# National Transportation Safety Board

## Railroad Accident Brief

## BNSF Railway Crude Oil Unit Train Derailment

## Heimdal, North Dakota

# The Accident

On May 6, 2015, at 7:21 a.m. central daylight time, a BNSF Railway (BNSF) crude oil unit train derailed six cars (81 through 86) near Heimdal, North Dakota.[1] The train, consisting of three locomotives, two buffer cars, and 107 loaded tank cars carrying crude oil, was operating at 45 mph when the cars derailed. The train separated after a broken wheel on the 81st car struck the leading edge of the highway-rail grade crossing at milepost 149.01. A mark on the track structure at milepost 153.87 indicated that the broken wheel could not maintain its normal position on the rail at that point and the derailment sequence began.[2] The momentum of the train pulled the 81st car and the following five cars off the track. Five of the derailed tank cars breached and released about 96,400 gallons of crude oil, which fueled a fire about 1 mile east of Heimdal.[3] About 30 people were evacuated from Heimdal and the surrounding area due to the smoke plume that extended north. At the time of the accident, the sky was overcast and the temperature was 57°F. BNSF estimated damage at $5 million.

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[1] The investigation of this accident was limited in scope and focused on the failure of the railroad equipment and its cause, regulations, and guidance regarding identification of the conditions that lead to such failures, and the results of railroad equipment failures on unit trains carrying hazardous materials, specifically crude oil from the Bakken region. These issues and their interrelation were detailed, broad, and timely, and, thus, the investigation did not look at the role of human performance in this accident.

[2] Milepost numbering decreases in the direction of train travel.

[3] The number of derailed cars that breached and released crude oil is incorrectly stated as four in documents in the NTSB public docket for this accident. This error is corrected in this brief report.

**Figure 1.** Accident scene.

# The Investigation

## Train Inspection

According to BNSF records, 2 days before the accident, mechanical inspectors conducted a Class I air brake test and a predeparture inspection of the train at the Hess Corporation loading facility in Tioga, North Dakota. The inspectors found a defective wheel on one car, which was removed from the train, and they had seven repairs made to other cars before the train went into service. After the accident, investigators conducted an air brake test and inspected the cars that did not derail. No significant defects were found.

During an inspection of the six derailed cars, investigators found that the left wheel in the second position on car 81was broken due to a vertical split rim (VSR).[4] Two pieces of the broken wheel were found at milepost 150.7.

## Wheel Impact Load Detector Data

A wheel impact load detector (WILD) is an electronic data collection device that measures the vertical impact forces of a train wheel on the rail via rail-mounted strain gauges placed on the web of the rail. A WILD can measure impact forces caused by flat, shelled, spalled, out-of-round, and damaged wheels and wheels with built-up tread.[5] A WILD measures impact force in kips (1,000 pounds of force). High-impact wheel forces can damage cargo and track infrastructure, primarily rails. The severe stress on a wheel from impacting the rail can cause a fracture that can spread and start chipping off pieces of the tread surface. Once this starts, the fracture and chipping

[4] *Vertical split rim* failures in wheels manifest as subsurface fatigue cracking parallel to the tread surface of the train wheel, followed by an inward vertical overstress fracture perpendicular to the tread surface. This complex cracking eventually leads to the catastrophic failure of the wheel under repeated loads.

[5] *Spalling* is the separation of particles in the form of flakes from a surface that is commonly associated with rolling-element bearings and with gear teeth. Spalling is usually the result of subsurface fatigue.

can continue to grow if the wheel is left in service; this process is called wheel shelling. The geometry of the shelled spot on the wheel does not conform to that of the rest of the wheel surface, and the spot impacts the rail with every rotation (similar to a hammer strike on the railhead). The larger the shelled spot, the harder the impact. A preemptive reduction of the high-impact forces is achieved by "truing" faulty wheels and removing damaged wheels.[6] These actions benefit the railroads by reducing derailments, rail fatigue, bearing damage, cold weather rail fractures, car and truck damage, concrete tie cracking, and wood tie-plate cutting and by improving wheel tread life and fuel efficiency. The WILD data history of the broken wheel indicated increasing forces that exceeded 80 kips before ultimate failure of the wheel. (See figure 2.)

