Transportation Safety Board
of Canada

Bureau de la sécurité des transports
du Canada

RAILWAY INVESTIGATION REPORT
R07Q0001

MAIN-TRACK TRAIN DERAILMENT

CANADIAN NATIONAL
FREIGHT TRAIN M-308-31-06
MILE 78.13, MONTMAGNY SUBDIVISION
MONTMAGNY, QUEBEC
07 JANUARY 2007

Canada

Railway Investigation Report

Main-Track Train Derailment

Canadian National
Freight Train M-308-31-06
Mile 78.13, Montmagny Subdivision
Montmagny, Quebec
07 January 2007

Report Number R07Q0001

Summary

On 07 January 2007, at 0133 eastern standard time, Canadian National freight train M-308-31-06 derailed 24 cars (19 loads and 5 empties) at Mile 78.13 on the Montmagny Subdivision, in the town of Montmagny, Quebec. Four of the derailed cars contained sulphuric acid. There were no injuries and no dangerous goods released. A workshop trailer was destroyed, and the VIA Rail Canada Inc. station building and two houses were slightly damaged.

Ce rapport est également disponible en français.

Other Factual Information

The Accident

On 07 January 2007, Canadian National (CN) freight train M-308-31-06 (the train) departed Joffre Yard, Quebec, and proceeded eastward on the Montmagny Subdivision destined for Edmundston, New Brunswick. The train consisted of 3 locomotives and 122 cars (72 loads and 50 empties), weighed 10 587 tons and was 8384 feet long. The operating crew, a locomotive engineer and a conductor, met fitness and rest standards and were qualified for their respective positions and familiar with the territory.

At 0133 eastern standard time,[1] while passing through the town of Montmagny (see Figure 1), a train-initiated emergency brake application occurred when the locomotive was at Mile 77.2 and travelling at 48 mph with the throttle in the idle position. The lead locomotive came to rest at Mile 76.85. The train crew followed emergency procedures, inspected the train and found that 24 cars (68th to 91st cars) had derailed.

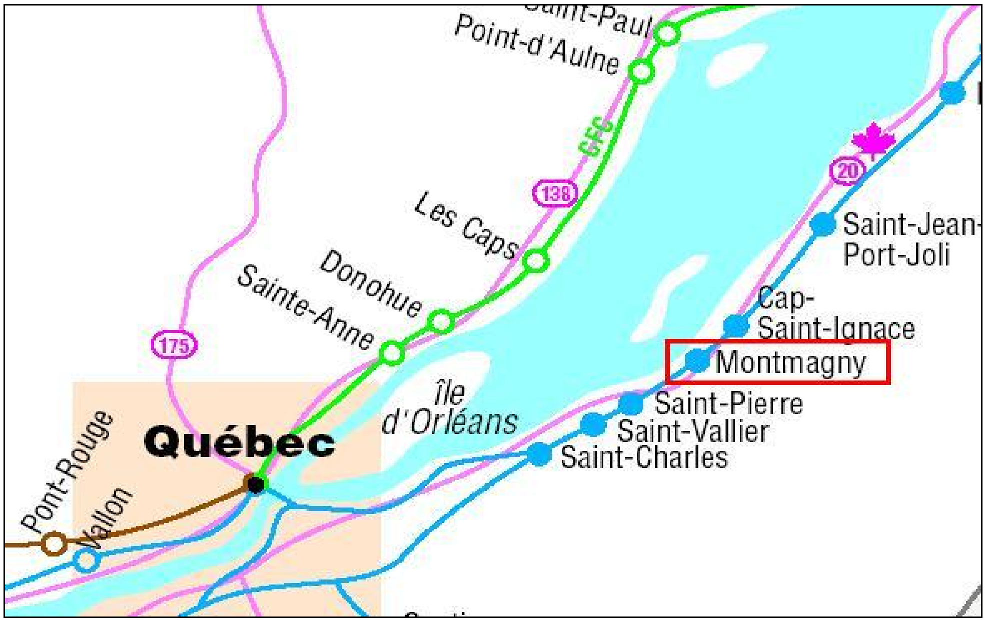

Figure 1. Location of derailment, Montmagny, Quebec (source: Railway Association of Canada, *Canadian Railway Atlas*)

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[1] All times are eastern standard time (Coordinated Universal Time minus five hours).

