Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R07D0030

MAIN-TRACK DERAILMENT

CANADIAN NATIONAL
FREIGHT TRAIN M-32721-28
MILE 202.51, CSX MONTRÉAL SUBDIVISION
HUNTINGDON, QUEBEC
29 MARCH 2007

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Railway Investigation Report

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Summary

On 29 March 2007, at 1226 eastern daylight time, Canadian National freight train M-32721-28 derailed eight cars at Mile 202.51 of the CSX Montréal Subdivision, while travelling southward towards Huntingdon, Quebec. Four of the derailed cars were low-pressure tank cars loaded with sulphuric acid (UN 1830). There was no release of product and no injuries. Approximately 1200 feet of track was damaged.

Ce rapport est également disponible en français.

Other Factual Information

On 29 March 2007, at approximately 1200 eastern daylight time,[1] southward Canadian National (CN) freight train M-32721-28 (the train) departed Coteau, Quebec, destined for Huntingdon, Quebec. The train consisted of 2 locomotives and 80 cars (78 loads and 2 empties). It was 4771 feet long and weighed 10 382 tons. It was operated by a CN crew, which consisted of a locomotive engineer and conductor. They met fitness and rest standards, were qualified for their respective positions, and were familiar with the territory.

The trip was uneventful until the locomotive passed south of a farm crossing at Mile 202.50. According to the locomotive event recorder, the train speed was controlled by throttle modulation from Mile 205.97 to Mile 202.51. At Mile 202.51, the locomotive engineer applied the dynamic brake from position 0 to position 3 over a 24-second period, which reduced the train speed from 27 mph to 25 mph. The dynamic brake was reduced over 39 seconds and released at a speed of 24 mph at Mile 202.1. The throttle was slowly increased over the next 59 seconds as the speed dropped. While the train was travelling in throttle position 5 at a speed of 16 mph, an undesired emergency application of the train air brakes occurred at Mile 201.57. At 1226, the lead locomotive came to rest at Mile 201.21 (see Figure 1).

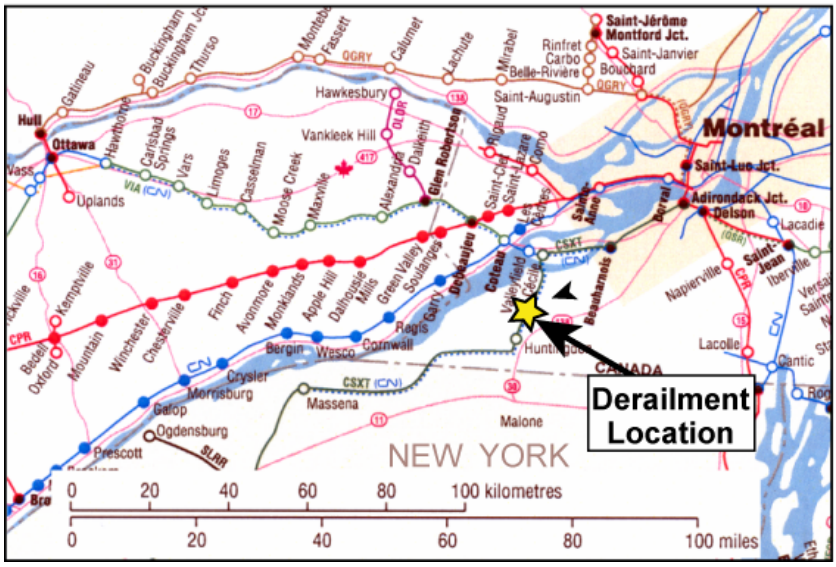

Figure 1. Derailment location (Source: Railway Association of Canada, *Canadian Railway Atlas*)

The train crew followed emergency procedures, inspected the train, and determined that 8 cars, the 68th car from the head end (car GATX 6545) and the 7 tail-end cars (74th to 80th), had derailed. The 68th and the 74th to 76th cars were low-pressure tank cars loaded with sulphuric acid (UN 1830). The 77th and 78th cars were loaded with paper and the 79th and 80th cars contained wood products. There was no release of product and no injuries.

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1 All times are eastern daylight time.

At the time of the accident, the sky was mainly clear, the temperature was approximately 6°C and the wind was from the northeast at 22 km/h.

Site Examination

At the north end of the derailment site, the track had buckled and shifted laterally, up to 24 inches, to the east. The buckle began 72 feet north of the farm crossing and extended southward in an "S" shape, up to the crossing surface (see Photo 1).

