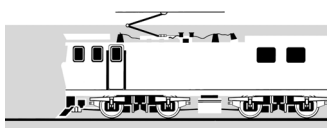
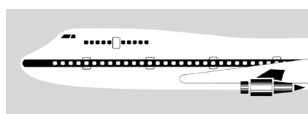


## RAILWAY OCCURRENCE REPORT

02-130      express freight Train 220, derailment, Rukuhia

18 December 2002



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## **Report 02-130**

**express freight Train 220**

**derailment**

**Rukuhia**

**18 December 2002**

### **Abstract**

On Wednesday 18 December 2002 at about 2230, northbound express freight Train 220 was approaching Rukuhia when dragging brake gear on a wagon near the middle of the train hit the spreader bar of the south-end turnout. As a result of the impact, the train parted and 11 wagons derailed.

Safety issues identified included:

- the limitations of the fulcrum pin connecting the brake vertical lever to the brake beam
- the absence of a safety wire to support the push rod in the event of a failure.

As a result of the safety actions taken by Tranz Rail, no safety recommendations have been made.



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## Abbreviations

DED	dragging equipment detector
FMI	Field Modification Instruction
km	kilometre(s)
km/h	kilometres per hour
kPa	kilopascals
m	metre(s)
NIMT	North Island Main Trunk
POD	point of derailment
t	tonne(s)
TIC	train inspection certificate
Tranz Rail	Tranz Rail Limited
UTC	coordinated universal time

## Data Summary

<b>Train type and number:</b>	express freight Train 220
<b>Date and time:</b>	18 December 2002 at about 2230 <sup>1</sup>
<b>Location:</b>	Rukuhia
<b>Persons on board:</b>	1
<b>Injuries:</b>	nil
<b>Damage:</b>	significant damage to rail infrastructure and 11 wagons
<b>Operator:</b>	Tranz Rail Ltd (Tranz Rail)
<b>Investigator-in-charge:</b>	P G Miskell

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<sup>1</sup> Times in this report are New Zealand Daylight Time (UTC + 13 hours) and are expressed in the 24-hour mode.

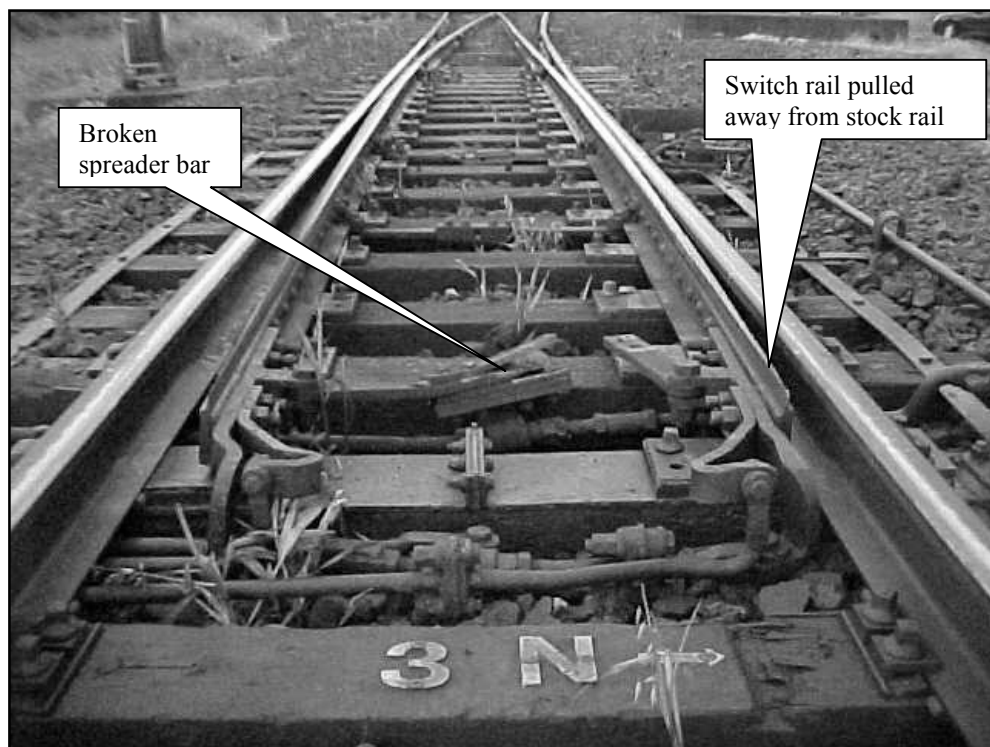




# 1 Factual Information

## 1.1 Narrative

- 1.1.1 On Wednesday 18 December 2002, Train 220 was a scheduled northbound express freight service from Wellington to Auckland on the North Island Main Trunk (NIMT). The train consisted of electric locomotives EF30042 and EF30094 and 31 bogie wagons, with a gross weight of 1139 t and length of 524 m.
- 1.1.2 At about 2230, as the train approached Rukuhia, dragging brake rigging on the fifteenth wagon in the consist (ZK 350) impacted with the spreader bar of the mainline turnout at the south end of Rukuhia. The impact broke the spreader bar, which connected the switch rails, and pulled the right-hand switch rail away from the stock rail (see Figure 1).



