Transportation Safety Board of Canada | Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R04Q0006

MAIN-TRACK DERAILMENT

CANADIAN NATIONAL
FREIGHT TRAIN A-403-21-07
MILE 77.8, MONTMAGNY SUBDIVISION
MONTMAGNY, QUEBEC
07 FEBRUARY 2004

Canada

Railway Investigation Report

Main-Track Derailment

Canadian National
Freight Train A-403-21-07
Mile 77.8, Montmagny Subdivision
Montmagny, Quebec
07 February 2004

Report Number R04Q0006

Summary

On 07 February 2004 at 1617 eastern standard time, Canadian National freight train A-403-21-07, travelling westward on the Canadian National Montmagny Subdivision, derailed 27 freight cars, including a pressure tank car loaded with chlorine, at Mile 77.8 in the city of Montmagny, Quebec. All of the derailed cars were damaged. Approximately 1500 feet of track and two public crossings were damaged. Three spans of the railway bridge over the Du Sud River were destroyed, and the remaining six spans were damaged. There was no release of dangerous goods, and no one was injured.

Ce rapport est également disponible en français.

Other Factual Information

The Accident

On 07 February 2004, at about 1430 eastern standard time,[1] Canadian National (CN) freight train No. A-403-21-07 (the train) departed Rivière-du-Loup, Quebec, destined for Joffre, Quebec. The train was 5489 feet long and weighed 9102 tons. It consisted of 2 locomotives, 70 loaded cars, and 24 empty cars. The operating crew, a locomotive engineer and a conductor, met established fitness and rest standards, were qualified for their respective positions, and were familiar with the route.

As the train approached Montmagny (see Figure 1), the locomotive engineer began to slow the train, using the locomotive dynamic brake. The crew felt a moderate run-in of train slack as the dynamic brake was applied. While passing through the city with the dynamic brake still applied, the train experienced an undesired emergency brake application. The crew carried out the emergency procedures and subsequently determined that 27 cars had derailed on the bridge over the Du Sud River, at Mile 77.8.

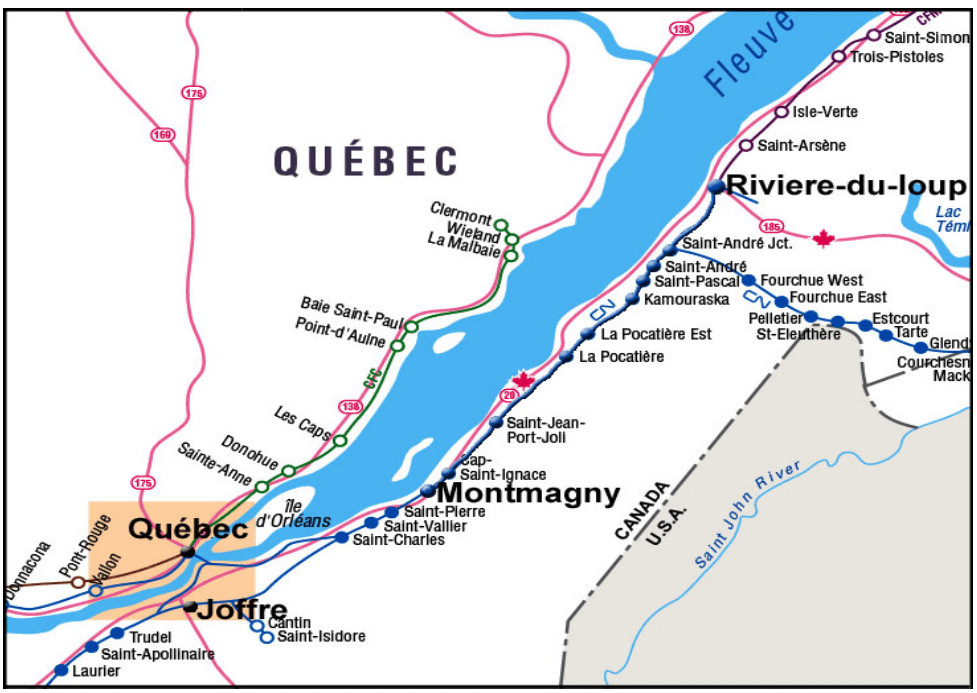

Figure 1. Map of derailment area (Source: *Canadian Railway Atlas*, Railway Association of Canada)

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

The locomotive event recorder data showed that the train was at full throttle from Mile 72.2 to Mile 76, attaining a maximum speed of 60 mph. The throttle was reduced gradually to IDLE, then the locomotive dynamic brake was applied while the train was moving at a speed of 59 mph. At Mile 76.02, the train was moving at 58 mph with the dynamic brake applied. While the train was moving at a speed of 53 mph with the dynamic brake still applied, the brake pipe pressure dropped rapidly to zero pounds per square inch (psi) at Mile 77.5. The locomotive came to a complete stop at Mile 78.1.