Photo 1. Southward view showing the track buckle and derailment

Near the middle of the track buckle, a diagonal wheel flange mark was observed on the head of the east rail, extending southward from the gauge side. Two feet from the mark and extending southward, the field side spikes, tie plates and ties exhibited impact marks. Corresponding marks were observed on the ties on the gauge side of the west rail. Track damage extended for about 1200 feet up to the trailing truck of the first derailed car, GATX 6545 (the 68th car from the head end). The 69th to 73rd cars did not derail; the 74th to 80th cars, including the three tank cars loaded with sulphuric acid, derailed and came to rest on their sides, down the embankment on the east side of the track (see Figure 2).

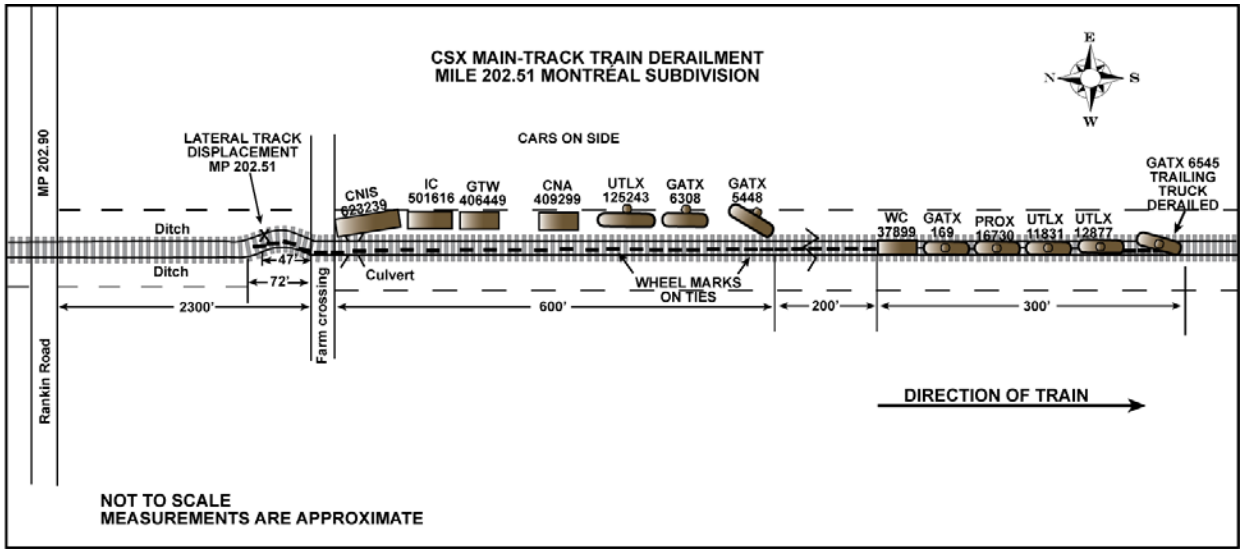

Figure 2. Derailment site diagram

The sulphuric acid was safely off-loaded from the three tank cars derailed on their sides. The seven derailed cars at the tail end sustained heavy damage and were scrapped. A mechanical teardown inspection was performed on the trucks of car GATX 6545; no pre-existing defects were observed. The car was repaired and returned to service. There were no pre-derailment equipment defects noted on any of the derailed cars that would have compromised the safe operation of the train.

In the immediate vicinity of the farm crossing, every tie was box anchored. North of the track buckle, and extending up to the public crossing at Rankin Road (Mile 202.90), rail anchors were scarcely applied, were not in contact with the ties, and had moved southward. There were multiple clusters of up to 32 consecutive ties with no rail anchors. Rail creep marks were observed on either side of track spikes along the base of a joint bar and the toe of the east rail base in several locations. The marks extended up to nine inches southward and three inches northward (see Photo 2). The rail joints were tight near the track buckle, but displayed gaps of up to 7/8 inch near Rankin Road.

Photo 2. Rail creep marks observed along the base of a joint bar

Track Information

The Montréal Subdivision is owned by CSX Transportation and extends from Massena, New York, United States (Mile 161.0), to Beauharnois, Quebec (Mile 225.2). Both CN and CSX operate trains over the subdivision. In September 2004, the crew change point moved from Massena to Huntingdon. Since that change, the track from Rankin Road to Mile 201.00 has become an area in which southward trains use either dynamic brakes or train air brakes to slow down in preparation for stopping at Huntingdon.

In the area of the derailment, train movements are governed by the Occupancy Control System as authorized by the *Canadian Rail Operating Rules* and are supervised by a CSX rail traffic controller located in Selkirk, New York, United States. The track is classified as Class 2 according to Transport Canada–approved *Railway Track Safety Rules* (TSR). The maximum authorized speed is 25 mph for freight trains. The traffic consists of two northbound and two southbound freight trains daily, with annual tonnage totalling over seven million tons.

