Rail Accident Investigation Branch

Rail Accident Report

Derailment at Wigan North Western station
25 August 2009

Department for Transport

Report 14/2010
August 2010

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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Derailment at Wigan North Western station 25 August 2009

Contents

Summary

A derailment occurred on the night of 25/26 August 2009 at Wigan North Western station. A container train travelling from Glasgow to Manchester and Birmingham was slowing down to stop at Wigan when one of its wagons derailed. The wagon which derailed was an empty container wagon and its front bogie derailed at low speed whilst running round a sharp curve into the platform.

The derailment was caused by a combination of factors including:

- the lack of a *check rail* on the track;
- the track alignment;
- a twist in the wagon chassis; and
- high friction between wheel and rail due to dry conditions and newly-turned wheels.

The RAIB has made one recommendation to DB Schenker, the operators of the train, and three to Network Rail, the owners of the infrastructure. The recommendation to DB Schenker concerns the maintenance procedures for the wagons and the recommendations to Network Rail relate to inspection of the track.

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 The terms left and right in this report are relative to the direction of travel.

4 Appendices at the rear of this report contain the following:

- 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.

The Accident

5 The accident occurred at midnight on 25/26 August 2009 as train 4M67, the 20:15 hrs service from Mossend, near Glasgow, to Birmingham and Manchester was approaching Wigan North Western station (figure 1). The train consisted of a class 92 locomotive and 40 *bogie* container wagons and was due to stop at Wigan for the train to be divided into two portions. The leading bogie of the 12th wagon in the train derailed as the train ran into platform one at Wigan North Western station. Nobody was injured in the derailment. Figure 2 shows the wagon involved.

6 The train was slowing down to stop and was travelling at 12 km/h (7.5 mph) at the time the derailment occurred on a left-hand curve on *plain line* to the north of the platform (figure 3). Slight damage was caused to the track and the derailed wagon. Some signalling cables were damaged in the derailment and the track through platform one was closed for 24 hours while repairs were undertaken.

The organisations involved

7 The train was operated by DB Schenker, who also employed the train driver and owned the wagons. The track was owned by Network Rail who also maintained it as part of their London and North Western Route.

8 DB Schenker and Network Rail freely co-operated with the investigation.

Location

9 The derailment occurred to the north of Wigan North Western station where the line is carried on an embankment leading up to a bridge over a road. The railway at this location consists of a double track main line with a loop on each side. The derailment occurred on the *up* loop, which leads into platform one.

The train

10 The train consisted of wagons of types FCA, FIA and FKA, which are all types of flat wagon (figure 2) designed to carry containers. The first eight wagons in the train were loaded with containers and the remaining wagons were empty, except for wagons 16, 21 and 39, which each had one 40 ft container.

11 Wagon 12, which was the only one to derail, was not carrying any containers at the time. This wagon, no. 610117, was of type FCA and was one of a semi-permanently coupled pair, being coupled to wagon 11 (no. 610116) by a bar coupling. The pair of wagons was not intended to be divided in normal service.