A workshop trailer, owned by CN, was destroyed, and the VIA Rail Canada Inc. (VIA) station building and two inhabited houses were slightly damaged. Approximately 600 feet of track, a main-track turnout, the deck and the west span of the bridge over the Rivière du Sud at Mile 77.8 were damaged. At the time of the accident, the temperature was approximately 2°C with cloudy skies.

The fire department was advised by local residents of the accident, and was on the scene within five minutes. Firemen received immediate information on the train and its cargo from the conductor. It was determined that no dangerous goods had been released and that no precautionary evacuation of local residents was necessary. The remaining work performed by fire and police services during the cleanup phase was limited to cooperating with the railway in ensuring site safety and limiting access to the site only to those residents living within the area and those involved in the cleanup until all public safety risks had been removed.

Site Examination

The derailed equipment consisted of four tank cars loaded with dangerous goods, three tank cars loaded with non-dangerous liquids, four centre beam flat cars, two automobile carriers, and eleven covered hopper cars. All the derailed equipment was examined; there were no pre-derailment defects observed on any car.

The first four derailed cars (68th to 71st cars) were tank cars loaded with sulphuric acid (UN 1830) and were located on the bridge. The tank shell of the 71st car, SHPX 207620, a Class 111A tank car, was deformed by impact after it had struck the northwest corner of the last span of the bridge. The tank shell was not breached and no product was released. The car was stripped of its trailing truck, which remained near the main-track turnout at Mile 78.13 leading to an industrial siding located on the north side of the main track. The cars behind the tank cars were derailed in an accordion pattern across the main track, the station platform, and into the street behind the station.

The turnout located at Mile 78.13 was a CN No. 12, 115-pound, hand-operated (CN Standard Plan Drawing TS-012) with the switch points facing east (see Appendix A). There were no records on the origin and history of the north switch point rail. It was rolled in 1965 but was probably never installed in track before its installation at the accident site in 2004. It had less than 2 mm of wear.

The track damage started in the vicinity of the turnout. The track structure was destroyed from that point, eastward, for a distance of 600 feet. The north switch point was broken into multiple pieces. Three joint bars were recovered. The inside joint bar from the north switch point was missing. One switch plate was broken and the adjacent switch plates were bowed downward and had heavily polished and worn surfaces. The four bolt holes at the outside joint bar at the heel block were asymmetrically elongated and two of the joint bars bolts were fractured.

The tie immediately beneath the heel block joint was severely damaged during the derailment; however, it showed signs of previous degradation and had several old longitudinal splits (see Photo 1). This tie was the only switch tie that did not shift laterally during the derailment.

Photo 1. Track ties beneath the heel block joint

Several broken components recovered from the heel block joint area were sent to the TSB Engineering Laboratory for analysis. The examination of the components revealed that pre-existing fatigue cracks were present at the end of the north switch point rail, on the broken switch plate, and on two joint bar bolts connecting the rails and the heel block (report LP 018/2007).

The north heel block had fractured in two due to overstress. The fracture surface contained a pre-existing crack with a dark surface, indicative of long-term oxidation. The heel block edges that were in contact with the rails had a smooth, polished appearance, consistent with long-term rubbing wear.

The end of the north closure rail had fractured in several parts. The vertical fracture surfaces had a rough texture consistent with fresh overstress failure while the horizontal fracture surfaces were damaged by extensive rubbing. No burrs or other anomalies were observed on bolt holes.

There was a fracture at the end of the north switch point rail at the connecting joint with the closure rail. The fracture extended horizontally through the two bolt holes, then propagated vertically at the bond wire hole (see Photo 2).

Photo 2. Fracture through the bolt holes

The holes were plastically deformed but there were no burrs around them. Although the fine surface details on the rail fracture surfaces had been obliterated, the smooth, polished appearance of the fracture surfaces was indicative of pre-existing fatigue cracks, whose surfaces were rubbing over an extended period. The base of the fractured north switch point rail and the south switch point rail were compared; the indications of long-term rubbing wear were more severe on the north switch point rail.

