



Rail Accident Investigation Branch

Rail Accident Report



Incident at Wellesley Road on Croydon Tramlink 15 June 2007

This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC;
- the Railways and Transport Safety Act 2003; and
- the Railways (Accident Investigation and Reporting) Regulations 2005.

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Introduction

- 1 The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future accidents and incidents and improve railway safety.
- 2 The RAIB does not establish blame, liability or carry out prosecutions.
- 3 Access was freely given by Tram Operations Ltd, Tramtrack Croydon Ltd and Bombardier Transportation UK Ltd to their staff, data and records in connection with the investigation.
- 4 Appendices at the rear of this report contain the following glossaries:
 - acronyms and abbreviations are explained in Appendix A; and
 - technical terms (shown in *italics* the first time they appear in the report) are explained in Appendix B.

Summary of the report

Key facts about the incident

- 5 At about 15:50 hrs on Friday 15 June 2007, a member of the public attempted to board a tram at the Wellesley Road stop on Croydon Tramlink. The man's hand or clothing may have become trapped in the tram doors. The tram then moved off, and the man ran alongside it for about 15 m before he moved away from the tram. The tram stopped very shortly afterwards, with the rear of the tram still in the platform. The man then left the scene of the incident.

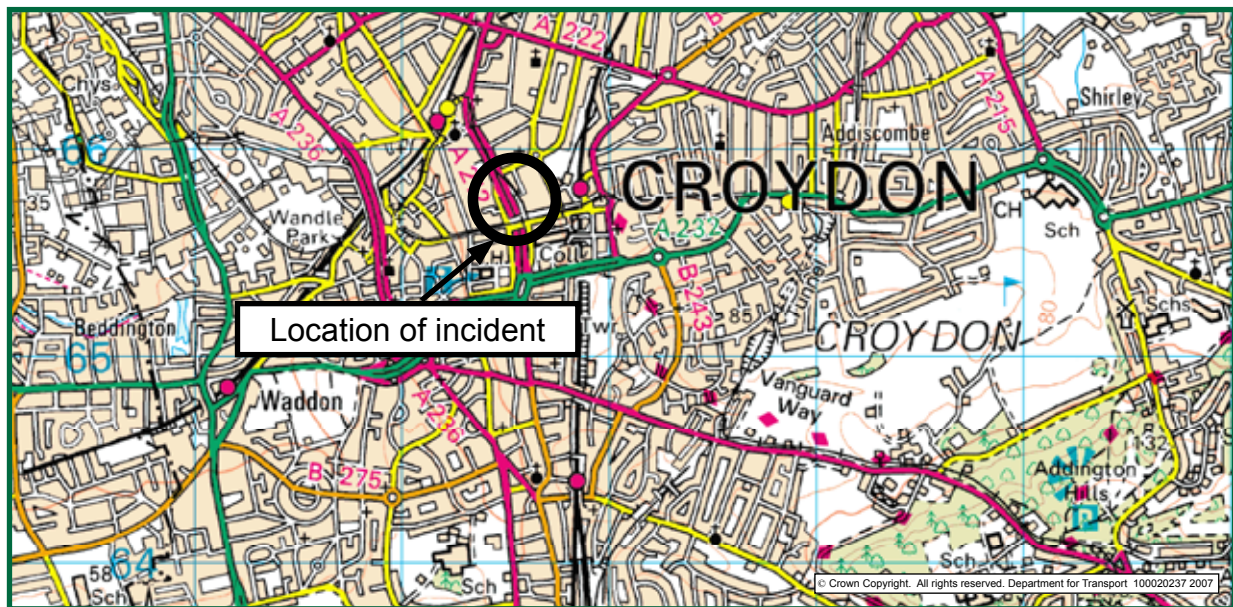


Figure 1: Extract from Ordnance Survey map showing location of incident

Immediate cause, causal and contributory factors, underlying causes

- 6 The immediate cause of the incident was that neither the tram driver nor the instructor reacted to the presence of a person with his hand apparently in between the doors of the tram as it moved off.
- 7 The person had placed his hand on or between the doors during the door closing sequence, and did not remove it when the doors came together.
- 8 The working relationship between the driver and the instructor contributed to the absence of a final check on the platform before the tram moved off.

Recommendations

- RAIB makes no recommendations as a result of this investigation.

The Incident

The parties involved

- 9 The Croydon Tramlink system, which opened in 2000, is run under contract by Tramtrack Croydon Ltd (TCL), which has a 99-year concession from Transport for London (TfL) to provide a service. The system is operated under contract to TCL by First Tram Operations Ltd (TOL), which employs the tram drivers and controllers, and the trams are maintained by Bombardier Transportation Ltd.

