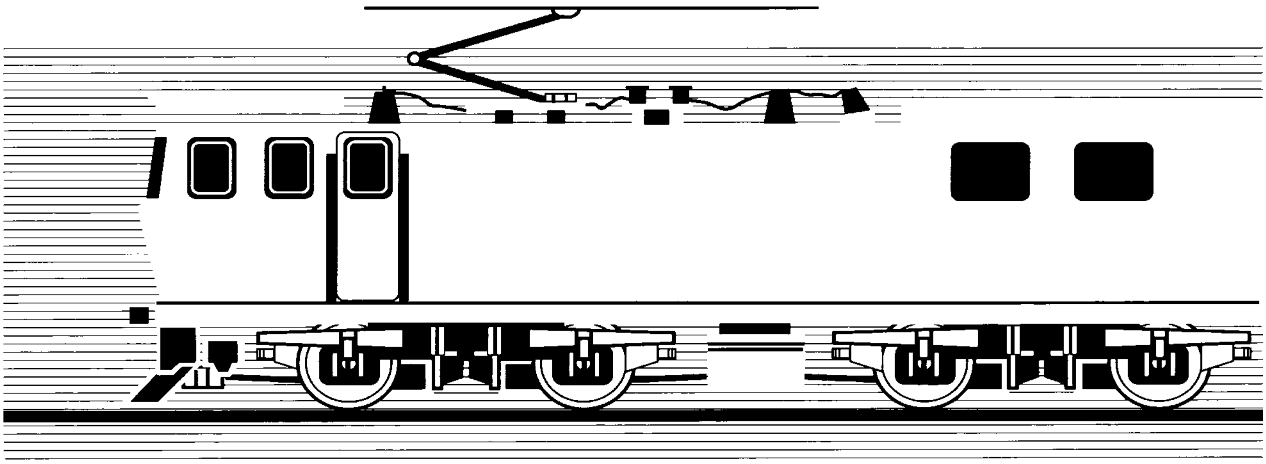

RAILWAY OCCURRENCE REPORT

02-110	Tranz Alpine passenger express Train 801, collision between locomotives and passenger rolling stock, Christchurch	5 April 2002

TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

Report 02-110

Tranz Alpine passenger express Train 801

collision between locomotives and passenger rolling stock

Christchurch

5 April 2002

Abstract

On Friday 5 April 2002 at about 0806, the locomotives for the *Tranz Alpine* passenger express collided with the stationary passenger car consist, which had been placed to the Christchurch station platform in preparation for the locomotives to be attached.

The locomotive engineer, who was driving from the lead locomotive, was not injured and major damage was confined to 2 passenger cars.

The consist was unoccupied at the time.

The safety issue identified was an incorrect component fitted to the locomotive braking system.

As a result of the actions taken by the operator following this and a similar occurrence, no safety recommendations have been made.

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Abbreviations

Alstom	Alstom New Zealand Transport
hr	hour(s)
km	kilometre(s)
km/h	kilometres per hour
kPa	kilopascals
m	metre(s)
Tranz Rail	Tranz Rail Limited

Data Summary

Train type and number:	Tranz Alpine passenger express Train 801
Date and time:	5 April 2002 at about 0806[1]
Location:	Christchurch station platform
Persons on board:	crew: 1 passengers: nil
Injuries:	crew: nil passengers: nil
Damage:	Substantial to 2 passenger cars Minor to the leading locomotive and other passenger cars
Operator:	Tranz Rail Limited (Tranz Rail)
Investigator-in-charge:	D L Bevin

[1] All times in this report are New Zealand Standard Time (UTC + 12) and are expressed in the 24-hour mode.

1 Factual Information

1.1 Narrative

1.1.1 On Friday 5 April 2002 at about 0800, the 9 passenger cars and power-van consist of Train 801, the Christchurch to Greymouth *Tranz Alpine* passenger express, was placed to the platform at Christchurch station. At about the same time, the locomotives for the train, DCP 4830 and DCP 4559, in multiple and coupled back-to-back, departed from the Alstom[2] locomotive servicing depot at Middleton, about 2.5 km away, en route to the station to be attached to the waiting passenger cars.

