



RAILWAY OCCURRENCE REPORT

02-122	express freight Train 215, derailments, Hamilton and Te Kuiti	18 October 2002
	express freight Train 934, derailment, Sawyers Bay	25 March 2003







TRANSPORT ACCIDENT INVESTIGATION COMMISSION NEW ZEALAND

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Report 02-122

express freight Train 215

derailments

Hamilton and Te Kuiti

18 October 2002

express freight Train 934

derailment

Sawyers Bay

25 March 2003

Abstract

On Friday 18 October 2002, at about 0515, 2 wagons on the rear of southbound express freight Train 215 derailed while negotiating a turnout as the train departed from the Hamilton container transfer depot. The derailed wagons were detached and the train continued its journey south, but at about 0750, as it entered Te Kuiti, 3 further wagons derailed as they crossed the north-end turnout.

On Tuesday 25 March 2003, at about 0145, 12 wagons on northbound express freight Train 934 derailed while crossing the south-end turnout at Sawyers Bay.

Although undetected dragging brake rigging was identified as the main cause in each of these derailments, other safety issues included:

- the adequacy of wagon management and monitoring procedures to ensure safety critical Field Modification Instructions were actioned expeditiously
- lack of procedures to ensure out-of-code wagons were removed from service pending completion of required checks
- the dispatch of Train 215 from Hamilton following the first derailment before the cause of the derailment was identified
- the terminal brake test and train examination at Dunedin not detecting the dragging brake rigging on UK16281 before Train 934 departed

One safety recommendation was made to Tranz Rail.

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Abbreviations

Alstom	Alstom New Zealand Transport Services
CTD	container transfer depot
DED	dragging equipment detector
ECMT	East Coast Main Trunk
FMI	Field Modification Instruction
km km/h	kilometre(s) kilometres per hour
m	metre(s)
NIMT	North Island Main Trunk
POD	point of derailment
SH3	State Highway 3
t TIC Transfield Tranz Rail TXO	tonne(s) train inspection certificate Transfield Infrastructure Services Ltd Tranz Rail Limited train examiner operations
UTC	coordinated universal time

Data Summary

Occurrence 02-122	
Train type and number:	express freight Train 215
Date and time:	18 October 2002, 0515 and 0750 ¹
Locations:	Hamilton and Te Kuiti
Type of occurrences:	derailments (2)
Persons on board:	crew: 1
Injuries:	nil
Damage:	extensive damage to infrastructure and rolling stock
Operator:	Tranz Rail Limited (Tranz Rail)
Occurrence 03-105	
Train type and number:	express freight Train 934
Date and time:	25 March 2003, 0145
Location:	Sawyers Bay
Type of occurrence:	derailment
Persons on board:	crew: 1
Injuries:	nil
Damage:	extensive damage to infrastructure and rolling stock
Operator:	Tranz Rail Limited (Tranz Rail)
Investigator in charge:	D L Bevin

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

Factual Information

1.1 Narrative

- 1.1.1 On Friday 18 October 2002, Train 215 was a scheduled Mt Maunganui to Wellington express freight service. For the first part of its journey Train 215 ran westbound from Mt Maunganui via the East Coast Main Trunk (ECMT) to Hamilton.
- 1.1.2 Enroute to Hamilton, Train 215 shunted at Morrinsville, detaching 9 and attaching 17 wagons. When it departed from Morrinsville, Train 215 consisted of a DF class locomotive and 34 wagons for a gross weight of 878 t and length of 420 m. On arrival at Hamilton the train berthed in a northerly direction at the container transfer depot (CTD) (see Figure 1).
- 1.1.3 At the CTD, the locomotive that had brought Train 215 from Mt Maunganui was detached along with 17 wagons for local and northern destinations, and containers were loaded onto wagons already attached to the train. Another locomotive was attached to the south end of the train and the CTD team leader² carried out an intermediate brake test³.
- 1.1.4 When it departed the CTD at about 0510,Train 215 consisted of an EF locomotive and 17 wagons for a gross weight of 379 t and length of 293 m and was crewed by a locomotive engineer.
- 1.1.5 As his train was moving through the turnouts "at about 20 to 30 km/h" the locomotive engineer sensed it was losing air so he stopped the train. He contacted the CTD team leader by radio and asked him to check the rear of the train. The team leader found the rear 2 wagons had derailed.
- 1.1.6 The derailed wagons were detached and Train 215 departed at about 0530 to continue its journey south. The team leader said he could not recall who had issued the instruction for him to detach the derailed wagons and dispatch Train 215, but he thought it might have come from the network control manager in Auckland via the Hamilton freight terminal manager.
- 1.1.7 The team leader later said that he had completed a walk around Train 215 as part of the intermediate brake test prior to its initial departure from the CTD, but he had not noticed anything mechanically wrong with the train, although he had not been trained to detect such things. After he had detached the derailed wagons he repeated this procedure, including the walk around the train, beforeTrain 215 departed.
- 1.1.8 As Train 215 approached Te Kuiti the locomotive engineer again sensed that something was wrong. Looking back he saw ballast flying from under the wagons so he immediately stopped the train. From his cab he could see that several wagons had derailed so he advised train control of the situation and went back to assess the damage.

1.2 Site information

Train 215 berthing in Hamilton CTD from ECMT

1.2.1 Following the derailment, the area co-ordinator for Transfield Infrastructure Services Ltd⁴ (Transfield) carried out a site inspection in Hamilton. He found minor damage to 182B points and 174B points (see Figure 1), minor gouging on the pavement at Grey Street level crossing, about 2.73 km east of Hamilton (see Figure 2), and ballast disturbance from the level crossing through to where Train 215 had berthed in the CTD, all of which was consistent with dragging brake rigging trailing beneath a wagon.

² The team leader supervised the work at the container transfer depot.

³ An intermediate brake test was carried out when a locomotive and or vehicles were added to or detached from a train.