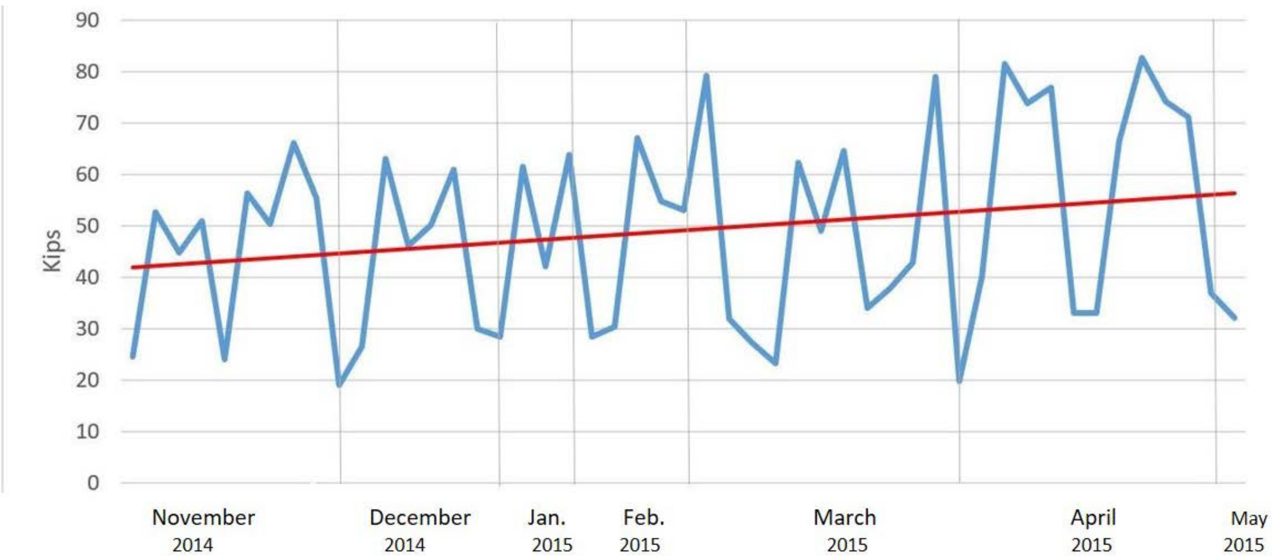


**Figure 2.** Wheel impact load of car TRFX 1224 November 5, 2014–May 3, 2015.

The impact load of car TRFX 1224 increased between November 5, 2014, and May 3, 2015, to the point where it exceeded 80 kips. In four instances before the derailment, the impact load reading for the subject wheel was near or above 80 kips: (1) March 2, 2015, 79.27 kips; (2) March 30, 2015, 79.02 kips; (3) April 19, 2015, 81.58 kips; and (4) April 24, 2015, 82.74 kips.

## Broken Wheel Examination

The fractured wheel fragments, sectioned axle halves, and an intact wheel were sent to the NTSB Materials Laboratory for examination. (See figure 3.) The fracture surface exhibited subsurface fatigue cracking parallel to the tread surface of the train wheel followed by a vertical overstress fracture perpendicular to the tread surface running inward. The wheel fracture features were consistent with VSR failure. Subsequent fatigue cracking propagated from the bottom of the VSR. Once these cracks progressed far enough into the wheel, the wheel catastrophically failed due to multiple overstress fractures, leaving a remnant of the inner wheel hub about the axle.

[6] *Truing* is a process that reshapes a defective wheel or wheel set to an acceptable standard (that is, the wheel becomes trued).

**Figure 3.** Broken accident wheel at accident site placed as if it were unbroken.

Additional examination of wheel sections found that the wheel met the prescribed chemical composition. The mechanical properties, including hardness and tensile strength, also met all requirements. There were no indications that the fractured wheel was manufactured improperly. Examination of the internal residual stress profile of the wheel found surface compressive stress followed by a subsurface tensile stress region. This residual stress profile was consistent with those of VSR failures and was also consistent with the observed fracture features.

