



U.S. Department of Transportation
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Fleet Composition of Rail Tank Cars Carrying Flammable Liquids: 2022 Report



Bureau of Transportation Statistics

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Executive Summary

In accordance with the 2015 Fixing America's Surface Transportation (FAST) Act, the Bureau of Transportation Statistics (BTS) released its *Fleet Composition of Rail Tank Cars Carrying Class 3 Flammable Liquids: 2022 Report*. The report discusses the progress in upgrading the rail tank car fleet to the DOT-117 standard, which meets new safety requirements, and summarizes the types of rail tank cars carrying Class 3 flammable liquids. There is a rolling phase out schedule of tank cars based on both tank car type and flammable liquids carried. All tank cars on the rails are currently in compliance with scheduled deadlines. There were no phase out deadlines in 2021. The next deadline is for all tank cars carrying ethanol to meet the DOT-117 specifications by July 2023. In 2021, 57 percent of all rail tank cars carrying Class 3 flammable liquids were built to the new DOT-117 or DOT-117R specification.

BTS is also required to provide statistically sound estimates of tank car production in the coming year which meet the DOT-117 specification. A census of rail tank car shops with the ability to produce or retrofit DOT-117 cars was conducted. It is expected that 5,642 new DOT-117 cars will be produced in 2022 and 2,680 existing tank cars will be retrofitted to the DOT-117R specifications, introducing 8,322 new DOT-117 or DOT-117R tank cars in 2022. There are 7,473 tank cars carrying ethanol in 2021, which need to meet the safety specifications by July 2023. The addition of these 8,322 new tank cars in 2022, will make the 2023 deadline for tank cars carrying ethanol an achievable milestone.

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, the FAST Act mandates that USDOT provide projected numbers of new builds and retrofits by tank car shops for the current year that satisfy Section 7308(c). Section 7308(c) requires the BTS to “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,

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 16, 2022).

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 Aug 16, 2022).

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 2021, 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

- 103,312 rail tank cars carried flammable liquids in 2021. This is a reduction of 7.1 percent compared to 2020.
- Of those 103,312 rail tank cars, 13,585 carried petroleum crude oil—a 45.0 percent reduction from 2020 to 2021 in the number of tank cars carrying crude only, reflecting a 32.1 percent drop in the volume of crude petroleum movements by rail in the same period.
- The share of crude carried by new or retrofitted DOT-117 cars increased from 80.8 to 85.6 percent from 2020 to 2021 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 5,642 tank cars and retrofit 2,680 tank cars in 2022.
- An increase in pipeline capacity in 2021 resulted in the reduction of crude oil shipments by rail.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.

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

³ Shipment data based on data provided by the Association of American Railroads, accessed in June 2022. This Energy Information Agency report, <https://www.eia.gov/todayinenergy/detail.php?id=51398>, accessed on August 16, 2022, shows an increase of 7.44 billion cubic feet per day (Bcf/d) in interstate pipeline capacity in the U.S. in 2021.

⁴ For more information on the incidents, see <https://tankcarresourcecenter.com/tankcar101/> accessed Aug. 16, 2022.

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 13,585 tank cars carrying petroleum crude oil in 2021. Out of these, there were 12,431 cars (including DOT-117s, retrofit DOT-117s, and cars classified as "Others"⁷) meeting phase-out dates outlined in the FAST act. The remaining 1,154 Jacketed CPC-1232 cars in use in 2021 are expected to be retrofit or repurposed before the May 1, 2025 phase-out deadline.

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 Aug. 16, 2022.

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.

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

Fuel and Car Type	Date for Phase-Out	Number of Cars Carrying Flammable Liquids	
		2020	2021
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	27*	0
Jacketed CPC-1232	May 1, 2025	3,832	1,154
Ethanol			
Non-Jacketed DOT-111	May 1, 2023	6,541	6,531
Jacketed DOT-111	May 1, 2023	102	94
Non-Jacketed CPC-1232	July 1, 2023	626	776
Jacketed CPC-1232	May 1, 2023	87	72
Other Flammable Liquids Packing Group I			
Non-Jacketed DOT-111	May 1, 2025	54	34
Jacketed DOT-111	May 1, 2025	5	8
Non-Jacketed CPC-1232	May 1, 2025	50	51
Jacketed CPC-1232	May 1, 2025	1	3
Other Flammable Liquids Packing Group II/III			
Non-Jacketed DOT-111	May 1, 2029	12,422	11,444
Jacketed DOT-111	May 1, 2029	4,376	4,148
Non-Jacketed CPC-1232	May 1, 2029	6,509	6,290
Jacketed CPC-1232	May 1, 2029	2,995	3,143
Multiple Service Flammable Liquids			
Non-Jacketed DOT-111	-	3,722	1,407
Jacketed DOT-111	-	113	150
Non-Jacketed CPC-1232	-	2,280	2,259
Jacketed CPC-1232	-	566	503

*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 August 15, 2022 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, 2013-2021, as of June 24, 2022.