12 The formation of the train is illustrated in figure 4.

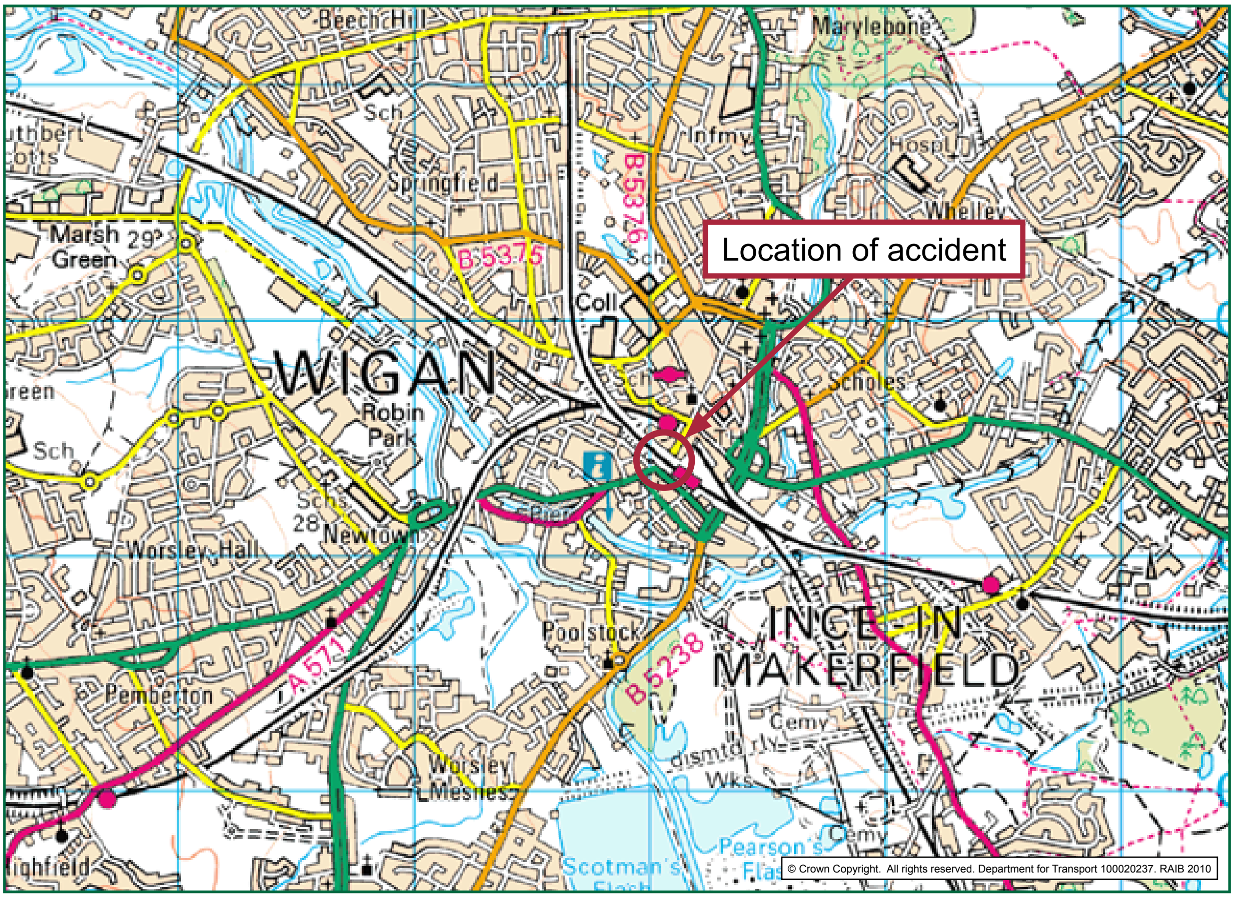

Figure 1: Extract from Ordnance Survey map showing location of the derailment

Figure 2: Wagon which derailed showing bar coupling to adjacent wagon

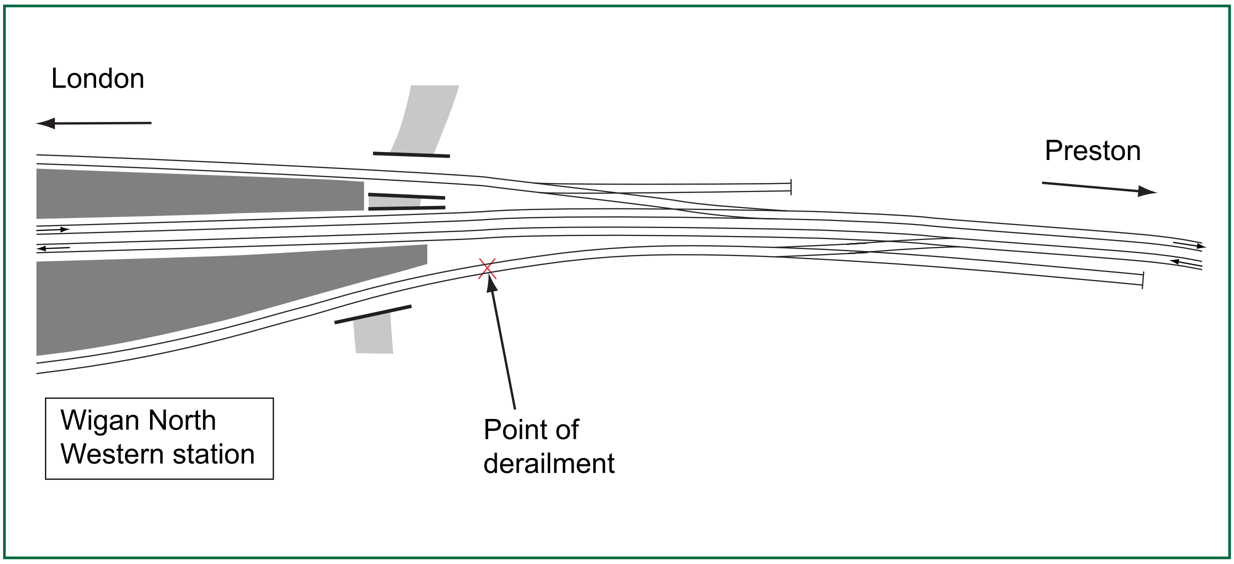

Figure 3: Plan of the site

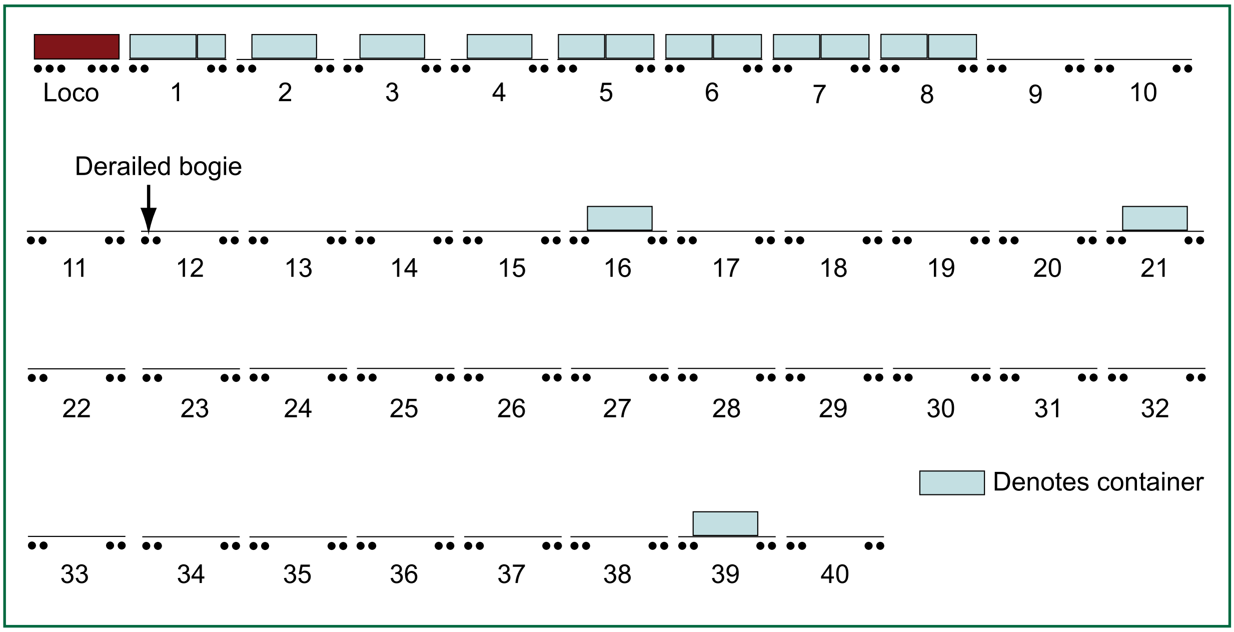

Figure 4: Formation of the train

The track

13 The track at the site of the derailment consisted of *UIC60* rails on *G44 concrete sleepers* leading up to the point of derailment. The point of derailment was on a transition between UIC60 rail and *BS113A* rail. The BS113A rail was on a variety of sleepers, including two G44 concrete sleepers, two hollow steel sleepers (providing ducts for cables to cross the track) and timber sleepers with *NRS1 baseplates*.

14 The maximum permitted speed over the line was 10 mph (16 km/h).

15 The track was ballasted with normal stone ballast up to the point where it reached the bridge over the road. The sleepers on the bridge were located in between the cross girders of the bridge deck with the space around them filled with small stone chippings.

Events preceding the accident

16 Wagons 610116 and 610117 underwent a vehicle inspection and brake test (VIBT) at Mossend, near Glasgow, on 22 August 2009. The DB Schenker maintenance plan for these vehicles requires a VIBT annually and the previous one had been carried out in July 2008. Although the interval between the previous VIBT and the most recent one was over the 365 day limit set by the maintenance plan, this was not significant to the derailment. During the VIBT on 22 August 2009 new wheelsets were fitted to both bogies of wagon 610117 and the leading end bogie of 610116 (610116 was leading at the time of the derailment).

