 - Tank head puncture resistance system – § 179.16(c)
 - Thermal protection system – § 179.18
 - Jacket is required (basis of all modeling)
 - Bottom outlet valve – prevent unintended actuation during a derailment
 - § 179.202-13

Retrofit Schedule

Car specification /Service	U.S. Retrofit Timeline	Car specification /Service	Canadian Retrofit Timeline
DOT111 (NJ)/PGI	January 1, 2017 January 1, 2018	DOT111 (NJ)/Crude Oil	May 1, 2017
DOT111 (J)/PGI	March 1, 2018	DOT111 (J)/Crude Oil	March 1, 2018
CPC-1232 (NJ)/PGI	April 1, 2020	CPC-1232 (NJ)/Crude Oil	April 1, 2020
DOT111 (NJ)/PGII	May 1, 2023	DOT111 (NJ)/Ethanol	May 1, 2023
DOT111 (J)/PGII	May 1, 2023	DOT111 (J)/Ethanol	May 1, 2023
CPC-1232 (NJ)/PGII	July 1, 2023	CPC-1232 (NJ)/Ethanol	July 1, 2023
CPC-1232 (J)/PGI and II and all remaining cars in PGIII	May 1, 2025	CPC-1232 (J)/PGI and II all remaining cars in other flammable liquid service	May 1, 2025

Retrofit Reporting

- **Owners of non-jacketed DOT111 cars**
- **PGI service in HHFT**
- **Unable to meet January 2017 deadline**
- **Report by March 1, 2017**
 - DOT117R
 - DOT117P
 - DOT111 (not retrofitted)
 - DOT117
 - ECP (ready/equipped)
- **§ 174.310(5)**



Alignment with Transport Canada

- **Retrofit schedule**

- U.S. based on packing group
- TC based on commodity

- **Applicability**

- U.S.-HHFT
- TC single tank car

- **ECP**

- U.S. required for HHFT after January 1, 2021 (PGI), and May 1, 2023 (PGII/III)
- Not yet required. TC orally committed to ECP brakes.



Questions?

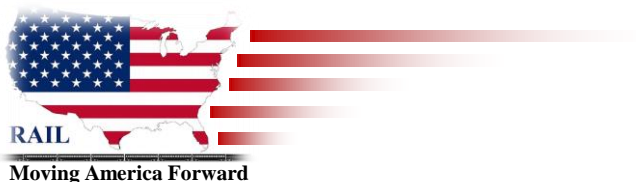
Karl Alexy

Staff Director – Hazardous Materials Division

Federal Railroad Administration

karl.alex@dot.gov

(202) 493-6245



FRA – Office of Railroad Safety

11/18/2015



U.S. Department
of Transportation
**Federal Railroad
Administration**



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TC 117 Tank Car Standard





TC 117 Tank Car Standard

Development of a new class of tank car has been a priority for Transport Canada.

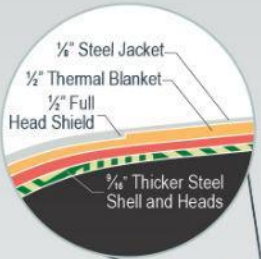
- Following the Lac-Mégantic incident, Canada's Transportation Safety Board (TSB) concluded that existing rail car standards are not sufficiently crash resistant/robust to withstand the forces in an accident.
- On April 23, 2014, the Minister of Transport announced that Canada would establish new rail car safety standards and phase-out legacy tank cars used to transport flammable liquid tank cars starting on May 1, 2017.
- Canada has worked with the U.S. to develop a new tank car standard.
- **On May 20, 2015, the new TC 117 Tank Car Standard was published as an amendment to the *Transportation of Dangerous Goods Regulations* in the *Canada Gazette, Part II* as SOR/2015-100**



A New Class of Tank Car – TC 117

The TC 117 specifications are harmonized between Canada and the U.S. and include the following safety features:

The new TC-117 tank car is required to be constructed as a thermally protected, jacketed tank car with steel that is 9/16th of an inch thick and full head shields. A jacket will be added as an outer cover on the exterior of the shell to keep insulation in place and provide additional strength and reinforcement. These features provide improved puncture resistance, structural strength and fracture resistance.



New mandatory top fitting protection will cover the valves on top of the tank car, guarding against damage in the event of an incident.

New full head shields will help protect the ends of the tank car from being punctured by equipment or collisions with adjacent rail cars in the event of excessive end impact or derailment. Previous standards of the class 111 tank cars did not require head shields in most cases.

