Rail Accident Investigation Branch

RAIB Bulletin 01/2015

Derailment near Mitcham Junction
29 December 2014

Preface

1 The purpose of an RAIB investigation is to improve safety by preventing future accidents and mitigating their consequences. Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose. The RAIB's investigation is independent of all other investigations, including those carried out by the safety authority or tramway industry.

Description of the accident

2 Shortly before midnight on 29 December 2014, a tram travelling from New Addington to Wimbledon became derailed near Mitcham Junction tram stop, London. There were about 20 passengers on the tram, plus a driver. No-one was hurt.

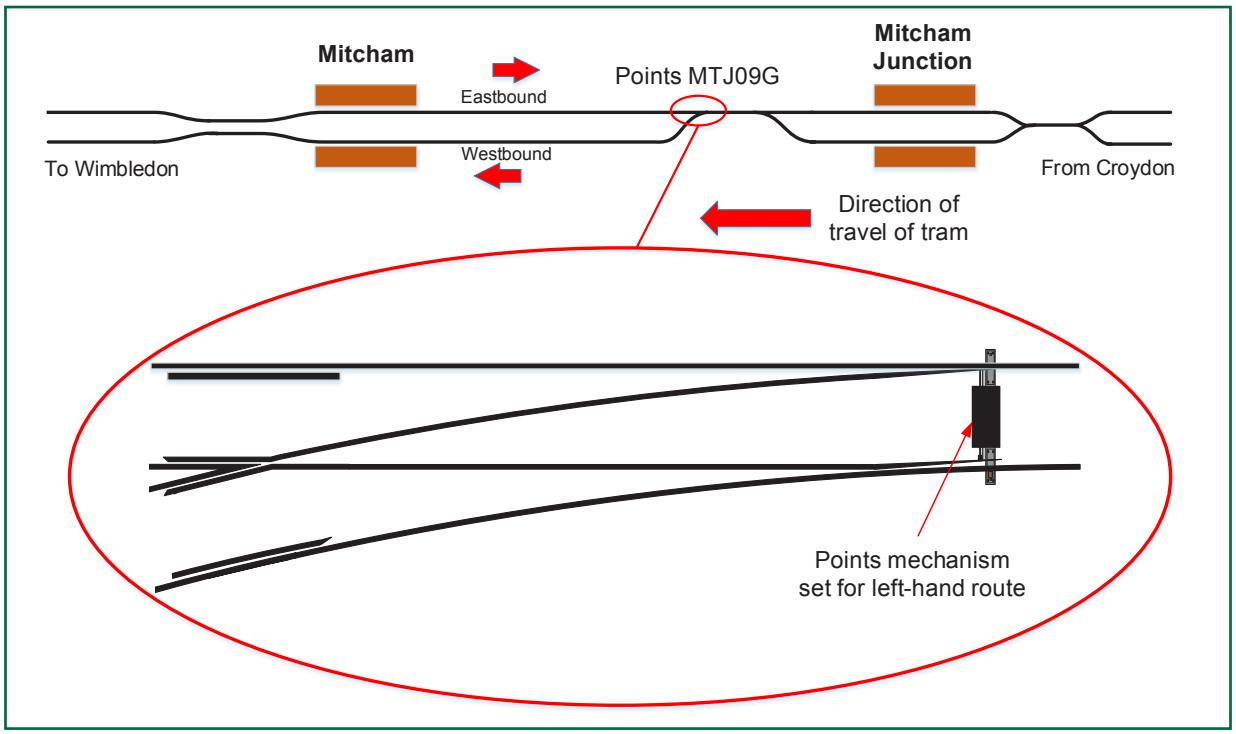

Figure 1: Location diagram and track layout

Background information

3 The Croydon tram system is operated by Tram Operations Ltd (TOL) under contract to London Tramlink (LT). TOL employed the driver of the tram involved in the accident and the control room staff. LT, which is part of Transport for London (TfL), owns and maintains the tramway infrastructure and the trams.