**Figure 1**  
**The south end points at Rukuhia, looking north, following the derailment**

- 1.1.3 The resulting gap between the curved stock rail and displaced switch rail forced the wheels of following wagons to try to take 2 diverging roads simultaneously, resulting in the train parting and 11 wagons derailing.
- 1.1.4 The locomotive engineer estimated that Train 220 was travelling between 75 and 80 km/h when approaching the mainline turnout at the south end of Rukuhia.
- 1.1.5 At the time of the derailment, while passing through Rukuhia station, the locomotive engineer heard a loud hissing sound. He looked at the head end display unit<sup>3</sup> of the train end monitor system and saw a brake pipe pressure value of 230 kPa, indicating to him that either a hose had blown or the train had parted. At the same time he also saw that the vacuum circuit breaker was

<sup>3</sup>The train end monitor system was made up of two basic components, the train end monitor and the head end display unit. The system monitored brake pipe pressure, last vehicle movement, battery condition, and whether the taillight was on or off. A built-in radio transmitted this information to the locomotive for processing and display on the head end display unit.

illuminated, indicating that the overhead power feed to the locomotive had been lost. The train drifted to a stop and the locomotive engineer advised the train controller of his situation.

- 1.1.6 The locomotive engineer remained in his cab until the train controller advised him that the overhead power had been switched off. The locomotive engineer then left the cab to check the train. He found that the train had parted and derailed.

## 1.2 Site information

- 1.2.1 Seventeen wagons remained on the front portion of the train, with 2 wagons immediately behind ZK 350 derailed. There was a gap of approximately 550 m separating the front and rear portions of the train. The first 9 wagons of the rear portion were derailed and foul of the crossing loop. The rear portion had stopped with the trailing bogie of the fifth wagon from the rear of the train at the point of derailment (POD), 533.517 km NIMT. The roadway over Rukuhia Road level crossing was blocked by the rear of the train.
- 1.2.2 While there was some minor ballast disturbance south of Rukuhia consistent with a bouncing brake rod, the first significant strike mark was on the south edge of the seal at Rukuhia Road level crossing some 27 m before the POD (see Figure 2).