1.1.2 The locomotives proceeded through Middleton in a southerly direction until they joined the Main South Line up main where the locomotive engineer, who was in the cab of DCP 4830, the leading locomotive, brought them to a stop. He then set up this locomotive for trail operation and moved to DCP 4559, from where he drove the locomotives in a northerly direction towards Christchurch station (see Figure 1).

1.1.3 As he proceeded along the up main line, the locomotive engineer made a brief brake application to satisfy himself that the brakes were working correctly. He said that as he approached Matipo Street level crossing he stopped momentarily, waiting for Signal 220RAB to clear before continuing on to Signal 108RABC, which displayed a low speed indication[3] and authorised him to proceed towards the station platform.

1.1.4 As the locomotives crossed Whiteleigh Avenue level crossing, about 300 m from the station, the locomotive engineer was contacted by radio on Channel 1[4] by a Tranz Scenic[5] employee who was waiting at the front of the leading car to couple the locomotives to the train. The locomotive engineer estimated his speed to be between 20 and 25 km/h when he crossed Whiteleigh Avenue and he maintained that speed for a short period before making a brake application to slow the locomotives in preparation for coupling up to the passenger cars.

1.1.5 There was little response to the brake application and the locomotive engineer said he thought the locomotives were going into a slide. He released the brake, applied it again and at the same time checked that the independent brake was properly cut in at the valve. The second application also had little effect so he again released and reapplied the brake. He also applied the train brake and operated the sand boxes[6] but he was unable to stop the locomotives before they collided with the stationary passenger cars.

1.1.6 When the locomotives were about 50 m away from the leading passenger car, the Tranz Scenic employee observed the locomotive engineer moving about in the cab. He had started to count down and called “4 lengths away, 3 lengths to catch on, 2 lengths to catch on, and STOP.” When he realised the locomotives were not going to stop and a collision was imminent, he took evasive action and moved away from the front of the passenger cars.

1.1.7 There were no passengers or staff in the passenger cars at the time of impact and the locomotive engineer did not sustain any injuries as a result of the collision.

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[2] Alstom New Zealand Transport is the Tranz Rail service provider for maintaining the locomotive fleet.
[3] This indicated that the points are in the proper position but not necessarily that the track is unoccupied. The locomotive engineer must proceed cautiously at such speed (not exceeding 25km/h) as will enable him to stop clear of any obstruction.
[4] The dedicated radio channel for the passenger yard shunting operation.
[5] Tranz Scenic 2001 Ltd operated long distance passenger services under Tranz Rail’s operating licence.
[6] Manual operation of the sanding valve can be used during heavy braking to release a layer of sand onto the rail to increase the co-efficient of friction between the wheel and rail, which will reduce the stopping distance.

