



Rail Accident Investigation Branch

Rail Accident Report



Collision near New Southgate 27 July 2008

Department for
Transport

Report 17/2009
June 2009

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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Any enquiries about this publication should be sent to:

RAIB	Email: enquiries@raib.gov.uk
The Wharf	Telephone: 01332 253300
Stores Road	Fax: 01332 253301
Derby UK	Website: www.raib.gov.uk
DE21 4BA	

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Contents

Preface	5
Key Definitions	5
The Incident	6
Summary of the incident	6
The parties involved	6
Location	7
External circumstances	8
The trains	8
Events preceding the incident	8
Events during the incident	12
Consequences of the incident	12
Events following the incident	12
Key Information	14
HST luggage van doors	14
Examinations, calculations and test results	16
Defective doors in service	19
Previous occurrences of a similar character	19
Analysis	22
Identification of the immediate cause	22
Identification of causal and contributory factors	22
Identification of underlying factors	24
Other factors for consideration	24
Conclusions	26
Immediate cause	26
Causal factors	26
Contributory factors	26
Underlying factor	27

Actions reported as already taken or in progress relevant to this report	28
Recommendations	29
Recommendations to address causal and contributory factors	29

Preface

- 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.

Key Definitions

- 3 Mileages are defined from a zero reference at London King's Cross station. The 'up' direction is towards London, and the down direction is away from London.
- 4 Left and right are always defined in relation to the direction of travel of the train being referred to.
- 5 Leading and trailing ends of luggage van doors are always referred to in relation to a rear power car of a High Speed Train (HST).

The Incident

Summary of the incident

- 6 At approximately 11:20 hrs on Sunday 27 July 2008, a luggage van sliding door on train 1S13, the 11:00 hrs King's Cross to Aberdeen, became detached and struck train 1A16, the 08:24 hrs Leeds to King's Cross. This happened in the vicinity of New Southgate (Figure 1), around 6¾ miles (10.8 km) north of King's Cross, at a closing speed of approximately 196 mph (314 km/h).
- 7 The side of train 1A16 suffered significant damage, although the passenger compartment was not penetrated. All doors and windows remained intact. A number of passengers and crew were shaken and one passenger reported suffering a minor eye injury as a result of glass-fibre particles entering a vestibule through a part open window.

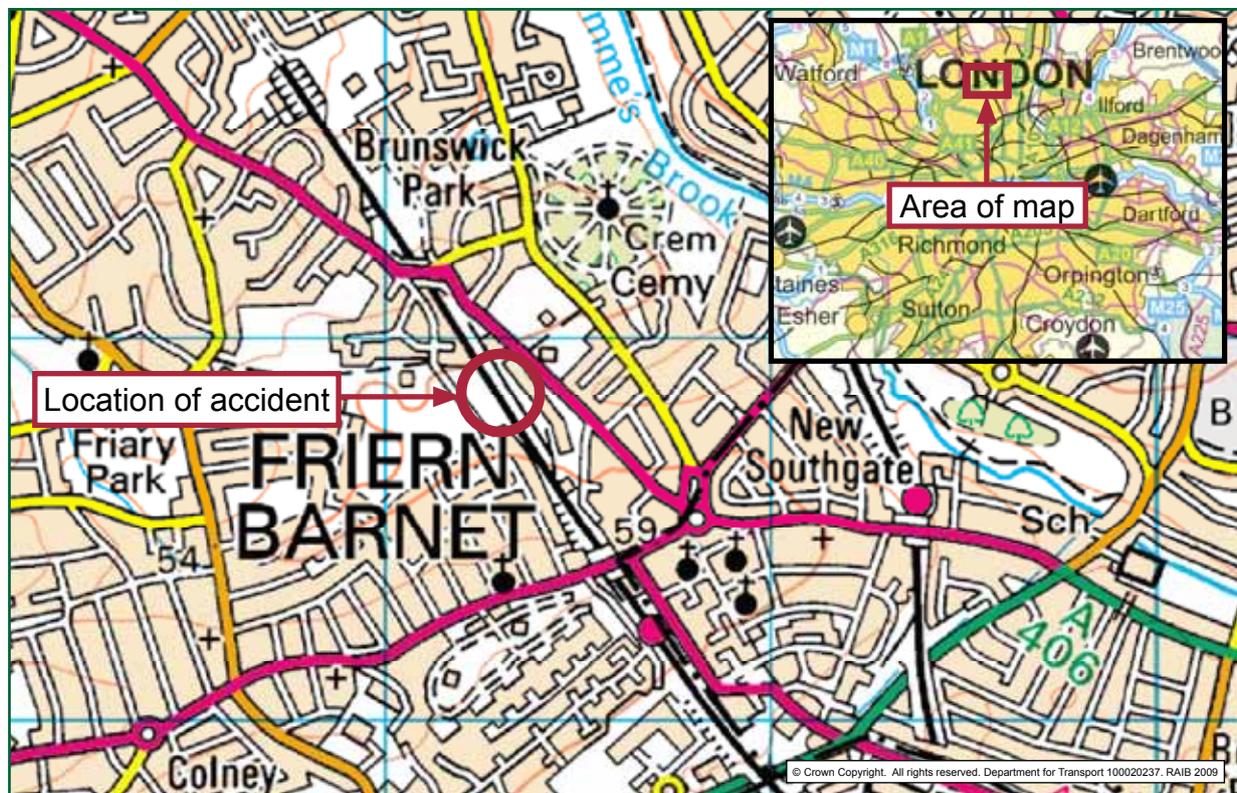


Figure 1: Extract from Ordnance Survey map showing location of incident

The parties involved

- 8 National Express East Coast operated and maintained both trains, and employed the drivers, train crew and train maintenance staff involved. Angel Trains own all vehicles involved except the rear power car of train 1A16, which is owned by Porterbrook.
- 9 Network Rail is the infrastructure owner and the controller of the track on which the incident occurred.
- 10 Brush Traction fitted the luggage van door involved in this incident as part of a refurbishment programme.

- 11 National Express East Coast, Brush Traction, Angel Trains and Network Rail freely co-operated with this investigation. Additional information and assistance was provided by First Great Western who was not involved with this incident.

Location

- 12 The incident occurred on the East Coast Main Line. At this location (Figure 2), the four-track line is broadly straight. The up and down fast lines, on which the trains were travelling, are adjacent to each other and both have line speed limits of 100 mph (160 km/h).

