

# RAIB Bulletin 03/2011

## Derailment at Dalchalm level crossing, Highland, Scotland 23 February 2011

### Description of the accident

- 1 At around 16:50 hrs on 23 February 2011, train 6E69, the early running 17:45 hrs freight service from Georgemas Junction Sidings to Hartlepool South Works, derailed at Dalchalm level crossing, Highland. The train was travelling at around 25 mph (40 km/h) in the up direction (towards Inverness) when it derailed.
- 2 Train 6E69 ran derailed for around 340 metres before becoming re-railed as it passed over East Brora Muir No.2 level crossing. Damage was caused by the derailed train to the road surface at both level crossings, to the permanent way and to signalling equipment. Nobody was injured in the derailment.

### Description of the train involved

- 3 Train 6E69 consisted of a Class 66 locomotive and 27 unladen BFA and RRA wagons in a configuration known as the 'pipe train'. The train was operated by DB Schenker Rail (UK) Ltd<sup>1</sup> who also maintained and owned the wagons which formed it. The vehicle which derailed was BFA wagon number 950544, the 20<sup>th</sup> wagon from the front of the train. This wagon was equipped with air-operated tread brakes<sup>2</sup>.
- 4 BFA wagons are mounted on two Y25 type bogies, each of which has two wheelsets. The configuration of these wheelsets is shown in figure 1. At the time of the incident, the leading wheelset of wagon 950544 was wheelset 4A/4B.

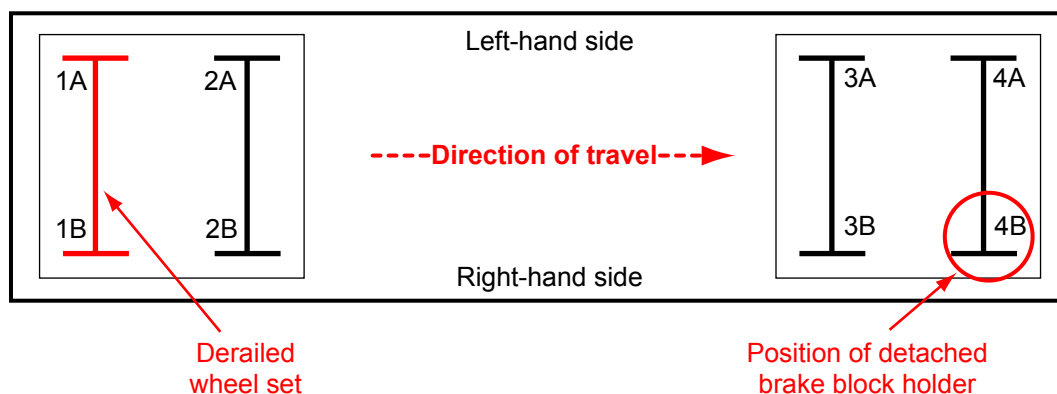


Figure 1: The wheelset configuration of wagon 950544 during the derailment

<sup>1</sup> Referred to as DB Schenker throughout this bulletin.

<sup>2</sup> BFA wagons may be equipped with either tread or disc air-operated brakes.

- 5 The braking equipment of a BFA wagon equipped with Y25 type bogies and air-operated tread brakes is shown in figure 2. There are two cast-iron brake blocks at each wheel, one situated at the leading face of the wheel tread and the other at the trailing face. The brake blocks on each face are held within brake block holders (also known as brake heads) which are mounted onto brake head pins, machined onto a brake beam. The brake beam is linked to the wagon's brake cylinder via additional brake rigging components.