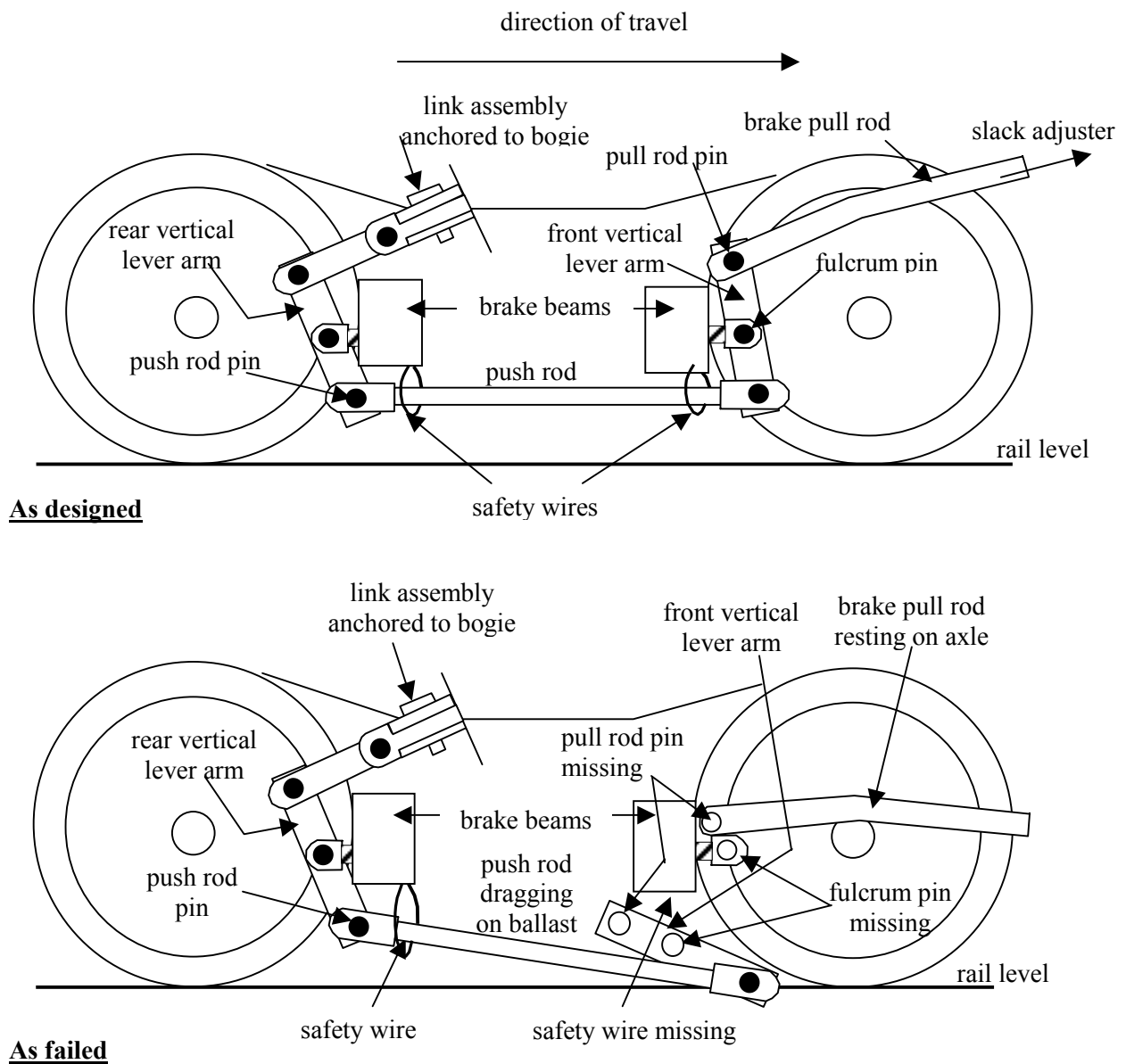


**Figure 2**  
**Strike marks at Rukuhia Road level crossing**

- 1.2.3 Although most of the infrastructure damage resulting from the derailment occurred within 100 m of the POD, there was other rail and sleeper damage between the front and rear portions of the parted train. An overhead traction pole about 90 m from the POD was demolished.
- 1.2.4 The maximum authorised line speed for express freight trains in the area of the derailment was 80 km/h.

### 1.3 Wagon ZK 350

1.3.1 Wagon ZK 350, which had the dragging brake rigging, was the last wagon on the front portion of the train remaining on the track. The trailing bogie's leading end brake rod was in contact with the ballast. The trailing end of the brake rod remained attached to the wagon.



**Figure 3**

#### **Diagrammatic section of the trailing bogie showing the brake gear as designed and as failed**

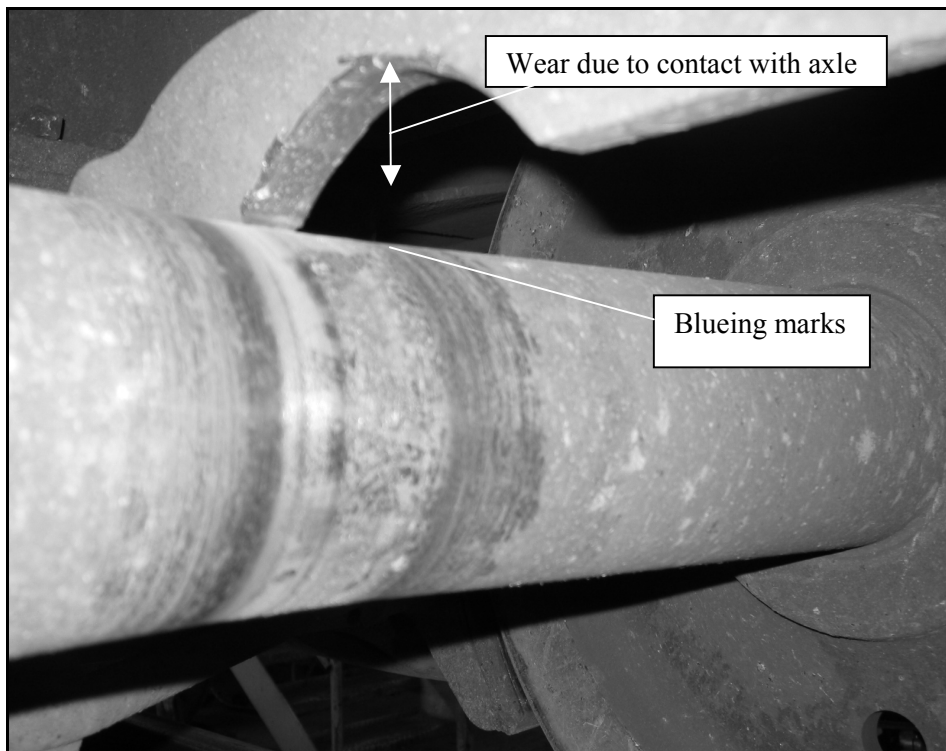
1.3.2 An examination after the incident of the brake rigging on the trailing bogie of ZK 350 found:

