



NATIONAL TRANSPORTATION SAFETY BOARD  
**Investigative Hearing**

Norfolk Southern Railway general merchandise freight train 32N  
derailment with subsequent hazardous material release and fires,  
in East Palestine, Ohio, on February 3, 2023

<b>GROUP</b>	<b>F</b>
<b>EXHIBIT</b>	
24	

Agency / Organization

**PHMSA**

Title

**Safety Advisory Notice for DOT-111 Tank Cars  
in Flammable Liquids Service .**



U.S. Department  
of Transportation

**Pipeline and Hazardous  
Materials Safety  
Administration**

1200 New Jersey Avenue, SE  
Washington, DC 20590

## **Safety Advisory Notice for DOT-111 Tank Cars in Flammable Liquid Service**

**U.S. Department of Transportation**

**Pipeline and Hazardous Materials Safety Administration**

**Office of Hazardous Materials Safety**

### **Why PHMSA Wrote this Safety Advisory Notice**

Due to the recent events in East Palestine, Ohio and as part of our ongoing efforts to advance the safe transportation of hazardous materials by rail, the Pipeline and Hazardous Materials Safety Administration (PHMSA)—in coordination with the Federal Railroad Administration (FRA)—is issuing this safety advisory to re-emphasize previously raised concerns about the survivability of DOT-111 tank cars and encourage tank car owners and shippers of flammable liquids to voluntarily upgrade their tank car fleets to the newest, and safest, available tank car design authorized for flammable liquid service—the DOT-117 specification tank car. PHMSA is also urging rail carriers to consider the risks inherent in the continued use of DOT-111 tank cars in flammable liquid service, and to consider applying the requirements applicable to high-hazard flammable trains (HHFT) to trains with fewer tank cars carrying flammable liquids in DOT-111 tank cars. These concrete steps would reduce the risks of hazardous material transportation by rail. It is in the interest of safety and protection of human lives and the environment to use the best available tank car, as well as to voluntarily adopt operational controls applicable to HHFT trains to trains containing fewer tank cars

carrying flammable liquids. *Disclaimer:* This safety advisory is considered guidance pursuant to DOT Order 2100.6A (June 7, 2021). Except when referencing laws, regulations, policies, or orders, the information in this safety advisory does not have the force and effect of law and is not meant to bind the public in any way. This document does not revise or replace any previously issued guidance.

PHMSA and FRA may take additional regulatory actions in the future if the National Transportation Safety Board (NTSB) investigation of the East Palestine, Ohio derailment reveals the need for more concrete advisories or requirements.

### **Background and Recent Incident**

On February 3, 2023, a mixed-consist freight train operated by Norfolk Southern Railway—comprised of two head-end locomotives, 149 railcars, and one distributed power locomotive—derailed in East Palestine, Ohio. Thirty-eight railcars derailed, including 11 tank cars carrying hazardous materials (hazmat) including Division 2.1 flammable gases, Class 3 flammable liquids, and combustible liquids. The derailment resulted in a fire impacting the derailed tank cars and damaging 12 additional railcars that were not derailed. The investigation into the cause of the incident, and the response to the resulting hazardous material release and fire, is ongoing. The NTSB is leading the investigation, with the support of PHMSA, FRA, and other parties with expertise in railroad operations, tank cars, and hazardous materials.

Preliminary Incident Data: The preliminary incident data released by the Environmental Protection Agency (EPA) highlights that the performance of the DOT-111 specification tank cars involved in the derailment continues to be a significant concern. Publicly available data showing the train consist and positioning of the rail cars involved in the derailment indicates that 16 DOT-

111 specification tank cars were involved in the East Palestine derailment and fire.<sup>1</sup> Seven of these DOT-111 tank cars experienced head and/or shell breaches—three of them contained hazmat that was released. Additionally, three DOT-111 specification tank cars containing non-hazardous material released product through other areas—two through their bottom outlet valves and one through a leak in the top fittings. Overall, of the 16 DOT-111 tank cars involved, over half of the tank cars released material as a direct result of the derailment. Anecdotally, of the three DOT-117 tank cars and six DOT-105 tank cars involved, only one of them released any product as a direct result of the derailment—a small leak in a DOT-117 tank car transporting petroleum lube oil which is a non-hazardous material. Three days after the derailment, on February 6, emergency responders conducted a controlled release of the contents of five DOT-105 tank cars containing vinyl chloride to vent pressure to prevent an explosion.