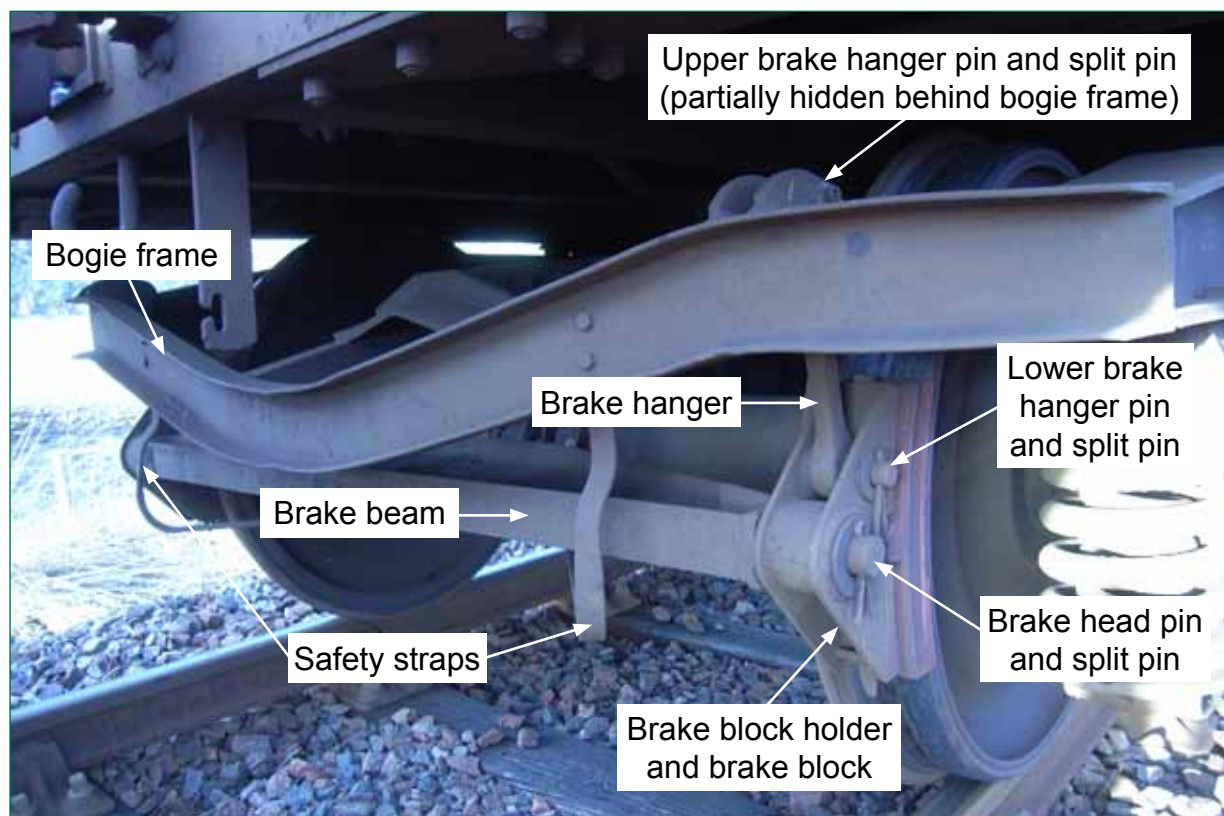


Figure 2: The braking equipment of a BFA wagon equipped with tread brakes

- 6 During a brake application, the brake beams on either side of a wheelset are moved by the brake cylinder through the brake rigging so that the brake block holders are pulled towards the wheel treads. The brake beams, however, only control the movement of the brake blocks in the horizontal plane and provide no vertical restraint. The brake block holders are prevented from dropping to the ground by brake hangers, to which they are connected by the lower brake hanger pins. The upper part of the brake hangers are connected to brackets on the bogie frame by the upper brake hanger pins. The brake head pins and the upper and lower brake hanger pins are all secured using washers and a split pin.
- 7 Two safety straps (also known as safety loops) are provided to retain a brake beam should a brake hanger or its pins fail or work loose. These safety straps are bolted to the frame of the bogie behind and to the front of the brake beam.
- 8 Wagon 950544 was not recorded as outstanding any maintenance activity at the time of the derailment. Its last annual vehicle inspection and brake test (VIBT) before this date took place in August 2010.

- 9 It is a requirement of the VIBT maintenance plan that brake rigging (specified to include shafts, levers, links, brake hangers and safety loops) is examined and that any missing, damaged or excessively worn components are replaced and that all pins and bolts are checked to ensure that they are the correct type and size and have been correctly assembled.
- 10 It was noted on the record of the August 2010 VIBT for wagon 950544 that one of the safety straps had become broken, although the location of the broken strap on the vehicle was not noted. The record showed that this broken strap was repaired by welding during the VIBT.