Events during the accident

17 The train was slowing down as it approached Wigan station and ran onto the up loop line, a left-hand curve. As the train was moving into the platform at 12 km/h (7.5 mph) the leading bogie of wagon 610117 derailed to the right. The derailed bogie ran for 6.5 metres until it struck the cross girders of the bridge. The bogie then rotated causing the leading left wheel to strike the air brake pipe, fracturing it. The loss of air caused the brakes to apply. Figure 5 shows the derailed bogie and broken air pipe.

18 The driver noticed the unsolicited brake application and the train came to a stand within 30 metres of the point of derailment.

Figure 5: The derailed bogie with (arrowed) the fractured brake pipe (photograph courtesy of Network Rail)

Consequences of the accident

19 Nobody was injured in the derailment. All wheels of the leading bogie of wagon 610117 were derailed and slight impact damage was caused to some of the sleepers and the cross girders of the bridge. Several signalling cables were cut, affecting signalling circuits of the up loop line.

20 The up loop line and platform one at Wigan North Western station were out of use for 24 hours while track and cable repairs were undertaken. The potential consequences of this derailment were limited by the low permitted speed of the line.

Events following the accident

21 The driver reported to the signaller that he had experienced an unsolicited brake application and went back to check his train. He discovered the derailed bogie and reported this to the signaller. The rear of the train was still on the up main line.

22 The derailment was reported to the RAIB at 00:31 hrs. The RAIB requested that Network Rail carry out a limited track survey at the site of the derailment. Once this was complete, permission was given for the vehicles at the back of the train to be removed so as to allow the up main line to be reopened to traffic. The up main line was reopened at 02:38 hrs.

23 The RAIB attended the site later that day to conduct a preliminary examination which included a full track survey done by Network Rail staff under RAIB supervision.

The Investigation

Sources of evidence

24 Evidence was obtained from the following sources:

- statements by Network Rail staff;
- data from the locomotive's on train data recorder;
- data from Network Rail's track recording vehicles;
- evidence gathered on site and from examination and testing of the wagon at DB Schenker's workshops in Wigan;
- photographs taken by the RAIB and by Network Rail;
- track survey information gathered by the RAIB and Network Rail;
- wagon maintenance procedures and records supplied by DB Schenker;
- track maintenance records and procedures supplied by Network Rail; and
- record drawings of the track layout at Wigan North Western supplied by Network Rail.

In addition to the above, the RAIB commissioned computer modelling of the wagon traversing the track geometry as measured at the site of the derailment. Two versions of the model were created. The first modelled the wagon with even load distribution across its wheels; this was validated against the results from the vehicle acceptance body (VAB) acceptance testing of the wagon design. A second model was created from this to represent the incident wagon by adjusting the model to replicate the weight on each wheel measured following the derailment.[1]

Previous occurrences of a similar character

25 There have been four previous derailments of FCA wagons since 1997, all of which involved the wagons derailing while being moved in yards over points that were not correctly set for them. There is no record of any previous derailment of FCA wagons on plain line.

[1] The computer analysis was done using the VAMPIRE® software.

Analysis

Identification of the immediate cause[2]

26 **The immediate cause of the derailment was the *flange* of the leading right-hand wheel of the leading bogie of wagon 610117 climbing over the right-hand rail at the point where it changed section from UIC60 to BS113A**.

27 Flange climb derailments occur when a vehicle encounters a section of the track where the level of one rail relative to the other changes rapidly over a short length (a track *twist* or steep *cant transition*) and the vehicle suspension is unable to keep one or more of the wheels firmly in contact with the rail.

Identification of causal[3] and contributory[4] factors

Track alignment

28 **The track had been installed with a radius that was sharper than designed and was not fitted with a *check rail*. The lack of a check rail was causal to the derailment.**

29 The track survey undertaken following the derailment showed that the track at the point of derailment had a minimum radius of 140 metres. The design drawing for the track showed that the design radius was 175 metres. Figure 6 shows the track at the site of the derailment following recovery of the train.

Figure 6: Site of the derailment, looking in the direction of travel of the train

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[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.

30 The track was re-laid in 2003/4 as part of the West Coast Route Modernisation (WCRM) works. The work at this location was carried out to improve train speeds on the main lines through the station and was known as Wigan north junction relaying. In the case of the up loop line, the existing *points* connecting the loop to the up main line were relocated further away from the bridge. This work was carried out by the WCRM *Switch and Crossing* (S&C) Alliance, which was an organisation formed by a partnership between Railtrack, GEC Tarmac Rail Maintenance Ltd (later known as GT Railway Maintenance then GTRM) and Central Track Renewals Ltd (Centrac). Changes in the organisations involved meant that, at the time of the Wigan north relaying, the S&C Alliance was between Network Rail and Carillion.

31 The design drawings for the Wigan north junction relaying scheme show that the alignment of the up loop was intended to consist of a circular curve parallel to the up main line, followed by a circular curve of 175 metres radius then a curve of 300 metres radius leading to a straight into platform one.

32 Network Rail's track construction standard, NR/SP/TRK/102, requires that track in passenger lines with a radius of 200 metres or less should be fitted with a check rail to reduce the risk of derailment. A check rail was not fitted at this location and the design drawing did not specify that one be fitted. The design for the Wigan north junction relaying scheme was checked in accordance with Network Rail's then-current procedure for Technical Approval (RT/CE/S/003 'Technical Approval of Design, Construction and Maintenance of Civil Engineering Infrastructure'). The drawing of the new track stated that the check certificate was issued on 7 March 2003. Network Rail were unable to provide a copy of the certificate. This check did not identify that the check rail had been omitted. The RAIB have been unable to determine the reason for this omission as the WCRM S&C Alliance no longer exists.

33 Following installation of the new track at Wigan north, the works manager responsible for the work completed the site quality checklist on 26 February 2004. This form recorded that all work had been completed apart from some follow-up tamping work. The form was passed, along with other documentation relating to the completed renewal, to the track maintenance engineer. Network Rail's procedures did not require the track maintenance engineer to check that the new work had been installed correctly. It is likely that the track maintenance engineer would expect the new work to have been installed in accordance with Network Rail's standards.

34 The RAIB commissioned computer modelling of the wagon traversing the as-measured track geometry, both horizontal and vertical components. This predicted derailment by flange climbing at the location of the joint between UIC60 and BS113A rail sections. The modelling showed that the tendency to flange climb was dependent on the coefficient of friction assumed between the wheel and rail. The wagon which derailed had new wheels and the weather at the time was dry, so a high coefficient of friction (0.6) was used. The analysis was repeated keeping all parameters the same but with the track radius increased to 200 metres, the radius below which the standard specifies a check rail. This showed that the wagon involved in the derailment would not have derailed had the track radius been 200 metres or greater.