DOT-111 Tank Car Survivability: The DOT-111 tank car design has a lower ability to survive derailments and fires without releasing its contents compared to current tank car designs. The basic DOT-111 tank car design does not include tank car safety systems and design details that have become standard in the rail industry. These safety features include head protection, metal jackets, thermal protection systems, top-fitting protection, and use of normalized steel. The normalization process improves steel strength and ductility—an established method to improve crashworthiness and tank puncture resistance. Additionally, the minimum thickness of steel for a DOT-111 tank car design is 7/16<sup>th</sup> inches—thinner than other hazmat tank cars. Taken all together, thinner non-normalized steel and lack of head protection, metal jacket, thermal

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<sup>1</sup> See <https://www.epa.gov/system/files/documents/2023-02/TRAIN%2032N%20-%20EAST%20PALESTINE%20-%20derail%20list%20Norfolk%20Southern%20document.pdf>. This train consist information indicates the tank cars involved in the derailment, the contents of each tank car, car type, and the disposition (punctured, leaked, etc..) of each tank car involved.

protection system, and top-fitting protection, makes the DOT-111 tank car substantially more vulnerable to significant releases of their contents in incidents, as seen in East Palestine, Ohio.

Improvements to the DOT-111 Tank Car: The issue of DOT-111 tank car survivability is well known and has been recognized for over a decade. In 2011, the Association of American Railroads (AAR) published an update to their tank car design standards known as CPC-1232,<sup>2</sup> that required upgrades to DOT-111 tank cars built for use with certain flammable liquids—specifically “petroleum crude oil,” “alcohols,” and “ethanol and gasoline mixtures.” The “CPC-1232” tank car, which conforms to the DOT-111 tank car minimum design standard, addressed some of the shortcomings of the basic DOT-111 tank car design. The CPC-1232 tank car design added a metal jacket, head protection, thermal protection system, top-fitting protection, and required the use of bottom outlet handles that could either be removed or would not activate in derailments—a design commonly known as a “disengaging bottom outlet valve handle.” The CPC-1232 tank car design also required that the steel used to construct the tank shell and head be normalized. However, the CPC-1232 tank car design maintained the 7/16<sup>th</sup> inch steel thickness—the bare minimum required thickness to conform to the DOT-111 tank car design.

DOT Finalizes Improved Tank Car Requirements: On May 8, 2015, PHMSA, in coordination with FRA, published a final rule that created a new tank car specification to address the deficiencies in the DOT-111’s safety systems.<sup>3</sup> Commonly known as the DOT-117J, this new tank car specification features a metal jacket, thermal protection system, top-fitting protection, disengaging bottom outlet handles, normalized steel and a minimum thickness of 9/16<sup>th</sup> inches—a 12.5% improvement in thickness as compared to the DOT-111 tank car design minimum. The

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<sup>2</sup> See [http://tankcarresourcecenter.com/wp-content/uploads/2017/07/CPC-1232\\_MSRP\\_combined.pdf](http://tankcarresourcecenter.com/wp-content/uploads/2017/07/CPC-1232_MSRP_combined.pdf)

<sup>3</sup> See 80 Fed. Reg. 26643 (HM-251). <https://www.federalregister.gov/documents/2015/05/08/2015-10670/hazardous-materials-enhanced-tank-car-standards-and-operational-controls-for-high-hazard-flammable>

final rule also created a pathway to retrofit existing DOT-111 tank cars (including DOT-111 tank cars built to the CPC-1232 specifications) to the DOT-117 standard, in a tank car specification known as the DOT-117R.