## Association of American Railroads Interchange Rules

Rail car equipment and wheel inspections are part of the Association of American Railroads (AAR) interchange rules. Interchange rule 41 specifies the impact threshold values at which qualified mechanical inspectors can remove a rail car from service and designate or schedule that car for specific billable repairs. The Federal Railroad Administration (FRA) mechanical equipment regulations also define specific deficiencies that an inspector uses to assess rail car repair decisions.[7] A WILD, described above, is one method of assessing in-service equipment and wheel health. As the railroad reviews the WILD data, it notifies the car owner to repair the car, provides a slow order for the car, or removes the car from service until repairs are completed.[8]

The AAR thresholds for impact loads at the time of this accident were:

[7] Title 49 *Code of Federal Regulations* (*CFR*) Part 215 "Railroad freight car safety standards;" Part 231 "Railroad safety appliance standards;" and Part 232 "Brake system safety standards for freight and other non-passenger train and equipment; end-of-train devices."

[8] A *slow order* is an operating procedure for informing train crews of a restriction in the authorized speed for a given area and track.

- 65 kips: Issue maintenance advisory for the affected car
- 80 kips: Change the wheel at the tank car's next visit to a repair or shop track
- 90 kips: Condemn the wheel and replace at the first opportunity[9]

Normally, the carrying railroad will make repairs to a car that has a defect and meets the AAR interchange rules criteria. These rules, if met, allow the carrying railroad to bill the car owner for repairs made to the defective condition. If a repair to a car does not meet this criterion, the carrying railroad is responsible for the cost and is less likely to make these repairs.

## FRA Safety Advisory

On April 27, 2015, the FRA issued Safety Advisory 2015-01, *Mechanical Inspections and Wheel Impact Load Detector Standards for Trains Transporting Large Amounts of Class 3 Flammable Liquids*. The safety advisory cited multiple derailments due to wheel failures and focused on the March 5, 2015, derailment and fire of a BNSF unit crude oil train near Galena, Illinois. The FRA's preliminary investigation concluded that a broken wheel from one of the loaded tank cars caused the derailment. During the investigation, the FRA discovered that the broken wheel's impact load registered 83.87 kips just prior to the derailment. The same wheel's impact load was measured over 80 kips 1 month earlier at two different WILD locations.

The FRA safety advisory recommended that railroads (and the AAR via amendment to its interchange rules) lower the impact threshold for action to replace the wheels on any car in a high-hazard flammable train (HHFT).[10] The safety advisory essentially lowered the wheel impact load thresholds below the AAR requirements, to 60-, 70-, or 80-kips for the actions listed above. If the parameters in the FRA advisory had been followed before the accident, the failure of the wheel and ultimate derailment may have been prevented. The AAR interchange rules restrict railroads subject to those rules to replacing wheel sets in accordance with the FRA's guidance. The 90-kip threshold appears to be too high a level of wheel impact/damage before initiating any remedial action as the Heimdal accident indicates.[11] However, with the FRA's safety advisory suggesting lower wheel impact load thresholds, it is advisable that the appropriate levels of those loads be determined before a regulation is developed and implemented. Therefore, the NTSB recommends that the FRA research and evaluate wheel impact load thresholds to find remedial actions that address the mechanical condition of tank cars used in HHFTs**.** The NTSB further recommends that after the evaluation is completed, the FRA mandate remedial actions that railroads should take to prevent mechanical defects that are identified by WILDs.

[9] According to L.B. Foster Salient Systems, a major manufacturer of wheel impact load detectors (WILD), "a series of strain gage load circuits, micro-welded directly to the neutral axis of a rail, create an instrumented zone for the measurement of vertical forces exerted by each wheel of a passing train. Signal processors, housed in a nearby enclosure, analyze the data to isolate wheel tread irregularities. If any wheel generates a force that exceeds a customer-configured alarming threshold, a report identifies that wheel for action. Customers can configure multiple alarm thresholds corresponding to their operation procedures. These reports are distributed in real time to such interested parties as rail traffic control centers and vehicle repair shops." (LBFoster Salient Systems website)

[10] An HHFT is a single train transporting 20 or more loaded tank cars of a Class 3 flammable liquid in a continuous block or a single train that is carrying 35 or more loaded tank cars of a Class 3 flammable liquid.

[11] See descriptions of additional accidents with similar impact load readings, below at "Review of Transportation Safety Board of Canada Accident Data.

