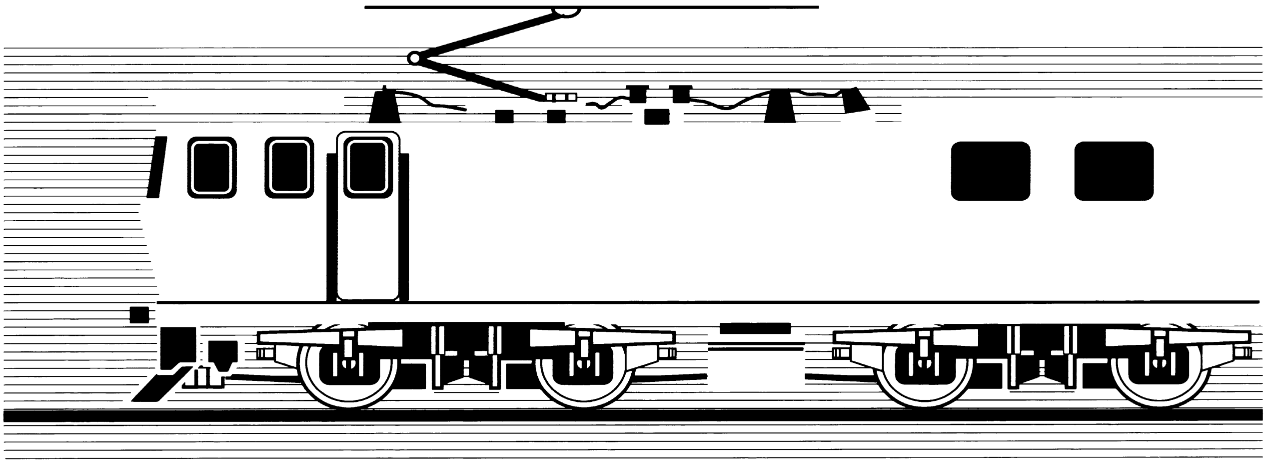

RAILWAY OCCURRENCE REPORT

05-103 **express freight Train 237, derailment, 206.246km Hunterville** **20 January 2005**

TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

Report 05-103

express freight Train 237

derailment

206.246 km Hunterville

20 January 2005

Abstract

On Thursday 20 January 2005, at about 0744, UK 3083, the eighth wagon on Train 237, an Auckland to Wellington express freight service, derailed as the train passed through the north end of Hunterville on the North Island Main Trunk. The train travelled a further 1100 m until the derailed wagon struck the curved closer rail at the south end points at Hunterville, derailing 3 other wagons and uncoupling the air brake system, which brought the train to a stop.

There were no injuries.

The safety issue identified was the compatibility of current track and mechanical tolerances.

The Commission made safety recommendations to the Chief Executive Officers of Toll NZ Consolidated Limited and ONTRACK as a result of Rail Occurrence Report 03-114, relating to a previous similar derailment. Those recommendations are equally applicable to this occurrence, so no new safety recommendations have been made.

Derailment site

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Abbreviations

Alstom	Alstom Transport New Zealand Limited
DOP	drop-off point
km	kilometre(s)
km/h	kilometre(s) per hour
m	metre(s)
mm	millimetres
NIMT	North Island Main Trunk
POD	point of derailment
t	tonne(s)
Toll Rail	Toll NZ Consolidated Ltd
UTC	universal coordinated time

Data Summary

Train type and number:	express freight Train 237
Date and time:	20 January 2005 at about 0744[1]
Location:	206.246 km at Hunterville
Persons on board:	crew: 2
Injuries:	nil
Damage:	extensive damage to rail infrastructure and rolling stock
Operator:	Toll NZ Consolidated Limited (Toll Rail)
Investigator-in-charge:	Vernon Hoey

[1] Times in this report are New Zealand Daylight Savings Times (UTC+13) and area expressed in the 24-hour mode.

1 Factual Information

1.1 Narrative

1.1.1 On Thursday 20 January 2005, Train 237 was a scheduled express freight service travelling from Auckland to Wellington on the North Island Main Trunk (NIMT). At the time of the derailment, the train consisted of 2 EF class locomotives in multiple hauling 25 wagons with a gross weight of 873 t and a total train length of 524 m. The train was crewed by a trainee locomotive engineer driving the train under instruction from a tutor locomotive engineer.