⁴ Transfield was responsible for the inspection, maintenance and renewal of the rail infrastructure.



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Figure 2 Strike marks at the eastern edge of the pavement at Grey Street level crossing (ECMT) Hamilton

Train 215 departing Hamilton CTD to NIMT

1.2.2 The area coordinator found gouging of the crushed ballast between the rails between 170 points and 172A points, and a broken spreader bar, in 172A points, all of which was consistent with dragging brake gear protruding forward (see Figure 3).



Figure 3 172A points showing the broken spreader bar

- 1.2.3 Turnout 168A was identified as the point of derailment (POD). The spreader bar and points rodding connecting the switch rails on 168A points were damaged, causing the left hand switchblade to be pulled from the stock rail. The resulting gap forced the wheels of PK562 and ZH1109, the last 2 wagons of the train, to take diverging roads.
- 1.2.4 PK562 and ZH1109 were then dragged in a derailed state from the POD and through trailing 168B points, the connection to the NIMT, totally destroying the points and the motor controlling their movement. When Train 215 stopped, the CTD team leader found the trailing bogie of PK562 had derailed and ZH1109 had derailed all wheels and was leaning to the left.
- 1.2.5 The trailing bogie of PK562 and both bogies of ZH1109 were buried in the ballast and could not be immediately inspected. The wagons were righted after the train departed and the bogies inspected by Alstom New Zealand Transport Services⁵ (Alstom) staff but no evidence of dragging brake rigging was found.
- 1.2.6 An inspection of the track south of the POD showed 192B points (see Figure 1), were also damaged when Train 215 departed after the derailed wagons had been detached.



Figure 4

The damaged 168B points with ZH1109 in the background. The ballast in the foreground shows evidence of wagons being dragged through 168B points

Hamilton to Te Kuiti

1.2.7 After the derailment at Te Kuiti the track inspector for the NIMT south of Hamilton carried out an inspection between Hamilton and Te Kuiti. He found pavement damage and evidence of major strike damage at Kahikatea Drive level crossing (see Figure 5), about 2 km south of Hamilton, and less severe damage to the pavement of several other level crossings enroute. The damage was consistent with impact from forward facing dragging brake rigging hanging beneath a wagon.

⁵ In April 2002, Tranz Rail contracted out the inspection and maintenance of locomotives and rolling stock to Alstom New Zealand to standards set by Tranz Rail.



Figure 5 Strike marks at the northern edge of the pavement at Kahikatea Drive level crossing (NIMT), Hamilton

1.2.8 Strike marks again consistent with forward-facing dragging brake rigging were found on the northern edge of the pavement of the State Highway 3 (SH3) level crossing at Te Kuiti (see Figure 6). No 7 points, about 5 m south of the level crossing was identified as the second POD as these points had sustained similar damage to 168A points in Hamilton.



Figure 6 Strike marks at the northern edge of the pavement of State Highway 3 level crossing at Te Kuiti. Beyond the tarmac can be seen No 7 points on which Train 215 derailed

1.2.9 The rear wagon of Train 215 stopped about 330 m beyond the POD (see Figure 7).



Figure 7 Diagram of derailment site at Te Kuiti showing location of wagons (not to scale)

1.3 Personnel

The locomotive engineer

1.3.1 The locomotive engineer of Train 215 had held grade 1 certification for about 16 years. He had commenced his rostered shift at 0400 on the day of the derailment.

The CTD team leader

1.3.2 The team leader had last been recertified in terminal train inspections in 2001. This included knowledge of the duties defined within Tranz Rail's procedures for terminal brake tests.

1.4 Locomotive event recorder

1.4.1 On 22 January 2004 Tranz Rail advised:

Network Control has confirmed that the request for the locomotive extraction was sent to Alstom. However, due to a procedural error the information was not downloaded and recorded, therefore we are unable to produce a copy at this time.

Since then the process for event recorder extraction has been addressed and improved to ensure that this does not happen again.

1.4.2 The preserving and availability of such data was not mandatory, however Tranz Rail's Rail Operating Code Section 2 Clause 1.3 and Section 4 Clause 11.4.3 required that data from locomotive event recorders be preserved in the event of a significant incident or derailment.

1.5 Wagon information

ZH1109 and PK562 (Hamilton derailment)

- 1.5.1 When the Alstom team leader arrived at the derailment site, he could not inspect beneath ZH1109 or PK562 because the bogies were buried in the ballast. After a quick walk around these wagons, he went with the area co-ordinator to examine the track and look for a possible cause of the derailment. He found damage consistent with something dragging when Train 215 had arrived from the ECMT.
- 1.5.2 When the team leader got back to the POD, the derailed wagons had been detached and Train 215 had departed. He later said that he had not been surprised as there was no requirement for him to check or inspect the train before it departed.
- 1.5.3 Tranz Rail's Railnet Code G 104, which was issued to infrastructure staff, contained a requirement to hold derailed wagons and wagons coupled to either side. However, this code was not available to staff required to undertake the mechanical inspection.
- 1.5.4 The team leader arranged for road cranes to lift the derailed wagons so that he could inspect beneath them. However, before the cranes arrived he was advised of the second derailment at Te Kuiti and he left to attend that site. He was later advised that the derailed wagons had been lifted and inspected, but no dragging brake rigging was found.



Figure 8 Diagrammatic section of the trailing bogie showing the brake gear as designed (above) and failed (below)

1.5.5 When the Alstom team leader arrived at Te Kuiti he carried out an inspection of the wagons. He found that the brake rigging on the leading bogie of UK20321, which had not derailed, was dragging (see Figure 9). The pin securing the vertical lever arm to the anchor link, was damaged but still in place, but the brake beam pin was missing.



Figure 9 Trailing axle of the leading bogie of UK20321 showing the dragging brake rigging following the impact with No 7 points at Te Kuiti

- 1.5.6 An examination of UK30321 following the derailment found the following:
 - the brake push rod was bent and had been forced back beneath the trailing axle of the leading bogie (see Figure 9)
 - the brake rigging safety wire had broken (see Figure 10)
 - the axle and brake push rod both showed wear signs consistent with the brake push rod resting on the revolving axle (see Figure 11).



