



U.S. Department of Transportation
Office of the Secretary of Transportation
Bureau of Transportation Statistics

Fleet Composition of Rail Tank Cars Carrying Flammable Liquids: 2021 Report



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U.S. Department
of Transportation

Bureau of Transportation Statistics

Patricia Hu
Director

Rolf Schmitt
Deputy Director

Cha-Chi Fan
*Director, Office of Data Development
and Standards*

Clara Reschovsky
Project Manager

Major Contributor

Joseph McGill

Editor

Spatial Front

William H. Moore

Visual Information Specialist

Alpha Wingfield

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Preface: Requirements of Section 7308 of the Fixing America’s Surface Transportation (FAST) Act

Section 7308 of the Fixing America’s Surface Transportation Act (FAST Act; P.L. 114-94; Dec. 4, 2015) requires the U.S. Department of Transportation (USDOT) to collect and report data on rail tank cars transporting Class 3¹ flammable liquids (box A). This legislation aims to track progress in upgrading the rail tank car fleet to the DOT-117 standard, which meets new safety requirements.

The new safety standards, finalized in 2015, specify the design characteristics of DOT-117 tank cars. These characteristics include a thicker, insulated/thermally protected tank; a full head shield; and top and bottom valve fitting protections.² Thick-walled head shields are on both ends of the tank car to resist puncture in a derailment. The top and bottom valves, used to fill and empty the tank car, need to be protected from shearing off in a derailment, allowing release of flammable liquids.

The FAST act mandates that USDOT provide an annual status report to Congress that presents the following information required in Section 7308(b):

- the total number of rail tank cars modified, or retrofitted, to meet the DOT-117R specification or equivalent;
- the total number of tank cars built to meet the DOT-117 specification or equivalent; and
- the total number of tank cars used or likely to be used to transport Class 3 flammable liquids that have not been modified.

Furthermore, this report includes the projected number of new builds and retrofits by tank car shops for the current year that satisfy Section 7308(c). Section 7308(c) requires the Bureau of Transportation Statistics (BTS) to “conduct a survey of tank car facilities modifying tank cars to the DOT–117R specification, or equivalent, or building new tank

¹ For the purposes of this report, flammable liquids refer to Class 3 flammable liquids.

² For more information and illustrations, see <https://tankcarresourcecenter.com/> (accessed August 24, 2021).

Box A What is a Class 3 Flammable Liquid?

A *flammable* liquid (Class 3) is a liquid with a flash point of not more than 60° C (140° F) or any material in a liquid phase with a flash point at or above 37.8° C (100° F) that is intentionally heated and offered for transportation or transported at or above its flash point in a bulk packaging. This includes liquids such as refined petroleum products, crude oil, and ethanol.

Class 3 flammable liquids are designated by four-digit United Nations (UN) numbers or North American (NA) numbers, used to identify hazardous materials worldwide and are required for the shipment of hazardous materials. In all, there are over 400 UN or NA numbers that fall within Class 3 flammable liquids.

Flash point is the minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

Packing Groups are the regulations that determine how a flammable liquid must be prepared for transport. Crude oil and ethanol are both packing group 1 and the 400 liquids in the “other” category are a mix of packing group 1, 2, or 3. Packing group 1 liquids are the most dangerous and packing group 3 liquids are less dangerous. Packing group 3 liquids have a higher flash point than packing group 2, and they are both higher than packing group 1 liquids.

SOURCE: <https://www.gpo.gov/fdsys/pkg/CFR-2011-title49-vol2/pdf/CFR-2011-title49-vol2-part173.pdf> (accessed July 26, 2021).

cars to the DOT–117 specification, or equivalent, to generate statistically valid estimates of the anticipated number of tank cars those facilities expect to modify to DOT–117R specification, or equivalent, or build to the DOT–117 specification, or equivalent.”

This annual report addresses Section 7308(b) by summarizing the progress of tank car safety upgrades, from 2013 through 2020, by tank car and flammable liquid type—as defined by the Association of American Railroads (AAR). See box B for more detail on the different types of tank cars referenced in this report.

Prior annual reports are on the BTS website: <http://www.bts.gov/tankcarreports>.

Box B Tank Car Type Definitions

DOT-111: A non-pressurized tank car with a thinner shell (7/16 in.) than is now required for the DOT-117 tank cars (9/16 in.). These tank cars can carry both hazardous and non-hazardous liquids. These cars are not required to have head shields to protect the tank car from an adjacent car in an incident. The top fittings and valves are not protected and are vulnerable to being sheared off in an incident, leading to a release of contents. These tank cars also do not have a pressure relief device sized to protect against rupture in the event of a large fire. DOT-111s do have pressure relief valves that offer some protection in some fires.

DOT-117 (TC-117 in Canada): A non-pressurized tank car with a shell thickness of 9/16 of an inch and insulating material that provides thermal protection. Additionally, DOT-117s have a skin that holds the insulation and thermal protection in place and doubles as additional protection from punctures. The tank cars have protected top fittings, a fully protected head shield, and a bottom outlet valve with an enhanced handle designed to prevent the tank car from emptying its contents in an incident. All the enhancements are designed to protect the tank from punctures and the valves from damage. DOT-117R tank cars are cars retrofitted to meet the 117 specifications.

CPC-1232: An industry-sponsored specification, intended to be safer than DOT-111 tank cars for carrying petroleum crude oil and ethanol. Cars ordered after October 2011 must meet this specification. These tank cars include a pressure relief valve, more extensive top fittings than on the DOT-111 rail tank cars, and a full height or half-height head shield. The shell of non-jacketed tank cars must be 1/2 inch thick, and for jacketed tank cars must be 7/16 inch thick.

***DOT-105:** A pressurized tank car that has more safety features than what is required on DOT-111 class non-pressurized tank cars.

***DOT-112:** A pressurized tank car that has additional safety features than what is required on DOT-111 class non-pressurized tank cars.

***DOT-114:** A pressurized tank car that has additional safety features than what is required on DOT-111 class non-pressurized tank cars. There are few of these cars actively operating in the fleet carrying Class 3 flammable liquids.

***DOT-115:** A non-pressurized tank car similar to the DOT-111 but with an inner container surrounded by

an outer shell. The inner container may house multiple compartments. There are few of these tank cars actively operating in the fleet carrying Class 3 flammable liquids.

***DOT-120:** A pressurized tank car that has additional safety features than what is required on non-pressurized tank cars. There are few of these tank cars actively operating in the fleet carrying Class 3 flammable liquids.

***DOT-211:** A non-pressurized tank car similar to the DOT-111 rail tank cars. There are few of these tank cars actively operating in the fleet carrying Class 3 flammable liquids.

* Tank car types included in the “other” category for analysis purposes in this report.

- DOT-105, DOT-112, DOT-114, and DOT-120 rail tank cars that are grouped because they are pressurized and already meet a more intense set of regulations than the DOT-117 specification. These tank cars also carry other non-class 3 hazardous materials.

- DOT-115 and DOT-211 rail tank cars that are grouped because they do not typically carry crude oil or ethanol.

Other Terms

Jacketed vs. non-jacketed tank cars: Jacketed tank cars have a layer of insulation and/or thermal protection between the tank shell and jacket that stabilizes the temperature of the liquid contained in the tank car and/or reduces the conductivity of heat from outside sources to the contents of the tank car.

Single service vs. multiple service: Rail tank cars may make one or more trips in a year. If they carry the same liquid for all their trips, then they are a single service car. If a tank car is washed between trips and carries different liquids, then they are in multiple service for that year.

Head shield: Located at the ends of the tank car, the 1/2-inch-thick steel shield provides extra protection in the event of an incident to prevent an adjacent car from puncturing the rail tank car.

