MEETING:	Rolling Stock Standards Committee Traffic Operation and Management Standards Committee Control, Command and Signalling Standards Committee
DATE:	08/04/2022 29/03/2022 14/04/2022
SUBJECT:	Five-year review of GMRT2131 issue one - Audibility and Visibility of Trains.
SPONSOR:	Mark Oakley
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1. Purpose of the paper

1.1 This paper sets out the assessment of the five-year review of GMRT2131 issue one Audibility and Visibility of Trains and the outcome of the subsequent consultation with industry.

1.2 This paper replicates the content of the five-year review paper submitted to the Committee in December 2021, with additional description of the outcome of the consultation added as section 4.2 and revision of the recommendations in section 5 to reflect the current status.

1.3 This paper seeks Standards Committee approval on the recommendations and way forward.

2. Background

2.1 GMRT2131 issue one was published in December 2015. It combined the predecessor standards GMRT2483 issue one Visibility Requirements for Trains and GMRT2484 issue two Audibility Requirements for Trains into a single document, and aligned the content with the requirements of the LOC&PAS TSI.

2.2 The technical requirements of the LOC&PAS TSI concerning train visibility were contained within BS EN 15153-1:2013 Railway applications - External visible and audible warning devices for trains - Part 1: Head, marker and tail lamps. In turn these requirements had been developed from RSSB research project T530 ‘Review of train head-lamps’ optical requirements’.

2.3 GMRT2131 issue one retained a National Technical Rule (NTR) for existing rolling stock which does not have front end lamps (headlamps and marker lamps) that are compliant with the requirements of the LOC&PAS TSI to display a yellow warning panel on the front end. GMRT2131 issue one also included guidance for users introducing front end colours other than yellow, because, in a change to its predecessor, the requirement to display a yellow front end warning panel does not apply to rolling stock with TSI-compliant front end lamps.

2.4 GMRT2131 issue one addressed a specific case in the LOC&PAS TSI to permit trains in GB to be equipped with a warning horn that emits a lower sound level at speeds below

100 mph.

3. Impacts of the document(s) following publication/entering into force

3.1 Consideration has been given to the following during the assessment:

a Impact assessment – The changes introduced to remove the requirement for a yellow front end on rolling stock with TSI-compliant front end lamps and introduce guidance on front end colour have been subject to different interpretations by industry, and railway undertakings seeking to introduce rolling stock with NTSN/TSI-compliant front end lamps and a front end without a yellow warning have encountered difficulties in the process. Partly this can be attributed to the wording of certain parts of GMRT2131 issue one, notably Appendix E. RSSB is developing additional guidance on this area under project 19-011, which it is expected will be published initially as stand-alone guidance before subsequently being incorporated into standards publications when GMRT2131 is revised.

The impact assessment accompanying publication of GMRT2131 issue one states that it is considered that industry is better served by containing audibility and visibility requirements in a single document. It is not clear whether this is indeed the case, and indeed it is possible that combining both subject areas into a single document could slow down the publication of updates if, for example, there are agreed changes to be made to audibility content but a lack of consensus over the visibility content.

b Deviations – The single deviation against GMRT2131 issue one was approved within six months of the publication of the standard and concerned a follow-on build of rolling stock to an existing design compliant to the predecessor documents, for which it was not proportionate to modify the design to comply with the new requirements in GMRT2131 issue one. This deviation does not introduce a need to change the technical requirements of GMRT2131 issue one.

c Current projects or proposals being processed – RSSB assessed the suitability of reflective plates to provide the rear end signal on freight trains in GB under project 19-007 in mid-2020. Revision of GMRT2131 would provide an opportunity to incorporate guidance informed by RSSB project 19-007.