The metallurgical analysis revealed that the north switch point rail was a carbon steel rail while the closure rail was a standard rail. No manufacturing defects or anomalies such as inclusions or porosities were found. The switch point rail material was coarse grained (American Society for Testing and Materials [ASTM] grain size of 1 to 2) with an average internal Brinell hardness of 255 BHN while the closure rail material was fine grained (ASTM grain size of 4 to 5) with a hardness of 341 BHN. Fine grained steels are found in rail that has been manufactured using more modern processes. They are less susceptible to cracking and are tougher[2] than coarse-grained steels.

On main lines, carbon steel rail is no longer used. Standard rail is laid on tangent track while high strength rail is normally used on curves and on special track work such as frogs or switch points. On main lines having tonnage higher than 7 million gross tons, CN Maintenance of Way Standard Practice Circular (SPC) 3200, Appendix B, requires "New Rail"[3] for the straight and the curved closure rails. On main lines having tonnage higher than 10 million gross tons, Appendix C of the same SPC calls for "New" standard rail (minimum Brinell hardness of 300 BHN) for tangent track and curves less than two degrees and for high strength rail (minimum Brinell hardness of 341 BHN) on curves higher than two degrees.

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[2] Fracture toughness is the resistance to brittle fracture (the degree of difficulty with which cracks propagate through a material).

[3] "New Rail" is defined as rail that has not been in service, regardless of its manufacturing date.

There is no specific mention in CN’s SPCs about the specifications required for switch point rail; however, the practice is to use standard rail or high strength rail. Canadian Pacific Railway (CPR) SPC 9 requires “Premium Rail” on turnouts located in main lines (premium rail has a minimum Brinell hardness of 370 HB).

Track Information

The Montmagny Subdivision consists of a single main track that extends from the junction with the Chemin de fer de la Matapédia et du Golfe (Mile 1.3) near Rivière-du-Loup, Quebec, to Joffre Yard (Mile 118.0). Train movements are governed by the Centralized Traffic Control System as authorized by the *Canadian Rail Operating Rules* and are supervised by a rail traffic controller located in Montréal, Quebec. The track is Class 4 according to the *Railway Track Safety Rules* (TSR) approved by Transport Canada (TC). Between Mile 15.3 and Mile 86.3, the maximum allowable speed is 80 mph for passenger trains and 60 mph for freight trains. Rail traffic consists of 12 freight and 2 passenger trains per day with an annual tonnage of about 25 million gross tons.

In the area of the derailment, the track consisted of 115-pound continuous welded rail manufactured in 1991 (RE Sydney Steel). The rail was laid on tie plates, fastened to the ties with two spikes and box-anchored every third tie. There were approximately 3200 ties per mile. The ballast consisted primarily of crushed rock ranging from 1 to 2 ½ inches in diameter, approximately 12 inches deep, with 18- to 24-inch shoulders.

The TSR govern the frequency of track geometry inspections, rail flaw testing, and visual track inspections, based on the tonnage and the class of track involved. The TSR require that:

- Track geometry inspections be carried out at least twice a year.
- Rail flaw detection be carried out at least once a year.
- Regular visual track inspections be performed by a qualified inspector twice weekly with at least two calendar days’ interval between inspections.
- Turnouts be inspected monthly on foot to observe the overall condition. A thorough detailed observation of the condition of each component is performed annually; in addition, inspectors must look at all turnouts while carrying their regular visual inspections.

All inspections were performed on the Montmagny Subdivision in accordance with the TSR.

Track geometry inspections were performed four times in 2006, with the most recent one done on 09 November 2006. No defects were reported. Track geometry inspections are carried out by a track evaluation car (TEST car). The instruments used include sensors, computers, monitors, printers, and recording equipment to measure and record several characteristics of the track geometry under traffic.

In 2006, eight rail flaw tests were carried out. The last in the derailment area was performed on 05 December 2006. No defects were noted. A review of the test records indicate that, in the vicinity of the north heel block, the only response signals observed were those generated by the bolt holes. There was no anomaly and the rail surface was in good condition.

The basic rail flaw testing system consists of a test vehicle equipped with ultrasonic probes, an ultrasonic signal generation unit, a signal processing unit and a host computer. All testing parameters are calculated in real time and can be analyzed either on board the rail vehicle or during post-test processing activities. Testing for internal rail defects on CN is performed by various contractors. Their fleet of hi-rail vehicles is equipped with state-of-the-art ultrasonic detection equipment that provides real-time analysis of the rail section. The test vehicles are equipped to operate in the extreme climatic conditions that are common throughout North America.

