



Report 98-103

Train 1603

collision with transition head

near Carterton

9 March 1998

Abstract

On Monday, 9 March 1998, at about 0655 hours Train 1603, a Masterton to Wellington suburban passenger service, collided with a transition head which had fallen from the locomotive cowcatcher. Damage to the underside of the train resulted in a 3000 litre diesel fuel spillage.

The cause of the collision was a transition head becoming displaced in transit due to inadequate stowage details.

Safety deficiencies identified were:

- The lack of adequate investigation of the work necessary to convert overseas rolling stock for New Zealand coupling requirements.
- The failure of the safety system to prevent unauthorised modification of rolling stock.

The suitability of the fixing detail for stowage of transition heads on cowcatchers was identified as a safety issue.

The Commission investigated this incident because of the potential for derailment associated with the loss of such a heavy and irregular object during transit.

Transport Accident Investigation Commission

Rail Incident Report 98-103

Train type and number:	Suburban passenger, 1603
Date and time:	9 March 1998, 0655 hours
Location:	Near Carterton at 74.5 km Wairarapa Line
Type of occurrence:	Collision with transition head
Persons on board:	Crew: 2 Passengers: approximately 120
Injuries:	Nil
Damage:	Minor damage to the underside of a locomotive and two carriages resulting in a 3000 litre diesel fuel spill.
Investigator-in-Charge:	R E Howe

1. Factual Information

1.1 Narrative

- 1.1.1 Train 1603 was a Tranz Rail Limited (Tranz Rail) scheduled suburban passenger service operating from Masterton to Wellington on Monday 9 March 1998. The train consisted of DQ6347 (leading), DQ6324, car/van AL2021 and five carriages.
- 1.1.2 Train 1603 was crewed by a locomotive engineer (LE) and guard, and was carrying approximately 120 passengers.
- 1.1.3 At approximately 0655 hours the train was travelling south of Carterton at 74.64 km Wairarapa Line when the train brakes were applied automatically and the train came to a stop.
- 1.1.4 The crew suspected a burst hose and proceeded to inspect the train. They found air and water escaping from under the two carriages behind the car/van, and diesel fuel leaking from the tank of the trailing locomotive.
- 1.1.5 The LE advised Train Control of the circumstances and obtained permission to bleed off the brakes on the five carriages and proceed at reduced speed to Featherston. He also requested Train Control to call out the ganger to inspect the track as he believed his train had hit an obstruction.
- 1.1.6 When Train 1603 arrived in Featherston the passengers were bused to Wellington. The damaged locomotive (DQ6324), car/van AL2021 and the two damaged carriages were placed in the loop and DQ6347 continued to Wellington with the three remaining carriages.
- 1.1.7 Tranz Rail staff alerted to the incident immediately arranged for appropriate restrictions to be placed on the track, for a search for the obstruction to be mounted, and for the necessary clean-up action associated with the diesel fuel spillage.
- 1.1.8 The locomotive event recorder was extracted and a speed/time graph was supplied for analysis.

1.2 The obstruction

- 1.2.1 At approximately 1200 hours on 9 March 1998, Tranz Rail staff found a damaged transition head, lying in brush on the left side of the track in direction of travel of Train 1603, at 74.6 km Wairarapa Line.
- 1.2.2 A transition head is a cast steel adaptor used to connect rolling stock with “Alliance” automatic couplers to rolling stock with standard Tranz Rail hook couplers. It is an irregularly shaped object weighing 23 kg.
- 1.2.3 Tranz Rail operates passenger stock, and some selected special purpose freight wagons and locomotives, with “Alliance” automatic couplers. The bulk of the Tranz Rail wagon and locomotive fleet is equipped with hook couplers.
- 1.2.4 All locomotives with “Alliance” couplers carry transition heads to enable them to be connected to hook couplers when required. Figure 1 shows a transition head in use between the two coupler types.
- 1.2.5 When not in use transition heads are either stowed in the locomotive cab, hung on hooks on the end of the locomotive, or located on spigots on the locomotive cowcatcher.

