



Australian Government

Australian Transport Safety Bureau

Fractured bogie frame on coal train TM78A

Kooragang, New South Wales, on 12 December 2017

ATSB Transport Safety Report

Rail Occurrence Investigation

RO-2017-018

Final – 17 March 2020

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Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 2463 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Email: atsbinfo@atsb.gov.au
Website: www.atsb.gov.au

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Addendum

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Safety summary

What happened

On 12 December 2017, a fractured bogie was identified on Pacific National train TM78A during a roll-by inspection at the Kooragang Coal Terminal, New South Wales. The fracture was on bogie NDCA 1199 of wagon NHBH 42954J. This wagon operated loaded between Tahmoor Colliery and Kooragang prior to identifying the fractured bogie.

What the ATSB found

The ATSB found that a fatigue crack went undetected during preventative maintenance activities prior to the structural failure of the bogie frame. It is probable that the fracture was visible at the time of unloading at Newcastle Coal Infrastructure Group on 11 December, which went undetected. The fractured bogie was identified during a roll-by inspection on 12 December, likely preventing a derailment.

What's been done as a result

Pacific National made changes to the maintenance standards used during scheduled maintenance, to increase the area of the bogie frame subjected to non-destructive testing. These changes are aimed at identifying and addressing fatigue cracking prior to the escalation of the defect.

Safety message

Asset managers should ensure that inspection techniques effectively monitor and report on asset condition. Risk controls should also be continuously assessed to control risk to an acceptable level through the life cycle of the asset.

The occurrence

What happened

On the morning of 12 December 2017, train TM78A operated by Pacific National (PN) was unloading coal at the Kooragang Coal Terminal (KCT).¹ At the time, a maintenance worker was conducting a roll-by inspection² after the train moved through the unloading bay. The worker visually identified a crack on the lead bogie of wagon NHBH 42954J, this was the 35th wagon in the direction of travel. The train was stopped and the wagon was removed to allow for inspection.

The train operated between KCT to Clarence on the 10 December, before returning to Newcastle Infrastructure Coal Group (NCIG). On 11 December the train operated empty from NCIG to Tahmoor before returning loaded to KCT (Figure 1). During these journeys, the trackside condition based monitoring equipment recorded elevated bearing temperatures on axle 4 of wagon NHBH 42954J, as well as an increased angle of attack (AoA).³ These recordings did not generate an alert at the time of passing the various detection sites and the train continued to operate until the fractured bogie was visually identified by the maintenance worker.

Figure 1: Incident location



Source: Geoscience Australia, annotated by OTSI

¹ Kooragang Coal Terminal is operated by Port Waratah Coal Services (PWCS).
² Roll-by inspections are a visual inspection of moving rail traffic to identify equipment, loading security or other defects or failure.
³ Angle of attack (AoA) refers to the alignment of the train axle and wheels relative to the rail.

Safety analysis

A PN maintenance worker was located inside the unloading bay at NCIG on 11 December, this worker's primary function was to observe the wagon doors close. It was not clear if this worker was deemed to additionally be conducting a roll-by inspection. The worker was positioned on the opposite side (to the bogie fracture) of wagon NHBH 42954J and did not report any defects. The bogie was probably visibly fractured at the time based on the increased AoA.

The roll-by inspection completed on 12 December was completed by a single worker, with the worker positioned on the same side as the fractured bogie and the defect was identified. The axle showed signs of rotating forward and up relative to the frame as the fracture opened under the weight of the wagon (Figure 2). As the fracture opened the effective axle spacing changed, lengthening the wheelbase on the side of the cracked frame. PN maintenance standards permit roll-by inspections being completed by a single worker. The defect was detected during a roll-by inspection, however could have been missed if the worker was positioned on the opposite side.

