**Specification for research project**

Relationship between train horn test measurements and perceived sound levels on the track (T1205-02)

The draft research specification and assessment criteria that follows is subject to change following supplier engagement. It outlines RSSB’s current proposed approach to ascertain the distance(s) at which train horns can be effectively heard considering environmental and topographical parameters.

A pre-tender suppliers meeting has been arranged for 28 February 2020 at 10:00 – 11:30, at RSSB’s offices in Moorgate, London. The purpose of this meeting is to:

* Provide an outline of the project proposal
* Provide interested suppliers an opportunity to discuss, understand and inform the research specification

Suppliers should be prepared to discuss the following:

* What resources (track access, etc) and information would suppliers require, in order to deliver robust outcomes?
* Are the timescales sufficient to deliver quality outputs to time?
* What are the challenges and barriers to delivering this work? What enablers would support successful delivery of the project?
* What is the estimated effort to deliver this work to quality and time?

Please note that following the suppliers meeting, RSSB may amend the document before publishing the invitation to tender.

Suppliers wishing to attend in person or by dialling into the meeting should contact [Tanja.Odinsen@rssb.co.uk](mailto:Tanja.Odinsen@rssb.co.uk) to confirm arrangements.

1. RSSB overview

RSSB is a membership organisation that supports the GB rail industry by:

* **Understanding risk** – Using safety intelligence with the latest risk modelling to inform members and support safe decision making.
* **Guiding standards** – Creating, reviewing and simplifying GB standards; managing the Rule Book and making it easier for the railway to deliver efficiently and safely.
* **Facilitating cross-industry collaboration** – As an independent cross-industry body, supporting activities which require collaboration such as supplier assurance schemes, confidential reporting and developing industry strategies.
* **Managing research, development and innovation** – Undertaking, commissioning and managing research and innovation programmes to address current and future needs and providing knowledge for decision making; supporting implementation and promoting step changes to deliver industry strategies.

1. Background
2. Project overview

Building upon documented requirements and previous studies, this project sets out to ascertain the distance(s) at which train horns installed and set within Technical Specifications for Interoperability (TSI) and Notified National Technical Rules (NTR) limits can be effectively heard by track workers, considering the anticipated range of environmental and topographical parameters.

1. Context

Audible warning devices (horns) are fitted to trains so that these can be utilised in a number of situations, including:

* To warn people[[1]](#footnote-1) that a train is about to move (in sidings, etc)
* When approaching anyone on or near the line
* As a train enters and leaves a tunnel
* When approaching some public foot crossings where there is no other form of warning available[[2]](#footnote-2)

1. Standards

A detailed overview of current technical standards related to the audibility of train horns is incorporated in Appendix A. Appendix A details the evolution of changes on the GB mainline and the reason for train horns with different audibility levels. The inclusion of this information is considered essential to contextualise the parameters, limits and methods used to set and test train horns.  
  
Appendix A explicitly references research commissioned to support changes to standards; and an overview of the rationale behind these changes.

1. Recent issues on the GB mainline

In 2019, there were numerous comments from track workers that raised concern on the effectiveness of audibility for compliant train horns[[3]](#footnote-3). This resulted in senior industry stakeholders and trade unions questioning the potentially reduced effectiveness of audibility for newer trains compared to older trains (for instance, the Class 43 HST).

RSSB undertook a desktop review[[4]](#footnote-4) in response to an industry query to detail the evolution of technical standards related to the audibility of train horns; and the rationale for trains with different audibility levels. Whilst the review focused on the acoustic characteristics (sound pressure levels) of train horns from a standards perspective, the review acknowledged that within the context of an operational railway, operational aspects and human factors can play a significant role in human perception of train horns. As such, further work was considered necessary to validate these assumptions.

Further to the above issues, a rolling stock manufacturer identified variability issues when undertaking compliant train horn testing within the same train class. As a result, concerns have been raised on the level of impact that train horn maintainability may have on testing.

1. Project objectives

Building upon documented requirements and previous studies (notably, the [2004 AEA Technology report ‘Audibility of warning horns’](https://www.sparkrail.org/Lists/Records/DispForm.aspx?ID=19844)), this project sets out to ascertain the distance(s) at which train horns installed and set within TSI and NTR limits can be effectively heard by track workers, considering the anticipated range of environmental and topographical parameters.

The project sets out to provide industry with the following project outputs:

* A defined list of independent variables (including but not limited to horn type, horn tonality, installed position, train speed (doppler effects), train noise, local environmental noise, local weather conditions, track geometry, distance) that could impact train horn audibility
* Evaluation of the influence that train horn maintenance may have on train horn audibility
* Assessment of the audibility of compliant horns under different operating, infrastructure and environmental conditions, validated from testing in an operational environment
* Good practice guide for train horn installation and test set up (in accordance with EN 15153-2)

1. Project scope

This section defines the tasks to be undertaken, and the technical content against which the submissions will be assessed.

In scope

**Stage 1: Literature review**

1. Establish known factors that influence train horn perceived audibility
   * Literature review of audibility testing and validation methodologies for warning systems undertaken in rail and other safety-critical industries (not limited to GB)
   * Review of available compliant horn test results to assess how requirements are interpreted, how compliance is verified, to determine the variability of interpretation and results. The review shall include (but not be limited to):
     + Horn set up
     + Train fitment variables
     + Number of repeats
     + Instrumentation
     + Weather conditions
     + Site arrangements
   * Review of incidents and close calls[[5]](#footnote-5) involving track workers and train horn audibility issues
     + Review of reports from train drivers (from the above incidents)
   * Defined list of verifiable requirements (independent variables) that could impact train horn audibility. This shall include (but not be limited to):
     + Horn type
     + Horn tonality
     + Installed position
     + Train speed (doppler effects)
     + Train noise
     + Local environmental noise
     + Local weather conditions
     + Track geometry
     + Distance

Rationale shall be provided for each verifiable requirement.   
Clarification shall also be provided to determine whether static testing can robustly be undertaken for each verifiable requirement without the need for a vehicle to be present (in reference to the testing conducted to assess the audibility at a distance from the train).

