RAILWAY OCCURRENCE REPORT

CN NORTH AMERICA
DERAILMENT
TRAIN NO. 380-06
MILE 8.7, YORK SUBDIVISION
MARKHAM, ONTARIO
06 MARCH 1994

REPORT NUMBER R94T0072

Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

Railway Occurrence Report

CN North America Derailment Train No. 380-06 Mile 8.7, York Subdivision Markham, Ontario 06 March 1994

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Synopsis

A CN North America (CN) eastward freight train derailed 22 freight cars, the 62nd to the 83rd behind the locomotives, as the train entered a curve at Mile 8.7 of the York Subdivision, two miles east of Markham, Ontario. No dangerous goods were involved and there were no injuries.

The Board determined that the derailment was a result of a rail head fracture initiated by an undetected vertical split head defect.

Ce rapport est également disponible en français.

TABLE OF CONTENTS

1.0 Factual Information

1.1 The Accident

CN North America (CN) freight train No. 380-06 (train No. 380) departed from the CN MacMillan Yard at Toronto, Ontario, eastward on the York Subdivision at 1715 eastern standard time (EST) on 06 March 1994, destined for Montreal, Quebec.

As the train passed through a two-degree right-hand curve in the direction of movement at Mile 8.7, it experienced a train-initiated emergency brake application. After conducting the necessary emergency procedures, a crew member walked back and determined that the 62nd to the 83rd car behind the locomotives had derailed.

There were no injuries and no dangerous goods were involved.

1.2 Damage to Equipment

Eighteen rail cars sustained extensive damage and three were slightly damaged.

1.3 Other Damage

The contents of one car of clay were spilled throughout the derailment area. Five cars of paper products and two tank cars of caprolactam remained intact and their contents were salvageable.

Seventeen hundred feet of main track was destroyed and a railway bridge sustained minor damage.

1.4 Personnel Information

The operating crew of train No. 380 consisted of one conductor and one locomotive engineer. Both 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, powered by two locomotives, was hauling 42 loads and 50 empties. It was approximately 5,320 feet in length and weighed about 6,600 tons. There were no loads of dangerous goods.

The train departed MacMillan Yard, Toronto, following a brake test and a train inspection. No irregularities were noted.

1.6 Particulars of the Track

The subdivision is a single main track running in an east/west direction. The authorized timetable speed is 50 mph for freight trains. Passenger trains are not scheduled. There was no slow order in effect in this area at the time of the derailment. Traffic over this location consists of an average of 16 trains per day.

Track destruction began at the entrance to a 1,000-foot, two-degree right-hand curve in the direction of movement, on a 0.7 per cent descending grade. There were no sudden deviations in cross-levels leading up to the derailment area.

The north rail consisted of

Table of Contents

136-pound Sydney continuous welded rail (CWR), rolled and laid in May 1993. The south

ail consisted of 136-pound Algoma CWR, olled and laid in 1984. The rail was laid on tandard tie plates on hardwood ties placed 3,250 per mile, and fastened with four spikes per tie. Rail anchors were applied in a boxed pattern every second tie.

Ballast is crushed slag with full cribs and shoulders extending one foot on each side. The subgrade consisted of a 20-foot-high embankment.

1.7 Method of Train Control

Traffic in this area is controlled by the Centralized Traffic Control System (CTC) and is supervised by a rail traffic controller located in Toronto.

1.8 Weather

The skies were overcast, visibility was unrestricted, and the temperature was five degrees Celsius.

1.9 Recorded Information

The event recorder data indicated that the train experienced a train-initiated emergency brake application while it was travelling at a recorded speed of 47 mph with the throttle in the No. 8 position.

1.10 Occurrence Site Information

Mile 8.7 of the York Subdivision is located approximately 3 km southeast of the city of Markham, Ontario. The tracks run approximately 100 metres south of farm buildings and a house and the derailment area includes a railway bridge over Steeles Avenue.

The first three cars to derail remained attached to the train and travelled 1,700 feet, coming to rest upright on the track. The bottom hatches on the third car, ACFX459854, were damaged as the car travelled in a derailed state and spread its contents (powdered clay) on the railway embankment.

The following 19 cars piled up approximately 300 feet eastward of Mile 8.7 on the south embankment in various states of upset.

The north rail, although showing signs of lateral movement, remained intact throughout the derailment area. The south rail, however, had broken at Mile 8.7 and was displaced and buried under the pile of derailed cars. The rail head at the rail break contained a crack displaying corrosion reaching into the web and extending approximately two feet westward.

Pieces of rail were found in the vicinity of the rail break; the gauge side rail head was missing.

The combined rail wear on the south rail was measured as 18 mm at the front of the break and 21 mm at a point estimated to have been in the middle of the curve. The amount of wear had been recognized by the railway and the rail had been scheduled for replacement in the summer of 1994.

1.11 *Other Information*

1.11.1 *The Evacuation*

The residents of three farm houses within 500 metres of the derailment area were evacuated for approximately four hours while it was determined that no dangerous goods were involved in the derailment.

1.11.2 *Rail Testing Inspections*

Transport Canada had inspected this portion of track on 13 April 1993; no abnormalities were observed.

The track was last inspected on 03 March 1994 by an assistant track supervisor. No irregularities were noted.

The York Subdivision had been ultrasonically tested on 19 April 1993 and 02 December 1993; no defects were noted in the vicinity of Mile 8.7.