Top and Bottom fittings and valves: Tank cars have valves on the top and bottom for the purposes of loading and unloading liquids. The top valve is surrounded by a steel structure to prevent damage to the top valve in a release. The bottom valve has specialized handles that prevent an unintended release.

Fleet Composition of Rail Tank Cars Carrying Class 3 Flammable Liquids

Key findings

- 111,177 rail tank cars carried flammable liquids in 2020. This is a reduction of 1.3 percent compared to 2019.
- Of those 111,177 rail tank cars, 24,703 carried petroleum crude oil—a 20.1 percent reduction from 2019 to 2020 in the number of tank cars carrying crude only, reflecting a 37.7 percent drop in the volume of crude petroleum movements by rail in the same period.
- DOT-111 rail tank cars have not carried crude oil, meeting the 2018 deadline prohibiting such use. (Sec 7304(b)(1)(A), 7304(b)(1)(B))
- Non-Jacketed CPC 1232 cars have not carried crude oil after April 1, 2020, meeting the deadline prohibiting such use. (Sec 7304(b)(1)(c))
- The share of crude carried by new or retrofitted DOT-117 cars increased from 72 to 81 percent from 2019 to 2020 with the balance primarily carried by Jacketed CPC 1232 cars, which are due to be phased out from crude oil service on May 1, 2025.
- Tank car shops certified to build or retrofit rail tank cars to the DOT-117 standards expect to build 5,139 tank cars and retrofit 2,274 tank cars in 2021.
- In the COVID-affected year of 2020, a variety of shifts have occurred, notably in the reduction of crude oil shipments.³ Regardless of the fleet size and economic fluctuations, DOT-117s have continued to become an increasingly significant proportion of the flammable liquid carrying fleet, which is expected to be in full compliance with FAST act requirements by 2029.

³ Shipment data based on data provided by the Association of American Railroads, accessed in June, 2021
This Energy Information Agency report, <https://www.eia.gov/todayinenergy/detail.php?id=46336>, accessed on July 21, 2021, shows sharp drop and gradual recovery of both crude price and demand beginning in March, 2020.

Background: Hazardous Materials Rule of 2015

Several high-profile incidents prompted the U.S. and Canadian governments to reexamine the safety standard that governs the transport of class 3 flammable liquids.⁴ USDOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) and Federal Railroad Administration (FRA) issued a final rule on May 8, 2015, intending to make transporting flammable liquids safer. This rule, Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains (HM-251), included regulations to upgrade those cars operating in high-hazard flammable trains (HHFT).⁵

The FAST Act further included provisions to make the transport of hazardous materials safer by phasing out tank cars built to lower safety standards and then finally prohibiting those cars from transporting Class 3 flammable liquids by 2029. Most notably, by 2025, petroleum crude oil must only be carried in DOT-117 or 117R rail tank cars. Cars that do not meet the new safety standards may switch to carrying non-flammable liquids or be retired. After the HM-251 rule was issued in May 2015, the FAST Act legislation revised the phase-out timeline in December 2015. In response to the FAST Act, PHMSA revised its rule so the phase-out dates in HM-251 matched the FAST Act via the HM-251C rule,⁶ eliminating any confusion as to when the phase-out must occur. The current dates are listed in table 1. The proportion of tank cars currently in compliance with the FAST Act as well as the proportions that will be phased out on a rolling basis are shown in figure 1. This figure shows the proportion of all tank cars which meet current phase-out guidelines. There were 24,703 tank cars carrying petroleum crude oil in 2020. Out of these, there were 20,844 cars (including DOT-117s, retrofit DOT-117s,

⁴ For more information on the incidents, see <https://tankcarresourcecenter.com/tankcar101/> accessed Aug. 25, 2021.

⁵ A high-hazard flammable train (HHFT) is defined as a single train 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.

⁶ For the full text of the Hazardous Materials: FAST Act Requirements for Flammable Liquids and Rail Tank Cars (HM-251C), see: <https://www.federalregister.gov/documents/2016/08/15/2016-19406/hazardous-materials-fast-act-requirements-for-flammable-liquids-and-rail-tank-cars> accessed June 17, 2021.

Table 1 FAST Act Phase Out Schedule and Status for Rail Tank Cars Carrying Class 3 Flammable Liquids

	Date for Phase-Out	Number of Cars Carrying Fluid	
		2019	2020
Crude			
Non-Jacketed DOT-111	January 1, 2018	0	0
Jacketed DOT-111	March 1, 2018	0	0
Non-Jacketed CPC-1232	April 1, 2020	208	27*
Jacketed CPC-1232	May 1, 2025	7,580	3,832
Ethanol			
Non-Jacketed DOT-111	May 1, 2023	8,480	6,541
Jacketed DOT-111	May 1, 2023	109	102
Non-Jacketed CPC-1232	July 1, 2023	986	626
Jacketed CPC-1232	May 1, 2023	142	87
Other Flammable Liquids Packing Group I			
Non-Jacketed DOT-111	May 1, 2025	65	54
Jacketed DOT-111	May 1, 2025	5	5
Non-Jacketed CPC-1232	May 1, 2025	25	50
Jacketed CPC-1232	May 1, 2025	0	1
Other Flammable Liquids Packing Group II/III			
Non-Jacketed DOT-111	May 1, 2029	13,027	12,422
Jacketed DOT-111	May 1, 2029	4,290	4,376
Non-Jacketed CPC-1232	May 1, 2029	6,529	6,509
Jacketed CPC-1232	May 1, 2029	3,128	2,995
Multiple Service Flammable Liquids			
Non-Jacketed DOT-111		4,023	3,722
Jacketed DOT-111		149	113
Non-Jacketed CPC-1232		1,719	2,280
Jacketed CPC-1232		873	566

*Trips made by the 27 Non-Jacketed CPC 1232 Cars carrying petroleum crude oil were made before April 1, 2020.

NOTE: Due to some rail tank cars carrying different fluids in a year, they are classified as Multiple Service Liquids and do not have a phase-out date because there are multiple phase-out dates. For more information on packing groups, see Box A.

SOURCE: Final Rule, <https://www.phmsa.dot.gov/news/hm-251c-final-rule-pdf>, accessed July 12, 2020 and U.S. Department of Transportation, Bureau of Transportation Statistics. Special analysis based on data provided by the Association of American Railroads: UMLER® and TRAIN II® rail tank car and annualized rail tank car movements, 2013-2020, as of June 24, 2021.

and cars classified as “Others”⁷) meeting phase-out dates outlined in the FAST act. The remaining 3,832 Jacketed CPC-1232 cars in use in 2020 are expected to be retrofit or repurposed before the May 1, 2025 phase-out deadline.

Current Fleet Composition (Section 7308(b))

Data Sources

To provide a complete picture of the tank cars carrying Class 3 flammable liquids that meet the safety requirements, BTS uses data from the Association

⁷ Other tank cars include DOT-105, DOT-112, DOT-114, and DOT-120 rail tank cars, which are pressurized and already exceed the DOT-117 specification, and DOT-115 and DOT-211 rail tank cars, which do not typically carry crude oil or ethanol, but may carry other flammable liquids.

of American Railroads (AAR), which maintains two databases:

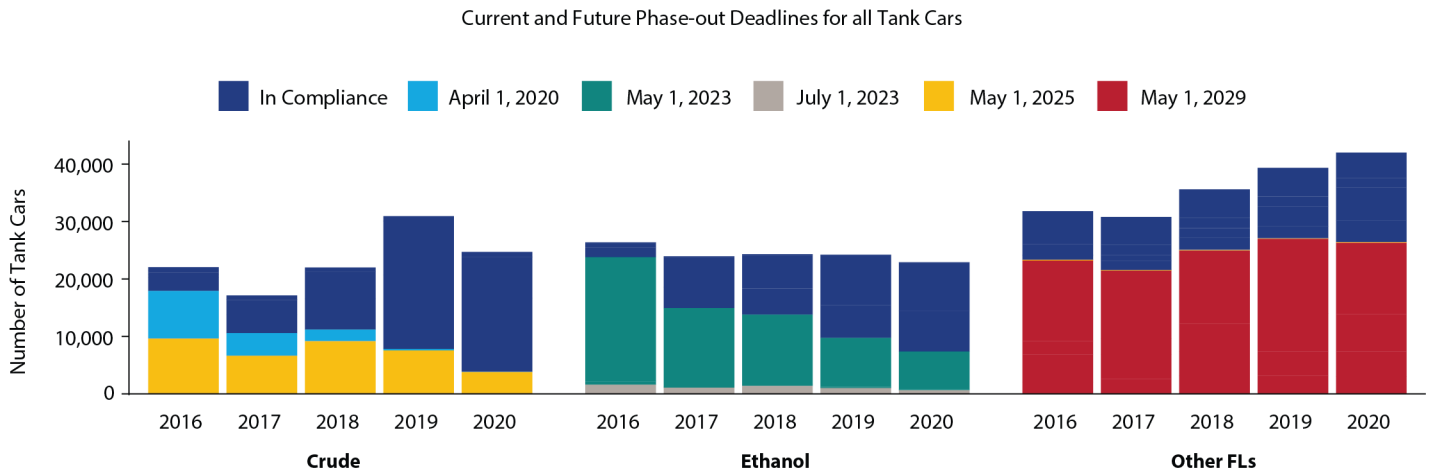
- UMLER®⁸: an inventory of individual tank cars (active or scheduled to be built) and their specifications, such as tank wall thickness, types of valves, etc.; and
- TRAIN II®⁹: a comprehensive listing of railcar movements.

These AAR databases consist of information on all rail tank cars in North America. Each car has a unique identification number to identify its specifications as well as track commodities transported over the North

⁸ UMLER®: Universal Machine Language Equipment Register

⁹ TRAIN II®: TeleRail Automated Information Network

Figure 1 A Breakdown of Tank Cars by Compliance with the FAST Act as well as Phase-Out Deadlines for Non-Compliant Tank Cars



NOTE: Cars listed in this report as Others are considered to be in compliance with the FAST Act as they meet a stricter set of regulations. See Box B.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. Special analysis based on data provided by the Association of American Railroads: UMLER® and TRAIN II® rail tank car and annualized rail tank car movements, 2016–2020, accessed June, 2021.

American rail network. For the purposes of this report, only rail tank cars with shipments carried entirely within the United States or that start or end in the United States are included in this report.

The UMLER® file is a database, managed by Railinc Corp. (a subsidiary corporation of the Association of American Railroads), that includes freight railcars in use in North America as well as locomotives and end of train devices, each identified by a unique number. UMLER® includes railcars in operation or soon to be in operation. It also includes the designated tank car specification with all the features of each tank car, such as the thickness of the tank wall, the types of valves on the top and bottom of the car, etc. UMLER® also designates cars retrofitted to meet the DOT-117R specification.

The TRAIN II® database, also maintained by AAR, tracks the movements of railcars on the North American rail network. A movement is a trip made by any rail car, loaded or empty, from one location to another. TRAIN II® also provides information on each commodity a rail car carries for any movement. For tank cars that carry Class 3 flammable liquids (box A), the specific type of flammable liquid (UN/ NA¹⁰) carried is tracked for each movement. Thus, any

¹⁰ UN/NA codes are United Nations (UN) or North American (NA) codes identifying all hazardous materials. The UN and NA codes are the same but there are more NA codes than UN codes.

rail tank car that switches from carrying one type of flammable liquid to another is counted twice within the database. For the purposes of this report, the counts are uniquely presented as single and multiple flammable liquid services.

Specifically, these databases were used to count the tank cars used in each year from 2013 to 2020 by tank car type as well as type of flammable liquid carried. These data allowed for analysis of the changes in the composition of the fleet along with the overall fleet size and what is carried by each car type. This analysis satisfies Section 7308(b) of the FAST Act.

In 2020 the flammable liquid tank car fleet accounted for about 25 percent of all tank cars and included tank cars built to the following specifications (See box B for detailed descriptions):

- DOT-117
- DOT-117R
- Jacketed CPC-1232
- Non-jacketed CPC-1232
- Jacketed DOT-111
- Non-jacketed DOT-111

- Other tank cars¹¹ including DOT-105, DOT-112, DOT-114, DOT-115, DOT-120, and DOT-211

For the purposes of this analysis, tank cars are placed in one of four categories based on the flammable liquids they carry:

- Petroleum crude oil
- Ethanol
- Other flammable liquids, such as refined petroleum products and chemicals
- Multiple service tank cars that carry various fluids in a year

The “multiple service” category was added to include those tank cars that carried different types of flammable liquids each year.

If an individual tank car made at least one trip carrying a specific Class 3 flammable liquid, then it is counted as a single tank car in this report, whereas if a tank car carried at least two different flammable liquids during one year, then it is counted under multiple service. This unit of analysis allows us to look at the changes in the composition of the fleet of rail tank cars that carry Class 3 flammable liquids from year to year. This report contains those unique combinations of individual rail tank car by the four flammable liquid categories and seven tank car types. Because these counts could comprise one or many movements during a single year, the data in this report cannot be compared to the reports of tank car loadings and movements produced by AAR or other analyses.

Analysis Results

Between 2013 and 2020, the number of rail tank cars carrying Class 3 flammable liquids has varied. There are numerous factors that determine whether a tank car will be used to transport Class 3 flammable liquids, such as:

- demand for each Class 3 flammable liquid, and

¹¹ Other tank cars include DOT-105, DOT-112, DOT-114, and DOT-120 rail tank cars, which are pressurized and already exceed the DOT-117 specification, and DOT-115 and DOT-211 rail tank cars, which do not typically carry crude oil or ethanol, but may carry other flammable liquids.

- North American pipeline capacity for transporting crude oil as an alternative to rail tank cars.

The size of the fleet is also affected by the number of tank cars that carry multiple flammable liquid types over the course of a year, which reduces the need for additional tank cars.

It is expected that by the end of the transition period in 2029, all Class 3 flammable liquids will be carried in rail tank cars that meet or exceed the DOT-117 or DOT-117R specification. One new phase out deadline occurred in 2020: Non-Jacketed CPC-1232s were required to stop carrying crude oil on April 1, 2020. According to data provided by AAR, the 27 Non-Jacketed CPC-1232 tank cars carrying crude oil in 2020 all completed their trips before the phase out deadline. Previous deadlines from 2018 regarding DOT-111s carrying crude oil continue to be adhered to.

As shown in figure 2, the total fleet of rail tank cars that actively carry Class 3 flammable liquids has fluctuated over the 2016 to 2020 period and findings include:

- 111,177 tank cars carried flammable liquids in 2020. This decrease of 1.3 percent is the first decrease in the population of tank cars carrying flammable liquid since 2017.
- The percentages of tank cars carrying multiple fluids remains in the 10–20 percent range.
- The number of tank cars carrying multiple fluids in a year increased to 21,526 in 2020, continuing a general upwards trend since 2016.