4 The tramway route from Croydon (Wandle Park) to Wimbledon uses the route of a former heavy rail line which was converted to a tramway and opened in 2000. At that time, the section between Mitcham Junction and Mitcham station tram stops was single track. In 2012, part of this section was doubled in a project to increase capacity on the network. Because of a narrow bridge just west of Mitcham Junction, the double track begins at a set of points about 200 metres west of the tram stop platforms. The derailment occurred at these points, known as MTJ09G (figure 1).

5 In common with all of the single/double line junctions on the system, MTJ09G points at Mitcham Junction are equipped with a Hanning & Kahl HW160 type mechanism, arranged to operate as spring points. The mechanism is shown in figure 2, and diagrammatically in figure 3.

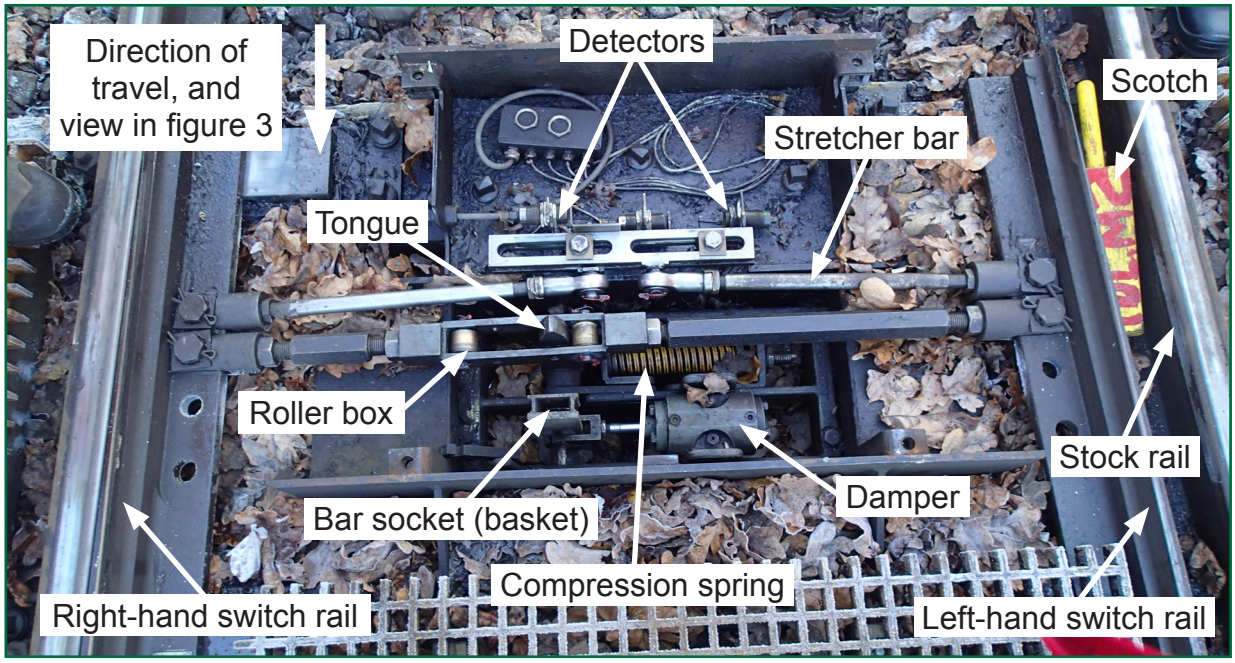

Figure 2: The switch mechanism of points MTJ09G (cover removed). The mechanism (the bar socket and tongue) is in the centre position where it was found after the derailment, and the roller box and switches are fully over to the right. A block of wood (known as a scotch) has been placed between the left-hand switch and stock rail, to prevent the points moving before a full examination had taken place.

6 In normal operation, westbound trams are directed to the left-hand route and eastbound trams approach from the right-hand route (as seen when facing in the direction of travel of the tram involved in the accident). The eastbound trams travel in the direction in which the two tracks are converging and push through the switches, which should then return to the normal position (for the left-hand route), and be held there by the action of the spring (see figure 1).