Rail flaw testing has been steadily enhanced to reduce accidents caused by rail defects but still has limitations, and a 100 per cent accuracy rate is beyond current equipment capability. Testing accuracy remains dependent on the skill, training, and experience of the operators to properly interpret data and identify defects. Testing accuracy is also affected by rail conditions because grease or dirt on the rail head, head checking and internal shelling can interfere with the ultrasonic signal. Defects must be large enough and oriented so that they present a reflective surface large enough to be detected.

The turnout was seldom used but was visually inspected on foot monthly. Several defects were reported during the turnout inspections performed in the 12 months preceding the accident (see Appendix B). According to the maintenance reports, most of these defects were corrected. In particular, the broken bolts at the heel block were replaced in November 2006. No records were found concerning the poor tie and the surface conditions reported in May 2006. The last monthly inspection was done on 18 December 2006; the only observation noted was the ½-inch open gauge condition that was reported since May 2006. There was no record of routine inspection of the turnout during the latest visual track inspection carried out on a hi-rail vehicle approximately three days before the accident, on 04 January 2007, and no exceptions were noted in the vicinity of the turnout.

Since its departure from Joffre, the train passed over several wayside inspection systems (WISs), the latest located at Mile 81.58, with no alarms generated.

Derailments in Montmagny

On 07 February 2004, CN freight train A-403-21-07, travelling at a speed of 58 mph, derailed 27 freight cars, including a pressure tank car loaded with chlorine, at Mile 77.8. Approximately 1500 feet of track and two public crossings were damaged. Three spans of the railway bridge over the Rivière du Sud were destroyed. There was no release of dangerous goods, and no one was injured. The derailment was due to a wheel lift caused by truck hunting while the run-in of train slack was taking place following the application of locomotive dynamic brakes (TSB investigation report R04Q0006).

As this latest derailment occurred in the limits of the municipality of Montmagny, less than half a mile from the location of the 2004 derailment, the mayor and the city council of Montmagny, as well as the Member of Parliament for the electoral district of Montmagny–L'Islet–Kamouraska–Rivière-du-Loup, addressed letters to CN, TC and the Transportation Safety Board of Canada (TSB) requesting a speed reduction to 40 mph through Montmagny to minimize the risks to the local population.

Risk Mitigation Strategies

Risk mitigation encompasses measures to reduce the frequency of accidents and measures to minimize the consequences of an accident.

In order to minimize the frequency of accidents, industry has enhanced the automated inspections carried by test vehicles to check the track condition; in addition, the railways have installed across their network wayside inspection systems (WISs) and wheel impact load detectors (WILDs) to check the condition of rolling stock.

WISs include dragging equipment detectors, hot box detectors, and hot wheel detectors. The dragging equipment detector detects any object hanging under a car or a locomotive. The function of hot box detectors and hot wheel detectors is to detect overheated bearings or wheels. Abnormally high temperatures indicate inadequate lubrication of the bearings or journals or brake pads stuck to wheel treads. WISs are installed every 10 to 20 miles on the Montmagny Subdivision. Two additional WISs were installed after the 2004 derailment, on each side of the municipality of Montmagny—one at Mile 75.02 and the other one at Mile 81.58.

The WILDs measure the impact load generated by each wheel of a car. This system helps in identifying flat, shelled, spalled, out-of-round and built-up-tread wheels so that defective wheels may be removed before they cause damage to rolling stock or track infrastructure. The Montmagny Subdivision is protected by two WILDs, one between Québec, Quebec, and Montréal and the other one between Moncton and Edmundston, New Brunswick (also installed after 2004).

Measures designed to reduce the consequences of accidents involving trains carrying dangerous goods have also been examined by the industry and the regulators in Canada and in the United States. Particular efforts are focused on the adoption of operational measures such as speed reduction and car marshalling or on the improvement of the crashworthiness of tank cars transporting dangerous goods.