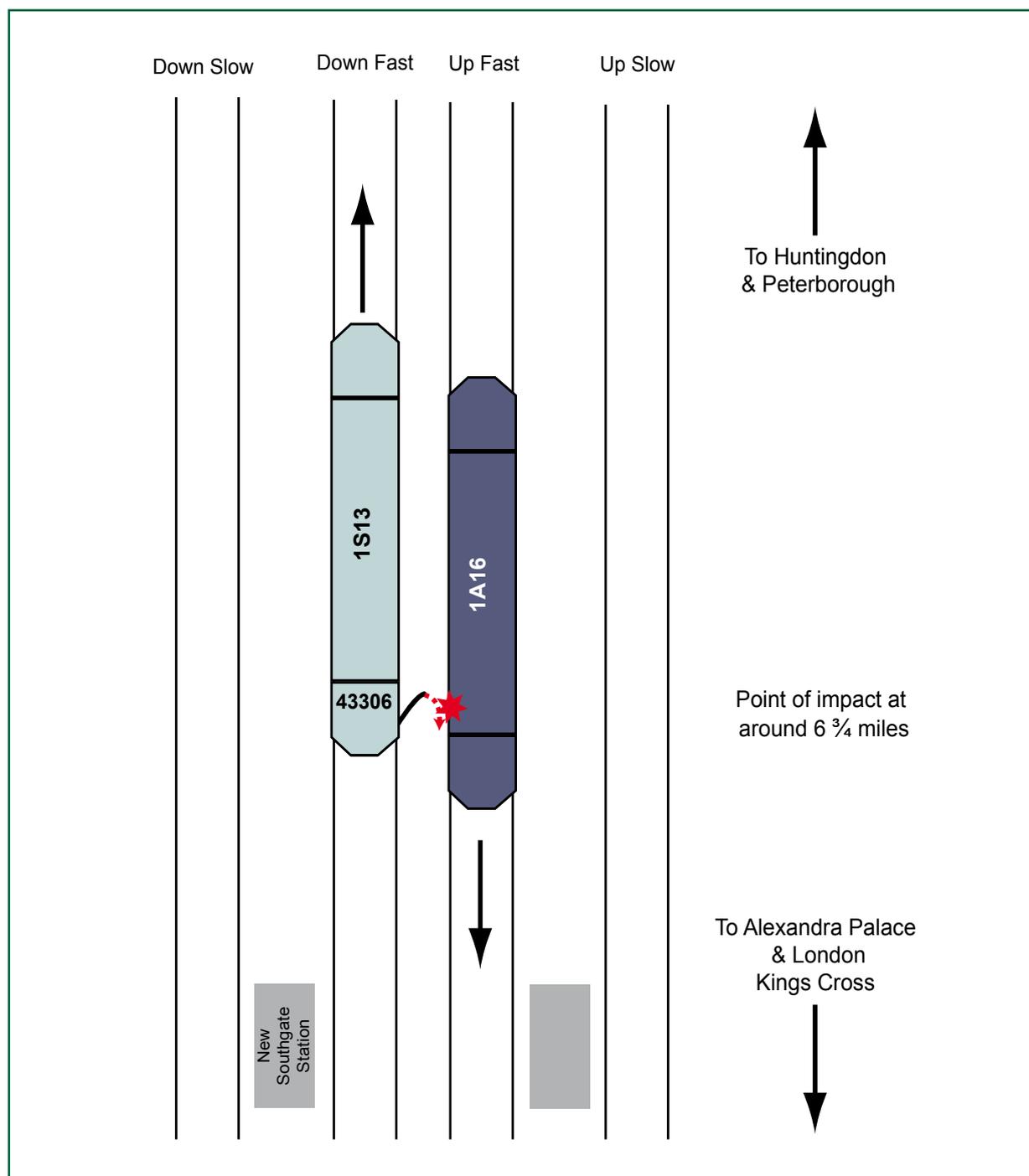


Figure 2: Detailed location of incident (not to scale)

- 13 The detached luggage van door was found just under seven miles (11.2 km) north of King's Cross (Figure 3). The initial impact occurred around the 6 $\frac{3}{4}$ mile post (10.8 km).



Figure 3: The door involved in the incident as found (the train shown is not related to the incident)

External circumstances

- 14 The incident occurred in daylight and the weather at the time was clear and dry.

The trains

- 15 Both the northbound and southbound trains were formed of class 43 High Speed Trains (HSTs), designed to run at up to 125 mph (200 km/h). These trains comprised a power car at each end and nine coaches. The power cars have a single sliding-plug door on each side, giving access to the luggage compartment (Figure 4). The working of this type of door is described in paragraphs 33 to 37.

Events preceding the incident

- 16 On the night before the incident, the northbound HST set was stabled at Bounds Green depot in north London, and underwent a daily safety check which includes ensuring that the sliding luggage van doors open and close correctly. This check is known as an S-exam.

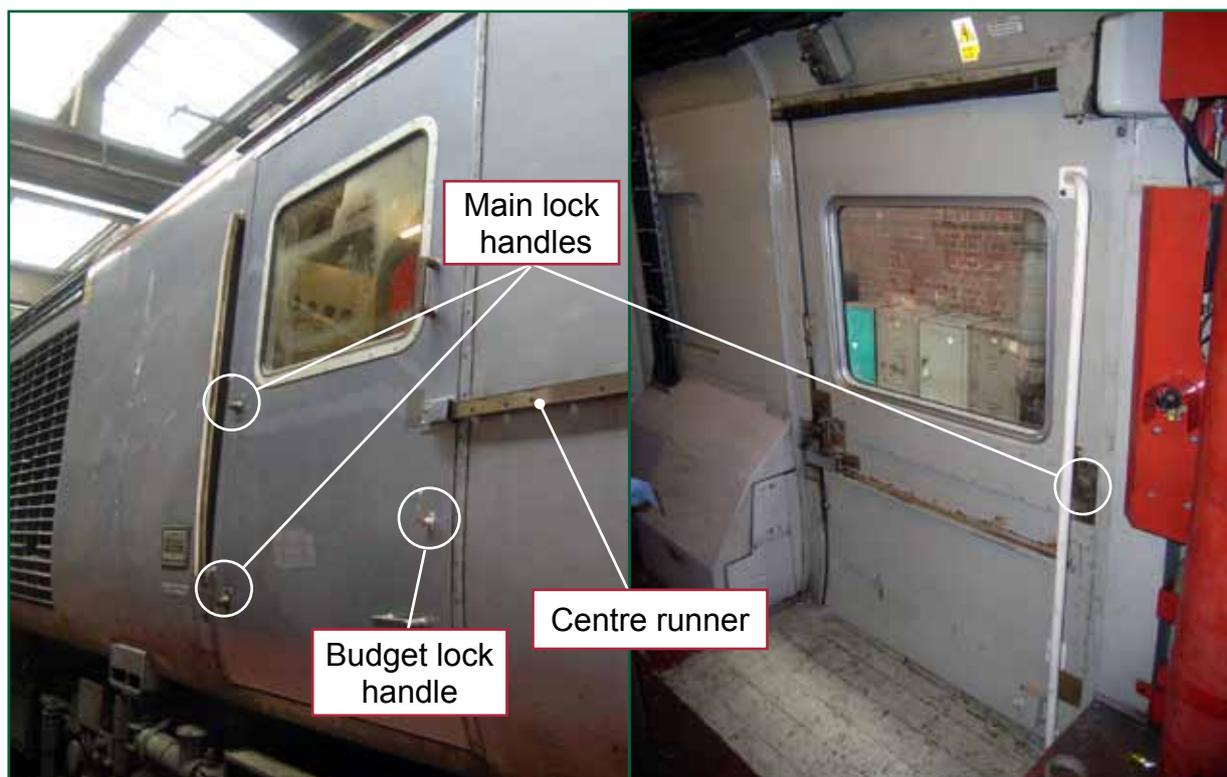


Figure 4: High Speed Train luggage van right-hand door (outside/inside)

- 17 While the set was at Bounds Green, two staff opened the luggage van door on power car 43306, that would later become the right-hand door on the rear power car when the set formed train 1S13 the next day. They did this to gain access to an engine control and monitoring panel in the luggage compartment and did not notice anything unusual about the door.
- 18 A third member of staff came to the open door and tried to close it from the outside as part of the S-exam that he was conducting. He found the door very stiff and was unable to get it fully closed. He moved into the luggage compartment, and noticed that the door was not hanging straight and the pivot arm was not engaged in the door channel (Figure 5 shows the relevant components). He summoned two additional members of staff to seek their opinion on the problem.
- 19 The staff realised that the leading edge of the door was hanging low because the centre roller had come off the centre runner. They also noted that the centre trolley was bent such as to move the door away from the vehicle body, and the centre pin had pulled through the centre trolley and was bent. The cam block was also not secured to the door. Figure 6 shows the state of the centre trolley assembly as recalled by the maintenance staff.
- 20 At the time of the incident, the only work conducted on HST sets each week at Bounds Green, was the Saturday night S-exam of a single set. There were no spares to carry out HST door repairs and staff were not specifically trained to do so. There was no instruction available to them describing how to deal with a faulty luggage van door that they could not repair.