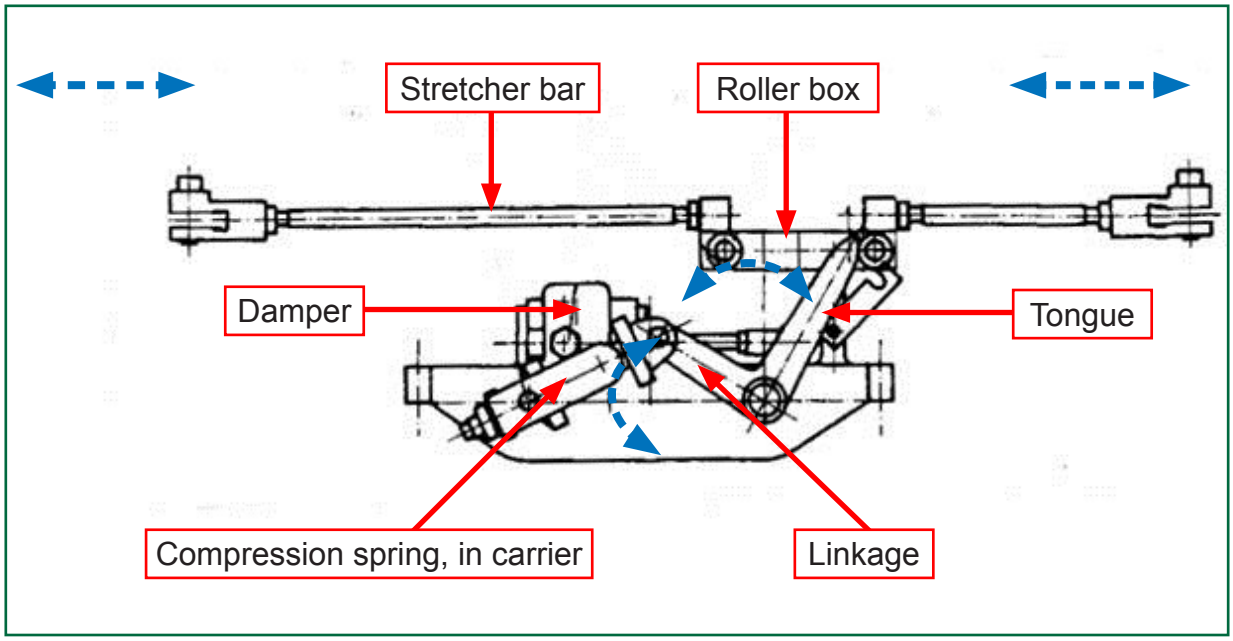

Figure 3: Diagram of switch mechanism, with tongue and roller box fully over to the right. The bar socket is hidden behind the tongue. The dashed arrows show the movement of the components of the mechanism when the points are moved to change the direction taken by rail vehicles passing over them.

7 The mechanism, shown in figures 2 and 3, drives the switches via a lever (known as the tongue) which acts through rollers that are contained within a roller box in the centre part of the stretcher bar. A compression spring acts through the linkage and the tongue to push the roller box in the stretcher bar, and thus the switches, over to the right-hand stock rail (the fixed rail, see figure 2), setting the points for the left-hand route. A damper is provided to reduce noise, and minimise shock loading to the mechanism, each time a tram trails through the switches.

8 If it is necessary to change the points manually for any reason (such as to investigate a fault, or to permit a tram to run in the 'wrong' direction over the eastbound line), this can be done by inserting a lever in the bar socket (basket) and moving the mechanism over the centre of its travel, to close the switch up to the left-hand stock rail. The points will then be set for the right-hand route, and as long as they are set this way the spring will return them to that position. They must then be changed manually back to the left-hand route for normal running to resume. If, for any reason, the mechanism sticks in a mid-position in its travel, so that the tongue is not forcing the switches to one side or the other, the switches will be free to float from side to side, and it is not safe for a vehicle to attempt to pass over them in the facing direction.

9 Proximity sensors detect the position of both switches when they are against the non-moving rails on either side. The output from the detectors appears on a points position indicator[1] (PPI) as a symbol indicating the right- or left-hand route (see figure 4, which shows the PPI associated with points MTJ09G, indicating that the route is set to the left). If neither of the switches is detected as properly against the stock rail, the PPI will display a horizontal bar. The detectors only indicate the position of the switches, and the display on the PPI indicating that the points are set to one route or the other does not mean that the switches are locked in position (tramway points, unlike points on main line railways, are not required to be mechanically locked in position when vehicles pass over them, and the spring is provided to prevent unwanted movement of the switches).