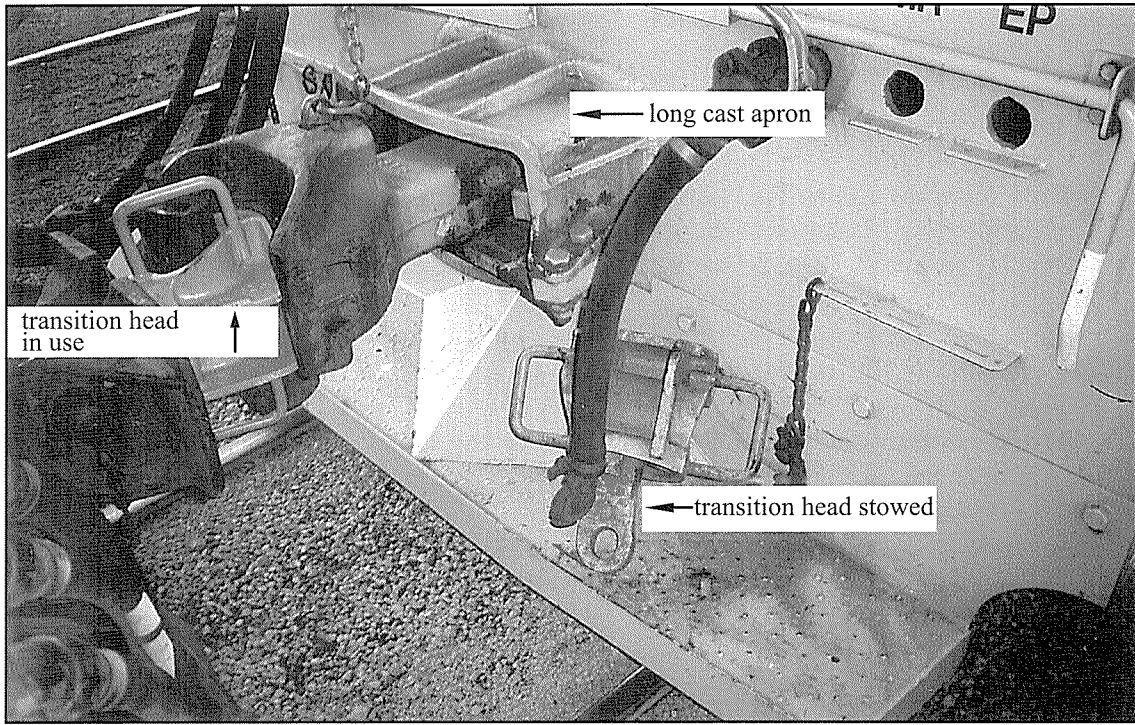


Figure 1

A transition head in use between “Alliance” couplers (right) and hook couplers (left).

Note the long cast apron on this locomotive (QR2027). Photograph taken 12 March 1998. Spigots had not been repositioned following the incident (cf. Figure 2) as they allowed a transition head to be stowed as intended. Field staff had not installed the spigots to the original plan, presumably to overcome the design deficiency.



Figure 2

A stowed transition head on a Tranz Rail DFT locomotive

- 1.2.6 The DQ locomotives hauling Train 1603 on the day were purchased from Queensland Railway and modified during 1997/1998 to permit them to operate on the Tranz Rail system. They were equipped with “Alliance” automatic couplers when purchased.
- 1.2.7 Transition heads on Tranz Rail locomotives have generally been stowed on a hook at a relatively low level because of their weight. Figure 2 shows a typical detail for a DFT locomotive. The drawbar apron and other equipment at low level on DQs and QR¹s precluded this solution and gave rise to the spigot detail for these locomotives. The two 25 mm diameter spigots were welded to the central portion of the cowcatcher (Figure 3). The transition head was intended to be stowed by placing it on the spigots, using two locating holes, with the opposite end supported on the level area of the cowcatcher, as shown in Figure 1.
- 1.2.8 As the suburban carriages were also equipped with “Alliance” automatic couplers a transition head was not needed on Train 1603 on the day of the incident.
- 1.2.9 Although the Queensland locomotives were modified to enable transition heads to be stored at each end it was common practice to carry only one at the long-hood (non-cab) end due to short supply. On 9 March 1998 the locomotives were running with long-hood ends coupled and reports indicated a transition head was stowed on each of the facing cowcatchers. The damage to the train indicated that one of these had become displaced and fallen under the train.

1.3 Damage to Train 1603

- 1.3.1 The underside of DQ6324 and carriages A2079 and A2052 were damaged as they passed over the fallen transition head.
- 1.3.2 The main damage to DQ6324 was a 15 mm diameter hole in the fuel tank and damage to the gear casing. The leading end cowcatcher lip was bent inward and the trailing end cowcatcher lip bent outward.
- 1.3.3 Damage to the carriages was limited to air supply components and water tanks. The damage to the air supply to either carriage was sufficient to cause the brakes to be automatically applied.

