



Report 95-122

Train 2650

Taita

13 December 1995

Abstract

On Wednesday, 13 December 1995 at about 1557 hours Train 2650, comprising two Ganz Mavåg electric multiple units running from Wellington to Upper Hutt, derailed while departing Taita Station. The derailed car, EM 1494, was second in the four car consist and all four wheels of the trailing bogie derailed. There were no injuries. The cause was the separation of the tyre from a wheel on EM 1494. Safety issues identified were the need to record and retain tyre fitting records, the inspection procedures for tyred wheels, the advantages of solid wheels, and the operator's training of part-time Passenger Operators.

Transport Accident Investigation Commission

Rail Incident Report 95-122

Train type and number:	Suburban Multiple Unit, 2650
Date and time:	13 December 1995, 1557 hours
Location:	Taita, 20.55 km Wairarapa Line
Type of accident:	Derailment
Persons on board:	Crew: 4 Passengers: 45
Injuries:	Crew: Nil Passengers: Nil
Nature of damage:	Unit: Moderate Traction overhead: Minor
Investigator in Charge:	R E Howe

1. Factual Information

- 1.1 On 13 December 1995 Train 2650 was the scheduled 1525 suburban service from Wellington to Upper Hutt. The four-car consist comprised ET 3494 (leading) EM 1494, ET 3488 and EM 1488.
- 1.2 Train 2650 was crewed by a Locomotive Engineer (LE), Guard, and two part-time Passenger Operators. There were 45 passengers on board when the train departed Taita Station at approximately 1557 hours.
- 1.3 As the train accelerated away from Taita the LE felt a surge and opened his side window to look back. He could see a dust cloud and EM 1494 at an odd angle and immediately applied full braking and pushed the “Pantograph Lower” button. He estimated his speed at the time as 30 km/hr to 40 km/hr. The train came to a halt with the rear of the train at 20.77 km.
- 1.4 The LE advised Train Control of the derailment and used the public address system to warn passengers to remain on the train until the traction overhead current was isolated by earthing.
- 1.5 The Guard was travelling in the front unit with the LE. As soon as the train stopped he went back through the cars to check the passengers and found no injuries as a result of the derailment of car EM 1494. He could not gain access from EM 1494 to ET 3488 due to the displacement of EM 1494 following derailment.
- 1.6 The Passenger Operators were seated at the back of the car which derailed. They felt a jolt and stated the car “rolled” until it came to rest, where upon they both instinctively jumped up and left the train by the sliding door in the luggage compartment at the rear of EM 1494. The LE, after advising Train Control of the situation, saw them preparing to re-board the train and told them to keep well away from the train until the overhead was isolated.
- 1.7 After checking the first two cars the Guard saw the Passenger Operators outside the train and directed them from the luggage compartment door to caution passengers in the rear two cars to remain on the train until they were advised the traction overhead had been isolated making it safe to leave. The Passenger Operators did this from the ground without coming into contact with the train.
- 1.8 At approximately 1605 hours Tranz Metro’s Service Operations Manager arrived on site. Having ascertained that the pantograph was clear of the damaged overhead he boarded the rear two cars to check and advise passengers personally.
- 1.9 The 1.5 kV power supply to the traction overhead equipment was isolated at approximately 1620 hours, at which time passengers were detrained and arrangements made for alternative transport.

Site details

- 1.10 EM 1494 came to rest with the four wheels of the trailing bogie derailed to the right in direction of travel. The tyre on wheel B2 (the right hand wheel on the leading axle of the trailing bogie) had separated from the wheel and was displaced to the right. (Figures 1 and 2.)



Figure 1

**Wheel B2 on EM 1494 from RHS in direction of travel
(derailed to RHS with tyre displaced to the right)**



Figure 2

**View of wheel B2 on EM 1494 from LHS in direction of travel
(tyre displaced fully off the wheel to the right)**

- 1.11 The tyre was fitted with a standard Gibson Retaining Ring, which is a circular split locking ring fitted to the tyre to inhibit its lateral movement on the wheel for a period of time should the shrink fit lose its clamping force. After the derailment the Gibson ring was found to be heavily worn and no longer restrained the tyre.
- 1.12 Investigation of the track approaching the point of derailment (POD) showed no sign of unusual contact marks until the crossing nose of the right hand turnout from the main line to Taita storage roads at 20.666 km. Although the train was routed through the straight road of the turnout the running edge of the left hand rail on the curved road from the crossing nose showed heavy abrasions and shaving for 8.5 m followed by a flange mark across the head of the rail from right to left. Supporting flange marks indicated two axles had been affected.
- 1.13 Recent deposits of small flakes of metal were found on the inside of the right hand rail at 20.543 km (in the vicinity of the stopping point of trains at Taita). A check at Wingate (the preceding stopping station) showed similar deposits over a short length at the platform.
- 1.14 The 1.5 kV DC overhead was damaged during the derailment. A pipe arm locating the overhead was pulled out and dropper wires joining the catenary and contact wire were damaged.
- 1.15 The pantograph on EM 1494 was not in the lowered position when the car came to rest and was damaged in the course of the derailment. Although damaged it was reported as free from the overhead.

Track details

- 1.16 A detailed track measure up showed no unusual track geometry characteristics. Track materials were to standard and in good condition.