1.11.3 *Rail Wear Limits*

The CN Engineering *Maintenance of Way Manual of Standard Practice Circulars* stipulates that, when combined head and flange wear on 136-pound rail reaches 23 mm, the rail must be replaced.

1.11.4 *Vertical Split Head Rail Defects*

A vertical split head (VSH) rail defect is a progressive longitudinal fracture in the head of the rail, where separation along a seam spreads vertically through the head at or near the middle of the head. The VSH grows rapidly once a seam has opened up. This rail defect presents a hazard to train movements because it is usually not visible on the surface until it has grown to a length of several feet. Since the VSH extends longitudinally, a considerable portion of track is normally adversely affected once growth commences.

A catastrophic VSH break will destroy the gauge integrity sufficiently, in many cases, to allow a wheel to drop inside the rail.

1.11.5 *Ultrasonic Testing*

Pandrol Jackson Technologies Inc. provides ultrasonic testing service to CN. The test system attempts to locate rail defects according to a preset test criterion. The test technique relies on the ability of ultrasonic waves to propagate through the rail and reflect off of discontinuities such as voids or cracks.

2.0 Analysis

2.1 Introduction

The operation of train No. 380 conformed to company instructions and government safety standards and was not a contributing factor in the derailment. The analysis will focus on the integrity of the rail and rail inspection procedures.

2.2 Consideration of the Facts

2.2.1 Vertical Split Head Rail Defect

The visual examination of the rail following the derailment revealed that the integrity of the south rail had been compromised by a VSH defect at Mile 8.7. The rail head broke when train No. 380 passed over the location (in all likelihood under the 62nd car). The wheels dropped to the rail web and base, shattering the rail and resulting in the destruction of the track and the subsequent derailment of the following 21 cars.

The appearance of cracks in the broken rail head coupled with corrosion deposits found under the rail head give a clear indication of the presence of a well-developed defect. There were no indications of any other abnormalities to suggest other contributing factors.

2.2.2 Rail Inspection and Ultrasonic Testing

The last ultrasonic test at the location, conducted approximately three months before the derailment, gave no indication of the existence of a rail defect at Mile 8.7. It is possible that the VSH defect was non-existent or at the stage where the seam was just forming.

The length of the VSH and the extent of the corrosion suggest that the defect existed at the time of the last visual inspection of the track three days before the derailment. Such inspections, carried out on Hi-rail vehicles, have limited potential for detection of this type of defect.

3.0 Conclusions

3.1 Findings

1. Train operation at the time of derailment conformed to company instructions and government safety standards.

2. The derailment occurred as a result of a rail head fracture caused by a vertical split head (VSH) defect.

3. A visual rail inspection, three days before the derailment, did not uncover the presence of the VSH defect although it would have existed at the time.

4. The ultrasonic rail testing equipment did not detect the VSH defect three months before the derailment.

5. The rail at this location was nearly worn to condemning limits, and scheduled for replacement.

3.2 Cause

The derailment was a result of a rail head fracture initiated by an undetected vertical split head defect.

4.0 Safety Action

4.1 Action Taken

4.1.1 Transportation Safety Board of Canada Recommendations

In January 1993, the Board recommended that the Department of Transport reassess 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 (R92-23). The Board also recommended that the Department of Transport sponsor research to improve the effectiveness of current rail testing methods (R92-24). In reply, Transport Canada stated that it has assessed its track safety rules and standards and is satisfied that they are consistent with other U.S. and Canadian industry standards. However, it will continue to monitor research into track safety and support technological research and development to the extent resources permit.

Again in May 1993, the frequency and potential consequences of undetected rail defects prompted the Board to recommend that the Department of Transport reassess the adequacy of current Canadian railway procedures and equipment for main track rail testing for identifying rail defects on curved track and identifying vertical split head defects (R93-01). In addition, the Board recommended that the Department of Transport reassess the adequacy of the training and suitability of the working conditions of the operators of rail testing vehicles (R93-02). In response to these recommendations, Transport Canada indicated that it is pursuing the issue of efficiency of rail testing on all tracks and reviewing test output tapes to determine errors.

4.1.2 Rail Flaw Detection

Ongoing work by CN and its Rail Flaw Detection (RFD) contractor has resulted in several improvements to the detection process. For example:

a)
The sliding carriages on RFD vehicles have been replaced with wheels mounted with transducers to improve contact with the rail surface and probe wheel/rail interface. Alignment problems have been addressed through lateral and cant controls.

b)
The configuration and quantity of transducers has been increased to an "array" of transducers covering a complete 70-degree range of testing.

c)
RFD data management and storage has been upgraded, facilitating technological upgrades.

d)
RFD reports now contain a "correct remedial

action" field assisting the track supervisor to prioritize and effect responses to detected rail defects.

e) RFD vehicles produce an "exception report" where testing was partially inhibited due to snow, grease, rail wear, spalling, or other factors. The corresponding track locations are then visually inspected.

f) An "objective" testing system has been developed with a sophisticated pattern recognition ability. It is currently going through validation. This system has the potential for testing at higher speeds.

4.1.3 Rail Testing Task Force

Transport Canada (TC) has indicated plans to set up a task force to review the future of rail testing. TC will invite participation from the railway industry and representatives for rail testing contractors.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, John W. Stants, and members Gerald E. Bennett, Zita Brunet, the Hon. Wilfred R. DuPont and Hugh MacNeil, authorized the release of this report on 28 February 1995.