- the leading brake beam (fulcrum) pin connecting the vertical lever arm to the brake beam fork was missing, allowing the push rod to hang down
- the leading vertical lever pin connecting the brake pull rod was missing
- the safety wire on the leading end of the bogie to support the push rod in the event of a pin coming out was missing
- the bolt and welded nut connecting the push rod and the leading vertical lever arm was intact (see Figure 4)
- the brake pull rod from the slack adjuster to the vertical lever was resting on the axle and the rod had worn 38 mm or about 50% of its original dimension (see Figure 5)

- the safety wire at the trailing brake beam was in place.



**Figure 4**  
**Dragging brake gear on trailing bogie of wagon ZK 350**



**Figure 5**  
**Blueing marks on the axle and wear on the pull rod from contact with the axle**

#### **1.4 Wagon inspection**

- 1.4.1 During April 2002, Tranz Rail contracted out the mechanical inspection and maintenance of rolling stock to Alstom New Zealand, to standards set by Tranz Rail.

- 1.4.2 At the time of the incident Tranz Rail rolling stock code inspection required a 4-level inspection regime:
- Random inspections.
  - A-check.
  - B-check.
  - C-check.
- 1.4.3 An A-check was a thorough walk-around inspection undertaken by yard operating staff immediately before a train departed from a terminal and included a check for loose or hanging brake gear. The person carrying out the inspection signed a Train Inspection Certificate (TIC) to confirm that the train was in proper condition for safe running. The TIC was attached to the work orders carried in the locomotive cab.
- 1.4.4 During the pre-departure check of Train 220, one wagon was identified as not safe to run and was removed before the train departed. Two other wagons were identified with inoperative brakes, but allowed to run on the train with the brakes disconnected. Their position on the train was noted on the signed TIC.
- 1.4.5 A B-check, which covered safety critical items on rolling stock, was performed by certified staff whenever 2 or more brake blocks were changed or after an incident involving the particular wagon.
- 1.4.6 The inspection requirements for brake rigging during a B-check were:
- Brake rigging: All components in place, secure and intact.  
Brake spreaders must be intact.  
Safety straps correctly fastened.  
No excessive wear.
- 1.4.7 The most recent B-checks on wagon ZK 350 had been carried out on 13 September, 28 November and 13 December 2002.
- 1.4.8 A C-check was performed before a wagon left a maintenance depot, but in any case the maximum period between C-checks was 27 months.
- 1.4.9 The inspection requirements for brake rigging during the C-check were:
- Brake rigging: All components in place, secure and intact.  
Brake spreaders must be intact.  
No excessive wear.
- 1.4.10 The most recent C-check was carried out on 16 August 2001.
- 1.4.11 The wagon maintenance and inspection process was initiated by generating specific work orders loaded into Tranz Rail's SAP<sup>4</sup> system that tracked the maintenance history of individual wagons.
- 1.4.12 The multi-level inspections on ZK 350 had not identified any issue with the brake rigging that resulted in recorded work.
- 1.5 Dragging equipment detection**
- 1.5.1 Since 1993 Tranz Rail had installed a number of dragging equipment detection units (DEDs) on key routes. Most DEDs were stand-alone units but some operated in conjunction with rail temperature sensor units. A frangible bar was mounted in 3 sections, one section between the

