

National Transportation Safety Board

Office of Railroad, Pipeline and Hazardous Materials Investigations

Washington, DC 20594



TANK CAR DERAILMENT DAMAGE FACTUAL REPORT

**March 30, 2023, Derailment of BNSF Railway Freight Train
L-TWI8801-29 and Subsequent Hazardous Materials Release**

Raymond, Minnesota

RRD23LR009

23 Pages

Report Date: July 21, 2023

TABLE OF CONTENTS

ACCIDENT	3
TANK CAR DERAILMENT DAMAGE GROUP	3
SUMMARY	4
FACTUAL INFORMATION	5
1.0 TRAIN INFORMATION	5
2.0 DERAILMENT LOCATION	6
3.0 HAZARDOUS MATERIALS SHIPPER	7
3.1. ADM, Marshall Corn Processing	7
3.2. Pre-trip Inspections.....	7
3.3. Tank Car Volumes and Weights.....	8
4.0 HAZARDOUS MATERIALS INFORMATION	8
5.0 RAILCAR (HAZMAT PACKAGE) INFORMATION.....	9
5.1. Tank Car Specification.....	9
5.2. Manway Gasket Material	9
6.0 EMERGENCY RESPONSE.....	11
APPENDIX A: TANK CAR EXAMINATIONS	13

ACCIDENT

Location: Raymond, MN
Date: March 30, 2023
Time: 0058
0458
Operator: BNSF Railways
System Type: Rail
Commodity: Mixed Freight

TANK CAR DERAILMENT DAMAGE GROUP

Group Chair Sean Lynum
National Transportation Safety Board
Washington, DC

Group Member Shawn Currie
National Transportation Safety Board
Washington, DC

Group Member Lawrence Strouse, P.E.
Federal Railroad Administration
Chicago, IL

Group Member Vinny Leishman
Federal Railroad Administration
Minneapolis, MN

Group Member Robert Clatterbuck
Pipeline and Hazardous Materials Safety Administration
Washington, DC

Group Member Patrick Brady
BNSF Railway
Ft Worth, TX

Group Member Sean Brewer
ADM
Decatur, IL

Group Member Greg Saxton
 The Greenbrier Companies
 Lake Oswego, OR

Group Member Ron Lawler Sr.
 Trinity Industries Leasing Co.
 Dallas, TX

SUMMARY

On March 30, 2023, at about 12:58 am local time, BNSF Railway local freight train number L-TWI8801-29 derailed in Raymond, Minnesota, as a result of an in-service rail failure at a mainline switch. The derailment resulted in approximately 23 mixed freight rail cars, lines 9-21 to derail on their sides, and rail cars lines 22-32 to derail in an accordion style fashion near the point of derailment. The derailment occurred at Milepost 11.9 at the Raymond Elevator Track Switch, which is located on BNSF's Marshal Subdivision. The train consisted of 2 head end locomotives, and 40 loaded rail cars. Maximum authorized track speed in the derailment area is 49 mph. The train speed at the time of the derailment was 43 mph.

A precautionary 1/2-mile evacuation radius affecting about 800 residents was implemented by the Incident Commander based on information ascertained from the Emergency Response Guidebook (ERG). Fire was extinguished the morning of March 31, 2023, according to BNSF officials.

Temperature at time of derailment was 3 degrees Fahrenheit with winds at 3mph.



Figure 1. Photo of derailed train (courtesy of BNSF)

Post-accident inspections revealed that a catastrophic broken rail event occurred along the straight main rail portion of the switch.

FACTUAL INFORMATION

1.0 Train Information

Train No. L-TWI8801-29 did not meet the definition of a high-hazard flammable train as defined in 49 CFR 171.8 and was not a Key Train, as defined by AAR publication OT-55R. Thus, this train was not subject to the safety and security planning requirements of 49 CFR Part 172, Subpart I. Train No. L-TWI8801-29 contained 40 loaded cars, no empties, The train was 2,264 feet long and weighed approximately 5,423 tons. There were 14 loaded hazardous materials cars throughout the train with 10 involved in the derailment. The hazmat cars involved in the derailment contained denatured ethanol. The train originated in Marshall, MN and was destined for Willmar, MN.