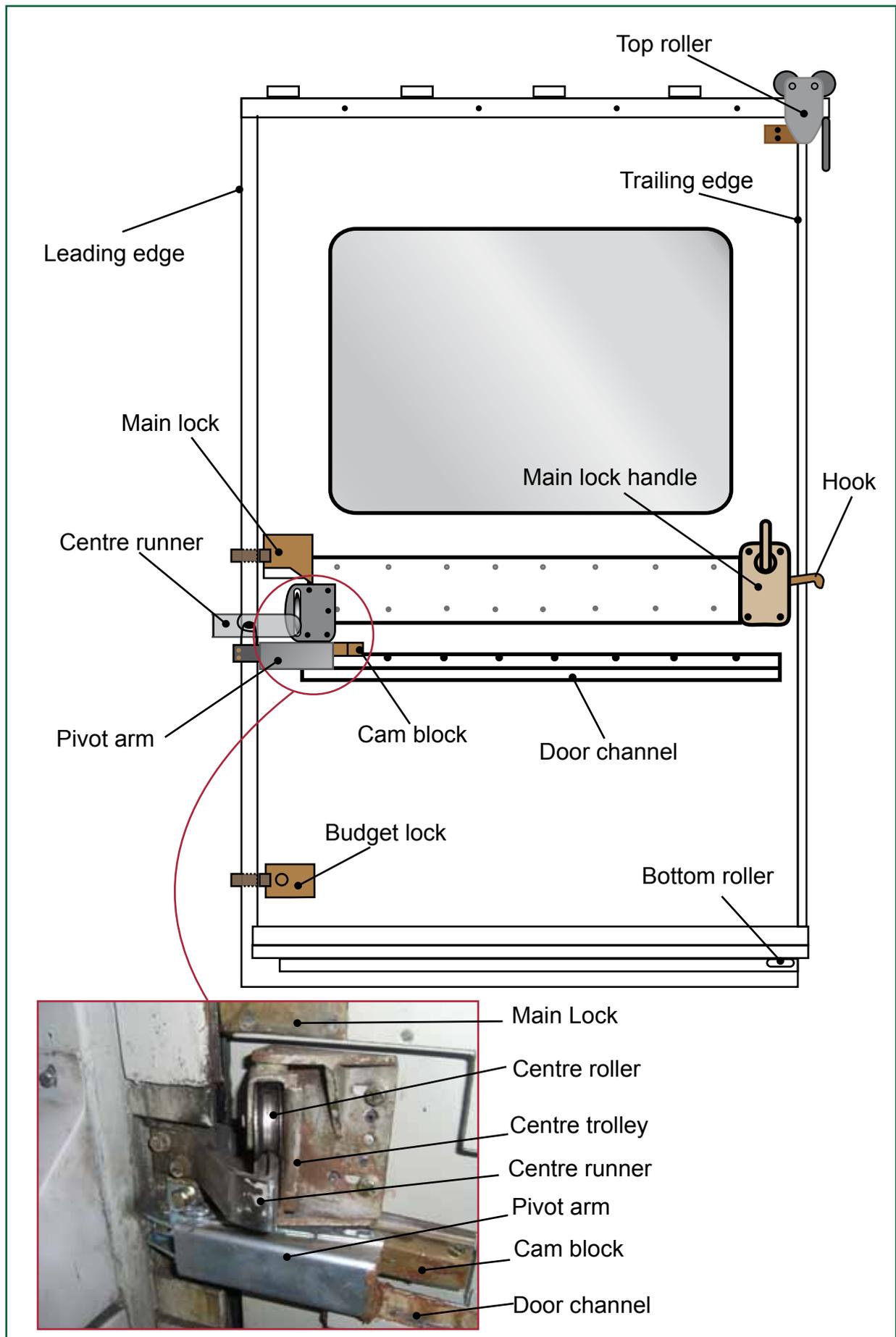


Figure 5: The relevant components of a High Speed Train luggage van door

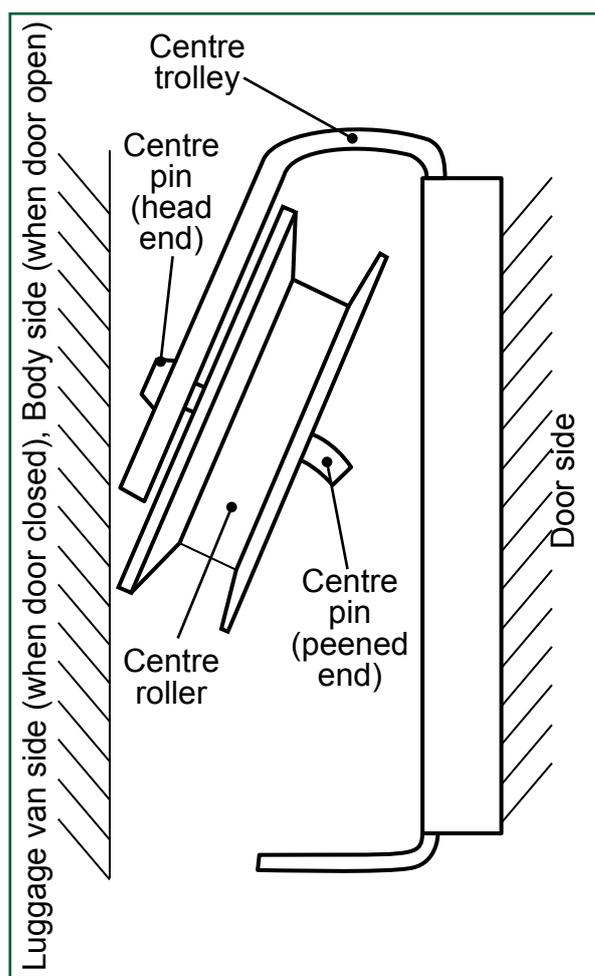


Figure 6: The centre trolley assembly recalled by staff at Bounds Green (note that the normal condition is shown in Figure 5)

- 21 As a result, the three staff, assisted by the two who had earlier been working with the engine control and monitoring panel, lifted and pushed the door back into its closed position and locked it with the budget lock (paragraph 36). This was not an easy task and it took the five of them around an hour to manhandle the door into position and close it.
- 22 Having got the door closed and locked, they checked that it was secure by pushing against it. They put a double sided 'Sorry, this door is not in use' sticker in the window, handwriting 'Runner defective do not open' on the outward face, and informed National Express East Coast service controllers of what they had done.
- 23 The set entered service the following morning, running empty to King's Cross platform 2 to form the 11:00 hrs to Aberdeen. At King's Cross, a fitter entered the 43306 luggage compartment from the platform through the left-hand door, to remedy a coolant fault in the adjacent engine compartment. After the incident, he told National Express East Coast that he had noticed that the damaged right-hand door was locked out of use and did not touch it.
- 24 The train left King's Cross late at 11:12 hrs. As it passed through Alexandra Palace station, around 5 miles (8 km) to the north, closed circuit television footage, whilst not conclusive, suggests that the rear right-hand sliding door might have been slightly open.

