# Consultation comments and responses

**Document Title:** Five-year review of Compatibility Requirements for Braking Systems of Rail Vehicles

**Document number:** GMRT2045 Issue 4

**Consultation closing date**: 29 July 2022

## 1. Responders to consultation

| No | Name | Company |
|---|---|---|
| 1 | **Keith Mack** | LNER |
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## 2. Summary of comments

| Code | Description | Total |
|---|---|---|
| - | Consulted | |
| CE | Critical errors | |
| ED | Editorial errors | |
| TY | Typographical errors | |
| OB | Observations | 14 |
| - | Total comments returned | 14 |

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 |
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| 1 | | | | Would it be possible to consider the effects of power change over systems and the potential for small periods of brake loss especially if it occurs at slow speed See NIR 3641. | 1 | DC | TBC | TBC | Fundamentally NIR 3641 was a result of a brake control software not functioning as intended; the fact it occurred during end-of stop blend is not causal. Ultimately compliance with the stopping distances is required, the standard is silent on how to design the brake control system with the particular exception of needing to mitigate against single point failures (see guidance in F.3).<br>However, it is acknowledged that the need to achieve:<br>• The level of brake force / deceleration demanded at the control position (subject to adhesion conditions and jerk rate limited transitions), and<br>• A satisfactory quality of blend and overall brake effort between varying brake energy types / modes of application as external circumstances (for example speed, line receptivity) change<br>Are both fundamental principles to be embodied in a braking system. The need to incorporate requirements pertaining to these aspects (which could cause stopping distance issues when traversing neutral sections, for example, and thus compatibility issues) will be determined during redrafting. |
| 2 | 3 | g | In the 60m review, it states that T1099 is the only relevant previous research. | All Electric Braking T860 I would have thought to be relevant? | 2 | NC | N/A | N/A | The final report of T860 was consulted during the review process.<br>Provision of all-electric braking is already covered by the standard, insofar as the motive power and the means (tread, disc, rail or other) of a braking system is not pre-supposed. As-per the conclusions of the T860 report:<br>*A key constraint to the adoption of all-electric brakes is the expectation defined by existing TSIs and standards for a safety critical friction brake. […] However, the standards do not specifically exclude the use of dynamic braking during an emergency brake application, nor do they require the dynamic brake to be isolated during wheel-slide protection activity*.<br>The supplier of an all-electric brake would need to comply with NTSN safety requirements in 4.2.4.2. Also, from a performance point the electric brake would need to be capable of operating on the variable low adhesion conditions regularly experienced on the UK (GB) mainline railway. To date this has not been demonstrated and under low adhesion conditions the brake control systems generally revert to using friction braking. Guidance on the application of eddy current track brakes as an adhesion-independent means of overcoming the latter point, as suggested in T860, is included in GMRT2045 issue four (F.11.2). |

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| 3 | 8 | G2.1.1.6 | The guidance note states that the brake system provides a holding brake, but there are no requirements in the document for the holding brake performance. | Holding brake should at least be designed to hold a train on a 1 in 37 gradient in all load conditions. System isolations and tolerances should also be considered. | 3 | DC | 10 | 2.3 | A clause to define the holding brake function is to be provided (tentatively 2.3.6). The suggested parameters will form a starting point for discussion, although the required performance capability of the holding brake will depend on the architecture of the brake system (more of an issue with combined traction brake controllers), the routes on which the train is intended to operate and the traction capability to restart the train. As such there will always be aspects that should be set out as part of the procurement specification, but inclusion of a 'baseline' minimum performance for holding brake functionality in railway group standards could ensure that vehicles have as wider route conformity as practical in this regard. |
| 4 | 11 | 2.3.1 | Guidance clause G2.12.1.2 says stopping performance tests should take into consideration a number of factors including equipment tolerances, fade of the friction material etc. However, there is no reference to this being a performance requirement. | Add a clause in the general requirements of clause 2.3.1. to point to these considerations and stating that a train must meet the performance requirements even with all system tolerances at their extremes most detrimental to the performance, unless this can be accommodated by the control system in some way. | 3 | DC | 21<br>11 | G 2.12.1.2<br>G 2.3.1.1.5 | Clause G2.12.1.2 is taken to refer to the effect the factors described have on braking distance during testing, as opposed to the assumed values used for the nominal braking distance calculation. An appreciation of this is necessary to verify the latter, since equivalent stopping distances have to be demonstrated between calculation and testing. Since this clause is evidently confusing, it will be rephrased as part of the redrafting exercise.<br>The braking curves in Appendix A are reductions from the minimum level track stopping distances permitted by the signalling standard GKRT0075. An explanation of these factors is set out below figure 4. These safety factors help to mitigate against the extreme conditions cited, also noting that the actual signalling distances are generally longer than the minimum permitted. As such, to meet the stopping distance performance specified in the standard with all extremes of tolerance incorporated would effectively be a form of 'double counting'. Clause G 2.3.1.1.5 will be redrafted to emphasise this.<br>With the introduction of ERTMS, the extreme are dealt with by a Monte-Carlo analysis of the tolerances and failure modes to generate the Gamma data that is then used to calculate the guaranteed braking curves for ERTMS operation. The need for guidance on the development of guaranteed emergency brake rates and brake build up times will be reviewed as part of the redrafting exercise. |