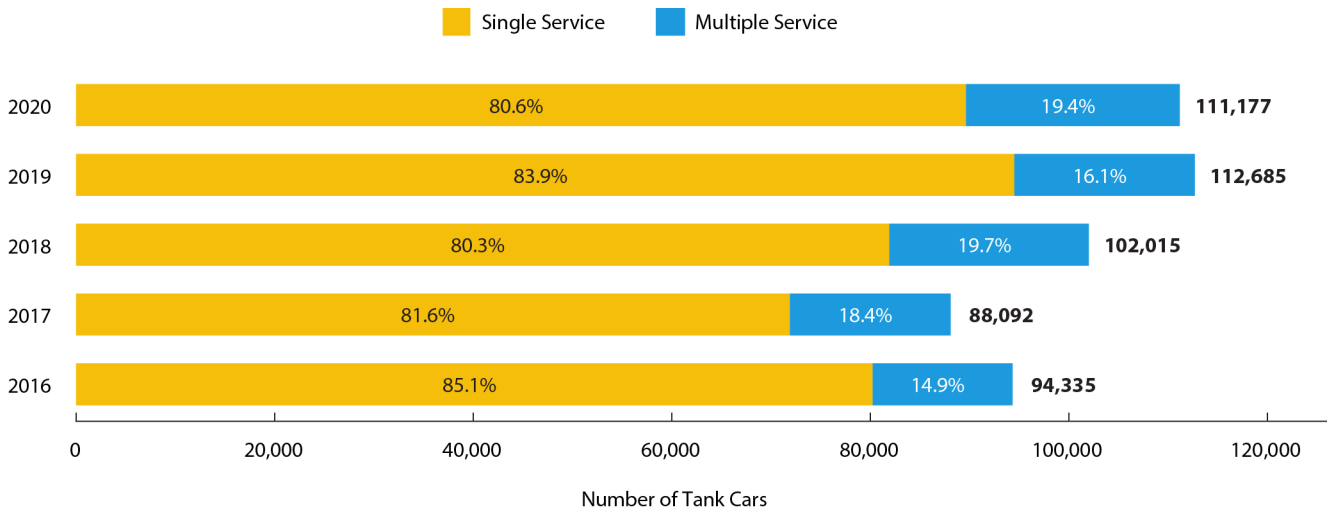
Over period from 2016 to 2020, the mix of fluids carried by train also changed. This was in part due to increased pipeline capacity for petroleum products, as well as decreased demand for crude oil following the start of the COVID-19 pandemic.¹² As seen in figure 3:

- While there has been a steady increase in tank

¹² This Energy Information Agency report, <https://www.eia.gov/todayinenergy/detail.php?id=46657>, accessed on July 21, 2021, shows the variation in pipeline capacity by flammable liquid type between 2010 and 2020. It does not show any changes in the amount of crude oil carried by rail.

This Energy Information Agency report, <https://www.eia.gov/todayinenergy/detail.php?id=46336>, accessed on July 21, 2021, shows sharp drop and gradual recovery of both crude price and demand beginning in March, 2020.

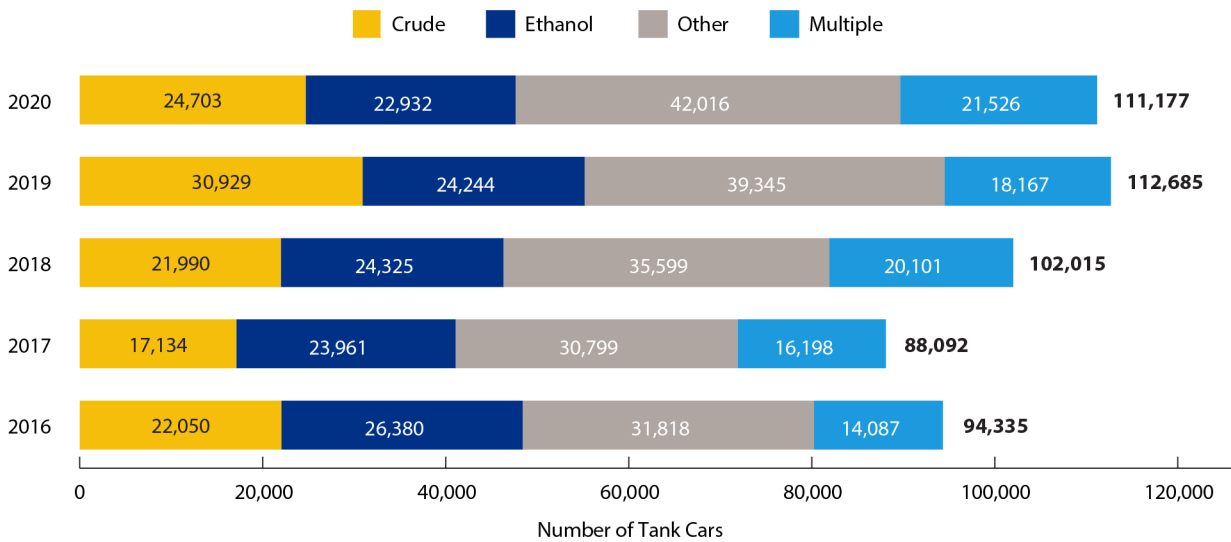
Figure 2 Rail Tank Cars by Percentage of Single and Multiple Flammable Liquid Service: 2016–2020



NOTE: A change was made in how the single service and multiple service rail tank cars are counted between the 2018 and 2019 reports causing the numbers to vary slightly, however, they are not substantially different.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. Special analysis based on data provided by the Association of American Railroads: UMLER® and TRAIN II® rail tank car and annualized rail tank car movements, 2016–2020, accessed June, 2021.

Figure 3 Rail Tank Cars by Type of Flammable Liquid Carried: 2016–2020



SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. Special analysis based on data provided by the Association of American Railroads: UMLER® and TRAIN II® rail tank car and annualized rail tank car movements, 2016–2020, accessed June, 2021.

cars carrying crude between 2017 and 2019, 2020 saw a drop of 20 percent from 2019 levels.

From 2016 to 2020, the composition of the fleet also changed. Figures 4a and 4b show that:

- There was a reduction in the numbers of tank cars carrying ethanol in 2020. This reduction was minor and remained within one standard deviation of the mean compared to 2013-2019 data.
- The number of cars in the fleet of Class 3 flammable liquids tank cars carrying other fluids continued the general upwards trend seen since 2013.
- 2020 is the first year when DOT-117 tank cars, both new and retrofitted, comprised more than 50 percent of the total number of cars carrying flammable liquids.
- The number of DOT-117s, both new and retrofitted, increased from 7,582 in 2016 to 59,686 tank cars in 2020 (figure 4a)—54 percent of the fleet carrying Class 3 flammable liquids (figure 4b).

Figure 4A Fleet Composition of Rail Tank Cars Carrying Class 3 Flammable Liquids: 2016–2020