Table 1. *Compromised Hazardous Materials Tank Car Information*

Line #	Car Number	Commodity	Tank Car Spec.	UN ID	Hazard Class
22	TILX 363092	Alcohols, n.o.s. (Ethanol, Natural Gasoline)	DOT117J100W	UN1987	3 (Flammable Liquid)
23	WFRX 160411	Alcohols, n.o.s. (Ethanol, Natural Gasoline)	DOT117J100W	UN1987	3 (Flammable Liquid)
24	WFRX 160417	Alcohols, n.o.s. (Ethanol, Natural Gasoline)	DOT117J100W	UN1987	3 (Flammable Liquid)
25	TILX 192381	Alcohols, n.o.s. (Ethanol, Natural Gasoline)	DOT117J100W	UN1987	3 (Flammable Liquid)
26	WFRX 160405	Alcohols, n.o.s. (Ethanol, Natural Gasoline)	DOT117J100W	UN1987	3 (Flammable Liquid)

2.0 Derailment Location

Train No. L-TWI8801-29 was operating on the BNSF Marshal Subdivision, traveling in a northeasterly direction, derailling at railroad milepost 11.9 at the Raymond Elevator Track Switch in Raymond, MN. Diagram of derailed cars in figure 1, with additional drone still pictures in figures 2, 3 and 4.



Figure 2. Labeled Derailment Photograph (Courtesy of BNSF)



Figures 3 and 4. UAS still photographs of derailment as shown in-situ (Courtesy of BNSF)

3.0 Hazardous Materials Shipper

3.1. ADM, Marshall Corn Processing

The ADM Marshall, MN (ADM) wet corn plant was started in 1983. The plant employs 250 people locally in the SW Minnesota area and operates 24 hours a day, 364 days a year. ADM takes in local corn within a 60-mile radius and processes that corn into many various food, feed, and ethanol products.

The derailment involved the following tank cars: (22) TILX 363092; (23) WFRX 160411; (24) WFRX 160417; (25) TILX 192381; (26) WFRX 160405. Product for all five tank cars were described on shipping bills of lading as: UN1987, Alcohols, n.o.s. (Ethanol, Natural Gasoline), Class 3, Packing Group II.

3.2. Pre-trip Inspections

On March 24, 2023, ADM loaded the tank cars that breached in the derailment. The ADM loading operator conducted a pre-loading inspection of each tank car that included checks for the following items, among other things:

- Safety Appliances not broken or bent excessively,
- Brake rigging not broken, bent or dragging,
- Truck Assembly (No signs of cracks or excessive wear, wheels in good shape, no missing springs),
- Couplers (must be double shelf),
- Obvious damage to tank,
- Deterioration or leakage evident with fittings or gaskets,
- All Stenciling is legible,

- Tank and safety valve test dates are current as indicated by the stenciling on the rail car,
- All four (4) placard holders are in place,
- Inspect the manway lid bolts/nuts, and ensure the threads are in good condition, not galled or stripped,
- Inspect the condition of the manway hinge pin,
- Inspect the interior of the rail car for residual product.

After the tank cars had been loaded, the ADM loading operator checked:

- Inspect the bottom outlet for leaking,
- Close the manway, ensuring the lid gasket is in the proper position,
- Secure the manway lid bolts using a 3-step tightening procedure,
- Perform a final walk-around of all cars on the load track.

The loader found no exceptions with the pre-load and post-load condition of the tank cars that breached.

3.3. Tank Car Volumes and Weights

ADM bills of lading identified the loading weight for each tank car. No loadings exceeded applicable load limits (by weight) for the breached tank cars. ADM loading records provided the preset volume of ethanol loaded into each tank car (Table 2). The breached tank cars carried a total of 145,823 gallons, or 959,516 pounds, of ethanol.

Table 2. *Loaded tank car volumes and weights*

Line #	Car Mark	Car Number	Tank Capacity (gal)	Loaded Volume (gal)	Load Limit (lb.)	Lading Weight (lb.)
22	TILX	363092	30300	28940	194900	190425
23	WFRX	160411	30590	29305	194200	192827
24	WFRX	160417	30560	29275	193800	192630
25	TILX	192381	30310	28950	195500	190491
26	WFRX	160405	30640	29353	194100	193143
Total				145,823		959,516

4.0 Hazardous Materials Information

The hazardous material transported in BNSF train L-TWI8801-29 was described as Ethanol, STCC 4909152, shipped as UN1987, Alcohols, n.o.s. (Ethanol, Natural Gasoline), Class 3, Packing Group II.

Ethanol is a renewable fuel made from various plant materials collectively known as biomass. More than 98% of U.S. gasoline contains ethanol to oxygenate the fuel.