Figure 10

Looking towards the rear of UK20321 and the trailing brake gear. The two ends of the broken safety wire are visible as is the bent brake push rod



Figure 11 Wear marks on the axle and brake pull rod of UK20321

- 1.5.7 When Train 215 departed from the CTD, the dropped brake push rod on the leading bogie on UK20321 was protruding forward in a ploughing position below the rail head but clear of the sleepers. As the wagon passed over 168A points, the dropped brake push rod impacted with the points spreader bar and split the points.
- 1.5.8 As Train 215 passed over No 7 points at Te Kuiti the dropped brake push rod hit the spreader bar and split the points. The impact forced the already bent brake push rod into a trailing position under the trailing axle of the leading bogie.
- 1.5.9 The Alstom team leader inspected the bogies of UK15178 after it had been rerailed at Te Kuiti. He found that the brake push rod on the leading end of the trailing bogie was hanging down in a ploughing position in the direction of travel. The leading brake beam pin was missing but the brake rigging was otherwise intact with only a small amount of abrasion evident on the leading edge of the brake push rod.



Figure 12 The brake push rod recovered from UK15178 following the derailment. Note straightness of brake push rod compared to that on UK29321 (see Figure 9)

1.6 Wagon inspection

- 1.6.1 During April 2002, Tranz Rail contracted out the mechanical inspection and maintenance of rolling stock to Alstom, to standards set by Tranz Rail.
- 1.6.2 Tranz Rail's Wagon and Container Inspection Manual M9202 dated 10 May 1999 required a 3-level inspection regime:
 - Random inspections
 - B-check
 - C-check.

- 1.6.3 Tranz Rail's Rail Operating Code Section 5, Instruction 1.15.4 required a thorough walk-around inspection to be carried out by yard operating staff (train examiner operations)⁶ immediately before a train departed from a terminal. This 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.
- 1.6.4 The terminal inspection carried out on Train 215 before it departed from Mt Maunganui was in accordance with Tranz Rail's Rule 806(a) Terminal Test which stated in part that situations requiring a terminal brake test included:
 - when any locomotive hauled train was made up
 - on any vehicles added to a train

Rail Operating Code Section 5, Clause 15.4.1 stated that a terminal inspection included a visual check for loose or hanging brake gear and rigging.

- 1.6.5 The original design of the T14 bogic required all brake rigging pins to be secured with a split pin and washer. Brake rigging safety wires were used to constrain the brake push rod should a pin fall out. If a brake push rod became detached as a result of a missing pin, the brake shoes on the respective wheel set became inoperative and hung free of the wheels when the brakes were applied. Tranz Rail's Rail Operating Code Section 5 Instruction 15.4.1 Freight Train Inspection, Terminal Station, required that the person undertaking the inspection observe the condition of the brake blocks so such a defect should be identifiable if present during the predeparture terminal inspection of a train.
- 1.6.6 The inspection carried out of Train 215 before it initially departed from the CTD in Hamilton was in accordance with Tranz Rail's Rule 807 (a) Intermediate Brake Test, which required such a test when a locomotive or vehicles were added to or detached from a train. In such situations the person carrying out the test was required to stand alongside "the vehicle immediately behind where the division was made", in the case of Train 215 this would have been alongside the last vehicle. From this position the locomotive engineer was requested to "apply brakes" then "release brakes" to ensure that the brakes responded promptly. There was no requirement for a "walk around" visual examination of the train as part of the intermediate brake test unless the train had been standing over for any length of time.
- 1.6.7 A B check⁷, which covered safety critical items on rolling stock, was performed by certified staff whenever 2 or more brake blocks were replaced or after an incident involving the wagon. If a wagon failed a B check it was to be "bad-ordered"⁸ and forwarded to a depot for repairs, However, there was no requirement for personnel undertaking B checks to report the non-completion of FMI MW3024 if identified at that time.
- 1.6.8 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.

⁶ "Train examiner operations" describes a specific function generally undertaken by yard based rail personnel. An individual performing this function must hold a Licence to Operate Classification E - Train Inspection Duties.
⁷ A field examination of the wagon as defined in Tranz Rail Code M9202 "Wagon and Container Inspection Manual".

⁸ A status on AMICUS which indicated the wagon was in need of repair

- 1.6.9 Tranz Rail had issued Field Modification Instruction (FMI)⁹ MW 3024 Issue A which consolidated previous FMIs with regards to brake rigging. The date of the original issue of this FMI could not be confirmed, but on 25 October 2000, it was reissued as FMI MW3024 Issue B to include the replacement of the split pin with either a welded bolt or a pin with a washer welded to it. FMI MW3024 Issue B stated that the work was to be carried out at depots, workshops or field units, and was compulsory on all wagons entering a depot from the date of issue.
- 1.6.10 SAP¹⁰ and MAXIMO¹¹ records showed that 5 B checks had been completed on UK20321 since the implementation of FMI MW3024 Issue B on 25 October 2000, the last of these on 19 September 2002. A bad order code 9939 (brake rigging and equipment repairs/adjust) had also been completed on the wagon on 20 November 2001. However there was no record of the FMI MW3024 modifications having been done at this time.
- 1.6.11 Records showed that 3 B checks had been completed on UK15178 since 25 October 2000, the last being on 14 May 2002. A bad order code 9962 (handgrabs and footsteps) had also been completed on 14 December 2001. However, there was no record of the FMI MW3024 modifications having been done at this time.
- 1.6.12 Work orders for each individual wagon were not loaded into SAP to track the progress on implementing FMI MW3024 Issue B throughout the fleet. However, from 2 April 2002, all outstanding work orders were loaded on to MAXIMO so they could be tracked and were removed once the work had been completed.
- 1.6.13 A C check¹², was performed before a wagon left a maintenance depot after repairs, or every 24 months, with an upper limit¹³ of 27 months between checks.
- 1.6.14 The inspection requirements for brake rigging during C checks were:

Brake rigging: All components in place, secure and intact. Brake spreaders must be intact. No excessive wear.