1/2" Thick Full Height Head Shield

Thermal protection increases the survivability of tank cars in the event of a fire. The new thermal protection required for the TC-117 must be able to withstand exposure to a 100-minute pool fire and a 30-minute jet fuel fire without rupturing.

New enhanced bottom outlet valve must remain closed and not leak during an incident.





Harmonized Canada-U.S. Standards

- In addition to a new class of rail tank car (TC 117), the amendments include retrofit requirements for existing TC/DOT 111 and TP14877/CPC 1232 tank cars.
 - Coordinated Canada – U.S. requirements.
 - Includes both a performance based approach as well as a prescriptive standard for industry.
- Implementation timelines and retrofit schedules have been harmonized as closely as practicable recognizing fleet size and industry capacity.
 - Implementation between May 1, 2017, and April 2025, phased-in according to risk.
 - Only time variance is the initial May 1, 2017, deadline as the U.S. has determined that industry capacity does not permit them to meet that date; some other Canadian timeframes have changed from initial consultations to match the U.S. and industry capacity.



Tank Car Retrofit Implementation Timelines

Canadian Implementation Dates	Flammable Liquid	Tank Car Type Removed From Service
May 1, 2017	Crude Oil	Legacy DOT-111 Non-Jacketed
March 1, 2018	Crude Oil	Legacy DOT-111 Jacketed
April 1, 2020	Crude Oil	CPC-1232 Non-Jacketed
May 1, 2023	Ethanol	Legacy DOT-111 Non-Jacketed & Jacketed
July 1, 2023	Ethanol	CPC-1232 Non-Jacketed
May 1, 2025	Crude Oil & Ethanol	CPC-1232* Jacketed
May 1, 2025	Flammable Liquids Other Than Crude Oil & Ethanol	Legacy DOT-111 & CPC-1232* Non-Jacketed & Jacketed

*: most jacketed CPC-1232 tank cars will meet the requirements of the TC117R specification with very minor changes, if any.



TC117R – Retrofit Prescriptive Standard

Recognizing their already higher standard, TC proposed a prescriptive retrofit standard for CPC1232/TP14877 tank cars to provide clear direction to industry as to how to achieve an equivalent level of safety and if they wish to remain in flammable liquid service.

1. Jacket and thermal protection

- The tank car must have a 3mm (gauge 11) thick steel jacket.
- The jacket must be made of ASTM A1011 steel, or steel of an equivalent standard.
- The jacket must be weather-resistant.
- The tank must be insulated or thermally protected to meet the requirements of clause 8.2.7 of TP14877; (30 minutes jet fire, 100 minutes pool fire).

(accommodations may be required on retrofit cars because of clearance issues)

2. Tank Material and Minimal Thickness

- The minimum thickness is 11.1 mm (7/16 in.).



Retrofit Prescriptive Standard – TC117R

3. Head Shields

- Tank cars must have full head shields of 12.7 mm (½ in) thick steel (structural or pressure vessel steel).

4. Braking:

- No ECP braking requirements

5. Bottom Outlets Valves

- In the case of a tank car equipped with a bottom outlet valve, the valve handle – unless stowed separately – is designed to bend or break free on impact without the valve opening, or is designed so that all of the handle is located within the bottom discontinuity protective structure.



Performance Standard for New Car Construction and Retrofits – TC117P

TC also proposed a performance standard for new car construction and for retrofits that would provide for an equivalent level of safety for older DOT-111 tank cars to meet the new tank car standard and to continue to be used in flammable liquid service:

A) For tank car heads

➤ The end structures of tank cars must be able to withstand the frontal impact of a loaded freight car, including the coupler, at a speed of 8.05 m/s (18 mph). Transport Canada expects that, in order for a tank car to meet retrofit puncture resistance standards for tank car heads, any test performed must demonstrate that there was no leaking through the shell or head due to this impact. The test is successful if there is no visible leak from the standing tank car for at least one hour after impact.

This performance standard replaces the need for head shields and thicker steel.

B) For tank car shells

➤ The shell structure of tank cars must be able to withstand the side impact of a loaded freight car, including the coupler, at a speed of 5.36 m/s (12 mph). Transport Canada expects that, in order for tank car side puncture resistance to meet the retrofit resistance standard, any test performed must demonstrate that there was no leaking through the shell or head due to this impact. The test is successful if there is no visible leak from the standing tank car for at least one hour after impact.