### Current Industry Practice

In September 2016, investigators contacted the seven largest freight railroads and Amtrak (National Railroad Passenger Corporation) for information about their adoption of (1) the FRA safety advisory, (2) the AAR's wheel change policy, and (3) the procedures for addressing impact loads of 80 kips or more. Six of the eight railroads responded: Two railroads had adopted elements of the FRA's safety advisory, four did not adopt any elements of the advisory, three follow the AAR requirement, and two have restrictions that exceed the AAR requirement for 80 kips or more.[12] . Three railroads did not respond.

### Review of Transportation Safety Board of Canada Accident Data

Specific data on VSR failures in the United States are limited because most train wheel fractures have been categorized as shattered rims, which are typically caused during manufacturing. The analysis of the VSRs showed that the fractures usually begin at areas of tread damage that result from shelling or from spalling and cracking that propagates into the rim section under load because of induced residual stresses.

The Transportation Safety Board of Canada (TSB) has investigated accidents where a VSR was the probable cause. The NTSB requested accident investigation data from the TSB to obtain data for VSR-caused accidents. The TSB's data show that the agency investigated multiple VSR accidents, including:

- **Fort Frasier, British Columbia**: A gondola car carrying coal sustained a VSR resulting in a derailment after receiving three impact load readings between 80 and 89 kips during the prior months.
- **Copart, Ontario**: A car sustained a VSR resulting in wheel failure and derailment about 6 hours after receiving an 83-kip impact load reading.
- **Cariboo, British Columbia**: A gondola car carrying coal sustained a VSR resulting in a wheel failure and derailment less than 2 hours after receiving an 83-kip impact load reading.
- **White River, Ontario**: A US Department of Transportation (DOT)-111 tank car carrying crude oil sustained a VSR that resulted in a derailment after receiving nine 80- to 89-kip impact load readings in the months before the wheel failure.

## Studies of Vertical Split Rim Failures

Loaded tank cars typically weigh 286,000 pounds and carry some of the heaviest loads impacting the railroad infrastructure. The Transportation Technology Center, Incorporated (TTCI) and the railroad industry test train wheels in both laboratory and field conditions that include finite element modeling.[13] Crack propagation studies have been performed using induced flaws to study

[12] The two railroads that made changes indicated that wheel replacements have increased, more wheels with impact loads greater than 80 kips are being removed, and crews are stopping trains that have impact loads greater than 120 kips.

[13] TTCI is a transportation research and testing organization that is a subsidiary of the AAR. TTCI also manages the FRA's Transportation Technology Center in Pueblo, Colorado, which is involved in the research, development, and testing of rail infrastructure and equipment and the training of first responders to handle hazardous materials accidents.

effects of crack growth rate, wheel and rail loads, and ambient temperature.[14] In a study of 24-wheel sets with broken wheels, the TTCI determined that the dominant failure mode was VSR. Re-creating a VSR defect under laboratory conditions has been difficult and has produced inconclusive results.[15] Based upon the FRA's initiative with its safety advisory, the accident WILD data, the lack of universal adoption by the railroads of the safety advisory, and the high risk associated with HHFT trains, the NTSB believes that additional research is needed to determine safe operating levels of equipment with elevated impact load readings. Therefore, the NTSB recommends that the FRA and the AAR collaborate in evaluating safe impact load thresholds to determine remedial actions for suspect defective wheels in HHFT service based upon equipment detector data and revise the FRA safety advisory and the AAR interchange rules.

## Hazardous Materials

In this accident, five of the derailed tank cars breached, releasing about 96,500 gallons of crude oil from the Bakken region of North Dakota.[16] The cars were placarded with United Nations number 1267, signifying petroleum crude oil, which is a Hazard Class 3 flammable liquid. The shipper classified the crude oil as a Packing Group (PG) I, which reflects the most severe level of danger.[17] The Pipeline and Hazardous Materials Safety Administration (PHMSA) tested crude oil samples from the Heimdal shipment and confirmed the shipper had appropriately classified and packaged the crude oil as PG I.

All the derailed tank cars were Specification DOT-111A100W1 (DOT-111) cars constructed to the AAR's CPC-1232 industry standard for tank cars that were ordered after October 1, 2011.[18] These nonjacketed CPC-1232 tank cars are authorized for the shipment of PG I crude oil until April 1, 2020.[19] The tank cars were equipped with 0.531-inch-thick heads, 0.5-inch-thick tank shells, and half-height head shields. The tank cars did not have jackets or thermal protection systems. Two of the tank cars were punctured from impact with objects in the derailment, two sustained small thermal tears from exposure to the pool fire, and one released some of its contents when the bottom outlet valve handle was damaged in the derailment and partially opened.