Train Operation

The Montmagny Subdivision consists of a single main track that extends from Rivière-du-Loup, Mile 1.3, to West Junction, Quebec, Mile 118.0. It carries two VIA Rail Canada Inc. passenger trains and 12 to 16 freight trains per day. Train movements are governed by the Centralized Traffic Control System in accordance with the *Canadian Rail Operating Rules* and are supervised by a rail traffic controller located in Montréal, Quebec. In the area of the derailment, the maximum authorized time table zone speed was 80 mph for passenger trains and 60 mph for freight trains. A temporary slow order of 40 mph for freight trains was in effect at Mile 78.56, due to track conditions.

Particulars of the Track

The track is tangent from Mile 72.8 to Mile 79. It crosses two rivers in the city of Montmagny, on bridges located at Mile 77.5 and Mile 77.8.

The track structure consisted of 115-pound continuous welded rail (CWR) laid on 14-inch double-shouldered tie plates, secured with four spikes per tie, and anchored every third tie. There were approximately 3120 ties per mile. The ties were properly anchored and the track was properly ballasted.

The track in the derailment area was tested by the CN track geometry car on 27 November 2003 and no track geometry defects were noted. The last ultrasound rail inspection was performed on 01 December 2003. A defective field weld was found at Mile 78.46, and repairs were effected on 03 December 2003. The assistant track supervisor last inspected the track by hi-rail vehicle on the day of the derailment, and no defects were noted.

The track crosses the Du Sud River at Mile 77.8 over a steel bridge consisting of nine through plate girder spans for a total length of approximately 593 feet. A detailed inspection of the structure was performed on 26 July 2002, and the last visual inspection was on 17 October 2003. The bridge capacity was considered adequate for 286 000 pounds loading at time table speed. The bridge was regularly maintained, the last repairs being performed in 2003.

Occurrence Site Information

The first marks on the track structure started at Mile 76.02. There were several tie plates gouged, and light wheel marks on the ties on the field side of the north rail and gauge side of the south rail. There were no wheel flange marks on the running surface of the rails. The marks continued westward for a distance of approximately 1.75 miles. The sliding expansion joint and the south guard rail of the bridge at Mile 77.5 were damaged. The marks continued across the bridge to the public road crossing at Mile 77.62. Between this crossing and the public crossing at Mile 77.7, there were rail car truck parts and air brake parts strewn along the right-of-way.

The track was destroyed over a distance of 1500 feet. The crossings and the bridge at Mile 77.8 were damaged. The entire timber deck of the bridge and the pedestrian walkway located on the north side were destroyed. Three spans were damaged beyond repair and required total replacement. The other six spans sustained major damage. During the derailment cleanup and bridge repair work, traffic was rerouted over the river on a bypass track constructed on a temporary causeway built using fill material from a local quarry, with a sufficient number of culverts to ensure proper hydraulic flow of the river. The causeway and culverts were removed and the stream bed was restored to its original condition and profile once the repairs to the bridge were completed.

Rolling Stock Damage

All 27 derailed cars were damaged beyond repair. The stub sill of the pressure tank car loaded with chlorine was twisted and forced upward, and the protective head shield was damaged slightly. There was no tank perforation or release of product. The damaged tank car was moved to a safe location where the cargo was transshipped.

The first derailed car was an empty wood chip gondola car, CN 879261, the 7th car behind the locomotives. The car had been stripped of its brake equipment and trucks. The front portion of the body centre plate and the rim of the truck bolster centre bowl of the A-end of the car showed a matching wear pattern and polished contact faces. The centre pin holes in the centre plate casting and the body bolster were distorted in the direction of the train movement (see Photo 1). The distortion was fresh, with no corrosion present. The extensive damage to the truck and the scattering of components from similar trucks precluded its reconstruction.

Photo 1. Centre pin hole in the body bolster

There was no pre-derailment damage or defects observed on the other derailed cars.