1.4 Diesel fuel spillage

- 1.4.1 DQ6324 had been refuelled shortly before departure from Wellington on 9 March 1998. It was estimated that 300 litres of the 3300 litre tank capacity had been used before the collision.
- 1.4.2 The hole in the fuel tank allowed immediate leakage of diesel fuel following the incident.
- 1.4.3 Contamination was minimal between the collision site and Featherston, although there were some noticeable spillages at passenger stops at Matarawa and Woodside. The major spillage was onto the loop at Featherston where the fuel tank emptied.
- 1.4.4 Tranz Rail arranged for the immediate removal of the contaminated ballast and subgrade at Featherston.

¹ A QR locomotive is a modified Queensland locomotive without a cab used for unmanned assistance in train consists

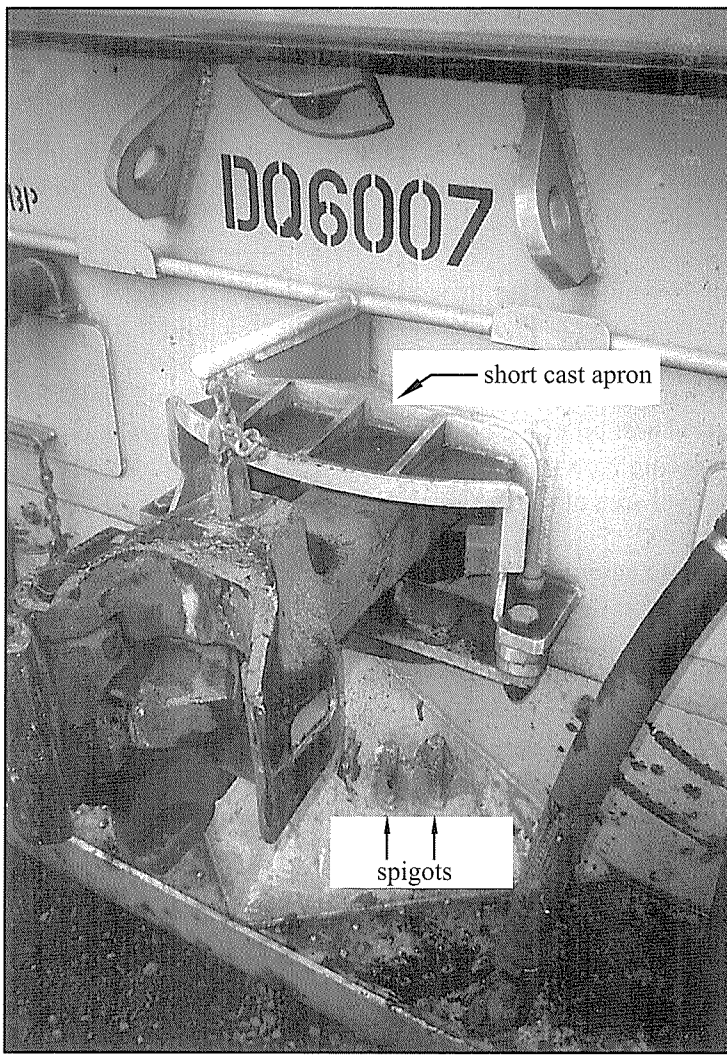


Figure 3
 A typical short cast apron locomotive. Photograph taken on 12 March 1998. Spigots, originally installed to plan, have not been repositioned as the clearance available allowed a transition head to be correctly stowed.