Typically, gasoline contains E10 (10% ethanol, 90% gasoline), which reduces air pollution.¹

ERG Guide 127 recommends an isolation distance of ½ mile in all directions if a rail car is involved in a fire.²

5.0 Railcar (Hazmat package) Information

In addition to the 5 hazardous materials cars that breached in the derailment, there were 5 others that also derailed, but did not lose their contents and another 4 cars that did not derail. Ten of the tank cars were constructed to specification DOT- 117J100W, with 2 constructed to specification DOT-117R100W.

5.1. Tank Car Specification

Title 49 of the Code of Federal Regulations (CFR) Part 179 outlines the following specification requirements for DOT-117 tank cars: (1) Subpart B of Part 179 - general design requirements; (2) Subpart D - specifications for non-pressure tank car tanks. Additional tank car industry standards incorporated in the HMR by reference are: The Association of American Railroads (AAR) Manual of Standards and Recommended Practices, Section C-Part III, Specifications for Tank Cars, Specification M-1002.

Among the DOT-117 specification requirements are:

- 9/16-inch normalized TC-128 steel minimum for heads and shells,
- Full height ½ inch thick head shield,
- Thermal protection system,
- Minimum 11-gauge jacket,
- Top fittings protection,
- Enhanced bottom outlet handle design to prevent unintended actuation during a train accident,
- 286,000 lbs. GRL authorized.

5.2. Manway Gasket Material

ADM utilized a Butadiene Acrylonitrile (nitrile) white gasket material in the manway closure of the derailed DOT-117J tank cars. They provided the specifications for the nitrile gaskets used on the derailed tank cars, which show an operating temperature of -50 °F to +225 °F.

¹ Excerpted from the U.S. Department of Energy, Alternative Fuels Data Center, "[Alternative Fuels Data Center: Ethanol Fuel Basics \(energy.gov\)](https://www.energy.gov/alternative-fuels-data-center/ethanol-fuel-basics)"

² Emergency Response Guidebook: a Guidebook for First Responders during the Initial Phase of a Dangerous Goods/Hazardous Materials Transportation Incident. (Washington, DC.: U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, 2020).

NTSB investigators found the nitrile manway gaskets on 3 of the derailed cars were thermally damaged (see Tables A-3 - A-5 near the end of this report for further details).