Speed Reduction

Analysis conducted on Federal Railroad Administration (FRA) accident data for 839 main-line freight derailments[4] over the period 1992-2001[5] revealed that a statistically significant linear relationship existed between derailment speed and the average number of cars derailed. Furthermore, the speed of derailment and number of derailed cars highly correlated with dangerous goods releases. These results were also confirmed by a chi-square test of independence, performed on TSB data on main-track derailments from 1997 to 2006, which indicated that higher train speeds are significantly associated with higher numbers of cars derailed. Two other research studies conducted to address operational measures to reduce the vulnerability of tank cars transporting hazardous materials in the United States[6, 7] concluded that the rear one-quarter of a train is the most desirable location for cars containing hazardous materials and that reducing the speed and size of trains can reduce the number of cars derailed in an accident.

On the other hand, a higher class of track, which allows a greater track speed, results in a lower probability of derailment. According to TSB data for the period 1997-2006, the rate of accidents (main-line derailments per million gross tons miles) was lower on high-speed tracks. For Class 4, 5 and 6 tracks (speed over 40 mph), the rate was seven times lower than in Class 1, 2 and 3 tracks (speed below 40 mph). Several other studies have shown that similar results were observed in the United States.[5]

Based on recommendations of the Inter-industry Task Force on the Safe Transportation of Hazardous Materials by Rail, in January 1990, the Association of American Railroads (AAR) issued Circular OT-55, *Recommended Railroad Operating Practices for Transportation of Hazardous Materials.* The circular, last amended in September 2007, included road and yard operating practices, designation of key routes, and speed reduction for specific trains.[8] It recommended a

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[4] Occurrences in which at least one dangerous goods car was damaged or derailed.

[5] C.P.L Barkan, C.T. Dick, and R. Anderson, *Railroad Derailment Factors Affecting Hazardous Materials Transportation Risk*, Transportation Research Record 1825, Paper No. 03-4429, Transportation Research Board, National Research Council, Washington, D.C., 2003.

[6] R.E. Thompson, E.R. Zamejc, and D.R. Ahlbeck, *Hazardous Materials Car Placement in a Train Consist*, Volume 1, Review and Analysis, Report DOT/FRA/ORD/92/18.I, Federal Railroad Administration, U.S. Department of Transportation, Washington, D.C., 1992.

[7] F.F. Saccomanno and S. El-Hage, *Minimizing Derailments of Railcars Carrying Dangerous Commodities Through Effective Marshaling Strategies*, Transportation Research Record 1245, Transportation Research Board, National Research Council, Washington, D.C., 1989.

[8] These trains, named "Key Trains," are defined as trains having five tank car loads of poison inhalation hazard (PIH), or 20 car loads of a combination of PIH, flammable gas, explosives, and environmentally sensitive chemicals, or one or more car loads of high-level radioactive waste.

speed limit of 50 mph for trains having more than a specified number of cars of some specific dangerous goods, mostly products that are poisonous by inhalation (over 200 products, including chlorine and anhydrous ammonia).

In Canada, a speed reduction is applied in high-consequence areas (mainly large municipalities) to trains carrying "special dangerous commodities." For instance, the Montmagny Subdivision timetable specifies that the maximum speed of this type of train must not exceed 35 mph between Mile 75.0 and Mile 82.0, unless an inspection is performed by the crew, car inspectors or WISs before entering that zone. Since the installation of WISs at Mile 75.02 and Mile 81.58, trains carrying special dangerous goods are allowed to travel at speeds up to 60 mph through Montmagny because they receive inspections just before entering the city limits.

Tank Car Crashworthiness

Over the years, industry and government have worked together to enhance both the physical tank car and the environment in which it operates. Railway tank cars used to transport dangerous goods are built to different standards depending on the usage. Class 111A tank cars are general-purpose tank cars used to transport flammable liquids, acids and other corrosives. These tank cars are non-pressurized, and can be insulated or non-insulated. They are not normally equipped with head shield protection. The tank shells and heads are generally constructed with 7/16-inch-thick AAR TC-128 Grade B steel. These cars do not have protective housings to safeguard the top fittings from impact damage. Protuberances are located on both the top and bottom of the tanks and are vulnerable to damage in the event of a derailment.

Class 111A tank cars are not considered to provide the same degree of protection against loss of product as tank cars built according to Class 105, 112 or 114 specifications. Cars constructed to these latter three specifications transport flammable, poisonous and corrosive gases, or highly poisonous liquids, and are often equipped with head shields, thermal protection and protected valving in the manway area.

