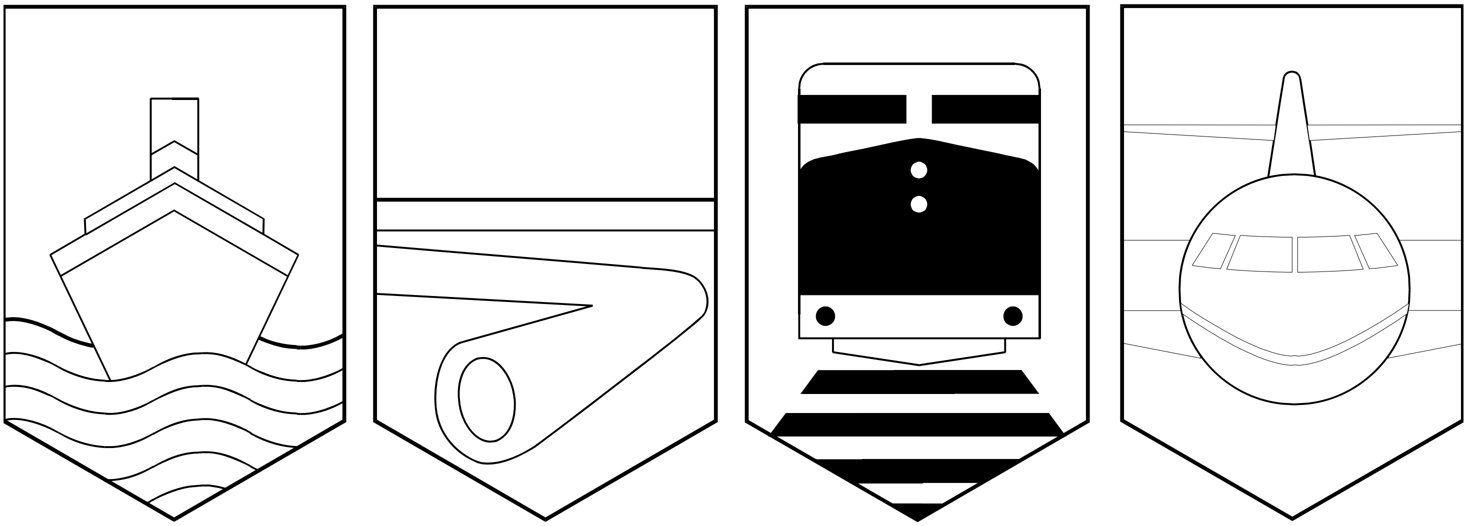
Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada



RAILWAY OCCURRENCE REPORT

CN NORTH AMERICA
DERAILMENT
TRAIN NO. 218-19
MILE 102.55, CARAMAT SUBDIVISION
LONGLAC, ONTARIO
23 JANUARY 1994

REPORT NUMBER R94W0019

Canada

MANDATE OF THE TSB

The Canadian Transportation Accident Investigation and Safety Board Act provides the legal framework governing the TSB's activities. Basically, the TSB has a mandate to advance safety in the marine, pipeline, rail, and aviation modes of transportation by:

- conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
- conducting special studies and special investigations on transportation safety matters.

It is not the function of the Board to assign fault or determine civil or criminal liability. However, the Board must not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.

INDEPENDENCE

To enable the public to have confidence in the transportation accident investigation process, it is essential that the investigating agency be, and be seen to be, independent and free from any conflicts of interest when it investigates accidents, identifies safety deficiencies, and makes safety recommendations. Independence is a key feature of the TSB. The Board reports to Parliament through the President of the Queen's Privy Council for Canada and is separate from other government agencies and departments. Its independence enables it to be fully objective in arriving at its conclusions and recommendations.

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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 Occurrence Report

CN North America
Derailment
Train No. 218-19
Mile 102.55, Caramat Subdivision
Longlac, Ontario
23 January 1994

Report Number R94W0019

Synopsis

A CN North America (CN) eastward freight train derailed 26 cars of an 81-car train at Mile 102.55 of the Caramat Subdivision, near Longlac, Ontario. There were no injuries and no dangerous goods were involved.

The Board determined that the cause of the accident was a closure rail fracture initiated by a vertical split head defect. The vertical split head defect may have been initiated and propagated by wheel impacts at a loose bolted joint.

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 The Accident

Eastward CN North America (CN) train No. 218-19, destined for MacMillan Yard, Toronto, Ontario, departed from Armstrong Yard, Mile 243.8 of the Caramat Subdivision, at 0321 eastern standard time (EST) after receiving the necessary brake tests and inspection. No irregularities were noted.