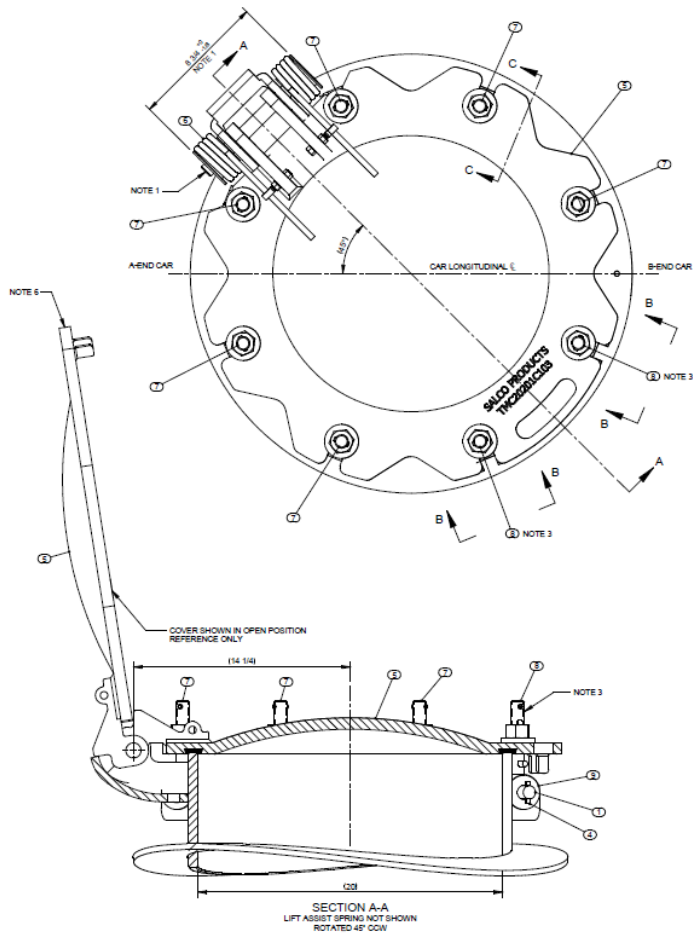


Figure 5. Excerpt of Greenbrier 20 Inch Manway Assembly

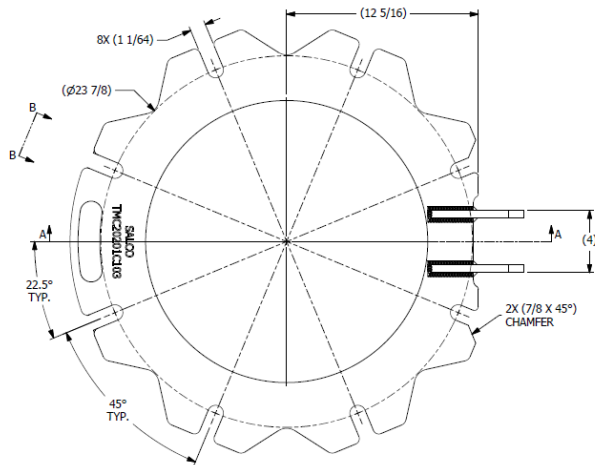


Figure 6. Excerpt of Greenbrier Manway 20" 8 Bolt Drawing

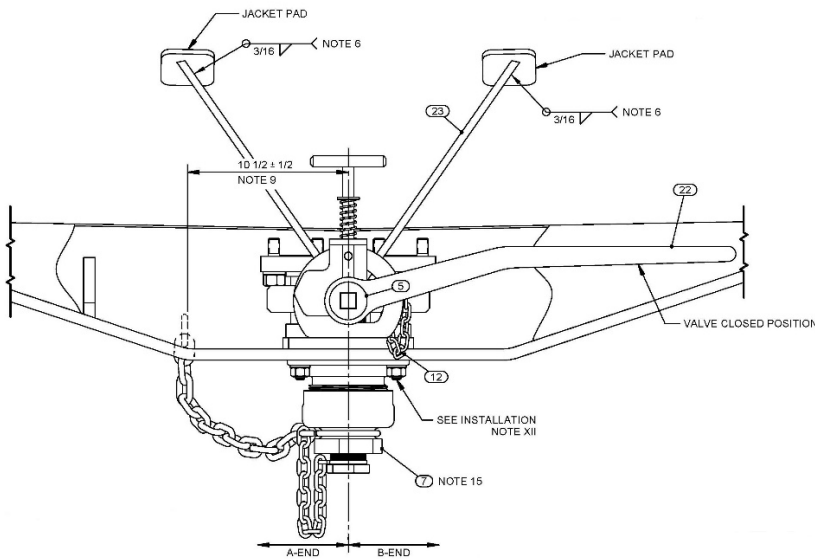


Figure 7. Greenbrier Bottom Outlet Valve Drawing

6.0 Emergency Response

Investigators spoke with the Chief Deputy from Kandiyohi Sherriff's Office, who indicated that he was one of the first members of public safety on-scene. Upon his arrival, he became the Incident Commander (IC). After the initial response, a half mile evacuation zone was established, and an evacuation begun.

The Chief Deputy additionally stated that fire and emergency medical crews responded from Wilmar and Randolph, MN. There were no issues with communication or coordination reported. Upon arrival of BNSF employees and

hazardous materials team members, a unified command was subsequently established.

Initial notification of the incident was received at 01:00 local time by Kandiyohi County Communications. Police, Fire and Emergency Medical Services were dispatched. The following is a listing of agencies involved:

Agency	Discipline
Raymond	Fire
Kerkhoven	Fire
Blomkest	Fire
Sunberg	Fire
Kandiyohi	Fire
Pennock	Fire
Prinsburg	Fire
Atwater	Fire
Lake Lillian	Fire
Raymond	Fire
New London	Fire
Kandiyohi County Rescue	EMS
Raymond Ambulance	EMS
Kandiyohi County Sheriff's Office	Law Enforcement
Wilmar Police	Law Enforcement
Chippewa County Sheriff's Office	Law Enforcement
Minnesota State Patrol	Law Enforcement

Highlights of the dispatch log from March 30, 2023:

Time	Log entry
0100	Notification received of incident
0103	BNSF notified dispatch of ethanol
0108	Raymond Fire arrived
0119	Evacuation message was relayed
0125	Prinsburg Fire arrived

Submitted by:

Sean Lynum
Chief, Pipeline and Hazardous Materials Division

APPENDIX A: TANK CAR EXAMINATIONS

Tables A-1 through A-5 summarize field observations collected for the derailed tank cars.