One of the punctured tank cars, car 83 (TRFX1374), sustained mechanical tears near the edge of its head and over a more than 12-feet-long area along the lower center of the tank where it had contacted a piece of broken rail. It is unknown whether thicker shell material, a jacket, and a thermal protection blanket would have added enough puncture resistance to prevent such severe breaching damage.

[14] Cameron Lonsdale, et. al, "Development of Railroad Wheel Rim Axial Residual Stress in Heavy Axle Load Service," proceedings of the ASME Rail Transportation Division 2013 Fall Technical Conference.

[15] K. Jones, S. Cummings. "Wheel Failures: Digging Down to the Roots," *Railway Age* (September 10, 2014).

[16] Bakken crude oil comes from the Bakken geological formation, which is a rich source of oil and natural gas that extends through North Dakota and Montana, as well as some Canadian provinces. For more information, see the Hazardous Material Group Factual Report.

[17] Title 49 *CFR* Part 173 contains packing group assignment criteria. The Packing Group of a hazardous material is based on the degree of danger it presents: Packing Group I - Great Danger, Packing Group II - Medium Danger, Packing Group III - Minor Danger. For more information, see the Hazardous Material Group Factual Report.

[18] AAR CPC-1232 required that tank cars ordered for crude oil or ethanol service after October 1, 2011, include a thicker shell and a half-height head shield for puncture resistance greater than other Specification-111 tank cars.

[19] Hazardous Materials: FAST Act Requirements for Flammable Liquids and Rail Tank Cars," *Federal Register* 81, no. 157 (August 15, 2016): 53935.

The second mechanically breached tank car, car 84 (TRFX1056), released part of its contents when it was impacted by the adjacent tank car coupler. This car was punctured near the head-shell interface. Headshields would normally be expected to arrest such an impact to prevent the head from breaching. However, the bolt-on, half-height headshield separated from the tank car and failed to protect the tank head from the impact damage. Full-height headshields, such as those affixed to jacketed tank cars, are incorporated into the jacket and would not have separated from a tank car even during severe derailment conditions. If the CPC-1232 tank cars in this accident had been equipped with full headshields incorporated into tank jackets, the head puncture and subsequent release of crude oil from this tank car probably would not have occurred.

Because the CPC-1232 tank cars in this accident were not equipped with jackets and thermal protection systems, they were not designed to survive prolonged pool-fire exposure. Nevertheless, the lack of a high-energy fireball in the case of two thermally exposed tank cars (TRFX1170 and TRFX1176) suggests that the rate and intensity of fire exposure did not overwhelm the capacity of the pressure relief devices. Moreover, both tank cars exhibited small 10-inch thermal tears, and the tank shell material did not show evidence of extensive thermal damage. Even though any tank car breach and any release of product are undesirable, the relatively minor thermally induced shell tears sustained in two tank cars did not significantly contribute to the severity of the accident.

Since this accident, PHMSA has issued regulations that require a more robust new Specification DOT-117 tank car for flammable liquids service, including crude oil.[20] The DOT-117 tank cars are designed with protective features to mitigate and prevent both mechanical and thermally induced breaching damages. The federal regulations require nonjacketed CPC-1232 tank cars in crude oil service, such as the derailed tank cars in this accident, to be either removed from service or retrofitted to DOT-117 standards by April 1, 2020, with the addition of jackets, thermal protection systems, full headshields, and top and bottom fittings protection.[21] Crude oil transportation market conditions have led to a reduction in the number of nonjacketed CPC-1232 tank cars used in crude oil service from 17,962 in 2015 to 8,498 in 2016.[22] Many of those tank cars taken out of crude oil service are idle or have been repurposed for other commodities. Also, only about 13.5 percent of the tank cars used to ship crude oil in 2016 were compliant with DOT specification 117.[23]

## Crude Oil Classification and Characterization

The classification of Bakken crude oil emerged as a safety concern after the TSB released its findings for the investigation of the July 6, 2013 Lac-Megantic crude oil rail accident.[24] The crude oil testing results from that shipment revealed that the shipper had reported the wrong packing group, indicating a less hazardous material. As a result of its participation in the TSB investigation, the NTSB issued the following safety recommendation to PHMSA:

R-14-6

[20] Specification requirements for DOT-117 tank cars are contained in 49 *CFR* Subpart 179.202.