35 A check rail, had one been fitted, would have prevented this derailment by restraining the back face of the wheel on the left side of the axle thus stopping the right side wheel climbing over the rail.

Track construction - rails

36 **The Wigan north relaying involved several *S&C units* and the associated plain line track, all of which was to the standard Railtrack design using UIC60 rails. As the existing track in the up loop was of BS113A rail section, *transition rails* were needed to join the differing rail sections. These were manufactured by forging the end of a length of UIC60 rail to a section resembling BS113A rail then welding it to a length of BS113A rail. One of the transition rails had been installed incorrectly. This led to a step in the running edge of the rail and promoted derailment at that point. The dynamic analysis showed that a derailment was likely anywhere on the 140 metre radius part of the curve, but the presence of the step at the transition made derailment more likely here. The fitting of the wrong transition rail contributed to the derailment occurring at this location.**

37 Transition rails were specified for the up loop line where the new UIC60 rail was to join the existing BS113A rail leading into the platform. The transition rails had to allow for the 2 mm difference in head width between UIC60 and BS113A rail. In the case of the rails fitted at Wigan north the transition rails were manufactured with the *running edges* aligned and a 2 mm step on the *field side* of the rail head. This meant that there were left and right-hand versions of the transition rail. When examined after the derailment, the transition rail fitted to the left side of the track (in the direction of travel) was found to be a left-hand one, but the rail fitted to the right side was also a left-hand rail. The effect of this was to produce a 2 mm step outwards (i.e. away from the *four-foot*) in the running edge of the rail where the UIC60 rail ended and the BS113A began (figure 7). The flanges of the wheels on the right-hand side of the train were in contact with the right-hand rail due to the curvature, as shown by the polished running edge of the right-hand rail. The derailment started at the transition between the rail sections.

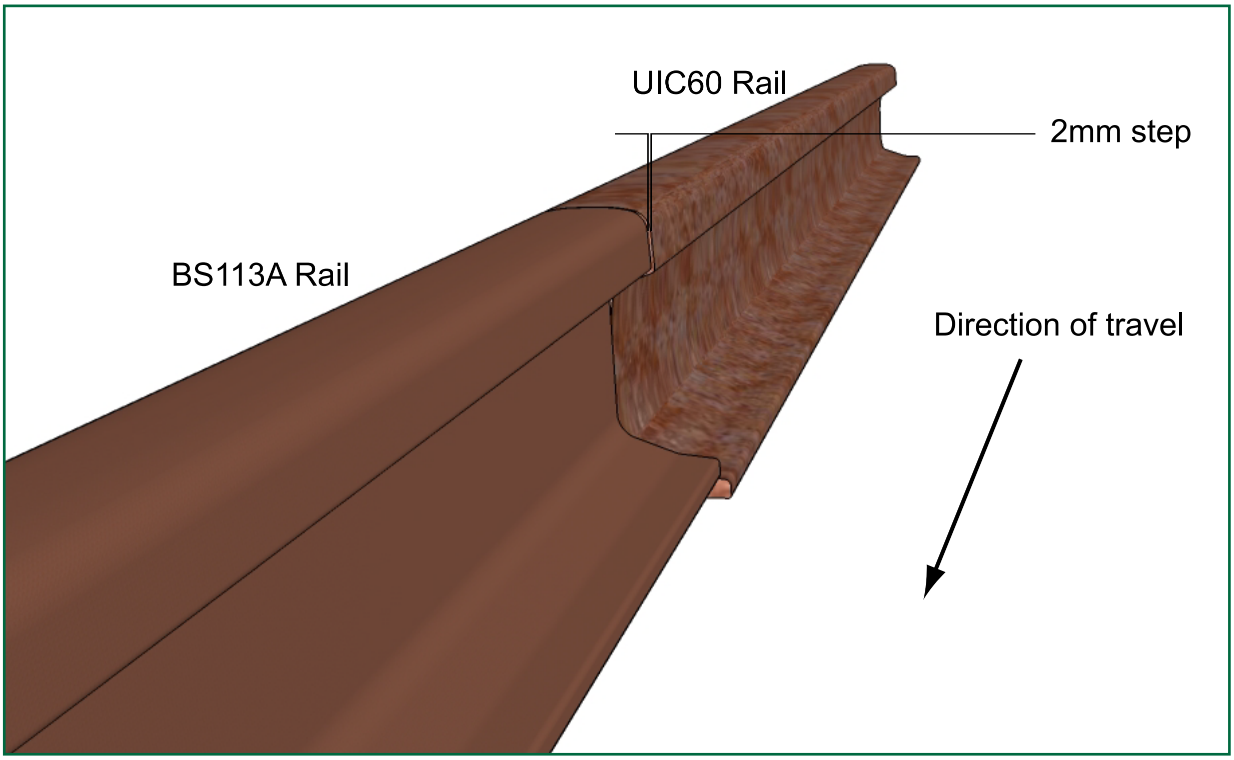

Figure 7: Transition between UIC60 and BS113A rail

38 The drawing produced by the S&C manufacturer showing the details of the track construction showed the transition rails in the wrong orientation, i.e. with the UIC60 rail at the south end adjacent to the existing BS113A rail. It is not known whether the rails were delivered to site this way round and had to be turned on site (they were 10.8 metres long) or whether the error was spotted before dispatch and rectified. There were a pair of transition rails in the up loop and another pair in the up main, a total of four rails; two left-hand and two right-hand. It is possible that the rails became wrongly placed during installation due to them becoming misidentified during an operation to turn them lengthways.

Track construction – sleepers and fastenings

39 **The rail *fastenings* used to hold the rail to the baseplates and sleepers were not all of the correct type. This allowed the rail to move laterally, widening the track *gauge*. However, the dynamic analysis did not find that wide gauge increased the likelihood of derailment. The use of incorrect track fastenings is noted here as an observation.**

40 Where the rail was of UIC60 section it was mounted on G44 concrete sleepers with *Pandrol Fastclip* fastenings. These were designed for UIC60 rail and were correct for this application. Network Rail's track construction standard NR/SP/TRK/102 specifies that there must be a minimum of two sleepers of the same material and depth each side of a joint, so the first two sleepers under the BS113A rail were also G44 concrete sleepers with Fastclip fastenings. The different foot widths of UIC60 and BS113A rails (UIC60 rail is 11.3 mm wider than BS113A) must be allowed for in the fastenings. In the case of Fastclip, this is done by means of nylon insulators used beside the foot of the rail. The insulators for UIC60 and BS113A rail have different thicknesses.

41 When examined following the derailment, the insulators used on the BS113A rail at the site of the derailment were found to be the wrong type for the sleepers and baseplates. This allowed the rail to move laterally, increasing the track gauge. Figure 8 shows the right rail seven sleepers after the transition from UIC60 to BS113A rail.