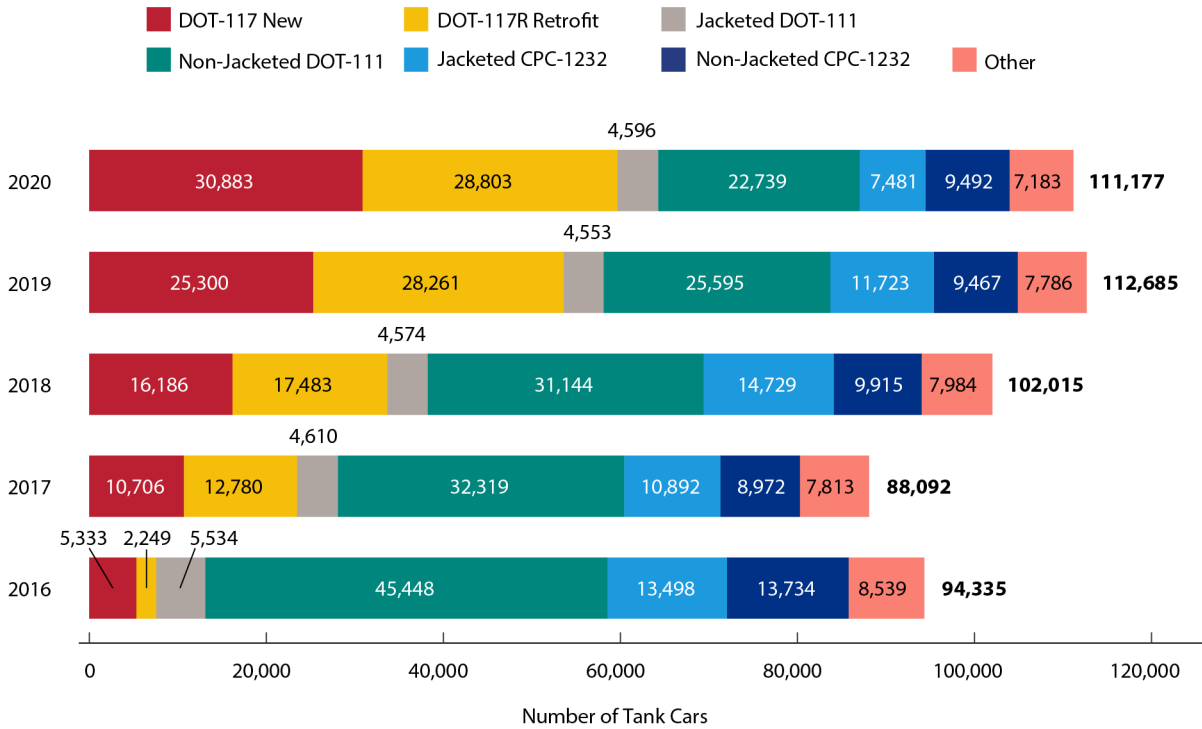
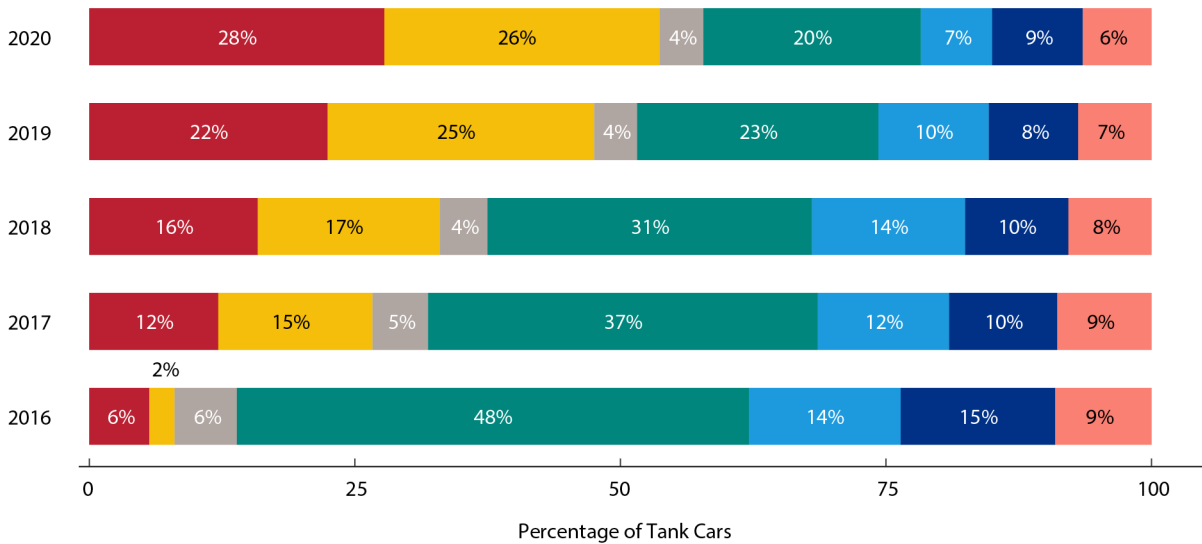


Figure 4B Percent Fleet Composition of Rail Tank Cars Carrying Class 3 Flammable Liquids: 2016–2020



SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. Special analysis based on data provided by the Association of American Railroads: UMLER® and TRAIN II® rail tank car and annualized rail tank car movements, 2016–2020, accessed June, 2021.

- Jacketed and non-jacketed DOT-111, Jacketed and non-jacketed CPC-1232, and all other rail tank cars¹³ have been declining between 2016 and 2020, going from 86 percent of the fleet in 2015 to 46 percent of the fleet in 2020.

The fleet of rail tank cars carries many shipments throughout the year. A shipment is defined as a carload movement which generates a waybill received from a rail customer, made by a single tank car from origin to destination. Any single tank car may carry one or many carloads in any given year. The total number of shipments, along with the mix of liquids needing transport, drives the active fleet size for the year. Demand is based on the needs of the industries for Class 3 flammable liquid movements, primarily the crude oil and ethanol used for transportation, heating, and other essentials. Rail tank cars capable of carrying Class 3 flammable liquids are also capable of carrying other liquids. Figure 5 shows the number of shipments in each year, 2016 to 2020, by flammable liquid type.

- Shipments in 2020 were down 15 percent from 2019.

¹³ The grouping of Other Rail Tank Cars includes specifications of DOT-105, DOT-112, DOT-114, DOT-115, DOT-120, and DOT-211. Most of the tank cars (88 percent in 2020) in the Other Rail Tank Car category carrying any flammable liquids meet DOT-105, DOT-112, or DOT-120 specifications, which exceed the DOT-117 specification. See Box A

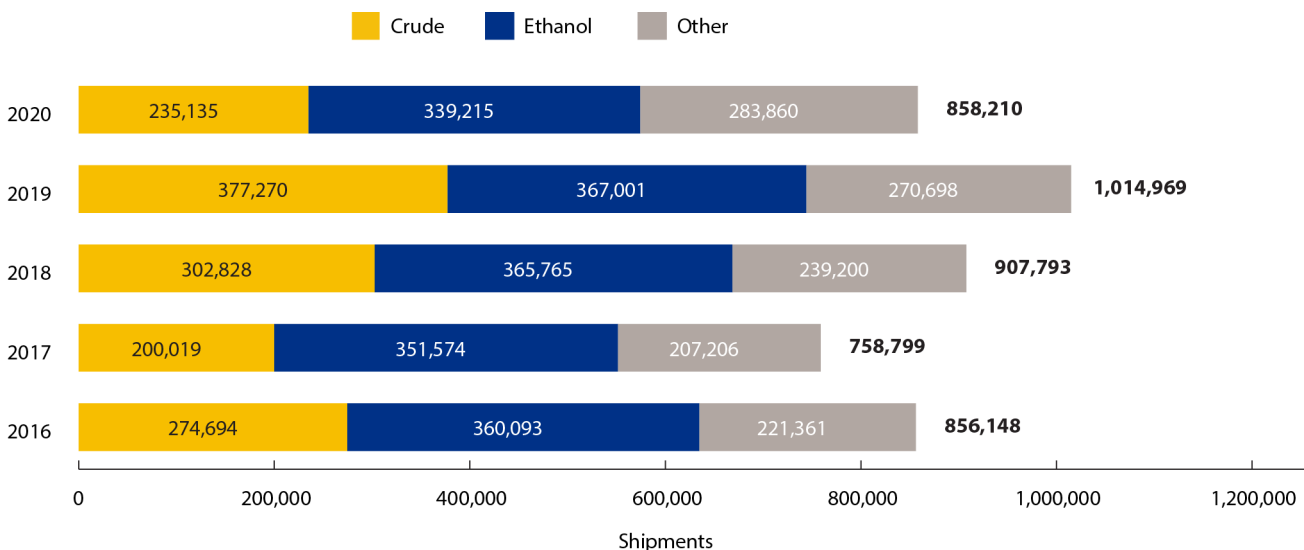
- From 2016 to 2020, fluctuations in the volume of shipments are attributable to fluctuations in crude oil demand. The volume of shipments for ethanol and other flammable liquids were stable between 2016 and 2020. The volume of shipments for crude oil varied from a high of 377,270 in 2019 to a low of 200,019 in 2017.