Location

- 10 The Wellesley Road tram stop is on the single track loop between West Croydon and East Croydon stations, which is used only by eastbound trams. The raised platform is straight, like all the tram stops on the Tramlink system, and is on the east side of the dual carriageway of Wellesley Road. It occupies the whole width of the footway of the road at this point.



Figure 2: Wellesley Road tram stop

External circumstances

- 11 The weather at the time of the incident was clear and dry, and visibility was good.

The Tram

- 12 The vehicle involved was tram 2542, one of the 24 units that make up the Tramlink fleet. It was built by Bombardier Transportation in Austria in 1998. There are four sets of *sliding plug* double doors on each side of the tram, all of which have 'doors open' buttons on the right-hand door (as seen from the outside).



Figure 3: Croydon tram, showing doors and push button (inset)

Events preceding the incident

- 13 Tram 2542 was eastbound on service 3 to New Addington, and the journey from Wimbledon had been uneventful.
- 14 The tram was being driven by a trainee driver (see paragraph 24), under the supervision of an instructor.

Events during the incident

- 15 The incident was recorded on a tram stop CCTV camera positioned adjacent to the rear of the tram (on the platform) and facing forward, in the direction of travel of the tram. The CCTV recording shows that the sequence of events was as follows:
 - a. The tram drew into Wellesley Road tram stop, where six people were waiting.
 - b. The doors were opened, passengers boarded and several alighted.
 - c. After the tram had been stationary for ten seconds, a man approached from the rear of the tram, ran towards the rear door and inserted his left hand between the doors as they closed.
 - d. The tram then moved off, 15 seconds after it had stopped.
 - e. The man moved up the platform alongside the tram, with his hand, or clothing, apparently trapped by the doors.
 - f. Just before he reached the end of the platform, the man removed his hand from the doors. He then walked back a short distance, picked up something from the platform, and left the tram stop.
 - g. At about the same time, a passenger in the tram operated the emergency alarm, and the tram stopped with its rear end in the platform. The doors were then released.

Consequences of the incident

16 There were no recorded injuries, and no damage to the tram.

Events following the incident

- 17 The instructor got out and spoke to people on the platform. A following tram drew into the stop and opened its doors.
- 18 The initial report from the crew of the tram to the control room (at 15:51 hrs) was of a youth who appeared to have got his hand caught (momentarily) in the closing doors as he was alighting from the tram. No injury was reported and the youth was nowhere to be seen so the crew were advised by the controller to continue.
- 19 It was not until the controllers had an opportunity to review the CCTV that the serious nature of the incident was appreciated. At 17:15 hrs the crew were relieved and instructed to return to the depot. On the basis that there were no door faults recorded and no allegations made in respect of the doors not operating as expected, the tram continued in service until its scheduled return to the depot at 20:15 hrs.
- 20 On 17 June the doors of tram 2542 were examined and tested (see paragraph 30) by Bombardier Transportation at the depot at Coomber Way. No faults were found.

The Investigation

Investigation process

- 21 The incident was notified to the RAIB by telephone on 15 June. An inspector subsequently visited the Tramlink depot, viewed a CCTV recording of the incident, examined the doors of a tram in the depot, and measured the force required to withdraw a test bar from between the closed doors.

Other sources of evidence

- 22 Information about the maintenance regime and standards applicable to the performance of tram doors was obtained from Bombardier Transportation.
- 23 Tram Operations Ltd provided information about the training and competence of the tram crew and CCTV footage and other records relating to the incident.

Factual Information

The crew of the tram

- 24 The tram driver had joined the company and commenced training nine weeks before the incident. He had been driving in passenger service (with an instructor) since 3 June, 12 days before the incident. The instructor had been a tram driver for four years, and an instructor since November 2006, seven months before the incident.