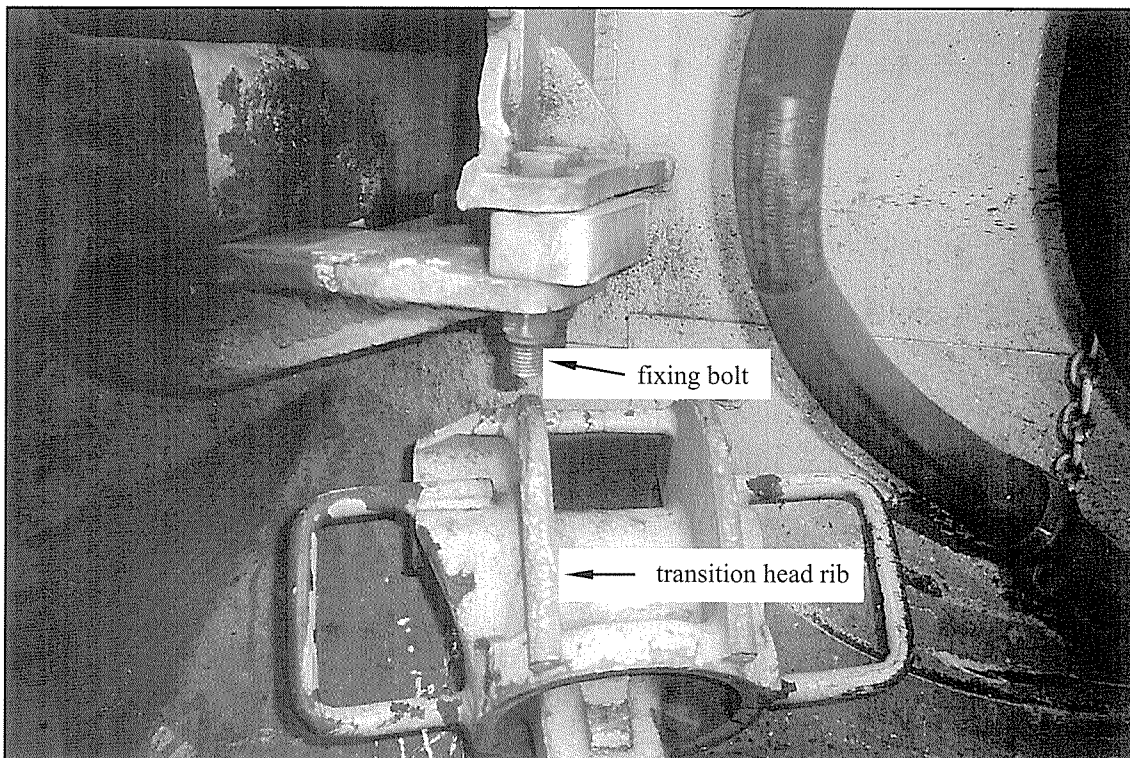


Figure 4
 DQ6347 showing a transition head stowed on the short spigots on this locomotive. When placing or removing the transition head interference could occur between the protruding fixing bolt and the transition head rib

1.4.5 The Wairarapa Regional Council was advised of the spillage and requested to inspect waterways between the point of impact and Featherston. The Council confirmed that there was no risk of contamination.

1.5 Stowage of transition heads on DQ and QR locomotives

1.5.1 Tranz Rail had designed the spigots for locating transition heads on DQ and QR locomotives when not in use. Requirements for these were defined in Tranz Rail plan 15001381, issue B, of 20 December 1996 which detailed the spigot dimensions, and plan 15001380, issue B, of 20 December 1996 which showed where to locate the spigots on the cowcatcher.

1.5.2 The staff member who compiled the plans stated they had been drawn up following measurement of the first Queensland locomotive received by Tranz Rail in 1995. This locomotive was commissioned in October 1996, with another eight commissioned as DQs or QRs from October 1997 to the incident date.

1.5.3 The first locomotive had a short drawbar apron similar to that shown in Figure 3 and the staff member who prepared the plans stated that he was not advised of any physical differences in the drawbar apron detail of the locomotives which were to follow the one on which he based the design.

1.5.4 Tranz Rail design staff were not aware that the Queensland locomotives, as supplied, had at least three different apron details:

- a short cast apron on which the stowage plans were based (Figure 3)
- a long cast apron as fitted to DQ6324 (Figure 1)
- a long fabricated apron as fitted to DQ6367.

1.5.5 Tranz Rail arranged for each locomotive to be modified on arrival, and work was carried out at the Wellington locomotive depot and at the Hutt workshops by members of Tranz Rail and by contractors staff.

1.5.6 A review of locomotives in service which was carried out immediately following the incident showed some unauthorised changes from the requirements of the designer had been made during the modification of some locomotives. The changes were made in an endeavour to overcome a problem created by the long apron, and other factors, which prevented correct stowage of transition heads. The review showed that following modifications the locomotives with long drawbar aprons fell into one of three categories:

- those fitted with spigots, installed to the plans, which did not allow correct stowage of a transition head (this category included DQ6324, the trailing locomotive in the incident), or
- those fitted with spigots, installed to the position shown on the plans but shortened from 125 mm to 70 mm (this category included DQ6347, the leading locomotive in the incident), or
- those fitted with correct length spigots installed further forward on the locomotive than shown on the plan to enable the transition head to be stowed in the manner intended.

1.5.7 Where changes had been made by the field staff these were without authorisation and without formal advice of the problem to Tranz Rail design staff.