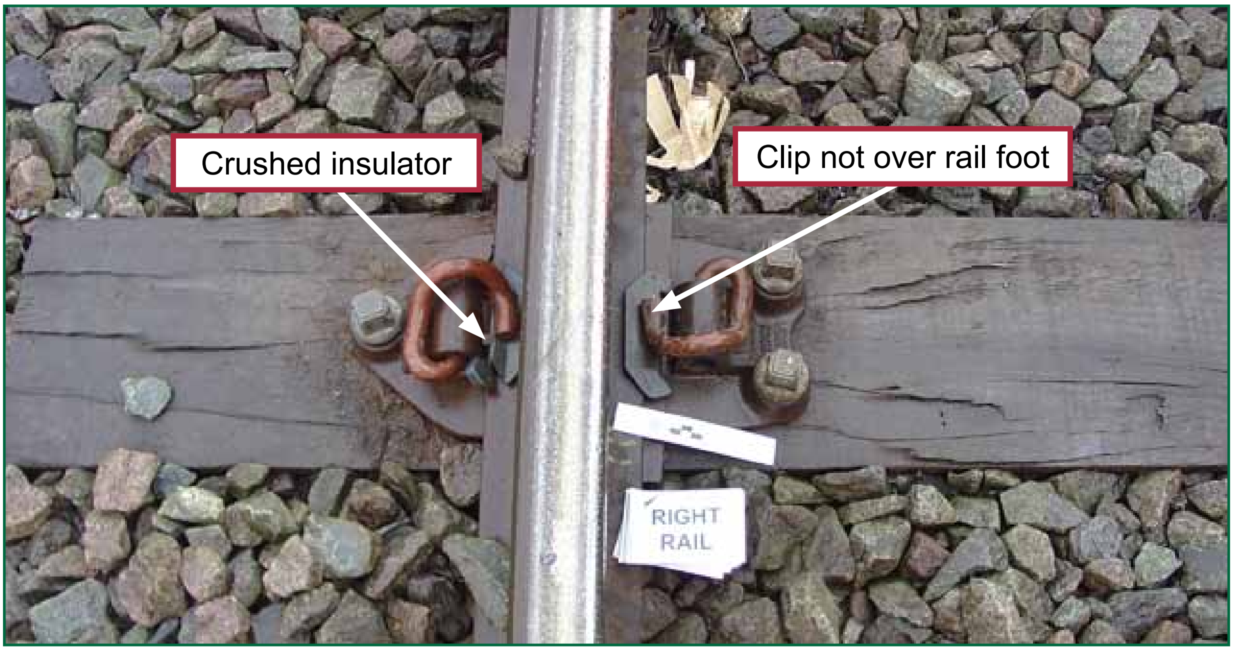

Figure 8: Right hand rail showing (arrowed) incorrect insulators and lateral displacement of rail

42 Wide gauge was evident on the recordings made by the track recording train in October 2007 and May 2008 (recording runs made in October 2008 and May 2009 did not record the gauge). The maximum gauge measured by the RAIB was 1446 mm. This is within the maintenance limit allowed by the Network Rail track standard NR/L2/TRK/001/C01, which is 1455 mm for track with speeds up to 25 mph. The dynamic analysis showed that the wide gauge had no adverse effect on the likelihood of the wagon to derail.

43 The standard NR/L2/TRK/001/C01 specifies that the maximum rate of change of gauge within a 3 metre length is 8 mm. Analysis of the track gauge measured following the derailment showed that it varied by up to 13 mm over a 3 metre length. The standard does not specify any minimum action to be carried out on discovery of gauge variation and the data handling processes that Network Rail employ to distribute track recording data and actions arising from a recording run do not deal with gauge variation.

44 Although not causal, it is observed that incorrect rail fastenings had been used at this site and that the gauge variation exceeded the limits in the Network Rail standard.

Track twist

45 A track twist occurs when the level of one rail relative to the other changes rapidly over a short distance. The track at the site of the derailment had a twist of 1 in 219 (i.e. one millimetre of level difference in a 219 mm distance) five sleepers before the point of derailment. The sense of the twist was that the right rail was lower than the left. A twist of this magnitude is within the limits allowed in Network Rail's track maintenance standard, NR/L2/TRK/001/C01, and is not abnormal.

46 The twist arose due to the rate of change of cant that existed on the approach to the platform. The cant on the up loop line was set to match the cant on the adjacent up main line. This was necessary as both tracks were carried by the same *bearers* at the nearby crossover. The amount of cant was governed by the speed of trains on the up fast line, and was 80 mm. The cant on the up loop line was reduced gradually, reaching zero at the straight into the platform. The length of the cant transition was shown on the design drawing to be 48 metres with a cant gradient of 1 in 600.

47 The cant gradient measured after the derailment was steeper than that shown on the design drawings, but was within the maintenance limits in the standard NR/L2/TRK/001/C01.

Wagon twist

48 **The frame of the vehicle which derailed was twisted, and the *sidebearers* of this wagon were fitted with packings that did not compensate for this twist. This reduced the weight on the leading right wheels. The uncompensated twist in the frame was a causal factor in this derailment.**

49 Twist can exist in wagons and is apparent as a difference in height between one corner of the wagon and the plane defined by the other three corners. The effect of twist in a wagon is to cause the wheel(s) at the corner that is raised to carry a reduced load, along with the wheel(s) at the diagonally opposite corner. Twist within the frame of a vehicle can cause a wheel to lose firm contact with the rail.

50 When surveyed by the RAIB following the re-railing operation, the frame of wagon 610117 was found to be twisted by 11 mm over its length, in the sense that the leading right-hand corner of the wagon deck was higher than the left. Given the low speed at the time of derailment and the fact that the wagon was unladen, the RAIB consider it unlikely that the wagon twist was caused by the derailment.

51 The wagon manufacturer, Thrall Europa, checked each wagon frame for twist at manufacture and their records show that wagon 610117 passed the twist check on 5 August 2000. The thickness of any packings that were present above the sidebearers at the time was not recorded on the inspection sheets.

52 The maintenance plan for the wagon was the EWS (now DB Schenker) Engineering Standard EWS/ES/0307 'Maintenance plan – container wagon, type FCA'. This standard stated that an annual VIBT was required, but that there was no requirement for any planned preventative maintenance. The standard also stated that 'For the underframe and body, wheelsets, bogie (suspension), buffing and drawgear the heavy maintenance attention, and where necessary repair work, is undertaken as part of routine VIBT attention'.