This performance standard replaces the need for thicker steel.

C) Alternative methods of testing

➤ Tank car manufacturers and tank car owners could use computer modeling to validate their new designs or retrofit packages. Therefore, the testing required to validate the performance criteria may be substituted by numerical modelling and simulation if the model and simulation methods are acceptable to Transport Canada, and if the model and simulation were validated by test data.

The tests in A) and B) can be substituted by C).



Tank Car Comparison

<u>Specifications</u>	Older Legacy DOT 111 tank cars	DOT-111 (CPC1232)/TP14877 built since 2011	New TC/DOT 117 standard (published in CG II as SOR/2015-100)
1. Head Shields	No	Half	Full
2. Top Fitting Protection	Optional	Mandatory	Mandatory
3. Thermal Protection (Jacket)	Optional	Optional	Mandatory
4. Thickness of Steel	11.1 mm (7/16inch)	12.7 mm (1/2 inch) for non-jacketed cars 11.1 mm (7/16 inch) for jacketed cars	14.3 mm (9/16 inch) minimum
5. Performance Standard for Bottom Outlet Valves	No	No	Yes
6. Performance Standard for Thermal Protection, Top-Fitting Protection and Head and Shell Puncture Resistance	No	No	Yes



Tank Car Safety Forum

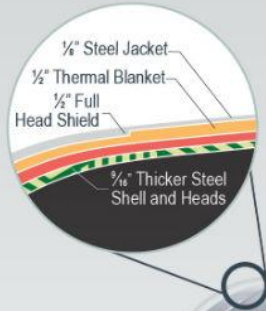
RSI / CMA 2015 – Minneapolis, MN

October 5, 2015

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ENHANCED SAFETY FEATURES

The new **TC-117 TANK CAR** standard includes several enhanced safety features to protect communities along Canada's railways



The new TC-117 tank car is required to be constructed as a thermally protected, jacketed tank car with steel that is 9/16" of an inch thick and full head shields. A jacket will be added as an outer cover on the exterior of the shell to keep insulation in place and provide additional strength and reinforcement. These features provide improved puncture resistance, structural strength and fracture resistance.

New mandatory top fitting protection will cover the valves on top of the tank car, guarding against damage in the event of an incident.

New full head shields will help protect the ends of the tank car from being punctured by equipment or collisions with adjacent rail cars in the event of excessive end impact or derailment. Previous standards of the class 111 tank cars did not require head shields in most cases.

$\frac{1}{2}$ " Thick Full Height Head Shield

Thermal protection increases the survivability of tank cars in the event of a fire. The new thermal protection required for the TC-117 must be able to withstand exposure to a 100-minute pool fire and a 30-minute jet fuel fire without rupturing.

New enhanced bottom outlet valve must remain closed and not leak during an incident.



New Tank Car Requirements DOT/TC-117

- 9/16" shell
- 11 gage (~1/8") jacket
- DOT 49 CFR§179.18 / TC 8.2.7 thermal protection
- Top fittings protection
- Full height 1/2" head shield
- Bottom outlet handle protection
- Appropriate pressure relief device
- Applicable to new cars constructed after October 1, 2015 (for DOT only applies to cars in HHFT service)



Retrofit Tank Car Requirements

DOT/TC 117-R

- 7/16" or 1/2" shell (depending upon whether retrofitting a non-jacketed DOT/TC-111 or CPC-1232)
- 11 gage (~1/8") jacket
- DOT 49 CFR§179.18 / TC 8.2.7 thermal protection
- Top fittings protection - whatever is on the car being retrofitted
- Full height 1/2" head shield
- Bottom outlet handle protection
- Appropriate pressure relief device



Retrofit Tank Car Requirements

DOT/TC 117-P

- Puncture resistance
 - Minimum side impact 12MPH when impacted at the longitudinal and vertical center by a rigid 12" x 12" indenter with a weight of 286K#
 - Minimum head impact 18MPH when impacted at the center of the head by a rigid 12" x 12" indenter with a weight of 286K#
- Thermal protection system
- Bottom outlet handle protection
- Top fittings protection



