

## Recommendation(s) Status: Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3

This report is based on information provided to the RAIB by the relevant safety authority or public body.

The status of implementation of the recommendations, as reported to us, has been divided into six categories:

### Key to Recommendation Status

<b>Implemented:</b>	All actions to deliver the recommendation have been completed.
<b>Implemented by alternative means:</b>	The intent of the recommendation has been satisfied in a way that was not identified by the RAIB during the investigation.
<b>Implementation ongoing:</b>	Work to deliver the intent of the recommendation has been agreed and is in the process of being delivered.
<b>In-progress:</b>	The relevant safety authority has yet to be satisfied that an appropriate plan, with timescales, is in place to implement the recommendation; and work is in progress to provide this.
<b>Non-implementation:</b>	Regulation 12(2)(b)(iii) = recommendation considered and no implementation action to be taken.
<b>Awaiting response:</b>	Awaiting initial report from the relevant safety authority or public body on the status of the recommendation.

RAIB concerns on actions taken by organisations in response to recommendations are reflected in this report and are indicated by one of the following:


-  The red triangle shows recommendations where the RAIB has concerns that no actions have been taken in response to a recommendation.
-  The blue triangle shows recommendations where the RAIB has concerns that the actions taken, or proposed, are inappropriate or insufficient to address the risk identified during the investigation.
-  The white triangle shows recommendations where the RAIB notes substantive actions have been reported, but the RAIB still has concerns.

Note: The tables which follow, report the status of recommendations on 31 December 2015. In some other cases the end implementer has already sent information to the relevant safety authority about the actions it has taken, or proposes to take and the safety authority is considering whether it is satisfied that those actions and the associated timescales are accepted.


**Number/ Date/ Report No/  
Inv Title / Current Status**

**Safety Recommendation**

**Summary of current status (based on latest report  
from the relevant safety authority or public body)**

<p>1            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p> 	<p>Train operators to: I make modifications to multiple units already fitted with sanding equipment to permit application of sand in brake step 2 and above (or the equivalent of brake step 2 and above on multiple units fitted with step-less brake controllers) for the duration of the period when the WSP system is active on the leading vehicle (paragraph 247); I adjust, as appropriate, rolling stock maintenance activities during the autumn low adhesion period to include enhanced monitoring of sand hoppers to ensure that sand is always available (paragraph 253); I review their maintenance polices and practices for sanding systems to check that they are targeted at ensuring that the system continues to deliver sand to the point where wheel meets rail (paragraph 254).</p>	<p>ORR has reported that most train operators have outlined the actions to be taken in response to the recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate. The RAIB was concerned to note that the reported actions were insufficient to prevent a train operating with empty sand hoppers and a subsequent low adhesion event at Stonegate in Nov 2010 (RAIB report 18/2011). The ORR has informed the RAIB of its intention to carry out spot checks of the management systems train operators have in place to ensure that sand hoppers are filled; this will be carried out prior to the low adhesion season in 2012. \$</p>
<p>2            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p>	<p>Train operators to: I Modify as appropriate their instructions to drivers regarding the braking of trains equipped with a WSP system in low adhesion conditions to ensure that if the expected level of retardation is not achieved during the initial stage of braking, the optimum position of the brake controller is immediately selected to maximise braking efficiency. This may involve selecting a full service brake application or, where appropriate, an emergency brake application. I Brief any revised instructions to drivers (paragraph 250).</p>	<p>Train operators have reported that they have taken actions in response to this recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.</p>
<p>3            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p>	<p>Train operators of multiple units operating in single unit formations to consider increasing the length of train consists during the autumn low adhesion season where reasonably practicable, e.g.: I where rolling stock is available; I where platforms can accommodate longer trains; I where, based on the train operator's review of low adhesion events and knowledge of problem areas for adhesion, there is a demonstrable benefit in so doing on specific routes and/or at specific times of day (paragraph 258).</p>	<p>ORR has reported that most train operators have outlined the actions to be taken in response to the recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.</p>
<p>4            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p>	<p>Network Rail to develop and implement a risk-based strategy for rail head treatment and vegetation control in consultation with train operators. The strategy should be based on a review of recent data and take particular account of locations such as the approaches to junctions and level crossings where the consequences of an overrun could be severe. At high risk locations such as junctions, level crossings and steep gradients, consideration should be given to one or more of the following solutions: I the targeted application of Sandite; I application of Sandite using strategically placed fixed applicators; I temporary restrictions in operational use (e.g. avoiding the use of a junction); I temporary modification of signalling controls to</p>	<p>Network Rail has reported that it has taken actions in response to this recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.</p>

extend effective overlaps beyond signals; I instructions to selected trains to perform running brake tests in order to assess the state of adhesion; I other effective measures defined by parties involved in managing the risk from low adhesion (paragraph 242).