Car Inspection

On 03 February 2004, four days before the accident, car CN 879261 received a safety inspection by a certified car inspector at Joffre, while en route for delivery to the customer at Rivière-du-Loup. No exception was reported. On the day of the occurrence, the car was inspected by the train crew, which performed a safety inspection at Rivière-du-Loup at the interchange with the Chemin de fer de la Matapédia et du Golfe (CFMG). No defects were noted during this inspection. On its route from Rivière-du-Loup, the train passed over four wayside inspection sites. No overheated bearing or dragging equipment alarms were generated. There was no record of the car having been involved in a prior occurrence.

Customer Car Handling

Wood chips are shipped by rail from the Abitibi region in northwestern Quebec to a paper mill in Rivière-du-Loup using CN wood chip cars, including CN 879261. The mill may require between 10 and 20 cars of wood chips per week, which are set off in a single-ended rail spur built off the east leg of the wye track. The cars are unloaded by a permanently mounted rotating overhead clam. The clam, designed specifically for forestry operations, has a capacity of 7500 pounds at maximum boom extension of 40 feet.

The cars are moved under the clam using a dedicated double-cable winch system capable of handling a maximum of five loaded wood chip gondola cars. The cars are normally left coupled together and moved as a group.

The facility operates year round. When unloading wood chips in winter operating conditions, there are sometimes problems with wood chips freezing to the sides and bottom of the car. However, the operators are usually capable of removing almost all of the product from the car, using the clam bucket, without lifting the car body or excessively shaking the product loose.

The cars are normally pulled from the east end of the wood chip spur by the CFMG crew. On the day of the accident, the cars were handed off to the CN crew and placed on the head end of the train. During switching, the cars are moved through two number 10 turnouts and a curve of 3 degrees, 15 minutes.

While the area had experienced some snow followed by freezing rain in the two weeks before the derailment, which had caused some problems due to icing, no cars had derailed on the spur. There was no report of the cars being involved in an occurrence or other information related to rough handling of cars during loading and unloading operations or during switching.

CN Wood Chip Fleet

CN owns and operates approximately 620 wood chip cars similar to CN 879261. The cars are part of three series, CN 878000–878299, CN 879250–879749, and CN 880006–880314, which differ slightly in construction detail but have identical dimensions and capacities. They have an overall length of 65 feet, 7 inches maximum, with an inside length of 61 feet, 7 inches maximum, with an empty weight of 63 500 pounds. They were manufactured in 1975, designed in accordance with accepted Association of American Railroads (AAR) standards in place at that time.

The cars ride on Dofasco-manufactured, Barber-patented, S-2 model three-piece trucks on 33-inch wheels equipped with roller bearings measuring 6 inches by 11 inches. They have standard single-roller side bearings and friction wedges, and are not equipped with any specialized stabilization systems such as constant contact side bearings (CCSBs) or centre plate extension pads (CPEPs).

In 1974, the original manufacturer advised the industry in its commercial product information that the truck design was subject to truck hunting at speeds in excess of 55 mph and recommended that end users install CPEPs to raise the hunting threshold by 15 mph. There are no operating or interchange restrictions on these cars. While CPEPs are not AAR-approved hunting stabilisation devices, they are known to raise the truck hunting threshold speeds.[2]

CN wayside system records show that these cars have been operated since 1991 on primary main lines where the maximum permissible speed is in excess of 50 mph. In eastern Canada, they were used principally on secondary main lines where the maximum freight train speed did not exceed 50 mph. Recently, the use of these cars was expanded to serve customers located on the Montmagny Subdivision. While cars of this series have been involved in several other derailments, none of these derailments were caused by truck hunting.

These cars are classified as gondola cars, Class GTS, according to the AAR *Official Railway Equipment Register*.

High-Speed Truck Hunting

Truck hunting is wheel set oscillation caused by the dynamic response of a railway car truck when operating above certain speeds. The truck oscillates between the rails with hard flange contact occurring at regular intervals of 30 to 50 feet. Truck hunting occurs on tangent track and is more severe where the track is stiff and where CWR is laid. It normally does not begin until around 45 to 50 mph in the case of cars with worn wheels, and 55 to 60 mph for cars with new wheels. Empty cars not equipped with CCSBs, CPEPs, or other special stabilization devices are more prone to truck hunting. Truck hunting may amplify car body lateral oscillation if the truck hunting oscillation frequency and the car body's natural oscillation frequency are synchronous.