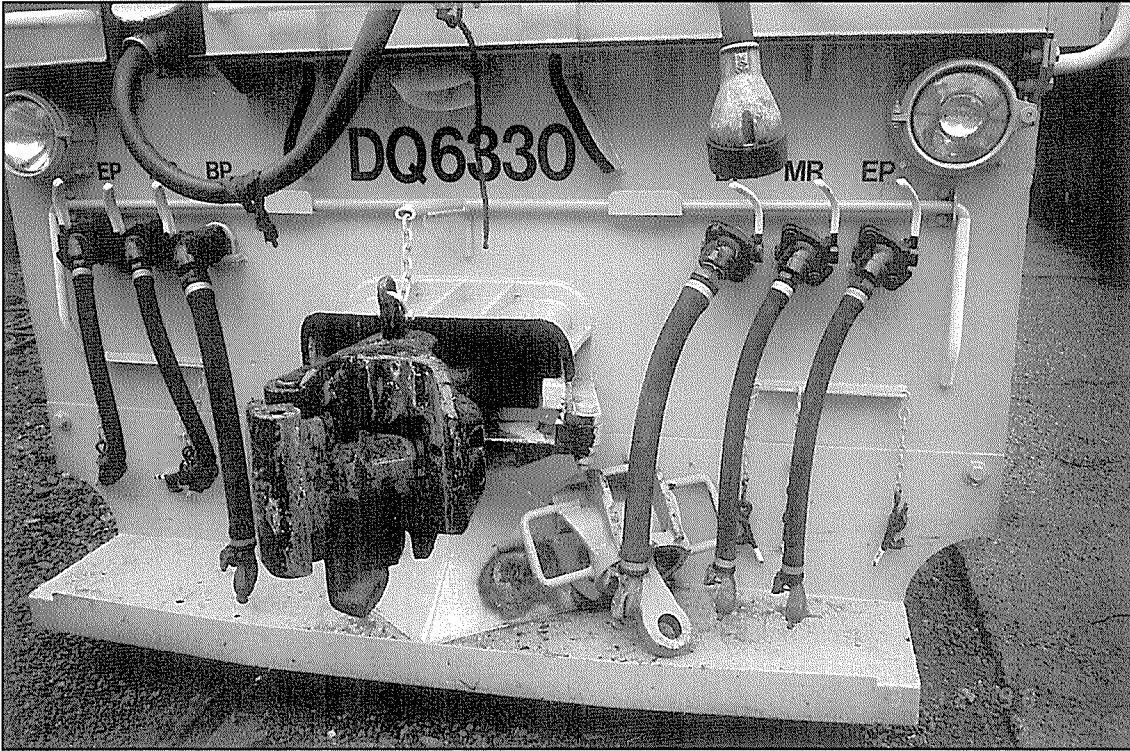


Figure 5

A correctly stowed transition head on a locomotive with a long cast apron. Photograph taken on 12 March 1998. The original position of the spigots prior to repositioning on 10 March 1998 can be clearly seen by the gas cut evidence