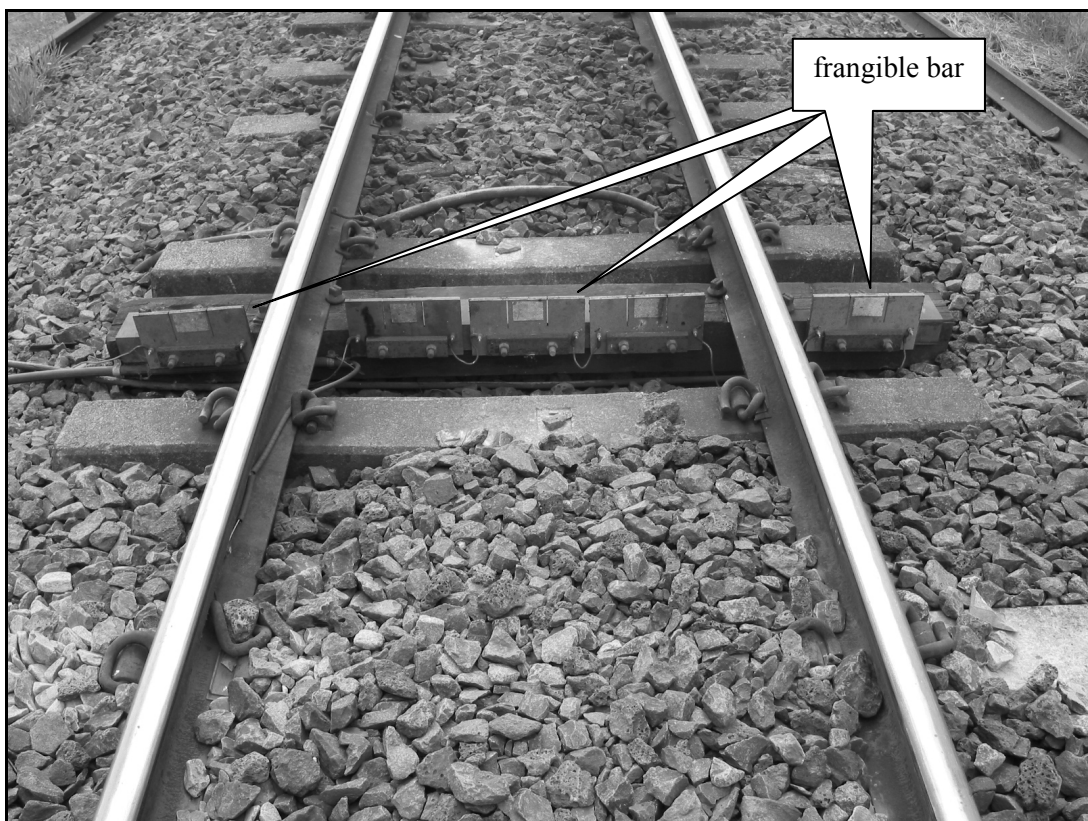
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<sup>4</sup> Network computer software system used by Tranz Rail.

rails and one on the outside of each rail. The bar formed part of an electrical circuit that provided an alarm output if any section of the bar no longer provided electrical continuity. If dragging equipment broke any part of the bar, the alarm was activated. The alarm output was fed into a radio controller that performed the following functions:

- an alarm message was sent via Selcall to train control. The alarm continued to be sent at regular intervals until acknowledgement was received from the train control computer
- a voice message was activated over the local radio channel (channel 1) for immediate advice to trains in the vicinity. The voice message was repeated 3 times.

1.5.2 At the time of the incident, there were 16 stand-alone DED units and 3 combined Heat/DED units between Taumarunui and Hamilton. The closest DED south of Rukuhia was a combined Heat/DED unit located between Te Kawa and Te Awamutu, some 24.5 km before the POD (see Figure 6). The DED was operational when Train 220 passed over it, but no strike from dragging equipment was recorded.



**Figure 6**  
**Combined heat/dragging equipment detection unit located near Te Kawa**

## **1.6 Locomotive event recorder**

1.6.1 The locomotive event recorder from the lead locomotive was downloaded and the data was supplied for analysis.

## **1.7 Locomotive engineer**

1.7.1 The locomotive engineer on Train 220 had held his grade 1 certification for about 25 years. On the day of the incident he commenced his shift at Te Rapa at 1455 and drove Train 229 to Taumarunui where he had a break before returning to Te Rapa with Train 220.

## 1.8 Other relevant occurrences investigated by the Commission

### Occurrence report 98-120, dragging brake gear Train 700, at Hapuku (near Kaikoura), 17 November 1998

- 1.8.1 On Tuesday 17 November 1998, Train 700 the northbound *Coastal Pacific* passenger express was travelling through Hapuku, near Kaikoura on the Main North Line, when dragging brake gear on a high-speed goods wagon at the head of the train struck and damaged the mainline turnout. The train travelled a further 26 km before the locomotive engineer became aware of track ballast being thrown up by the dragging brake gear and stopped the train.
- 1.8.2 The report noted that in March 1998 Tranz Rail had initiated a programme to replace all push rod pins on standard bogie wagons with welded bolts and nuts. This programme should have resulted in all wagons being modified by approximately June 2000, based on the work being carried out during a C-check.
- 1.8.3 As a result of the Hapuku incident the Commission recommended to the Managing Director of Tranz Rail that he:

Issue standards and procedures to ensure that safety straps effectively restrain loose brake rodding gear clear of all obstructions within the permitted tolerances associated with rolling stock/track interaction.  
(03/99)

- 1.8.4 On 29 March 1999, the Managing Director of Tranz Rail advised that the recommendation had been accepted and was being implemented.