Testing of CN 879 Series Wood Chip Gondola Cars

On 11 May 2004, the Transportation Safety Board of Canada (TSB), with the cooperation of CN, performed an in-service test of two empty sister cars, CN 879640 and CN 879656, on freight trains A-402 and A-403 on the Montmagny Subdivision. The test was carried out in normal operation from Joffre to Rivière-du-Loup, a round trip of 250 miles. The cars were selected by

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[2] Transportation Technology Center, Inc. (TTCI) technical digests TI 00-012, 03-001, 03-011, 03-014, 03-015, 03-023, 03-024, 03-025, 04-003, and 04-007.

the railway and their condition was representative of the condition of the wood chip gondola cars present at Joffre on May 10, as well as those that were on the train involved in the accident. Pre-departure inspection of the two test cars did nor reveal any condemnable defects as defined in the *Railway Freight Car Inspection and Safety Rules* and the AAR *Field Manual of the Interchange Rules*.

The running tests were performed up to the maximum allowable subdivision time table speed of 65 mph for freight trains. Three digital video cameras were installed underneath the two cars, oriented toward the trucks. One camera was mounted on the side of the locomotive cab to film car body motion, and another was mounted in the locomotive cab to film the locomotive speedometer.

Truck hunting was observed on both test cars, with the onset beginning between 48 mph and 54 mph, depending on track condition and location. The hunting motion and car body side-to-side oscillation became more severe as speed increased, leading to visible hard flanging of the wheels, and initiation of wheel lift (see Photo 2).

Photo 2. Test run image showing wheel lift at 60 mph

On 04 June 2004, the TSB issued Rail Safety Advisory (RSA) 04/04 (*High Speed Truck Hunting on Empty CN Wood Chip Gondolas*) to Transport Canada (TC) (see Safety Action Taken section).

CN challenged the RSA regarding truck hunting and indicated that the methodology was unsuitable and not consistent with normally used industry testing parameters. CN indicated that wood chip car fleet history and environmental conditions at the time of the derailment (blowing snow) do not support truck hunting as a cause. CN stated that a displaced car body on car CN 879261 caused wheel climb and the subsequent derailment.

In its response, TC indicated that CN's analysis of the issue did not support the TSB's conclusion of truck hunting. Furthermore, TC could not find any evidence of excessive truck hunting for wood chip gondola cars owned by other railways. Therefore, based on the above, TC considered the matter closed.

NUCARS Simulation

Subsequent to the CN and TC response, the TSB contracted the National Research Council of Canada to perform a high-speed stability test (TSB Engineering Laboratory report LP 128/2004) on NUCARS,[3] using the wheel profiles of axle 1 and axle 3, the lead axles of the leading and trailing trucks from a sister car, and the rail head profile and track geometry measurements from the initial point of derailment.

In the 1980s, the hunting criteria and test procedures for new cars were specified by the AAR in the *Manual of Standards and Recommended Practices* (MSRP), Section C, Part II, Volume 1, Chapter XI, Paragraph 11.7.2 (AAR Chapter XI in the following sections of this report). The limit criteria were as follows: minimum critical speed of 70 mph, maximum lateral acceleration of 1.5 g, and maximum lateral acceleration standard deviation of 0.26 g. In 2002, new hunting limits for new 286 000-pound gross rail load cars were introduced in the AAR MSRP section entitled "Truck and Truck Details, Truck Performance Specification for Rail Cars, Specification M-976-2002." The critical speed and the maximum lateral acceleration were not changed; however, the limit for the lateral standard deviation was decreased to 0.13 g.

Multiple runs were performed for speeds ranging from 38 mph to 74 mph, using truck shear stiffness varying from 3000 pounds (worn truck) to 6000 pounds (new truck). The friction parameters used in the simulation were 0.5 for dry rail, 0.4 standard friction defined in the MSRP, and 0.3 for well-lubricated or wet rail to simulate the effect due to blowing snow caused by the passage of the train. These parameters were identical to those commonly used by the Transportation Technology Center, Inc. (TTCI), a subsidiary of the AAR.

The NUCARS simulations showed the following:

- The critical hunting speed of the wood chip gondola cars determined by the NUCARS mathematical model is lower than the AAR Chapter XI required limit of 70 mph.

- For cars representative of the wood chip gondola fleet, simulated lateral accelerations increase dramatically as the speed exceeds 50 mph. The cars go into hunting at a speed of 50 to 58 mph. These results confirm the results of the video test in May 2004 with the sample cars.

- Wheel/rail profiles are very sensitive factors contributing to hunting.