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| 5 | 12 | 2.3.2.2 | Although this clause has been in this format for years, it has always seemed illogical to me that it specifies an increase in clamp load for the enhanced EB. Maybe that was the best that could be specified for older units that were modified, but a 15% increase in clamp load doesn't necessarily lead to a 15% increase in deceleration. | Provide a range of figures that define the increase in achieved deceleration that should be achieved in EB. Say the clamp load increase only refers to existing trains.<br>This also helps on trains where the brake force is balanced between cars, when it is possible that each car doesn't see an increase of at least 15% in clamp load, but the overall braking performance of the train still increases by the required amount. | 3 | DC | 10 | 2.3.2.2 | The definition of Enhanced Emergency Brake (EEB) by clamp force was logical while the focus was on retrofit of existing classes, where the critical factor was the stresses set up in the brake system and supporting structure (although even the latter would be subject to the change in coefficient of friction at high block loads resulting in a non-linear relationship of torsion reaction to block force). Now that EEB is instead considered at the design stage of rolling stock, it seems advisable (in line with the suggestion) to specify the performance of EEB in terms of the required TPWS brake rate, i.e. 12%g overall for a multiple unit (30% above the nominal 9%g full service).<br>The minimum 15% increase requirement is so the driver can perceive an increase in brake rate over full service, in the event that the latter significantly over-performs the nominal 9%g. As such, undertaking this on a multiple unit rather than individual vehicle level is plausible, and supports balancing of brake force between vehicles such that the adhesion demand during EEB on any one vehicle / wheelset does not exceed the NTSN emergency braking limit. |
| 6 | 12 | 2.3.2.2 | The clause asks for a nominal of 30% brake force increase, with a minimum of 15%. Does this mean that the 15% has to be achieved even when the full service BCPs are on their maximum tolerance and the Emergency BCPs are on their minimum? | The minimum increase should be a nominal of 15%, i.e. considering FS and EB BCPs at their nominal values.<br>If the train deceleration proposal is taken on board as suggested above, then the deceleration increase should be at least 15%, based on nominal values achieved during testing. | 3 | DC | 10 | 2.3.2.2 | As noted above, the 15% requirement relates to a perceivable difference in brake effort. The requirement will be reviewed as part of the redrafting, for example making the requirement a perceivable difference in effort, citing the minimum 15% figure in guidance as that typically employed. |
| 7 | 12 | 2.3.2.2 | The requirement for an enhanced EB is only applicable to multiple units. Fixed formations of >5 cars can meet the requirements of either MUs or loco-hauled trains (Definitions on P63). Hence there are differences in performance across the network on fixed formation trains in EB, depending on the choice of the original customer for the trains. | New fixed formations trains generally have an enhanced EB. Why doesn't the standard specify this. | 3 | DC | TBD | TBD | The original decision to restrict mandating of EEB to multiple units of five vehicles or fewer was based on the relative risk of station overruns occurring. Short multiple unit trains are likely to be forming local services, stopping frequently, while longer units will generally be used for inter-city services with infrequent station stops. The longer fixed formation trains, such as HSTs, also at that time tended to employ brake systems using distributors, which would not have been practicable to retrofit for enhanced emergency brake. As related in the suggestion, there is a tendency for disc braked new build fixed formation trains to have EEB regardless of length; the exception for longer multiple units, in the case of new build, will therefore be reviewed as part of the redrafting of the standard. This would then also allow the vehicle definitions used in GMRT2045 to be harmonised with those applied by the LOC & PAS NTSN, subject to review of the other clauses where multiple units are cited. |

