

TECHNICAL SPECIFICATION

NOISE BARRIER ELEMENTS

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DEFINITIONS

The following terms are used throughout this document:

Term	Definition
Principal	RB Rail AS.
Purchaser	Either the Principal and/or any of the Implementing Bodies as the case may be, which procure the Noise Barriers in compliance with the Agreement from the Supplier.
Supplier	The company, which is engaged by the Principal as an independent professional Supplier to perform the obligations envisaged under the Agreement towards the other Parties.
Producer	Entity who carries out the production process of Noise Barrier elements.
Implementing Body	RB Rail Estonia, EDZL and Rail Baltica Statyba, LTG Infra.
Contractor	Entity contracted by any Implementing Body to carry out construction works and/or material base management.
Delivery Point	Any delivery location indicated by the Principal.
Structural Element	Element whose primary function is to hold in place acoustic elements.
Noise Barrier	Wall-shaped constructions that, placed between the source of noise and the receiver, allow to reduce the sound levels at the area to be protected. It serves as a noise reducing device, which obstructs the direct transmission of airborne sound emanating from railways; it should span the railway. Noise barriers are generally made of acoustic and structural elements.
Absorbing Acoustic Panel	A panel used to mitigate background noise and reduce the reverberation and echo in a space by absorbing the sound waves.
Reflective Acoustic Panel	A panel used to mitigate background noise on one side of the panel by reflecting the sound waves back to the noise source.
Rail Baltica Line	A new railway line connecting the three EU Member States - Estonia, Latvia and Lithuania, and connecting them to the Central European railway network (provided by the Rail Baltica project).
Sound Absorption Index	The measure of the amount of energy removed from the sound wave as the wave passes through a given thickness of material.
Sound Insulation Index	The ability of building elements or structures to reduce sound transmission and is measured over a range of frequencies.
Sound Reflection Index	Sound reflection under specified sound field conditions
Declaration of performance (DoP)	A document to be drawn up and issued by the Producer. The content of DoP and the conditions are strictly ruled by Construction Products Regulation 305/2011 (CPR).
Yellowing Index	A number calculated from spectrophotometric data that describes the change in colour of a test sample from clear or white to yellow. This test is commonly used to evaluate colour changes in a material caused by real or simulated outdoor exposure.
Luminous Transmittance	The ratio of the luminous flux transmitted by a body to the flux incident upon it.

Mock-up Model	A demonstration model that reproduces a fragment of the structure in full size, using the same materials as the eventual finished product. These models help to better understand the detailing, visual, acoustic, and structural aspects of a structure before actual construction/assembly begins.
Design Working Life	Assumed period for which a structure or part of it is to be used for its intended purpose with anticipated maintenance but without major repair being necessary.
Acoustic Working Life	Period during which the declared acoustic performance index levels of the device will be maintained.

1 Introduction

1.1 Scope

1. This Technical Specification defines the requirements for the manufacture and supply of Noise Barrier elements - acoustic panels (including gaskets, sealants, and fasteners necessary for assembly and installation) and structural steel posts with welded base plates, intended to be used in the construction of Rail Baltica Line.
2. This Technical Specification is applicable to the following types of the Noise Barriers:
 - 2.1. Metal Absorbing Noise Barriers;
 - 2.2. Wooden Absorbing Noise Barriers;
 - 2.3. Transparent Reflective Noise Barriers.

1.2 Layout

3. Noise Barriers used in the vicinity of the Rail Baltica Line are intended to be used to reduce/block the noise transmission from train traffic to the surroundings, they will also be an element of Rail Baltica Line identity.
4. The Noise Barrier structure shall consist of:
 - 4.1. Modular absorbing/reflective panels made up of the corresponding materials defined by this document;
 - 4.2. Modular panel framing system (if necessary) and fasteners;
 - 4.3. Standardized vertical steel profiles with welded base plates;
 - 4.4. Concrete pile foundations – outside the scope of this Technical Specification (TS);
 - 4.5. Foundation beams - outside the scope of this TS;
 - 4.6. Cast-in anchors and/or chemical anchors, self-locking nuts, and lock washers - outside the scope of this TS.
5. Modular acoustic panels shall be arranged between standardized steel profiles. The modular panels have the acoustic function while the standardized steel profiles constitute the support structure. These profiles will be attached to the foundation by means of anchor bolts and fixed with self-locking nuts and lock washers.

1.3 Design Working Life

6. The intended Working Design Life of Noise Barrier elements shall be:
 - 6.1. 50 years for the supporting structural steel vertical profiles and base plates;
 - 6.2. 25 years for the acoustic panels, supporting systems and fastenings;
 - 6.3. 25 years for sealants and gaskets.

1.4 Quality Assurance and Control

7. The Producer shall ensure that the goods/supplies are in conformity with the Conformité Européenne (CE) marking requirements for their supplied goods if such goods are identified under the applicable product groups listed by the European Commission. The CE marking conformity verification system for noise barriers is type 3

of the Construction Products Regulation 305/2011/ EU which requires an initial test of the product in a notified laboratory and a factory production control.

8. Producer must be ISO 9001 certified.
9. Field testing of the acoustic properties of the fully installed Noise Barriers might be carried out by the Contractor according to the provisions of Environmental Impact Assessment report, a representative of the Producer must be present in such cases.
10. Manufacturer representative shall oversee the installation process – the frequency of site visits shall be agreed upon with the Principal in advance.