The tram doors

- 25 The door mechanisms of the Croydon trams were manufactured by IFE AG in Austria, now the IFE division of Knorr-Bremse GmbH. They are sliding plug doors, which, when closed, are flush with the outside of the tram car body. To open, the door initially moves outwards and then slides along the car body. The closing sequence is the reverse of this. The manufacturer provided figures for the door closing force, which should be between 150 N and 200 N (peak value). No figures are available for the force required to remove an object from between closed doors.
- 26 The current British and European Standard for train and tram doors (BS EN 14752:2005: Railway Applications: Body Entrance Systems) states that when an obstacle, in the form of a smooth bar with maximum dimensions of 10 x 50 mm, is trapped with its long edge vertical between the door panels, it shall be capable of being withdrawn with a force not higher than 150 N. The RAIB carried out tests on a Croydon tram and found that the force required to withdraw a steel test piece of the dimensions specified in the standard varied between 58 N and 116 N, with a mean value of approximately 90 N.
- 27 The doors of the tram are edged with draught-excluding rubber mouldings which overlap when the doors are closed. During the door closing sequence, the movement of the doors is monitored by a door control unit. The value of the current taken by a normal motor during the closing sequence is stored during operation and automatically adjusted on each closing sequence to take account of wear and other variable factors. The actual value is then compared with the stored value, and if it exceeds the nominal stored value then obstacle detection becomes active and the doors re-open.
- 28 When the doors attempt to re-close, the motor current value increases on each attempt until a maximum current curve corresponding to 200 N maximum closing force is reached. If the doors are still unable to close after five attempts, they re-open and a 'doors failed' alarm is given to the driver, who must then re-set the system.
- 29 Additionally, the door position is monitored. Door movement during the closing sequence is measured in small increments via a position sensor. If the doors do not travel a certain distance in a given time period (as measured internally by the door control unit) the system assumes that an obstruction is preventing the doors from moving, and re-opens them.

- 30 The driver can only apply power to move the tram if the door traction interlock is obtained, ie if the doors are fully closed. The specification supplied by the manufacturers and used by the maintainers of the trams, Bombardier Transportation, requires the door traction interlock to be obtained with a 15 mm obstruction between the doors, and the doors to re-open with a 30 mm obstruction between them. Tests supervised by the RAIB found that in the range 15–30 mm, the doors may re-open or lock depending on the exact gap, which is affected by the width, hardness and shape of the obstruction. Other factors that may affect this include the flexibility of the door rubbers, and the adjustment of the limit switches.
- 31 Bombardier Transportation carry out functional tests on the doors as part of the regular maintenance schedule of the trams, every 60 days. This test involves the use of a wooden gauge, 55 mm wide and with two thicknesses, 15 and 30 mm, which is inserted between the closing doors to check that the interlock specifications described above are achieved.
- 32 The tram involved in the incident was examined by Bombardier on 17 June as part of the post-incident investigation and all the door interlock limits were found to be within specification.

Previous occurrences of a similar character

- 33 On Croydon Tramlink, there was an incident on 22 March 2007 at the Church Street tram stop, in which a child's clothing was caught in the closing doors of a tram and he was dragged for about 4 m along the platform before the driver was alerted by passengers and passers-by and stopped the tram. The RAIB carried out a preliminary examination of this incident, and concluded that the incident occurred because the driver was inexperienced and did not complete all necessary checks before moving off. Following this incident TOL briefed all their drivers on the importance of following the correct 'drill' when leaving a tram stop to ensure that all necessary checks are made, at the right time and in the right order.
- 34 Power operated doors have been in use on trains and trams for many years, and have a good record of safe operation. However, incidents of people being dragged after becoming trapped in doors do occur from time to time. An incident occurred at Huntingdon station on Network Rail on 15 February 2006 in which a member of the public was seeing a passenger off on a train, when he became trapped by the edge of his coat in the doors of a class 365 electric train. The train departed and the person ran, then was pulled along the platform before falling down the gap between the train and the platform edge. He sustained serious injuries. The RAIB has published a report on this incident (number 11/2007), which can be viewed at:
http://www.raib.gov.uk/publications/investigation_reports/reports_2007/report112007.cfm
- 35 Among the recommendations made following the Huntingdon incident were that:
 - the train owner should review the design of the door seal and door control mechanism so as to reduce the door closing forces, with a view to reducing the force required to extract trapped objects; and
 - the relevant Railway Group Standard should be reviewed in terms of the correlation between the obstacle extraction test, the door seal design, and the forces required to extract trapped objects or materials.

Analysis

Identification of the immediate cause

- 36 The incident occurred because the tram driver and instructor did not react to the sight of the man close to the doors as the tram moved off, although the CCTV evidence showed that he would have been clearly visible in the external mirrors. The driver had seen the man with his hand on the side of the tram before moving off, but had assumed that he was trying to operate the 'doors open' button.
- 37 The instructor was standing in the offside footwell in the cab, in a position in which he would have had a clear view of the platform via the nearside external mirror. There was one other person on the platform at the time.