## Description of the infrastructure

- 11 Dalchalm level crossing is an automatic open crossing locally monitored (AOCL) crossing, situated on Network Rail's Far North line, 91 miles 30 chains (150 km) from Inverness station. The crossing is situated towards the end of a left-hand curve (for trains travelling towards Inverness) on a single track, on which trains are able to run in either direction. The maximum permitted speed that a freight train should pass over the crossing is 25 mph (40 km/h).
- 12 At Dalchalm level crossing, the running rails are fitted with check rails (see figure 3). The ends of these check rails are angled inwards towards the four foot. This angled portion is known as the flare and is intended to guide rail wheels into the flangeway before they pass over the crossing. The check rail and running rail are both mounted onto sleepers using check chairs. As well as securing the rails to the sleeper, these fastenings maintain the flangeway gap between them using check blocks which are fixed between the rails.

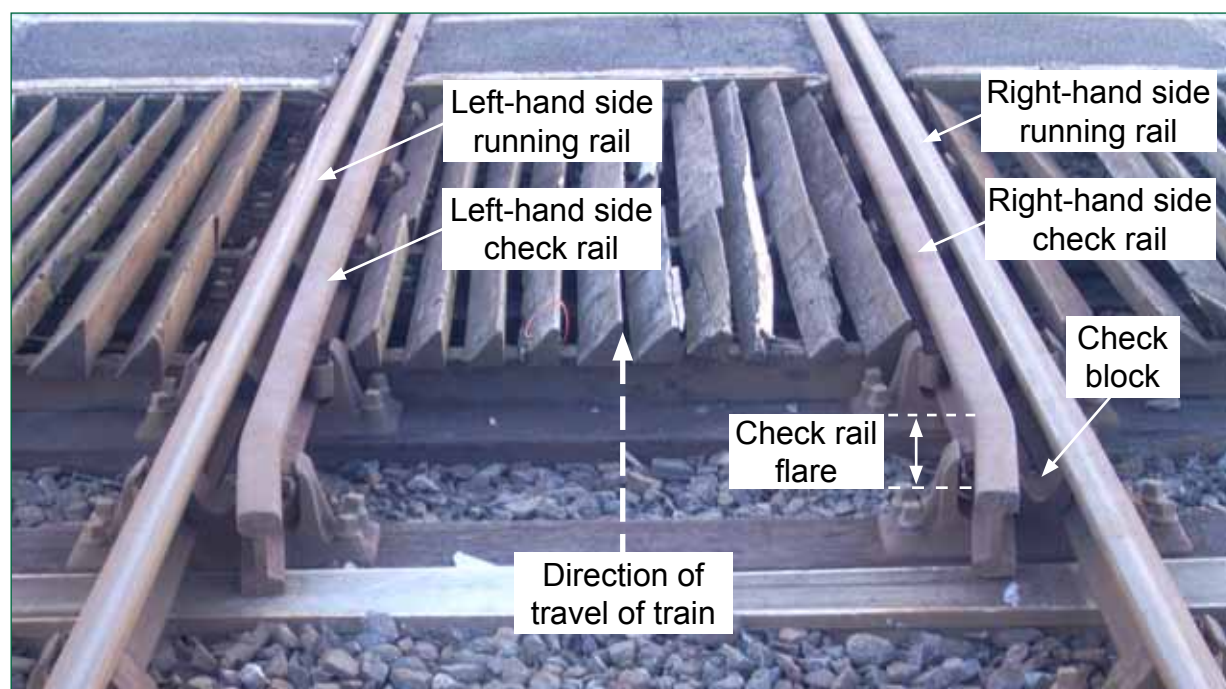


Figure 3: Arrangement of check rails at Dalchalm level crossing

## Findings of the Rail Accident Investigation Branch

### Events preceding the accident

- 13 Before it departed Georgemas Junction Sidings, a train examiner working for DB Schenker undertook a train examination of 6E69 during which he observed nothing of concern. Examinations of this type include an inspection of the wagons' wheels and axles, suspension, braking equipment and structure for safety critical defects. For trains operated by DB Schenker they are undertaken in accordance with their engineering manual DBS/EM/0030 'Examination of Freight Trains & Vehicles'<sup>3</sup>.
- 14 DBS/EM/0030 requires that, if brake rigging is found to be hanging down or fractured on a wagon or if a safety strap is found to be missing or fractured, then the wagon may be allowed to go forward for later repair as part of the train. However this is only permitted if the brake affected is isolated and a temporary repair has been undertaken. The wagon will otherwise have to remain at the location until other arrangements for repair or movement can be made.
- 15 At 15:00 hrs the train underwent a brake continuity test before departing Georgemas sidings at 15:05 hrs. As the train departed, the train examiner undertook an additional 'roll-by' inspection of the train during which he again noted nothing untoward. Around a quarter of a mile after departure, the driver successfully conducted a running brake test in accordance with the requirements of the rule book.
