

**Oliver Stewart**  
**RAIB Recommendation Handling Manager**



7 February 2024

Mr Andy Lewis  
Deputy Chief Inspector of Rail Accidents

Dear Andy,

**RAIB Report: Derailment of a passenger train at Carmont, Aberdeenshire on 12 August 2020**

I write to provide an update<sup>1</sup> on the action taken in respect of recommendation 15 addressed to ORR in the above report, published on 10 March 2022.

The annex to this letter provides details of actions taken in response to the recommendation and the status decided by ORR. The status of recommendation 15 is '**Closed**'.

We do not propose to take any further action in respect of the recommendation, unless we become aware that any of the information provided has become inaccurate, in which case I will write to you again.

We will publish this response on the ORR website.

Yours sincerely,

Oliver Stewart

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<sup>1</sup> In accordance with Regulation 12(2)(b) of the Railways (Accident Investigation and Reporting) Regulations 2005

## Recommendation 15

*The intent of this recommendation is to minimise the risk of serious cuts and lacerations to passengers caused by broken glazing in any future accidents.*

RSSB should:

- a) investigate the performance of the bodyside windows on the leading coach of train 1T08 to understand the detachment of large shards of glass into the vehicle interior (including the effects of bodyside deformation) and how this relates to the requirements of relevant standards regarding spalling and passenger containment, and disseminate the findings to owners and operators of both mark 3 coaches and any other relevant rolling stock
- b) in the light of findings from (a), review the current acceptance tests and criteria in railway glazing standards to determine if there are practicable improvements (including retrofit options) that should be made to minimise the quantity and size of broken glass that could enter vehicle interiors in future accidents, without adversely affecting the passenger containment performance of the glazing
- c) where appropriate, integrate practicable improvements into revised standards for railway glazing.

## ORR decision

1. RSSB does not consider that it is practicable to modify the method of installing windows that isolates the glazing from the loads that would be transmitted by bodyside distortion, so it has analysed the behaviour of glazing when subject to such loads. It carried out 'knowledge search' *Glass Coating Technologies for Bodyside Windows (S372)* in accordance with its established processes.
2. Previous research (notably Project T424 *Requirements for train windows on passenger rail vehicles*) concluded that passenger containment is the priority in the design of windows. This is the reason why laminated glass is mandated by the current crashworthiness standard, as it is considered to offer the best protection against passenger ejection. The scope of the knowledge search was therefore defined to consider the ways in which the performance of the existing specification of glass can be improved when subject to the bodyside deformation identified at Carmont. The research considers the use of coatings or films added to laminated glass, in order to keep the retention capabilities already mandated through standards. The research has been explicitly shared with owners and operators of Mk3 coaches through the industry's Carmont rolling stock recommendations steering group, and is available through the RSSB website. This addresses part (a) of the recommendation.
3. RSSB followed the knowledge search with an options analysis that compared the safety benefits of a range of proposals relating to improved window performance with the cost of delivering those benefits. This drew on the 2009 research project *Review of injury causation and human factors in vehicle accidents (T310)* to identify the potential harm arising from broken glazing and assumed that each option was

able to completely eliminate that risk. This assumption ensures that the safety benefits are not underestimated at an early stage, resulting in potentially beneficial measures being disregarded. Further work, if justified, would then provide a more accurate measure of benefits.

4. ORR required RSSB to explain its analysis and approach to calculating the benefits of a standards change, to ensure that the parameters were not unrepresentative or limited. RSSB explained that its established approach to making a business case for standards change calculates the benefits arising from any standards change over the five-year period between publication of a standard and its formal review. In this case the cost and safety benefit are applied to the 'cohort' of rail vehicles expected to be subject to the changed standard over the five years. This is simply calculated on the basis of the number of vehicles in the UK main line rail fleet and their expected life. The safety benefit is considered to apply to those vehicles in the five-year 'cohort' for the full life of the change – in this case the ten-year warranty period of the protective film.

5. There is an argument that a standards change relating to crashworthiness is likely to remain in force for longer than five years. However the five-year period of application is the approach RSSB takes when establishing the business case for all standards, so it is being consistent with its processes. It is also important to understand that many assumptions are being made, most particularly that the risk control measures being considered eliminate all of the risk. This analysis gives a broad-brush evaluation, which would be refined by subsequent work where appropriate. ORR accepts that it is appropriate for the 'business case for change' in this case to follow RSSB's established methodology for assessing benefit of any standards change.

6. The analysis considered the cost of making modifications to existing rolling stock, and RSSB assured themselves that the costs were grossly disproportionate to the safety benefits. These costs include provision to conduct testing to confirm any proposed changes were appropriate, which is not a foregone conclusion. The testing requires the creation of test rig that replicates body twist, which is thought to be the load case that resulted in the undesirable behaviour of the glazing at Carmont. It would apply the appropriate forces to the glazing which would then be broken to see how the glass performs. As stated, RSSB uses a broad-brush value for the cost of this testing based on its own experience of research and testing, which the ORR deemed a reasonable approach. This analysis demonstrated by way of a Cost Benefit Analysis (CBA) that the costs of both the testing itself and the modifications to the standard were grossly disproportionate to the potential safety benefits. RSSB therefore concluded that it would not fit the definition of reasonably practicable to progress testing further than the analysis already undertaken. The work carried out here addresses part (b) of the recommendation.