Events during the incident

- 25 To the north of New Southgate, while travelling at just under 100 mph (160 km/h), train 1S13 passed train 1A16 travelling southwards at a similar speed. As the rear power car of train 1S13 (43306) passed the front of train 1A16, the leading edge of the right-hand sliding door came off the centre runner and pivoted about the top and bottom runner at the trailing edge. This was a result of aerodynamic action and is explained in paragraphs 48 and 49.
- 26 The door swung across and its leading edge hit the leading coach of 1A16 and ran along the right-hand side of train. At some point, the door was torn from the top and bottom rollers, and after the trains had passed, it flew free and landed on, or close to, the up slow line.

Consequences of the incident

- 27 A number of passengers and crew on train 1A16 were shaken and one passenger reported suffering a minor eye injury as a result of glass-fibre particles entering a vestibule through a part open window. The right-hand side of the train suffered significant damage, although the passenger compartment was not penetrated. All the doors and windows remained intact (Figure 7).

Events following the incident

- 28 In the immediate aftermath of the incident, the driver of train 1A16 was not aware of what had happened. He had not noticed anything untoward about train 1S13 as it approached and the door had struck his train behind the leading power car. The crew heard the bang and noted damaged interior trim and glass fibre in vestibules, however, they did not know exactly what had happened. They contacted the driver to ask if the train had hit anything and the driver responded that as far as he was aware, it had not.
- 29 The train arrived at King's Cross around ten minutes later and the extent of the external damage became clear to the crew. They reported this to National Express East Coast control who, in turn, reported the incident to Network Rail control at 11:30 hrs.
- 30 At 11:49 hrs another southbound train reported striking a road sign on the up slow line in the New Southgate area. Network Rail control asked a Mobile Operations Manager to attend and train 2Y30 to examine the up fast line. At 12:10 hrs, the driver of train 2Y30 reported that there was a door lying alongside the up slow line.
- 31 The driver and crew of train 1S13 were unaware of the incident and continued northwards. The train called at Huntingdon where the missing door was not on the platform side and went unnoticed. It then went forward to Peterborough, arriving at 12:15 hrs where the missing door was noticed. In order to minimise inconvenience to passengers, the luggage van was emptied and the train continued in service to Doncaster and terminated there.



Figure 7: Examples of damage to right-hand side of southbound train 1A16

- 32 After the incident National Express East Coast secured all HST sliding doors out of use and implemented a series of checks into their condition. They also commissioned Interfleet Technology to review and re-write the overhaul and maintenance specifications for the doors. This was assisted by, and shared with, the HST User Group that includes representatives from other Train Operating Companies and Rolling Stock Leasing Companies.

Key Information

HST luggage van doors

Sliding-plug mechanism

- 33 HST luggage van doors are moulded glass-fibre structures which, with all the locks, handles and a window in place, weigh around 90 kg. They function using a sliding-plug mechanism as explained below.
- 34 When the door is being opened or closed its weight is taken by a top roller at the trailing end of the door and a centre roller at the leading end. There is also a bottom roller at the trailing end which provides guidance and retention but does not bear weight. The top and bottom rollers run in tracks on the vehicle body directly above and below the door opening. The centre roller runs on a track that guides the leading edge of the door along the outside of the vehicle body and into or out of the door opening, depending upon whether the door is being closed or opened. The centre pin holds the centre roller into a trolley attached to the door (Figures 4 and 5).
- 35 When the door is closed, it is held by a spring loaded hook at the trailing edge and a spring loaded main slam lock at the leading edge. The main lock engages with a two stage striker plate on the vehicle body (Figure 8), providing primary and secondary (safety) catch positions. The design is such that the level of engagement of the main lock tongue with the secondary catch is around 5 mm less than with the primary catch. Operating any one of the three main lock handles lifts the hook and withdraws the main lock tongue, allowing the leading edge of the door to be pushed out of the opening and slid along outside the vehicle. The reverse occurs when closing, except that no operation of the lock handles is required because the main lock and hook are spring loaded allowing the door to be slammed shut.
- 36 As well as the main lock, the door is fitted with a budget lock. This is a simple rotating lock tongue that engages with a single catch striker plate in the door frame. On National Express East Coast HST sets, the budget lock is operated from the outside with a handle (Figure 4) and from the inside with a key. This is unlike most other HST sets on which a key is used both inside and outside.
- 37 To help guide the door movement, there is a pivot arm on the vehicle body carrying two rollers (Figure 9). The lower roller runs along the door channel. The upper roller engages in a brass cam block just as the front edge of the door closes into the door opening. This mechanism helps the centre roller steer the leading edge of the door into the door opening correctly. If the cam block is not set up in the correct position, the upper roller will not enter it cleanly when the door is closed and the resulting impact forces will tend to loosen the fixings between the cam block and the door.