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

- UMLER® : 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® : a comprehensive listing of railcar movements.

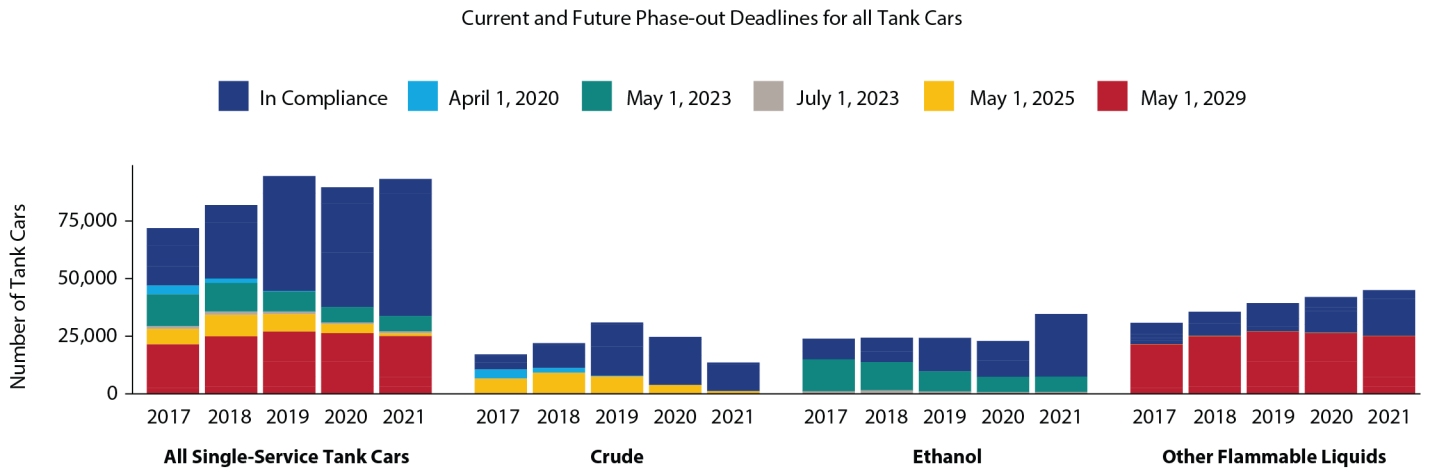
These AAR databases consist of information on all rail tank cars in North America. Each car has a unique identification number to identify its specifications as well as track commodities transported over the North American rail network. For the purposes of this report, only rail tank cars with shipments 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

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, 2013–2021, accessed June, 2022.

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 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 2021 by tank

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.

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 2021 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

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.

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 cars by the four flammable liquid categories and seven tank car types. Because these counts could comprise of 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 2021, 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
- 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. No new phase out deadlines occurred in 2021 and all previous deadlines since the passage of the FAST Act 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 2017 to 2021 period and findings include:

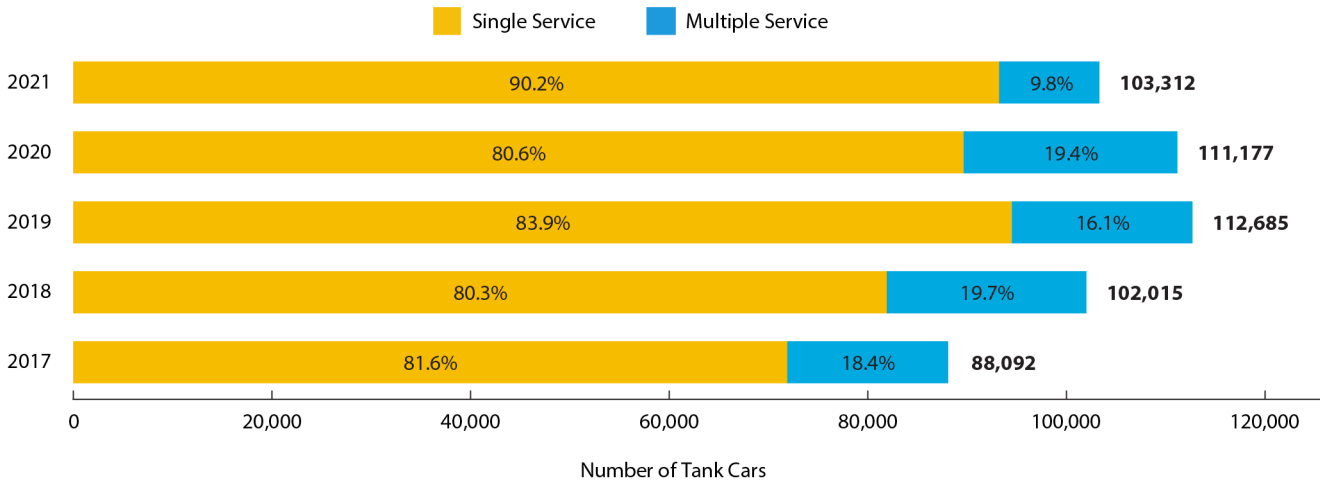
- 103,312 tank cars carried flammable liquids in 2021. This decrease of 7.1 percent since 2020 is the second consecutive decrease in the population of tank cars carrying flammable liquid since 2017.
- The percentages of tank cars carrying multiple fluids was down to 9.8 percent in 2021 compared to 19.4 percent in 2020.
- The number of tank cars carrying multiple fluids in a year decreased to 10,094 in 2021 (figure 3), the lowest number of tank cars carrying multiple fluids in both number of cars and as a percentage of all tank cars carrying hazardous materials since data collection began in 2013.