- 16 At 16:46 hrs, train 6E69 approached Dalchalm level crossing at 56 mph (90 km/h). The driver started braking the train in anticipation of the lower permitted speed at the crossing. By the time it reached the special speed restriction board for the crossing, the train's speed had reduced to just below the required 25 mph (40 km/h).

### Events during the accident

- 17 At 16:48 hrs, as train 6E69 passed through Dalchalm level crossing, the rear axle of the trailing bogie (wheelset 1A/1B) of wagon 950544 (the 20<sup>th</sup> wagon from the front of the train) derailed to the left (in the direction of travel) just beyond the check rail flare. The driver of the train was unaware that a derailment had taken place and noticed nothing unusual about the train's handling.
- 18 The train ran with this wheelset derailed for around 340 metres when it reached East Brora Muir No.2 level crossing. This is a user worked crossing (UWC), not fitted with check rails. The derailed wheels struck the hardwood crossing surface and rode on top of it briefly before both wheel flanges were able to drop into their respective flangeways, thereby re-railing the wheelset.

### Events following the accident

- 19 A resident of one of the homes near to Dalchalm level crossing could see train 6E69 from his house and noticed that some of the wagons seemed to jump as they passed over the crossing. He then left his home to look at the crossing where he found an item lying on the track nearby (later identified as the brake block holder and brake hanger from wheel 4B of wagon 950544). The resident reported what he had seen to the Network Rail signaller at Inverness.

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<sup>3</sup> DBS/EM/0030 is produced by DB Schenker to provide inspection criteria for their staff which will support the overall requirements of Railway Group Standard GM/RT 2455 'Freight Vehicle In-Service Inspections'.

20 As a result of this report, the signaller instructed the driver of 6E69 to stop and examine the train. The train came to a stand between Golspie and Rogart, around 10 miles (16 km) beyond the point of derailment. On inspecting wagon 950544, the driver found that the brake block holder and brake hanger were missing from the leading face of wheel 4B and that the leading brake beam of wheelset 4A/4B was dragging in the four foot (see figure 4). He also noticed that wheels 1B and 1A had sustained some sort of damage.