Because it will take time to fully upgrade the fleet of rail tank cars that carry flammable liquids, it is useful to look at the types of flammable liquids carried by the various rail car types. The remainder of the report summarizes the specific types of rail tank cars carrying Class 3 flammable liquids between 2016 and 2020. Figure 6 shows a broader historical view of all the data from 2013 to the present report.

DOT-117 Rail Tank Cars

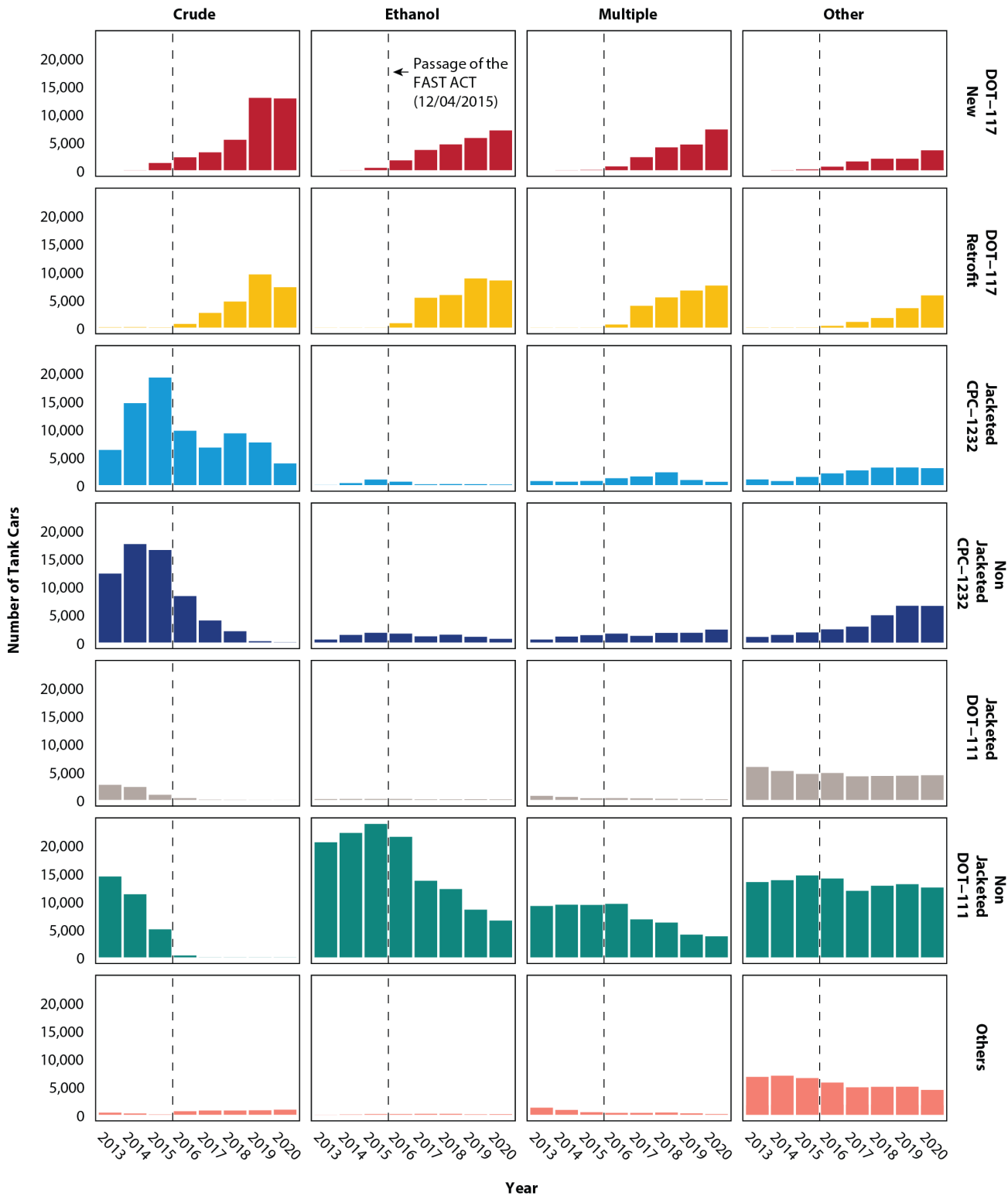
DOT-117 rail tank cars, both new and retrofitted, are tank cars built to the technical and safety specifications finalized in 2015 Federal regulations. All tank cars carrying Class 3 flammable liquids are required to meet or exceed the DOT-117 specification at the end of the transition period in 2029. In 2015, there were fewer than 2,000 of these new tank cars, and by 2020 59,686 were in use carrying Class 3 flammable liquids, as shown in figure 7. Key findings include:

Figure 5 U.S. Shipments of Class 3 Flammable Liquids by Year and Fuel Type: 2016–2020



SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. Special analysis based on data provided by the Association of American Railroads: UMLER® and TRAIN II® rail tank car and annualized rail tank car movements, 2016–2020, accessed June, 2021.

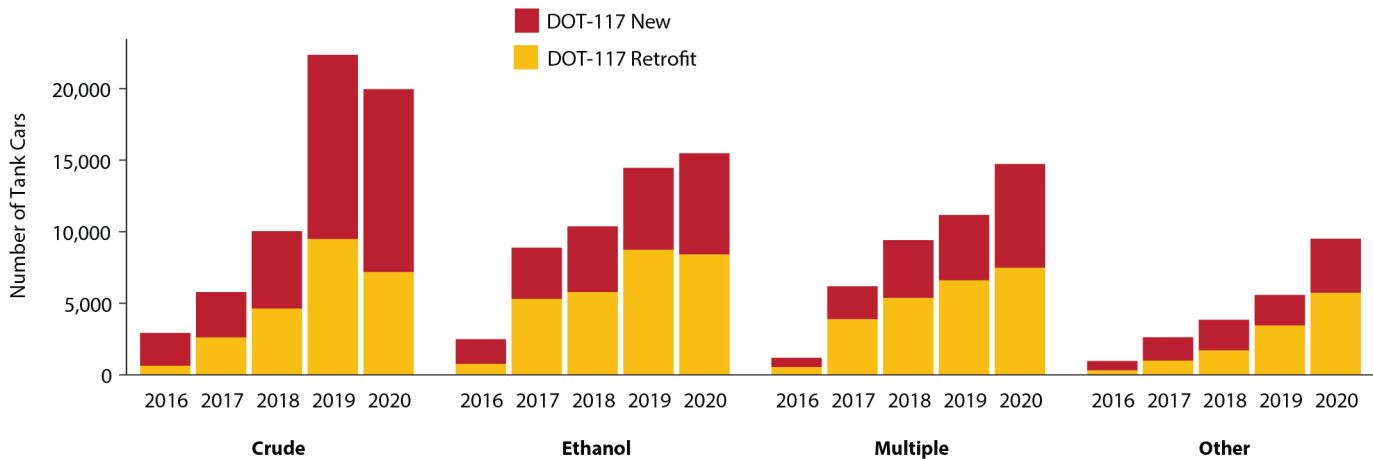
Figure 6 Trends in the Count of Rail Cars by Fuel Type and Type of Car: 2013–2020



NOTE: The dashed line indicates the passage of the FAST Act on Dec. 4, 2015.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. Special analysis based on data provided by the Association of American Railroads: UMLER® and TRAIN II® rail tank car and annualized rail tank car movements, 2013–2020, accessed June, 2021.

Figure 7 DOT-117 Rail Tank Cars by Liquid Type: 2016–2020 (new and retrofit)



SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. Special analysis based on data provided by the Association of American Railroads: UMLER® and TRAIN II® rail tank car and annualized rail tank car movements, 2016–2020, accessed June, 2021.