Over the period from 2017 to 2021, the mix of fluids carried by train also changed. This was in part due to increased pipeline capacity for petroleum products.¹² As seen in figure 3:

- The number of tank cars carrying crude oil decreased from 24,703 in 2020 to 13,585 in 2021, a 45 percent drop. This is a 56 percent decline from the high of 30,929 in 2019.
- There was a sharp increase in the numbers of tank cars carrying ethanol in 2021. The number of tank cars carrying ethanol has been relatively steady from 2013-2020, with an average of 24,264. In 2021, 34,618 tank cars carried ethanol, an increase of 51 percent over the number in 2020

¹² This Energy Information Agency report, <https://www.eia.gov/todayinenergy/detail.php?id=50236>, accessed on July 11, 2022, shows the shows an increase in pipeline capacity coming from Canada, which supplies 60 percent of US crude oil imports.

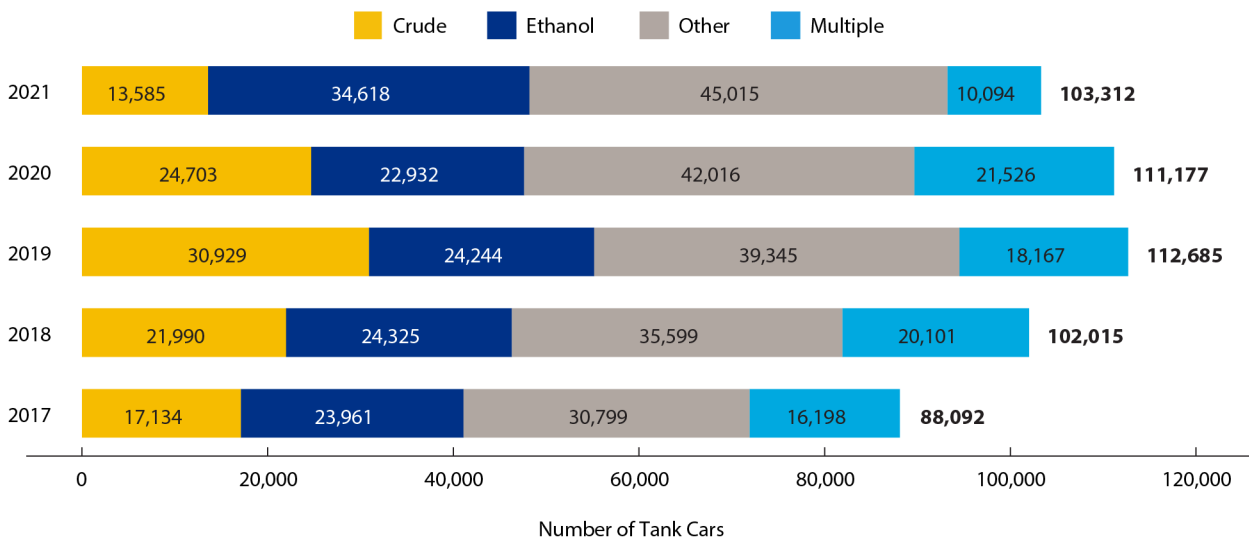
Figure 2 Rail Tank Cars by Percentage of Single and Multiple Flammable Liquid Service: 2017–2021



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, 2013–2021, accessed June, 2022