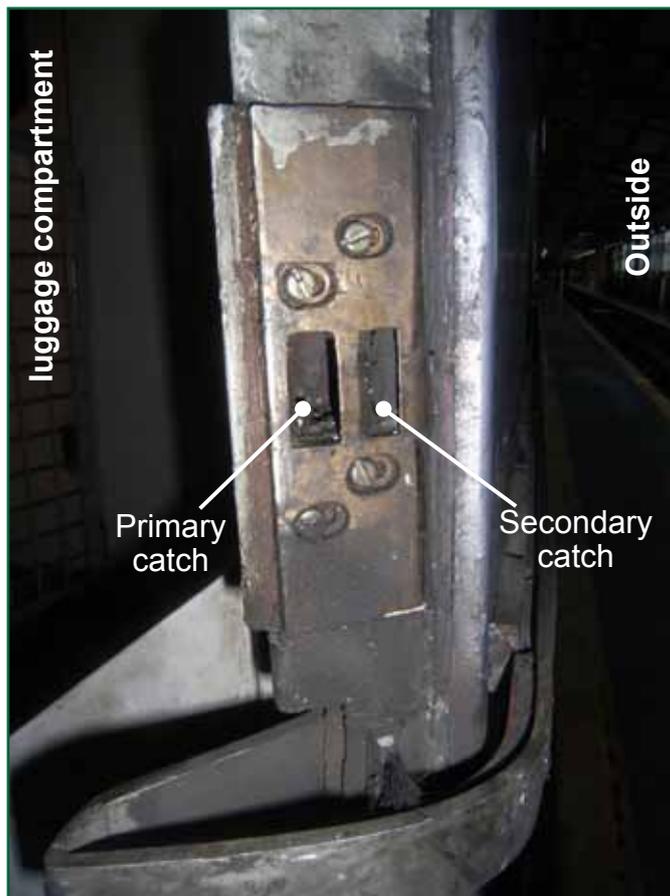


Figure 8: 43306 main lock striker plate after the incident

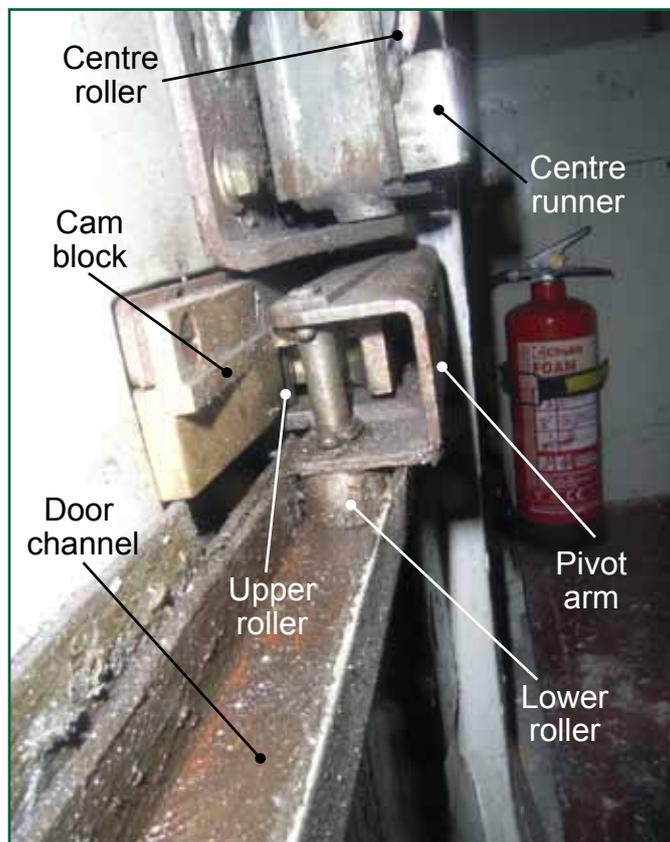


Figure 9: A cam block and pivoted arm (note: this is a left-hand door)

Maintenance

General

- 38 Examination of a sample of HST luggage van doors by the RAIB, National Express East Coast, Interfleet Technology (paragraph 32) and First Great Western have shown that some doors were operating with significant faults and that the general standard of installation, overhaul and maintenance of luggage van doors across large parts of the HST fleet were highly variable.
- 39 Examples of the more common faults found were cam blocks not secured to the doors, levels of main lock tongue engagement too low and poor dimensional set up, making doors difficult to open and close. Reportedly much less common were centre pins secured with very little peening¹. Such faults increase the risk of doors coming open or detaching.
- 40 A major reason for this was that the specifications being used by train maintainers were not detailed and clear enough to ensure that defects were identified consistently and repaired correctly.

The door concerned

- 41 The door involved in the incident was fitted by Brush Traction in 2006 as part of the HST power car refurbishment programme. The glass-fibre door mouldings used in the programme were new. The locks and other door furniture were re-used from existing doors if condition allowed as was permitted by the specifications.
- 42 Maintenance records show that in the days prior to the incident there were no recorded problems with the door during the daily S-exam. The last recorded maintenance intervention was on the 12 July 2008. The door main lock was found not to be engaging with the secondary catch (paragraph 35) and was adjusted to correct the problem. Additionally, the cam block was found not to be securely fastened to the door and the retaining screws were tightened. No issues with the centre trolley assembly were noted at that time.
- 43 The last related intervention prior to that was on 1 May 2008 when the cam block was again found not to be securely fastened to the door and the retaining screws tightened, and the budget lock handle (paragraph 36) was loose and refitted.

Examinations, calculations and test results

Examination of the damaged door

- 44 The door, as found, is shown in Figure 3; the leading edge had been largely destroyed. Of the components mounted on that edge, the main and budget locks were recovered from the trackside, but the centre trolley, roller and pin were not found.

¹ Peening is the mechanical working of metal; in this case hammering the end of a pin so the hammered end can not pass through the same hole as the rest of the pin, thus retaining it.

- 45 Measurements of the door and the frame confirmed that the key dimensions of both were in accordance with the design drawing. They also indicate that the main lock tongue would have had between 8 and 11 mm of engagement with the primary catch and around 3 mm to 6 mm engagement with the secondary catch (the difference between levels of primary and secondary catch engagement are explained in paragraph 35). The design drawings indicate that a correctly set up door would have a maximum primary engagement of around 11 mm and secondary engagement of around 6 mm.
- 46 Figure 8 shows that the wood of the door frame had not been completely removed from behind the secondary catch position. This could have limited the secondary engagement to little more than the thickness of the striker plate, although this would have had little effect because the level of secondary catch engagement is not usually more than 6 mm (the thickness of the plate).

Examination of the door locks

- 47 The RAIB arranged for specialist metallurgical examinations of the recovered locks by a consultant. These and the RAIB's own examinations showed that:
- the main lock tongue had fractured by ductile bending overload, almost certainly as a consequence of the incident;
 - the main lock was likely to have had only one of its two springs in place prior to the incident, which would have resulted in around half of the normal outward force on the tongue (this was supported by tests on a new lock, as the incident lock was too badly damaged to test);
 - marks on the main lock tongue indicated that, for the majority of its life, there had been at least 8 mm of engagement with a striker plate; and
 - marks on the budget lock tongue indicated a maximum engagement of 7 mm.

Aerodynamic forces on the sliding door

- 48 The RAIB arranged for a consultant aerodynamicist to review previous relevant aerodynamic studies on pressure pulses between passing trains and to estimate the likely forces on the luggage van door on power car 43306. The RAIB performed calculations to determine the effects of those forces on the door.
- 49 The results indicated that for a luggage van door on a trailing power car, with the two trains closing on adjacent lines at approximately 196 mph (314 km/h):
- even if the door was open before the two trains passed, the aerodynamic force as a result of train 1S13's forward movement alone would generally not be sufficient to pull the centre roller off its runner either with the centre roller vertical (as designed) or inclined as it is believed to have been (paragraph 19, Figure 6);
 - if the door was open as the two trains passed, the steady state aerodynamic force (above bullet) combined with the pulse associated with the trains passing would have been sufficient to pull the centre roller off the centre runner if it were inclined, as it is believed to have been, but not if it were vertical.

Tests on centre trolley

- 50 The RAIB commissioned tests on another centre trolley assembly and used the results as a basis for calculations which showed that for the trolley tested:
- whichever way round the centre pin is fitted, if the peened end is sound and secure in the centre trolley, slamming a sliding door closed cannot cause the trolley to bend (Figure 10a);
 - if the pin head is on the luggage compartment side and the peened end has pulled through the trolley (paragraph 19), a single hard slam of the door can cause the trolley to bend (Figure 10b), as all the door force (F) has to pass through only part of the trolley assembly (X) into the door; and
 - if the pin head is on the door side and the peened end has pulled through the trolley, a single hard slam of the door can not cause the trolley to bend (Figure 10c), because the relatively stiff pin provides an additional load path back to the door.

It should be noted that because the actual trolley assembly was not found, it is not possible to be certain whether it was identical to the tested assembly. However, it is the RAIB's view, based on their calculations, that the first two conditions described above apply to all trolley assemblies. The third condition would only apply to assemblies that have similar pins and rollers to that tested. As there is no evidence to suggest that the incident trolley was dissimilar in this respect, it is probable that the third bullet was applicable to the incident trolley.