[21] *Federal Register* 81, no. 157 (August 15, 2016): 53935.

[22] R. Fronczak, "Status of the North American Flammable Liquids Fleet," presentation to the AAR Tank Car Committee, April 19, 2017.

[23] Fronczak, 2017.

[24] Transportation Safety Board of Canada, *Runaway and Main-Track Derailment, Montreal, Maine & Atlantic Railway Freight Train MMA-002, Mile 0.23, Sherbrooke Subdivision, Lac-Mégantic Quebec, 06 July 2013,* Railway Investigation Report R13D0054 (Gatineau, Quebec, Canada: Transportation Safety Board of Canada, 2014).

> Require shippers to sufficiently test and document the physical and chemical characteristics of hazardous materials to ensure the proper classification, packaging, and record-keeping of products offered in transportation.

PHMSA has not issued new requirements for shippers with specific testing requirements, and the NTSB changed the status of Safety Recommendation R-14-6 to "Open—Unacceptable Response."

Both PHMSA and the FRA issued safety alerts to warn the public and emergency responders that crude oil from the Bakken region "may" be more flammable than traditional heavy crude. The agencies also issued joint safety advisories and emergency orders to shippers of hazardous materials and rail carriers to emphasize the importance of "proper characterization, classification and selection of a packing group for Class 3 materials." The advisories also instructed shippers not to rely solely on generic Safety Data Sheets, which do not validate the properties of each shipment of crude oil.

Recent research by both federal agencies and the petroleum industry evaluated the physical and chemical properties of crude oil and found wide variations in the composition of the material.[25] This was due to a number of factors such as geographical origin and lack of uniform and consistent sampling and testing methods for crude oil. The inconsistencies with the crude oil and testing methods could lead the shipper to misclassify the material and erroneously select the wrong packing group.

In response to the classification issues and a spate of crude oil accidents in North America, the North Dakota Industrial Commission (NDIC) issued Oil Conditioning Order 25417, which took effect on April 1, 2015.[26] The NDIC order focused on the vapor pressure of crude oil, requiring production facilities in North Dakota to separate gaseous and light hydrocarbons from Bakken crude oil and establish vapor pressure limits for crude oil in transportation. The order to limit crude oil vapor pressure was intended to decrease its volatility or flammability and enhance transportation safety, in an attempt to reduce the risk of major fires and energetic fire ball releases in accidents. The Heimdal accident was the first crude oil unit train accident to occur since the NDIC issued the order.

To reduce the vapor pressure of crude oil, the material must be treated in a process called "stabilization," which is a distillation process to separate the gas, or "light ends," from the liquid. Oil producers have used stabilization for many years to adjust vapor pressure limits for the transport in pipelines, as well as for refinery specifications.[27] The shipper involved in this accident had been stabilizing its crude oil for decades prior to the NDIC order. The shipper's records indicate that its crude oil product exhibited a lower than mandated vapor pressure before the NDIC order went into effect.

The volatility of crude oil has also been a subject of federal rulemaking. On January 17, 2017, PHMSA issued an Advanced Notice of Proposed Rulemaking requesting scientific, safety, and cost/benefit information to assess the merits of a petition to require a Reid vapor pressure limit less

[25] (a) PHMSA, "Operation Safe Delivery Update", July 23, 2014; (b) The North Dakota Petroleum Council Study on Bakken Crude Properties, Bakken Crude Characterization Task Force, August 4, 2014; (c) Survey of Bakken Crude Oil Characteristics Assembled for the U.S. Department of Transportation, American Fuel & Petrochemical Manufacturers, May 14, 2014.

[26] See NDIC Oil Conditioning Order 25417.