- 1.6.15 The last C check on UK20321 had been carried out on 6 July 2000. Alstom advised that an inspection of the wagon confirmed that the requirements of FMI MW3024 Issue A had been completed and, although there was no record of when this had been done, it was probably during this C check. FMI MW3024 Issue B was issued after that date and the next scheduled C check for UK20321 was on 6 July 2002, with an upper limit of 6 October 2002. However, the wagon had not been directed to a depot for inspection and was 12 days past that upper limit date at the time of the derailment and was therefore out of code.
- 1.6.16 The last C check on UK15178 had been completed on 18 December 2000, but although FMI MW3024 Issue B had been issued about 2 months prior to that, the modifications contained therein had not been done. The next C check for UK15178 was scheduled for 18 December 2002.
- 1.6.17 On 2 April 2004 Alstom advised that the number of overdue checks had been reduced from about 700 in April 2002, when it's contract with Tranz Rail had commenced, to 14 as at 19 March 2004.

⁹An instruction authorised by Tranz Rail to modify wagons in the field or in depots.

¹⁰ Trade name for software used by Tranz Rail to track the maintenance history of a wagon.

¹¹ Trade name for software used by Alstom to track the maintenance history of a wagon.

¹² A full examination of the wagon as defined in Tranz Rail Code M9202 "Wagon and Container Inspection Manual" and usually conducted at depots.

¹³ The last day an inspection may be carried out before the wagon becomes out of code.

- 1.6.18 Tranz Rail's code M9202 Wagon and Container Inspection Manual provided for an extensive brake check every 10 years. Such a check on UK20321 was due on 31 January 2004 and for UK15178 on 30 January 2005.
- 1.6.19 On 15 April 2003, in response to a question relating to the state of fleet compliance with FMI MW 3024 as at 18 October 2002, Tranz Rail stated:

At this time we believe over 50% of the bottom and middle pins on the wagons have been welded and therefore 50% of the fleet is compliant as at 18 October 2002. Regrettably our record keeping does not reflect these figures and we are taking steps to rectify the situation immediately. ALSTOM is currently carrying out special re-checks of the rigging security and rectification for all wagons in the fleet, which will include an FMI assessment and specific fault finding criteria. This will take place on a rolling schedule over the next six months.

Furthermore, in conjunction with the re-check all wagons sent to a depot will have all pins welded in place over the next twelve months.

- 1.6.20 Alstom advised that records for fleet compliance with FMI MW3024 were not kept prior to 18 October 2002 but as at 28 March 2003 there were 2599 outstanding MW3024 work orders on MAXIMO. By the end of February 2004 this figure had been reduced to 557.
- 1.6.21 Tranz Rail advised that the SAP system was no longer in use as Alstom preferred the management system MAXIMO, which focussed specifically on the maintenance of wagons. Wagon information such as kilometres travelled, location and bad order creation was generated within AMICUS and transferred to MAXIMO for use by Alstom staff.

1.7 Dragging equipment detection

1.7.1 Since 1993 Tranz Rail had installed a number of dragging equipment detectors (DED) on its network. Dragging equipment was detected by frangible plates mounted in 5 sections, 3 between the rails and one on either side (see Figure 13). This bar formed part of an electrical circuit, which provided an alarm output if any section of the bar no longer provided electrical continuity, for example if it was broken by dragging equipment.



Figure 13 The dragging equipment detector at Te Kawa

- 1.7.2 The dragging equipment alarm was fed into a radio controller which performed the following functions:
 - sent an alarm message via SelCall to train control this alarm continued to be sent at regular intervals until an acknowledgement was received from the train control radio computer
 - activated a voice message over the local radio channel (channel 1) for immediate advice to any trains in the immediate vicinity. This voice message was repeated 3 times.
- 1.7.3 The closest DED site on the ECMT approaching Hamilton was at Motumaoho, about 20 km away, and southbound on the NIMT the closest DED site to Te Kuiti was at Te Kawa, midway between Hamilton and Te Kuiti. Neither of these detectors was activated on 18 October 2002.

Occurrence 03-105, derailment Train 934, Sawyers Bay, 25 March 2003

1.8 Factual Information

Narrative

- 1.8.1 On Tuesday 25 March 2003, Train 934 was a scheduled Invercargill to Christchurch express freight service. After shunting at Dunedin, the train consisted of a DFT and a DC class locomotives in multiple and 27 wagons for a gross weight of 1031 t and length of 529 m. The train was crewed by a locomotive engineer.
- 1.8.2 At about 0145, as Train 934 approached Sawyers Bay, dragging brake rigging on UK16281, the second wagon behind the locomotive, impacted the spreader bar of the south-end turnout. The impact broke the spreader bar, which connected the switch rails, and pulled the switch rails away from the stock rails (see Figure 14). The gap created between the curved stock rail and the displaced switch rail forced the wheels of the following wagons to take diverging roads and derail.



Figure 14 The damaged south-end turnout at Sawyers Bay

1.8.3 The locomotive engineer stopped the train, but not before 12 wagons had derailed causing significant damage to the track.

Site information

1.8.4 Gouge marks were found in the crushed ballast between the rails of No 25 road and No 26 road in Dunedin (see Figure 15), consistent with the brake rigging dragging when UK16281 was pulled in a northerly direction from No 26 road for placing to No 25 road. Strike marks were also visible on the points traversed by Train 934 when it departed from Dunedin.