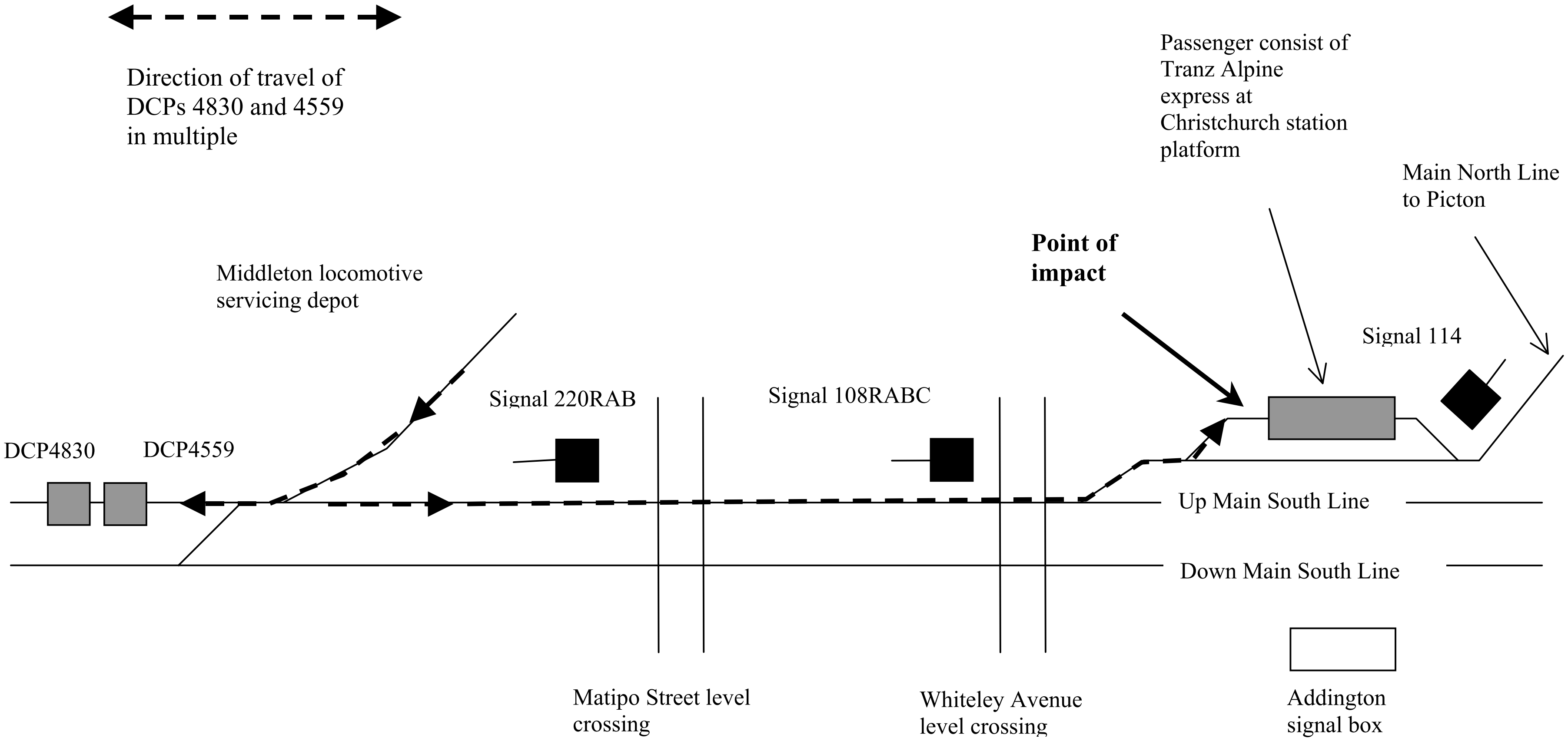

Figure 1
Route of locomotives from Middleton to Christchurch station platform
(not to scale)

1.2 Site details and signalling arrangements

1.2.1 The movement of the locomotives from Middleton locomotive depot to the Christchurch station platform was controlled by fixed signals operated by the signalman at the Addington signal box.

1.2.2 The Christchurch station platform was located adjacent to the loop road, which is connected to the Main North Line (see Figure 1). The passenger car consist overhung the south end of the platform by about 35 m.

1.3 Damage to passenger cars

1.3.1 The leading and third passenger cars sustained major damage and were taken to Dunedin workshops for repair, while the five cars which sustained minor damage were repaired locally in time for the following day's *Tranz Alpine* passenger express service.

1.4 Locomotive event recorder

1.4.1 The lead locomotive DCP 4559 was fitted with an old-style "black box" event recorder. After the collision the event recorder was not disconnected before moving the locomotive, so by the time it had returned to Middleton servicing depot the 6 minutes of short-log data pertaining to the collision had been over-written.