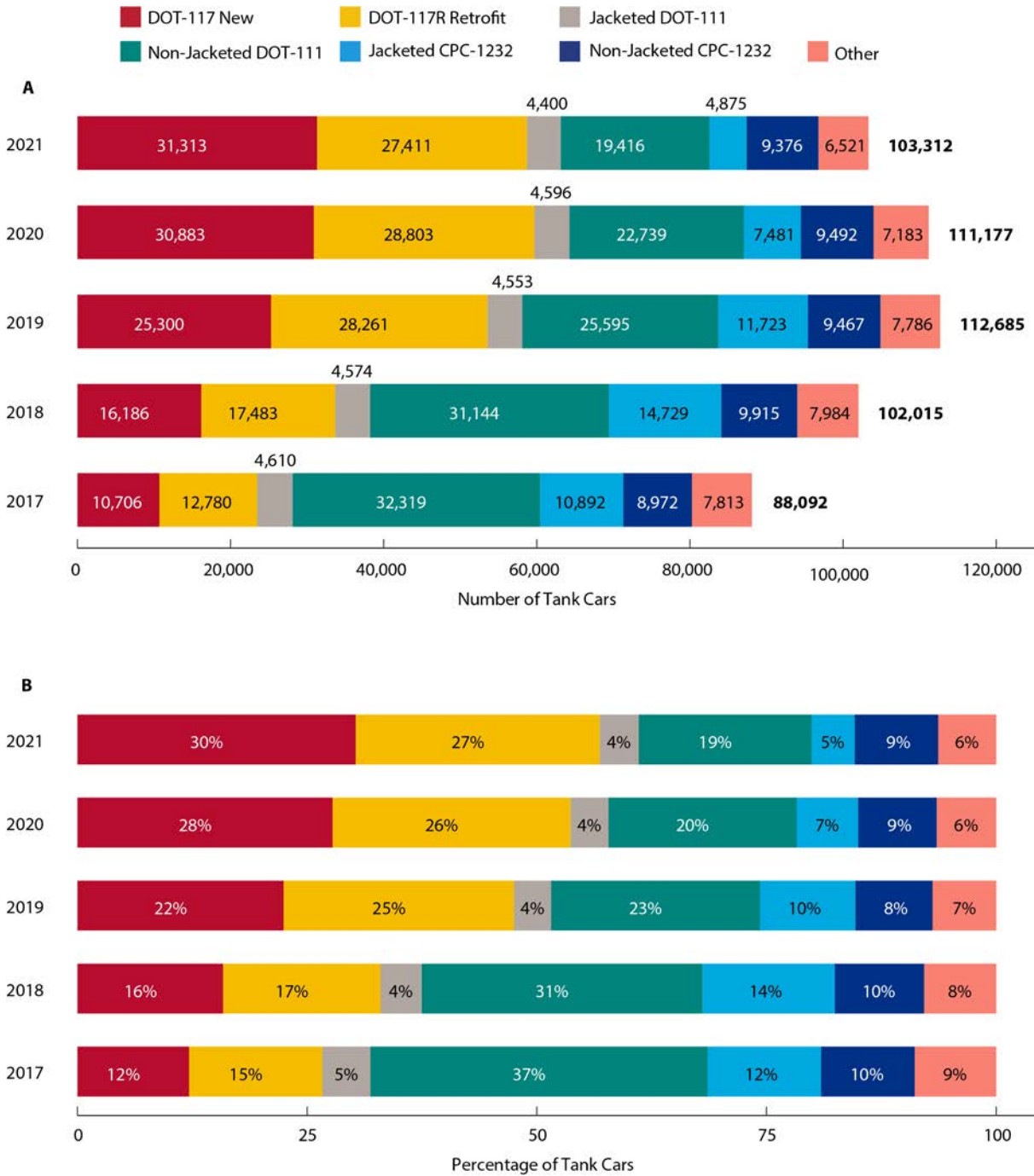
Figure 3 Rail Tank Cars by Type of Flammable Liquid Carried: 2017–2021



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, 2013–2021, accessed June, 2022.

- 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.
- The number of DOT-117s, both new and retrofitted, increased from 23,486 in 2017 to 58,724 tank cars in 2021 (figure 4a)—57 percent of the fleet carrying Class 3 flammable liquids in 2021 (figure 4b).
- The percentage of tank cars meeting the DOT-117 standards continued to rise, from 54 percent in 2020 to 57 percent in 2021
- Jacketed and non-jacketed DOT-111, Jacketed and non-jacketed CPC-1232, and all other rail

Figure 4 Fleet Composition of Rail Tank Cars Carrying Class 3 Flammable Liquids: 2017–2021



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, 2013–2021, accessed June, 2022.

tank cars¹³ have been declining between 2017 and 2021 going from 73 percent of the fleet in 2017 to 43 percent of the fleet in 2021.