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[3] The industry developed the software New and Untried Car Analytic Regime Simulation (NUCARS) to evaluate and compare new vehicle designs as well as perform failure analysis such as derailment studies.

- Both wet rail and wet wedge in snowy weather may still cause high hunting close to the case of dry rail and dry wedge because the opposing effects of lower friction of wet rail and wet wedge can cancel each other.

- The dynamic brake force applied at the time of the accident has minimal effect on the hunting performance of the cars, but may increase the risk of a wheel shift when the car is already hunting and wheel lift occurs.

- As the track was tangent, the simulation did not indicate that the hunting performance of the car was affected by centre plate binding.

- Several simulation runs became unstable, indicating a loss of wheel-to-rail contact. These unstable runs cannot be equated to derailments, but imply a higher risk of derailment during severe hunting.

Truck Hunting Derailments

The industry is aware of the issue of high-speed truck hunting on freight cars, and the research is ongoing. Existing studies and available accident data on high-speed truck hunting reveal several probable contributing factors when examining the phenomenon. The first is an overall car length of 50 feet or more. The second is that the car is empty or very lightly loaded. The third is the lack of secondary stabilization devices such as CCSBs or CPEPs on the three-piece trucks with roller bearing axles. The fourth is operation on high-speed CWR track in good condition. While truck component and wheel wear may exacerbate the phenomenon, hunting will occur on cars with these components in good condition. The impact of worn wheel and worn rail profiles on ride quality is still not fully understood.

In March 1991, the TSB investigated a CN derailment at Mile 41.59 of the Kingston Subdivision, near Coteau, Quebec (TSB investigation report R91D0045). The derailment occurred as a result of truck hunting of an empty gondola car at a depression in the track, combined with car body twist motion, causing a wheel to climb and derail. In the Board’s report on the investigation of this occurrence, reference was made to CN’s 1989 study on the truck hunting behaviour of gondola cars.

Concerned that other rail cars in Canada of foreign or domestic ownership may not be equipped with CCSBs and would therefore be susceptible to derailments from truck hunting, the Board made the following two recommendations:

> The Department of Transport ensure that appropriate speed restrictions are in effect for all empty bulkhead flatcars and long gondola cars which are not equipped with constant contact side bearings.
>
> (R93-08, issued August 1993)

> The Department of Transport assess the requirement for speed restrictions on other rail car types to reduce the likelihood of derailments related to truck hunting.
>
> (R93-09, issued August 1993)

On 03 May 1995, at Fleming, Saskatchewan (TSB investigation report R95W0117), a Canadian Pacific Railway freight train derailed while proceeding at a recorded speed of 62.9 mph. The first car to derail was an empty 52-foot gondola car that was 17 cars behind the locomotives. The investigation found that the gondola car had experienced a wheel climb derailment due in part to speed-induced truck hunting.

On 29 August 1996, St. Lawrence & Hudson Railway (StL&H) freight train 902-29 derailed 36 cars at Mile 42.7 of the StL&H Winchester Subdivision (TSB investigation report R96H0021). One of the derailed cars turned on its side and released up to 1900 litres (500 U.S. gallons) of hydrogen peroxide, a dangerous commodity. The Board determined that an empty, open-top hopper car experienced a wheel climb derailment due to excessive car body roll and speed-induced truck hunting. The excessive car body roll and susceptibility to truck hunting were attributable to the fact that worn truck components are not recognized as safety defects.

Since the recommendations were made in 1993, there have been 19 main-track derailments where truck hunting has been identified as a cause or a contributing factor by the railways or by the TSB. All of these derailments occurred at speeds of 50 mph or more. The total number of main-track freight train derailments at speeds of 50 mph or more reported to the TSB was 217 since 1993 for all of Canada. These truck hunting–related derailments involved six different types of freight cars.

Regulatory Action

Subsequent to recommendations R93-08 and R93-09, TC responded on 22 November 1993 that the railways had taken steps to restrict the speed of empty bulkhead flat cars and long gondola cars not equipped with CCSBs. TC also indicated that it would monitor accident reports to identify safety deficiencies in railway performance, including any indication of specific safety problems associated with types of freight cars. It was agreed that the Surface Group would continue to analyse these reports and communicate with the industry on the results of testing to determine the susceptibility of car designs to truck hunting at various speeds.

TC, acting through the Transportation Development Centre, in partnership with industry suppliers and the railways, cosponsored freight car truck performance research, and the development of a prototype lightweight freight car truck with improved high-speed performance characteristics. The prototype was tested in Canada, and submitted to further accelerated testing and development at the AAR test facilities in Pueblo, Colorado, United States.