Rolling stock details

- 1.17 The axle of wheelset number 2 of EM 1494 was identified uniquely as axle 1873.
- 1.18 Tranz Rail Limited (TRL) records indicated axle 1873 was fitted new to EM 1183 in August 1982 and removed during a bogie change in 1989.
- 1.19 Hutt Workshop records showed axle 1873 was ultrasonically tested on 8 November 1989 before a new tyre was fitted to wheel B2 as indicated by the tyre stamping on the detached tyre following derailment.
- 1.20 TRL did not record axle numbers when wheelsets were changed in the Multiple Unit Depot and the history of axle 1873 from November 1989 until February 1995 is unknown.
- 1.21 In February 1995 axle 1873 was fitted to EM 1494.
- 1.22 EM 1494 underwent an "E1" service check at 27 000 km on 25 May 1995 and an "E2" service check (54 000 km) on 3 November 1995. The latter was the last inspection prior to the derailment.

1.23 Tyre profile condition was monitored by four parameters measured by gauges during these service checks.

Code	Parameter being controlled	Unworn Value	Measurement at which lathe reprofiling required	Condemning limit
X	Flange width	0	24	40
Y	Flange height	0	5	10
W	Flange sharpness	0	10	15
Z	Tyre thickness	Approx. 65	*	35

Note: * Any wheel turning to improve X or W must not reduce Z to below 38.

The measurement of wheel B2 at each inspection and following the derailment were:

Date	X	Y	W	Z
25/5/95	30	1	4	42
3/11/95	24	2	3	42
13/12/95 (following derailment)	30	2	not measured	39.5

- Note:
1. Measurements following derailment were taken from a worn surface and are approximate.
 2. The size of the difference in X readings between 25 May 1995 and 3 November 1995, particularly without a change in Z values, is considered unusual by TRL and attributed to measurement techniques introducing errors in measurement. This is supported by the reading of 30 following derailment.
 3. Although an X reading of 24 as recorded on 3 November 1995 indicates lathe reprofiling was required the low Z value (42) would have reduced Z below 38 after such reprofiling. In such cases wheels are run until condemning limits are reached.

Component testing

1.24 Analysis of the tyre showed the material composition to be within specification requirements.

1.25 A section of the tyre was metallographically examined. This revealed it to be of relatively fine grained pearlitic structure that had also been tempered. This is typical of a high carbon steel and consistent with a railway tyre that has been heated before being shrink fitted.

Therefore as a tyre is machined the clamping force is reduced. Although no specific records can be related to this wheel and tyre fitting it is likely that the tyre went to the lathe for reprofiling at least twice in the six years since it was fitted. As a result at the time of derailment the tyre thickness was approaching condemning limits and no other machining would have been programmed. There is a critical clamping load required to ensure that the tyre stays on the wheel without moving relative to the wheel. For normal situations it is presumed that the critical clamping load will not be reached until the tyre is machined below the minimum size. However, this may not have been the case due to an initial low strain in the tyre after the shrink fitting. This would be caused by the difference in dimensions between the outside diameter of the wheel and the inside diameter of the tyre being smaller than normal prior to the shrink fitting. It is not known if these machined dimensions would have met the minimum specification requirements as no records are kept by TRL for tyre fittings in 1989.

3. Findings

- 3.1 The derailment was caused by the loose tyre on wheel B2 being able to move laterally on the wheel and take the wrong road at a crossing nose.
- 3.2 The tyre was able to move laterally because the relative movement of the wheel on the tyre had resulted in the wearing away of the Gibson Retaining Ring.
- 3.3 The tyre had been loose on the wheel for some time prior to the derailment.
- 3.4 Appropriate inspection procedures were not in place to detect the loose tyre before the failure of the Gibson Retaining Ring.
- 3.5 The tyre material composition and hardness were as specified.
- 3.6 The material, heat treatment and microstructure of the tyre were as expected.
- 3.7 The probable cause of the loose tyre was loss of the clamping load below a critical level as a result of the difference in dimensions between the outside diameter of the wheel and the inside diameter of the tyre being less than that required prior to the shrink fitting and the result of subsequent machining of the tyre reducing the thickness.

4. Safety Actions

- 4.1 Following the derailment TRL initiated a specific visual inspection of all Ganz Mavàg tyres as the cars were passed through the depot. This commenced 14 December 1995 and was completed 17 January 1996, with no further loose tyres being found.
- 4.2 As a result of the lack of knowledge of part-time staff to react appropriately, as revealed by this incident, TRL has initiated specific instruction sessions for such staff to ensure detraining does not occur in similar circumstances and to ensure appropriate staff are available to assist and advise passengers in each car.

5. Safety Recommendations

5.1 As a result of the investigation of this incident, it was recommended to Tranz Rail Limited that it:

5.1.1 Introduce procedures to record and retain all details of the fitting of new tyres for a minimum period of 10 years. (025/96)

5.1.2 Give priority to developing a suitable solid wheel option to replace tyred wheels on Electric Multiple Units. (038/96)

5.1.3 Review the periodicity and suitability of pit inspection to detect loose tyres on Electric Multiple Units before lateral movement on the wheel is possible. (039/96)

5.2 Tranz Rail Limited responded:

5.2.1 025/96
Procedures are being developed and will be introduced in the near future.

5.2.2 038/96
This has been carefully studied. The Ganz Mavåg wheelset has been designed in such a way that solid wheels can only be fitted if the wheelset is completely stripped of axle bearings, and brake discs or drive gear and suspension bearings, each time wheel replacement is carried out. This would dramatically increase the cost of wheel refurbishment and introduce further possibilities for error, so it is not intended to proceed with changing to solid wheels at this stage.

However it is intended to specify solid wheels for future orders of passenger rolling stock.

5.2.3 039/96
The review has already commenced.

23 October 1996

M F Dunphy
Chief Commissioner