### Occurrence report 00-104, derailment of Train 326 at Pukekohe, 6 April 2000

- 1.8.5 On Thursday 6 April 2000, Train 326 was a northbound express freight service travelling on the up main line of the NIMT through Pukekohe when dragging brake gear on a wagon near the middle of the train hit the spreader bar of the south-end turnout. The impact caused the facing points to split and derailed 13 of the following wagons.
- 1.8.6 Immediately following the incident Tranz Rail carried out a spot survey on the wagon fleet and concluded that 10% of wagons still required the bolt and welded nut modification to the push rod adopted in March 1998.
- 1.8.7 On 18 July 2000, Tranz Rail issued Field Modification Instruction (FMI) MW 3024 that addressed the following:
- consolidated previous FMIs with regards to brake rigging
  - required the replacement of brake beam (fulcrum) pins as well as clevis pins with a bolt and welded nut
  - required the replacement of safety chains with safety wires
  - made the brake beam and safety chain modifications compulsory when wagons entered a depot
  - required B-checks outside depots to identify, and either action or specifically programme wagons requiring pin modification, and to identify and replace worn chains.
- 1.8.8 On 25 October 2000, FMI MW 3024 was enhanced to include pins omitted from Issue A. The revised FMI 3024 Issue B is attached as Appendix 1.
- 1.8.9 Report 00-104 concluded that the controlled approach required by FMI MW 3024 Issue B should result in the replacement of the brake beam (fulcrum) pin with either a welded bolt or a

pin with a washer welded to it by the end of 2000, providing the work was undertaken during the next B-check inspection. Work orders against each individual wagon were not loaded into SAP to track the progress on implementing FMI MW 3024 Issue B.

- 1.8.10 In view of the safety actions taken, no safety recommendation was made as a result of the investigation.

## **2 Analysis**

- 2.1 Analysis of the event recorder data confirmed the locomotive engineer's estimated train speed of about 75 km/h at the time of the derailment, which was less than the maximum authorised line speed for express freight services.
- 2.2 The locomotive engineer correctly interpreted the illumination of the vacuum circuit breaker light to indicate that the main electrical circuit had tripped and was caused by either a short circuit within the traction motor, or the locomotive pantagraph had dropped away from the overhead power lines. After the front portion of the train stopped, the locomotive engineer did not compromise his personal safety and remained in the locomotive until the train controller confirmed that the overhead power had been isolated.
- 2.3 Because there were no impact marks on either the facing points at Ohaupo or road crossings south of Rukuhia, and only intermittent strike marks in the ballast between Ohaupo and Rukuhia, the brake rigging on ZK 350 probably dropped near Rukuhia.
- 2.4 The dragging brake rod resulted from the loss of the fulcrum pin assembly. This was a known weakness as indicated by FMI 3024 Issue B. While the push rod pin connecting the brake vertical lever and push rod had been replaced by a welded bolt and nut, the fulcrum pin and pull rod pin modifications had not been completed in accordance with current instructions. Had all the modifications been completed on ZK350 at its next B-check, as expected by the end of 2000, it was likely that this incident would have been avoided.
- 2.5 The split pin retaining the fulcrum pin on the leading end of the trailing bogie had failed allowing the fulcrum pin to fall out and the brake rigging to drop. It was likely the split pin was worn but had not been detected during the 3 most recent B-checks, and would not be expected to be found during a pre-departure A-check.
- 2.6 The safety wires were intended to restrain the brake rod until the failure was identified and repaired, but without the safety wire, the pull rod rested on the leading axle and slowly wore through and eventually allowed the push rod to drop sufficiently to allow it to strike the points spreader bar at Rukuhia. The amount of wear on the pull rod indicated that it had been resting on the axle for some considerable time.
- 2.7 The modifications identified in FMI MW3024 were compulsory the next time a wagon entered a depot after 25 October 2000. The most recent C-check on ZK 350 occurred on 16 August 2001 and the 3 most recent B-check inspections were carried out on 13 September 2002, 28 November 2002 and 13 December 2002. Each inspection provided an opportunity to complete the modifications to the brake rigging but these were not completed. As a consequence ZK 350 had been in service for more than 2 years without the required modification to the brake rigging being carried out.
- 2.8 Although there has been a significant increase in the number of DED units on principle lines, these will reduce but not eliminate derailments caused by dragging equipment.