DOT Final Rule HM-251 5/8/15

US Tank Car Service ¹	Transport Canada Tank Car Service	Retrofit Deadline
NJ DOT-111 in PGI	NJ TC-111 in CO	DOT 1/1/18 ² TC 5/1/17
J DOT-111 in PGI	J TC-111 in CO	3/1/18
NJ CPC-1232 in PGI	NJ CPC-1232 in CO	4/1/20
NJ DOT-111 in PGII	NJ TC-111 ethanol	5/1/23
JK DOT-111 in PG II	JK TC-11 in ethanol	5/1/23
NJ CPC-1232 in PGII	NJ CPC-1232 ethanol	7/1/23
JK CPC-1232 in PGI & II and all remaining PGIII in HHFT PRV BH	JK CPC-1232 in CO & ET and all PGIII (PRV & BH)	5/1/25

¹ The DOT requirements are tied to high hazard flammable train service i.e. 20 or more tank cars loads in a block or 35 or more in the train

² The 1/1/17 date triggers a reporting requirement for shippers to report the # of DOT tank cars they own or lease that have and have not been retrofitted



Enhanced Braking

- Require HHFTs to have in place a functioning two-way end-of-train (EOT) device or a distributive power (DP) braking system
- Require any high-hazard flammable unit train (HHFUT) —a train comprised of 70 or more loaded tank cars containing Class 3 flammable liquids traveling at greater than 30 mph— transporting at least one packing group I flammable liquid be operated with an electronically controlled pneumatic (ECP) braking system by January 1, 2021
- Require all other HHFUTs be operated with an ECP braking **system** by May 1, 2023.
- See more at: <http://www.dot.gov/mission/safety/rail-rule-summary#sthash.TYrDYTvD.dpuf>



Reduced Operating Speeds

- Restrict all HHFTs to 50-mph in all areas
- Require HHFTs that contain any tank cars not meeting the enhanced tank car standards required by this rule operate at a 40-mph speed restriction in high-threat urban areas defined the Transportation Security Administration's regulations at 49 CFR 1580.3. - See more at: <http://www.dot.gov/mission/safety/rail-rule-summary#sthash.TYrDYTvD.dpuf>



More Accurate Classification of Unrefined Petroleum-Based Products

- Document sampling and testing program for all unrefined petroleum-based products, such as crude oil
- Certify that programs are in place, document the testing and sampling program outcomes, and make information available to DOT personnel upon request. - See more at: <http://www.dot.gov/mission/safety/rail-rule-summary#sthash.TYrDYTvD.dpuf>



Rail routing - Risk Assessment

- Railroads operating HHFTs would be required to perform a routing analysis that considers, at a minimum, 27 safety and security factors and select a route based on its findings - these planning requirements are prescribed in 49 CFR § 172.820
- - See more at:
<http://www.dot.gov/mission/safety/rail-rule-summary#sthash.TYrDYTvD.dpuf>