- DOT-117s, both new and retrofitted, that carry other flammable liquids besides crude oil increased 20 percent from 2019 to 2020, from 31,212 to 39,727.
- In 2020, there was a 37.7 percent reduction in the volume of crude oil shipments from 2019 as well as a 10.7 percent reduction in the number of DOT-117 tank cars (both new and retrofitted) carrying crude oil.
- The percentage of new or retrofitted DOT-117 tank cars carrying crude rose from 72 percent in 2019 to 81 percent in 2020.

CPC-1232 Rail Tank Cars (Jacketed and Non-Jacketed)

The number of CPC-1232 tank cars decreased from 2015 to 2019. Figure 6 details how many jacketed and non-jacketed CPC-1232 rail tank cars were used to transport Class 3 flammable liquids. Key findings include:

- The phase out date for non-jacketed CPC-1232 cars carrying crude oil was April 1, 2020.
- All 27 non-jacketed CPC-1232 cars carrying crude made those trip before April 2020.
- There was a 49 percent reduction in jacketed CPC-1232 cars carrying crude oil.

- There was a 37 percent decrease in jacketed and non-jacketed CPC-1232 cars carrying ethanol.
- The number of CPC-1232 cars carrying other flammable liquids remained relatively stable between 2019 and 2020.

DOT-111 Rail Tank Cars (Jacketed and Non-Jacketed)

Mandated in HM-251 (table 1), Non-Jacketed DOT-111 rail tank cars are prohibited from carrying crude oil as of January 1, 2018. Jacketed DOT-111 rail tank cars are also prohibited from carrying crude oil as of March 1, 2018. Both deadlines were met. Prior to 2018, non-jacketed DOT-111 rail tank cars carrying crude oil had a significant presence in the fleet of rail tank cars that carry Class 3 flammable liquids as seen in figure 6. Figures 4 and 6 show more detail for the jacketed DOT-111 rail tank cars. Key findings include:

- The phase out dates for DOT-111 tank cars carrying crude oil were in 2018. All 27,335 DOT-111 tank cars carried flammable liquids other than crude oil in 2020.
- There were 9 percent fewer DOT-111 tank cars, both jacketed and non-jacketed, in use in 2020 compared to 2019.
- The number of non-jacketed DOT-111s carrying other flammable liquids held relatively steady between 2013 and 2020 (figure 6).

Other Rail Tank Car Types

Several other tank car types can carry Class 3 flammable liquids. However, their numbers are notably lower, representing just 6 percent of the flammable liquid carrying fleet in 2019. Therefore, for analysis purposes, they are grouped together and include DOT-105, DOT-112, DOT-114, DOT-115, DOT-120, and DOT-211 rail tank cars. In 2019, 88 percent of the other rail tank cars were DOT-105, DOT-112, or DOT-120 cars which exceed the DOT-117 standard for carrying Class 3 flammable liquids. In 2020 the “Other” category comprised 7,183 rail tank cars. The ones used for transporting crude oil and ethanol numbered just 978, or 14 percent, in 2020. As seen in figure 6, there have been small increases in the number of “other” tank cars carrying crude oil, 885 in 2020 versus 611 in 2016. Most “other” tank cars transport other flammable liquids.

Anticipated Number of Rail Tank Cars Meeting New Safety Standard (Section 7308(c))

Data Sources

Section 7308(c) requires USDOT to estimate the anticipated number of DOT-117 and DOT-117R tank cars for each year through 2029 by collecting data from tank car shops that build or retrofit tank cars. This data collection program collects information from tank car retrofitting and manufacturing facilities on planned and projected numbers of tank cars to be retrofitted or manufactured in 2021. Any facility identified with the capacity to build new DOT-117 tank cars or modify tank cars to the DOT-117R specification, as described in Section 7308(c) of the FAST Act, is included in the voluntary data collection plan. Because not all tank car shops or facilities are capable or certified to build or retrofit tank cars to the DOT-117 or DOT-117R specifications, the Association of American Railroads and the Railway Supply Institute¹⁴ assisted BTS in identifying facilities with the capabilities and certifications to build or retrofit tank cars to the DOT-117 specification. In 2021, 145 tank car shops or facilities were identified for this data collection. The data collected from this annual program is summarized in the next sections.

¹⁴ The Railway Supply Institute is a trade association representing rail tank car manufacturers and facilities performing repairs and maintenance.

Responses from Facilities:

Of the 145 shops identified to have the ability to build or retrofit tank cars to the DOT-117 specification, 123, or 85 percent, responded. Based on these responses from U.S. owned and operated tank car shops, it is expected that 5,139 new rail tank cars will be built in 2021 to meet the DOT-117 specification. Additionally, these shops plan to retrofit 2,274 existing rail tank cars to meet the more rigorous DOT-117 safety standards as seen in table 2.

Table 2 Rail Tank Car Projections, 2021

	Projected to be built in 2021
DOT-117	5,139
	Projected to be retrofit in 2021
Former DOT-111 or CPC-1232	2,274

NOTE: Based on the 2021 Annual Tank Car Facility Survey results from 123 facilities.

This data was collected in the summer of 2021, a period of economic recovery following the COVID-19 pandemic, and many businesses are facing uncertainty in the near future. Due to fluctuations in the business environment and market conditions, it is challenging for the facilities to predict the exact numbers of new tank cars that will be built or retrofitted to meet the DOT-117 specification in 2021.

Also note, that the data collected from this data collection program will not match future counts of rail tank car movements in the AAR data for the following reasons:

- Tank car movements account for all tank cars that carried a shipment, regardless of when they were built or retrofitted to meet a different specification.
- Newly built or retrofitted cars may enter service at any point in the year and may not be used until the following year.
- Facilities that build or retrofit tank cars for the North American market outside the United States and not owned by an American company are not included in the data collection.
- We did not receive responses from 22 tank car shops which have the ability to build new DOT-117 tank cars or retrofit or retrofit existing cars to the DOT-117 standard. The projections listed

here do not include tank cars that may be built or retrofit by these 22 tank car shops resulting in an underestimation of new and retrofit DOT-117 tank cars for 2021.

Summary

In 2020, 111,177 tank cars transported Class 3 flammable liquids— a 1.3 percent reduction from 2019. The 2020 data covers a highly volatile economic period that included the COVID-19 pandemic. For example, a sharp decrease in crude oil production¹⁵ and crude oil prices going negative¹⁶ for the first time in history. Shipments of flammable liquids were down 15 percent overall, and crude

¹⁵ [EIA forecasts U.S. crude oil production to fall in 2020 and 2021 - Today in Energy - U.S. Energy Information Administration \(EIA\)](#)

¹⁶ A press release from the Commodities Futures Trading Commission, <https://www.cftc.gov/PressRoom/PressReleases/8315-20>, provides additional context on the negative price of crude oil in April 2020.

shipments alone were down 38 percent compared to 2019. For the first time, in 2020, DOT-117s comprised over half of the fleet at 54 percent. Among the fleet of rail tank cars that meet the DOT-117 specification in 2020, 52 percent (30,883 tank cars) are new, and 48 percent (28,803 tank cars) are retrofitted. In 2020, 65 percent of DOT-117 rail tank cars carried crude or ethanol, and 55 percent of retrofitted DOT-117 tank cars carried either crude oil or ethanol. Based on the responses to the data collection, the 123 respondents plan to build or modify 7,413 tank cars during 2021 to meet the new safety requirements.

In 2020, a variety of economic challenges and shifts have occurred, notably in the reduction of shipments of crude oil. Regardless of the fleet size and economic fluctuations, DOT-117s have continued to become an increasingly significant proportion of the fleet transporting Class 3 flammable liquids, allowing for the expected compliance to all parts of the FAST act by 2029.