Northbound trains are mostly empty while southbound trains are heavily loaded. From January to March 2007, the average monthly traffic tonnage was 117 000 tons northward and 538 000 tons southward. CSX Engineering employees were aware of the number of trains per day, but unaware of the disparity between northward and southward traffic tonnage.

The track consisted of a tangent single main track oriented in a north-south direction. From Mile 203.30, the track descends southward at a one per cent grade to Mile 203.10 then at a 0.06 per cent grade to Mile 202.80. From Mile 202.80 to Mile 202.10, the track is relatively flat. At Mile 202.10, the track ascends at a grade of 0.60 per cent to Mile 201.70 before descending towards Huntingdon Yard.

The rail in the area of the derailment was 105-pound jointed rail manufactured by Dudley-Lackawanna in the 1920s and 1930s using the open hearth process. Rail manufactured using the open hearth process is known to be susceptible to the rapid growth of transverse defects due to impurity inclusions. The rail was laid on a mix of 10- to 13-inch, single- and double-shouldered tie plates. Two spikes were used to secure the plates to the wood ties. There were approximately 60 No. 2 treated hardwood ties per 100 feet. There were up to 11 defective ties per 39-foot section of track, which is within the TSR allowable limits for Class 2 track. The ballast was crushed stone, the cribs were full, and the shoulders were a minimum of 12 inches wide and were in good condition.

Track Inspection and Maintenance

The track was visually inspected by a certified track inspector twice weekly with at least two calendar days between inspections. The lack of rail anchors was not recorded as a condition that required attention at any time. The most recent visual inspection of the derailment area was conducted on 27 March 2007 by hi-rail. On that day, the track inspector reported "tight track"[2] just north of the farm crossing at Mile 202.70. Two bolts on one end of a joint had broken and the inspector was unable to replace them. However, after the passage of a northward train, the rail had moved and the broken bolts were replaced. There were no other defects reported.

In the area of the derailment, the track is inspected by a geometry test vehicle once a year. The most recent geometry inspection was performed on 26 October 2006, and no defects were identified. However, starting at Mile 202.60 and extending southward, there were a number of consecutive alignment deviations that progressed from ½ inch up to 1 ¼ inches at Mile 202.51, which is still within the TSR limit of three inches.

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[2] Tight track refers to a section of jointed track where the joint gaps are closed.

The rail is tested monthly by a rail flaw detection vehicle. The most recent test was performed on 08 March 2007 and no defects were found. The area had been relatively problem free up until 2005 when rail pull-aparts[3] and track buckles began to occur. A review of the Track Disturbance Reports[4] for the previous two years revealed the following:

- A total of seven rail pull-aparts occurred between Rankin Road and the farm crossing.
- On 20 December 2005, 3 ½ inches of rail was added to the east rail following a pull-apart at Mile 202.60.
- On 27 January 2006, 2 inches of rail was added to the east rail following a pull-apart at Mile 202.80.
- On 31 March 2006, a track buckle occurred at Mile 202.40, immediately south of the farm crossing. During the track buckle repair, the 5 ½ inches of rail previously added was removed and every tie within 100 feet south and 70 feet north of the farm crossing was box anchored.
- On 29 January 2007, while the temperature was approximately -14°C, 9 inches of rail was added to the east rail following a pull-apart at Mile 202.80. Track maintenance personnel planned to adjust the rail length in the spring, before the onset of hot weather.

Track Buckle Prevention

Part II, Subpart D (VII) of the TSR states that "a sufficient number of anchoring devices will be applied to provide adequate longitudinal restraint" of the rail, regardless of the class of track. The CSX Maintenance-of-Way Field Manual (MWI) requires that, in jointed rail, 8 ties per 39-foot section of track should be box anchored. The MWI also specifies that inadequate rail anchoring, and other factors such as poor joint maintenance and low rail neutral temperature[5] may contribute to rail pull-aparts.

The MWI contains detailed information on the installation and maintenance of continuous welded rail (CWR), which includes the steps required to prevent track buckling. A track buckle is a lateral shift of the track that occurs when longitudinal compressive stresses in the rail overcome the lateral resistance of the track structure. Track buckles more commonly occur on curves but they can also occur in tangent track. The vast majority of track buckles occur in CWR as a result of thermal expansion of the rail during hot weather. However, they can also occur in jointed rail when certain conditions are present.

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3 This occurs when the rail or a joint breaks due to excessive tensile force and pulls apart.