Additionally, as described, above RSSB project 19-011 is producing guidance on the assessment of front end visibility and front end colour selection, which could be incorporated into a revised version of GMRT2131.

d Limited change release – There have been no limited change releases to GMRT2131 issue one published.

e Amendments and clarifications – Two amendments and one clarification have been published for GMRT2131 issue one. The two amendments addressed minor typographical errors in the document. The clarification, GMRT2131 AM002, was published following an enquiry from industry on the required dimensions of a yellow warning panel on the front of a train when the warning panel does not have a regular shape, and provided additional guidance on what does and does not meet the requirements contained in GMRT2131. The content of this clarification will need to be incorporated into GMRT2131 at its next revision.

f Enquiries – Enquiries have been received on various topics related to GMRT2131 issue one, including:

i. Requirements for lamp controls and the permitted number of lit front end lamps. GMRT2131 issue one requires only three front end lamps to be lit, which places an additional requirement on users over and above those in the NTSNs. This has been captured on the NTSN issues log and the issues log entry is reproduced in Appendix A. Revision of GMRT2131 would support the close out of the identified issue.

ii. Horn switching arrangements to change between low and high sound levels. Clarification of this is also recommended by RSSB research project T1205 (see 3.1g below).

iii. Introduction of new or modified rolling stock without a yellow front end warning panel. As mentioned above, project 19-011 is producing guidance on this subject.

iv. The use of LED light strips for the upper marker lamps.

v. Dimensions of the yellow warning panel required on rolling stock which does not have TSI/NTSN-compliant front end lamps fitted. As noted in 3.1e above, this has resulted in a clarification to GMRT2131 issue 1 being published.

vi. Operation of rolling stock which has a yellow warning panel when part or all of that warning panel is missing or not visible.

g Research projects – RSSB research project T1205 *Relationship between horn test measurements and perceived sound levels on the track* made two recommendations that are relevant to the content of GMRT2131 issue one, these are: a) Revise GMRT2131 concerning the application of low speed settings; and b) Develop guidance in an RSSB standard on design and maintenance to minimise excess attenuation.

Further relevant RSSB research projects that are ongoing or in development are 2021-SSH-002 *Improving the effectiveness of the train horn in emergency situations* and *Optimising drivers' use of audible warnings in all potential scenarios* [reference not yet allocated]. Whilst these are System Safety / Human Factors and Operations focused projects respectively they have the potential to produce recommendations that are relevant to GMRT2131.

h Changes in regulations – Since GMRT2131 issue one was published, the UK has left the EU and TSIs have been replaced in GB by NTSNs. The relevant ENs called up by the TSIs/NTSNs have also been revised and republished in 2020. However despite these legislative changes, there are no material changes to the technical requirements for train audibility and visibility.

i Changes in technology – There are no developments in technology that need to be addressed in GMRT2131.

j National Technical Specification Notices (NTSNs) and European standards – Through discussions with stakeholders as well as during the course of RSSB project 19-007 it has been identified that there are elements of the LOC&PAS, WAG and OPE NTSNs that do not accurately describe the situation in GB concerning front and rear end visibility, and where the guidance in GMRT2131 issue one does not provide sufficient guidance on the NTSN requirements or obligations. These include;

i. Statements in the NTSNs that the headlamps provide visibility

for the driver at night and the marker lamps make the train visible to others, whereas it is the headlamps that make the train visible and are specified to provide sufficient warning time to trackside staff and level crossing users.

ii Lack of alignment concerning rear-end signals on freight trains, where the OPE NTSN states that there is a requirement for the end indication on freight trains to be two steady red lights and also includes reference to requirements for reflective plates, whereas the practice is to display a single flashing red light to the specification given in GMRT2131.

iii Inconsistent terminology – e.g. 'day' and 'night' headlamp settings vs 'full' and 'dimmed'

These are all issues that already existed within the TSIs that previously applied in GB. Whilst resolution of some of these issues may require changes to the NTSNs, additional guidance within GMRT2131 would likely be beneficial.

k Published list of NTRs – GMRT2131 issue one contains requirements that do not meet the criteria of NTRs, and which are not on the published list of NTRs. To align with the standards strategy, requirements that do not meet the NTR criteria should be removed from the RGS and published in a RIS.

l Any other observations – It has been established that the specification for the portable head lamp contained in GMRT2131 issue one was defined to provide 25 seconds of warning time at 75 mph. At that speed it therefore does not provide the 45 seconds of warning time in daylight that a main headlamp is designed to provide. A review of the portable headlamp specification and its usage is recommended so that in use it can provide 45 seconds warning time.