1. Establish the influence train horn maintenance[[6]](#footnote-6) has on static testing results
   * Evaluate how trains that are ready for first service, perform against older trains (within the same train class)
   * Assess restrictions to maintaining train horns (proximity to railway neighbours, etc)
   * Propose suitable mitigations that could lead to an improvement in train horn maintenance

**Stage 2:** **Numerical acoustic modelling and validation**

1. Propose and plan for a set of static and dynamic tests[[7]](#footnote-7) to determine the influence of factors that influence train horn perceived audibility. Carry out static and dynamic testing and analysis of factors that influence train horn perceived audibility using measurement equipment, to include (but not be limited to):
   * Horn type, horn tonality and installed position
   * Train speed (doppler effects) and noise
   * Local environment noise
   * Local weather conditions
   * Track geometry
   * Distance
2. Enhance/validate an existing numerical acoustic model, using compiled data to further quantify the factors that influence measured and perceived audibility levels. To support appropriate use of the model, the key influencing factors should be determined/re-affirmed.
3. Validate the audibility criteria stated in standards by testing in the operational environment using a sample of track workers[[8]](#footnote-8).
4. Produce analysis to support understanding of the factors that influence the audibility of compliant train horns by track workers.

On-going requirements

In addition to the above, the supplier will be required to undertake the following tasks during delivery (Stage 1 and Stage 2):

* Attendance at project kick-off meeting at RSSB’s offices (London)
* Attendance at four steering group meetings (at RSSB’s offices (London) or elsewhere)
* Presentation at three client group meetings (RSSB’s offices, London)
* Attendance at project closure meeting (at RSSB’s offices (London) or elsewhere)
* Creation and maintenance of project management plan
* Creation and maintenance of project risk register
* Provision of monthly progress reports

RSSB’s facilities can be provided to the supplier for meetings and/or workshops without cost (subject to RSSB meeting room availability). Where appropriate, meetings can be held elsewhere if RSSB considers this beneficial.

Out of scope

* Passengers’ perception of train horn audibility
* Members of the public (for example users of level crossings) perception of train horn audibility
* Development of new numerical acoustic model (a revised existing numerical acoustic model may be used)
* The effect of ear defenders and noise from tools and equipment used by the track workers
  + These factors will compromise horn audibility and should therefore be taken into account when establishing a safe system of work at a site.

1. Methodology

Tenderers should factor the following methodology requirements within their proposals:

* Static testing[[9]](#footnote-9) sound pressure levels shall be measured at a distance of 25m in accordance with EN 15153-2:2013 ‘Railway applications - External visible and audible warning devices for trains - Part 2: Warning horns’[[10]](#footnote-10), but with consideration of EN 15153-2:2020 ‘Railway applications - External visible and audible warning devices - Part 2: Warning horns for heavy rail’[[11]](#footnote-11)
  + Further to the above, readings beyond 25m (e.g. 400m, 800m etc) should also be undertaken to understand how installation variables affect sound projection; and to validate the numerical acoustic model
* Dynamic testing is to be undertaken to measure a variety of in-service train types (DMU, EMU etc) to measure background train noise and doppler effects[[12]](#footnote-12).
* Acoustic modelling is to be undertaken including testing to quantify or verify variables as appropriate
* Practical validation testing is to be undertaken with a representative panel of track workers[[13]](#footnote-13). The validation testing is expected to prove the acoustic model with respect to the layout (geography/topography) of the site being used for validation.

1. Project structure

This project is structured in two work packages, **of which Work Package T1205-02 is subject to competitive tender**.

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| Work Package T1205-01 | |
| **Title** | Relationship between train horn test measurements and perceived sound levels on the track – RSSB development of the project specification, investment paper and business case |
| **Delivery** | RSSB |
| **Start** | October 2019 |
| **Completion** | March 2020 |

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| **Work Package T1205-02** | |
| **Title** | **Relationship between train horn test measurements and perceived sound levels on the track – Project delivery** |
| **Delivery** | Supplier (competitive tender) |
| **Start** | May 2020 |
| **Completion** | February 2021 |
| **Stage gate review** | The delivery of this work package is separated into two stages to allow a stage gate review to be conducted.  A stage gate review will take place between Stage 1 and Stage 2, to enable RSSB and the project steering group to decide whether changes are required to the work conducted in Stage 2. This decision will be dependent upon:   * The findings of Stage 1 * The likelihood of securing access to industry assets and personnel to undertake testing for Stage 2   If RSSB and the project steering group decides that no work shall be undertaken in Stage 2, the stage gate review shall lead to early termination of the project. |

1. Deliverables

This work package will provide the following deliverables:

**Stage 1: Literature review**

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| **Deliverable Title** | Relationship between train horn test measurements and perceived sound levels on the track – Literature review |
| **Deliverable Type** | Report |
| **Description** | The literature review shall provide key findings relating to:   * Audibility testing and validation methodologies for warning systems undertaken in rail and other safety-critical industries (not limited to GB) * Review of available compliant horn test results to assess how requirements are interpreted, how compliance is verified, to determine the variability of interpretation and results (to be anonymised for publication) * Review of incidents and close calls involving track workers and train horn audibility issues * Defined list of verifiable requirements (independent variables) that could impact train horn audibility * Clarification whether static testing can robustly be undertaken for each verifiable requirement without the need for a vehicle to be present (in reference to the testing conducted to assess the audibility at a distance from the train) * Establishing the influence of train horn maintenance on compliant horn test results * Suitable mitigations that could lead to an improvement in train horn maintenance   The deliverable shall be used to directly inform Stage 2. |
| **Publication** | The deliverable is to be produced in the standard RSSB format and shall be reviewed by RSSB and the project steering group, to allow for comment. The deliverable is to be made widely available. |