Figure 15 Gouge marks between the rails of No 25 and No 26 roads at Dunedin

- 1.8.5 Shortly after departing from Dunedin, Train 934 crossed St Andrews Street level crossing. The pavement of the level crossing showed strike marks, but these were not severe.
- 1.8.6 At Ravensdown, about 5 kms from the POD, sleepers had been laid between the rails to act as a pedestrian crossing point. These sleepers were positioned at railhead level and showed evidence of a strike by the dragging brake gear. This strike mark was in the centre of the sleeper and continued for about 210 mm in a straight line across the top of the sleeper.
- 1.8.7 About 400 m south of the POD Train 934 crossed Bridge 214. A bedplate securing the left rail to the sleeper had been torn from the sleeper and the screw spike securing the bedplate to the sleeper showed signs of a significant impact.
- 1.8.8 Guard rails, which ran inside and parallel to the running rails (see Figure 16), were in place across Bridge 214 to prevent any derailed wagons from going over the side of the bridge by ensuring that the wheels of such wagons were steered into the space between the running rail and the check rail as they crossed the bridge. The guard rails came together in a V shape at each end of the bridge.



Figure 16 Diagram showing positioning of guard rails

- 1.8.9 The distance between Dunedin and Sawyers Bay was about 10 km and Tranz Rail advised that there were no DEDs within that track section.
- 1.8.10 The maximum authorised line speed for express freight trains in the area of the derailment was 70 km/h.
- 1.8.11 Two leading wagons and 13 wagons at the rear of the train remained on the rails but the 12 wagons between these groups were derailed.

Locomotive event recorder

1.8.12 Tranz Rail advised that although an extraction of the data from the locomotive event recorder had been done following the derailment, the data had subsequently been lost and they were unable to source another copy.

Wagon UK16281

- 1.8.13 UK16281 was the second wagon behind the locomotives on Train 934. It was conveyed from Port Chalmers to Dunedin marshalling yard by shunt service and placed to No 26 road before being moved to No 25 road and attached to the consist of Train 934.
- 1.8.14 Examination of UK16281 following the derailment showed that an impact with track infrastructure had buckled and bent the brake push rod (see Figure 17).



Figure 17 The trailing axle of the leading bogie of UK16281 showing the brake rigging after impacting the south-end turnout spreader bar at Sawyers Bay

1.8.15 The leading end of the brake push rod showed strike marks consistent with having ploughed through ballast. The leading vertical lever arm, attached to the front end of the brake push rod, was bent and showed signs of having been wrenched from the brake beam fork assembly during the impact (see Figure 18).



Figure 18 The leading edge of the brake push rod with the leading vertical lever arm attached



Figure 19 The deformed brake beam fork assembly on UK16281

- 1.8.16 The split pin securing the vertical lever arm to the brake beam fork assembly on the leading end of the leading bogie had failed, allowing the pin to become dislodged from the brake beam fork assembly and the vertical lever arm. The end of the brake push rod was hanging below railhead level.
- 1.8.17 The brake rigging safety wire for the leading wheel set of the leading bogie was missing and was not found at the derailment site. The brake rigging safety wire for the trailing wheel set of the leading bogie, although broken, was still attached by one end to the wagon (see Figure 17).

Wagon Inspection

- 1.8.18 An A check in the form of a terminal train inspection was carried out on Train 934 prior to its departure from Invercargill and a TIC provided to the locomotive engineer. An intermediate inspection of Train 934 as required under Rail Operating Rule 807 (a) was carried out prior to its departure from Dunedin.
- 1.8.19 SAP and MAXIMO records showed that 6 B checks had been completed on UK16281 since FMI MW3024 Issue B became effective on 25 October 2000. Other brake maintenance was also recorded as being carried out on 6 December 2002 and 21 January 2003 with a MAXIMO entry for 29 January 2003 endorsed:

BRAKES - SAFETY STRAP - RIGGING PIN REPLACED

- 1.8.20 Alstom advised that although the requirements of FMI MW3024 Issue A, to replace the bogie pushrod with a welded nut and bolt, had been completed on UK16281, the requirements of FMI MW3024 Issue B, to replace the brake beam pin with a bolt and welded nut, had not.
- 1.8.21 Information contained in SAP showed that the last C check on UK16281 had been carried out on 28 May 2001, 7 months after FMI MW3024 Issue B became effective. The frequency clause of FMI MW3024 Issue B stated that:

This FMI is compulsory on all wagons which enter a depot from the date of issue

1.8.22 The next C check on UK16281 was due on 28 May 2003.

1.9 Other relevant occurrences investigated by the Commission

Prior to 18 October 2002

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

- 1.9.1 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.
- 1.9.2 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.
- 1.9.3 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)

1.9.4 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 express freight Train 326 at Pukekohe, 6 April 2000

- 1.9.5 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.
- 1.9.6 Immediately following the incident, Tranz Rail carried out a spot survey on its wagon fleet and concluded that 10% of wagons still required the bolt and welded nut modification to the push rod adopted in March 1998.
- 1.9.7 On 18 July 2000, Tranz Rail issued Field Modification Instruction (FMI) MW3024 Issue A 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.
- 1.9.8 On 25 October 2000, FMI MW 3024 was enhanced to include pins omitted from Issue A. The revised FMI MW 3024 Issue B is attached as Appendix 1.
- 1.9.9 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.
- 1.9.10 In view of the safety actions taken, no safety recommendation was made as a result of the investigation.

Subsequent to 18 October 2002

Occurrence report 02-130, derailment of express freight Train 220 at Rukuhia, 18 December 2002

- 1.9.11 On Wednesday 18 December 2002, Train 220, a northbound express freight service, 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. The impact caused the facing points to open, derailing 11 of the following wagons.
- 1.9.12 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 Field Modification Instruction 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 drawgear for code compliance and welding the bolt thread if not already welded
 - completing an independent check to ensure all work was completed
- 1.9.13 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.

1.9.14 In view of the safety action taken to inspect and replace the bolt and split pin connection with a bolt and welded nut on the brake rigging of all Type 14 bogies, no safety recommendations regarding this issue were made to the operator.