Identification of causal and contributory factors

- 38 The driver and instructor had been working together for nine weeks, throughout the driver's training period. The instructor did not check the platform as the tram moved off, although it was his responsibility to do so. The trainee driver was still developing his 'tram stop drill' (paragraph 33) and missed the final mirror check on this occasion.
- 39 It is likely that the reason why both the driver and the instructor did not make the final check is related to the way in which they were working together, with the instructor being confident that the driver would make the check, and the driver relying on the instructor to duplicate his own actions, with the result that neither of them looked. This was a contributory factor in this incident. No recommendation is made in this area, because the RAIB considers that this was an isolated incident and TOL has already taken appropriate action (paragraph 50) to prevent a recurrence.
- 40 The member of the public put his hand on or between the doors during the door closing sequence, and did not remove it when the doors came together. This was a causal factor in this incident.
- 41 Because the member of the public left the scene immediately after the incident, it is not possible to be certain to what extent he was trapped and why he did not or could not release his hand earlier.
- 42 The member of the public may have had difficulty in withdrawing his hand from the doors. The RAIB has considered the forces involved in closing the doors, the design of the door seals, and the forces required to extract a trapped object or material.
- 43 The test conducted during the investigation found that, if a man's average size fingers were inserted between the doors, the doors would close on them and interlock could be obtained. It was then possible, without difficulty, for the man to withdraw his fingers. It was suggested by Tramlink staff that women and children, whose hands are smaller, would have more difficulty in withdrawing their fingers in the same situation, and evidence of past incidents in the depot when staff had been trapped in the doors was offered in support of this belief. The tests carried out, both with a hand and with a test piece (paragraph 26), indicated that it was unlikely that an adult would have any difficulty withdrawing their hand.

- 44 There is a risk, as demonstrated by the incident at Church Street on 22 March 2007, that a person's fingers or clothing could be trapped between the closed doors and be difficult or impossible to withdraw. Should the tram then start to move, there is a high risk of serious injury. However, this risk must be balanced against the need to ensure that the doors are securely closed and will prevent people and objects from falling out of the tram, both in normal service and in emergencies, as well as providing a comfortable travelling environment. To achieve this, the doors must be locked shut, and the design of the door edges should be optimised to exclude draughts and retain heat, as well as providing a soft face that will not harm people and objects that may come into contact with the door edge as the doors close. The doors of the Croydon trams appear to fulfil these requirements.
- 45 The RAIB's investigation into the train door incident at Huntingdon (paragraph 34) recommended that the relevant standards for main line trains should be reviewed. In addition to the European Standard (BS EN 14752) described in paragraph 26, there is a Railway Group Standard (GM/RT 2473) which covers the forces required to extract objects strapped between door leaves of trains. The test piece defined in this standard is of the same dimensions as specified in BS EN 14752, and the maximum withdrawal force is the same (150 N).
- 46 The results of the tests carried out as part of this investigation showed that the doors of the Croydon trams are compliant with both of these standards (applying to main line trains and to trams) for the force required to withdraw trapped objects. The doors also have a suitable sealing mechanism and soft door edge. The RAIB's analysis suggests that the withdrawal force specified in the standards is appropriate for these vehicles and the conditions in which they are used. Therefore the RAIB has no recommendations to make.

Conclusions

Immediate cause

- 47 The immediate cause of the accident was that neither the tram driver nor the instructor reacted to the presence of a person with his hand on or between the doors of the tram, as it moved off (paragraph 36).

Causal factor

- 48 The person had placed his hand on or between the doors during the door closing sequence, and did not remove it as the doors came together (paragraph 40).

Contributory factor

- 49 The perception of a split of responsibility between the driver and the instructor may have contributed to the lack of a final check on the platform before the tram moved off (paragraph 39).

Actions reported as already taken or in progress relevant to this report

- 50 TOL have briefed all their drivers and instructors on the lessons from this incident, including the importance of checking the mirrors after the tram has begun to move, and the need for instructors to ensure that at each stop they are in a position in the cab from which the whole of the platform can be seen.

Appendices

Glossary of abbreviations and acronyms

Appendix A

CCTV	Closed circuit television
RAIB	Rail Accident Investigation Branch
TCL	Tramtrack Croydon Ltd
TfL	Transport for London
TOL	First Tram Operations Ltd

Glossary of terms

Appendix B

Sliding plug (doors)	Doors which when closed are flush with the outside of the vehicle body. To open, the door initially moves outwards and then slides along the body side.
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