Industry Initiatives

In 1989, CN studied the truck hunting behaviour of gondola cars, and concluded that empty or lightly loaded long cars experienced severe truck hunting above 50 mph. Worn truck components were shown to exacerbate the problem. The study found that the application of CCSBs raised the hunting threshold speed for such cars. In July 1991, CN restricted the speed for trains handling empty gondola cars 61 feet in length and over to 50 mph unless these cars are equipped with CCSBs. In 1997, CN restricted all empty gondola cars, open hopper cars, bulkhead flat cars, and rotary coal gondola cars to a maximum of 50 mph unless equipped with CCSBs, with the restriction appearing on the train journal. The wood chip gondola fleet was not included in the restrictions.

In November 1999, the AAR issued Maintenance Advisory MA-59 to chief mechanical officers concerning potential speed restrictions for certain bulkhead flat cars as a result of the Federal Railroad Administration's concern over a derailment attributed to an empty bulkhead flat car not equipped with CCSBs that was operated at 60 mph. The maintenance advisory noted that most Class I carriers were aware that these cars had a greater potential to hunt at higher speeds, and that a number of carriers had placed speed restrictions when operating these cars when empty. Carriers and car owners were advised to use the Special Transportation Service Code for such cars in the Universal Machine Language Equipment Register (UMLER) database so that they could be identified when electronically generated train journals are created by members who subscribe to the UMLER information.

The AAR Equipment Engineering Committee recommended that chief mechanical officers review their current policy with their chief operating officers to ensure that adequate procedures and instructions are in place if the nature of their operations warrants taking necessary precautions.

In July 2001, the AAR issued a supplement to MA-59, MA 59-S1, which added short hopper cars of 35 feet or less, hopper cars of all types, gondola cars, and tank cars, with examples of the prevailing speed restrictions for these car types when not equipped with CCSBs. The AAR reiterated the initial recommendation, and extended it to regional carriers and short lines connecting with Class I carriers.

Emergency Response

The Montmagny Fire Department and the Quebec Provincial Police were on the scene almost immediately. The dangerous goods documentation and the train journal were handed over to the emergency responders by the train crew. The train journal supplied by the crew was what is called the "cut list," which contains all of the car numbers in sequence for the cars within the train, and the work to be performed en route. This document indicated that the train contained two cars of dangerous goods, pressurized tank cars containing liquefied chlorine gas (UN 1017). The positions of the cars in the train did not correspond to their positions indicated on the cut list.

The first responders were initially unsure of the location of the cars of dangerous goods until a physical inspection confirmed their actual position, that only one of the cars was involved directly in the derailment, and that there was no release of product. No evacuation of the local population was necessary.

Previous TSB investigations have examined the necessity for accurate train documentation. In the Mont-Saint-Hilaire accident (TSB investigation report R99H0010), the Board expressed the concern that:

> Since the shipping documents are used by the train crews and the emergency response personnel, their availability and accuracy are critical to safety. The Board is concerned that the risks identified with the EDI [electronic data interchange] system and the potential inaccuracies in the train consist were not addressed and still create unsafe conditions to which emergency response personnel and the general public may be exposed.

Since the Mont-Saint-Hilaire accident and the coming into force of the *Transportation of Dangerous Goods Regulations* on 15 August 2002, train consists are now required. The information on the consist must be kept up to date by the train crew and kept with the shipping documents. Despite the reinforced *Transportation of Dangerous Goods Regulations*, errors in train journal documentation involving dangerous goods continue to occur. On 12 May 2003, CN freight train Q-149-11-12 derailed 17 platforms loaded with 34 containers at Mile 53.1 of the Drummondville Subdivision (TSB investigation report R03Q0022). Three of the containers were carrying dangerous goods. The investigation revealed that the inaccurate container numbers identified on the train consist impeded the identification by emergency responders of all the potential hazards presented by the derailed containers.

Analysis

In this occurrence, all the necessary elements that initiate high-speed truck hunting were present. The train was operating at high speed on CWR track with excellent track geometry and worn rail profiles. The wood chip gondola car design was such that the characteristics fit the profile of the length, empty car weight, and truck type that many studies and prior investigations have shown to be susceptible to truck hunting.