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| 8 | 14 | 2.3.3.10 | There are no requirements for trains that run in excess of 250km/h in the text, although the figures provided in Appendix A Figure 4 cover up to 300km/h. | Performance requirements for trains travelling up to 360km/h need to be included to cover HS2. Hence clause wording needs revision and the data in Fig. 4. | 3 | DC | 14 | 2.3.3.10 | Figure 4 arises from the development of the Class 91 and Mk4 coaches, these being designed to operate at 140mph (225km/h) on the existing signalled railway utilising an additional flashing green signalling aspect. Operational measurements had shown the available adhesion reduces with increasing speed so above 125mph the Full-Service braking rate was reduced from 9%g to 6%g. Figure 4 reflected this change in performance, and (when later introduced) the maximum operating speed of the Class 373s that also braked at 6%g above 125mph.<br>The NTSNs now specify for operation above 125mph the train needs to be equipped with ERTMS and braking intervention curves will be calculated from the Gamma data entered into the DMI. Consequently Figure 4 is no longer needed for compatibility and the train specification can choose the braking performance for ERTMS operation provided the adhesion limits set out in LOC&PAS NTSN are not exceeded with an emergency brake application. As such, figure 4 and the clauses that refer to it will be reviewed and are likely to be withdrawn in the redrafting of the standard. |
| 9 | | | A general comment is that this document quotes speeds in mile/h but distances in metres. We should be consistent with units and quote speed in km/h (miles/h can be provided in brackets in the text if necessary) but tables should use metric units consistently. | Use consistent units throughout the document, e.g. speed in km/h primarily. | 3 | DC | General | General | The definition of speed in mph comes from compatibility with signalled railway, that is still signed in mph. As such GMRT2045 sets out the Full-Service stopping distances for compliance with lines signalled to GKRT0075 in mile/h exclusively, and elsewhere uses mile/h with km/h in brackets. This is the opposite of the current standards style guide, which indicates the metric value should be primary with the imperial in parenthesis. The suitability of adopting this mode of reference will be reviewed during the redrafting process, however it should be noted that, in an operational context, ERTMS was originally going to use km/h but there have been requests for the ETCS DMI to display speeds in mph to avoid confusion running on and of ERTMS routes and signalled lines. |
| 10 | 16 | G2.4.1.3 | Should we now be referencing EN15595:2018? It's acknowledged that the LOC&PAS TSI and hence NTSN still refer to the 2011 version, but shouldn't we stay up to date? | Refer to EN15595:2018. | 3 | DC | 16 | G2.4.1.3 | The update to GMRT2045 will reflect the updated text of the NTSN following the updates made subsequent to the 2022 TSI update. The latest draft of the latter cites EN 15595:2018+AC:2021, and it is likely this update will be retained in the final vote on the TSI and transposed into the NTSN. |
| 11 | 22 | G2.12.1.4 | BS EN 16834:2019 is now released. | Replace reference to prEN 16834 | 3 | DC | 22 | G2.13.1.3 | Review of all reference documents and update as required will take place as part of general standards update, although in this instance the comment is addressed in amendment four (AM004) to issue four of GMRT2045, published 26/10/2021. All amendments to issue four of the standard will be incorporated as part of the redrafting process. [Note this comment pertains to the previous clause; G2.12.1.4 does not contain reference to prEN 16834] |

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| 12 | 23 | G2.12.4.2(b) and (c) | Should we clarify what is an acceptable difference between vehicles for them to be considered to be similar, e.g. +/-5% of brake force, mass etc. | Clarify ‘similar’, say ‘for example within +/-5%’. | 3 | NC | N/A | N/A | The difficulty here would be that ‘similar’ may not be the same in all circumstances, in the case of vehicle design masses depending on things like the presence of load / weigh systems (and how close such a system is to saturation), where the mass is located (for example rotating mass) and so on. It must also be considered if the vehicle barely passed stopping distance tests previously, and is likely to be sensitive to any change, or passed with significant margins. Given such questions as these it would be inadvisable to codify hard-and-fast limits.<br>The default will remain to conduct stopping distance tests, the onus being on the proposer to justify to the approval bodies that new vehicles are sufficiently similar to an existing design that the previous results can apply. |
| 13 | 24 | G2.12.5.5 | This clause requires the energy stored in the BSR after WSP activity to be sufficient to provide an EB application. Appendix K is referenced, but in Appendix K, clause K.1.7 it says the pressure should be sufficient to provide a FS application. | Consistency between the clauses. Would recommend there is sufficient to provide a FS application | 3 | DC | TBD | TBD | The anomaly will be reviewed and the correct state adopted in both instances it is called up in the standard. As compatibility with the signalled railway is on the basis of Full Service brake applications, it would suggest that this should be the minimum target. However variation in adhesion, and thus air-usage rates, through a stop may have to be considered and some margin allowed for the effects of this. |
| 14 | | | A general comment is that there are no longer requirements for sizing the BSR, which used to be covered by section 6 of the previous release. Nor is there a requirement pointing to the provision of a Low BSR governor, as in section 7.2 of the previous release. | Reinstate these requirements as it clarified the rules to be followed for sizing of the BSR. | 3 | DC | N/A | Appendix F | Sizing of BSR is taken to be covered by clause 4.2.4.2.1 point (9) of the LOC & PAS NTSN (TSI) in the first instance, with specific functional requirements with regards to volume of energy storage to be determined in accordance with clause 4.2.4.2.2 point (2) and the WSP air consumption assessment. Appendix F will be updated with some guidance to support 4.2.4.2.1 (9) with regards to ‘required brake forces’ and ‘stored energy’.<br>Inclusion of a Low BSR Governor is covered in issue four of GMRT2045 in clause F.12.2. The brake interlock is now guidance rather than being a requirement, in accordance with the general principle adopted by the TSI (and now NTSN) of indication only (clause 4.2.4.9) but otherwise the content of issue 3 is largely intact. |