1.1.2 At about 0744, after the train passed through No.7 points at the north end of Hunterville, the leading wheel set of the trailing bogie on the eighth wagon, UK 3083, derailed to the left-hand side in the direction of travel, followed by the trailing wheel set on the same bogie a short distance later.

1.1.3 The trailing bogie ran derailed for about 1100 m until it struck the curved closer rail of No.3 points at the south end of Hunterville, where the leading bogie also derailed (see Figure 1). Both bogies of wagon UK 17124, immediately in front of UK 3083, also derailed at this point.

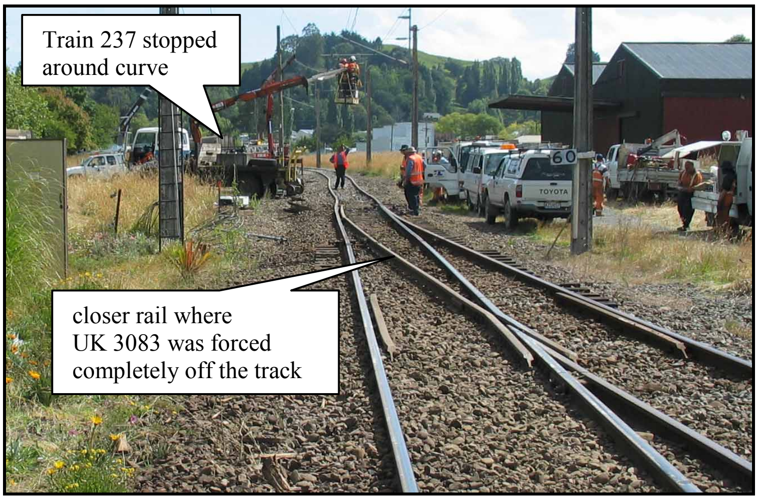

Figure 1
Infrastructure damage under repair at Hunterville, looking south

1.1.4 The wagons in front of UK 17124, and behind UK 3083, derailed one bogie each, but both wagons remained upright on the track. Neither the locomotives nor any other wagons on the train derailed.

1.1.5 The force of the derailment tore both bogies and other equipment off UK 3083 and the trailing bogie off UK 17124.

1.1.6 The derailment caused a flexible air brake connection to pull apart between 2 wagons, releasing the air supply and automatically applying the brakes to bring the train to a stop.

1.2 Site information

1.2.1 The derailment occurred as Train 237 was travelling along a 400 m section of straight track located between 2 reverse curves on a descending gradient of 1 in 200. The maximum authorised line speed for express freight trains was 80 km/h. No.7 points were located within the straight section of track (see Figure 2).

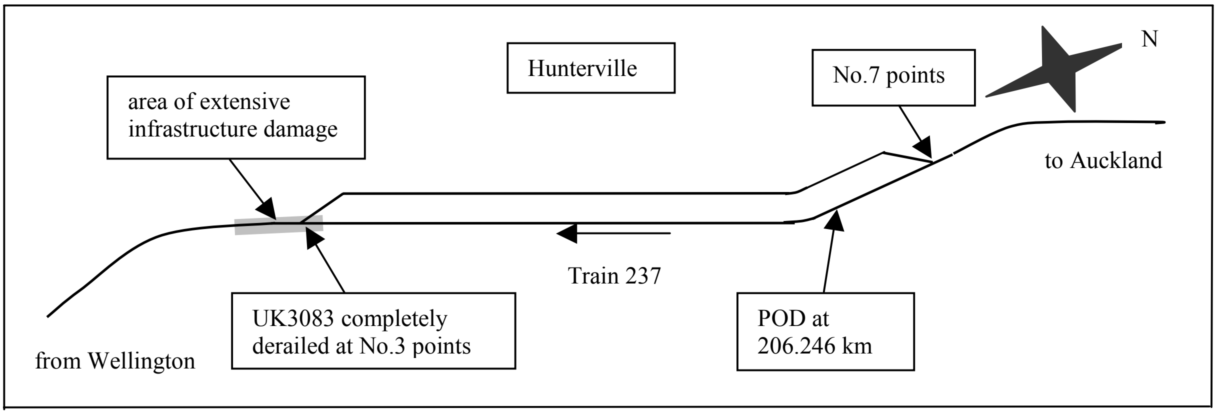

Figure 2
Site plan of derailment area (not to scale)