4. Discussion

4.1 Review assessment

4.1.1 The outcome of the review is that GMRT2131 issue one is no longer fit for purpose and requires revision. It is recommended that a standards project is established to revise GMRT 2131 issue one. It is anticipated that the project will, inter alia:

a) separate requirements that do not meet the criteria of an NTR into one or more RISs;

b) incorporate outputs from the T1205 RSSB research project on audibility of train horns;

c) develop improved guidance on the process of assessing visibility when introducing or modifying rolling stock;

d) revise the requirements and guidance in GMRT2131 to support close-out of the issue concerning the number of lit front end lamps described in the NTSN issues log;

e) align references with the post-Brexit legislative landscape;

f) incorporate outputs from ongoing RSSB research projects that are delivered ahead of or during the drafting phase of the revision; and

g) review the portable headlamp specification.

Development of the revision will also consider whether it remains appropriate to combine audibility and visibility requirements and associated content in the same document, or whether separate documents should be produced for audibility and

visibility respectively.

4.1.2 There are errors in the relevant NTSNs that require correction. Undertaking a revision of GMRT2131 will help to identify the necessary changes.

4.2 Consultation

4.2.1 Following presentation of the 60-month review to RST SC in December 2021, consultation with industry took place in January 2022.

4.2.2 Nine organisations responded to the consultation, all of whom supported the findings of the review. Of these nine organisations, four additionally provided comments. The comments received and RSSB's responses to them are attached to this paper as Appendix B.

4.2.3 The consultation specifically asked the consultees for their views on whether the audibility and visibility elements should be separated into different documents. Three of the comments received addressed this question, one each supporting and opposing this proposal and a third expressing no preference either way but noting that the original reasons for combining the two previously separate topics should be understood.

4.2.4 From the consultation responses received it is concluded is supportive of the original recommendation to undertake a revision of GMRT2131, and that there are a range of views on whether or not to separate the audibility and visibility requirements. Therefore it is concluded that a decision on this should taken within the project to revise GMRT2131.

5. Recommendations

5.1 The Rolling Stock Standards Committee is asked to:

a DISCUSS the outcome of the review consultation and the following proposed recommendations:

Action required:

i) Initiate a standards change project to revise GMRT2131 issue one.

ii) Submit one or more Requests for Help to amend the NTSNs to correctly describe the situation in GB concerning front and rear end visibility.

b APPROVE:

The recommendations.

RSSB completion:

Lead Standards Committee	*Meeting date*	*Recommendation approved*	*Minute numbers*		*Next review date*
			Pre-consultation review	*Post-consultation review*	
Rolling Stock	10/12/2021 08/04/2022	Yes	Decision 13	RST/08042022/11.1	N/A

Appendix A Extract from NTSN Issues Log

Issue:

The LOC& PAS TSI requires the fitment of 2 headlights in order to give visibility for the train driver. It also allows for additional head lamps to be provided (for example upper head lamps). It also says that additional head lamps are not mandatory and their use at operational level may be subject to restrictions.

The TSI also requires 3 white marker lamps to be provided at the front end of the train in order to make the train visible. The third marker lamp is to be located centrally above the two lower lamps. It is permitted to use the same component for both head lights and marker lights but there no explicit restriction ie separate head lights and white marker lamps can be installed giving more than 3 lights (at least 5 lights). The requirements in the LOC&PAS TSI on lamp controls are also not precise in this regard. It should be noted that the LOC&PAS TSI does not refer to any other external lights other than those fitted on the driving cab. Therefore the LOC&PAS TSI gives a degree of flexibility to vehicle manufacturers on the number of lights that can be fitted to the driving cab. However operationally railway undertakings have to comply with the OPE TSI which contains a requirement for the front of a train to be recognised by 3 white lights in an isosceles triangle formation.