10 The mechanism at points MTJ09G had previously been fitted to the points at Mitcham Station when the tramway was opened in 2000, and was moved to the new junction when the double track was extended in 2012.

Sequence of events

11 At 23:45 hrs, the Tramway Management System (the computer software which collates and presents real-time data from the various elements of the tramway) posted an alarm to the tramway controller, on duty in the control room at Therapia Lane depot, indicating that points MTJ09G had not returned to the normal position (ie set for the left-hand route), 15 seconds after an eastbound tram had trailed through them. The controller acknowledged this alarm.

12 At 23:55:25 hrs, tram 2544 departed from Mitcham Junction travelling west. The tram driver saw that the points position indicator (PPI) associated with MTJ09G points was showing a horizontal bar, meaning that the points were not detected in the normal position. He stopped the tram about 10 metres before reaching the points, and contacted the controller.

13 The controller instructed the tram driver to try and obtain detection on the PPI by moving the points manually. The driver got out of the tram and put the operating bar, which is carried on all trams, into the bar socket in the operating mechanism. He found that the switches and the mechanism were almost fully over to the right (if they had been completely over, the PPI would have shown the appropriate indication). He used the bar to pull the points over to the left, to try and release any obstruction, and then tried to move them back to the right. He found that he could move the mechanism to just past the centre position, but no further. The driver could see that there was still a gap between the right-hand switch rail and the stock rail. He took the bar out of the socket, and used it as a lever between the switch rail and the stock rail to force the switches over to the right.

14 After the driver had done this, he looked at the PPI again and saw that it now indicated that detection was achieved (this was at 23:58:05 hrs, 2 minutes 40 seconds after leaving the tram stop, and the fact that detection had been obtained was also indicated to the controller in the control room). However, although the right-hand switch was now against the stock rail, there was nothing holding it there, and the switch rails were free to move. This was because the points operating mechanism was still in the centre position, and so the spring-loaded tongue was not in contact with the rollers.

[1] A lineside indicator mounted on a post and positioned to be clearly visible to tram drivers.

15 The tram driver got back into the cab, and drove the tram slowly over the points, with a maximum speed of 11 km/h (7 mph). The leading bogie passed over the points normally, but the switches moved between the leading and centre bogies (23:58:38 hrs). The wheels of the centre bogie passed to the wrong side of the right-hand switch, and became derailed. Immediately afterwards, contact between the back of the left-hand wheels and the switch blade pushed the switches back to the right-hand side (the control room data records show that detection was lost at 23:58:38 hrs, and regained at 23:58:40 hrs).

16 The switches moved again between the centre and trailing bogies, and the trailing wheelset of the last bogie was derailed (causing detection to be lost again for two seconds, from 23:58:42 hrs to 23:58:44 hrs). The driver realised from the motion of the tram that something was wrong, and he stopped the tram with its rear end 2.5 metres past the switch tips. The trailing wheels of the tram had pushed the switches back to the right-hand side, where they were found after the accident.

17 The driver made contact with the controller, and after checking that no-one was hurt, he escorted the passengers back to Mitcham Junction tram stop, where arrangements were made for them to continue their journey by road.

RAIB investigation findings and analysis

18 The RAIB examined points MTJ09G once the tram had been re-railed and removed (which was completed, under the supervision of the RAIB, by 10:15 hrs the following morning). At that time, the air temperature (which had fallen to below -5º C overnight) was still around freezing.

19 The switches were found hard over to the right, with the PPI indicating that detection was obtained for the route to the left (figure 4). However, in this state, the switches were free to move (for the reasons explained in paragraphs 8 and 13), and they could be pushed manually as far as their mid-position (where they came up against the tongue of the mechanism, which restrained them from moving any further).

20 The mechanism could not be moved to the right beyond the centre position, and there was a solid obstruction to any further movement. LT staff dismantled the mechanism under the supervision of the RAIB, and found that the source of the obstruction was the damper. Releasing the damper bleed screws caused the resistance to movement to disappear. The fluid in the damper appeared to be heavily contaminated, with evidence of small solid particles within the fluid (figure 5).