The fleet of rail tank cars carry 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 an origin to a 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, 2017 to 2021, by flammable liquid type.

- Shipments in 2021 were down 10 percent from 2020.
- Crude oil shipments accounted for most of the decline in shipments in 2021 with a decrease of

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 (90 percent in 2021) 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

32 percent since 2020.

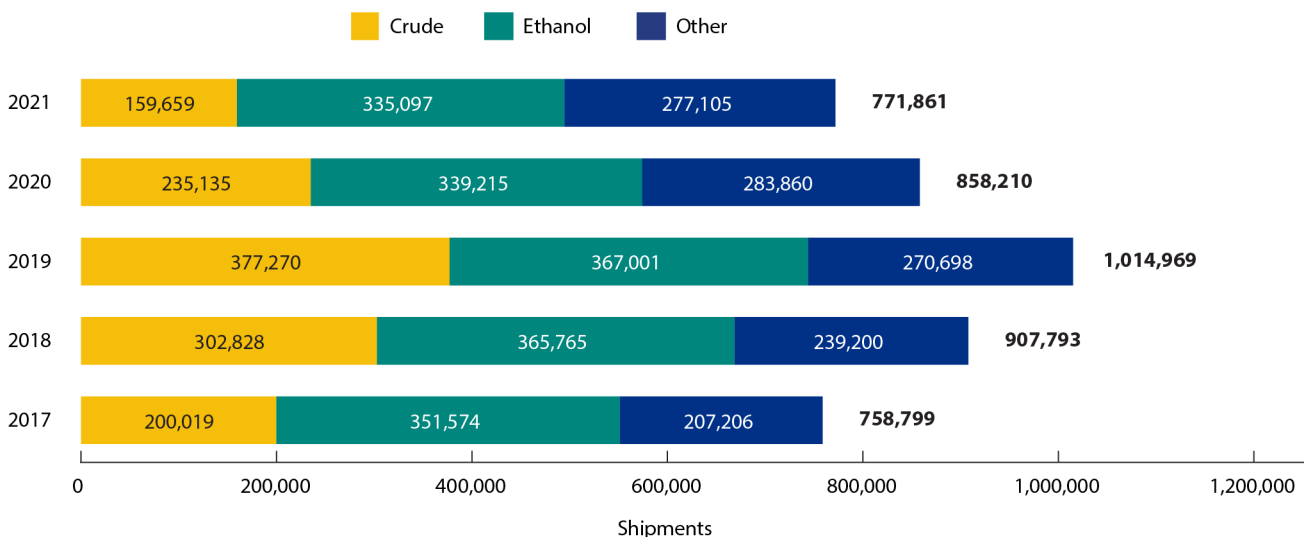
- From 2017 to 2021, fluctuations in the volume of shipments are attributable to fluctuations in crude oil demand. The volume of shipments for crude oil varied from a high of 377,270 in 2019 to a low of 159,659 in 2021. The volume of shipments for ethanol and other flammable liquids were stable between 2017 and 2021.

Because it is taking 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 2017 and 2021. Figure 6 shows a broader historical view of all the data from 2013 to the present report.