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| **Deliverable Title** | Relationship between train horn test measurements and perceived sound levels on the track – Interim presentation |
| **Deliverable Type** | Presentation |
| **Description** | Summary presentation to highlight key findings from the literature review:   * The presentation is to be delivered to the project steering group * The presentation is to be prepared with notes to explain slide content |
| **Publication** | The deliverable is to be produced in the standard RSSB format and shall be reviewed by RSSB, to allow for comment. The deliverable is not to be published by RSSB. |

**Stage 2: Numerical acoustic modelling and validation**

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| **Deliverable Title** | Outputs from validated numerical acoustic model |
| **Deliverable Type** | Dataset (Excel output) |
| **Description** | A dataset from a validated numerical acoustic model that quantifies independent variables (including but not limited to horn type, horn tonality, installed position, train speed (doppler effects), train noise, local environmental noise, local weather conditions, track geometry, distance) that could impact train horn audibility. |
| **Publication** | The dataset output is to be made available in Microsoft Excel format. The dataset will not be published by RSSB. |

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| **Deliverable Title** | Relationship between horn test measurements and perceived sound levels on the track – Report |
| **Deliverable Type** | Report |
| **Description** | The report shall provide key findings relating to:   * Testing of independent variables (including but not limited to horn type, horn tonality, installed position, train speed (doppler effects), train noise, local environmental noise, local weather conditions, track geometry, distance) that influence train horn perceived audibility * Commentary on numerical acoustic model outputs * Validation of the distance(s) at which train horns installed and set within TSI and NTR limits can be effectively heard by track workers, considering the anticipated range of environmental and topographical parameters. * Analysis of the factors that influence the audibility of compliant train horns by track workers   The report is to use suitable infographics to convey key points to a wide audience. |
| **Publication** | The deliverable is to be produced in the standard RSSB format and shall be reviewed by RSSB and the project steering group, to allow for comment. The deliverable is to be made widely available. |

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| **Deliverable Title** | Guidance on test set ups and train horn installation variables |
| **Deliverable Type** | Good practice guide |
| **Description** | Guidance on test setups and train horn installation variables to enable an improvement in interpretation and testing consistency to EN 15153-2, especially with respect to undefined or unspecified parameters (e.g. horn type, installed position) that may affect the relationship between measured and perceived audibility levels. |
| **Publication** | The deliverable is to be produced in the RSSB template and shall be reviewed by RSSB and the project steering group, to allow for comment. The deliverable is to be made widely available. |

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| **Deliverable Title** | Relationship between horn test measurements and perceived sound levels on the track – Presentation |
| **Deliverable Type** | Presentation |
| **Description** | Summary presentation to capture project methodology, analysis and substantiated findings using suitable infographics to convey key points to a wide audience:   * The presentation is to be delivered to three cross industry client groups (Rolling Stock Standards Committee; Traffic Operation and Management Standards Committee; Infrastructure Safety Leadership Group) * The presentation is to be prepared with notes to explain slide content |
| **Publication** | The deliverable is to be produced in a format to be agreed by RSSB at the project kick-off meeting. The deliverable shall be reviewed by RSSB and the project steering group, to allow for comment. The deliverable will not be published by RSSB. |

1. Stakeholder roles and responsibilities

The key stakeholders and their responsibilities are detailed in the table below:

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| **Role** | **High level description** | **Specific responsibilities are to:** |
| RSSB Project Manager | The RSSB Project Manager is the first point of contact for the suppliers once the contract has been put into place.  The RSSB Project Manager is responsible for ensuring that the supplier delivers the project as agreed in their proposal. | * Organisation, co-ordination and chair of project meetings. * Monitoring and tracking of project progress and spend * Point of contact for escalation for enquiries from supplier, steering group, or project sponsor. * Dissemination of deliverables to project steering group and client group. * Authorisation of payment within agreed project spend. |
| RSSB Technical Lead | Throughout the project, the Technical Lead, generally an RSSB employee, ensures that technical aspects are considered and reflected accurately. | * Provide input to the specification, either by writing it or reviewing its content, and assure it is technically sound and appropriately scoped * Assess tenders * Review and provide input to draft deliverables * Review final deliverables to ensure that they are technically sound and the conclusions defensible |
| RSSB Sponsor | The RSSB Sponsor is a senior RSSB employee that is best placed to actively monitor the project through development and delivery, keeping the project aligned with and informed by industry's expectations and initiatives; and steers implementation facilitation activities. | * Sponsors the RSSB business case and implementation plan, focusing on how RSSB can support industry benefiting from the findings * Advises the Project Steering Group on shaping the project and its deliverables to most effectively support industry take up and to get most value out of it * Actively monitor the project through delivery working with the Industry Sponsor to successfully navigate the project through any points of conflict between stakeholders, and decision points relating to emerging findings * Keep active awareness of the emerging findings and, as appropriate, bring them (and any related decision points) to the attention of the Industry Sponsor to jointly provide advice to the steering group * Provide advice and steer on activities required to facilitate implementation |
| Industry Sponsor | The Industry Sponsor has a senior role in the industry and represents a stakeholder organisation that is expected to realise benefit from successful, timely delivery of the research or, as a minimum, has a strong interest in the research.  They are expected to act as a figurehead for the research, championing its importance and its outputs, and exerting pressure on the industry to ultimately adopt its findings. | * Advises the Project Steering Group on shaping the project and its deliverables to most effectively support industry take up * If required, facilitate access to industry data, people and equipment needed to deliver the project * Oversees the project through delivery working with the RSSB sponsor to successfully navigate the project through any points of conflict between stakeholders, and decision points relating to emerging findings * Promote industry take up and implementation of the research beyond completion of the R&D project * Provide feedback to RSSB during project delivery and after completion |
| Industry Supporters | The two project supporters represent parts of industry complementary to the Industry Sponsor’s organisation. | * Offer expertise during project development and delivery * If required, facilitate access to industry data, people and equipment needed to deliver the project * Support the implementation of findings |
| Project Steering Group | The Project Steering Group ensures the project is specified and delivered to take into account different stakeholders’ needs. The group is made up of representatives from within the rail industry and other industries where appropriate. | * Provides input to and reviews the ‘case for research’ (i.e. the business case, specification and implementation plan) * Monitors and steers the project through delivery * If required, facilitates access to industry data, people and equipment needed to deliver the project * Attends meetings with Project Team and suppliers * Reviews draft and final output(s) |
| Primary Client Group | The primary client group (Rolling Stock Standards Committee) is an established cross-industry group that has responsibility to steer and oversee activities in a specific topic area. | * Comment on research ideas and consider outcomes from idea review activities that RSSB undertakes * Endorse the findings and support their implementation |