1.4.2 The trailing locomotive DCP 4830 was fitted with a Kaitiaki type event recorder. This contained relevant data, which was provided for analysis.

1.5 Other braking incidents involving DCP 4830 and DCP 4559

1.5.1 On Saturday 6 April 2002, the day after the collision, the *Tranz Alpine* passenger express returned to Christchurch, again with DCP 4559 leading and DCP 4830 trailing. The 2 locomotives were cut off from the passenger cars and departed via the north end of the loop on to the main north line (see Figure 1).

1.5.2 After passing Signal 114, the locomotive engineer made a brake application and he noted the brakes were slow to respond. When the locomotives eventually stopped there was a "run-in" that indicated to him that there had been no braking contribution from the trailing locomotive. He alighted from the cab of DCP 4559 and went back to DCP 4830. He found that the brake controls were correctly set for the trail position but there was no air in the brake cylinders. The locomotives were returned to the locomotive servicing depot at Middleton and withdrawn from service.

1.5.3 Because of these 2 incidents, another locomotive engineer reported that he had experienced a similar lack of braking response while approaching Christchurch station to attach the locomotives to the *Tranz Alpine* passenger express consist on 30 March. On that occasion DCP 4513 was in the lead position and DCP 4830 was trailing. There was no resulting collision but the locomotive engineer felt that only one locomotive was providing effective braking. After coupling the locomotives to the train, he walked around the locomotives and observed that all brake cylinders had extended, so he thought the brakes must have worked correctly and he decided not take any further action.

1.6 Post-collision brake tests

1.6.1 After the collision, locomotives DCP 4559 and DCP 4830 were taken to the locomotive servicing depot where brake operating efficiency tests were carried out. This was a check of the brake application and release of the locomotive brakes, train brakes, and the emergency brake, as well as a check of the locomotive vigilance device. A visual inspection of the locomotive brake piston travel was also made. These tests did not identify any faults and both locomotives were released to run the *Tranz Alpine* passenger express the following day as rostered.

1.6.2 If doubt existed as to the correct functioning of the locomotive brake equipment, a full brake code check in accordance with Tranz Rail's Mechanical Code Supplement M9103 "Standard Test Code For Locomotive Brakes" was required. This code check encompasses 21 individual tests.

1.6.3 A full air brake code check was not carried out on the locomotives after the collision.

1.6.4 On Sunday 7 April, after the second incident, staff from Alstom and Tranz Rail were able to simulate the reported brake fault. When DCP 4559 was set up in lead and DCP 4830 in trail, the brake cylinder pressure on DCP 4830 was approximately half that recorded on DCP 4559.

1.6.5 The Loco 54D[7] Repair Book for each locomotive contained no entries that identified previous inadequate braking performance.

1.7 Time cycle for standard locomotive routine checks

1.7.1 Tranz Rail Mechanical Code M2000 required locomotive checks to be performed at 18 000 km intervals. Brake efficiency tests were carried out as part of these checks and were supplemented by a more detailed full air brake code test at 72 000 km intervals.

1.7.2 At 864 000 km a major examination of the locomotive was required. This was last carried out on DCP 4830 during 1998. At that time the code required the replacement of only those air brake components that failed the full air brake code tests. A code change was made in May 1999, which required all main air brake components to be replaced with refurbished units during the 864 000 km check.

1.7.3 The records showed that the service requirement for DCP 4830 was in accordance with Tranz Rail's Mechanical Code.

1.8 Full air brake code test results for DCP 4559 and DCP 4830

1.8.1 A standard air brake code test in accordance with Tranz Rail's Code supplement M9103 was carried out on DCP locomotives 4559 and 4830 during the week following the 2 incidents.

1.8.2 The tests on DCP 4559 showed that the cab main reservoir pressure gauge was reading incorrectly and this was replaced before the locomotive was returned to service. No other faults were identified.