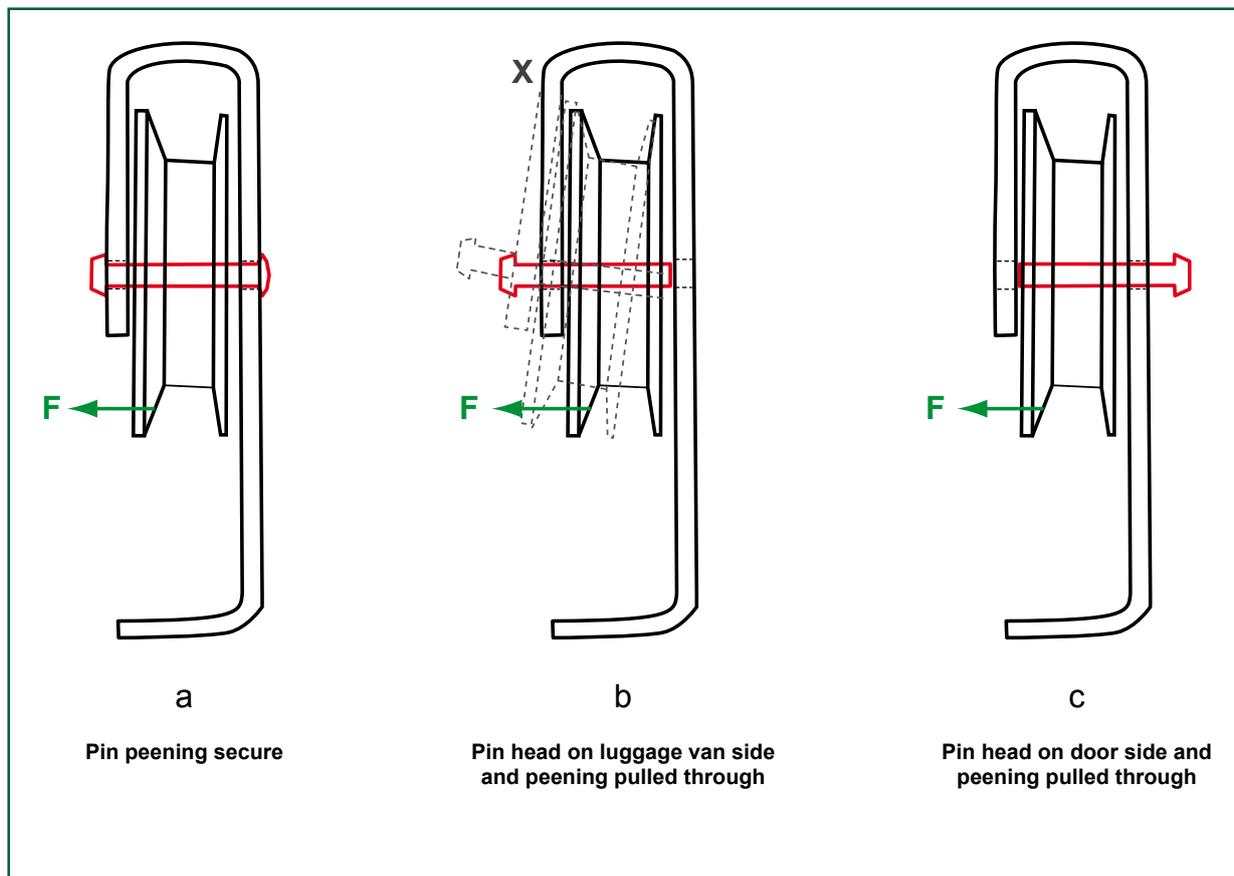


Figure 10: Simplified schematic of centre trolley assembly test

Defective doors in service

The Defective On-Train Equipment Contingency Plan

- 51 The Railway Rule Book GE/RT8000 module TW3: Preparation and movement of locomotive-hauled trains (including HSTs, push-pull, postal, parcels); states that, 'You must not allow a vehicle or unit to enter service from a maintenance depot, if any door is defective'. It does allow trains to enter service with a defective door from somewhere other than a maintenance depot with it locked out of service in a prescribed manner. This is written around passenger doors and makes no reference to luggage van doors.
- 52 A maintenance depot for a given type of train is defined in each Train Operating Company's Defective On-Train Equipment Contingency Plan. The National Express East Coast plan stated that Bounds Green was a maintenance depot and that trains should not enter service from there with defective doors.
- 53 National Express East Coast has since stated that their Defective On-Train Equipment Contingency Plan was incorrect; Bounds Green is a maintenance depot for Inter-City 225 sets, but only a service depot for HST sets. For this reason, few HST spares were available and staff were not trained in HST maintenance at Bounds Green (paragraph 20).

Handling defective HST doors at Bounds Green

- 54 There were no procedures defining what staff should do at Bounds Green when faced with a door for which they had neither the spare parts nor the up-to-date training to repair.
- 55 Faced with this situation the depot staff acted as described in paragraphs 21 and 22. There is no evidence that their actions were questioned within supervisory levels of the maintenance and operations organisations of National Express East Coast. Since the incident, National Express East Coast management have expressed a view that they would not have expected any other action to have been taken by staff, given the procedures and training available to them.

Previous occurrences of a similar character

HST luggage van doors coming adrift and hitting other trains

- 56 The RAIB has found only one previous occurrence of an HST luggage van door coming adrift and hitting another train. This incident occurred at Thirsk on 4 April 1987 and has some significant similarities to that at New Southgate.
- 57 In each case, two HSTs passed each other at high speed on the East Coast Main line and a trailing power car door came adrift and hit another train resulting in minor injuries. At Thirsk, the degraded condition of the centre roller was a key factor.

- 58 The Thirsk incident industry report concluded that, “Whilst the station staff at Darlington maintain that the sliding door was closed when 1V78 departed from Darlington there can be little doubt that the lock had not been properly engaged. When 1V78 passed 1S24 at a closing speed of approximately 250 mph the shock wave created was sufficient to lift the worn roller of the partially open door from its tracking which in turn imposed excess shock loading on the top and bottom runners resulting in their fracture and the door becoming completely detached”.
- 59 In that instance the centre trolley, roller and pin were recovered. The centre trolley was bent and the pin fractured. No conclusion was drawn as to whether this damage occurred before or after the incident.

HST luggage van doors coming adrift and hitting structures

- 60 The RAIB has found formal investigation records of one further occurrence of an HST luggage van door coming off completely in traffic. This occurred at Laira (Plymouth) on 19 March 1990. The industry report is not detailed, however, it appears that the door, on a rear power car, swung open to such an extent that it hit a signal post and was torn off.
- 61 Soon after this, documentary records suggest that there were problems with the attachment of centre trolleys and cam blocks to doors. It is possible that one or more doors may have become detached around that time.
- 62 As a result of these incidents and the incident at Thirsk, the InterCity business unit of British Rail issued a written instruction, initially in 1991, and a later up-issued version in December 1992. The later version contains instructions relating to checking that the centre pin is not pulling out of the trolley, that the trolley is not bent and that the cam block is securely attached to the door.
- 63 A member of the public has informed the RAIB that a door fell off an HST power car at King’s Cross in 1997, but no record of such an incident has been found.

HST sliding doors found open in traffic

- 64 An HST luggage van door becoming open in traffic is not a rare event. Such incidents have occurred in the past at a rate of around one per week for all parts of the railway network that HSTs operated over, although in recent times that frequency has fallen. Figure 11 shows the figures from the Rail Safety and Standards Board Safety Management Information System for National Express East Coast, and its predecessor, Great North Eastern Railway since 1998. The figures for First Great Western, who operate the biggest HST fleet, around four times the size that on the East Coast Main Line, are provided for comparison.
- 65 The figures show that trailing power car doors are much more likely to be found open than those on forward power cars and that the general trend is reducing. The predominance of these events on trailing power cars is explained by the fact that the airflow past them tends to open the sliding doors because the opening edge faces forwards into the airstream; on a front power car the reverse is true and the airflow tends to keep the sliding doors shut.