### **3 Findings**

Findings are listed in order of development and not in order of priority.

- 3.1 Train 220 derailed because dragging brake gear on wagon ZK350 impacted the spreader bar of the facing points at the south end mainline turnout at Rukuhia, forcing the remaining wagons to attempt to take diverging roads.
- 3.2 A failed fulcrum pin caused the push rod to drop and there was no safety wire to support it.
- 3.3 The brake beam pin with split pin fastening was a known weak link and a replacement programme using a bolt and welded nut had been in place for more than 2 years.
- 3.4 Although there had been one C-check and several B-checks on wagon ZK350 since the issue of FMI MW 3024 Issue B, the modification to the fulcrum pin connection had not been actioned.
- 3.5 The time at which the safety wire became detached could not be established, however the wear on the push rod would indicate that it had been missing for some time.
- 3.6 Train 220 was being correctly operated and the actions of the locomotive engineer did not contribute to the derailment.

### **4 Safety Actions**

- 4.1 Following the incident, Tranz Rail and Alstom prepared a joint procedure to control the hazard of dropped brake rigging on wagons by:
  - creating a Brake Rigging Depot Maintenance work order for every wagon in the fleet
  - recording the results of the inspection and resulting actions
  - completing FMI MW 3024 Issue B
  - fitting handbrake pins with welded collars
  - inspecting brake beams for wheel flange burns
  - inspecting all lever handbrakes for code compliance
  - inspecting all fabricated brake beams and replacing if cracked or bent
  - inspecting all yoke pin retention bolts on the draw gear for code compliance and welding the bolt thread if not already welded
  - completing an independent check to ensure all work was completed.
- 4.2 The project was given a high priority with a target of completing the inspection and modifications to 3300 wagons (80% of the fleet) by 30 September 2003. On 22 August 2003, 2611 wagons had been inspected and modified since commencing the programme in April 2003.

In view of the safety action taken to inspect and replace the bolt & split pin connection with a bolt and welded nut on the brake rigging of all Type 14 bogies, no safety recommendations have been made.

# Appendix 1

Page 1 of 3

<b>Tranz Rail</b>		Mechanical Engineering	
<b>FIELD MODIFICATION INSTRUCTION: LOCO 520</b>			
Contact:		Pages:	3
Designation:	Fleet Engineer	Issue:	B
Phone:		Continue on page:	3
Fax:-		Date:	25-10-2000
		FMI No:	MW3024
<b>Subject:</b> Bogie brake rigging push rod and fulcrum pins. Change from pin to welded bolt and nut or pin and washer.			
<b>Scope:</b> All freight bogie types except T22. This FMI supersedes MW0049 and MW0066 which will now be archived. Issue B includes pins omitted from issue A.			
<b>Drawings required:</b> See Attached Sketches			
<b>Purpose of modification:</b> To prevent possible derailment caused by dragging brake rigging after the loss of pushrod or fulcrum pins. <b>Note:</b> these bolts are removed to adjust the brake rigging after a wheel turn, replacement of wheelsets, or when changing brake beams.			
<b>Frequency:</b> This FMI is compulsory on all wagons which enter a depot from the date of issue.			
<b>Instructions:</b> <ol style="list-style-type: none"><li>All pushrod pins connecting the brake vertical lever and push rod are to be replaced by welded bolt and nut. Items 1 on figure 2.</li><li>All fulcrum pins connecting the brake vertical lever to the brake beam are to be replaced by welded bolt and nut (items 2 on figure 2) unless pins and washers are specified (T14 metric and T16 only).<ol style="list-style-type: none"><li>Use bolts with the size given in the chart, which follows. Those marked as "Local Purchase" should be purchased locally and be the same nominal size as the pins they are replacing.</li><li>The nut is hand tightened with minimal clearance between the pushrod and bolt. At least 6mm of thread must protrude beyond the nut. Pins and washers must have minimal clearance across the brake beam but still be able to turn.</li><li>Weld the nut to the bolt with two continuous fillets 15 mm long and opposite each other with a minimum 5 mm leg length. Refer Fig. 1. Pins and washers are to be welded in the same manner.</li></ol></li><li>The work will be carried out at depots, workshops or field units. Notifications with "FMI MW3024" in the Description will be placed on all vehicles not previously covered by FMIs MW0049 or MW0066 and must be closed after the work is completed. This will ensure all relevant vehicles are modified.</li></ol>			

# Appendix 1

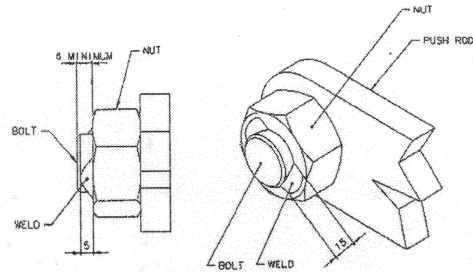


Figure 1: Weld Detail

4. **Safety Wires** (material number 108073) are to be fitted as per Task instruction M9201/16 in all cases.
5. The existing safety chain or rod can be left in place unless it is worn by more than 25% of its cross sectional area. Check particularly at the end links. If it is worn excessively it must be removed.