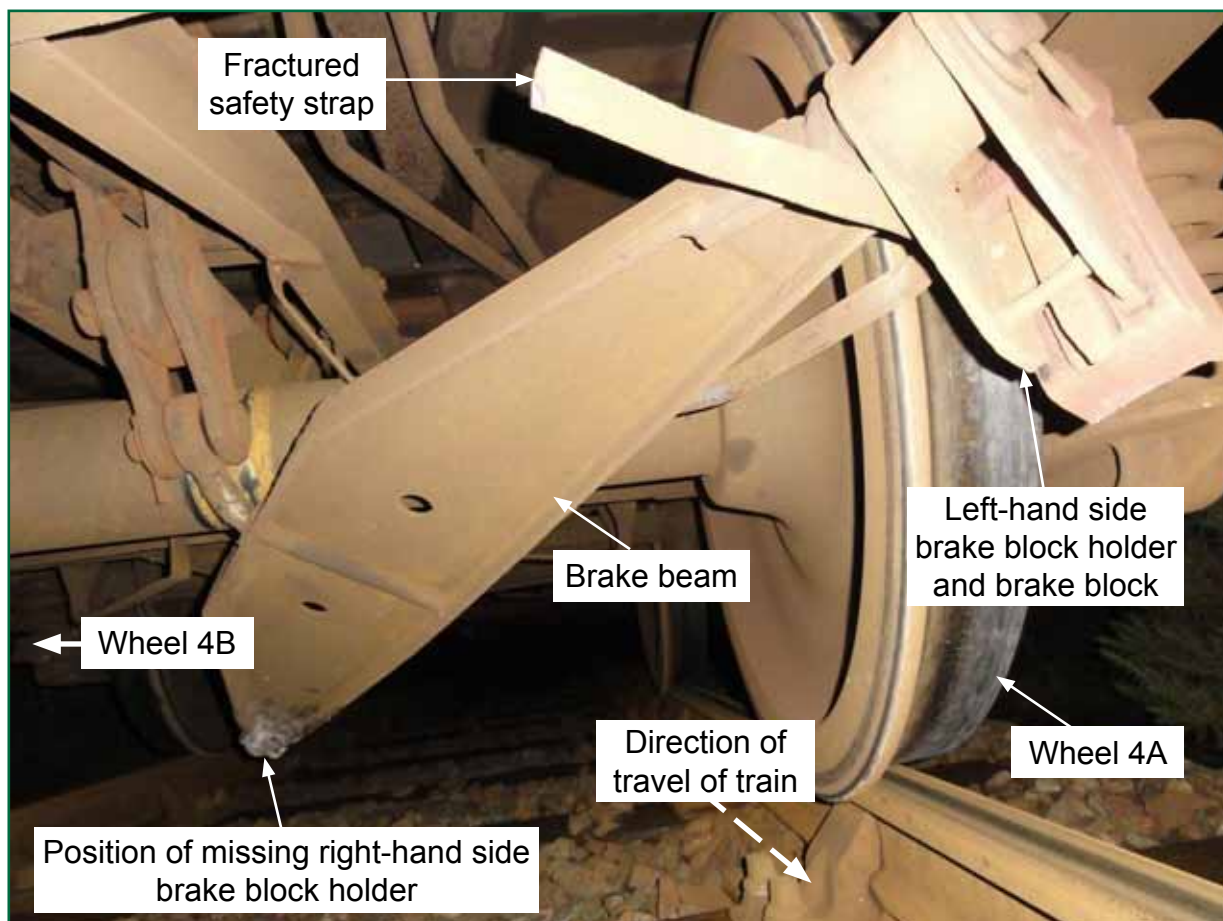


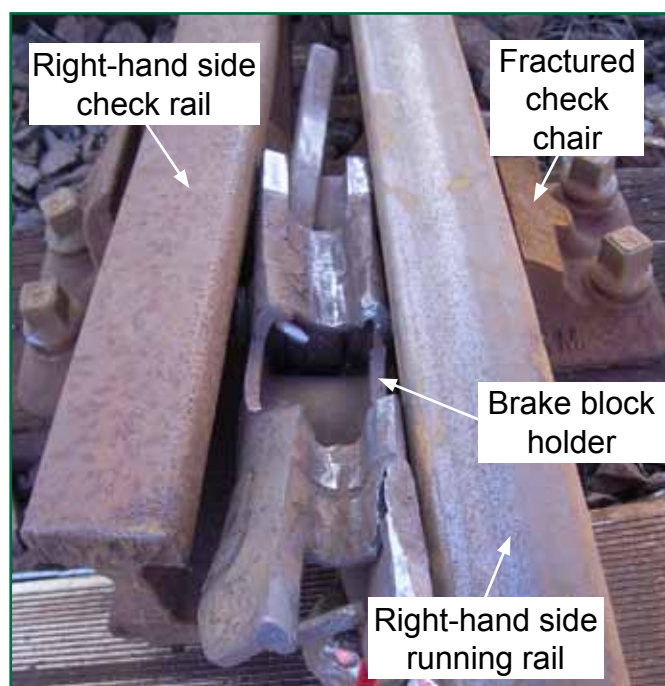
Figure 4: The brake rigging on the leading face on wheelset 4A/4B following the derailment (photograph courtesy of DB Schenker)

21 The driver decided that his train was unsafe to travel onwards further and so reported his findings and obtained further assistance. An inspection of Dalchalm level crossing was subsequently undertaken by Network Rail staff, who determined that a derailment had taken place.