4 The CSX Maintenance-of-Way Field Manual (MWI) requires that a Track Disturbance Report be completed whenever there is a pull-apart or track buckle and rail is added or removed.

5 Rail neutral temperature is the temperature at which the rail is stress free, neither in compression nor in tension.

The MWI identifies tight track, rail creep, insufficient anchors, and alignment deviations as indicators of potential track buckles and indicates that special attention should be paid to areas at the bottom of a grade, where heavy train braking occurs and where the rail is running.[6] The addition of rail to repair winter pull-aparts is identified as a factor that can contribute to the formation of track buckles if the rail is not adjusted before the onset of hot weather.[7] This section also indicates that a temporary speed restriction of 25 mph should be placed on track that has insufficient anchors if the ambient air temperature is expected to exceed 85°F (29°C). In addition to the material contained in the MWI, CSX also provides a training course entitled "Prevention of Buckled Track" to all of its maintenance-of-way personnel. Both the MWI and the training course focus on track buckles in CWR.

Regulatory Overview

In its monitoring and audit activities, Transport Canada conducted routine track inspections of the Montréal Subdivision on a yearly basis since 2002. In April 2006, Transport Canada conducted a track audit of the Montréal Subdivision that was submitted to CSX. Section 2, General Findings, of the audit report identified several areas of concern pertaining to the track infrastructure. It specifically indicated that poor anchoring was a condition that was present throughout the subdivision and seemed to be systematically overlooked. In August 2006, CSX responded and indicated that the track was inspected regularly by a qualified track inspector and that precautionary measures would be implemented as necessary. CSX regional office in Albany, New York, United States, indicated that a request for capital improvements was submitted to head office for 2007.

In November 2006, Transport Canada re-inspected the Montréal Subdivision and issued CSX a Notice pursuant to Section 31 of the *Railway Safety Act*. The Notice stated that there was insufficient longitudinal restraint of the track (lack of anchors) and that the degraded condition of the track structure and the standard of maintenance did not meet the minimum standards in the TSR. CSX repaired a number of defects and placed slow orders on several areas of track, but did not address the rail anchoring concerns. In January 2007, CSX outlined work that was planned for 2007, which included the installation of 3500 to 5000 ties and rail anchors.

Analysis

The train was operated in compliance with the operating requirements of both CSX and CN. No equipment defects were observed that could be considered causal in the accident. Therefore, the analysis will focus on the circumstances surrounding the formation of the track buckle.

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6 Industry term that describes longitudinal rail movement or creep.

7 CSX defines hot weather as an ambient air temperature of 85°F (29° C) or higher.

The Accident

The diagonal mark on the rail head and track damage observed on the field side of the east rail as well as wheel drop-in marks on the gauge side of the west rail identified that the initial point of derailment was located near the middle of the track buckle at Mile 202.51. From this point, the track damage extended southward and terminated at the trailing truck of the 68th car from the head end, GATX 6545, which indicated that this was the first car to derail. The rail creep marks and the condition of the rail joints, which were open near Rankin Road and tight near the farm crossing, show that the rail had moved southward and was in compression at the north end of the farm crossing. These compressive stresses in the rail likely contributed to the development of the progressive alignment deviations recorded at that location before the accident. As the train passed over the alignment deviations, the wheel action exerted lateral forces that increased the track misalignment and led to the derailment of the 68th car. Under the passage of the following five cars, which did not derail, the track shifted further and caused the derailment of the seven tail-end cars of the train.

The function of a rail anchor is to secure the rail longitudinally and prevent creep. When rail is not secured properly, longitudinal rail movement and bunching of the rail can occur at certain locations, leading to a build-up of compressive stresses in the rail. The anchoring of the jointed rail in the area between Rankin Road and the farm crossing did not comply with either the Transport Canada-approved TSR or CSX standards. The rail was sporadically anchored and multiple clusters of ties had no anchors. In addition, the anchors that were present were not effective and had moved away from the ties. Consequently, the rail was not restrained longitudinally and was free to move.

Before moving the crew change point to Huntingdon, in September 2004, the area between Rankin Road and the farm crossing was relatively problem free. Since that time, southward trains traversing this area use brakes to slow down while approaching Huntingdon yard limits. Furthermore, southward traffic tonnage was four times higher than the northward traffic. Consequently, in the absence of rail anchors, the braking action of the trains on a downward grade combined with the higher volume of southward traffic induced southward rail creep, which increased the longitudinal compressive force on the rails near the farm crossing. The tight track observed two days before the derailment further indicated rail movement and the presence of these compressive stresses.