1. Budget, timescales and responsibilities

The budget for this work is up to £140k. If, whilst compiling a response, tenderers determine that it is not feasible to submit a quote to this budget but still wish to provide a response, they shall:

* Provide a quote for all work as requested, even if this exceeds the budget. This allows RSSB to conduct a like-for-like comparison as required by the evaluation criteria. Those who price within RSSB’s budget will score more highly in line with the pricing calculation, however, higher bids will not be automatically disqualified.
* Provide a supporting explanation as to why an increase in budget is required to deliver the work to a good standard.

RSSB expects the work to start in May 2020 and to conclude in no more than nine months. However, these are indicative dates and RSSB will consider bids that cannot meet these expectations if the supplier includes a robust project plan and an explanation as to why they cannot meet the preferred start and end dates, while still meeting the project objectives.

1. Critical success criteria

The following critical success criteria have been identified to help ensure successful delivery and to increase likelihood of industry acceptance/implementation:

1. Defined list of independent variables (including but not limited to horn type, horn tonality, installed position, train speed (doppler effects), train noise, local environmental noise, local weather conditions, track geometry, distance) that could impact train horn audibility
2. Access to train horn test reports
3. Access to test facilities and rolling stock
4. Establishing the influence of train horn maintenance on compliant horn test results
5. Robust validation of the distance(s) at which train horns installed and set within TSI and NTR limits can be effectively heard by track workers, considering the anticipated range of environmental and topographical parameters
6. Selection and award criteria

**The stated limit on the length of each response must be adhered to. Responses will only be evaluated within the stated length limit, any response exceeding the stated limit will be disregarded beyond that limit.**

(Note: RSSB reserves the right to amend the Selection and Award criteria and will communicate any changes via the Guidance Notes to Tenderers when the tender goes live via Delta eSourcing).

Selection criteria

| **Selection criteria** | **Detail and Evaluation Criteria** |
| --- | --- |
| **S1** Tenderer’s organisational expertise in acoustic theory and practice in the rail industry  [Max 1 page for all examples] | The tenderer should provide a short description of at least one completed example within the past five years that focused on acoustic theory and practice in the rail industry.  In order to pass the selection criteria, the tenderer’s response must address the above and:   * Demonstrate a track record of successfully delivering work on acoustic theory and practice in the rail industry * Give RSSB full confidence in the tenderer’s ability to apply its knowledge and expertise on acoustic theory and practice in the rail industry * Have undertaken work involving acoustic modelling |
| **S2** Tenderer’s organisational expertise in on-site data gathering within the GB rail network  [Max 1 page for all examples] | The tenderer should provide a short description of at least one completed example within the past five years that focused on on-site data gathering within the GB rail network.  In order to pass the selection criteria, the tenderer’s response must address the above and:   * Demonstrate a track record of successfully delivering on-site data gathering within the GB rail network * Give RSSB full confidence in the tenderer’s ability to apply its knowledge and expertise on on-site data gathering within the GB rail network * Have undertaken site-based subjective acoustic testing using people |
| **S3** Insurance | Please confirm whether you meet RSSB’s minimum insurance requirements.  Employer’s (Compulsory) Liability Insurance = £5M  Public Liability Insurance = £1M  Professional Indemnity Insurance = £1M  Please provide your evidence of self-certification as an attachment using the filename:427185958\_YourSupplierName\_S3  Max response length: 2 A4 pages  Pass: You have answered 'Yes' and provided confirmation of self-certification  Fail: You have answered 'No' and not provided confirmation of self-certification |
| **S4** Modern Slavery | 4.1 Are you a relevant commercial organisation as defined by section 54 ("Transparency in supply chains etc.") of the Modern Slavery Act 2015 ("the Act")?  YES/NO  4.2 If you have answered yes to question 4.1 are you compliant with the annual reporting requirements contained within Section 54 of the Act 2015?  YES/NO/NOT APPLICABLE  If applicable, please provide your response as an attachment using the filename:427185958\_YourSupplierName\_S4  Max response length: 1 A4 page  Pass:  You have answered ‘NO’ to 4.1; or  You have answered YES to 4.1 and YES to 4.2; or  You have answered YES to 4.1 and NO to 4.2 and have included evidence of ‘self-cleaning’ which is acceptable to RSSB against the relevant ground for exclusion to which you have answered ‘NO’.  Fail:  You have answered Yes to 4.1 and NO to 4.2 and failed to provide evidence of ‘self-cleaning’, which is acceptable to RSSB, against the relevant ground for exclusion to which you have answered NO. |

Award criteria – scoring methodology

Each of the criteria set out in the weighted award criteria are scored 0-5. The below gives an explanation of the scoring system used:

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| **Grade** | **Definition of grade** |
| 5 | An Excellent Tender Response that (where applicable):   * Addresses all aspects of the question in an informed and comprehensive manner; * Demonstrates a thorough understanding of what is being asked for; * Provides evidence of how that understanding can be applied in practice; * Offers full confidence that the Tenderer will deliver the service in full; * Addresses the majority of areas of doubt and uncertainty; and * Provides certain, unambiguous commitments or statements of intent that permit reliance through translation into contractual terms |
| 4 | A Good Tender Response that (where applicable):   * Addresses all aspects of the question and is generally of a good standard; * Demonstrates a good understanding of what is being asked for; * Provides a worked-up methodical approach; * Offers confidence that the Tenderer will deliver the service in full, with limited areas of doubt or uncertainty; * Addresses key areas of doubt and uncertainty; and * Provides commitments that can be translated well into contractual terms |
| 3 | A Satisfactory Tender Response that (where applicable):   * Addresses the majority of the question and is generally of a good standard but lacks substance or detail in some areas; * Demonstrates an understanding of what is being asked for; * Provides a satisfactory approach; * Offers a general level of confidence that the Tenderer will deliver the service (but with room for doubt in some areas); * Address some areas of doubt and uncertainty; and * Provides some commitments that can be translated well into contractual terms. |
| 2 | A Poor Tender Response that (where applicable):   * Addresses some of the question but either lacks relevant information and detail or lacks substance in a manner that would suggest the response is a “model answer”; * Demonstrates some understanding but with a lack of clarity in key areas; * Provides an approach which is not wholly appropriate or viable or lacks evidence; * Shows that the level of confidence that the supplier can deliver does not outweigh the doubt; * Does not address many areas of doubt and uncertainty; and * Does not offer sufficient commitment (with doubt as to the extent to which would translate into contractual terms). |
| 1 | An Unsatisfactory Tenderer response that (where applicable):   * Does not address the question or has omissions; * Lacks understanding in significant areas: * Provides an approach which has gaps or creates concerns; * Shows that the level of confidence that the supplier can deliver is low; * Creates uncertainty; and * Displays significant lack of commitment (with doubt as to the extent to which would translate into contractual terms) |
| 0 | An Unacceptable Tenderer response that (where applicable):   * Provides no response or omissions/oversights that prevent scoring; * Refuses to deliver the requirement; and * Creates concerns so significant that the response would be detrimental to the interests of RSSB |

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| **Award criteria** | **Detail and Evaluation Criteria (** | **Weighting** |
| **W1** Summary of proposal  [Max 1 page] | Tenderers should outline their ability to concisely summarise key aspects of their proposal. The information will be used by RSSB to contextualise the tenderer’s response.  The tenderer’s response shall be evaluated on the following criteria within the maximum stated page limit:   * The tenderer has clearly outlined their understanding of the project’s objectives and outputs; * The tenderer has summarised their proposal (excluding any pricing information), outlining how it shall clearly address the project’s objectives and outputs. | N/A (For information only) |
| **W2** Supplier’s understanding and methodology  [Max 5 pages] | Tenderers should clearly outline their understanding and methodology to carry out the required works defined in the project specification.  The tenderer’s response shall be evaluated on the following criteria within the maximum stated page limit:   * The tenderer clearly demonstrates their understanding of each of the project objectives and outputs; * The tenderer presents a sound methodology to address each of the project objectives and to deliver each of the project outputs, detailing how it shall commit to ensuring the project and outputs are delivered to a sufficient quality; * The tenderer presents a viable and practical approach to:   + Assess the practical implementation of specified test requirements (in accordance with EN 15153-2), especially with respect to undefined or unspecified parameters (e.g. horn type, installed position) that may affect the relationship between measured and perceived audibility levels   + Define and quantify independent variables (including but not limited to horn type, horn tonality, installed position, train speed (doppler effects), train noise, local environmental noise, local weather conditions, track geometry, distance) that influence the relationship between measured and perceived audibility levels in the form of a numerical acoustic model   + Validate the relationship between measured and perceived audibility levels, enabling the assumptions from the 2004 AEA Technology report to be revisited and refined. * The tenderer addresses the success criteria in order to ensure successful project delivery and increased likelihood of industry implementation | 20% |
| **W3** Organisational experience andindividual expertise  [Max 4 pages] | Tenderers should clearly outline how their organisational experience and individual expertise can directly address the required works defined in the project specification.  The tenderer’s response shall be evaluated on the following criteria within the maximum stated page limit:   * The tenderer outlines relevant activities undertaken by their organisation, that demonstrates suitable experience to meet the project requirements; * The tenderer demonstrates what capabilities individual project team members will bring and how this shall contribute to successfully meeting the project’s objectives and outputs. To support RSSB’s evaluation, the tenderer shall provide a one-page CV for each key project member within an appendix.   + **The tenderer must not provide names of any team members or CVs unless that person is expected to have a role in the project** | 20% |
| **W4** Project management: Planning and engagement  [Max 4 pages] | Tenderers should outline the processes and resources it proposes to use in order to fulfil RSSB’s requirements.  The tender’s response shall be evaluated on the following criteria within the maximum stated page limit:   * The tenderer provides adequate allocation of resource to successfully deliver outcomes to time, cost and quality[[14]](#footnote-14). To support RSSB’s evaluation, the tenderer shall provide:   + A Gantt chart detailing key tasks and timeframes   + A resource table that details task, role, name and effort (in days). The table should include total effort (in days). * The tenderer provides a clear engagement plan detailing:   + Which stakeholders it intends to engage with   + When (and how) it intends to engage with stakeholders   + What input it shall seek from stakeholders   + A ranking of stakeholders by order of priority, outlining how the stakeholders will have impact on successful delivery of the project. | 20% |
| **W5** Risks and opportunities  [Max 3 pages] | Tenderers should detail what risks and opportunities[[15]](#footnote-15) are foreseen in the delivery of the project.  The tenderer’s response shall be evaluated on the following criteria within the maximum stated page limit:   * The tenderer shall provide a risk and opportunities table which at minimum details appropriate risk, opportunity, probability, mitigation, impact and owner. * Through the risk and opportunities table, the tenderer shall:   + Identify effective mitigation actions with regards to each risk, stating how it shall respond if the risk is realised   + Identify approaches to maximising any opportunities through effective management. | 10% |
| **W6** Cost of project | Tenderers should provide a fixed cost for the project and the associated cost break down.  The tender with the lowest total cost will receive 100% of the available weighted score (30%). Other tenderers will receive a pro-rated score relative to the lowest cost according to the following formula:   * Score of other tender = lowest tender total cost / other tender total cost x 100%. | 30% |