## Analysis

22 Inspection of train 6E69 by the RAIB showed derailment damage to wheels 1A and 1B of wagon 950544. There was evidence that wheel 4B had ridden on its flange tip and that wheel 2B had sustained damage to its flange back. There were also general indications of rough riding on both this wagon and the one immediately to its rear.

- 23 This inspection confirmed the driver's findings regarding the missing brake components on wheel 4B. Examination of the brake beam at wheelset 4A/4B showed that the safety strap on the 4A side of the loose beam was fractured and that the strap on the 4B side was missing entirely. It could be seen that the fractured safety strap at the 4A side had recently broken at one end, just below its front fixing bolts, and that the strap had also been repaired by welding at the rear fixing at some point in the past. It was evident from the build-up of dirt on the bogie frame surface that the missing safety strap at the 4B side had probably been absent for some time. Although not causal to the accident, it was noted that one of the safety straps of the trailing brake beam on wheelset 1A/1B was also missing.
- 24 An examination of Dalchalm level crossing showed single wheel derailment marks on the left-hand side running rail (towards the cess) and the right-hand side check rail (towards the four foot). These marks started just past the check rail flare and continued through the crossing surface and onto the railway beyond. Bright metal marks were found on the first right-hand side check block, whose check chair was fractured.
- 25 The detached brake block holder and hanger from the leading face of wheel 4B were inspected. The upper brake hanger pin was missing from the brake hanger and both the hanger and the brake block holder (which remained attached to the hanger via the lower pin) had been heavily damaged. This damage was consistent with the brake block holder and hanger having been forced into the right-hand check rail flare at the crossing.



*Figure 5: The detached brake block holder and the check rail flangeway – the brake block holder has been replaced into this position post-incident for photographic purposes*

26 The damaged remains of the split pin from the brake head pin on the leading face of wheel 4B were also recovered at the crossing, as was the brake block, which had become separated from the brake block holder. The brake block face showed evidence of having been in contact on several occasions with a wheel flange.

## Conclusion

- 27 The RAIB has concluded that the cause of the derailment was that the upper brake hanger pin on the leading face of wheel 4B either fractured or worked loose. This allowed the brake hanger to detach from the bogie frame and for the brake beam to drop onto the single remaining safety strap. This strap then fractured, allowing the brake beam to drop further towards the track and for the brake hanger to drop completely clear of the bogie frame. This would have allowed the brake block holder to pivot away from its normal position.
- 28 On the immediate approach to Dalchalm level crossing the brake block holder and hanger were able to enter into the gap between the right-hand check and running rails. This caused the split pin on the brake head pin to shear, allowing the brake block holder and hanger to detach from the brake beam and become lodged in the flangeway.
- 29 In this position the brake block holder was probably struck by the following wheels on right-hand side of the wagon, which would have driven it further into the flangeway, against the first check block. At some point, wheel 1B also struck the block holder; this caused the wheel to run onto the head of the right-hand side check rail, before it derailed into the four foot. This would also have forced wheel 1A on the opposite side of the wheelset to ride up onto the head of the left-hand side running rail before derailing towards the cess.
- 30 It has not been possible to determine whether the upper brake hanger pin fractured or if it was able to work loose due to a missing or broken split pin. Examination by the RAIB of brake hanger split pins from other similar wagons showed that they can be subject to wear just under the pin head, probably due to the degree of free movement inherent in the hanger pin assembly design. For this reason, and taking into account the relative size and robustness of the two components, the failure of a split pin seems to have been the more likely initiating event in this derailment.
- 31 Although the train underwent an examination around two hours prior to the derailment, the train examiner did not notice anything unusual either about the brake rigging, the hanger pins, the split pins or the safety straps on the wagon which derailed. There is a very restricted view of the upper brake hanger pin and its split pin when standing to the side of the wagon and both can only be seen clearly from a position directly beneath the wagon's underframe. This is not a position which would be safely accessible by a train examiner during their normal duties and so it is very unlikely that a loose upper hanger pin and/or the absence of its split pin could have been detected at Georgemas Junction.
- 32 Wagon 950544 was required to undergo a train examination every time that it was prepared for service as part of a train. Given the difficulties in viewing the upper brake hanger pin and its split pin, it is not possible to determine exactly when the last occasion was that a train examiner would have been able to inspect the upper brake hanger pin and its split pin. However these items would have been checked as part of the VIBT which took place in August 2010 (paragraph 9).