DOT-117 Rail Tank Cars

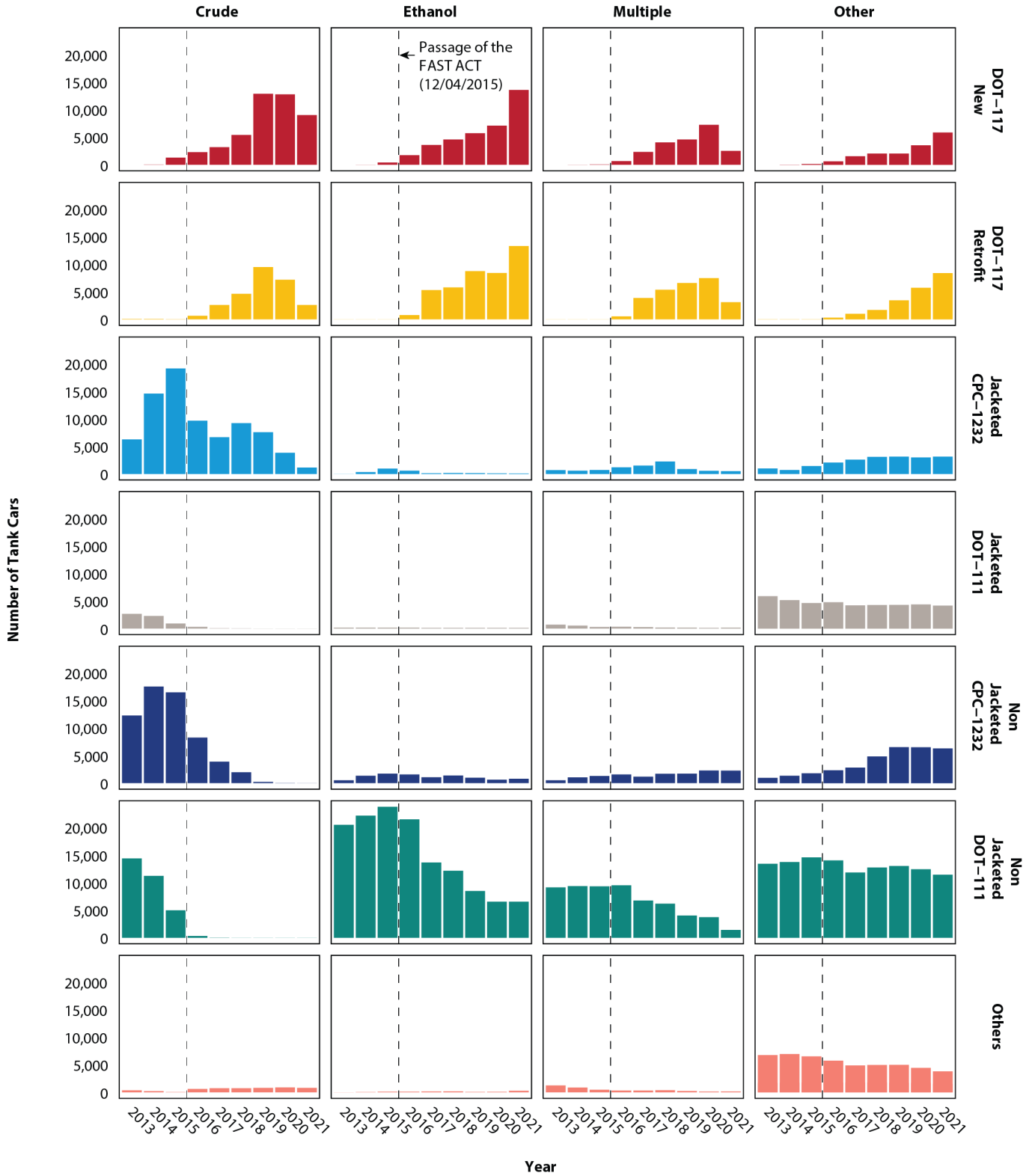
DOT-117 rail tank cars, both new and retrofitted, are tank cars built to the technical and safety specifications finalized in 2015 federal regulations. All tank cars carrying Class 3 flammable liquids are required to meet or exceed the DOT-117 specification at the end of the transition period in 2029. In 2015, there were fewer than 2,000 of these new tank cars, and by 2021 58,724 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: 2017–2021



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, 2013–2021, accessed June, 2022.

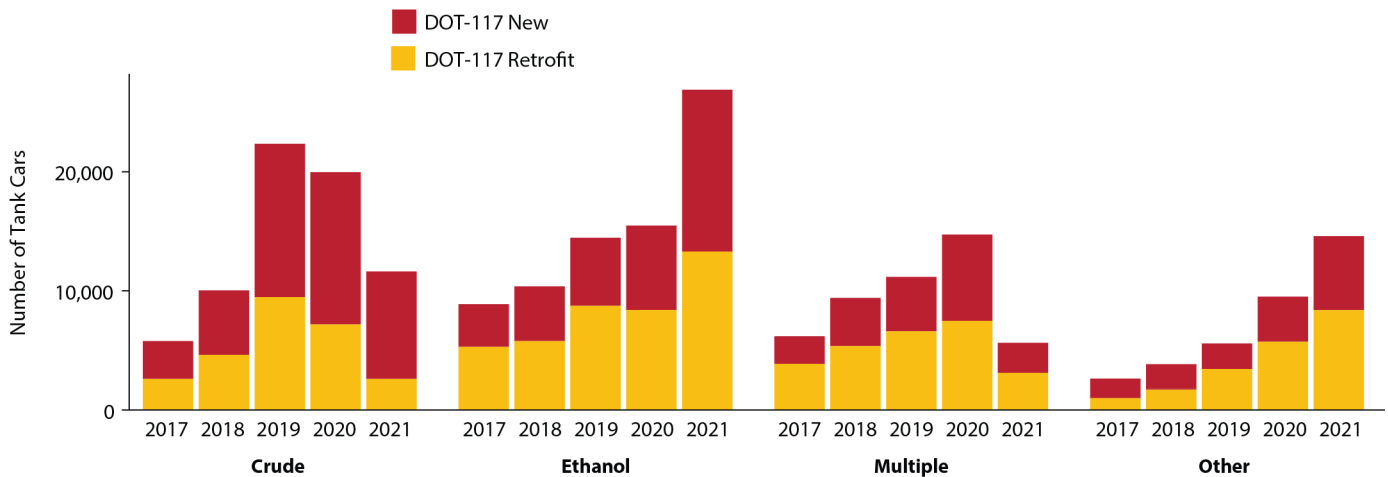
Figure 6 Trends in the Count of Rail Cars by Fuel Type and Type of Car: 2013–2021