[27] High vapor pressure can result in pump cavitation, which can damage pumps.

than 9.0 psi for crude oil transported by rail.[28] This information is needed to supplement the limited available scientific data on crude oil properties and the role of flammable liquid volatility in the consequences of railroad accidents. Other factors such as thermodynamic properties, weather conditions, volume of material released, and landscape, have also been identified as relevant factors in the severity of injuries and damages caused by fiery crude oil releases. Furthermore, available empirical accident data is not yet available to evaluate the extent to which new specification DOT-117 tank cars mitigate the risk associated with transporting volatile crude oil. As of the date of this report, PHMSA has not announced any regulatory initiatives to address this issue.

In 2014, the Department of Energy (DOE) and the DOT commissioned Sandia National Laboratories (Sandia) to develop a multiphase plan to study and quantify the risks associated with frequent and large volume rail transport of flammable crude oils. In March 2015 Sandia released a report following the first phase to assess publicly available chemical and physical data on crude oil properties that could contribute to the potential for accidental combustion events.[29] The report found the data on crude oil properties to be insufficient because of the lack of standardized sampling and testing methods across the crude oil supply chain. Sandia's next tasks involve actual sampling, testing, and modeling of different crude oils obtained from different regions of the United States to understand the behavior of the material. As of the date of this report, work is ongoing; the DOE is expected to publish another report in early 2018.

The completion of Sandia's research would assist in identifying the key chemical and physical properties of crude oil, as well as any other external factors, which may contribute to the severity of a rail accident, including validating what role, if any, that vapor pressure plays in tank car accident performance. Such information is critical when trying to develop effective regulations for safe transport of crude oil.

# Postaccident Actions

BNSF modified its Level 1, 2, and 3 handling instructions for cars as follows:

- **Level 1** (stop and inspect)
    - for hazardous materials: greater than or equal to 120 kips
    - for all other traffic: greater than or equal to 140 kips
- **Level 2** (next assigned set out location)
    - for hazardous materials: 110–120 kips
    - for all other traffic: 120 –140 kips
- **Level 3** (next scheduled mechanical or empty return)
    - for hazardous materials: 90–110 kips
    - for all other traffic: 90–120 kips

[28] (a) Hazardous Materials: Volatility of Unrefined Petroleum Products and Class 3 Materials, Advance Notice of Proposed Rulemaking *Federal Register* 82, no. 11 (January 18, 2017): 5499, January 18, 2017; (b) Reid vapor pressure is one of several methods for measuring vapor pressure.

[29] Literature Survey of Crude Oil Properties Relevant to handling and Fire Safety in Transport, DOT/DOT Tight Crude Oil Flammability and Transportation Spill Safety Project (Sandia National Laboratories, Albuquerque, New Mexico, 2015).

According to BNSF, the company did not change or add to the handling instructions for wheels with 60-, 70-, and 80-kip readings. BNSF implemented the Comprehensive Mechanical Equipment Health application to raise the visibility to actionable alerts as follows: (1) car wheels with readings greater than or equal to 80 kips while on the repair track will be replaced, and (2) car wheels with readings greater than or equal to 90 kips in the train yard will be replaced.

# Probable Cause

The National Transportation Safety Board determines that the probable cause of this derailment was failure of a wheel on the 81st tank car due to a vertical split rim.

# Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations:

**To the Federal Railroad Administration:**

> Research and evaluate wheel impact load thresholds to find remedial actions that address the mechanical condition of tank cars used in high-hazard flammable trains. (R-17-032)
>
> Mandate remedial actions that railroads should take to avoid or identify mechanical defects that are identified by wheel impact load detectors. (R-17-033)

**To the Federal Railroad Administration and the Association of American Railroads:**

> Collaborate in the evaluation of safe kip thresholds to determine the remedial actions for suspected defective wheels conditions in high-hazard flammable train service based upon equipment detector data, and revise the Federal Railroad Administration Safety Advisory 2015-01 and the Association of American Railroads interchange rules. (R-17-034)

## BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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**Adopted: December 29, 2017**

For more details about this accident, visit the NTSB Docket and search for NTSB accident identification number DCA15FR009.

The NTSB has authority to investigate and establish the facts, circumstances, and cause or probable cause of a railroad accident in which there is a fatality or substantial property damage, or that involves a passenger train. (49 *United States Code*, Section 1131 - *General authority*)

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties … and are not conducted for the purpose of determining the rights or liabilities of any person." 49 *Code of Federal Regulations*, Section 831.4. Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report. 49 *United States Code*, Section 1154(b).