1. Procurement timeline

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|  | **Start Date** |
| Supplier engagement meeting | 28 February 2020 |
| Request for proposal issued on Delta eSourcing | 2 March 2020 |
| Supplier clarification questions deadline | 30 March 2020; *12:00* hours |
| **Deadline for Submitting tenders** | **2 April 2020; *15:00*** |
| Evaluation and moderation | 17 April 2020 |
| Estimated notification of award decision | 27 April 2020 |
| Target contract commencement date | 13 May 2020 |

Note: RSSB reserves the right to amend these dates as business requirements demand and will communicate any changes to tenderers.

1. Appendix A: Details of the evolution of technical standards related to the audibility of train horns

**Current legislative regime and associated standards**

All new, renewed or upgraded vehicles are required by Railway (Interoperability) Regulations 2011 (as amended) to comply with relevant Technical Specifications for Interoperability (TSIs) and Notified National Technical Rules (NNTRs) which are contained in Railway Group Standards (RGSs) for the GB Mainline Network.

Clause 4.2.7.2.1 of the ‘Rolling Stock – Locomotives and Passenger Rolling Stock’ (LOC&PAS)’ TSI (Commission Regulation (EU) No 1302/2014) mandates that *‘Trains shall be fitted with warning horns in order to make the train audible’*, with the intention for warning horns ‘*to be recognisable as being from a train and not… similar to warning devices used in road transport or as factory or other common warning device.’*

Railway Group Standard GMRT2131 Issue 1 ‘Audibility and Visibility of Trains’ (2015) states that *‘an approaching train needs to be clearly audible and recognisable as a train to members of the public and trackside staff … for a distance of at least 400 m along the track. This condition is considered adequately fulfilled if the warning horn sound pressure levels specified further in* [GMRT2131 Issue 1] *are achieved when measured using the method specified in* [GMRT2131 Issue 1]*’*.

Methods, parameters and limits mandated by TSIs and NNTRs govern the emitted frequency range and sound pressure levels (SPL) measured at a specific distance from the subject vehicle in an unobstructed area. The test conditions isolate many variables so that the installation and setting on the train can be assessed.

Clause 4.2.7.2.2 of the LOC&PAS TSI specifies the SPL from each horn fitted to a train. The TSI mandates compliance to EN 15153-2:2013 ‘Railway applications - External visible and audible warning devices for trains - Part 2: Warning horns’ which sets out the detailed requirements for SPL. The verification measurement in line with the EN is taken at 25m distance when the train is stationary, measured using a C-weighting filter[[16]](#footnote-16) [[17]](#footnote-17). The need to comply with TSIs or NNTRs does not apply retrospectively; therefore in the context of comparators with older rolling stock (for instance, Class 43s), older rolling stock are unlikely to have been designed to standards identical to TSIs or current NNTRs, while modern rolling stock (for instance, Class 800s) will be TSI and NNTR compliant.

EN 15153-2:2013 is expected to be superseded by EN 15153-2:2020 'Railway applications - External visible and audible warning devices - Part 2: Warning horns for heavy rail' by late July 2020 at the latest.

**GB uniqueness codified in a Specific Case in the TSI**

GB has a Specific Case in the LOC&PAS TSI (Clause 7.3.2.9) to permit the use of SPLs as specified in an NNTR[[18]](#footnote-18). The NNTR is GMRT2131 Issue 1, which permits the use of lower SPL (compared to the EU wide requirement) on trains travelling below 160 km/h (100 mph). At speeds higher than 160 km/h, GMRT2131 Issue 1 retains the same limits as specified in EN 15153-2, i.e. aligned with EU wide requirements.

The work around this area had significant industry and wider stakeholder engagement as GB had to formally request and get approval for a Specific Case from the EU for lower SPLs. The reason for the Specific Case was due to the greater proximity of neighbours to railway networks in GB and the balance of the impact on the health of neighbours vs. effectiveness of the SPLs to aid audibility of trains in an operational railway.

**The GB basis for specified lower SPL values for speeds lower than 160km/h**

The limits in GMRT2484 Issue 1 ‘Audibility Requirements for Trains’ (2005) were specified following research undertaken for RSSB and published in the 2004 report ‘[Audibility of Warning Horns’](https://www.sparkrail.org/Lists/Records/DispForm.aspx?ID=19844)[[19]](#footnote-19). The levels specified were found to be high enough to ensure adequate audibility at 400m from the train whilst not causing excessive annoyance to neighbours. The report concluded that the environmental impact could be reduced with the horns still clearly audible at 400m by using devices that are quieter than those that were specified for speeds of 160 km/h or less at that time[[20]](#footnote-20).