1.2.2 The point of derailment (POD) was identified at 206.246 km. A 3.5 m long wheel flange mark was found on the top of the left-hand rail in direction of travel. The mark became deeper as it got closer towards the drop-off point (DOP) on the outside of the rail (see Figure 3)

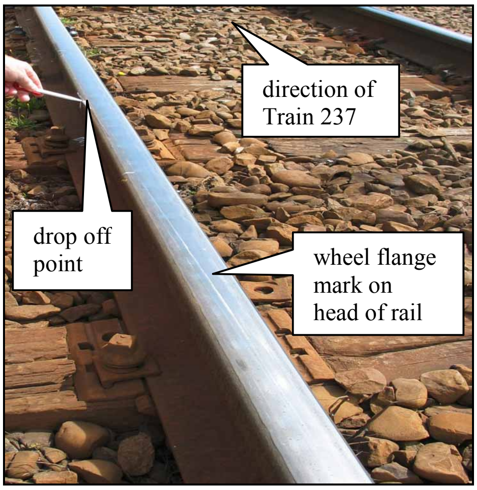

Figure 3
POD at 206.246 km looking south

1.2.3 The derailment resulted in minor damage to sleepers and fastenings between the POD and the frog[2] at No.3 points. However, track materials and overhead traction equipment were extensively damaged for about 150 m beyond No.3 points.

1.3 Locomotive event recorder

1.3.1 The locomotive event recorder was downloaded and made available for analysis.

[2] Frog is the term used to describe the V intersection of the 2 rails at a set of points.

1.4 Wagon inspection

1.4.1 Toll Rail's Mechanical Code M2000 required all freight wagons to undergo a pre-departure check on every train. Individual wagons were required to undergo a scheduled B-check and C-check. The B-check covered safety critical items and was performed when 2 or more brake blocks were changed, or after an incident. The more detailed C-check was performed generally every 24 months, with an upper limit of 27 months. If a wagon was under repair for whatever reason, a C-check was generally carried out at the same time.

1.4.2 The B-check included in part:

Underneath wagon:

Float including side bearers:	check visually as satisfactory

1.4.3 Float was the measurement between the side bearing pad on the bogie bolster and the corresponding float block on the underside of the wagon body (see Figure 4). The Code stipulated that the float limit at the handbrake end was limited between 6 mm and 10 mm and between 12 mm and 16 mm at the non-handbrake end.

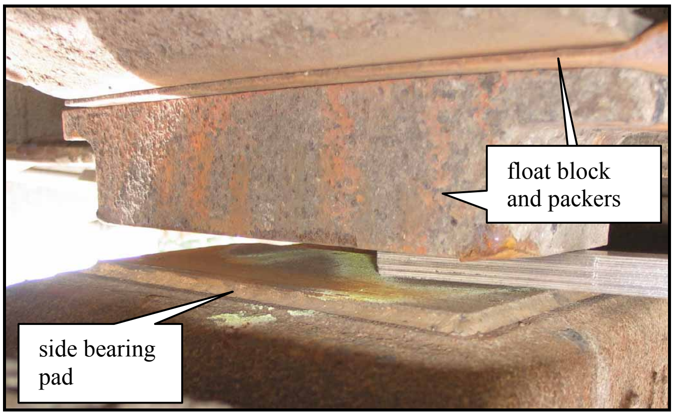

Figure 4
Float arrangement

1.4.4 The C-check criteria did not stipulate a specific examination of wagon float but did include the B-check criteria. The inspection and maintenance records for UK 3083 showed that the most recent check, which was a B-check, was carried out on 15 November 2004, but the float measurements were not recorded.

Wagon UK 3083

1.4.5 UK 3083 was a general-purpose low deck container wagon. The UK class of wagon had an average tare weight of 14.3 t and a design load capacity of 43 t. UK 3083 was carrying two 20-foot containers from Auckland to Palmerston North. The leading container was loaded with bulk sugar and the trailing container was empty. The gross weight of the wagon was recorded as 39 t.