2 Analysis

Hamilton to Te Kuiti

- 2.1 Once the split pin retaining the vertical lever arm pin on UK20321 had failed, the pin subsequently fell out and caused the end of the brake push rod to which it was attached to drop on to the brake rigging safety wire. This initial drop by the brake push rod would not have been very significant and, if it happened before the departure of Train 215 from Mt Maunganui, would probably have been difficult to detect during the terminal inspection prior to departure. However, if the brake push rod had dropped on to the brake rigging safety wire, the resulting loose hanging brake blocks when the brakes were applied should have been detected during the terminal train examination walk-around, if indeed the failure had occurred prior to the departure of Train 215. However, it was not possible to establish when the failure had occurred.
- 2.2 The brake rigging safety wire was designed to hold the dropped brake push rod at a sufficient height above the rail head to prevent it impacting with track infrastructure. However, the brake rigging safety wire only delayed the inevitable dropping of the brake push rod below the rail head level if the restrained brake push rod was not detected during a terminal or intermediate train inspection or during a B or C check.
- 2.3 With the brake rigging safety wire severed, the brake push rod would hang below the rail head at such a height that it would impact with any raised infrastructure between the rails such as points spreader bars or level crossing pavement. Given the number of derailments caused by detached but unrestrained brake push rods, the adequacy of the brake rigging safety wire as a defence against this is questionable. However, in view of the safety action recommended by Alstom to Tranz Rail regarding brake rigging safety wires, no safety recommendation covering this issue has been made.
- 2.4 Although it had not been possible to determine conclusively if the brake rigging safety wire had failed before Train 215 crossed the DED site at Motumaoho, it seems likely that, as an alarm had not been activated, the brake rigging safety wire was probably still intact at that time, with the brake push rod restrained at a sufficient height to avoid contacting the frangible bar detector between the rails. However, from the disturbed ballast between the rails and the strike damage to the pavement at Grey Street level crossing, it is probable that the brake rigging safety wire had broken after Train 215 crossed the DED site but shortly before its arrival in Hamilton.
- 2.5 As Train 215 berthed at Hamilton CTD, the brake push rod on UK20321 was trailing rather than leading which accounted for the lesser damage compared to that caused when Train 215 later departed. There was no reason to suspect dragging brake gear on Train 215 when it arrived at the CTD as the infrastructure damage sustained after the brake push rod dropped had not affected the track circuiting, which would have alerted the signalman or train controller. The minimal damage sustained to the infrastructure would probably not have been noticed by a casual observer because of the darkness.
- 2.6 The intermediate brake test undertaken on Train 215 before it departed from the CTD was in accordance with Tranz Rail's procedures. Although such a test did not require a "walk-around" visual inspection of the train, the CTD team leader said that he had done such an inspection but this had not detected the hanging brake blocks on UK20321.
- 2.7 Train 215 negotiated several sets of facing points when it departed from CTD, some of which showed damage consistent with being struck by hanging brake rigging. The spreader bar of 172A points was broken, but the rails did not split under the train, probably because a wheel of UK20321 was on the guiding rail of 172A points at the time the spreader bar was broken. Train

215 would have been travelling slowly as it moved towards the NIMT and the weight of the wheel on the guiding rail probably prevented it from moving away from the running rail. Had the guiding rail moved, the derailment would have occurred at that turnout.

- 2.8 There was sufficient on-site evidence to suggest that dragging brake rigging was responsible for the derailment at Hamilton, yet no visual inspection was made on the wagons in front of ZH1109 and PK562 after they were detached and before the train was dispatched. The decision to dispatch Train 215 was probably based on an assumption that the derailed wagons were responsible for their own derailment.
- 2.9 Train 215 should not have been dispatched from Hamilton until the cause of the derailment had been identified and the wagons responsible detached. An inspection of the bogies of the derailed wagons was not possible while they were buried in the ballast, but an inspection by mechanical staff should have been carried out on the remaining wagons on Train 215 prior to its departure. Such an inspection by qualified staff would probably have detected the dragging brake rigging on UK20321.
- 2.10 The dispatch of Train 215 without a full inspection allowed the train to continue its journey while in an unsafe condition and compromised safety by creating potential risks to staff and members of the public en route. The condition of the train meant that another derailment was inevitable and it was fortunate that no serious injuries to either staff or members of the public resulted when it eventually derailed at Te Kuiti. A safety recommendation relating to identifying the cause of a derailment and the mandatory inspection of rolling stock derailed before a train was dispatched has been made to the Chief Executive Officer of Tranz Rail.
- 2.11 Once the leading brake beam pin dislodged from the brake beam fork assembly, the vertical lever arm dropped until the brake push rod rested on the brake rigging safety wire. If undetected and with continued operation, the brake rigging wire would eventually fail and allow the brake push rod to drop further, pulling the vertical lever further down until the anchor link rested on the top of the brake beam fork assembly. When the brake push rod dropped at the leading end of the bogie, it exerted pressure on the other end of the brake rod and allowed the brake pull rod to drop down until it rested on the revolving axle.
- 2.12 The brake push rod on UK20321 was probably bent before it impacted with No 7 points at Te Kuiti. The pavement at the north edge of the SH3 level crossing, immediately before the POD, showed a strike mark at a left facing angle (see Figure 5) which suggested that the hanging brake push rod was probably bent either when it impacted with the turnouts as Train 215 departed the CTD in Hamilton, or when it struck the edge of the pavement of a level crossing, probably Kahikatea Drive (see Figure 4), after departing from Hamilton. Given the extent of bending and damage sustained, it is considered that the second scenario is the most likely as Train 215 would have been travelling at a much higher speed and the pavement edge at Kahikatea Drive showed evidence of a significant impact.
- 2.13 The upward bend of the brake push rod on UK20321 would probably explain why it did not make contact with the frangible bar of the DED at Te Kawa and why the damage sustained by the pavement at other level crossings south of Kahikatea Drive was relatively minor indicating it could have been caused by a strike from the underside, rather than the protruding end of the brake push rod.
- 2.14 The B check carried out on UK20321 on 19 September 2002, one month before the derailment, had not identified wear or potential fatigue on the brake rigging split pins. Whether the wear on the split pins was evident but missed during that inspection or the deterioration commenced after the wagon re-entered service could not be ascertained. There had been 4 previous B checks on UK20321 between the implementation of FMI MW3024 Issue B on 25 October 2000 and the latest check on 19 September 2002 but neither these nor the brake rigging and equipment repair work carried out on 20 November 2001, had detected wear or potential fatigue on the brake rigging split pins if they existed at those times. Although it is likely that