The May 2015 final rule, commonly known as the HHFT rule, created a phaseout schedule for DOT-111 tank cars in flammable liquid service based on the relative hazards of the flammable liquid materials transported. These phaseout requirements were originally limited to HHFTs, mainly petroleum crude oil and ethanol, due to the increased risks presented by the transportation of large blocks of tank cars. A HHFT is a train that is transporting 20 or more loaded tank cars of a Class 3 flammable liquid in a continuous block or a single train carrying 35 or more loaded tank cars of a Class 3 flammable liquid throughout the train consist. The HHFT rule phaseout schedule would have prohibited the carriage of flammable liquids in DOT-111 tank cars in a HHFT by May 1, 2025. See Appendix B below for a complete description of the HHFT rule phaseout schedule. PHMSA denied requests from industry representatives to loosen the final rule as it related to the phaseout schedule.<sup>4</sup>

Congressional Mandates Require Revised Phaseout Schedules: In December 2015, the Fixing America's Surface Transportation (FAST) Act changed the phaseout schedule for flammable liquid tank cars,<sup>5</sup> and on August 15, 2016, PHMSA published a final rule to align the requirements of its regulations with the FAST Act.<sup>6</sup> The new phaseout applied to flammable liquids transported in all types of train arrangements—not just an HHFT. The FAST Act also set separate dates for crude oil and ethanol phaseouts, and allowed use of DOT-111 tank cars for

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<sup>4</sup> See 80 Fed. Reg. 71952 (Nov. 18, 2015). <https://www.federalregister.gov/documents/2015/11/18/2015-28774/hazardous-materials-enhanced-tank-car-standards-and-operational-controls-for-high-hazard-flammable>.

<sup>5</sup> Public Law 114-94, 129 Stat. 1312 (2015), <https://www.govinfo.gov/app/details/PLAW-114publ94>.

<sup>6</sup> See 81 Fed. Reg. 53935 (HM-251C). <https://www.federalregister.gov/documents/2016/08/15/2016-19406/hazardous-materials-fast-act-requirements-for-flammable-liquids-and-rail-tank-cars>

other flammable liquids in Packing Group (PG) II and III (i.e., materials of medium and low hazard, respectively) until May 1, 2029. See Appendix C below for a complete description of the FAST Act phaseout schedule.

The FAST Act mandates authorized DOT-111 tank cars to remain in flammable liquid service until May 1, 2029, and does not provide the Secretary of Transportation with discretion to change this date. The NTSB—which advocated for a more aggressive phaseout schedule in Safety Recommendation R-15-16—recognized that PHMSA and the DOT as a whole had no further discretion to address this issue, noting, “[b]ecause the congressional mandates and industry actions have overtaken PHMSA’s ability to implement the recommended action, Safety Recommendation R-15-16 is classified “Closed—No Longer Applicable.”<sup>7</sup>

Proactive Action Needed by Industry to Upgrade Their Flammable Liquid Tank Car Fleet Now! PHMSA believes that it is possible, and in the clear safety interest of the public, for tank car owners and shippers using DOT-111 tank cars to acquire the DOT-117J, or even DOT-117R, specification tank cars they need to continue operating well before the May 1, 2029, phaseout. There is sufficient shop capacity to retrofit existing tank cars to the DOT-117R standard and to build new DOT-117J tank cars to replace the existing DOT-111 tank car and CPC-1232 tank car fleet. AAR estimates that there is a need for approximately 27,000 DOT-117 tank cars to meet the current May 1, 2025 (PG I flammable liquids other than crude oil and ethanol) and May 1, 2029 (PG II and III flammable liquids other than crude oil and ethanol) phaseouts, compared to approximately 86,000 DOT-117 tank cars produced through new construction and retrofitting.<sup>8</sup>

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<sup>7</sup> See <https://www.nts.gov/about/employment/ layouts/nts.recsearch/recommendation.aspx?rec=r-15-016>. The Safety Recommendation R-15-016 stated, “Require an aggressive, intermediate progress milestone schedule, such as a 20 percent yearly completion metric over a 5-year implementation period, for the replacement or retrofitting of legacy DOT-111 and CPC-1232 tank cars to appropriate tank car performance standards, that includes equipping these tank cars with jackets, thermal protection, and appropriately sized pressure relief devices. (Urgent)”

<sup>8</sup> Source: AAR 3<sup>rd</sup> Quarter 2022 North American Flammable Liquid Tank Car Statistics.