On several occasions, TSB investigations have revealed the vulnerability of Class 111A tank cars when used in the transport of dangerous goods. Investigations R94C0137, R95D0016, R99D0159, R04Q0040, and R05H0011 identified these cars as susceptible to puncture and more likely to release content when involved in an accident. Following its investigations into occurrences R94C0137 (Lethbridge, Alberta) and R04Q0040 (Lévis, Quebec), the Board issued recommendations to the regulator to reduce the risks to the public from derailments and release of dangerous goods.

Remedial action was taken by TC and the industry. The number of products that Class 111A tank cars are allowed to transport was reduced when the *Transportation of Dangerous Goods Regulations* were amended and new tank car construction standards were established. New requirements applicable to higher gross weights, which have been incorporated into the AAR Specifications for Tank Cars M-1002-2003, include higher puncture resistance through better material selection, half-head shields, and improved protection of service equipment such as valves.

In June 2006, the FRA started an in-depth assessment of the construction standards of pressure tank cars used to transport hazardous goods, with a view to minimizing the risk of spills occurring during derailments. TC is working closely with the FRA to address the same issues and ensure harmonization. In addition, TC, the FRA, Dow Chemical Company, Union Pacific Railroad Company and Union Tank Car Company signed a memorandum of cooperation in April 2007 to develop a better understanding of the factors contributing to high-pressure tank car safety and to enhance the effectiveness of railway-specific hazardous material bulk packaging under the project "Next Generation Tank Car." The Union Tank Car Company has suggested that a prototype of the new car should be in production in 2009. The car will feature improvements in puncture resistance, safety appliance, and valve and fitting designs as well as shell and head construction using improved, stronger steels.

In March 2008, a proposed rule was developed by the U.S. Department of Transportation in consultation with the FRA to address issues raised by the National Transportation Safety Board (NTSB), after the accident in Graniteville, South Carolina, which resulted in the death of nine people due to chlorine gas inhalation. The proposed rule would require tank cars transporting chlorine, anhydrous ammonia, and other liquefied gases designated as poisonous by inhalation to be equipped with puncture-resistance protection that would prevent puncture at speeds more than double the existing stipulated speeds. The average amount of energy a tank car must absorb during an accident before failure will increase by 500 per cent. The proposed rule also sets a maximum speed limit of 50 mph for cars carrying products poisonous by inhalation. For cars that do not meet the puncture-resistance standard, a temporary speed restriction of 30 mph must be applied in dark (non-signalled) territory.

Analysis

Neither the condition of the rolling stock nor the manner in which the train was operated is considered contributory to this accident. Defects were observed in several pieces of rail and track components recovered in the vicinity of the north heel block. The analysis will focus on track components defects, track inspection, and risk mitigation strategies.

The Accident

The laboratory examination of the fractured components recovered in the north heel block joint area revealed that pre-existing fatigue cracks were present. The fracture surface on the north heel block contained a pre-existing crack with a dark surface due to long-term oxidation. Although the fine surface details on the fracture surfaces of the switch point rail had been obliterated, the smooth, polished appearance of the fracture surfaces was indicative of pre-existing fatigue cracks, whose surfaces were rubbing over an extended period.

The condition of the switch plates, the plastic deformation of the bolt holes, and the degradation of the switch tie located immediately under the heel block were indicative of inadequate track support and pumping under traffic. The repetitive movement under each passing truck led to the looseness and the fracture of the bolts of the north heel block joint and increased the risk of crack development. Once initiated on the north switch point rail, the cracks propagated horizontally between the bolt holes and then vertically at the bond wire hole, breaking the rail and causing the derailment of the train.

Turnout Inspection

The pumping in the north heel block area due to the degradation of the switch tie and the looseness of different components exacerbated load impact and contributed to the development of fatigue cracks.

The turnout was visually inspected on foot regularly. The inspections, carried out by experienced engineering inspectors, were thorough and led to the identification and correction of several defects, including broken bolts at the north heel block joint, which were replaced in November 2006. However, the looseness condition in the north heel block area did not attract the inspectors' attention. It is most likely that the inspectors were not alerted by its severity because the turnout was seldom used and was almost permanently lined for the main track. Furthermore, the pumping, being within acceptable limits, was never reported by the track geometry car during the four inspections performed in 2006, so the awareness of the inspectors was not raised.