7. RSSB conducted a similar comparison exercise to conclude that the costs of revising standards are also grossly disproportionate to the safety benefits, based on the CBA value. A significant factor in their conclusion is the cost of testing to establish the basis for the standards change. This addresses part (c) of the recommendation.

8. However, ORR would like to further inform RAIB that whilst this testing has been demonstrated to not be reasonably practicable, ScotRail has approached RSSB independently to secure their services in undertaking similar testing for their own knowledge. This work is part of ScotRail's ongoing health and safety responsibilities, and RSSB will consider any outcomes in line with normal industry arrangements. These matters are beyond the scope of this recommendation

9. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, RSSB has:

- taken the recommendation into consideration; and
- has taken action to close it.

**Status: Closed.**

### **Previously reported to RAIB**

10. On 9 March 2023 ORR reported the following:

Work to address this recommendation is being coordinated by the RSSB Carmont Recommendations Steering Group.

RSSB has conducted a knowledge search of available relevant information on glazing and produced a table of potential options for retrofit, based on cost benefit analysis. For the ScotRail HST fleet the cost of any of the retrofit glazing options would be grossly disproportionate. We have asked RSSB to clarify if the cost benefit analysis only refers to HSTs or all relevant rolling stock operating in the UK.

### **Update**

11. On 24 March 2023 RSSB provided the following update:

*As we have noted in our monthly Recommendations Tracking updates to ORR, RSSB has led the GB rail industry in preparing a response to the rolling stock-related Recommendations (12, 14-20) from RAIB's report into the derailment at Carmont in August 2020.*

*A steering group was established, together with a separate, but parallel, group in Scotland, to monitor and guide progress with each recommendation.*

*RSSB is not a 'duty holder' and therefore does not have the power to impose actions on the industry (except by making changes to standards, but these would generally only be applicable to new train designs). Recommendations addressed to RSSB have therefore been addressed by a collaborative compilation and evaluation of options available to the train owners and operators.*

*This report gives the response to Recommendation 15, which is as follows:*

**RSSB should:**

***a) investigate the performance of the bodyside windows on the leading coach of train 1T08 to understand the detachment of large shards of glass into the vehicle interior (including the effects of bodyside deformation) and how this relates to the requirements of relevant standards regarding spalling and passenger containment, and disseminate the findings to owners and operators of both mark 3 coaches and any other relevant rolling stock.***

***b) in the light of findings from (a), review the current acceptance tests and criteria in railway glazing standards to determine if there are practicable improvements (including retrofit options) that should be made to minimise the quantity and size of broken glass that could enter vehicle interiors in future accidents, without adversely affecting the passenger containment performance of the glazing.***

***c) where appropriate, integrate practicable improvements into revised standards for railway glazing.***

*RSSB has completed a Knowledge Search (S372) which is complemented by an Options Analysis. This has concluded that the costs of any change, whether retrofit or for future standards, are grossly disproportionate to the potential benefits in terms of reduced injuries. Further testing is needed to understand the effect of any changes to bodyside glazing on its performance, both under the current standard and under circumstances similar to those experienced at Carmont.*

*The full detail of RSSB's investigation into the performance of the carriage windows as recommended, and our review of acceptance tests and criteria, may be found in the attached document. Knowledge Search S372 (Glass Coating Technologies for Bodyside Windows) is also attached. Both will be published on the RSSB website shortly.*

*In light of this work, we consider Carmont Recommendation 15 to be closed.*



RSSB Response to Carmont Recommendation 2023-03-S372-glass-coatings-for-bodyside

## Previously reported to RAIB

### Recommendation 15

*The intent of this recommendation is to minimise the risk of serious cuts and lacerations to passengers caused by broken glazing in any future accidents.*

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- b) in the light of findings from (a), review the current acceptance tests and criteria in railway glazing standards to determine if there are practicable improvements (including retrofit options) that should be made to minimise the quantity and size of broken glass that could enter vehicle interiors in future accidents, without adversely affecting the passenger containment performance of the glazing
- c) where appropriate, integrate practicable improvements into revised standards for railway glazing.

### ORR decision

1. Work to address this recommendation is being coordinated by the RSSB Carmont Recommendations Steering Group.
2. RSSB has conducted a knowledge search of available relevant information on glazing and produced a table of potential options for retrofit, based on cost benefit analysis. For the ScotRail HST fleet the cost of any of the retrofit glazing options would be grossly disproportionate. We have asked RSSB to clarify if the cost benefit analysis only refers to HSTs or all relevant rolling stock operating in the UK.
3. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, RSSB has:
  - taken the recommendation into consideration; and
  - is taking action to implement it

**Status: Open**

### Information in support of ORR decision

4. On 23 June 2022 RSSB provided the following initial response to recommendations 15, 17 & 20:

*Thank you for your letter of 30 May 2022, requesting a response regarding Recommendations 15, 17 and 20 in RAIB's report on the Carmont accident. As you*