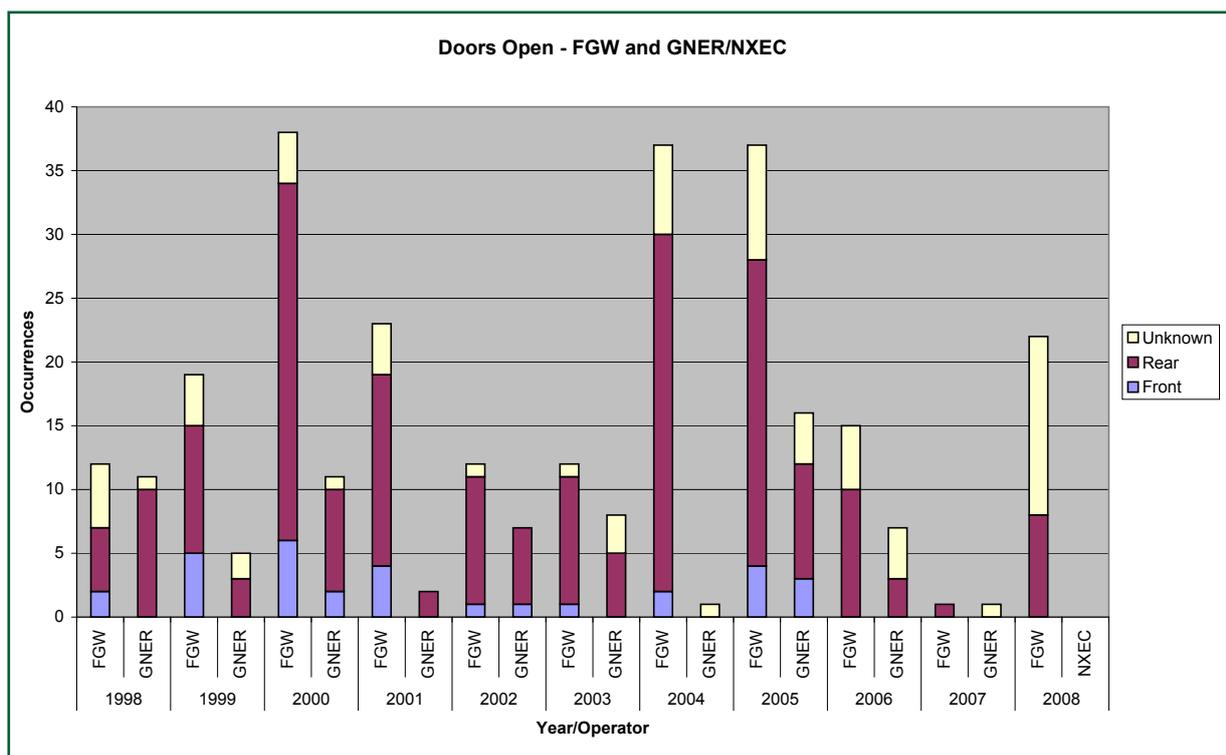


Figure 11: East Coast and Great Western luggage van door open statistics

- 66 The dramatic reduction in First Great Western's figures between 2005 and 2007 followed an instruction issued to train crew in March 2006, requiring them not to check that the budget lock was applied by pulling any main lock handles (which sometimes had the effect of moving the main lock to the secondary catch position without the crew being aware that this had happened and increasing the likelihood of the door later becoming unlocked and opening). The subsequent increase in 2008 followed allowing the luggage van to be used for the carriage of passengers' bicycles during that year.
- 67 National Express East Coast were not aware of any specific reasons that might have explained the variations in their figures.

Analysis

Identification of the immediate cause²

68 The immediate cause of the incident was the centre roller of the door being pulled off the centre runner by aerodynamic forces (paragraphs 25 and 49).

Identification of causal³ and contributory⁴ factors

69 In order for the centre roller to come off the centre runner in this way, the following conditions needed to be present (paragraph 49):

- the door was in service with a bent centre trolley;
- the door was open before the trains passed;
- the door was on a trailing power car; and
- both train 1S13 and train 1A16 were travelling at high speed.

These four factors were therefore causal, but the last two are also normal conditions.

The bent centre trolley

Bending the centre trolley

70 The centre trolley was not noticed as bent during daily examinations in the days before the incident (paragraph 42). This suggests the bending was not gradual because the daily S-exam requires the door to be successfully opened and re-closed and this is highly unlikely to be achieved with the trolley significantly bent.

71 Tests were conducted on a single centre trolley assembly not involved in the incident. Subsequent calculations indicated that in order for the test trolley to become bent by only one or two heavy slam closures, the following conditions would have been required:

- the peening at the end of the centre pin pulled through the centre trolley; and
- the centre pin head on the luggage compartment side of the centre trolley.

For the reasons explained in paragraph 50, the first condition is a causal factor. The second condition is a probable causal factor. The reason why the centre pin had pulled through the centre trolley cannot be determined because the trolley assembly was not found after the incident.

² The condition, event or behaviour that directly resulted in the occurrence.

³ Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

⁴ Any condition, event or behaviour that affected or sustained the occurrence, or exacerbated the outcome. Eliminating one or more of these factors would not have prevented the occurrence but their presence made it more likely, or changed the outcome.

72 The cam block is designed to assist the door to close (paragraph 37) and in doing this, reduces the loads on the centre roller as it turns the corner of the centre runner to move the front edge of the door into the closed and locked position. The fact that it came loose on at least two occasions and was not attached when the door came off at Bounds Green would have increased the stresses on the centre trolley assembly making it more likely that the peening would pull through and the trolley become bent. The cam block not being securely fastened to the door on at least two occasions prior to the incident was a contributory factor. It is probable that any continual loosening over time was caused by incorrect set-up of the cam block.

Allowing the door into service

73 Bounds Green depot was not able to repair the damaged door (paragraph 20) as a result of a management decision that HST maintenance would not be carried out there. However, having made that decision, National Express East Coast did not put in place procedures to inform staff how to deal with a luggage van door that they could not repair. Not providing such procedures was a causal factor.

74 As written at the time, and in combination with the Railway Rule Book, the Defective On-Train Equipment Contingency Plan required that the train not be put into service with the door unrepaired (paragraphs 51 to 53). However, because the Defective On-Train Equipment Contingency Plan was incorrect, there was no management expectation that the train should not have been allowed into service.

75 Had the error in the plan been noticed and corrected prior to the incident, there is a possibility that an instruction to staff at service depots relating to luggage van doors that could not be repaired, may have been provided. However, it may well have been a general instruction to lock any door out of use, without specific measures being described for luggage van doors. The incorrect Defective On-Train Equipment Contingency Plan was a contributory factor.

The opening of the door prior to detaching

76 The RAIB has not determined exactly how the door became unlocked and opened; such occurrences are not uncommon (paragraph 64). A number of witnesses have stated that the door was locked and checked after the door was refitted at Bounds Green. However, a number of hours elapsed between then and the train's departure from King's Cross.

77 There were no marks on the outside of the door to suggest that a pre-incident impact affected the lock handles. Although it is not possible to be certain because the door had suffered considerable damage as a result of the incident, such a scenario is considered unlikely.