Figure 2: Fractured bogie frame NDCA 1199



Source: Pacific National, annotated by OTSI

The train underwent unit train maintenance (UTM) and a full train examination (FX) on 8 December 2017 at the PN Lithgow maintenance depot. During this inspection, there were no defects reported in relation to bogie NDCA 1199. Prior to identifying the fractured bogie, the train was compliant with the PN technical maintenance plan.

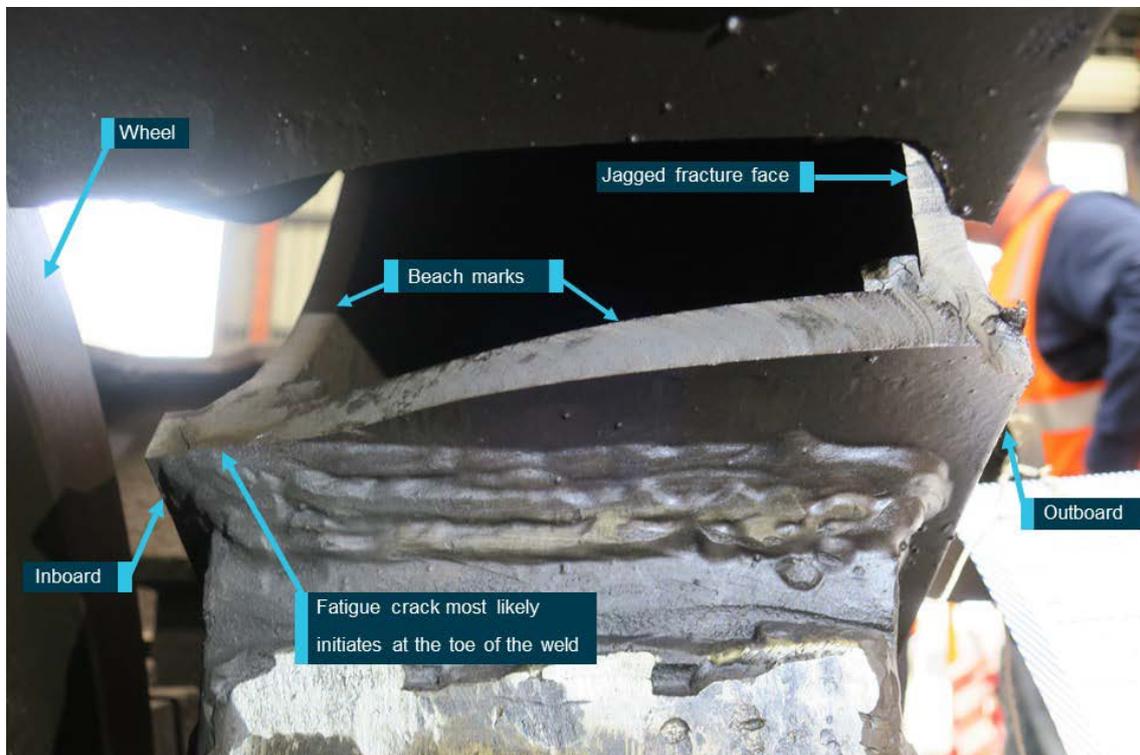
Bogie NDCA 1199 underwent schedule maintenance in July 2015. The bogie frame was subjected to non-destructive testing (NDT) consisting of magnetic particle inspection (MPI) and tested in accordance with PN procedure *WMM 11-08_06 One Piece Bogie Inspection*. There were no defects detected at the time of testing and the location of the fracture was at the extremity of the area subjected to NDT. Evidence of remnant MPI marker paint was present on the outboard plate, but there was no apparent marker paint on the inboard plate at the region of the fracture.

Fatigue cracking has historically been identified in the NDCA bogies at the welded junction joining the vertical plate and bottom plate section due to the design and manufacturing process used to build this class of bogie at the time. The NDCA bogie is comprised of welded steel plates to form a single piece box section bogie frame.