Key to abbreviations used in this Appendix

B-end: the end of the car with the handbrake wheel

A-end: the end of the car opposite the B-end

A-L: A-end, left side

A-R: A-end, right side

B-L: B-end, left side

B-R: B-end, right side

BOV: bottom outlet valve

PRD: pressure relief device

Top: 4-feet to the right and left of the top longitudinal centerline

Bottom: 4-feet to the right and left of the bottom longitudinal centerline

All observations and orientations provided are from the perspective of facing the B-end of the tank car.

Table A-1: Tank Car TILX 363092, 117J100W

Consist order	22
Orientation in the consist	Unknown.
Derailed resting position	Unknown, car was in staging yard for inspection.
Heads	The A-end and B-end heads had no impact damage.
Shell	Puncture damage, 62 inches high by 44 inches long, right side middle, fire exposure
Bottom outlet valve	No damage.
Top fittings, PRD and Manway	There was no damage to the top fittings protective housing or the manway. The manway swing bolt? at the 10 o'clock position was loose and could be turned by hand.
Stub sills and couplers	Sub-sills attachments were not fractured.



1(a) B-end head, damage to head at 7 to 8 o'clock position.



1(b) B-end trailing head, looking down the top of rail car.



1(c) A-end head, minor damage to head at approx. 6 o'clock position



1(d) A-end head looking toward B-end along bottom. Impact damage on right side.



1(e) Right side of car. Triangle shaped puncture.

Table A-2: Tank Car WFRX 160411, 117J100W

Consist order	23
Orientation in the consist	Unknown
Derailed resting position	Unknown, car was in staging yard for inspection.
Heads	Various dents to upper-right B-end head. B end head shield missing (possibly during post derailment handling).
Shell	Multiple impact damages. About 65% of the shell/jacket surface was thermally damaged.
Bottom outlet valve	No damage.
Top fittings, PRD and Manway	Protective housing was impacted by rollover and contact. No breaching damage to top fittings or manway.
Stub sills and couplers	Stub sills remained attached to head pad.



2(a) A-end head.



2(b) Shell puncture damage near protective housing



2(c) B-end showing missing head shield and damage at 1 o'clock position



2(d) Bottom, showing fire damage and bottom outlet.

Table A-3: Tank Car WFRX 160417, 117J100W

Consist order	24
Orientation in the consist	Unknown.
Derailed resting position	Unknown, car was in staging yard for inspection.
Heads	A-end missing (possibly during post derailment handling), damage to B-end at 9 o'clock.
Shell	Thermal damage and evidence of multiple impact.
Bottom outlet valve	No damage.
Top fittings, PRD and Manway	Thermal damage to manway gasket.
Stub sills and couplers	A-end coupler pushed upward 90-degrees, tearing into stub sill top plate. B-end coupler was broken at the striker plate.



3(a) B-end, showing damage at 9 o'clock



3(b) B-end damage looking on left side.



3(c) A-end looking along right side. A-end head shield missing



3(d) Left side of car from A-end showing damage to heat shield.



3(e) Showing thermal damage to manway gasket.

Table A-4: Tank Car TILX 192381, 117J100W

Consist order	25
Orientation in the consist	Unknown.
Derailed resting position	Unknown, car was in staging yard for inspection.
Heads	Dent to center of A-end head, B-end minor scraping.
Shell	Damage at A-end where head shield was welded to tank jacket.
Bottom outlet valve	No damage.
Top fittings, PRD and Manway	Thermal damage, Manway was leaking from damage to gasket.
Stub sills and couplers	Stub sills remained attached to head pad.



4 (a) A-end, showing impact damage.



4 (b) A-end left side showing head shield separation and impact damage.



4 (c) left side from A-end showing thermal damage.



4 (d) B-end, damage.



4 (e) Right side, thermal damage.



4(f) right side, B-end qualification stencil.

Table A-5: Tank Car WFRX 160405, 117J100W

Consist order	26
Orientation in the consist	Unknown.
Derailed resting position	Unknown, car was in staging yard for inspection.
Heads	A-end head dent at 9-10 o'clock, B-end head shield weld was fractured.
Shell	About 65% of shell/jacket surface was exposed to fire, left side thermal damage.
Bottom outlet valve	Bottom outlet valve gasket thermally damaged, leaking through valve.
Top fittings, PRD and Manway	Thermal damage to manway gasket.
Stub sills and couplers	Stub sills remained attached to head pad.



5(a) A-end showing damage to head at 9 to 10 o'clock.



5(b) Right side showing thermal damage.



5(c) B-end, showing certification dates and damage to head shield.



5(d) left side thermal damage.



5(e) Thermal damage to manway gasket.



5(f) Bottom outlet valve gasket thermally damaged.