The matching gouge marks on the truck bolster centre bowls and the centre plate on the A-end of car CN 879261 suggest that the car body centre plate had moved longitudinally and was riding on the lip of the bolster bowl. Therefore, the car body centre plate of the first derailed wood chip gondola car, CN 879261, was improperly seated in the bolster bowl. Although it is not clear that this would have made the car more susceptible to truck hunting and car body oscillation, the wear patterns and polished contact surfaces of the bolster bowl and car centre plate suggest that the trucks were subjected to high-speed truck hunting.

While the car as designed and built would not be retroactively subject to the current Chapter XI standard for NUCARS design validation, comparison of the actual performance of the car against that current standard, which is the valid comparative baseline, demonstrates that the cars in the two groups examined cannot meet accepted performance standards, even when in good condition. Post-accident road testing video imagery and NUCARS simulations, including simulation of operation in a moist environment, demonstrate that the CN 879 series of wood chip gondola cars, despite being in good mechanical condition, do not meet the existing AAR-defined safe operating thresholds for their maximum operating speed when operated in an empty condition. They are prone to truck hunting when operating empty in trains at speeds in excess of 50 mph, presenting a risk of derailment.

The marks on the track and ties at the initial point of derailment and the absence of wheel flange marks on the running surface of the rails indicate that a wheel lift derailment event occurred. While the train was travelling at a speed of 58 mph, it is likely that a loss of contact between the wheel and the rail occurred due to truck hunting. This is confirmed by the video imagery and the NUCARS results that indicate that wheel lift does take place at that speed. Following the initiation of locomotive dynamic brakes, a run-in of train slack most likely took place at the same time as the wheel lift, causing the derailment of the wheel. The A-end of car CN 879261 derailed first, at Mile 76.02, on tangent track, and was dragged from that point to the public crossing at Mile 77.62, where the truck was dislodged and the train emergency brakes applied as a result of the derailment action while the train was moving at a speed of 53 mph. The derailed car struck the girders of the bridge at Mile 77.8, resulting in the derailment of the following cars.

Truck off-Centre

While it is possible for freight car trucks to be knocked off-centre by a variety of conditions, related to rough handling of cars during switching or loading and unloading operations, there is no factual report of the car being involved in a reportable incident or other information in this instance to support this possibility. Moreover, the car negotiated the turnouts and curve in the yard tracks at Rivière-du-Loup, where it would have been subjected to increased lateral forces. Furthermore, the patterns and polished contact surfaces of the bolster bowl and car centre plate were typical of truck hunting, and the distortion of the centre pin hole indicates that the damage to the centre pin holes occurred during the derailment and that the centre pin was in place up until the time the car derailed. Given all these factors, it is unlikely that the car was off-centre at the point of interchange.

High-Speed Truck Hunting

Occurrences reported to the TSB where truck hunting has been causal in a main-track derailment have involved different types of cars. AAR studies on various car types suggest that a worn wheel profile may have a greater impact in lowering truck hunting initiation speed than was previously realized, even if CCSBs or CPEPs are installed on the car. The number of aborted NUCARS simulations performed during this investigation indicates that, with worn wheel and worn rail profiles, loss of wheel-to-rail contact may occur more frequently than existing research indicates, suggesting a need for further research into the impact of worn wheel/worn rail profiles on truck hunting onset speeds.

Train Operations

When customer requirements define a change in operations such as the assignment of a specific type of freight car to meet a new demand, a risk assessment is normally performed to determine if the selected car type assigned to the service is suitable for operating at the maximum allowable speed on the subdivisions over which the cars will be operated, for both loaded and empty movements. However, the wood chip gondola cars were in service for more than 25 years and had never presented any indications of truck hunting problems. There were no operating or interchange restrictions put in place during that period; consequently, when the customer base for wood chips was expanded to a customer on a high-speed subdivision, no risk assessment was performed. A risk assessment would have provided the railway with the opportunity to identify the design similarities between these cars and other cars prone to truck hunting, and to take safety action akin to that taken for gondola cars of similar dimensions.

Emergency Response

In this accident, a rapid evaluation of the risks involving the dangerous goods carried was difficult because there was no accurate train journal information. While the first responders had the necessary information about the nature of the cargo carried, the location of those cars within the train was inaccurate, and had to be visually confirmed. Despite the concerns expressed by the Board after the Mont-Saint-Hilaire accident and the reinforced *Transportation of Dangerous Goods Regulations*, inaccurate train journal information continues to place first responders and the public at risk.