*will be aware from ORR colleagues, RSSB is playing a wider role in delivering progress against the requirements of RAIB's recommendations.*

*Following a meeting on 6 April 2022, it was agreed that the eight recommendations relating to rolling stock (i.e. 12, 14, 15, 16, 17, 18, 19 and 20) would be rolled into the existing, Angel Trains-led, "Carmont Seniors Group", which was considering the four recommendations applicable to owners/operators. The group is to be renamed the Carmont Recommendations Steering Group (CRSG), and this revised approach to delivering the industry response will be chaired by RSSB, supported by industry.*

*CRSG will include one representative (and one alternate) from each relevant organisation, and ORR as an observer. It will provide the overarching leadership of the response, and ultimately provide the industry responses to the recommendations.*

*Each of the recommendations will be managed by a working group, where required, noting that some items (such as RSSB project work) will not require a direct working group, but may request representatives to be part of the project stakeholder group. Each working group will have a lead individual and consist of relevant stakeholders. The working group will be tasked with collating, analysing, and delivering a response. This may require external support, and this will be managed by the working group as required.*

*Each working group will develop a plan or route map, agreed by CRSG. Reporting will be via a scorecard supplied to each CRSG meeting. It is proposed that RSSB will lead the working groups for Recommendations 15, 17 and 20 and – jointly with RDG and Network Rail – Recommendation 12.*

*Although the structure of the various recommendations varies, the approach to each recommendation, except for RSSB projects, is expected to consist of three main stages:*

- Stage 1. A knowledge search or collation of available information*
- Stage 2. A cost benefit or ALARP analysis/development of a solution*
- Stage 3. A response to the recommendation*

*Ultimately it will be for the CRSG to decide the required approach, but the quantified safety risk underpinning much of this work was supported by a database of injuries based on the accidents at Southall, Ladbroke Grove, Hatfield, Great Heck, Potters Bar, Ufton Nervet and Watford. RSSB will investigate whether this database can be updated with data from Carmont and Grayrigg, so that working groups have the most current and complete information to develop their ALARP analysis, supported by resources such as the Safety Risk Model.*

*The working groups are detailed in the attached document, along with relevant RSSB work already completed or soon to be under way.*

- 5. On 11 January 2023 RSSB provided the following update covering period 5-10 of 2022/23:*

**Period 5 (2022):**

*25/08/22: As noted in our email of 23 June 2022, Recommendations 12, and 14-20 are being managed by RSSB via the Carmont Recommendations Steering Group. Regarding Recommendation 15, draft Knowledge Search S372 (Window Coatings) is now with the Steering Group for review..*

*In addition, Recommendation 12 (on RDG and Network Rail in conjunction with RSSB) will be delivered by RSSB project T1316, for which a project plan is being formed.*

**Period 6 (2022):**

*26/09/22: As noted in our email of 23 June 2022, a number of recommendations are being managed by RSSB via the Carmont Recommendations Steering Group. Regarding Recommendation 15, draft Knowledge Search S372 (Window Coatings) is still with the Steering Group for review.*

*In addition, Recommendation 12 (on RDG and Network Rail in conjunction with RSSB) will be delivered by RSSB project T1316, for which a project plan is being formed.*

**Period 7 (2022):**

*20/10/22: Drafting of Knowledge Search S372 (Window Coatings) has been completed and is being reviewed by the Steering Group.*

**Period 8 (2022):**

*17/11/22: The draft Knowledge Search S372 (Window Coatings) was reviewed by the Steering Group. Comments received are now being actioned.*

**Period 9 (2022):**

*14/12/22: An options analysis is in preparation, including a cost-benefit assessment. This will be presented to the Steering Group during December 2022.*

**Period 10 (2023):**

*11/01/23: The options analysis is nearly complete. The knowledge search (S372, window coatings) report and executive summary are being prepared and will be presented to the Steering Group on 9 January 2023.*

6. On 15 February 2023 RSSB provided the following update:

*RSSB has completed Knowledge Search S372 which assesses the potential for using Safety Window Films or alternative interlayers for the laminated interior panels of bodyside glazing. Both options could be considered for retrofit or for inclusion in new vehicle designs. However, the effects of both options on compliance with the containment requirements (developed after the Ufton Nervet incident) are unknown and would therefore require a comprehensive set of testing.*

*It has been determined that the cost of suitable testing would be around £100,000 per option and would take approximately six months to complete; economies of scale and parallel workstreams could improve upon this. It is likely that 9-12 months would be*



*needed before any new windows could be in series production and/or reflected in standards.*

*The options are set out in Appendix A (see below) with indicative costs and quantifiable benefits in terms of reduced injuries. The conclusions of the options analysis are:*

*1. For retrofit, the costs are grossly disproportionate to the potential benefits. Nevertheless, since the behaviour of laminated glass with additional safety film is unknown, further testing is required to establish whether this would achieve the desired result.*

*2. The behaviour of the alternative interlayers under the loading conditions experienced at Carmont are unknown; testing would assist in determining this.*

*Therefore, without testing, there is currently no justification for either retrofit or change to standards.*



Appendix A.docx