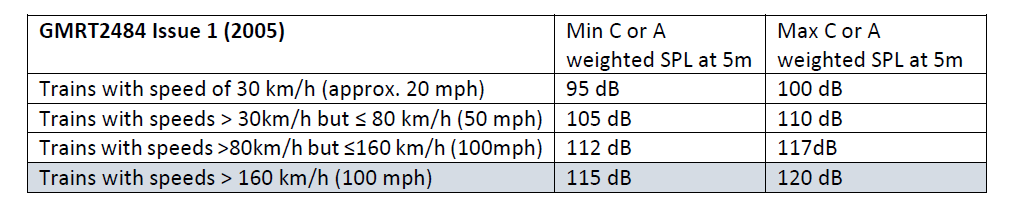
For the investigation, the following four basic models were used:

* Propagation of sound over a boundary with non-infinite acoustic impedance
* Diffraction of sound around the front of a train
* A statistical model of the background noise near a Railway
* The hearing of a warning in a masking background comprising the hearing threshold and the ambient noise

This information was combined with measured data to answer a number of questions including:

* The effect of the height of the horn
* The effect of the ground impedance
* The best position to measure the sound pressure levels produced by the horn
* The sound output required from a variety of warning devices to ensure they were just clearly audible

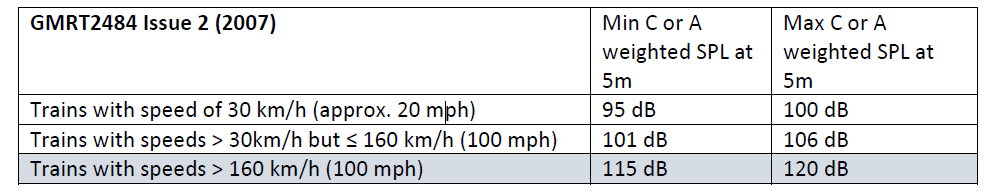
The 2004 ‘Audibility of Warning Horns’ report examined measures and predicted SPLs for Classes 153, 308, 309, 312, 375/377, 458, 465, 91 with various assumptions of ground conditions, background noise and acoustic impedance. It concluded that in all cases trains would be clearly audible at 400m and remain so even at 800m.

The table below[[21]](#footnote-21) sets out the SPLs in GMRT2484 Issue 1:

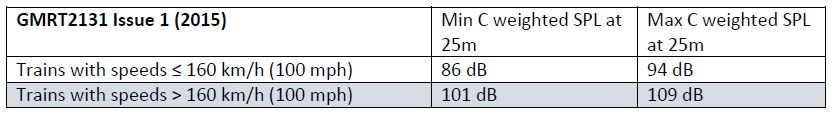
RSSB project [T668 ‘Research into the safety benefits of train horn use at level crossings’](https://www.sparkrail.org/Lists/Records/DispForm.aspx?ID=532) (2006) examined the use of horns near whistle boards. The introduction of new types of rolling stock from the year 2000 (which had train horns that were louder than some older trains) had contributed to a significant increase in the number of noise complaints from residents living near crossings with whistle boards. Two specific issues the work had to investigate were the possibility of introducing ‘quiet periods’ in which sounding of the train horn would not be mandatory (which was eventually reflected in the Rule Book), and the possibility of reducing the loudness of the newer horns.

The sound pressure levels from horns used on earlier types of rolling stock were considered as broadly acceptable based on surveys of railway neighbours as documented in RSSB project [T681 ‘Understanding the problems that train horn noise causes to neighbours’](https://www.sparkrail.org/Lists/Records/DispForm.aspx?ID=543) (2006). The typical sound pressure levels from horns used on earlier types of rolling stock levels were used as the basis for revised minimum sound pressure levels in GMRT2484 Issue 2 ‘Audibility Requirements for Trains’ (2007).

T668 concluded that it found no evidence that a reduction in sound pressure levels would lead to a significant change in the risk to crossing users. Alerting people on or about the line of the approach of trains using warning horns was not considered to be the only control measure related to this risk. Provision of lookouts, warning signs at footpath crossings and lineside security were some examples of the other controls in place to manage the risk of being struck by trains.

Therefore, GMRT2484 Issue 2 had the following dB levels (11 dB lower for 80km/h to 160 km/h range and 4 dB lower for 30 km/h and 80 km/h range compared to SPLs set out in GMRT2484 Issue 1)[[22]](#footnote-22) [[23]](#footnote-23):

**The basis for different SPLs set in current RGS GMRT2131 Issue 1 compared to GMRT2484 Issue 2**

The values from the current standard GMRT2131 Issue 1 are summarised in the table below[[24]](#footnote-24) [[25]](#footnote-25):

The SPLs in GMRT2131 Issue 1 are equivalent to the SPLs defined in the predecessor standard GMRT2484 Issue 2. The numbers appear to be lower because GMRT2484 values are for tests at 5m while GMRT2131 is aligned with the EU testing regime at 25m.

Additionally, GMRT2484 also permitted measurements using an A-weighting compared to C-weighting in the newer standard which aligns with the EN; and C-weighting was considered more aligned to measuring louder sounds. According to the 2004 ‘Audibility of Warning Horns’ report, there should be a negligible difference in results for the two weightings.

**Testing**

Testing of train horns is done in line with the EN which is referenced from the TSI (i.e. it is compulsory). Train horns are an Interoperability Constituent (IC), as such, some design aspects of the horns can get certified independently from requirements applying to a vehicle. The horn frequency can be tested without installation on a train. However, SPLs are tested with the horn (sample based) installed on a train. Acoustic measurements of warning horns are carried out with the horns mounted to stationary rail vehicles in an open, flat site. Neither acoustically reflective nor acoustically absorbing surfaces are allowed in the test site, and the procedures must account for background noise to ensure accurate testing. A controlled environment is essential to ensure accurate testing.

The notes of the audible warning horns are intended to be recognisable as being from a train and not be similar to warning devices used in road transport, factories or other common warning devices.

Sound pressure levels are measured at a distance of 25m, with a relative tolerance of ± 0.8 % from the front of the train along the centre-line of the track, at a height of 1.6m, with a relative tolerance of ± 3% above the upper surface of the rail, and over a ground covering of ballast.