53 The section of the standard dealing with the underframe required that, as part of the VIBT, the wagon be placed on straight level track and examined visually for:

> 'signs of negative longitudinal frame camber, misalignment, bending or twist, and where already fitted with compensation packings for frame twist, (indicated by a letter 'Q' on the solebar), ensure that the packings are the correct thickness as recorded on the solebar. Where evidence of frame twist exists or packings are fitted but no thickness is recorded on the solebar the packings should be removed and the frame twist measured and compensated for in accordance with EI WF/81.'

Following the derailment DB Schenker stated to the RAIB that measurements of frame twist would only be made if the visual check showed twist was suspected.

54 The standard EI WF/81 was a former British Rail engineering instruction issued in 1980 and entitled 'Measurement and compensation of frame twist'. The scope was defined as torsionally rigid two-axled wagons. 'Torsionally rigid' was defined as wagons where the underframe and body structure did not significantly deflect when traversing a track twist. It specified a limit of ¼" (6 mm) for the twist between the corners of the frame of a 4-wheeled wagon. The standard stated that the aim of the process was to compensate for the twist by introducing packing to lower the wheel under a raised part of the frame down by a distance equal to the twist, rather than to correct it. However, the method outlined for calculating the thickness of this packing is open to misinterpretation as to where the packing should be placed.

55 The twist of the frame measured on wagon 610117 after the derailment (11 mm) exceeded the 6 mm maximum specified in EI WF/81. Given the requirement to apply this standard, measures should have been taken to correct this. EI WF/81 specified how twist was to be compensated for but was inappropriately worded for modern wagons, such as FCA container wagons. Examples were given in EI WF/81 showing where and how packing was to be done for wagons with different types of suspension. The suspension types illustrated were mainly now-obsolete designs and did not include bogie vehicles or vehicles with coil spring suspension.

56 The FCA wagon is fitted with resilient rubber sidebearers which support part of the weight of the body on the bogies. These are blocks made of rubber and steel which support the sides of the wagon body on the bogie crossmember (figure 9). The maintenance standard states that these must be set up to a height tolerance of 129 +/- 2 mm, as shown on figure 9 as dimension ***Y***. When measured by the RAIB following the derailment, the heights were found to be 129 mm at the leading right and trailing left corners but were outside the specification at the leading left corner (120 mm) and trailing right corner (122 mm). This corresponds with the sense of the frame twist, which would tend to apply more load to the leading left and trailing right corners.

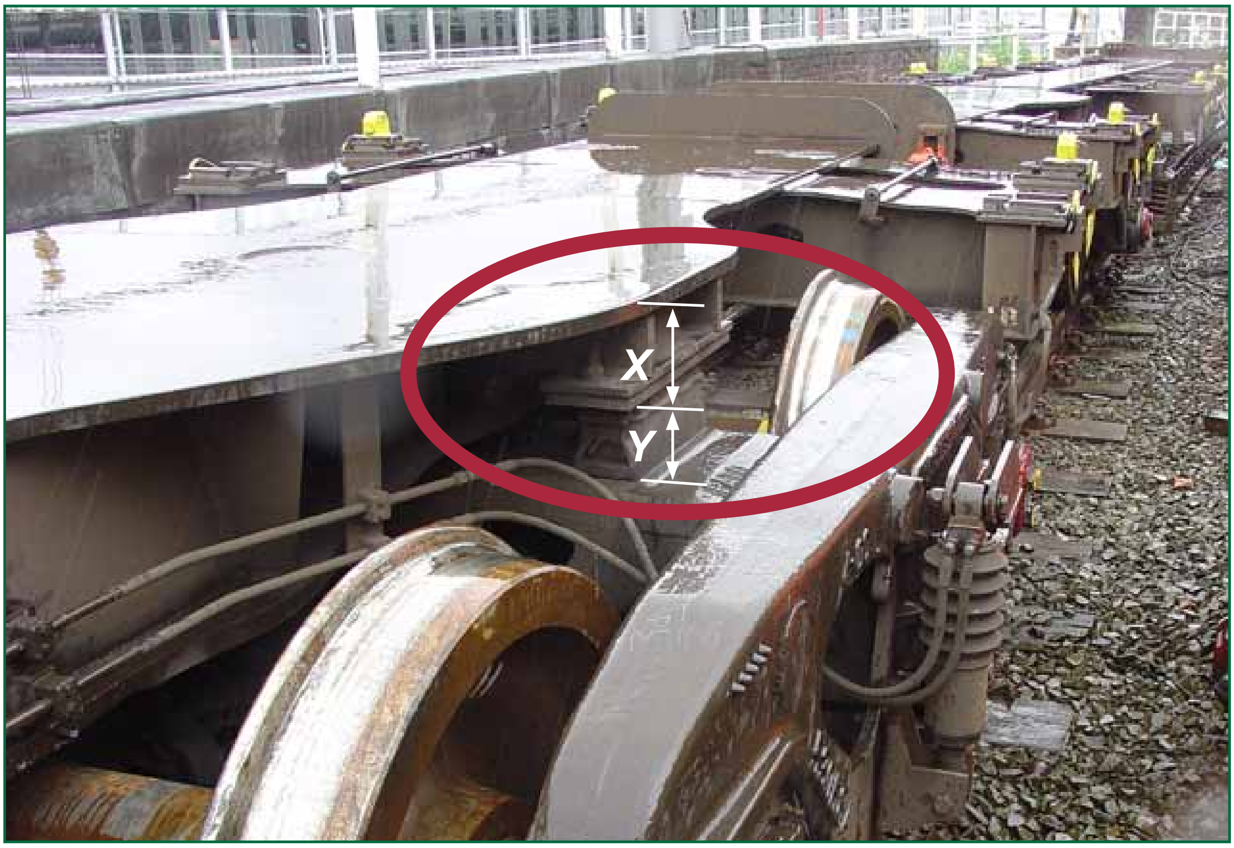

Figure 9: Right side of leading bogie of wagon 610117 showing (circled) sidebearer unit

57 The maintenance standard states that packing shims should be inserted to correct the sidebearer clearance. When measured by the RAIB the total distance from the top surface of the deck to the underside of the sidebearer shims (dimension ***X*** in figure 9) was as given in table 1.

Bogie	Left side	Right side
leading	177	165
trailing	174	175

Table 1: Distances from top surface of the wagon deck to underside of the sidebearer shims

58 The packings at the leading end were 12 mm thicker on the left side than the right. This is in the opposite sense to the wagon twist and sidebearer clearance and would have acted to further unload the leading right wheel. The packing shims were retained by bolts and, when examined after the derailment, the appearance of the bolts did not suggest that they had been removed during the recent VIBT. Figure 10 shows the sidebearer and its packings at the leading left side of wagon 610117.