1.4.6 The bogies on UK 3083 were standard 3-piece bogies as used on most freight wagons worldwide. The 3 main pieces were one bolster and 2 side frames (see Figure 5). The end of bolster was supported by 2 sets of coil springs. The larger diameter coil springs, known as primary suspension, provided vertical support. The smaller diameter coil springs, known as wedge springs, applied pressure to the friction wedge to provide damping of wagon roll oscillating movement and were positioned out of sight within the side frames.

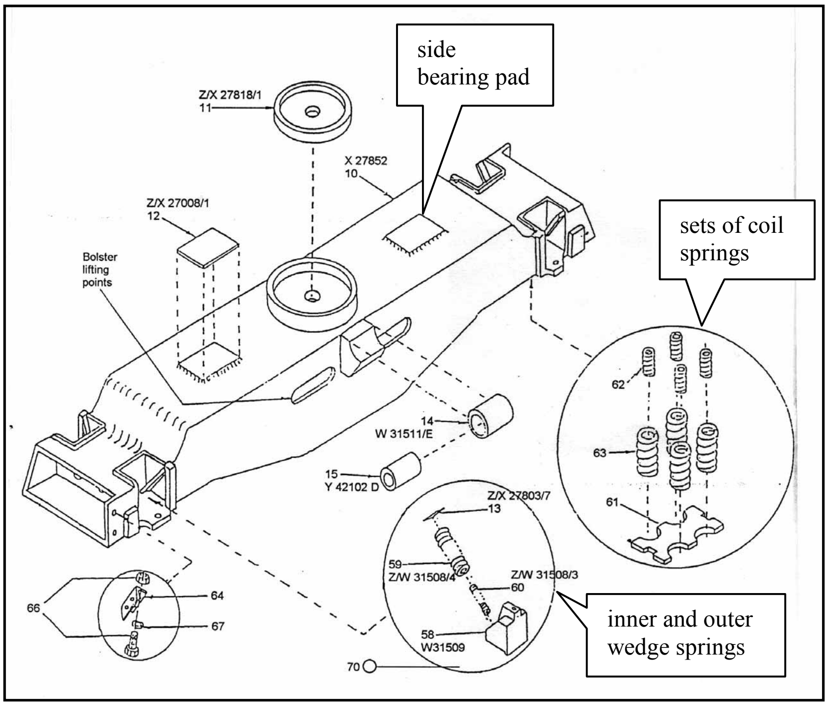

Figure 5
Diagram of bogie bolster
Note bogie side frames omitted for clarity

Post-derailment inspection of UK 3083

1.4.7 A post-derailment examination of the bogies on UK 3083 found that 2 of the 4 inner wedge springs from each bogie were up to 2 mm less than the minimum length required for reuse, if the bogie was to be overhauled at the time. Additionally one outer wedge spring from the leading bogie was on the minimum required length required for reuse, if the bogie was to be overhauled at the time. The combined effect of the springs being below the minimum length would be the same as increasing the wedge height by 0.2 mm and the short springs did not mean either bogie was out of code, rather that the springs were out of specification for reuse.

1.4.8 Both wheel sets from the trailing bogie had more tread damage than the wheels of the leading bogie. The level of tread damage was consistent with the trailing bogie having travelled in a derailed condition over ballast for about 1100 m. Damage to the bogies was consistent with the effects of the derailment, and no defects that existed prior to the derailment were found in either bogie.

1.4.9 Derailment damage and subsequent loss of equipment precluded an accurate measurement of the float being taken on the wagon. Two float blocks and associated packers had been dislodged, one from each end of the wagon. One of the dislodged float blocks was recovered during a ground search. The second float block was not found, but fresh markings where the float block was mounted indicated that it was dislodged during the derailment.

1.4.10 The recovered float block and packers were identified from markings as most likely to have come from the non-handbrake end of the wagon. Bogies were refitted onto the inverted wagon body and the float measurements were taken. To allow for the missing float block at the handbrake end, an assumption was made that it was the same thickness as the adjacent intact block. Float measurements based on this assumption would have meant that the handbrake end was 26 mm in excess of code and the non-handbrake end was 6 mm in excess of code.

1.4.11 An internal report compiled by Alstom Transport New Zealand Limited[3] (Alstom) for Toll Rail stated that it was highly unlikely that the handbrake end was 26 mm out of code and it was probable that the missing float block was a greater height than estimated. However it may have been out of code by a lesser amount. The report also noted that it was possible that the non-handbrake end had excessive float although this could not be positively confirmed, as there were inaccuracies in measurement due to derailment damage, and it was possible that additional packers from the non-handbrake end were not recovered.