Prior to this occurrence, a derailment occurred in 2011 at Leigh Creek, South Australia. This derailment was reportedly the result of a fractured NDCA bogie. The bogie fracture increased the wheelbase on the side of the fractures, likely placing additional loading on the axle bearing as the axle tracked abnormally, this led to the bearing overheating and failing.

Post-occurrence inspection of the bogie NDCA1199 showed a fatigue crack most likely initiated at the toe of the weld on the inboard corner of the bogie side frame before progressing across the lower plate and inboard vertical plate (Figure 3). The inboard fracture face was smooth and displayed beach marks (slow progression), while the outboard face was jagged in appearance indicative of rapid progression.

Figure 3: NDCA 1199 fracture analysis



The image shows the bogie fracture from the underside of the bogie to show the three fracture faces.
Source: OTSI

The trackside condition based monitoring equipment recorded increased bearing temperatures from 10 December after departing Clarence, as well as an increased AoA on 11 December. Analysis of this recorded data following the event, indicates that the change was likely the result of the bogie frame fracture progressing. As the fracture progressed, the wheelbase (spacing between the axles) increased between axle 3 and 4, affecting the AoA and placing additional loading on the bearing.

At the time of passing through the various trackside condition based monitoring sites, the recorded bearing temperatures did not trigger an automatic alarm to notify the rail infrastructure manager (RIM) or PN. The track side detection equipment utilises algorithms to determine critical levels⁴ that trigger automatic alarms to advise the RIM or operator. In relation to bearing temperature,

⁴ Bearing and Brake Temperature Alarm Model, T HR RS 133003 ST, Version 1.0. Issue date 12 January 2017. Asset Standards Authority, Transport NSW.

only warm or hot bearing alarms will trigger an automatic alarm that requires immediate attention. Low bearing temperature alerts and AoA are recorded by the system but do not generate automatic alarms.

The wagon loading for the previous journeys was reviewed and indicated, that between 10 December and 12 December, the wagon operated within the allowable 100 t gross limit. The operation of the train and wagon loading does not appear to have contributed to this occurrence.

Findings

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- A fatigue crack likely originated at the toe of a weld on the inboard lower plate of the bogie frame that was not identified during the preventative maintenance activities, prior to the structural failure of the frame. The fatigue cracking most likely progressed across the full face of the lower plate and inboard side plate before rapidly progressing across the outboard side plate.
- The NDCA bogie design has a history of fatigue cracking which increases the risk of derailment if the cracking is not identified. Pacific National had processes in place to identify fatigue cracking but this crack was likely not detected due to the location of the defect.
- Trackside condition based monitoring equipment recorded elevated bearing temperature and increased angle of attack in the days prior to the fractured bogie being identified. This was likely a result of the bogie fracture progressing. The recorded temperature did not trigger an automatic alert to advise the rail infrastructure manager or operator.

Safety action

The ATSB has been advised of the following safety action in response to this occurrence.

Pacific National

As a result of this occurrence, Pacific National has advised the ATSB that they have taken the following safety actions:

Bogie Survey

Pacific National undertook a visual inspection of all NDCA bogie frames for evidence of cracking as directed by Office of the National Rail Safety Regulator (ONRSR).

Revised Maintenance Standard

Pacific National revised maintenance standard *WMM 11-08_06 One Piece Bogie Inspection* to increase the area subjected to NDT testing during schedule overhauls. The entire side frame is now tested on the inboard and outboard plates as well as the underside of the bogie frame through the horn cheek area.

General details

Occurrence details

Date and time:	12 December 2017 – 0554 AEST	
Occurrence category:	Incident	
Primary occurrence type:	Rolling stock irregularity	
Location:	Kooragang, New South Wales	
	Latitude: 32° 52.437' S	Longitude: 151° 46.166' E

Train details

Train operator:	Pacific National	
Registration:	TM78A	
Type of operation:	Coal	
Departure:	Tahmoor Colliery	
Destination:	Kooragang Coal Terminal	
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within the ATSB's jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.