Data from the AAR shows that DOT-117J production peaked at over 1,900 tank cars per month, and DOT-117R retrofit conversion peaked at approximately 750 tank cars per month. However, current production of new DOT-117J and DOT-117R retrofits has fallen precipitously from these peaks, to approximately 275 DOT-117Js produced and 90 DOT-117R retrofits per month. Based on the results highlighted in the Bureau of Transportation Statistics (BTS) and AAR reports, PHMSA is confident that with a strong commitment from the tank car industry, steel and labor are available in sufficient quantities to substantially increase the current rate of production and adopt the DOT-117 tank cars well ahead of the mandated phaseout schedules.<sup>9</sup>

With respect to tank car availability, it is notable that the three DOT-117 tank cars involved in the East Palestine, Ohio derailment were not in hazardous materials service at the time of the derailment. Two were carrying petroleum lube oil, and the third was carrying propylene glycol, none of which are not subject to regulation under the HMR as hazmat. Clearly DOT-117 tank cars are available for lease, and PHMSA applauds the shipper(s) involved for their commitment to safety in using a DOT-117 tank car in a service that did not require it. This proactive action underscores a critically important point: the requirements of the HMR, including the flammable liquid tank car phaseout discussed extensively in this safety advisory, are minimum Federal safety standards. Many entities choose to exceed these standards to meet their own company policies and responsibilities as community leaders. Tank car shippers and owners may also decide to utilize DOT-117 tank cars for combustible liquids, although the current phaseout requirements do not require it.<sup>10</sup> Tank car owners and shippers should carefully and

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<sup>9</sup> See Bureau of Transportation Statistics Fleet Composition of Rail Tank Cars Carrying Flammable Liquids: 2022 Report, p.12 & tbl 2 (Sept. 15, 2022), Fleet Composition of Rail Tank Cars Carrying Flammable Liquids: 2022 Report (bts.gov)

<sup>10</sup> Combustible liquids have a higher flash point than flammable liquids (i.e., require exposure to a higher temperature before flammable vapors are produced). Two of the DOT-111 tank cars that breached in the East Palestine, OH derailment contained combustible liquid.



closely consider whether their decisions place financial considerations ahead of safety and protection of human lives and the environment.

Rail Carrier Actions to Address DOT-111 Risks: As noted above, the HMR's requirements are minimum safety standards and rail carriers—as well as shippers—may decide to exceed the HMR's minimum requirements. As one example, until tank car owners and shippers make the shift to safer tank cars, rail carriers may decide to apply the requirements applicable to HHFTs to trains transporting fewer DOT-111 tank cars loaded with flammable liquids, potentially even a single DOT-111 containing these materials. As a second example, rail carriers may decide to include the number of loaded tank cars containing flammable liquids, combustible liquids and flammable gases—like vinyl chloride—when determining whether to apply HHFT requirements to a train. As a reminder, HHFT requirements include routing analysis, improved braking performance, speed limits, and notification of state and tribal emergency response coordinators of the estimated weekly volume of HHFTs moving through each county or tribal jurisdiction.<sup>11</sup> Proactive actions like these would mitigate risks of transporting loaded DOT-111 tank cars containing flammable liquids.

### **Safety Advisory**

PHMSA, in coordination with FRA, advises all entities who own or use DOT-111 tank cars (including DOT-111 tank cars built to the CPC-1232 specification) in flammable liquid service to consider removing these tank cars from this service, and replacing them with DOT-117 or DOT-117R specification tank cars as soon as practicable. Rail carriers should also consider the risks inherent in the continued use of DOT-111 tank cars in flammable liquid

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<sup>11</sup> 49 C.F.R. 174.310 and 49 C.F.R. 174.312.

service and determine whether applying HHFT requirements to fewer tank cars carrying flammable liquids is appropriate to ensure safe operations. The social and environmental costs of delaying a shift to the DOT-117 specification tank car—a car which has clearly demonstrated its superior performance in accident scenarios—should be paramount. Equally, there are significant potential economic repercussions to delaying safety improvements in a bid to reduce near-term costs, as demonstrated by the tragic consequences of the recent East Palestine, Ohio derailment.<sup>12</sup> Had all of the breached DOT-111 tank cars been DOT 117s, the outcome and consequences may have been different for the railroad and the East Palestine community.

### **Future Actions**

PHMSA and FRA may take additional regulatory actions in the future if the NTSB investigation of the East Palestine, Ohio derailment reveals the need for more concrete advisories or requirements.

Issued in Washington, D.C., on March 22, 2023.