1.4.12 The internal report concluded that the condition of the bogies and the load configuration of UK 3083 could not have caused the derailment on their own. It was considered unlikely that the condition of the wagon contributed to the derailment although it was possible that the float may have been out of code and may have influenced the dynamic interaction[4] of the wagon with the track.

1.5 Track inspection

1.5.1 The track was inspected and maintained by Transfield Services Limited[5] (Transfield Services), to standards and frequency that were determined by ONTRACK. A track inspector made a twice-weekly visual inspection of the track from a light inspection vehicle, with a maximum of 5 days between inspections.

1.5.2 The purpose of a track inspection was to ensure that the track and structures were safe for the passage of trains at authorised speeds until the next inspection. On completion of each inspection run, the findings were to be reported to the area coordinator who was responsible for inspection, maintenance and renewal of the rail infrastructure. The report detailed all defects, track geometry faults, and any items outside code limits or requiring attention to prevent further deterioration that could not be repaired personally by the track inspector.

1.5.3 An annual engineering inspection primarily focused on the condition of track assets such as sleepers, rail, track formation, turnouts, level crossings, bridges and culverts. A contract manager was responsible for this inspection.

1.5.4 The findings from the engineering inspection were entered into the track database and used to prepare the national annual, 5-year, and 10-year track renewal plans. The most recent completed engineering inspection through the area of the derailment was carried out in December 2003. ONTRACK advised that the 2004 engineering inspection was not complete at the time of this incident. All the mainline points had been inspected, but not all the track in the area.

Track information

1.5.5 The track at the POD was re-laid with new treated pinus radiata sleepers in about 1980, and 50 kg rail was secured to the sleepers with N type[6] fastenings.

[3] Alstom were contracted to supply the inspection and maintenance of rolling stock to standards set by Toll Rail.
[4] Dynamic interaction was a condition where the natural forces of a wagon coincide with the speed at which the wagon is passing over track.
[5] Transfield Services were responsible for the inspection, maintenance and renewal of the rail infrastructure.
[6] N type fastenings consisted of screw spikes, bedplates and spring washers.

Post-derailment track inspection

1.5.6 The measure-up of the static track geometry following the derailment identified 2 track conditions within 67 m of the POD (see Figure 6).

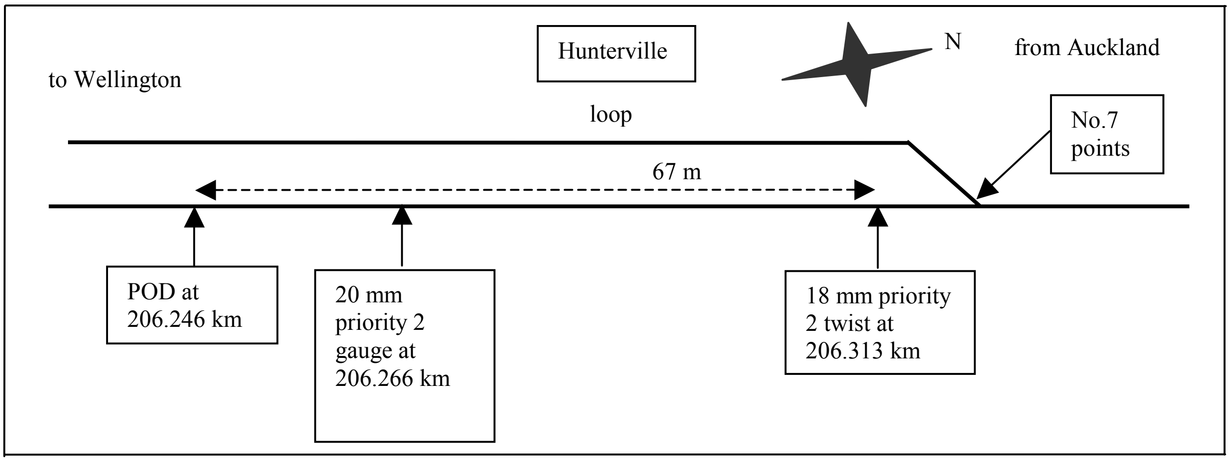

Figure 6
Location of identified track conditions (not to scale)