In the two years before the accident, the rail creep had contributed to seven pull-aparts and a track buckle in the area. The addition of nine inches of rail in January 2007 to repair a pull-apart just north of the farm crossing further exacerbated the problem and created even higher compressive forces in the rail. Since the rail within 70 feet north of the farm crossing had been securely box anchored while repairing a previous track buckle in March 2006, this area acted as a focal point for longitudinal compressive stresses in the rail. The addition of nine inches of rail, the rail creep resulting from mostly southward traffic tonnage, and the influence of train braking through this area increased the compressive stresses in the vicinity of the farm crossing and led to the track buckling under the passing train.

Track Maintenance and Regulatory Overview

Both Transport Canada and CSX acknowledged the rail anchoring condition and Transport Canada had issued CSX a Notice that identified rail anchoring as a concern. While CSX repaired a number of problem areas, implemented several voluntary slow orders and had planned remedial track maintenance for 2007, at the time of the derailment, the rail anchoring concern had not yet been addressed. Neither Transport Canada nor CSX foresaw the impending risk of a track buckle occurring as they were not cognisant of the effect that the transfer of the crew change point, the associated train braking and the predominantly southward traffic tonnage had on the track in the absence of rail anchors.

Since much of the subdivision contained rail known to be susceptible to the rapid growth of transverse defects, the most common track maintenance challenge facing CSX was broken rail. CSX understood and managed the risk by testing the rail monthly and by replacing defective and broken rails. Similarly, the rail anchoring on this subdivision had been in this condition for some time and it had been managed with relatively few problems. In addition, the subdivision had a maximum speed limit of 25 mph, which was the speed limit required by the CSX MWI when insufficient anchoring was present in CWR. Since this area contained jointed rail, which is generally less prone to track buckling than CWR, it was perceived that adequate safety measures were in place to protect against track buckling particularly if pull-aparts repaired in the winter were adjusted before the onset of hot weather.

Transport Canada identified that rail anchoring on the Montréal Subdivision was insufficient according to the TSR. However, the TSR is subjective and does not provide a threshold for rail anchor application that distinguishes clearly between safe and unsafe track. Consequently, the adequacy of rail anchoring is subject to interpretation by each track inspector. In addition, the same TSR rail anchoring criterion applies to all classes of track, in both CWR and jointed territory. Because rail anchoring is a greater priority for CWR and higher classes of track, an inspector's perception of risk may be reduced when dealing with insufficient anchoring in a lower class of jointed track.

Findings as to Causes and Contributing Factors

1. Due to lateral forces exerted by the wheels as the train passed over alignment deviations, the track shifted, causing the derailment.

2. In the absence of rail anchors, the heavy southward traffic and train braking on the downward grade caused the rail to move southward and bunch immediately north of the farm crossing, increasing the compressive stress in the rail.

3. The addition of nine inches of rail on the east rail, which was scheduled for removal before the onset of hot weather, further exacerbated the compressive stresses in the vicinity of the farm crossing and contributed to the development of the track buckle.

Findings as to Risk

1. Neither Transport Canada nor CSX foresaw the impending risk of a track buckle occurring as they were not cognisant of the effect that the transfer of the crew change point, the associated train braking, and the predominantly southward traffic tonnage had on the track in the absence of rail anchors.

2. Since the subdivision had a maximum speed limit of 25 mph and contained jointed rail, which is less prone to track buckling than continuous welded rail (CWR), it was perceived that adequate safety measures were in place to protect against the risk of a track buckle occurring.

3. Because the rail anchoring criteria in the *Railway Track Safety Rules* are subjective and the same criteria apply to all classes of track, a track inspector's perception of risk may be reduced when dealing with insufficient anchoring of jointed rail in a lower class of track.

Safety Action Taken

In April 2007, the TSB issued Rail Safety Advisory (RSA) 02-07 to Transport Canada regarding the condition of the track on the Montréal Subdivision. The advisory identified that the anchoring condition was poor and may have played a role in the accident.

In June 2007, Transport Canada responded that its Rail Safety inspectors had inspected the track and that CSX had voluntarily reduced the speed to 10 mph on several portions of the subdivision.

In 2007, CSX performed track rehabilitation on the Montréal Subdivision from the Canadian border (Mile 183.2) to Beauharnois (Mile 225.2), which is the end of CSX operation in Canada. The rehabilitation included track surfacing as well as the installation of approximately 3800 feet of continuous welded rail, 7000 tons of ballast, 13 000 ties and 10 000 rail anchors. Additional anchors were installed on the north approach to Huntingdon yard limits, where trains reduce speed. Two track geometry inspections were performed, one of which also tested the lateral strength of the track using a gauge restraint measuring system (GRMS).

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 30 January 2008.

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