The trip was without incident until the train reached Mile 102.55, where it experienced a train-initiated emergency brake application while travelling at approximately 40 mph.

After conducting the necessary emergency procedures, the crew determined that the 11th to 36th cars inclusive had derailed.

There were no injuries and no release of dangerous goods.

1.2 Damage to Equipment

The 26 derailed cars sustained extensive damage.

1.3 Other Damage

Approximately 360 feet of main track was destroyed. The circuitry for an automatic crossing signal at Mile 102.62 was also destroyed.

1.4 Personnel Information

The train crew consisted of a conductor and a locomotive engineer. Both were positioned in the lead locomotive at the time of the emergency brake application. They were qualified for their respective positions and met fitness and rest standards established to ensure the safe operation of trains.

1.5 Train Information

The train was powered by two locomotives and was hauling 53 loaded cars and 28 empty cars. It was approximately 5,520 feet long and weighed about 7,660 tons.

1.6 Particulars of the Track

The derailment occurred on a two-degree right-hand curve in the direction of movement, on a 0.32 per cent descending grade. The maximum authorized speed for this portion of the subdivision was 60 mph for freight trains. Approximately 22 trains use this subdivision each day.

The track structure was comprised of 132-pound continuous welded rail (CWR) on hardwood ties and slag ballast. The general track condition was good. The combined head and flange wear, measured at 15 millimetres (mm), met CN standards.

Before the derailment, the track was last inspected by the assistant track supervisor in a Hi-rail truck on 17 January 1994. No exceptions were noted in the area of the derailment.

A Pandrol Jackson Technologies Inc. ultrasonic rail testing machine scanned the rail through the derailment area on 18 November 1993, with no exceptions noted.

1.7 *Method of Train Control*

Train movements on the Caramat Subdivision are governed by the Centralized Traffic Control System authorized by the Canadian Rail Operating Rules and supervised by a rail traffic controller (RTC) located in Toronto.

1.8 *Weather*

The sky was overcast and a light snow was falling. Visibility was six miles. The wind was light and the temperature was minus 18 degrees Celsius.

1.9 *Occurrence Site Information*

The 11th car behind the locomotives came to rest derailed to the south side of the track at about Mile 102.3. Approximately 1,500 feet westward from the 11th car, the 12th to 15th cars inclusive were derailed to the south side of the track and the 16th to 35th cars inclusive were jammed crosswise to the track. The 36th car came to rest on the crossing at Mile 102.62. There were no markings on the roadbed, ties or rails leading up to Mile 102.62.

Wheat, zinc, spelter (impure zinc), and urea nitrite had spilled from the damaged cars.

Pieces of a broken 19-foot closure rail were located approximately 700 feet east of the crossing at Mile 102.62. The closure rail had been connected to the adjoining 132-pound rail with 136- and 132-pound compromise bars to compensate for the 3-mm wear difference in rail wear.

The compromise bar bolt holes showed elongation and excessive wear on the inner surface, particularly the No. 2 hole. Originally, there were only two factory-drilled holes per rail end and field welding was planned to eliminate the joint. Later, when the field welding did not take place, a third hole was drilled and bolts were installed. The bolts were severely bent and the underside of the rail head, local to the joint, was worn.

1.10 *Tests and Research*

The pieces of the broken rail were examined by TSB investigators at Longlac and then forwarded to CANAC Railroad Technologies (CANAC), in Saint-Laurent, Quebec, for laboratory examination.

CANAC concluded that:

1. the rail head fractured along a vertical split head (VSH) defect, generating high bending moments in the web portion and triggering the split-web fracture along the bolt holes;

2. the formation of the VSH defect in the closure rail occurred sometime before the derailment; and

3. the progressive detachment of small pieces of the rail under wheel impacts created a substantial opening that ultimately led to the derailment.

2.0 Analysis

2.1 Introduction

The operation of the train conformed to company instructions and government safety standards. The train derailment and separation was sudden and without warning. The analysis will focus on areas, not related to the operation of the train, that were considered to determine the cause.

2.2 Consideration of the Facts

2.2.1 Equipment

Before the point where track destruction began, there were no marks on the track or roadbed to indicate that a wheel climb had occurred or that equipment failure such as a broken wheel or axle had initiated the derailment.

2.2.2 The Closure Rail Break

The head of the closure rail fractured along the VSH defect followed by a horizontal web failure along the bolt holes. Progressive disintegration of parts of the closure rail, related to the impacts of passing wheels, left an opening in the rail such that a derailment occurred.