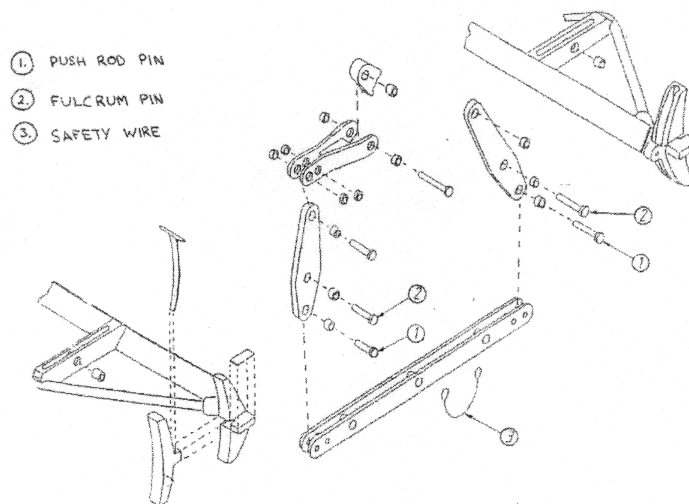


Figure 2: Brake Rigging

# Appendix 1

Page 3 of 3

Pushrod Pins Replacements									
Bogle Type	Bogle Dwg No:	Brake Rigging Dwg No:	Pin 1	SAP Material No:	No. Off	Pin 2	SAP Material No:	No. off per bogie	
14 (Imp)	X27850	X27854	1 1/4"x 5"	117718	2	1 1/4"x5"	117718	2	
14 (met)	X27850	X27854	1 1/4"x 5"	117718	2	Pin & washer	122710	2	
14A,B,S		X28034	1 1/4"x 5"	117718	2	1 1/2"x5"	122510		
16	X27800	X27806	1 1/2"x 5"	122510	2	Pin & washer	123084		
16A,B,E	11050303	11050309	7/8" x 4"	122603	2	7/8"x4 1/2"	100121		
16A,B	11050992	11050947	7/8"x3 1/2"	108191	2	7/8"x3 1/2"	108191		
X27396 type 1,2,3	X27396	X27396	1 1/4" x 4 1/2"	250751	2	1 1/2"x5"	122510	2	
X26463 type 1,2,3	X26463	X26463	1" x 4"	122602	2	1 1/8" x 4 1/2"	Local Purchase	2	
D & L	X25340	X25340	7/8"x3 1/2"	108191	2	7/8"x4 1/2"	100121	2	
D & L	X25830	X25830	7/8"x3 1/2"	108191	2	1" x 3 1/2"	-	4	

If no slack adjuster is fitted on wagons with D & L bogies then pins and split pins may be used.







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- 02-127 Train 526, track warrant overrun, Waitotara, 17 November 2002
- 02-126 hi-rail vehicle 64892, occupied track section without authority, near Kai Iwi, 18 November 2002
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- 02-118 express freight Train 484, near collision with hi-rail vehicle, Tauranga, 7 August 2002
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- 02-116 express freight Train 533, derailment, near Te Wera, 26 July 2002
- 02-112 passenger fell from the Rail Forest Express, Tunnel 29, Nihotupu Tramline, Waitakere, Saturday 4 May 2002
- 02-104 express freight and passenger trains, derailments or near derailments due to heat buckles, various localities, 21 December 2001 to 28 January 2002
- 02-113 passenger express Train 700 TranzCoastal and petrol tanker, near collision Vickerman Street level crossing, near Blenheim, 25 April 2002
- 02-107 express freight Train 530, collision with stationary shunt locomotive, New Plymouth, 29 January 2002
- 01-111 passenger EMU Train 2621, door incident, Ava, 15 August 2001
- 01-107 passenger baggage car Train 201, broken wheel, Otaihanga, 6 June 2001
- 01-112 Shunt 84, runaway wagon, Stillwater, 13 September 2001
- 01-113 DC4185 light locomotive and private car, collision, Egmont Tanneries private level crossing 164.14 km Stratford, 19 September 2001

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