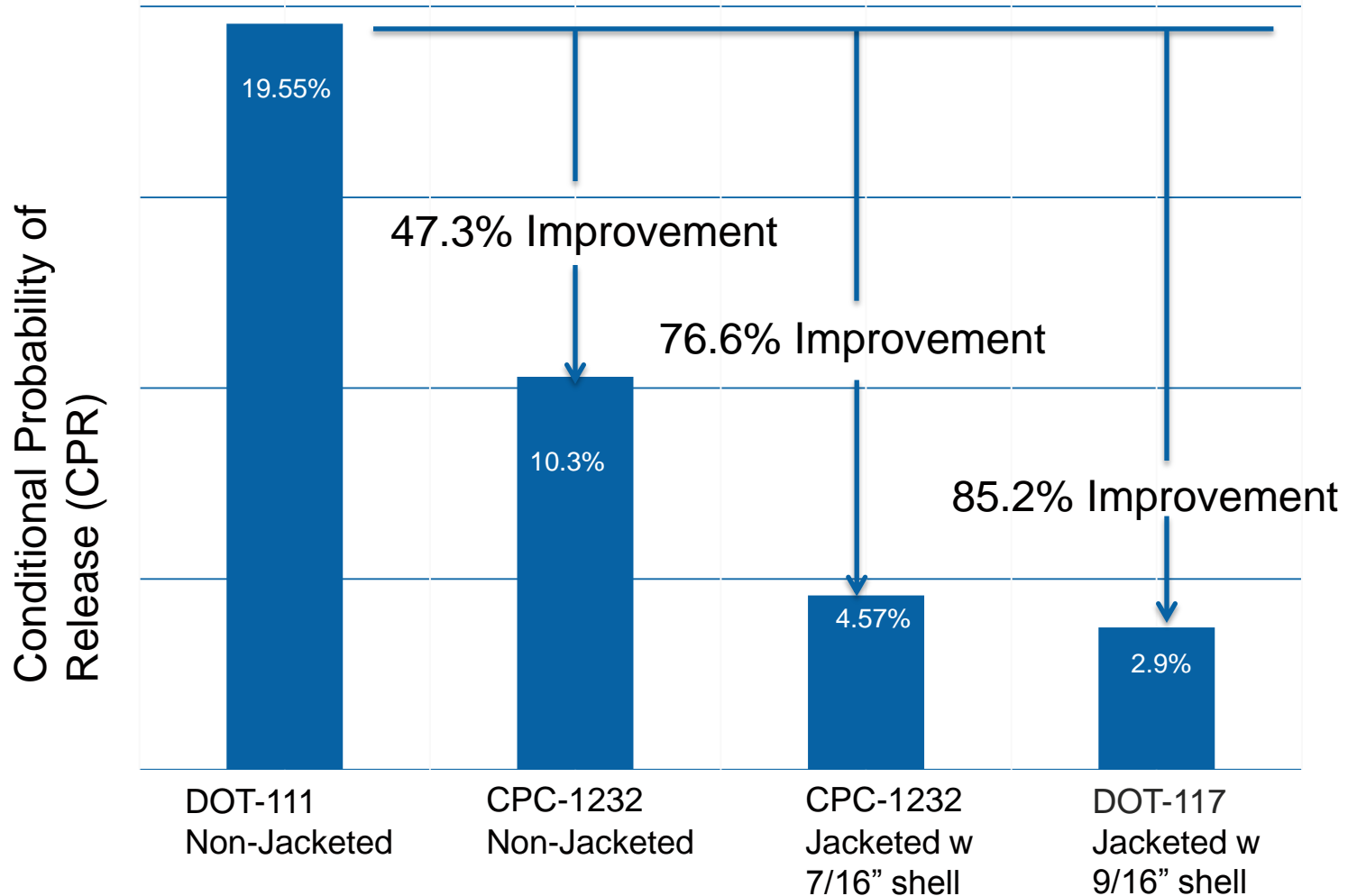


Rail routing – Information Access

- Ensures that railroads notify State and/or regional fusion centers, and that State, local and tribal officials who contact a railroad to discuss routing decisions are provided appropriate contact information for the railroad in order to request information related to the routing of hazardous materials through their jurisdictions
- - See more at:
<http://www.dot.gov/mission/safety/rail-rule-summary#sthash.TYrDYTvD.dpuf>