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, 2013–2021, accessed June, 2022.

**Figure 7 DOT-117 Rail Tank Cars by Liquid Type: 2017–2021
(both 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, 2013–2021, accessed June, 2022.

- DOT-117s, both new and retrofitted, that carry flammable liquids besides crude oil increased 19 percent from 2020 to 2021, from 39,727 to 47,099.
- In 2021, there was a 32.1 percent reduction in the volume of crude oil shipments from 2020 (see figure 5) as well as a 41.7 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 among all DOT-117 tank cars fell to 19.8 percent in 2021 from 33.4 percent in 2020.

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

The number of CPC-1232 tank cars decreased from 19,864 in 2017 to 14,251 in 2021. 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 jacketed and non-jacketed CPC-1232 cars carrying ethanol is May and July of 2023 respectively.
- There was a 37 percent decrease in jacketed and non-jacketed CPC-1232 cars carrying ethanol.

- There was a 70 percent reduction in jacketed CPC-1232 cars carrying crude oil.
- The number of CPC-1232 cars carrying other flammable liquids remained relatively stable between 2020 and 2021.

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 23,816 DOT-111 tank cars carried flammable liquids other than crude oil in 2021.
- There were 13 percent fewer DOT-111 tank cars, both jacketed and non-jacketed, in use in 2021 compared to 2020.

- The number of non-jacketed DOT-111s carrying other flammable liquids has steadily declined between 2013 and 2021 from 19,445 to 15,634 (figure 6).

Other Rail Tank Car Types

Several other tank car types can carry Class 3 flammable liquids. However, there are notably fewer, representing just 6 percent of the flammable liquid carrying fleet in 2021. 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 2021, 90 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 2021 the “Other” category comprised 6,521 rail tank cars. The ones used for transporting crude oil and ethanol numbered just 1,069, or 16 percent, in 2021. As seen in figure 6, there have been small increases in the number of “other” tank cars carrying crude oil, 806 in 2021 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 2022. 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

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

the capabilities and certifications to build or retrofit tank cars to the DOT-117 specification. In 2022, 121 tank car shops or facilities were identified for this data collection. The data collected from this annual program is summarized in the next sections.

Responses from Facilities:

Of the 121 shops identified to have the ability to build or retrofit tank cars to the DOT-117 specification, 93, or 77 percent, responded. Based on these responses from U.S. owned and/or operated tank car shops, it is expected that 5,642 new rail tank cars will be built in 2022 to meet the DOT-117 specification. Additionally, these shops plan to retrofit 2,680 existing rail tank cars to meet the more rigorous DOT-117 safety standards as seen in Table 2.

Table 2 Rail Tank Car Projections, 2022

Tank Car Type	Projected to be built in 2022
DOT-117	5,642
Tank Car Type	Projected to be retrofit in 2022
Former DOT-111 or CPC-1232	2,680

NOTE: Based on the 2022 Annual Tank Car Facility Survey results from 121 facilities.

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 2022.

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 are not owned by an American company, are not included in the data collection.

- We did not receive responses from 28 tank car shops which have the ability to build new DOT-117 tank cars 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 28 tank car shops resulting in an underestimation of new and retrofit DOT-117 tank cars for 2022.

Summary

In 2021, 103,312 tank cars transported Class 3 flammable liquids— a 7.1 percent reduction from 2020. Shipments of flammable liquids were down 10 percent overall, and crude shipments alone were down by 32 percent compared to 2020. In 2021, DOT-117s comprised over half of the fleet at 57 percent. Among the fleet of rail tank cars that meet the DOT-

117 specification in 2021, 53 percent (31,313 tank cars) are new, and 47 percent (27,411 tank cars) are retrofitted. In 2021, 72 percent of DOT-117 rail tank cars carried either crude oil or ethanol, and 58 percent of retrofitted DOT-117 tank cars carried either crude oil or ethanol. Based on the responses to the data collection, the 93 respondents plan to build or modify 8,322 tank cars during 2022 to meet the new safety requirements.