The OPE TSI is not clear on whether the three lights layout explicitly includes or excludes one or more head lights to aid the visibility for the driver. In any case, at least one head light would be expected to be lit by night and during low light conditions. Therefore it is not clear whether despite their presence, the lighting of additional lights is permitted or forbidden when the vehicle is in operation. Operating with extra lights lit is likely to improve visibility of a train and perform other functions but recognisability could be affected as additional lights could jeopardise the triangle layout agreed. This leads to two questions for railway undertakings in terms of compliance with the OPE TSI:

- Whether marker lamps and adjacent headlamps may be illuminated simultaneously (resulting in more than 3 lights, in an approximate isosceles triangle).

- Whether lights for different purposes can be additionally displayed (for example low-level track illumination lights, pantograph monitoring system lights), potentially resulting in more than 3 lights not in an isosceles triangle, being lit and visible from in front of the train.

Solution:

Safe integration of vehicles with operations (railway undertakings and other affected parties) is an obligation on railway undertakings to be managed under their Safety Management System. Therefore any railway undertaking operating a train where more than 3 lights may be lit and visible from in front of a train when in operation, should assure themselves (for example by undertaking a risk assessment and consultation with affected parties where necessary) that the triangle light layout required by the OPE TSI for Interoperability is not jeopardised to the extent that it causes confusion to track workers or members of the public who are likely to encounter the train.

OPE TSI Mirror Group agreed:

November 2020: The OPE TSI Mirror Group approved the following 'way forward' which closes the issue:

Railway undertakings operating a train where more than 3 lights may be lit and visible from in front of a train when in operation, should assure themselves that the triangle light layout required by the OPE TSI is not jeopardised to the extent that it causes confusion to track workers who are likely to encounter the train.

Appendix B Consultation Comments and Responses

Document number: **Consultation on the Five-year review GMRT2131 Issue 1 - Audibility and Visibility of Trains**

Consultation closing date: **03 February 2022**

1. Responders to consultation

No	Name	Company
1	**Nick Swift**	Eversholt Rail
2	**Nathalie Morgan**	GWR
3	**Laurence Gregory**	Angel Trains
4	**Yuki Ohashi**	Angel Trains
5	**Giles Haley**	Siemens

2. Summary of comments

Code	Description	Total
-	Consulted	275
CE	Critical errors	-
ED	Editorial errors	1
TY	Typographical errors	-
OB	Observations	12
-	Total comments returned	13

Classification codes for a way forward:

- DC – Document change
- NC – No change

3. Collated consultation comments and responses

No	Page	Clause	Comment	Suggestion	By	Way forward	Page	Clause	Response
1			The standard need to be updated to be clear on the maximum permissible delay between the drivers action to call for the horn to sound and for the sound level to reach the required volume. There have been issues where some new train designs have an unacceptable delay resulting in insufficient warning times	A requirement is added in seconds between actuation of the control and the sound reaching the required volume. Some testing to determine the maximum delay acceptable may be required	1	OB			This was a significant finding from research project T1205 and identified as a follow-on activity. Delay will be addressed in the next document revision, and we are setting out the scope of work to determine how delay is controlled.
2		Item i	The ISCC paper states there are no changes to technology to consider. We should consider electric sounders. This technology is a credible alternative to horns and could avoid many of the technical issues we face with horn maintenance and operation		1	OB			Electronic sounders have not been considered but could be considered within the scope of the revision project if the technology were sufficiently mature to set out requirements or guidance. It would certainly help if our requirements were not predicated on a fixed horn technology.
3			I believe that this document should remain as one for Audibility and Visibility as they go hand in hand, one should not negate the other. They should complement each other.	Keep this as one document.	2	OB			There are benefits to keeping the requirements in one document but there are also benefits to having separate documents. Although they are both means to identify the approach of an oncoming train, the scenarios where they are effective are different and a change to one of the means does not warrant a corresponding change to the other. We will consult further with stakeholders at the start of the revision project and make a balanced decision in the best interests of the industry.
4	Gene ral	General	[p7, Clause 2.21 of the standard] It is understood that the 25m testing requirement is taken from BS EN 15153-2:2013. I have heard however that the requirements can make it harder/not possible to carry out the test at train depot locations.	Is there consideration on how the previous requirements within GM/RT2484 Issue 2 where the testing distance was 5m could be used to guide if the space required for the BS EN15153-2:2013 25m test is not possible.	4	OB			Although the 25m test is necessary to comply with the NTSN, there may be some benefit in testing at 5m for in-service checks where space does not permit testing at 25m. This could at least be included in guidance. (Given the way that sound dissipates over distance, testing at 25m gives much greater confidence that the horn would be audible at operational distances than 5m would)
5	Gene ral	General	GM/RT2484 Issue 2 had a clause (2.1.5.1) concerning reliability of horns. The impact damage element is mirrored in the LOC & PAS TSI, however the blockages part of the clause is no longer mentioned in GM/RT2131 (or LOC & PAS TSI)	Is there a consideration on whether the reliability clause from GM/RT2484 should be re-introduced?	4	OB			We intend to add further guidance on installation and maintenance to reduce the variability of horn performance between trains and over the life of a train so impact damage will be included.
6			The following comments relate to both GM/RT2131 issue 1 and the 5-year assessment paper dated 10/12/2021		3				Noted.