1.5.7 Both track condition sites had previously been identified as having exceedances by the EM 80 track evaluation car[7] on 3 November 2004 as follows:

Metrage of exceedance/track condition	EM 80 dynamic exception report on 3 November 2004	Date of correction	Static exception report on 20 January 2005, post-derailment
206.313 at thermit weld	20 mm class 1 twist[8]	14 December 2004	18 mm priority 2 twist
206.266 at rail joint	27 mm class 1** low joint 20 mm class 1 low joint 20 mm class 1 line 26 mm class 1 gauge	Not recorded as being corrected	Not significant Not significant 19 mm line 20 mm priority 2 gauge

1.5.8 The limit values of track beyond tolerances differed between those identified dynamically as exceedances by EM 80, and those identified as track conditions from a static measure-up, because of additional lateral loading applied by EM 80 when compared to a static, unloaded measure-up.

1.5.9 ONTRACK's code for EM80 track geometry exceedances were classified and were to be actioned as follows:

Priority	Description	Action to be taken
Class 1**	Beyond maximum	To fix immediately. If not fixed within 24 hours impose temporary speed restriction – if considered necessary
Class 1	Beyond acceptable limits but below maximum	To be fixed within 4 weeks. If not fixed within 4 weeks impose temporary speed restriction – if considered necessary
Class 2	Marginally beyond acceptable limit	Infrastructure maintenance service provider to evaluate and forward supplementary list to Ganger at a later stage, directing action to be taken

[7] The track evaluation car measured and recorded track geometry under load and identified track conditions/exceedances beyond tolerance.
[8] Twist exceedance was the difference in cant between the 2 rails measured at 4 m spacing.

1.5.10 ONTRACK's code for track conditions found during a static measure-up were prioritised and were to be actioned as follows:

Priority	Action required
Priority 1	Consider the need for a temporary speed restriction and fix within 30 days
Priority 2	Program for maintenance
Priority 3	Note and review for action

1.5.11 Transfield Services' derailment report noted that the sleeper condition over 110 m of track before the POD was in poor condition with 90% of the sleepers still usable but with a limited life, and the remaining 10% of sleepers needed to be replaced in the near future.

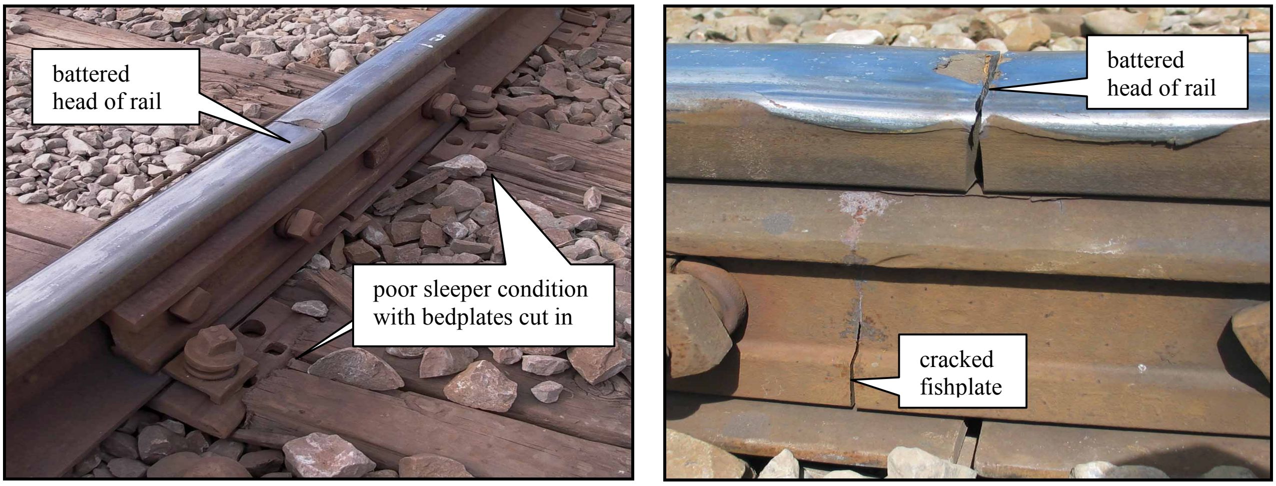

Figure 7
Rail joint at 206.266 km

1.5.12 The Commission's site investigation found that the rail joint at 206.266 km had a battered head of rail, and the fishplate on the field side[9] of the right hand rail had a developing fracture (see Figure 7). The 2 halves of a discarded fishplate that had fracture in the about the same place were laying trackside close to this joint.