59 As described in paragraph 48, uncorrected twist in the frame of a vehicle will result in uneven wheel loadings. Packings of the wrong thickness inserted above the sidebearers will also produce the same effect. The wheel loads of the wagon were measured following the derailment using equipment that can only give an approximation of the true load. The values used in the computer simulation were adjusted to remove an erroneous reading and are given in figure 11. A sensitivity analysis indicated that when the values for the wheel loads were changed to those recorded, the derailment became more likely.

Figure 10: Sidebearer and packings fitted to leading left side of wagon 610117

60 The computer simulation compared two vehicle models, one with the sidebearers set up to provide an even load on both sides of the vehicle, and one where the sidebearers were set up so as to produce wheel loads which matched those measured on wagon 610117 after the derailment. The wheel loads used are given in figure 11. The wagon with evenly loaded sidebearers was found to not derail when run over the track geometry measured at the site, even with the step in the running edge. The model with uneven loadings was predicted to derail shortly after passing the UIC60 to BS113A rail profile transition.

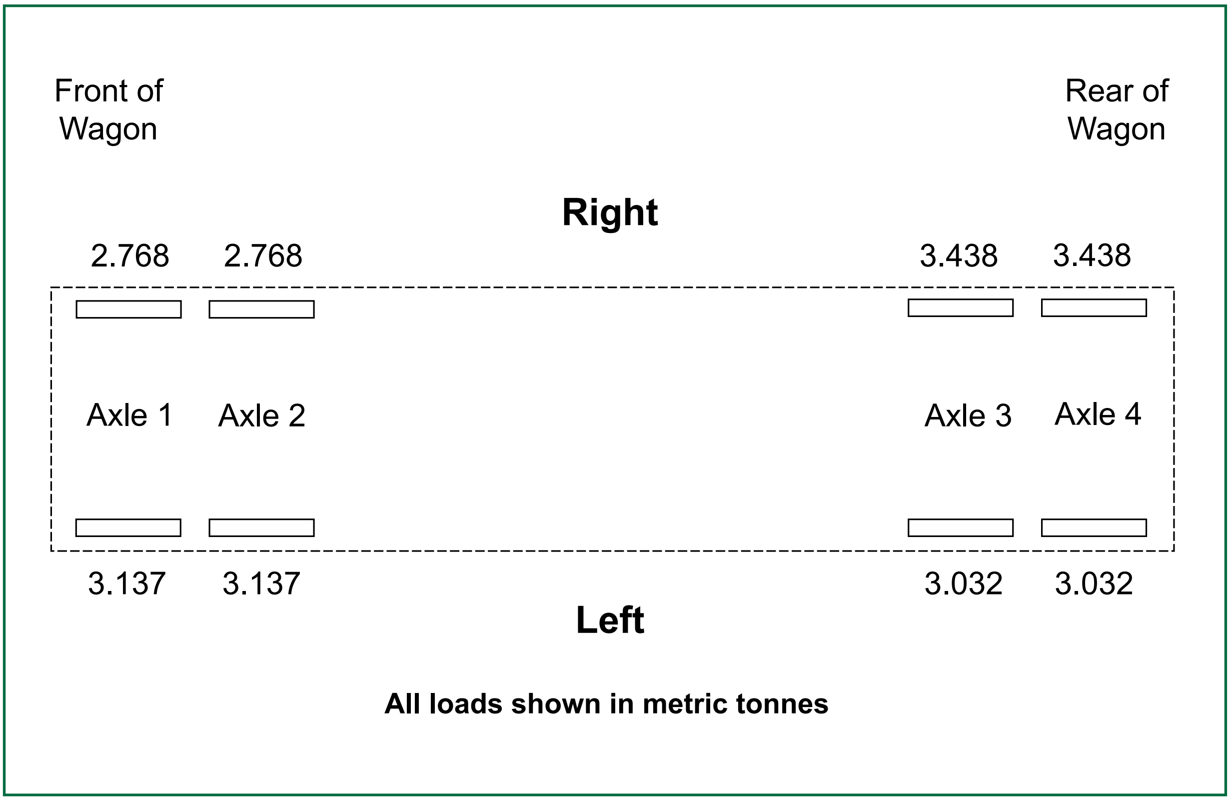

Figure 11: Wheel loads used in the dynamic analysis

Wagon condition

61 The wagon was checked for other conditions which may have led to its derailment. This examination and tests were carried out by the RAIB at the DB Schenker wagon maintenance facility at Wigan.

62 If either of the bogies were unable to rotate freely this could cause the vehicle to derail by flange climbing in a curve. The ability of the bogies to rotate freely was checked by observing the vehicle traversing left and right-hand curves of similar radius to the derailment site. The bogies were seen to rotate without any tendency for the wheels to flange climb.

63 The wheel profiles were measured by the RAIB and compared with the specified profile. They were found to correspond very closely, having been recently turned. Newly turned wheels have a rougher surface finish than wheels that have run for some time, as the surface becomes polished with use. The coefficient of friction between newly turned wheels and the rail is therefore higher than for other wheels. The computer simulation used the coefficient of friction for newly turned wheels.

64 The back-to-back measurement of all the wheelsets (the distance between the backs of the wheels on the same axle) were measured and found to be between 1360 mm and 1361 mm, within the allowable range of 1360 mm to 1363.3 mm specified by Railway Group Standard GM/RT2466.

Previous RAIB investigations involving wagon twist

65 Frame twist has been identified as a causal factor in previous RAIB investigations into the derailment of a freight train at King Edward bridge, Newcastle on 10 May 2007 (report 02/2008) and the derailment of a freight train at Ely Dock junction on 22 June 2007 (report 02/2009). Both reports are available at www.raib.gov.uk. Recommendation 2 of the King Edward bridge derailment report proposed that Network Rail should investigate the capability of the *Wheelchex* wheel load monitoring system to provide a warning of wagons with laterally out of balance loads. Wheelchex is a wheel load monitoring system installed at various locations around the network. Recommendation 1 of the Ely report proposed that Network Rail should consider the use of Wheelchex or a similar system to detect out of balance loads and to instigate such a system.

66 Network Rail proposed an alternative implementation of Ely recommendation 1, using a new wheel load system that it is planning to install. ORR are still reviewing the actions that Network Rail propose to take regarding this recommendation.

67 Train 4M67 had passed a Wheelchex site near Glasgow on its journey to Wigan but the equipment was not fully operational at the time (it has since been repaired) and was unable to show the wheel loads on both sides of the wagon. Wagon 610117 had not been noted as having out of balance wheel loads when passing other Wheelchex installations on previous journeys as the software had not been altered to produce such warnings.