Switch Point Rail Specifications

There were no manufacturing defects or anomalies such as inclusions or porosities that could have caused the metal fatigue. However, the metallurgical and mechanical properties of the north switch point rail and the closure rail were very dissimilar in terms of grain size and Brinell hardness. The north switch point rail, being a carbon steel rail, had a coarser grain and a lower internal Brinell hardness. Therefore, its tensile strength and fracture toughness were lower, which made it more susceptible to crack propagation.

There is no specific requirement in CN's SPCs about the specifications for switch point rail; in addition, the criteria laid out in SPC 3200 do not provide clear guidelines on rail usage. For instance, Appendix B requires "New Rail" for the straight and the curved closure rails, without any mention about Brinell hardness, while Appendix C calls for "New" standard rail (minimum Brinell hardness of 300 BHN) for tangent track and curves less than two degrees but does not refer to any switch component. In the absence of clear specifications and guidelines, the common practice to use standard rail on tangent track and high strength rail on high-degree curves and on special track work such as frogs or switch points was not respected, which may explain why the switch point installed in 2005 was made of carbon steel even though this type of steel is no longer used on main lines. Had the mechanical properties of the switch point rail matched those of the closure rail, the cracks would have been less likely to develop.

Rail Flaw Detection

The cracks observed on the north switch point rail grew horizontally between the bolt holes. They were concealed by the rail joint bars and could only be detected by rail flaw testing. Eight rail flaw tests were carried out in 2006; the last rail flaw test was performed less than five weeks before the derailment and did not detect the presence of any defect. The rail surface was in good condition and there were no head checking or internal shelling that could have interfered with the ultrasonic signal and affected the test accuracy. Moreover, the testing records of the rail in the north heel block area were also reviewed and did not show any anomaly that could have been missed by the operator. Therefore, the absence of detection cannot be attributed to operator misinterpretation or to signal interference due to surface or internal shelling. It is likely that the defects were too small to be detected or they were not present at the time of the testing. Crack propagation was accelerated by the pumping and looseness of the heel block joint and the low mechanical properties of the north switch point rail.

Risk Mitigation Strategies

Efforts by the industry and the regulators in North America to reduce the risks to the public from derailments and release of dangerous goods are ongoing. The railways have multiplied WISs across their network, two of which were just recently installed on each side of the municipality of Montmagny. They have steadily enhanced the frequency and accuracy of automated inspections performed by on-track vehicles to capture critical track defects and minimize the frequency of accidents.

Particular efforts were focused on the improvement of the crashworthiness of tank cars transporting dangerous goods following recommendations issued by the TSB and the NTSB on tank safety. The measures taken to date and the future enhancements in the detection of unsafe conditions and the improvement of the crashworthiness of the tank cars will not eliminate the risks of derailments immediately, but are positive steps to reduce them further.

The severity and consequences of a derailment are related to speed as the energy dissipated during a derailment depends on the kinetic energy of the train in movement, thus its speed and mass. This has been confirmed by several studies that show that the number of cars derailed, an indicator of accident severity, is highly correlated with speed. However, historical data clearly indicate that the rate of accidents is higher on low-speed tracks. This is due to the fact that track maintenance standards are less stringent for lower classes of track. Therefore, while speed reduction would reduce the severity and consequences of derailments, it would not necessarily result in a reduction of the number of derailments unless the track is maintained at a level higher than what is required by the TSR. Speed reduction can negatively affect the capacity and the ability to transport passengers and goods efficiently. However, the negative impacts on railway operations can be minimized if the speed reduction is applied selectively to trains that present high risks.

Measures to minimize the frequency of accidents or to reduce the consequences of derailment and dangerous goods release can be taken individually or collectively. Additional safety benefits can be achieved when speed reduction is coupled with other mitigation measures, as is intended in the FRA proposed rule on tank car safety.

Findings as to Causes and Contributing Factors

1. The train derailed when the north switch point rail broke under the train.

2. The inadequate track support and pumping under traffic led to the looseness and the breaking of the bolts of the north heel block joint and increased the risk of fatigue crack development.

3. The north switch point rail, being a carbon steel rail, had a low tensile strength and poor fracture toughness, which made it more susceptible to crack propagation.