those undertaking the various B checks had noticed that the modifications specified in FMI MW3024 had not been completed on UK20321, there was no requirement for them to report this, and as a result an opportunity to track those wagons which had not been modified was lost. However, in view of the safety action recommended by Alstom to Tranz Rail regarding the identification of wagons requiring FMI MW3024 and the completion of the modifications, no safety recommendation has been made.

- 2.15 The failure to programme UK20321 for its C check by the upper limit date of 6 October 2002 meant that a further opportunity to identify and replace the worn split pins in accordance with FMI MW3024 Issue B was missed. The fact that UK20321 could miss a two-yearly safety critical inspection and also miss the upper limit of an additional 3 months so that it continued to operate out of code in an unsafe condition raises concerns regarding the management of the wagon inspection process. However, in view of the significant reduction achieved in the number of wagons with overdue checks following the safety action recommended by Alstom to Tranz Rail, no safety recommendation has been made.
- 2.16 Following the derailment, a dropped brake push rod was also found on the trailing bogie of UK15178. From the minimal damage sustained by the brake push rod it is likely that it had probably been hanging, but restrained by the brake rigging safety wire, before the derailment, and came free as a result of the forces when the wagon derailed. It is therefore unlikely that the detached brake push rod on UK15178 contributed to the derailments at either Hamilton or Te Kuiti.

Sawyers Bay

- 2.17 The brake rigging on UK16281 had probably become detached and dropped shortly before the wagon arrived in Dunedin. It is unlikely that the brake rigging safety wire was present at this time as the depth of the gouge marks in the crushed ballast at Dunedin suggested that the brake push rod was hanging much further down below the rail head level that would have been possible had it been restrained by the brake rigging safety wire at that time. The amount of drop of the brake push rod when the brake rigging fell on to and rested on the brake beam fork assembly was substantially greater than would have been possible had the brake push rod dropped only as far as the brake rigging safety wire.
- 2.18 UK16281 was moving in a southerly direction when it arrived in No 26 road at Dunedin so the dragging brake rigging was trailing and caused only minimal damage to the infrastructure. However, the northward movement of the wagon when it was pulled from No 26 road in preparation for attaching to the consist of Train 934 on No 25 road meant the dropped brake push rod was now protruding forward and in that position it ploughed a groove through the crushed ballast. When UK16281 was then pushed in a southerly direction on to No 25 road, the brake push rod was again trailing and little, if any, damage was visible. The resulting gouge marks and any resulting damage to turnouts would probably not have been noticed due to the darkness.
- 2.19 When Train 934 departed north from No 25 road, the dropped brake push rod was again protruding forward and ploughed a groove in the crushed ballast between the rails. An inspection after the derailment identified further evidence of dragging brake rigging in the form of strike marks at turnouts and level crossings, but these had not affected the passage of the train, probably because of its low speed while departing from the yard.
- 2.20 The strike marks in the centre of the sleepers at the pedestrian crossing point at Ravensdown were smooth and straight indicating that the leading edge of the brake push rod had struck the edge of the first sleeper and then slid across the surface, gouging only a shallow groove. The strike marks did not indicate a significant impact, but confirmed that the brake push rod was still straight at that stage and that the brake rigging was probably resting on the brake beam fork assembly, which was still undamaged.

- 2.21 Before Bridge 214 there was no evidence on the track infrastructure of any strike by the brake push rod that would have been severe enough to not only bend the brake push rod but also cause severe deformation of the brake beam fork assembly. However, as Train 934 approached Bridge 214, the brake push rod was hanging below railhead level in the centre of the rails and pointing straight ahead. While in this position the leading edge of the brake push rod probably collided with the facing nose of the guard rails and the push rod was forced to the left. The impact buckled the brake push rod and wrenched the leading vertical bar from the brake beam fork assembly. This wrench buckled the brake beam fork assembly to the left and bent the end of the leading vertical bar as it sprung free. The buckled brake push rod then impacted with and tore off a bedplate securing the running line to the bridge.
- 2.22 After these impacts, the bent and buckled brake push rod was dragged along in a trailing position under the leading axle of the leading bogie of UK16281. The bend near the centre of the brake pushrod was slightly off-centre as it hung between the rails, although it was now trailing instead of protruding, and it was probably this bend that impacted with the spreader bar at the south end turnout at Sawyers Bay.
- 2.23 The construction of the spreader bar at the south end turnout incorporated several joints which meant that it would have offered little resistance to the force of the dragging brake rigging moving at high speed. Therefore it was unlikely that the spreader bar would have been responsible for the damage sustained by the brake push rod, the brake beam fork assembly and the leading vertical arm, although the impact did split the points and force the following wagons to take diverging routes.
- 2.24 Tranz Rail's procedures required only an intermediate inspection before Train 934 departed from Dunedin, although the code requirements specified that a terminal test was required on any vehicles added to the train. The required intermediate inspection had been completed but it could not be established if a terminal inspection, in accordance with Tranz Rail's Rule 806(a) had been done on the wagons attached to Train 934.

General

2.25 Although data from the locomotive event recorders was not available for analysis, there was nothing to suggest that speed or train handling had been a contributing factor to the derailments.