2.2.3 Closure Rail Joint

Evidence of considerable wear damage on the underside of the rail head indicated considerable vertical and longitudinal stresses likely as a result of the joint being loose and the repetitious impacts of the passing wheels on the rail ends. These stresses and impacts may have initiated or propagated the development of the vertical split head defect.

2.2.4 Rail Flaw Detection

The Pandrol Jackson Technologies Inc. ultrasonic rail flaw detector unit did not detect a defect at Mile 102.55 on 18 November 1993. As the development and growth of this type of defect are unpredictable, the likelihood of the VSH defect being present in November cannot be evaluated.

3.0 Conclusions

3.1 Findings

1. The train operation conformed to company instructions and government safety standards.

2. The derailment occurred as a result of a rail fracture under the train at a pre-existing vertical split head (VSH) defect.

3. The VSH defect may have been initiated and propagated as a result of the closure rail being loose and subjected to wheel impacts.

4. The ultrasonic rail testing equipment did not detect the presence of a VSH defect at the derailment location during testing two months before the derailment.

5. The development and growth of a VSH defect are unpredictable and the likelihood of the defect being present at the fracture location at the time of testing cannot be evaluated.

3.2 Cause

The cause of the accident was a closure rail fracture initiated by a vertical split head defect. The vertical split head defect may have been initiated and propagated by wheel impacts at a loose bolted joint.

4.0 Safety Action

4.1 Action Taken

4.1.1 Rail Testing

As indicated in the report, ultrasonic testing did not detect a vertical split head approximately two months before the occurrence. It was not determined if the rail defect had existed at the time of the ultrasonic test. However, as a result of previous occurrences where the ultrasonic detection system had failed to detect vertical split heads, the Board made four recommendations to the Department of Transport. The recommendations addressed the following areas:

a) a reassessment of the adequacy of Canadian railway requirements for main track rail testing, taking into account the age of the rail and the nature of the traffic;
(TSB R92-23, issued January 1993)

b) research to improve the effectiveness of current rail testing methods;
(TSB R92-24, issued January 1993)

c) improvement for identifying rail defects on curved track and identifying vertical split head defects; and
(TSB R93-01, issued April 1993)

d) a reassessment of the adequacy of the training and suitability of the working conditions for the operators of rail testing vehicles.
(TSB R93-02, issued April 1993)

In response to these recommendations, Transport Canada indicated that initiatives have been taken by the railways to improve the reliability of detection of sizeable vertical split head defects in track. These actions include more frequent ultrasonic testing and improved test car operator qualifications. In addition, the industry has increased awareness of rail defect types and improved its visual detection ability.

4.1.2 Rail Flaw Detection (RFD) Improvements

Over the past five to six years, CN has been working with the Rail Flaw Detection (RFD) contractor in improving the RFD process. This process has resulted in a number of innovations:

a) sliding carriages on the RFD vehicles have been replaced with wheels mounted with transducers;

b) the configuration and quantity of transducers have been improved;

c) the data accumulated by the RFD vehicles are now PC-software driven for better management;

d) a "correct remedial action" has been added to the RFD reports so track supervisors can immediately handle defective rail as per CN's Standard Practice Circular 3207; and

e) the RFD vehicle now produces an "exception report" so the track supervisor can visually inspect such locations.

In addition, CN has commissioned an expert to develop a reliable acoustic emission testing device for thermite and flash butt welds. This would allow for defective welds to be identified and corrected before being placed into service.

4.1.3 Rail Inspection Development Program

A joint project to test and develop rail inspection technology is being conducted by the Transportation Development Centre (TDC) in cooperation with CN, Canadian Pacific Limited, Tektrand International Inc., Canac International Inc., and Transport Canada.

The project will focus on the following issues:

a) how the current testing equipment (state of the art) and technology meet the American Rail Engineering Association (AREA) recommendations and performance standards;

b) review the methods of data collection and analytical process currently being utilized in the industry;

c) develop a computer intelligence system to enhance the current data collecting systems being used by the industry;

d) develop alternate technologies for future improvements to the rail testing methods; and

e) establish laboratory test facilities to develop and provide a scanner that would allow for various transducer position and configuration allowing for testing at a speed of up to 36 feet per second. The laboratory facilities also would develop and design probe assemblies suitable for the scanner to identify bulk flaws, surface conditions, and weld conditions on both tangent and curved track.

This project would specifically identify internal track defects such as vertical and horizontal split heads, transverse head defects, web cracks, and defective welds.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, John W. Stants, and members Zita Brunet and Hugh MacNeil, authorized the release of this report on 05 July 1995.

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