1.5.13 The 1999 annual engineering inspection noted that bedplates were digging into the sleepers between 205.25 km and 206.31 km (see Figure 7). Twice-weekly track inspections, occasional ganger run-throughs, 4-monthly EM 80 recordings and annual engineering inspections continue to monitor this area.

1.6 Personnel

Locomotive engineers

1.6.1 The trainee locomotive engineer had transferred to locomotive engineer training in April 2004 after working in various shunting roles since September 2000.

1.6.2 The tutor locomotive engineer held a current operating certificate and had been a Grade 1 locomotive engineer for over 20 years.

[9] Field side referred to the outside face of the rail.

1.6.3 As Train 237 was running late, the locomotive engineers travelled from Palmerston North to Mangaweka by road from where they took over the running of Train 237. The locomotive engineers said they felt nothing unusual when the trainee locomotive engineer applied the regenerative brake approaching the north end of Hunterville. This was done to allow the train to slow gradually for a 60 km/h curve followed by a temporary 40 km/h restriction at the south end of Hunterville.

1.6.4 As Train 237 entered the 60 km/h curve the brake pipe pressure dropped. The tutor locomotive engineer said that something was amiss and when he looked back along the train he said that he saw the wagons coming off.

Track inspector

1.6.5 The track inspector had about 20 years of track maintenance and inspection experience. He was appointed to the role of track inspector at Taihape in 2000. His area of responsibility extended from Marton to Owhango, a distance of about 192 km.

1.6.6 The track inspector said that he last inspected the track through Hunterville 2 days before the derailment. Following that inspection, he sent to the area coordinator an infrastructure inspection report on which he identified a priority 2 track condition behind No.7 points at the north end of Hunterville.

1.7 Previous similar rail occurrence investigated by the Commission

Occurrence report 03-114, express freight train derailment, Shannon, 21 November 2003

1.7.1 On Friday 21 November 2003, Train 220 was a northbound express freight service travelling through Shannon on the NIMT when the 26th wagon in the consist derailed.

1.7.2 Following the derailment, an examination of the derailed wagon identified that the friction wedges were worn but were within code. The float limit at the handbrake end of the wagon was 2 mm outside the limit but Tranz Rail (now Toll Rail) considered that this was not enough on its own to cause the derailment.

1.7.3 The track measure-up of the track following the derailment identified 2 opposing track twists about 12 m and 2 m respectively before the POD. The twists were within acceptable maintenance tolerances at the time of the derailment and Tranz Rail (now ONTRACK) considered that on their own they would not have caused the derailment.

1.7.4 It was concluded that the derailment was probably caused by dynamic interaction between the wagon and the track.

1.7.5 The wagon and track condition details present in the derailments that occurred at Shannon and Hunterville, although similar, were not exactly alike. The track condition at Shannon included a class 1** alignment condition, followed by two priority 2 track twists, whereas the track conditions at Hunterville were not as acute and included a priority track twist followed by a priority 2 gauge condition. Also, there were differing float condition factors on the 2 wagons involved in that the wagon at Shannon was measured accurately, but the wagon at Hunterville could not be.

2 Analysis

2.1 Analysis of the locomotive event recorder confirmed that at the time of the derailment Train 237 was not exceeding the maximum authorised line speed. The data showed that regenerative braking had slowed the train from about 78 km/h to about 53 km/h over about 90 seconds before the brake system lost air pressure.

2.2 Although the track geometry exceedances identified in November 2004 were corrected the following month, the two priority 2 track conditions were present at the time of the derailment, 5 weeks after they were corrected. As the post-derailment measurements were taken while the track was not under load, it was likely the track conditions would probably have been greater if measured by the track evaluation car, which had more tolerant limits to compensate for load factors. However, the track conditions on their own would probably have not caused the derailment. The track measure-up after the derailment did not identify any track conditions that required the imposition of a temporary speed restriction on the 100 m of track leading to the POD.