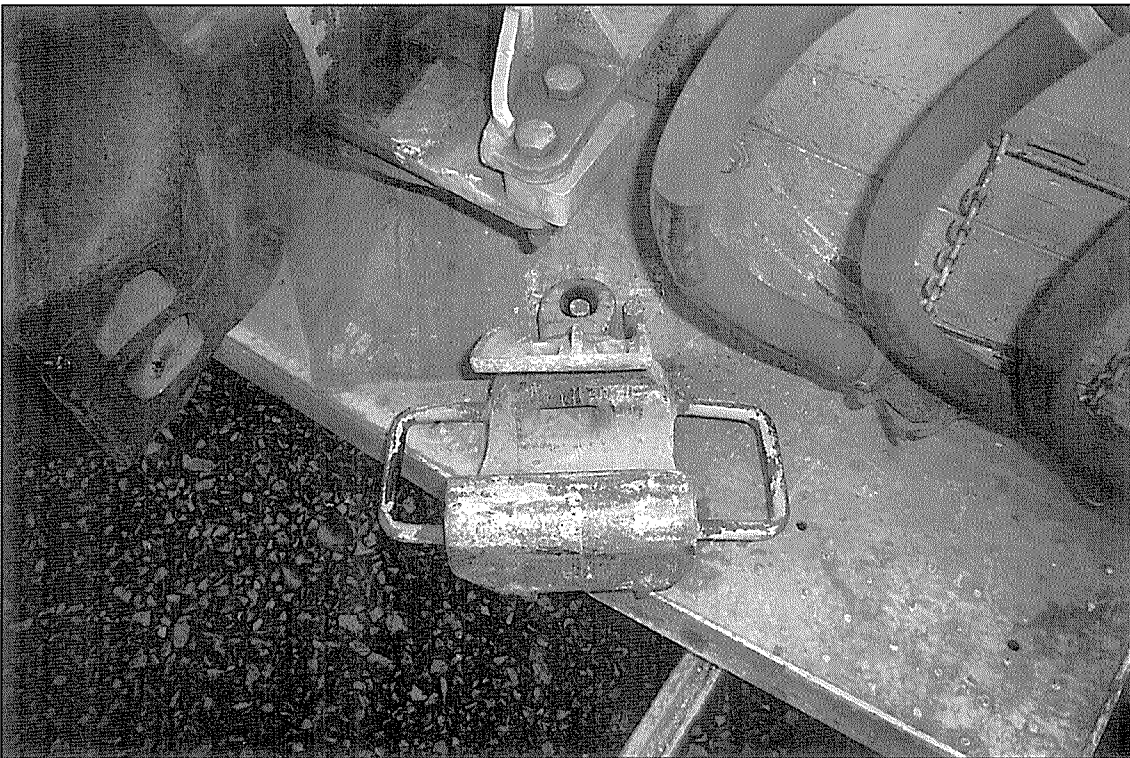


Figure 6

DQ6347 showing a transition head stowed with the coupling hole over one short spigot. This is the likely stowed position on the day of the incident

- 1.5.8 The Programme Manager for the QR conversion at Wellington depot recalled becoming aware of the problem about August 1997 and drawing it to the attention of mechanical design staff by telephone. This resulted in a site visit by the Tranz Rail Fleet Services Engineer. Due to a misunderstanding the Programme Manager awaited instructions while the Fleet Services Engineer awaited detailed measurements relating to the plans which were not available on site at the time. In the event neither party took action and the issue was forgotten.
- 1.5.9 Two separate modifications required to the Queensland locomotives also had an effect on transition head stowage:

Drawbar gear height

As part of the conversion program the bottom support of the apron was lowered when necessary to drop the drawgear to the correct height for Tranz Rail operations. This required removal of the fixing bolts. Some of these fixing bolts protruded further than others when replaced and adversely affected the removal/placement of the transition head for both short and long apron configurations, but particularly the latter. (Figure 4)

Cowcatcher height

Tranz Rail changed the limits for cowcatcher height above rail level on all its mainline locomotives from “the bottom of any cowcatcher must be between 75 mm and 150 mm above the top of the rail” to “the lowest point of any cowcatcher must be between 100 mm and 175 mm . . . above the top of the rail” by code amendment on 23 April 1997. This was after the stowage design had been finalised. New cowcatchers were installed on all Queensland locomotives and as from 23 April 1997 these were to the new standard. Any raising of the cowcatcher relative to the apron adversely affected the clearance necessary to stow the transition head correctly.

- 1.5.10 On 10 March 1998, the day after the incident, Tranz Rail commenced resiting of spigots on all QR and DQ locomotives which did not permit correct stowage of transition heads. Figure 5 shows the result of one such modification.
- 1.5.11 Tranz Rail field staff did not have any procedures, prior to the incident, advising them how to stow transition heads on QR or DQ locomotives correctly. Servicing staff and others associated with their placement either:
- stowed them as intended on the two location holes if room permitted, or
 - stowed them on one location hole only, or
 - stowed them using the hole for the coupling pin, which was located on the opposite end of the transition head to the location holes.
- 1.5.12 Reports indicated that both the trailing end of the leading locomotive (DQ6347) of Train 1603 and the leading end of the trailing locomotive (DQ6324) had transition heads stowed on them before the coupled locomotives left Wellington on 9 March 1998.
- 1.5.13 The locomotive maintainer who prepared the locomotives for dispatch from Wellington stated that QR6324 had been set up and made ready during an earlier shift. He recalled backing DQ6347 onto DQ6324 and stowing a transition head on the long-hood end of DQ6347. He stated the transition head would not fit on the spigots “because of long bolts on the casting” (Figure 4) and he had to turn it around and hang it through the coupling pin hole (Figure 6). His recollection was that the transition head on the long-hood end of DQ6324 had also been located through the coupling pin hole.

- 1.5.14 Field tests carried out by the Investigator-in-Charge following the incident confirmed it was not possible to stow a transition head as intended on DQ6324. Although it was possible to stow a transition head as intended on the two short spigots on the long-hood end of DQ6347 an interference fit was also possible and stowage became a trial and error process.
- 1.5.15 Following the incident a series of measurements were taken on DQ6347 and DQ6342 to quantify the vertical clearance in the stowage areas of these two locomotives with the results shown in Table 1. Figure 7 shows the source of the measurements taken.