1.8.3 Although DCP 4830 failed the brake cylinder air leakage test at the No. 1 bogie because of leakage at a clamp, this leakage was minor and would not have significantly affected braking performance.

1.8.4 DCP 4830 also failed the "Break in Two" test because of a faulty F1 selector valve. The failure indicated a sticking protection valve, which would have impeded breaking performance in a "Break in Two" situation only. When the F1 selector valve was removed and examined, it was found to be contaminated with water. The F1 selector valve was replaced and when the "Break in Two" test was repeated, it was within code and the locomotive was returned to service. No other faults were detected at this time.

1.8.5 The defective F1 selector valve had a Hutt Quality sticker on it dated 10/07/92. Locomotive DCP 4830 had its half-life overhaul at Hutt shops in 1992, and it is probable that this F1 selector valve was last replaced at that time.

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[7] A record of repairs or adjustments, identified by the locomotive engineer and actioned by repair staff. The book remains in the locomotive cab.

1.9 Poor braking occurrence involving DCP 4513 and DCP 4945

1.9.1 On 13 April 2002, a poor braking occurrence, similar to that which resulted in the collision on 5 April, was reported with light locomotives DCP 4513 and DCP 4945 in multiple, when DCP 4945 was in the trail position.

1.9.2 These locomotives were immediately confined to the locomotive depot for the problems to be diagnosed and rectified.

1.9.3 During extensive testing the fault was simulated on DCP 4945 when the controls were set for the trail position. During a brake application initiated from the lead locomotive, the double check valve had the same air pressure applied to both sides of the piston but there was minimal air flow from the outlet port to the J1 relay. As a consequence, the brakes were slow to apply to the trail locomotive (see Figure 2).

1.9.4 The double check valve of DCP 4945 was stripped and on examination it was found that:

- The piston was slightly wider than the outlet port and when positioned centrally prevented air flow to the J1 relay valve
- There was no bleed off groove adjacent to the outlet port to facilitate air flow should the piston stop in the mid position
- The component fitted was suitable for a 26L 4-pipe braking system but was not the correct component for a 26L 3-pipe braking system with a horizontally-mounted check valve.

1.9.5 After consultation between Alstom and Tranz Rail, the outlet port of the double check valve was elongated so that it was 3 mm wider than the piston. The double check valve was reassembled and when retested the fault could not be reproduced.

1.9.6 Tranz Rail advised that there was no brake test that would have identified the double check valve as the source of the brake malfunction. The unsatisfactory braking performance occurred randomly and only on locomotives fitted with the 3-pipe 26L braking system, such as the DC/DCP class locomotives.

1.9.7 Westinghouse Australia, suppliers of the 26L braking system, advised that:

- In systems where a double check valve can be subjected to equal pressures it must be designed to provide adequate air flow should the piston become positioned centrally over the delivery port. This is normally achieved by providing a delivery port that is sufficiently longer than the piston or by the use of bypass porting.
- Unsuitable double check valves can usually be modified by the elongation of the outlet port to 3 mm wider than the shuttle. However, this modification must not prevent the free movement of the piston in the bore.

1.9.8 Given that the double check valve on DCP 4945 was of the wrong type, the corresponding component valve was also removed from DCP 4830, the trail locomotive involved in the collision. This valve was found to be the same type as fitted to DCP 4945, so the outlet port was elongated to be 3 mm wider than the piston in accordance with the supplier's recommendation. No further brake problems have been experienced by either locomotive since the modifications were made.