Appendix A Rail Tank Car Movement Data Supporting this Report

DOT-117 New	2013	2014	2015	2016	2017	2018	2019	2020
Crude	0	11	1,279	2,287	3,176	5,408	12,872	12,773
Ethanol	0	0	408	1,728	3,583	4,590	5,715	7,083
Other Flammable Liquids	0	0	133	671	1,635	2,143	2,142	3,786
Multiple Service of Flammable Liquids	0	0	34	647	2,312	4,045	4,571	7,241
Totals	0	11	1,854	5,333	10,706	16,186	25,300	30,883
DOT-117 Retrofit	2013	2014	2015	2016	2017	2018	2019	2020
Crude	60	73	24	638	2,612	4,632	9,477	7,186
Ethanol	3	3	3	765	5,301	5,785	8,744	8,400
Other Flammable Liquids	12	14	6	303	992	1,702	3,440	5,730
Multiple Service of Flammable Liquids	2	2	0	543	3,875	5,364	6,600	7,487
Totals	77	92	33	2,249	12,780	17,483	28,261	28,803
Jacketed DOT-111	2013	2014	2015	2016	2017	2018	2019	2020
Crude	2,667	2,286	898	295	51	29	0	0
Ethanol	143	147	152	149	103	102	109	102
Other Flammable Liquids	5,870	5,151	4,627	4,785	4,202	4,269	4,295	4,381
Multiple Service of Flammable Liquids	700	518	280	305	254	174	149	113
Totals	9,380	8,102	5,957	5,534	4,610	4,574	4,553	4,596
Non-Jacketed DOT-111	2013	2014	2015	2016	2017	2018	2019	2020
Crude	14,388	11,230	4,980	302	5	0	0	0
Ethanol	20,494	22,163	23,762	21,477	13,643	12,146	8,480	6,541
Other Flammable Liquids	13,575	13,864	14,697	14,153	11,914	12,813	13,092	12,476
Multiple Service of Flammable Liquids	9,141	9,360	9,321	9,516	6,757	6,185	4,023	3,722
Totals	57,598	56,617	52,760	45,448	32,319	31,144	25,595	22,739
Jacketed CPC-1232	2013	2014	2015	2016	2017	2018	2019	2020
Crude	6,252	14,589	19,150	9,659	6,658	9,208	7,580	3,832
Ethanol	0	336	957	586	123	164	142	87
Other Flammable Liquids	988	701	1,436	2,063	2,596	3,100	3,128	2,996
Multiple Service of Flammable Liquids	689	591	716	1,190	1,515	2,257	873	566
Totals	7,929	16,217	22,259	13,498	10,892	14,729	11,723	7,481
Non-Jacketed CPC-1232	2013	2014	2015	2016	2017	2018	2019	2020
Crude	12,266	17,534	16,470	8,258	3,899	1,979	208	27
Ethanol	507	1,334	1,709	1,570	1,069	1,378	986	626
Other Flammable Liquids	963	1,361	1,806	2,344	2,834	4,862	6,554	6,559
Multiple Service of Flammable Liquids	509	1,044	1,299	1,562	1,170	1,696	1,719	2,280
Totals	14,245	21,273	21,284	13,734	8,972	9,915	9,467	9,492
All Other Tank Cars	2013	2014	2015	2016	2017	2018	2019	2020
Crude	362	205	46	611	733	734	792	885
Ethanol	4	34	112	105	139	160	68	93
Other Flammable Liquids	8,383	8,653	8,287	7,499	6,626	6,710	6,694	6,088
Multiple Service of Flammable Liquids	1,249	855	453	324	315	380	232	117
Totals	9,998	9,747	8,898	8,539	7,813	7,984	7,786	7,183
Total Cars	99,227	112,059	113,045	94,335	88,092	102,015	112,685	111,177

*Trips made by the 27 Non-Jacketed CPC 1232 Cars carrying petroleum crude oil were made before April 1, 2020.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics. Special analysis based on data provided by the Association of American Railroads: UMLER® and TRAIN II® rail tank car and annualized rail tank car movements, 2013-2020, as of June, 2021.

Appendix B: Annual Tank Car Facility Data Collection Methodology

Data Sources

Section 7308(c) requires USDOT to estimate the anticipated number of DOT-117 and DOT-117R tank cars for each year through 2029 by collecting data from tank car shops that build or retrofit tank cars. This data collection program collects information from tank car retrofitting and manufacturing facilities on planned and projected numbers of tank cars retrofitted or manufactured in 2021. Any facility identified with the capacity to build new DOT-117 tank cars or modify tank cars to the DOT-117R specification, as described in Section 7308(c) of the FAST Act, was included in the voluntary data collection. Because not all tank car shops or facilities are capable or certified to build or retrofit tank cars to the DOT-117 or DOT-117R specifications, Association of American Railroads and the Railway Supply Institute¹⁷ assisted BTS in identifying facilities with the capabilities and certifications to build or retrofit tank cars to the DOT-117 specification. The AAR certifies the tank car shops to build and/or retrofit tank cars to the DOT-117 specification. The data collected from this effort is summarized in this report.

Methodology

The 2020 Annual Tank Car Facility Data Collection, conducted from May to August 2021, included U.S. owned or operated facilities, known as tank car shops, with the capability of retrofitting and/or manufacturing rail tank cars to the new safer standards. In total, 145 tank car shops were identified and asked to respond to this voluntary questionnaire.

Tank car shops were contacted by phone. Follow up calls and emails were made to non-respondents. Respondents were asked to provide the number of tank cars they expect to build (DOT-117) in 2021 as well as the number of cars to be retrofitted (DOT-117R) from a previous rail tank car specification

type (e.g., DOT-111).¹⁸ For more information on the specifications, see box B. As in the past, all information is collected with the assurance of confidentiality of the reported information. The information collected from this program is protected by the Confidential Information Protection and Statistical Efficiency Act of 2002 (CIPSEA); therefore, only aggregate statistics are provided in this report to ensure the confidentiality of individual participants and responses.

The data collected from this program will not match future counts of rail tank car movements in the AAR data. Tank car movements account for all tank cars that carried a shipment, regardless of when they were built or retrofitted to meet a different specification. Newly built or retrofitted cars may enter service at any point and may or may not be counted for that year. Furthermore, facilities outside the United States but in North America and not owned by an American company are not included in the data collection.

Responses to this voluntary data collection were obtained from 123 out of 145, or 85 percent. Due to non-response from 22 tank car shops, these projections of newly built DOT-117 rail tank cars and retrofits to the DOT-117R specifications underestimate the total projected numbers. It is difficult to discern the effects of nonresponses in this data collection given the variation in business operations of tank car shops and the lack of auxiliary information to gauge that extent. The tank car shops included in this data collection are varied in their capabilities as well as their industry reach geographically, across different modes of transport, and through supply chain control. Some shops are part of larger corporations and others are standalone entities. Of the 123 respondents, 92 percent of the respondents are part of corporations with more than three railcar shops. Of the 113 shops that are part of corporations with three or more locations, 93 percent reported. Of the 32 shops that are part of corporations with no more than three railcar shop locations, 56 percent reported. Some tank car shops focus solely on repairs and retrofits with certifications from AAR to do that work, while others

¹⁷ The Railway Supply Institute is a trade association representing rail tank car manufacturers and facilities performing repairs and maintenance.

¹⁸ Per the FAST Act, Section 7308(c): The Secretary shall conduct a survey of tank car facilities modifying tank cars to the DOT-117R specification, or equivalent, or building new tank cars to the DOT-117 specification, or equivalent, to generate statistically- valid estimates of the anticipated number of tank cars those facilities expect to modify to DOT-117R specification, or equivalent, or build to the DOT-117 specification, or equivalent.

have the AAR certified capability to build brand new cars.

It is of note that these numbers reported in our data collection program are not equivalent to the actual numbers of new and retrofit tank cars entering service. In the three years of data available, 2018-

2020, the numbers of DOT-117 tank cars being built exceeded projections by 43, 36, and 55 percent. A comparison of actual retrofit DOT-117 cars and projections from this program shows both under and over performing projections with no discernable pattern.