In 2021, there was a decrease in rail cars likely due to the reduction of shipments of crude oil. While the total fleet size has decreased, the proportion of tank cars meeting the DOT-117 specification continues to increase. 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	Fuel Type	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Crude	0	11	1279	2287	3176	5408	12872	12773	9021
	Ethanol	0	0	408	1728	3583	4590	5715	7083	13577
	Other Flammable Liquids	0	0	133	671	1635	2143	2142	3786	6202
	Multiple Service Flammable Liquids	0	0	34	647	2312	4045	4571	7241	2513
	Totals	0	11	1854	5333	10706	16186	25300	30883	31313
DOT-117 Retrofit	Fuel Type	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Crude	60	73	24	638	2612	4632	9477	7186	2604
	Ethanol	3	3	3	765	5301	5785	8744	8400	13305
	Other Flammable Liquids	12	14	6	303	992	1702	3440	5730	8386
	Multiple Service Flammable Liquids	2	2	0	543	3875	5364	6600	7487	3116
	Totals	77	92	33	2249	12780	17483	28261	28803	27411
Jacketed DOT-111	Fuel Type	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Crude	2667	2286	898	295	51	29	0	0	0
	Ethanol	143	147	152	149	103	102	109	102	94
	Other Flammable Liquids	5870	5151	4627	4785	4202	4269	4295	4381	4156
	Multiple Service Flammable Liquids	700	518	280	305	254	174	149	113	150
	Totals	9380	8102	5957	5534	4610	4574	4553	4596	4400
Non-Jacketed DOT-111	Fuel Type	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Crude	14388	11230	4980	302	5	0	0	0	0
	Ethanol	20494	22163	23762	21477	13643	12146	8480	6541	6531
	Other Flammable Liquids	13575	13864	14697	14153	11914	12813	13092	12476	11478
	Multiple Service Flammable Liquids	9141	9360	9321	9516	6757	6185	4023	3722	1407
	Totals	57598	56617	52760	45448	32319	31144	25595	22739	19416
Jacketed CPC-1232	Fuel Type	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Crude	6252	14589	19150	9659	6658	9208	7580	3832	1154
	Ethanol	0	336	957	586	123	164	142	87	72
	Other Flammable Liquids	988	701	1436	2063	2596	3100	3128	2996	3146
	Multiple Service Flammable Liquids	689	591	716	1190	1515	2257	873	566	503
	Totals	7929	16217	22259	13498	10892	14729	11723	7481	4875
Non-Jacketed CPC-1232	Fuel Type	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Crude	12266	17534	16470	8258	3899	1979	208	27	0
	Ethanol	507	1334	1709	1570	1069	1378	986	626	776
	Other Flammable Liquids	963	1361	1806	2344	2834	4862	6554	6559	6341
	Multiple Service Flammable Liquids	509	1044	1299	1562	1170	1696	1719	2280	2259
	Totals	14245	21273	21284	13734	8972	9915	9467	9492	9376
Others	Fuel Type	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Crude	362	205	46	611	733	734	792	885	806
	Ethanol	4	34	112	105	139	160	68	93	263
	Other Flammable Liquids	8383	8653	8287	7499	6626	6710	6694	6088	5306
	Multiple Service Flammable Liquids	1249	855	453	324	315	380	232	117	146
	Totals	9998	9747	8898	8539	7813	7984	7786	7183	6521

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, 2013-2021, as of June 24, 2022.

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 2022. 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 Institute¹⁵ 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 2022 Annual Tank Car Facility Data Collection, conducted from May to August 2022, 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, 121 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 2022 as well as the number of cars to be retrofitted (DOT-117R) from a previous rail tank car specification

type (e.g., DOT-111).¹⁶ 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 93 out of 121, or 77 percent. Due to non-response from 28 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 121 respondents, 78 percent of the respondents are part of corporations with two or more railcar shops. Of the 94 shops that are part of corporations with two or more locations, 84 percent reported. Of the 27 shops that are part of corporations with no more than one railcar locations, 52 percent reported. Some tank car shops focus solely on repairs and retrofits with certifications from

¹⁵ The Railway Supply Institute is a trade association representing rail tank car manufacturers and facilities performing repairs and maintenance.

¹⁶ 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.

AAR to do that work, while others 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 four years of data available

the numbers of DOT-117 tank cars being built exceeded projections by 43, 36, and 55 from 2018-2020 and was 5 percent below projections in 2021. A comparison of actual retrofit DOT-117 cars and projections from this program shows both under and over performing projections with no discernable pattern.