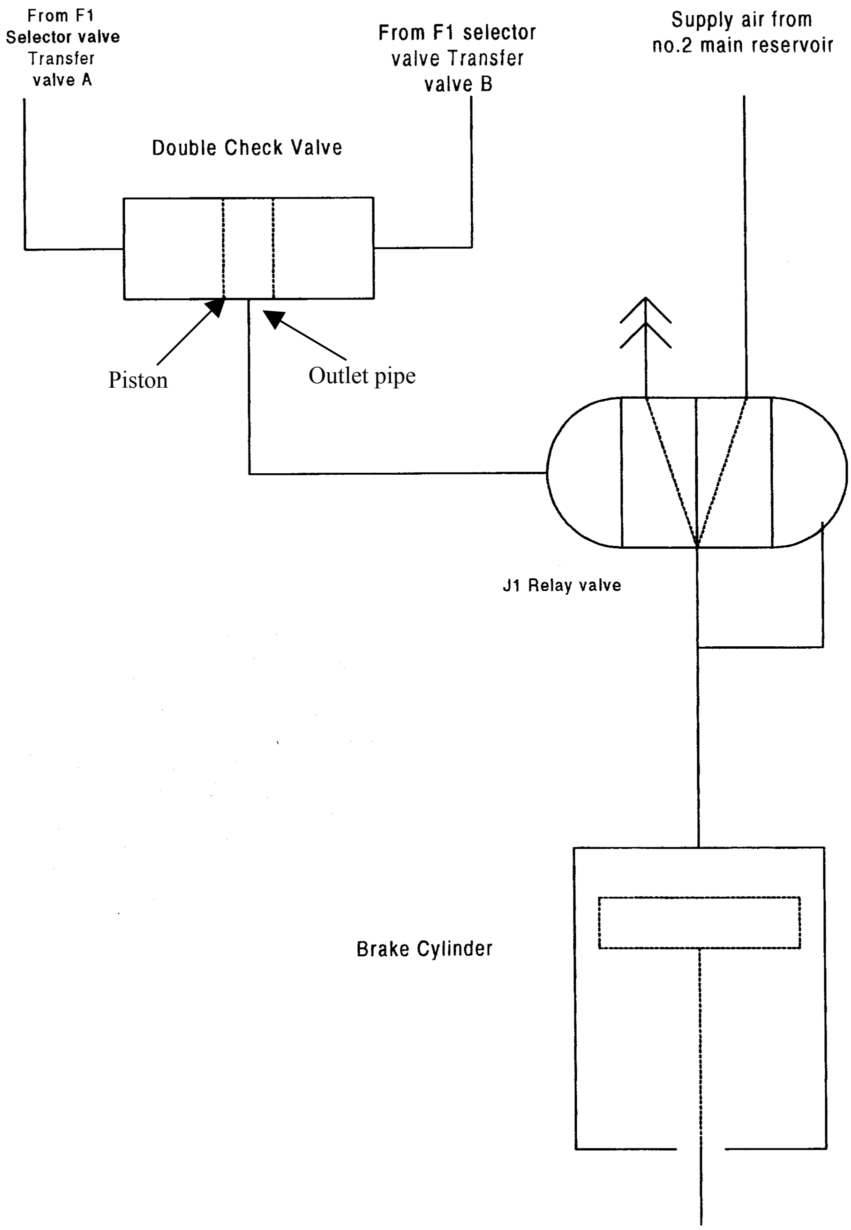

Figure 2
Schematic of J1 relay valve and double check valve on a Westinghouse 26 L airbrake system.
Drawn in Trail/Fault Condition
(diagram courtesy of Tranz Rail)

1.10 Personnel

1.10.1 The locomotive engineer involved in the collision had 21 years experience and held a grade 1 certification.

1.10.2 The locomotive engineer had been off work as a result of a non-work related accident since 29 July 2001 and had resumed work on light duties on 6 January 2002, following which he completed his bi-annual re-certification. A formal safety observation was carried out on 4 February, prior to him returning to full locomotive engineer's duties. Three further safety observations by suitably qualified personnel occurred during the next fortnight.

1.10.3 The Tranz Scenic employee who was engaged to couple the locomotives to the passenger cars had previously been employed by Tranz Rail for 22 years, the last 12 years involving similar work to what he was now doing. He was suitably qualified for the duties he was performing.