21 LT replaced the entire mechanism before the line was re-opened to traffic during the afternoon of 30 December. At the request of the RAIB, LT subsequently arranged for the damper from the mechanism of points MTJ09G to be examined by specialist consultants, with the aim of understanding the reasons for its failure and recommending any appropriate action.

Figure 4: The tram following the derailment, showing the PPI indicating that points MTJ09G are detected for the correct (left) route

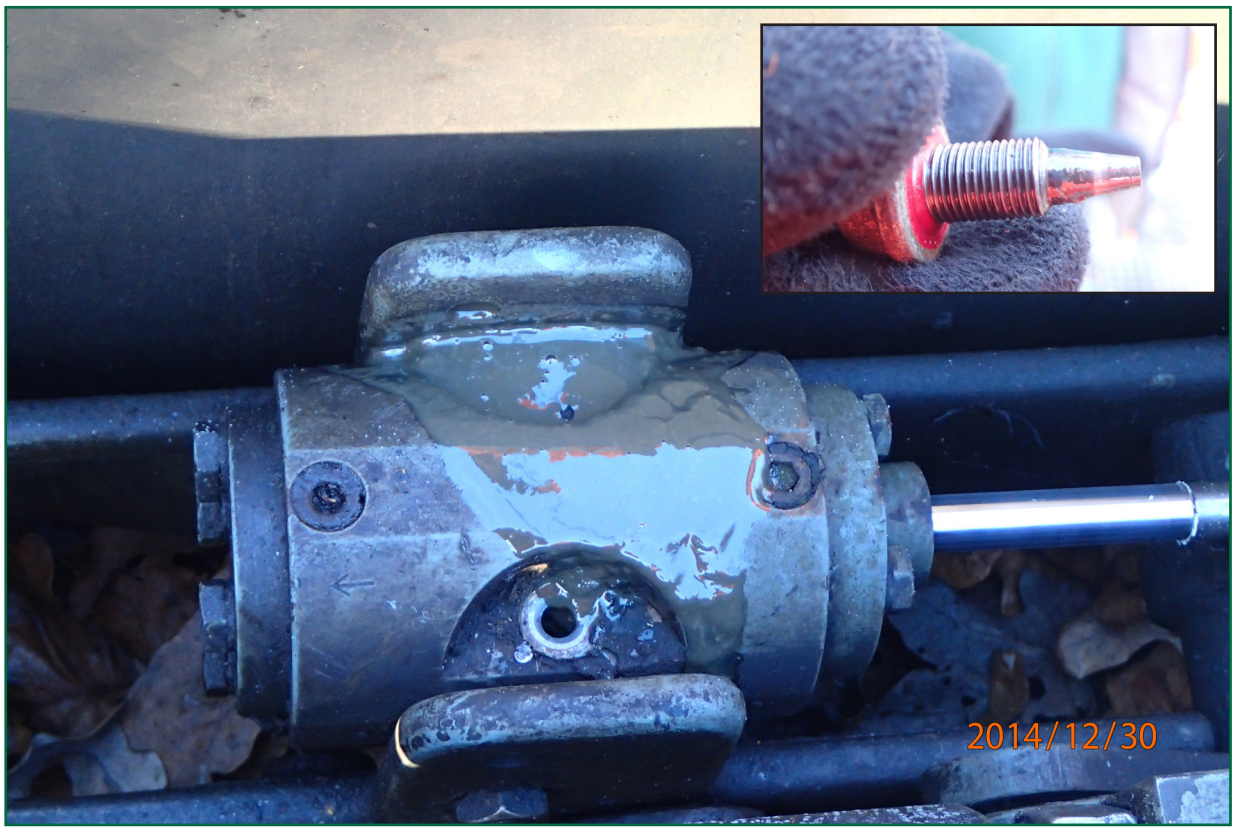

Figure 5: Damper after removal of bleed screws, showing contaminated fluid. ***Inset:*** *bleed screw, with small particles of grit on the coned end*

22 At the time of the accident, the points mechanisms were subject to a maintenance regime which involves different levels of inspections by LT staff, and defined servicing actions, every week, four weeks, three months and six months. The RAIB obtained copies of records indicating that these tasks had been carried out at the specified intervals. At a three-monthly inspection and service on 2 December 2014, the technician commented '*Setting lever rubbing against roller box. Damper may need to be changed (loud banging). Walter bushes due to be changed soon*'. At the weekly inspections on 16 and 23 December 2014, no problems were noted, and no action was taken in response to the 2 December comment before the derailment on 29 December.