Findings as to Causes and Contributing Factors

1. The A-end of car CN 879261 derailed first, at Mile 76.02, and was dragged from that point to the public crossing at Mile 77.62, where the truck was dislodged. The derailed car struck the girders of the bridge at Mile 77.8, resulting in the derailment of the following cars.

2. A wheel lift initiated by high-speed truck hunting occurred as the run-in of train slack was taking place following the initiation of locomotive dynamic brakes, while the train was travelling at a speed of 58 mph.

Findings as to Risk

1. CN 878 and CN 879 series wood chip gondola cars are prone to truck hunting when operating empty in trains at speeds in excess of 50 mph, presenting a risk of derailment.

2. The risks of derailment due to truck hunting presented by CN 878 and CN 879 series wood chip gondola cars were not identified as being similar to other gondola cars of similar dimensions that were known to be prone to truck hunting.

3. Despite the concerns expressed by the Board after the Mont-Saint-Hilaire accident and the reinforced *Transportation of Dangerous Goods Regulations*, inaccurate train journal information continues to place first responders and the public at risk.

Other Findings

1. Given the freshness and pattern of the wear marks and the distortion of the centre pin holes, the absence of mishandling of the car by the customer, and the presence of curves and turnouts at the yard at Rivière-du-Loup, it is unlikely that the car was off-centre before Canadian National took the car at the interchange point.

2. Loss of wheel-to-rail contact occurs more frequently than existing research may indicate, suggesting a need for further research into the impact of worn wheel/worn rail profiles on truck hunting onset speeds.

Safety Action Taken

On 04 June 2004, the Transportation Safety Board of Canada (TSB) issued Rail Safety Advisory (RSA) 04/04 (*High Speed Truck Hunting on Empty CN Wood Chip Gondolas*) to Transport Canada (TC). In that RSA, the TSB advised TC that:

> Considering the potential use of these cars on high-speed tracks with an attendant risk of truck hunting and possible derailment, Transport Canada may wish to assess the performance of the CN wood chip gondolas, and other similar equipment on other railways, when operated empty at high speed.

Information copies of this RSA were forwarded to the Railway Association of Canada, the United States Federal Railroad Administration, and the Association of American Railroads.

Subsequent to the accident, TC regional office staff met with Canadian National (CN) representatives to discuss this matter of non-compliance of the train journal information with the *Transportation of Dangerous Goods Regulations*.

During a recent TC safety review of CN operations, inaccurate train journals were raised again, and this was found to be an issue. Therefore, a Railway Safety Inspector (RSI) took enforcement action on 14 September 2005, with the issuance to CN under Section 31 of the *Railway Safety Act* of a letter containing a Notice and Order. The RSI ordered that:

> CN Rail ensure that all trains operating are accompanied by accurate consists or train journals before trains depart yards and/or terminals under the following terms and conditions:
>
> 1. Verify that the actual cars on the train are accurately reflected on the train journal as to the number of cars and their sequencing, including the location or presence of dangerous goods, before departing a yard or terminal;
>
> 2. Verify the makeup of the train as per item #1 whenever cars are added or set off en-route;

3. A written record of each verification including the name and title of the person verifying the same is to be maintained for the duration of this order.

On 20 September 2005, CN replied to the Notice and Order by indicating that accurate transportation reporting is a priority for CN, and that steps required to comply with it have been undertaken.

CN has taken a number of measures to ensure the accuracy of train journals. These include additional cameras to monitor cars during switching, enhanced automatic identification systems technology to quickly highlight discrepancies between train journals and clearing trains, prompt response processes to communicate errors to train crews as soon as they are identified, and significant internal focus on both the causes and corrective action.

Safety Concern

The CN 879 series of wood chip gondola cars were not included in the speed limit protection provided to cars of similar dimensions not equipped with supplementary stabilisation systems. The cars had not been recognized as presenting a risk of truck hunting, with the attendant derailment risks, due to the absence of a derailment history. However, post-accident road testing video imagery and NUCARS simulations, including simulation of operation in a moist environment, demonstrate that the CN 879 series of wood chip gondola cars, despite being in good mechanical condition, are prone to truck hunting when operating empty in trains at speeds in excess of 50 mph, presenting a risk of derailment. Furthermore, these cars do not meet the existing AAR-defined safe operating thresholds for their maximum operating speed when operated in an empty condition. Considering the use of CN wood chip gondola fleet on high-speed tracks with an attendant risk of truck hunting and possible derailment, the Board is concerned that the performance of these cars presents a risk to the public and environment.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 10 January 2006.