1.10.4 The locomotive engineer assigned to the *Tranz Alpine* passenger express on Saturday 6 April, had about 30 years experience and held a grade 1 certification.

2 Analysis

2.1 Locomotive event recorder data from DCP 4830

2.1.1 The locomotive event recorder confirmed that a full service independent brake application, with the correct brake cylinder pressure, had been made at about 0801, shortly after the locomotives departed from the locomotive servicing depot at Middleton. This was probably when the locomotives stopped on the main line prior to changing direction to run to Christchurch station.

2.1.2 A 100 kPa independent brake application was recorded at about 0804. This was consistent with the locomotive engineer's statement that the brakes seemed to be working and confirmed the brake controls were correctly set on the lead locomotive, DCP 4559.

2.1.3 From 0805:12 to 0805:28, while approaching Christchurch station at about 30 km/h, another small independent brake application of up to 50 kPa was recorded and the locomotive throttle was moved into notch 1. At 0805:35 the throttle was returned to idle and the brake cylinder pressure was zero. This again was consistent with the locomotive engineer's comments that he felt the brakes had locked up. Notch 1 was used to unlock the brakes and then release them for a reapplication. The locomotive engineer reported applying, releasing, and then reapplying the brakes while approaching the stationary passenger cars.

2.1.4 At 0805:45 the locomotive speed decreased at a more rapid rate even though no brake cylinder pressure was registered on locomotive DCP 4830. This implied that the brakes had responded on the lead locomotive but not on the trail locomotive.

2.1.5 At 0805:50 the brake pipe pressure dropped rapidly indicating that the lead locomotive train brake had been placed in full service and 2 seconds later, the rising brake cylinder pressure registered.

2.1.6 At 0805:56 the speed line on the graph stopped, confirming the collision had taken place. At that time the brake cylinder pressure on the trailing locomotive was 35 kPa. If an emergency brake application was made, the brake cylinder pressure in the lead locomotive needed to rise from 0 to 350 kPa within 6 to 9 seconds. The trail unit normally replicated the lead unit brake cylinder pressure within 2 seconds but in this case the required brake cylinder pressure was not achieved within that time frame.

2.2 Braking performance of locomotives

2.2.1 The random nature of the reported poor braking performance made an accurate diagnosis extremely difficult. The problem only occurred when the piston in the double check valve of the trailing locomotive was in a central position, preventing airflow from the double check valve outlet port. As a consequence the brakes on the trailing locomotive were slow to or did not respond. This could also occur while hauling a train but probably would not be noticed because of the braking contribution from the trailing vehicles.

2.2.2 The double check valve fitted was the appropriate component for any 4-pipe system and when vertically mounted on a 3-pipe system. However, it was not suitable for the 3-pipe system on a DC/DCP class locomotive because the double check valve was mounted horizontally due to physical constraints. This component may have been used in the DC/DCP class locomotive fleet for more than 30 years and any poor braking performance of light locomotives when running in multiple may have been accepted by locomotive engineers who thought that it was a result of their braking technique. There are some 70 locomotives currently in service fitted with the incorrect double check valve.

2.3 Locomotive engineer

2.3.1 The locomotive engineer's expectation that the locomotive braking system was operating normally probably influenced his judgement when approaching the Christchurch station platform and, under the circumstances, his actions were not out of the ordinary. The random event of the double check valve failing while he brought the locomotives onto the stationary passenger cars could have extended his required stopping distance by about 50%.

3 Findings

3.1 The double check valve was not suitable for the 26L 3-pipe braking system on DC/DCP class locomotives.

3.2 The brake operating efficiency test conducted immediately after the collision did not reveal any deficiency in the locomotive braking system of DCP 4559 and DCP 4830, but was not the appropriate test when the braking performance of a locomotive was in doubt.

3.3 The faulty F1 selector valve, which was replaced on DCP 4830 after a full air brake code test, did not contribute to the collision.