2.3 The poor sleeper and joint condition would probably not have provided resilience and strength in the track to prevent the return of the track conditions at the same locations. Having rectified the track exceedances, but without addressing the underlying sleeper and track condition problems in the area, the track was liable to relapse to the pre-existing problems more quickly with the passage of trains than would otherwise be expected. The date that the fractured fishplate had been replaced at 206.266 km was not known.

2.4 The track conditions were 47 and 20 m before the POD. After the wagon travelled through No.7 points, rolling oscillations on the wagon would probably have been amplified when it travelled over the track condition at 206.313 km. Then, the rolling oscillations probably continued, but slowly decreasing in severity until the wagon reached the priority 2 track condition at 206.266 km. Track marks showed that 20 m beyond this track condition , the rear bogie, which was carrying the lesser weight, lifted and the wheel flange rode along over the top of the rail. The deepening score line on the head of the rail towards the DOP was probably due to the wheel dropping back down.

2.5 As UK 3083 was travelling at about 73 km/h, the wagon would have taken about 3 seconds to travel the 67 m between the first track condition and the POD and this would probably have been insufficient time for the oscillation movements to stabilise after each impacting influence before experiencing the next.

2.6 The worn condition of the friction wedge springs in the bogies on their own probably did not cause the derailment. As float conditions on wagons were not required to be measured and recorded during the B or C checks, it would have been difficult to monitor this condition. Not having this recorded information meant that the post-derailment float examination had no previous information with which to be compared. Nevertheless, the results of post-derailment float measurements proved inconclusive due to a missing float block and some packers. Therefore, without historical records and being unable to obtain an accurate float measurement after the derailment, it was not possible to say what part, if any, float condition played in the derailment.

2.7 If the float condition was out of code at the time of the derailment, then it would have made UK 3083 more susceptible to dynamic interaction when travelling over an area of track with 2 track condition sites in quick succession.

2.8 Following the derailment, Toll Rail accepted a recommendation from Alstom to record float measurements during the C check examination of wagons, and therefore a safety recommendation covering this issue has not been made.

3 Findings

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

3.1 Train 237 was being operated correctly, and the actions of the locomotive crew did not contribute to the derailment.

3.2 The requirement to visually check, rather than measure and record, the float condition on a wagon during a B check was insufficient to ensure tolerances were not exceeded.

3.3 The float conditions on UK 3038 at the time of the derailment could not be determined but were probably out of code.

3.4 The track conditions at the time of the derailment were close to the exceedances measured by the EM 80 track evaluation car, 5 weeks earlier.

3.5 Poor sleeper condition through the area of the derailment diminished the resilience of the track to withstand the reappearance of track conditions.

3.6 The derailment was probably caused by dynamic interaction between wagon UK 3083 and the track.

3.7 The dynamic interaction was probably caused by combination of track conditions and wagon conditions that on their own were unlikely to have caused the derailment.

4 Safety Action

4.1 On 25 November 2005, Toll Rail advised that they intended to ensure that float measurements are recorded as part of the C-check. Toll Rail envisaged that the check sheets would be modified by March 2006.

5 Safety Recommendations

5.1 On 23 March 2005, the Commission made the following safety recommendation to the Chief Executive Officers of Toll Rail and ONTRACK following an investigation into a previous mainline derailment in rail occurrence report 03-114 that, in conjunction with each other, they:

> critically review current track and mechanical code standards and maintenance tolerances to ensure they are compatible and minimise the potential for derailments caused by dynamic interaction (009/05) (010/05).

5.2 Both organisations accepted the recommendations.

5.3 The safety recommendations are equally applicable in this investigation, so no new safety recommendations have been made.

5.4 On 26 January 2006, the Manager Track Engineering for ONTRACK advised as follows:

> ONTRACK and Toll have agreed to jointly sponsor an independent study to model aspects of wheel/rail interaction based on a specific derailment or derailments to confirm the suitability of their respective current Codes to minimize the potential for derailments caused by dynamic interaction. A brief is currently being compiled based on the least predictable occurrence(s) for which reliable factual information is held.

Approved on 17 February 2006 for publication

Hon W P Jeffries
Chief Commissioner

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04-126	Express freight Train 244, derailment inside Tunnel 1, North Island Main Trunk, near Wellington, 11 October 2004
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