	X Rail level to underside of cowcatcher	Y (to underside of bolt)	Z (to drawbar bearing height)	C Vertical clearance in stowage area
DQ6347				
Long-hood end	105 mm	475 mm	550 mm	375 mm
Cab end	150 mm	500 mm <td 560 mm	400 mm	
DQ6324				
Long-hood end	90 mm	510 mm	560 mm	415 mm
Cab-end	85 mm	495 mm	565 mm	395 mm

Table 1

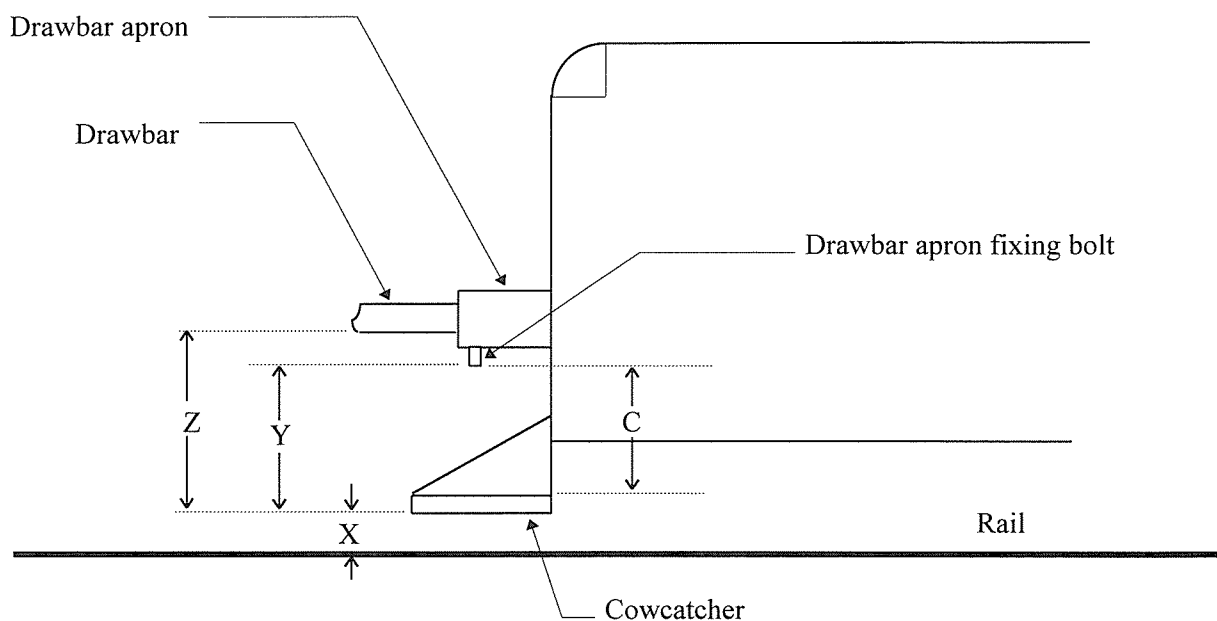


Figure 7
Vertical clearance in stowage area

- 1.5.16 The specific height at which a cowcatcher was installed within the code range on any particular Queensland locomotive during conversion depended on its wheel wear and suspension details at the time, and is the reason for the 15 mm range in the Z dimension. Variations in bolt length accounts for the 35 mm range in dimension Y. The combination of these factors give a 40 mm variation in the vertical clearance C in the transition stowage areas of these two locomotives.

1.6 Notification of the incident

- 1.6.1 Tranz Rail area management staff were aware of the role of the transition head in the collision at midday on 9 March 1998. The incident was not notified to the Land Transport Safety Authority (LTSA) until Thursday 12 March 1998. The LTSA notified the Commission at 1100 hours on 12 March 1998 and the investigation began that day.

2. Analysis

2.1 Train speed

- 2.1.1 Analysis of the event recorder output showed the train was travelling at the authorised line speed, 90 km/h, when the brakes were applied.

2.2 The fallen transition head

- 2.2.1 Late notification of the incident meant it was not possible to establish with certainty where the transition head which fell was stowed. Reports indicated that both of the coupled long-hood ends carried transition heads which were incorrectly stowed on one spigot only. It is more likely that the dynamic effect of the train's motion dislodged a transition head from the short (70 mm) spigot on the trailing end of DQ6347 than from the correct length (125 mm) spigot which was on the leading end of DQ6324. This was supported by the damage to the leading cowcatcher lip on DQ6324 which was more consistent with the transition head falling from DQ6347.
- 2.2.2 The combination of variable spigot length, spigot position and vertical clearance resulted in a number of locomotives either not allowing correct transition head stowage or inhibiting correct stowage. Both DQ6324 and DQ6347 were in this category.
- 2.2.3 The original securing detail had the potential for the dynamic effect of train motion to dislodge the transition head as a major portion of its weight was supported away from the spigots. The post-incident resiting of the spigots further down the cowcatcher may have decreased the safety factor of the original securing detail.