3.4 The incorrect component in the double check valve was also responsible for other poor braking performance incidents involving DCP locomotives.

3.5 The manner in which the locomotive engineer approached the stationary passenger cars would have resulted in a successful couple-up had the brake failure not occurred.

4 Safety Actions

4.1 Tranz Rail advised, on 8 November 2002, that:

- should any future incident occur, where any part of the locomotive brake system is called into question, a full brake code test will be mandatory.
- Air brake code tests had been carried out using air inputs from the short-hood headstock cocks. The problem experienced on DCP 4830 only showed when the locomotive was coupled at the long-hood end. In future the brake pipe maintaining test and break-in-two test will be carried out from both ends of the locomotive to verify the condition of the brake pipe, main reservoir, and emergency pipe.
- A review of the change-out period for locomotive airbrake components has been carried out and a recommendation has been made to the Locomotive Technical Committee to bring forward the component replacement from 864,000 km to 432,000 km.
- A copy of the Field Modification Instruction No. ML 1043 has been prepared for review at the next Locomotive Technical Committee meeting scheduled for November 2002. This instruction requires the double check valves fitted to any DA, DBR, DC/DCP, and DQ class locomotive to be removed, inspected for the bypass grove (or lack thereof) and elongate the outlet port if required, at the next service check. A copy of the instruction is attached as Appendix 1.

4.2 In view of the safety actions taken, no safety recommendations regarding this issue are necessary.

Approved for publication 29 January 2003

Hon. W P Jeffries
Chief Commissioner

Appendix 1

Field Modification Instruction No: ML 1043

Approval: Locomotive Technical Committee No.
Checked:
Date: 25th October 2002

Contact:	Author:	Phone:
	Inventory:	Phone:
	Design:	Phone:

Applies to: **All DBR,DC,DCP Locomotives**

I. Subject: **Double Check Valve To The J1 Relay Valve**

II. Distribution: Alstom Transport, Tranz Scenic 2001, Motive Power Inspector, Tranz Rail Hillside.

III. Action By: Alstom Transport Locomotive Repair Depots, Tranz Scenic 2001 depots.

IV. Purpose of Modification: To inspect the double check valve and identify whether the correct model for 3 pipe 26L brake systems is fitted. If identified as an incorrect model carry out modification as suggested by Westinghouse Australia.

V. Background: As a result of a collision involving two DCPs attaching to the Tranz Alpine, it was found that some DBR,DC,DCP locomotives may have the incorrect model double check valve installed in the J1 relay valve, reference signal line.

When locomotives fitted with the incorrect valve are set up for Trail 6 or 26 (trail 3 pipe) mode, equal pressures on the 2 inlets to the double check valve can centre the piston, blocking the double check valve outlet to the J1 relay valve resulting in little or no braking on the affected locomotive.
The correct model double check valves have a small feed groove that can bypass the piston when it is in the centre position.

VI. Drawings Required: X48272

VII. Parts Required: PTFE thread tape.

VIII. Tools Required: General hand tools, pencil grinder

IX. Priority: To be completed as part of the the next service check.

X. <u>Instructions:</u> In the short hood below and behind the 26D control valve assembly, locate the double check valve that couples to port 16 of the J1 relay valve and remove it for inspection.

Once the double check valve iss off the locomotive strip it, then ascertain whether it is fitted with a feed groove in the outlet (centre) port area, that can bypass air around the piston to the outlet poet when the piston is in mid position over the outlet port.

Where a double check valve is found to lack the feed groove, use a pencil grinder or similar to elongate the internal side of the outlet port so that it is 3mm wider than the width of the piston. Smooth off any rough edges around any port that has had the modification carried out and ensure that the piston moves freely over the whole length of its travel within the double check valve.

Reinstall the inspected/modified double check valve, then carry out Test 10 and Test 12 of code M103. During the double check valve test portion of test 10 use soapy water to check the double check valve connections for leakage.

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ISSN 0112-6962