4. It is most likely that the inspector was not alerted to the severity of the looseness condition of the heel block joint because the pumping, being within acceptable limits, was never reported by the track geometry car and the turnout was seldom used.

Findings as to Risk

1. In the absence of clear specifications and guidelines, the common practice to use standard rail on tangent track and high strength rail on high-degree curves and on special track work such as frogs or switch points is not consistently respected.

2. Speed reduction would reduce the consequences of derailments but would not necessarily result in a reduction of the number of derailments unless the track is maintained at a level higher than that required by the *Railway Track Safety Rules*.

Other Finding

1. Because the crack propagation was accelerated by the pumping and looseness of the heel block joint and the lower mechanical properties of the north switch rail, the rail flaw testing did not capture the crack in time.

Safety Action Taken

A temporary slow order at 40 mph was set after the derailment and is still in force. The entire turnout was removed and replaced by standard track and all rail joints were eliminated in the Montmagny area to reduce track discontinuities and improve track quality. The frequency of inspection has been increased; the track will be inspected twice per month on foot and will be ultrasonically rail tested 12 times a year. Canadian National (CN) has amended switch designs and removed heel blocks.

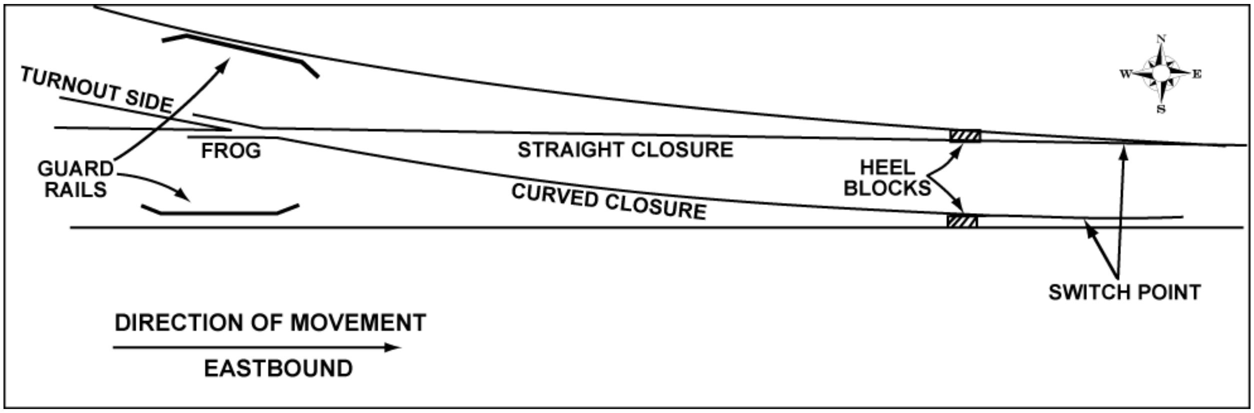
Safety Concern

Even though in practice CN requires that premium rail be used for all new or replacement switch points and other special track work, there is no specific requirement in the Standard Practice Circulars (SPCs) about the specifications for switch point rail. In addition, the criteria laid out in SPC 3200 do not provide clear guidelines on rail usage. Consequently, critical safety information is not disseminated to field employees, allowing conditions similar to those in this occurrence to exist. Without clear guidelines and specifications, an additional safety mechanism was rendered ineffective because maintenance employees at different levels of supervision were not provided with the tools to assess the adequacy of the north switch point rail.

The Board is concerned that, without a comprehensive and formalized set of guidelines and specifications, the railway's ability to maintain safe practices such as the use of premium rail on switch points and other special track work will not be consistently respected, which increases the risks of mishaps.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 31 July 2008.

Appendix A – Turnout Diagram



Appendix B – 2006 Monthly Inspection Records of Turnout at Mile 78.13

Month	**Condition Reported**
March	Switch pedal adjustment
April	Need for tie plugs
May	Poor tie condition
May	Surfacing
May	Rebuild the frog point
May	Need resurface and alignment
May	½-inch open gauge
June	Replace switch plate 567R
June	Bolts need to be tighten
September	Rebuild north switch point
September	Frog to be weld
October	Missing bolts at the frog
October	Install Pandrol plate at the guard rail
October	Line the guard rail
November	Replace bolts at guard rail
November	Replace broken bolts at north heel block