2.3 The Queensland locomotive conversion programme

- 2.3.1 Four aspects of the control of this programme contributed to the loss of the transition head:
- the design deficiencies which resulted in unauthorised modifications to overcome perceived difficulties,
 - the management deficiencies which permitted a cowcatcher height change to be incorporated into the conversion program without checking its possible repercussions,
 - the supervisory deficiencies which resulted in unauthorised modifications entering service, and
 - the management deficiencies which permitted these locomotives to enter service without any procedures detailing the correct way to stow transition heads on modified Queensland locomotives.
- 2.3.2 The lack of control within this particular Tranz Rail programme is of concern, particularly as such programmes are more common with increased numbers of second-hand locomotives and rolling stock being purchased by Tranz Rail.

2.4 Diesel fuel spillage

- 2.4.1 Tranz Rail took prompt and effective action as soon as the potential contamination from the fuel tank leak was realised.

2.5 Notification procedures

- 2.5.1 Senior Tranz Rail staff were aware of the link between the damage and the fallen transition head at approximately 1200 hours on 9 March 1998, some five hours after the incident but Tranz Rail did not notify the LTSA of the incident until three days later.
- 2.5.2 This time lapse had two adverse effects on the investigation. Of particular importance was the lack of information necessary to ascertain from which position the transition head fell. A further impediment to effective investigation was the modifications to the spigots which were commenced the day following the incident, and were essentially completed when the investigation commenced. Tranz Rail mechanical staff had arranged these modifications, which involved gas cutting and resiting of all spigots which did not allow transition heads to be stowed as intended. No specific “before” records were kept resulting in a lack of information regarding the detail of the spigots on the commissioned locomotives as at 9 March 1998.
- 2.5.3 The LTSA advised that it is currently renegotiating the memorandum of understanding with Tranz Rail, and that this will address current problems with incident notification. In view of this no specific recommendations have been made regarding this aspect of the investigation.

3. Findings

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

- 3.1 The spigots on the locomotives hauling Train 1603 provided inadequate stowage for the transition heads carried as standard equipment.
- 3.2 The stowage for transition heads on some other Queensland locomotives converted for Tranz Rail operation and in service at the time of the incident, were also inadequate.
- 3.3 The provision of inadequate stowage on locomotives in service resulted from a combination of factors.
- 3.4 Faulty design assumptions resulted in the details of the transition head stowage being inappropriate for some locomotives.
- 3.5 Changes to the standards for cowcatcher height above rail level had the potential to reduce the clearance available for transition head stowage.
- 3.6 Changes in the fixing detail for lowered drawgear resulted in some reduced clearances for transition head stowage.
- 3.7 Tranz Rail depot and shop staff carried out unauthorised modifications in an attempt to overcome the factors preventing correct stowage of transition heads.
- 3.8 Tranz Rail quality assurance procedures failed to prevent the unauthorised modifications or identify them before the locomotives were placed into service.

- 3.9 The depot staff drew the attention of the design staff to the problem in August 1997 but a misunderstanding prevented identification of the problem and appropriate action before commissioning.
- 3.10 Tranz Rail did not have procedures in place defining the correct way to stow transition heads on DQ and QR locomotives.
- 3.11 If procedures for correct stowage had been in place they may have allowed earlier recognition of the problem.

4. Safety Actions

- 4.1 Tranz Rail took immediate interim action following the incident to relocate spigots on all commissioned locomotives as necessary to permit correct stowage of transition heads.
- 4.2 Following the incident Tranz Rail issued procedures regarding the correct manner of stowing transition heads on QR and DQ locomotives.

5. Safety Recommendations

- 5.1 On 25 August 1998 it was recommended that the Managing Director of Tranz Rail:
- 5.1.1 Reviews the procedures for converting used rolling stock purchased overseas to ensure:
- variations within the stock purchased are recognised and provided for,
 - each modification required for safe operation on Tranz Rail systems is identified,
 - the modifications required are designed, and installation managed, to ensure controlled implementation,
- (067/98); and
- 5.1.2 Reinforces procedures to prevent unauthorised modifications by field staff to overcome design deficiencies, (068/98); and
- 5.1.3 Reviews the acceptability of the relocated spigots as a safe stowage for transition heads on QR and DQ locomotives. (069/98)
- 5.2 On 14 September 1998 the Managing Director of Tranz Rail responded as follows:
- 5.2.1 **067/98**
Tranz Rail will review its procedures for converting used rolling stock before the next similar project commences.
- 5.2.2 **068/98**
The reinforcement of procedures to prevent unauthorised modifications in the field to overcome design deficiencies has already begun and will continue as an ongoing task.

5.2.3

069/98

Transition head stowage arrangements are being reviewed for both classes of locomotives.

Approved for publication 30 September 1998

Hon. W P Jeffries
Chief Commissioner