<p>5            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p>	<p>Network Rail to: I plan and execute trials in conjunction with train operators to validate changes made to rail head treatment for autumn 2006 and assess potential adjustments for autumn 2007 (paragraph 243); I develop a strategy for rail head treatment in consultation with TOCs, based on the outcome of the trials (paragraph 243).</p>	<p>Network Rail has reported that it has taken actions in response to this recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.</p>
<p>6            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p>	<p>Network Rail to conduct a review with ADAS to determine the scope for improving the accuracy of low adhesion prediction (paragraph 244).</p>	<p>Network Rail has reported that it has taken actions in response to this recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.</p>
<p>7            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p>	<p>Network Rail and train operators to develop a joint strategy for investigating adhesion related overrun and SPAD incidents that addresses: I Which low adhesion incidents are investigated; _ criteria for undertaking an investigation (e.g. length of overrun, potential severity of outcome); _ whether different levels of investigation are appropriate and if so, the criteria that apply to each one. I What data is gathered, when, how and by whom; _ justification for gathering each item of data; _ when wheel swabbing is appropriate and clear guidance on the extent and number of rail swabs to be undertaken; _ train data recorders; _ brake Control Unit; _ traction Control Unit; _ Network Rail and TOC staff responsibilities. I Whether enhancements can be made to existing swabbing techniques to improve the value gained from swabbing; I Management of investigations; I Use of alternative approaches or technology to estimate levels of contamination and/or adhesion available paragraph 261).</p>	<p>Network Rail has reported that it has taken actions in response to this recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.</p>
<p>8            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p> 	<p>RSSB to extend research and testing into how severe low adhesion conditions occur with particular reference to the phenomenon of micro layers of contamination on rail surfaces, invisible to the eye. The research will seek to establish the nature of the contaminant, how it reaches the rail and bonds with it, the circumstances under which the contaminant poses a particular threat to train braking (e.g. the factors that exacerbate its impact), the factors that determine how long it endures, possible methods for identifying its presence and methods for</p>	<p>The ORR has informed the RAIB that low adhesion is one of its priority risks and that there are a number of activities being taken forward. The ORR also refers to research already undertaken by Arup on causes of rail head contamination. The ORR states that there is significant activity in GB and internationally to better understand low adhesion and preventative measures, and is using this intelligence to form a strategic view of this subject. For example, the ORR has been monitoring original work done by industry in autumn 2010, where</p>

Number/ Date/ Report No/  
Inv Title / Current Status

**Safety Recommendation**

**Summary of current status (based on latest report from  
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preventing its formation and dispersing it (paragraph 252).

Network Rail, Wessex Region has collected and analysed a number of data sets to inform and support its 365 day weather strategy.  
The RAIB considers that the the research carried out to date is valuable and notes the ORRs view that the research carried out to date addresses some of the issues of concern. However, the RAIB will continue to urge the industry to carry out further research to better understand the fundamental causes of poor rail head adhesion. The RAIB is hopeful that further work being carried out by the industry will assist this understanding. \$

9 30/11/2005 25/2006 pt3  
Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3  
Status: Implemented

Train operators to fit automatic sanding equipment to those multiple units of five cars or less that are not currently so equipped, unless they are specifically excluded from doing so by GM/RT2461 paragraph 245).

ORR reports that it is seeking further information from ScotRail. ORR has advised RAIB that most train operators have reviewed the case for fitment of sanders to those vehicles currently unfitted. In some such cases sanders have now been installed. ORR has also advised the RAIB that following successful trials Network Rail and Transys have an agreed time bound plan for the fitting of sanders to all multiple units that were previously excluded by GMRT 2461 from the requirement for sanders. ORR is monitoring the programme and fitment and is engaged with both Transys and the relevant TOCs to agree plans and actions.  
The RAIB is encouraged to hear that the fitment of sanders to certain types of vehicles that had previously been excluded is now to take place.

10 30/11/2005 25/2006 pt3  
Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3  
Status: Implemented by alternative means

RSSB to lead research into ways of deriving quantitative criteria for braking performance under low adhesion conditions and the implications of each identified approach (including the potential impact on railway infrastructure). The research should include a consideration of the levels of adhesion against which performance (e.g. stopping distances or deceleration rates) should be demonstrated (paragraph 251). The implications of adopting the approach proposed in the draft second issue of the high speed rolling stock TSI should be considered. The results from the research should be incorporated into the relevant RGS as appropriate and disseminated to those who are revising the high-speed rolling stock TSI.

ORR has identified that there are a number of activities ongoing in the railway industry which has the potential to address the issues in Recommendation 10.  
The ORR reports that there are a number of areas of work being undertaken by the rail industry. This includes further wheel/rail interface testing by Sheffield University.  
The RAIB notes this position and is awaiting further information on the outcome of current and proposed research.  
ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate, although they will be monitoring the referenced research.