**Installation**

There are no specific horn installation related requirements or guidance in GMRT2131 Issue 1 or EN 15153-2:2013. The TSI provides very general requirements such as *‘Trains shall be fitted with warning horns in order to make the train audible’* and protection requirements such as *‘Warning horns and their control systems shall be designed or protected, so far as is practicable, to maintain their function when impacted by airborne objects such as debris, dust, snow, hail or birds.’* Nothing more specific is provided or required.

**Conclusion of a recent review of GMRT2131**

GMRT2131 Issue 1 was published in December 2015 and underwent a basic 12-month review in February 2017. The review and its conclusions/recommendations were approved by relevant Standards Committees where all industry constituents are represented and at that time the requirements were deemed to be fit for purpose.

**Potential reasons why HSTs (Class 43s) are louder than newer trains**

Trains will normally comply with the relevant requirements when designed or upgraded. If requirements change subsequently these will not normally be retrospectively applied. GMRT2484 Issue 2 was published in 2007, while GMRT2484 Issue 1 was published in 2005, therefore any vehicles with train horns built to requirements prior to these dates and prior to GB getting a Specific Case could have significantly higher SPLs. To illustrate this, the SPLs in British Rail Board group standard GMTT0163 Issue 1 ‘Visibility and Audibility of Trains on the Track’ (1994) were the SPL figures that were retained until the reduced SPLs in GMRT2484 Issue 1 (2005). The original SPL for soft mode[[26]](#footnote-26) was a minimum of 115 dB and a maximum of 119 dB for all speeds which was nearly the same as those in the EN for greater than 160 km/h even today. However, for loud mode[[27]](#footnote-27) the original SPLs were 7 - 8 dB higher for both above and below 160 km/h compared to those in GMRT2484 Issue 1. Although current SPL levels are lower, they are underpinned by the assumptions (based on the 2004 report ‘Audibility of Warning Horns’ and RSSB project T668) that even with lower SPLs requirements in standards, the trains remain audible enough at 400m (which was the original outcome-based criterion in the early set of standards) even if they may not be the *‘most audible’* compared to other trains.

1. Passengers, members of the public and railway personnel [↑](#footnote-ref-1)
2. Audibility of Warning Horns, Final Report, AEATR-PC&E-2004-002 Issue 3, AEJ Hardy, April 2004, PG 1 [↑](#footnote-ref-2)
3. Including, but not limited to the Western and LNE routes [↑](#footnote-ref-3)
4. See Appendix A [↑](#footnote-ref-4)
5. RSSB is to provide data to the supplier [↑](#footnote-ref-5)
6. I.e. inspecting (and where necessary) retaining train horn equipment to ensure the required sound pressure levels can be achieved [↑](#footnote-ref-6)
7. Access to sites is to be provided through key project stakeholders [↑](#footnote-ref-7)
8. Access to track workers is to be provided through key project stakeholders [↑](#footnote-ref-8)
9. Measurement equipment shall not be provided by RSSB [↑](#footnote-ref-9)
10. RSSB cannot share EN 15153-2:2013 with tenderers due to copyright, tenderers will have to purchase/acquire the document without RSSB’s assistance. [↑](#footnote-ref-10)
11. EN 15153-2:2020 shall supersede EN 15153-2:2013 by July 2020 at the latest. RSSB cannot share EN 15153-2:2020 with tenderers due to copyright. [↑](#footnote-ref-11)
12. Track access is to be provided through key project stakeholders [↑](#footnote-ref-12)
13. Access to track workers is to be provided through key project stakeholders [↑](#footnote-ref-13)
14. For clarity, ‘quality’ is defined as the delivery of robust outputs that successfully meet the project’s objectives [↑](#footnote-ref-14)
15. For clarity, ‘opportunities’ is defined as an upside, beneficial source of risk [↑](#footnote-ref-15)
16. Weighted sound pressure level: *‘A numeric value of the sound pressure level after frequency weighting to simulate the frequency response of the human ear’* - GMRT2131 Issue 1 (Audibility and Visibility of Trains, 2015, PG 31) [↑](#footnote-ref-16)
17. C-weighting correlates better with the human response to high noise levels compared to other weightings [↑](#footnote-ref-17)
18. i.e. GB is permitted to do something different to the TSI in a domestic context [↑](#footnote-ref-18)
19. Audibility of Warning Horns, Final Report, AEATR-PC&E-2004-002 Issue 3, AEJ Hardy, April 2004 [↑](#footnote-ref-19)
20. GMRT2180 Issue 3 ‘Visibility and Audibility Requirements for Trains’ (2000) had two SPL modes. For soft mode the SPL was a minimum of 115 dB (decibel) and a maximum of 119 dB for all speeds. For loud mode, the SPLs were 7 - 8 dB higher for both above and below 160 km/h compared to those in GMRT2484 Issue 1. All testing was done with a C-weighting only. [↑](#footnote-ref-20)
21. The row highlighted in grey is where the GB and EU are aligned [↑](#footnote-ref-21)
22. ‘Trains with speeds > 30km/h but ≤ 160 km/h (100 mph)’ as specified in the GB A-deviation in EN 15153-2:2013 Annex D [↑](#footnote-ref-22)
23. ‘Trains with speeds > 160 km/h (100 mph)’ as specified in EN 15153-2:2013 [↑](#footnote-ref-23)
24. ‘Trains with speeds ≤ 160 km/h (100 mph)’ as specified in the GB A-deviation in EN 15153-2:2013 Annex D [↑](#footnote-ref-24)
25. ‘Trains with speeds > 160 km/h (100 mph)’ as specified in EN 15153-2:2013 [↑](#footnote-ref-25)
26. *‘[Warning] horns shall… include a “soft” mode for use at low speeds’* – GMTT0163 Issue 1, 1994, PG 16 [↑](#footnote-ref-26)
27. *‘Warning horns on trains designed to exceed 160 km/h shall produce a “loud” sound to warn people on the track of their approach at high speed’* - GMTT0163 Issue 1, 1994, PG 16 [↑](#footnote-ref-27)