Improvement in Conditional Probability of Release

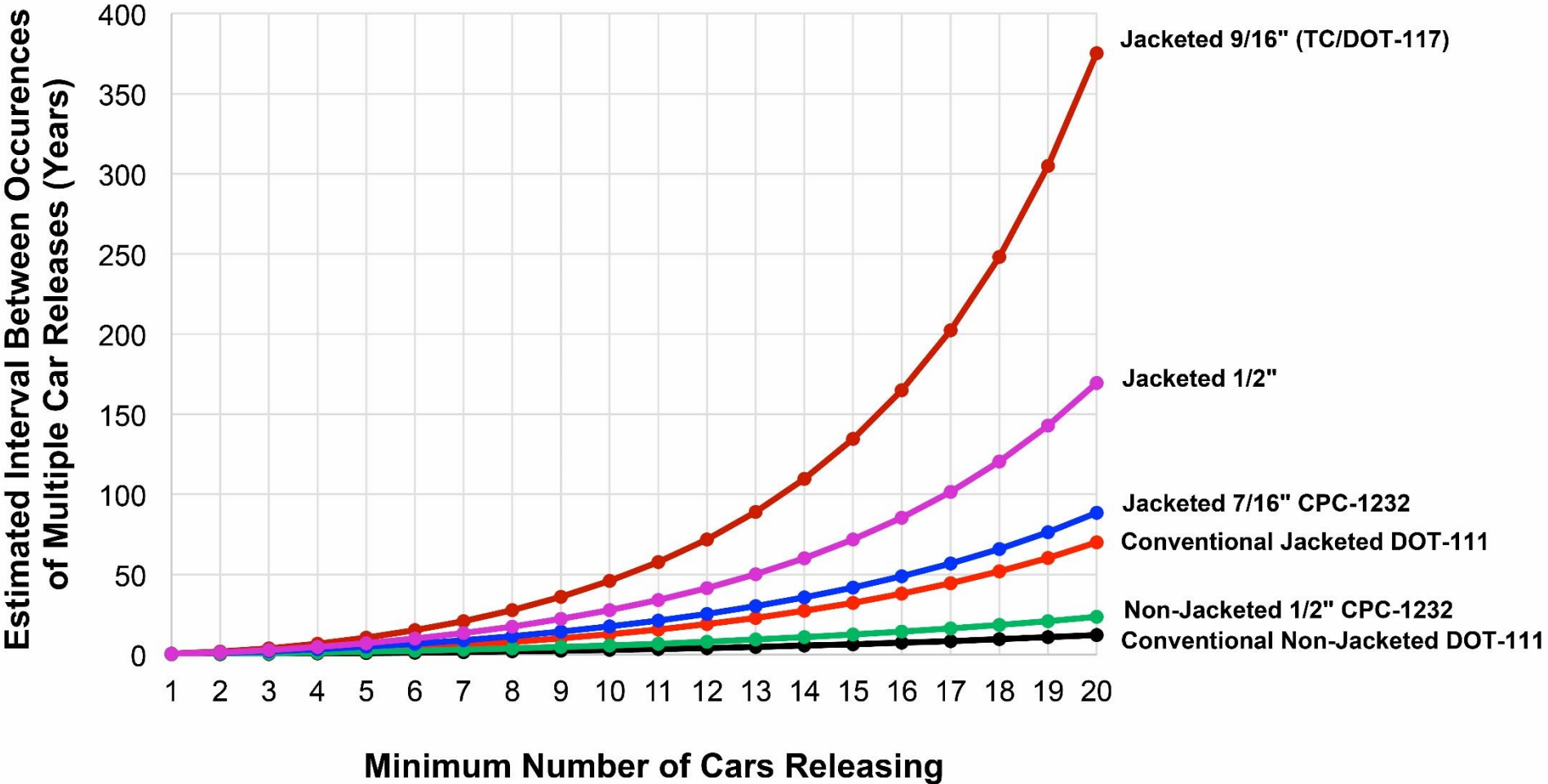


*This graph displays CPR>100 which represents the conditional probability of release (CRP) for large releases, defined as those greater than 100 gallons.

Note: The conditional probability of release for each tank car was calculated by the RSI-AAR Railroad Tank Car Safety Research and Test Project, a cooperative program by the Railway Supply Institute (RSI) and the Association of American Railroads (AAR)



Improvement in multi-car release performance is dramatic



North American Tank Car Fleet

	Crude Oil	Ethanol	FL ⁴ Total
Total number of tank cars in North America			389,969 ¹
Total number of DOT-111's			270,448 ¹
Non Jacketed DOT-111's	5,957 ²	27,098 ²	49,591 ²
Jacketed DOT-111's	1,107 ²	73 ²	5,650 ²
Non Jacketed CPC-1232's	15,640 ²	1,333 ²	18,643 ²
Jacketed CPC-1232's	12,862 ²	394 ²	14,251 ²
Total	35,584 ^{2,3}	28,898 ^{2,3}	84,135 ^{2,3}

Notes:

1. Total number of tank cars and DOT-111's are from UMLER
2. Including cars making at least one loaded shipment 1st quarter 2015
3. Some cars transported more than one type of commodity in the study period so column totals are not additive
4. FL = Flammable Liquids



Issues with HM-251

- ECP Brakes
 - No substantial evidence to support a safety justification for mandating ECP brakes, which will not prevent accidents
 - DOT report- “Given that this is based on a limited simulation set, the results could be a bit optimistic and should be taken with a grain of salt.”
 - 100 percent dependent on the actions of rail customers or tank cars owners
 - trains moving 30 mph will compromise network capacity by at least 30 percent



Issues with HM-251 (cont.)

- Applicability
 - DOT rule is applicable to cars in HHFT's / HHFUT's
 - TC rule is based on commodity
- Thermal protection requirement
 - Thermal protection system vs. thermal blanket



AAR Interchange Rule

- AAR is in the process of implementing an interchange rule to fix the issues with the rule:
 - Applicability
 - Top fittings protection
 - Thermal protection



Thank You

Questions?

Matthew Forister
Director of Tank Car/Hazmat Safety
Association of American Railroads
425 Third Street S.W.; Suite 1000
Washington, DC 20024
Phone: (202) 639-2262
Fax: (202) 639-2930
Email: mforister@aar.org