11 30/11/2005 25/2006 pt3  
Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3  
Status: Implemented

RSSB to review the relevance of existing sanding parameters within GM/RT 2461 (paragraph 248) and amend, enhance or supplement them with additional guidance where appropriate. The review is to encompass: implications (cost, benefits and disbenefits) of increasing the guide value of 2kg/minute for maximum sanding rate (taking account of the trials undertaken

ORR is aware of ongoing work being undertaken by RSSB in support of work to provide guidance on the optimum performance characteristics for sanders. It is planned that the research project will be completed by 16 December 2011 which will in turn inform changes to industry standards and guidance - this is planned to be completed by 30 December 2013. The

during August 2006 by Southern Railway); I the current sanding initiation threshold (full service and emergency braking) and the effect of reducing it to Step 1 or equivalent value for trains equipped with stepless brake controllers; I the need for criteria covering minimum sanding duration; I the need for criteria on sanding at low speeds including the implications of permitting sanding until the train has come to a stand; I identification of ways in which currently excluded vehicles (e.g. Classes 142-144, 153) can be equipped with sanders (paragraph 246).

RAIB notes that the other changes envisaged by this recommendation may not be incorporated into standards until December 2013 .

<p>12            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p>	<p>RSSB to carry out research in conjunction with Network Rail and train operators into the implications, (cost, benefits and disbenefits) of: I adopting enhanced sanding rates under emergency conditions above a defined speed threshold (either activated manually by the driver or automatically activated by the placing of the brake controller into the emergency position when WSP is active); I allowing leading wheel sanding for high speed emergency braking; I permitting units other than the leading unit to dispense sand under emergency conditions; I methods of avoiding the problem of excessive sand causing failures to operate track circuits (e.g. use of different materials or additives) (paragraph 255).</p>	<p>ORR is aware of ongoing work being undertaken by RSSB in support of work to provide guidance on the optimum performance characteristics for sanders. It is planned that the research project will be completed by 16 December 2011 which will in turn inform changes to industry standards and guidance - this is planned to be completed by 30 December 2013. The RAIB notes that the other changes envisaged by this recommendation may not be incorporated into standards until December 2013 .</p>
<p>13            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p>	<p>Train operators to ensure that until RGS GM/RT2461 has been reissued, clauses on sanding are contained within specifications for new rolling stock. TOCS should specify, as a minimum, the requirement for continuous sanding while WSP is active in Brake Step 2 (or equivalent for trains equipped with stepless brake controllers) and above and a sanding rate of 2kg/minute (paragraph 249).</p>	<p>Train operators have reported that they have taken actions in response to this recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.</p>
<p>14            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Implemented</p>	<p>Train operators to check the sand dispensing rate of each train within their fleets and ensure that it is set to the RGS GM/RT2461 guidance value of 2kg/minute except where a higher value has been permitted (paragraph 256).</p>	<p>Train operators have reported that they have taken actions in response to this recommendation. ORR proposes to take no further action unless they become aware that the information provided becomes inaccurate.</p>
<p>15            30/11/2005    25/2006 pt3</p> <p>Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3</p> <p>Status: Non-implementation</p>	<p>RSSB to establish a project to: Measure the accuracy of existing WSP simulation rigs that could be used to support rolling stock approvals. This validation should include reference to records obtained from train data recorders following actual incidents and full-scale testing as appropriate. The latter should include a direct comparison between UIC detergent test data and a simulation of the same (paragraph 259).</p>	<p>RSSB facilitated a steering group to assess the actions taken to address RAIB recommendations; this group considered that the project proposal in the recommendation was not reasonably practicable. This was based on a lack of confidence that any safety benefit would ultimately be achieved as a result of implementing the recommendations or that the research would ultimately result in the implementation of any new or revised control measures. Given the industry's reliance on effective</p>

Examine the feasibility of extending the capability of an existing WSP simulation tool in order to predict more accurately the behaviour of an entire train in low adhesion conditions (e.g. allowing for rail head conditioning, the effect of sanding and more than one vehicle) (paragraph 259). The results from the project should be used to inform the developing Euronorm on WSP equipment testing (paragraph 259)

WSP systems, the RAIB continues to believe that further work in this area is necessary. However, the RAIB also acknowledges that progress made in recent years to better understand and predict low adhesion, and major improvements to the extent and quality of sanding systems on trains, are likely to have contributed to a reduction in the overall risk.