No	Page	Clause	Comment	Suggestion	By	Way forward	Page	Clause	Response
7	23	E.1 & related parts of section 3.1 of the assessment paper.	Guidance on Front End Colours. It is appreciated that Appendix E in GMRT2131 Issue 1 is for guidance, and steers the proposer to carry out a risk assessment if a non—yellow front end is selected, and lists a number of considerations to be consulted with all affected parties. E.1.8 then implies that it is important to make all affected parties aware of the change so they can manage its impact. Where this approach seems challenging from a standardisation perspective; is in the example of the same class of train, both with TSI / EN15153-1 compliant headlights, operating over the same route (e.g. LNER), where one has been deemed to require a yellow front end and the other has not. How is it, that the risk assessments carried out in the above example, concluded opposite outputs? However, I am pleased to note in the assessment paper that RSSB is developing additional guidance on this aspect, under project 19-011, which I hope will deliver a 'standardised' output, rather than the current situation. RSSB Research Report T530 '*Report into train headlamps' optical performance' (*circa 2009), suggests the case for removing yellow front ends is 'generally supported'. Caveats around this (T530 6.12), suggests that the case for removing the requirement for yellow front ends is generally supported by the hazard analysis process – (T530-Appendix F). Noting that this is dependent on the T530 *'milestone 8- Performance Requirements Specification*' and management of in-service alignment and optical performance. Further, the workshop output (mentioned in Appendix F T530), '*allowed a safety/ALARP argument to be developed on the removal of the requirement for yellow front ends'*. The question therefore is; why have we got to a 'non-standardised' position with yellow front ends on vehicles that meet all visibility requirements set out the TSI / EN15153-1? If we remain concerned (yellow front end or no yellow front end) for the safety of staff on or about the line, then perhaps we should consider track worker body worn devices to warn of oncoming trains?		3	OB			The requirement for a yellow warning panel only applies to rolling stock that is not equipped with front end lamps that comply with the requirements of the LOC&PAS NTSN. However this does not prohibit the use of yellow on the front end of rolling stock that is equipped with NTSN-compliant front end lamps, and an operator is free to voluntarily choose yellow as part of the front end colour scheme of their trains if they wish. Further guidance on this will be set out in the output from project 19-011. However it will remain the responsibility of each Railway Undertaking in question to carry out their own risk assessment, so it is not expected that a standardised risk assessment outcome can be produced as part of the standards change. Project 19-011 is expected to include guidance to the effect that where an approaching train that complies with the visibility requirements (NTSN-compliant lamps or yellow warning panel) cannot be seen in time to provide the necessary warning time, alternative means of protection will be required to mitigate risk. Body-worn devices could be a such an alternative means of protection.