3 Findings

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

- 3.1 These derailments resulted when damage to points spreader bars caused the points to split and forced the wagons to take diverging routes.
- 3.2 In all cases the damage to the spreader bars was caused by unrestrained and dropped brake push rods on wagon brake rigging.
- 3.3 Split pin fastenings in the brake rigging were a known weak link and a programme of replacement with a bolt and welded nut had been in place for more than 2 years.
- 3.4 The brake rigging safety wire could not be relied on to restrain a dropped brake push rod indefinitely and therefore was not an effective defence against the brake push rod dropping below the rail head and becoming a potential derailment risk.
- 3.5 Dropped brake push rods cradled in a brake rigging safety wire beneath the bogies were not easy to detect during train inspections, however the resulting hanging brake blocks wheels would have been more easily detected during terminal train inspections.

- 3.6 The programming of wagons for modifications specified in FMI MW3024 Issue B was ineffective and the reporting of progress of the implementation throughout the fleet was largely non-existent prior to 2 April 2003.
- 3.7 The C checks on UK20321, UK15178 and UK16281 since 25 October 2000 had not detected that the modifications specified in FMI MW3024 Issue B had not been carried out.
- 3.8 UK20321 was 12 days past the upper limit date for its C check and therefore did not comply with Tranz Rail's maintenance codes.
- 3.9 The train inspection undertaken on Train 215 following the derailment at Hamilton was inadequate given that the wagons responsible for the derailment had not been identified.
- 3.10 The decision to dispatch Train 215 without having positively identified the wagons responsible for the derailment was the major contributing factor to the derailment at Te Kuiti.
- 3.11 The terminal brake test and train inspection of Train 934 before its departure from Dunedin did not detect the dragging brake rigging on UK16281, which was present at that time.
- 3.12 Train 215 and Train 934 were being operated correctly and the actions of the respective locomotive engineers did not contribute to the derailment.

4 Safety Actions

- 4.1 As a result of its own investigations dated 23 October 2002 and 1 April 2003 for the Hamilton and Sawyers Bay derailments respectively, Alstom made several recommendations to Tranz Rail which included:
 - All wagons with overdue checks are bad ordered until inspected and found to be in a satisfactory condition
 - That wagons requiring FMI MW3024 issue B to be completed are identified and the completion is managed in an effective manner
 - That training for Alstom staff that attend derailments include that they shall examine all wagons in a derailed train before allowing the train to depart
 - Reinforce with all Alstom wagon maintenance staff that they must examine all brake rigging pins when carrying out inspections...
 - A review of the Tranz Rail Mechanical Code M2000 with respect to the inspected items, the frequency of inspection, and kilometre based inspection program verses time. In particular, how often is a split pin changed.
 - Review the effectiveness of the brake rigging safety wire and make recommendation to Tranz Rail on improvements to its fitting and construction
 - Tranz Rail staff carrying out terminal brake tests and inspections be reminded and retrained if necessary on identifying faulty or problem brake rigging
 - Speed up the completion of safety critical FMIs

- 4.2 On 11 March 2004 Tranz Rail advised its comments on the recommendations contained in Alstom's incident report, in the order they appear above, were:
 - Accepted. This has been actioned.
 - All wagons have been identified. Completion by end of March 2004 has been targeted.
 - In the first instance this is a Rule/Code issue. All staff, including Alstom, will need to be trained in changed procedures.
 - Accepted.
 - The changed method of securing components of brake rigging that could fall onto the track will make inspection of these split pins redundant.
 - The brake rigging safety wire was a temporary solution until the work required by FMI MW3024 issue B was completed. Safety wires may not be necessary in the future. This is presently under investigation.
 - As this appears to be a practicality rather than training issue Tranz Rail is presently reviewing the Freight Train Inspection process.
 - Accepted.
- 4.3 On 11 December 2003 Tranz Rail advised:
 - 4.3.1 Alstom is currently implementing an updated wagon management process, which should see all outstanding wagon checks completed by the end of February 2004 in conjunction with the standard field check process.
 - 4.3.2 The Brake Rigging Inspection regime is currently being implemented by all Alstom Depots and field staff and should be completed by March 2004.

5 Safety Recommendations

Safety recommendations are listed in order of development and not in order of priority.

5.1 On 26 February 2004 it was recommended to the Chief Executive of Tranz Rail that he:

develop a process which, subsequent to a derailment, requires an inspection by qualified wagon maintenance staff of those portions of the train which have not derailed, before the train is authorised to move (007/04)

5.2 On 14 June 2004 the Chief Executive of Toll NZ Consolidated Ltd replied in part:

Toll NZ accepts this recommendation. We expect to have it implemented by the end of June 2004.

Approved on 26 May 2004 for publication

Hon W P Jeffries Chief Commissioner Page 1 of 3

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Contact:		Pages: 3
Designa	tion: Fleet Engineer	Issue: B
Phone:		Continue on page 13
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		MW3024
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14 (imp)	X27850	X27854	1 1/4"× 5"	117718	2	1 1/4"×5"	117718	~
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"×5"	122510	
16	X27800	X27806	1 1/2"x 5"	122510	2	Pin & washer	123084	
16A.B.E	11050303	11050309	_7/8" × 4"	122603	2	7/8"x4 1/2"	100121	
18A.B	11050992	11050947	7/8 ×3 1/2"	108191	2	7/8"x3 1/2"	108191	
X27396 type 1,2,3	X27396	X27396	1 1/4" × 4 1/2"	250751	2	1 1/2"x5"	122510	2
X26463 type 1,2,3	X26463	X26463	t" x 4"	122602	2	1 1/8" × 4 1/2"	Local Purchase	2
D&L	X25340	X25340	7/8"×3 1/2"	108191	2	7/8"x4 1/2*	100121	2
D&L	X25830	X25830	7/8"×3 1/2"	108191	2	1" x 3 1/2"	I	4
If no slack adjust	ter is fitted on w	agons with D &	. L bogies then p	ins and split pi	ed yan ed	ų		



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