78 The combined evidence of maintenance records (paragraph 42), measurements of the door (paragraph 45) and metallurgical examination (paragraph 47), whilst not conclusive, suggests that the main lock tongue was adjusted for the correct levels of engagement with the striker plate prior to the incident. However, the condition of the door as it entered service from Bounds Green, having been forced into position, may have affected levels of engagement. It is therefore possible that the level of main lock tongue engagement at the time of the incident was less than the design levels.

- 79 The following factors, singularly or in combination, are plausible explanations as to how the door became unlocked:
- the main lock only had one spring (paragraph 47), not two as designed (this is not checked as part of the maintenance regime);
 - in the hours that elapsed between the door being confirmed as locked at Bounds Green and leaving King's Cross, there is a possibility that a person may have somehow unlocked the door, whether intentionally or not;
 - given the way the door was re-fitted at Bounds Green, there is a possibility that locked-in forces were present that were pushing the door outwards against the lock (paragraph 21); and
 - there is a possibility that the level of lock tongue engagement with the striker plate was less than designed.

Identification of underlying factors⁵

- 80 That some National Express East Coast HST luggage van doors were found to be operating with the faults described in paragraphs 38 and 39, and that no procedure existed to tell staff how to deal with a door with a major fault that they were unable to repair, indicates that National Express East Coast did not fully appreciate the risks associated with this type of door.
- 81 Incidents of these doors coming adrift and hitting other trains are very rare, however, such an incident has occurred in the past (paragraph 58). The lessons from that and other previous incidents whilst appreciated at the time, were no longer guiding National Express East Coast's, or other operators', understanding of the risks (paragraphs 38 to 40) indicating that such awareness had been lost.
- 82 It is therefore an underlying factor that National Express East Coast did not appreciate the risk associated with HST luggage van doors, in part because the lessons of previous incidents were not incorporated in current processes. This situation arose as part of a general loss of awareness of the criticality of set-up and maintenance of luggage van doors within the industry.

Other factors for consideration

- 83 Paragraphs 28 to 31 summarise the actions of both train crews in the immediate aftermath of the incident. The crew of northbound train 1S13, had no knowledge of the incident until they arrived at Peterborough and, given the timings, no one could have been expected to determine which train the door had come from and warn them earlier. The subsequent decision to clear the luggage compartment and continue to Doncaster without the door, thereby increasing the options passengers would have when the train was finally terminated, was reasonable.

⁵ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

- 84 Other than the driver, the crew of the southbound train 1A16 heard banging and were able to see damage and glass-fibre inside vestibules, they were also told by the driver that he did not believe that the train had hit an object on the track. The four emergency situations that National Express East Coast crews carry instruction cards for did not include this situation. Given that the crew could not be expected to determine exactly what had happened in the few minutes before the train reached King's Cross and that nothing suggested that the train or its passengers were in further immediate danger, the decision not to stop the train before the terminus was reasonable.

Conclusions

Immediate cause

85 The immediate cause of the incident was the centre roller of the door being pulled off the centre runner by aerodynamic forces (paragraph 68).

Causal factors

86 Causal factors were:

- the door was in service with a bent centre trolley (paragraph 69, Recommendation 1);
- the door was open before the trains passed (paragraph 69 and Recommendation 3);
- the door was on a trailing power car (paragraph 69);
- both train 1S13 and train 1A16 were travelling at high speed (paragraph 69);
- there was no procedure in place to inform staff how to deal with a luggage van door they could not repair (paragraph 73, Recommendation 4); and
- the peened end of the pin had pulled through the centre trolley (paragraph 71, Recommendations 1 and 2).

87 The following factors, singularly or in combination, are plausible explanations as to how the door become open (paragraph 79):

- the main lock only had one spring, not two as designed (Recommendation 1);
- there is a possibility that a person may have somehow unlocked the door, whether intentionally or not;
- given the way the door was re-fitted at Bounds Green, there is a possibility that locked-in forces were present that were pushing the door outwards against the lock; and
- there is a possibility that the level of lock tongue engagement with the striker plate was less than designed at the time of the incident (Recommendation 1).

88 A probable causal factor was that the pin head was on the luggage compartment side of the trolley (paragraph 71, Recommendation 2).

Contributory factors

89 Contributory factors were :

- the cam block was not securely fastened to the door at various times prior to the incident probably as a result of incorrect set-up (paragraph 72, Recommendation 1); and
- the incorrect Defective On-Train Equipment Contingency Plan (paragraph 75, Recommendation 4).

Underlying factor

- 90 The underlying factor was that National Express East Coast did not appreciate the risk associated with HST luggage van doors, in part because the lessons of previous incidents were not incorporated in current processes. This situation arose as part of a general loss of awareness of the criticality of set-up and maintenance of luggage van doors within the industry (paragraph 82).

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

- 91 After the incident, National Express East Coast secured all HST sliding doors out of use and implemented a series of checks into their condition. They also issued a National Incident Report to inform other operators of the incident.
- 92 They have since, in conjunction with Interfleet Technology and the HST User Group (paragraph 32), produced a revised set of maintenance procedures and associated training material.

Recommendations

93 The following safety recommendations are made⁶:

Recommendations to address causal and contributory factors

- 1 HST owners, National Express East Coast and other HST operators should re-examine the set-up and maintenance requirements for HST luggage van doors to promote safer operation. They should include consideration of previous incidents, original design drawings and maintenance experience. As a result they should amend their procedures as necessary, paying particular attention to:
 - inspection of the centre trolleys, pins and rollers;
 - set-up and attachment of cam blocks;
 - checking main lock spring rates; and
 - correct set-up of main lock engagement with the striker plate.
 (paragraphs 86 1st and 6th bullets, 87 1st and 4th bullets, and 89 1st bullet).
- 2 HST owners and operators should consider whether peened centre pins should be replaced by a more reliably fixed pin. If the use of peened pins is continued, consideration should be given to positioning the pins' heads towards the door and the peening towards the luggage van (paragraph 86 6th bullet and 88).
- 3 National Express East Coast should put in place procedures mandating the monitoring of the frequency of luggage van doors being found open in traffic and the factors that may be causing this. The procedures should also require that corrective actions should be identified and put in place (paragraph 86 2nd bullet and 87 2nd bullet).

continued

⁶ Those identified in the recommendations, have a general and ongoing obligation to comply with health and safety legislation and need to take these recommendations into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Incident Investigation and Reporting) Regulations 2005, these recommendations are addressed to the Office of Rail Regulation to enable it to carry out its duties under regulation 12(2) to:

- (a) ensure that recommendations are duly considered and where appropriate acted upon; and
- (b) report back to RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 167 to 171) can be found on RAIB's website at www.RAIB.gov.uk.

- 4 National Express East Coast should modify their Defective On-Train Equipment Contingency Plan to define Bounds Green as a servicing depot for HSTs. They should consider in detail, what safety precautions should be put in place before a train can enter service from such a depot with unrepaired defective on-train equipment and generate procedures to enable staff to put such precautions in place. Such procedures should include a reliable method of securing HST luggage van doors out of service and clearly differentiate between passenger and non-passenger doors (paragraphs 86 5th bullet and 89 2nd bullet).
- 5 HST owners and operators of rolling stock with similar designs of luggage van door (in particular Mk 3 and Mk 4 Driving Van Trailers) should consider the applicability of Recommendations 1, 2 and 3 to their operations and act upon them where applicable.

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Any enquiries about this publication should be sent to:

RAIB	Telephone: 01332 253300
The Wharf	Fax: 01332 253301
Stores Road	Email: enquiries@raib.gov.uk
Derby UK	Website: www.raib.gov.uk
DE21 4BA	