No	Page	Clause	Comment	Suggestion	By	Way forward	Page	Clause	Response
8	24	GMRT2131 Issue 1E.1.9 a)	Again, it is appreciated that this Appendix is for guidance. However, a) implies that colours such as red and green could introduce a potential risk to operating practice. The recently introduced new GA class 720,745 and 755 trains display red panels either side of the windscreen. Did the risk assessment, covering all affected parties, conclude that the red colour on the front of the train differs enough to that of a red signal aspect?		3	OB			We are not able to comment on the content of individual risk assessments by any particular organisation. As part of the standards change to GMRT2131 we will assess whether the guidance on specific colours in Appendix E should be revised, for example to only describe the subjects of risk rather than suggest colours that could be associated with each risk area.
9	25	GMRT2131 Issue 1 F.1.1.1	Grammatical error? *'……..layout required by this document achieve are deemed to provide….'*		3	ED			The standards change project will include a full review of the document for grammatical errors, as well as spelling and other typographical issues, with an independent quality check before consultation on the draft standard and again before publication of the final standard.
10		General	Splitting the audibility and visibility content. I have no strong views about this. However, if I'm not mistaken, the requirements did start out as one standard (GM/TT0163), then split at a later date, only to be combined again in GM/RT2131. Before any decision is made, the historic reasons for either having one combined standard or two separate ones, should be considered.		3	OB			There are benefits to keeping the requirements in one document but there are also benefits to having separate documents. Although they are both means to identify the approach of an oncoming train, the scenarios where they are effective are different and a change to one of the means does not warrant a corresponding change to the other. We will consult further with stakeholders at the start of the revision project and make a balanced decision in the best interests of the industry.
11	All	All	Siemens supports the suggestion of separating the visibility and audibility parts of the existing standard.	Derive separate standards for visibility and audibility requirements reflecting the structure of EN15153 Parts 1 & 2.	5	OB			There are benefits to keeping the requirements in one document but there are also benefits to having separate documents. Although they are both means to identify the approach of an oncoming train, the scenarios where they are effective are different and a change to one of the means does not warrant a corresponding change to the other. We will consult further with stakeholders at the start of the revision project and make a balanced decision in the best interests of the industry.
12	7	2.2.1	The differential sound pressure levels according to speed do not align with EN15153-2:2020 Section 5.2.2 and in particular its reference to Annex E GB Deviation. Noted that NTSN 01/01/21 REFERS IN App. J-1 Index 41 to EN15153-2:2013…	Observation	5	OB			EN15153-2:2020 Section 5.2.2 requires an SPL range of 101-109dB and then permits 86-94dB for GB by reference to annex E GMRT2131 2.2.1 table 1 uses these values and sets the required speed ranges. All references and corresponding content will be updated in the revision as a matter of course. The revisions between the 2013 and 2020 version of EN15153-2 do not substantially affect the content of GMRT2131 and generally relate to refinement of test parameters.
13	N/A	N/A	Whilst maintenance of headlamps is to some degree covered in RIS-2004-RST, there is currently no reference to arrangements for managing performance and reliability of horns, particularly in respect of noise restrictions which apply at depot locations.	Might some guidance be provided on determining an appropriate maintenance or performance monitoring regime which permit the necessary level of assurance within widespread restrictions against routine testing.	5	OB			We intend to add further guidance on installation and maintenance to reduce the variability of horn performance between trains and over the life of a train

No	Page	Clause	Comment	Suggestion	By	Way forward	Page	Clause	Response
14	16	A.1	Noted that a “A minimum of…66dB” is cited as appropriate for depots and sidings, with the following paragraph that a value of 10dB above ambient is necessary. Given the residential location of many depots & sidings, nature of applicable speed limits and usual time of day for train movements is it necessary to fix a value for this environment.	Consider option for a more flexible risk-based approach to sound pressure levels appropriate for depots and sidings.	5	OB			It is generally accepted through numerous acoustic studies that a warning needs to be 10dB above the ambient sound level to be heard (and 15dB above to gain attention). The content of this appendix is guidance and not mandatory and is already intended to support a flexible risk-based approach.