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<sup>12</sup> In addition to costs to the impacted community for clean-up and response equipment exceeding hundreds of thousands of dollars, the rail carrier will be responsible for direct cleanup costs of the derailment site and larger community projected between \$40 and \$50 million. See <https://www.wkyc.com/article/news/local/financial-ramifications-east-palestine-train-derailment-felt-throughout-city/95-81543849-43f4-4967-891c-d00257be1441> and; <https://www.foxbusiness.com/markets/norfolk-southerns-ohio-train-cost-cleanup-minimal-buttiגיעg-tours-region>

**Appendix A. This table summarizes the safety features of the legacy DOT-111, jacketed CPC-1232, DOT-117R retrofit, and DOT-117J new construction tank car.**

<b>Tank Car Specification</b>	<b>Bottom Outlet Handle</b>	<b>Max Gross Weight (lbs)</b>	<b>Head Protection Type</b>	<b>Minimum Shell Thickness (inches)</b>	<b>Jacket</b>	<b>Tank Material</b>	<b>Tank Material Normalized</b>	<b>Top Fitting Protection</b>	<b>Thermal Protection System</b>
Legacy DOT-111	Outlets optional; no standard for handle.	263,000	Not required	7/16	None required	Numerous. ASTM A 516 carbon steel; TC 128B carbon steel; aluminum alloys; stainless steel alloys.	Not required.	None required.	Not required.
Upgraded DOT-111 (Jacketed CPC-1232)	Disengaging bottom outlet handle	286,000	Full height, ½ inch steel	7/16	11 gauge steel jacket	ASTM A 516 carbon steel; TC 128B carbon steel.	Yes.	Equipped per AAR Specifications for Tank Cars Appendix F 10.2.1	In accordance with 179.18.
DOT-117R Retrofit	Disengaging bottom outlet handle	286,000	Full height, ½ inch steel	7/16	11 gauge steel jacket	Numerous. Steels authorized at time of original tank construction.	Not required.	Equipped per AAR Specifications for Tank Cars Appendix F 10.2.1	In accordance with 179.18.
DOT-117J New Construction	Disengaging bottom outlet handle	286,000	Full height, ½ inch steel	9/16	11 gauge steel jacket	TC 128B carbon steel.	Yes.	Equipped per AAR Specifications for Tank Cars Appendix F 10.2.1	In accordance with 179.18.

**Appendix B. This table summarizes the 2015 HHFT final rule phaseout schedule.**

<b>Tank car type/service</b>	<b>Retrofit deadline</b>
Non Jacketed DOT-111 tank cars in PG I service	(January 1, 2017 *). January 1, 2018.
Jacketed DOT-111 tank cars in PG I service	March 1, 2018.
Non-Jacketed CPC-1232 tank cars in PG I service	April 1, 2020.
Non Jacketed DOT-111 tank cars in PG II service	May 1, 2023.
Jacketed DOT-111 tank cars in PG II service	May 1, 2023.
Non-Jacketed CPC-1232 tank cars in PG II service	July 1, 2023.
Jacketed CPC-1232 tank cars in PG I and PG II service and all remaining tank cars carrying PG III materials in an HHFT (pressure relief valve and valve handles)	May 1, 2025.

\* The January 1, 2017, date would trigger a retrofit reporting requirement, and tank car owners of affected cars would have to report to DOT the number of tank cars that they own that have been retrofitted, and the number that have not yet been retrofitted.

**Appendix C. This table summarizes the FAST Act phaseout schedule. The phaseout schedule for tank cars used in Class 3 flammable liquid service mandated in the FAST Act is as follows:**

<b>Material</b>	<b>Jacketed or non-jacketed tank car</b>	<b>DOT-111 not authorized on or after</b>	<b>CPC-1232 not authorized on or after</b>
Unrefined petroleum product	Non-jacketed	January 1, 2018	April 1, 2020.
	Jacketed	March 1, 2018	May 1, 2025.
Ethanol	Non-jacketed	May 1, 2023	July 1, 2023.
	Jacketed	May 1, 2023	May 1, 2025.
Class 3, PG I (flammable liquid) material other than unrefined petroleum products and ethanol	Non-jacketed	May 1, 2025	May 1, 2025.
	Jacketed	May 1, 2025	May 1, 2025.
Class 3, PG II or III (flammable liquid) material other than unrefined petroleum products and ethanol	Non-jacketed	May 1, 2029	May 1, 2029.
	Jacketed	May 1, 2029	May 1, 2029.