Identification of underlying factors[5]

Track Maintenance

68 **Network Rail's track inspection standard, NR/L2/TRK/001/A01, requires the track maintenance engineer's visual inspection to 'confirm the integrity of the track asset, review condition, trends, work sufficiency, proposals for renewals or refurbishment work, quality of maintenance and renewal work…'. The track maintenance engineer is required to conduct an inspection at intervals of 104 weeks. The inspection is purely visual and the track maintenance engineer is not equipped to be able to measure track alignment. The track maintenance engineer's most recent inspection of the track at Wigan was in March/April 2009. This inspection did not identify that the track alignment and the components used were not in accordance with the design and, as a consequence of this, no corrective measures were implemented.**

Wagon Maintenance

69 **The twist in the wagon frame had not been compensated for correctly and the maintenance plan did not specify how to correct frame twist in FCA wagons; it referred to EI WF/81, but this did not cover wagons of this type.**

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

Conclusions

Immediate cause

70 The immediate cause of the derailment was the flange of the leading right-hand wheel of the leading bogie of wagon 610117 climbing over the right-hand rail at the point where it changed section from UIC60 to BS113A (paragraph 26).

Causal factors

71 The causal factors were as follows:

- the track had been installed to a minimum radius of 140 metres without the fitting of a check rail (paragraphs 28 and 75); and
- the wagon had a twist in its frame that had not been correctly compensated (paragraph 48 and **Recommendation 1**).

Both factors had to be present to cause the derailment.

Contributory factors

72 The contributory factor was:

- A transition rail of the wrong hand was installed in the right-hand rail. Network Rail maintenance staff were unaware of the presence of this (paragraph 36 and **Recommendation 2**).

Underlying factors

73 The underlying factors to this derailment were:

- the Network Rail track inspection process did not identify that the track alignment and the components used were not in accordance with the design (paragraph 68 and **Recommendations 2 and 3**); and
- the maintenance plan did not specify how to correct frame twist in wagons of this type (paragraph 69 and **Recommendation 1**).

Observations

74 The following factors, while not causal, were observed during the investigation:

- incorrect rail fastenings had been installed at the site and had not been reported during inspections (paragraph 39 and **Recommendation 3**);
- track gauge varied at a rate in excess of the maximum allowed by Network Rail's track standard NR/L2/TRK/001/C01 (paragraph 44 and **Recommendation 4**); and
- Network Rail's systems for dealing with track recording data and defects did not handle gauge variation (paragraph 43 and **Recommendation 4**).

Actions reported as already taken or in progress relevant to this report which would otherwise have lead to a recommendation being made

75 Network Rail has realigned the track so that the curve radius is greater than 200 metres and therefore a check rail is not required. *Sleeper end restraint plates* have been fitted to prevent the sleepers from moving laterally and tightening the radius further. Network Rail are also planning to change the nylon insulators for the correct type.

Recommendations

76 The following safety recommendations are made[6]:

Recommendations to address causal and contributory factors

1. *The purpose of this recommendation is to put in place a clear and consistent set of instructions to maintenance staff on the measurement and rectification of twist in wagons.*

   DB Schenker should put in place a system to assess and mitigate, so far as is reasonably practicable, the risk arising from twisted frames on container wagons and audit compliance with it. This should include an update of procedure EI WF/81 to reflect the types of wagon to which it is applied and to clarify where packings are to be placed.

2. *The purpose of this recommendation is to identify and rectify other sites where design or construction is not in accordance with the track construction standard.*

   Network Rail should check, on a risk basis, other sites where WCRM S&C Alliance has installed track to verify that it has been designed and installed correctly and should implement corrective action where necessary.

Recommendation to address factors observed during the investigation

3. *The purpose of this recommendation is to prevent the situation arising where the maintainer does not recognise that incorrect components are fitted and so does not rectify the situation.*

   Network Rail should update its processes for track management to include checks that the rail fastening components are of the correct type for the particular rail and sleeper combination.

4. *The purpose of this recommendation is to provide advice on dealing with gauge variation, which is given limits in the inspection standard but is not routinely monitored.*

   Network Rail should update its track recording information handling process to deal with gauge variation and should issue guidance to staff on minimum actions to be taken at each alarm level.

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[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 (Accident Investigation and Reporting) Regulations 2005, these recommendations are addressed to ORR 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 web site at www.raib.gov.uk.

Appendices

Appendix A - Glossary of abbreviations and acronyms

BR	British Rail(ways)
S&C	Switch and crossing
VAB	Vehicle Acceptance Body
VIBT	Vehicle inspection and brake test
WCRM	West Coast Route Modernisation

Appendix B - Glossary of terms

Baseplate	A metal casting used to support the rail on the sleeper.
Bearer	A wider than normal sleeper designed to support the track at switches and crossings.
Bogie	An assembly of two wheelsets in a frame which is pivoted at the end of a long vehicle to enable the vehicle to go round curves.
BS113A	A type of flat bottomed rail which weighs 113 lbs/yd.
Cant	The elevation of one rail above the other in a curve.
Cant transition	A length of track where the cant changes from one value to another.
Check rail	An additional rail mounted alongside the inside rail in a sharp curve to restrict the lateral movement of the wheels.
Fastenings	The components of the track which hold the rail.
Field side	The side of a rail which faces away from the centre line of the track.
Flange	The part of a railway wheel which is designed to bear against the inside edge of the rail.
Four-foot	The space between the rails of a track.
G44 concrete sleeper	A particular design of concrete sleeper that can support rails of either BS113A or UIC60 section.
Gauge	The distance between the rails.
NRS1 (baseplate)	A type of baseplate supplied by NRS Ltd.
Pandrol Fastclip	A type of rail fastening system manufactured by Pandrol Ltd.
Plain line	A section of railway track which does not include any points.
Points	A section of track with moveable rails that can divert a train from one track to another.
Running edge	The part of the rail section which the wheel flange bears against.
S&C unit	A single item of switch and crossing, i.e. a set of points or a crossing between two tracks.
Sidebearers	Supports situated on each side of a bogie wagon which bear on the bogie.
Sleeper end restraint plates	Steel plates attached to the sleepers and projecting down into the ballast. They are designed to limit the tendency of the sleepers to move sideways.
Transition rail	A length of rail designed to provide a smooth transition between rails of two different cross sections.

(track) Twist	The difference in cant between two points a fixed distance apart (the twist base).
Up	The name generally given to lines used by trains travelling in the direction of London.
UIC60	A type of flat bottomed rail which weighs 60 kg/m.
Wheelchex ®	A proprietary system for measuring wheel loads of passing trains.

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