16 30/11/2005 25/2006 pt3

Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3

Status: Non-implementation

Subject to the successful development of the simulation tool described in Recommendation 15, RSSB to undertake a programme of modelling to evaluate the impact of different control strategies for minimising stopping distances under various low adhesion conditions. The simulation should specifically address potential alternative strategies for extreme circumstances including:  
Changing WSP control algorithms for the level of slip permitted from the current value of 17-20%.  
Permitting different levels of slip on wheels on the same train to optimise overall braking during low adhesion conditions. All the simulations should be designed to evaluate the effect of different strategies on braking performance and rail head conditioning and should include simulations with sanding operative (paragraph 257). The results from the programme should be shared with those responsible for drafting relevant highspeed and conventional TSIs for possible inclusion in new or revised versions of those documents.

RSSB facilitated a steering group to assess the actions taken to address RAIB recommendations, this group considered that the project proposal in the recommendation was not reasonably practicable. Given the industry's reliance on effective WSP systems, the RAIB continues to believe that further work in this area is necessary. However, the RAIB also acknowledges that progress made in recent years to better understand and predict low adhesion, and major improvements to the extent and quality of sanding systems on trains, are likely to have contributed to a reduction in the overall risk.

17 30/11/2005 25/2006 pt3

Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3

Status: Implemented



RSSB to initiate a project to evaluate the costs and benefits of equipping multiple units operating over the British mainline network with magnetic track brakes for use in emergencies under low adhesion conditions. The project will: | Address and resolve the outstanding issues identified in Interfleet report ITLRT17544-001. | Subject to successful resolution of outstanding issues, specify and procure magnetic track brake (MTB) equipment and fit it to a small number of units. The units chosen should represent different traction types with different operating regimes and operate in different geographical areas. Develop and implement trials of these units, incorporating in-service experience and specific comparative tests with a similar unit not equipped with MTB. The project will aim to determine whether MTBs are a cost effective solution for new-build rolling stock and/or retrofitting to existing rolling stock (paragraph 260).

ORR has reported that RSSB has carried out a study in response to this recommendation (T540). This concluded that the objectives of this recommendation can be met by enhanced communications and enhanced track side signage. The ORR has informed the RAIB that it considered RSSB's study sufficiently addressed consideration of how the information could be used by the railway industry. Whilst recognising the useful work that has been undertaken by the railway industry the RAIB continues to believe that there is still further potential for adhesion / wheel slide data collected by modern trains to be utilised to provide valuable input to railway operators and as an input to wheel slide protection system simulators. The RSSB has informed the RAIB of research that is now being undertaken at Loughborough University (as part of project T959) to investigate the feasibility of using data related to the dynamic behaviour of wheel sets and bogies during normal running to predict the levels of adhesion available for braking. \$

**Number/ Date/ Report No/  
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**Safety Recommendation**

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18 30/11/2005 25/2006 pt3

Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3

Status: Implemented

RSSB to establish a study into the potential uses of systems on modern rolling stock to: I automatically sample adhesion conditions, e.g. by the controlled braking/release of a single wheel-set on service trains (other than during train braking)(paragraph 235); I establish the profile, nature and distribution of low adhesion conditions on the national rail network currently and provide input to SP simulation packages (paragraph 241); I improve intelligence about adhesion conditions in real time, e.g. use of wireless data transmission to feed details of low adhesion conditions encountered during braking to a monitoring system. (paragraph 262). The study should take into account operating experience with the Low Adhesion Warning System (LAWS) and consider the lessons learnt in relation to the development of a network wide solution for monitoring low adhesion conditions. The study should be developed in the context of the work currently being undertaken by RSSB in research project T540, 'Scoping and Development of the Adhesion Management System'. The output from this study must include consideration of how the information can be used by the railway industry including the need for signallers and drivers to be made aware of low adhesion conditions in real time.

The RSSB project T540 was completed. This considered different ways of monitoring adhesion. This concluded that attention should be focussed on the use of track based equipment and reporting by train drivers. Nevertheless, the RAIB is now aware of recent trials by a train operator using a rail vehicle to enhance adhesion and to monitor adhesion levels. Further work is being undertaken as part of RSSB's project T959 to investigate the feasibility of using data related to the dynamic behaviour of wheel sets and bogies.

19 30/11/2005 25/2006 pt3

Class investigation - Autumn Adhesion incidents at Esher and Lewes Pt3

Status: Implemented



Network Rail to review ERTMS low adhesion assumptions in the light of the findings of this report and consider whether any changes are needed to ERTMS design or operating parameters in the light of the review (paragraph 263).

ORR has reported to RAIB that the recommendation has been implemented. However, the RAIB has noted that the ERTMS program is still developing requirements and the anticipated Railway Group Standard designed to cover braking performance for ERTMS fitted vehicles has yet to be issued. The RAIB is seeking further information on the actions to be taken to implement this important recommendation. Office of Rail Regulation (ORR) proposes to take no further action unless they become aware that the information provided becomes inaccurate. \$b