23 The dampers in the spring point mechanisms are not serviced by LT. If an inspection of points finds evidence of wear (such as that noted in paragraph 22), or if points become stiff to operate, components are replaced. LT has stated that 'the damper fault as reported [on 2 December], would not have given rise to an urgent replacement because it indicated that the damper was doing very little damping. The purpose of the dampers' design function is to reduce noise and undue shock loadings as opposed to offering additional resistance.'

24 Following this derailment, LT replaced seven dampers on the tramway during January 2015 in a prioritised programme (based on the age of the dampers) as a precautionary measure, pending the results of the consultant's examination of the failed damper. The consultant's findings became available in March 2015. They concluded that the damper had become stuck in the middle position due to particle contamination and/or frozen water within the damper's hydraulic circuit. The fluid in the damper was found to be highly contaminated with iron, chromium and silicon, and contained more water than would normally be found in hydraulic oil. The consultant recommended that LT should replace dampers of similar age to the one that failed (15 years), and take action to prevent water from pooling around the restrictor valve tops on the dampers. It should also review the service life and maintenance regime of the dampers, in conjunction with the manufacturers of the points mechanism.

25 The RAIB has considered the causes of this accident in the light of two previous derailments at facing spring points on the Tramlink system, which occurred at Phipps Bridge tram stop on 21 October 2005 and 25 May 2006[2]. On those occasions a similar set of points failed in the mid-position. The drivers of trams did not notice that the PPI was not indicating that the points were properly detected, and ran over the points at speed, leading to derailment. Following these accidents, the RAIB recommended that the non-detection indication shown on the PPI should be changed (it had previously been a single dot, rather than a horizontal bar), and that the infrastructure manager of the Tramlink system should demonstrate to the safety regulator that it had overhauled its arrangements for investigating and rectifying faults in this type of points mechanism. The intention of this recommendation was that the infrastructure manager should develop a systematic approach to how it dealt with points faults.

26 Since that time, control of the tramway infrastructure has passed from the previous concessionaire to LT. The PPIs were changed to show a horizontal bar for the non-detected position by 2008, and the regulator (the Office of Rail Regulation (ORR)) reported to RAIB in 2008 that it was satisfied with the actions taken by the previous concessionaire to implement the RAIB's other recommendation.

[2] RAIB investigation reports 04/2006 and 28/2007, available at www.gov.uk/raib.

27 In this case, the driver responded correctly to the non-detected indication on the PPI, and sought guidance from the controller. The driver was authorised by the controller to drive the tram over the points at reduced speed, once he had obtained detection. These measures mitigated the risk associated with the unlocked facing points (which are a characteristic of tramways), so that when the derailment occurred, the tram was travelling slowly and there was little risk of injury to the driver and passengers. However, the driver's lack of understanding of how the mechanism worked, which meant that his actions left the points free to move, led to the derailment, and in other circumstances could have resulted in injury and/or damage. The driver did not speak to the controller after he had moved the points, as there was no requirement for him to do so, as long as he had obtained the correct indication on the PPI. It is important that staff are aware of the possible consequences of operating equipment in a degraded condition (see learning point, paragraph 28).

Learning points[3]

28 The RAIB has identified the following key learning points for tramway companies, drivers and others responsible for using spring operated points:

1 It is important that tram drivers and tramway controllers are aware of how spring operated points work. If spring pressure is not acting on the switch blades, the points are defective and should be secured (using suitable, authorised equipment) before making a move over them in the facing direction. In practice, if detection cannot be achieved just by using the operating bar in the bar socket, the points should be treated as defective.

2 UK tram operators need to be aware of the findings of the consultant's report on the condition of the points mechanism damper, and consider whether any changes are necessary to their own maintenance policies and arrangements in the light of this accident.

[3] 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when the RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where the RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

This bulletin is published by the Rail Accident Investigation Branch, Department for Transport.

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