- 33 Brake beam safety straps are visible during train examination. The safety strap on the 4B side of the wagon had probably been missing for some time and DB Schenker's procedure DBS/EM/0030 required that it be at least temporarily repaired before the wagon was allowed forward. Despite this no action was taken by either the train examiner at Georgemas, or previous train examiners who would have inspected the train, to affect a repair or to remove the wagon from service. This is probably because it had become practice amongst DB Schenker's train examiners only to make a repair or to take other action where a safety strap was found to be broken (as opposed to missing completely) and thus potentially able to become foul.

### Actions reported as already taken

- 34 Immediately following the incident, DB Schenker undertook a one-off special check of all of its wagons fitted with Y25 type bogies which had air-operated tread brakes. This required a competent member of staff to visually examine each bogie and its associated brake equipment. This check was undertaken to ensure that all split pins were present and opened correctly, with repairs to be made to any found to be missing, and that any missing or loose brake beam safety straps were repaired if possible before a wagon was allowed forward.
- 35 DB Schenker collated the results of this one-off special check. Data collected by the beginning of April 2011 showed that around 7% of wagons fitted with Y25 bogies were reported as having had a missing bolt or missing or excessively worn split pin, a worn brake rigging bush or a missing or fractured safety loop. The majority of these reports (around 80%) related to safety loops.
- 36 On 23 February 2011, DB Schenker issued National Incident Report (NIR) No.2699 '*Detached brake rigging, Y25 Bogie*' in order to provide details of the incident, its cause and the actions being undertaken to the rail industry in Great Britain.
- 37 On 28 February 2011, DB Schenker issued its internal Operations Digest No.174 '*Y25 Wagons - Brake Rigging/Safety Loops and Straps*' in order to raise awareness amongst its staff of the need to ensure that defects involving brake rigging or safety straps are rectified before a wagon is released back into traffic.
- 38 On 17 March 2011 the RAIB issued Urgent Safety Advice to the rail industry concerning this incident. This detailed the incident, its causes and the actions undertaken to date by DB Schenker. This advice was issued in order to raise awareness of the incident among operators in the UK and Europe, particularly those who do not receive national incident reports.
- 39 DB Schenker has arranged for its existing general requirements:
- that split pins of 6 mm diameter or less are to be made of stainless steel;
  - that split pins of 10 mm diameter or less are not to be reused; and
  - that split-pins over 10 mm diameter may be re-used dependant on condition
- to be repeated within the relevant DB Shenker engineering manuals for specific items of equipment, including those relating to Y25 bogies.



## Lessons learned

- 40 On the basis of the information collected during its preliminary examination of this accident, the RAIB has concluded that actions have been taken to address the immediate issues identified. For this reason it is unlikely that further investigation by the RAIB would lead to formal recommendations for the improvement of safety.
- 41 However, the derailment has highlighted the need for operators of rolling stock mounted on Y25 bogies (and their derivative types) fitted with tread brakes to review their safety assurance, train examination and rolling stock overhaul and maintenance systems to ensure that:
- They are satisfied that they have in place arrangements which will ensure that split pins are correctly fitted to brake rigging components and that they are controlling the risk of a failure of these split pins;
  - They are satisfied that they have in place arrangements to withdraw from service at the first opportunity any wagons with hanging brake rigging or missing/defective safety straps; and
  - They are satisfied that, where brake rigging safety straps are fitted, that they will retain unsecured brake rigging in line with their intended function.

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