2 Normative References

The following documents, in whole or in part, are normatively referenced in this section of the Technical Specifications and are indispensable for its application. Latest edition of the referenced document (including any amendments and respective national annexes) applies:

Ref.:	Document number:	Document title:
1.	EN 1317-2:2010	Road restraint systems- Part 2: Performance classes of safety barriers, including vehicle parapets, acceptance criteria for impact tests and test methods.
2.	EN 16272-1:2012	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation - Test method for determining the acoustic performance - Part 1: Intrinsic characteristics - Sound absorption in the laboratory under diffuse sound field conditions.
3.	EN 16272-2:2012	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation - Test method for determining the acoustic performance - part 2: intrinsic characteristics - Airborne sound insulation in the laboratory under diffuse sound field conditions.
4.	EN 16272-5:2014	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation - Test method for determining the acoustic performance - Part 5: Intrinsic characteristics - In situ values of sound reflection under direct sound field conditions
5.	EN 16272-6:2014	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation - Test method for determining the acoustic performance - Part 6: Intrinsic characteristics - In situ values of airborne sound insulation under direct sound field conditions
6.	EN 16727-1:2018	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation – Non-acoustic performance - Part 1: Mechanical performance under static loadings - Calculation and test method
7.	EN 16727-3:2017	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation – Non-acoustic performance - Part 3: General safety and environmental requirements
8.	EN 1992-1-1:2004+A1:2014	Eurocode 2: Design of concrete structures. General rules and rules for buildings.
9.	EN 16951-1:2018	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation - Procedures for assessing long term performance - Part 1: Acoustic characteristics.
10.	EN 16951-2:2018	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation - Procedures for assessing long term performance - Part 2: Non-acoustic characteristics.
11.	EN 1991-2:2003	Eurocode 1: Actions on structures - Part 2: Traffic loads on bridges
12.	EN 1991-1-3:2003+A1:2015	Eurocode 1. Actions on structures General actions. Snow loads

13.	EN 1991-1-4:2005+A1:2010	Eurocode 1. Actions on structures General actions. Wind loads
14.	EN 16727-2-1:2018	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation – Non-acoustic performance - Part 2-1: Mechanical performance under dynamic loadings due to passing trains - Resistance to fatigue
15.	EN 14388:2015	Road traffic noise reducing devices
16.	EN 1793-1:2018	Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 1: Intrinsic characteristics of sound absorption under diffuse sound field conditions
17.	EN 1793-2:2017	Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 2: Intrinsic characteristics of airborne sound insulation under diffuse sound field conditions
18.	EN 1794-1:2018, Annexes A-E	Road traffic noise reducing devices. Non-acoustic performance Mechanical performance and stability requirements
23.	EN 1794-2:2020, Annexes A-B	Road traffic noise reducing devices – Non-acoustic performance Part 2: General safety and environmental requirements
24.	EN 1993-1-1:2005+A1:2014	Eurocode 3. Design of steel structures General rules and rules for buildings
25.	EN 1993-2: 2006	Eurocode 3. Design of steel structures Steel bridges
26.	EN 1992-2:2005	Eurocode 2 - Design of concrete structures - Concrete bridges - Design and detailing rules
27.	EN 1993-1-8:2005	Eurocode 3. Design of steel structures Design of joints
28.	EN 1999-1-3:2007+A1:2011	Eurocode 9: Design of aluminium structures - Part 1-3: Structures susceptible to fatigue
29.	ISO 9223:2012	Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation
30.	EN 1090-1:2009+A1:2011	Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structural components
31.	EN 1090-2:2018	Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures
32.	EN 10365:2017	Hot rolled steel channels, I and H sections. Dimensions and masses
33.	ISO 1461:2022	Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods
34.	EN 1011-1:2009	Welding - Recommendations for welding of metallic materials - Part 1: General guidance for arc welding
35.	ISO 15609-1:2019	Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding
36.	EN 10204:2004	Metallic products - Types of inspection documents

37.	EN 16727-2-1:2018	Railway applications - Track - Noise barriers and related devices acting on airborne sound propagation – Non-acoustic performance - Part 2-1: Mechanical performance under dynamic loadings due to passing trains - Resistance to fatigue
38.	DB RIL 804.5501	Noise protection systems on railway lines
39.	ISO 1183-1:2019	Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pycnometer method and titration method
40.	ISO 527-2:2019	Plastics — Determination of tensile properties — Part 1: General principles
41.	ISO 178:2019	Plastics — Determination of flexural properties
43.	ASTM D-696-16	Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between –30°C and 30°C with a Vitreous Silica Dilatometer
44.	ASTM D1003-21	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics
45.	ASTM E313-20	Standard Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates
46.	EN 12206-1:2021	Paints and varnishes. Coating of aluminium and aluminium alloys for architectural purposes Coatings prepared from thermosetting coating powder
47.	EN 573-3:2019+A1:2022	Aluminium and aluminium alloys - Chemical composition and form of wrought products - Part 3: Chemical composition and form of products
48.	EN 13501-1:2018	Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests
49.	ISO 29767:2019	ISO 29767:2019 - Thermal insulating products for building applications - Determination of short-term water absorption by partial immersion
50.	ISO 16535:2019	Thermal insulating products for building applications - Determination of long-term water absorption by immersion
51.	EN 10034:1993	Structural steel I and H sections - Tolerances on shape and dimensions
52.	EN ISO 11600:2003	Building construction - Jointing products - Classification and requirements for sealants

3 Requirements for noise barriers and elements

3.1 Geometry

11. The layout of the noise barriers is as depicted in Figure 1, where:

L – distance between vertical structural posts

h_{panel} – height of modular acoustic panel

H_{total} – total height of noise barrier.

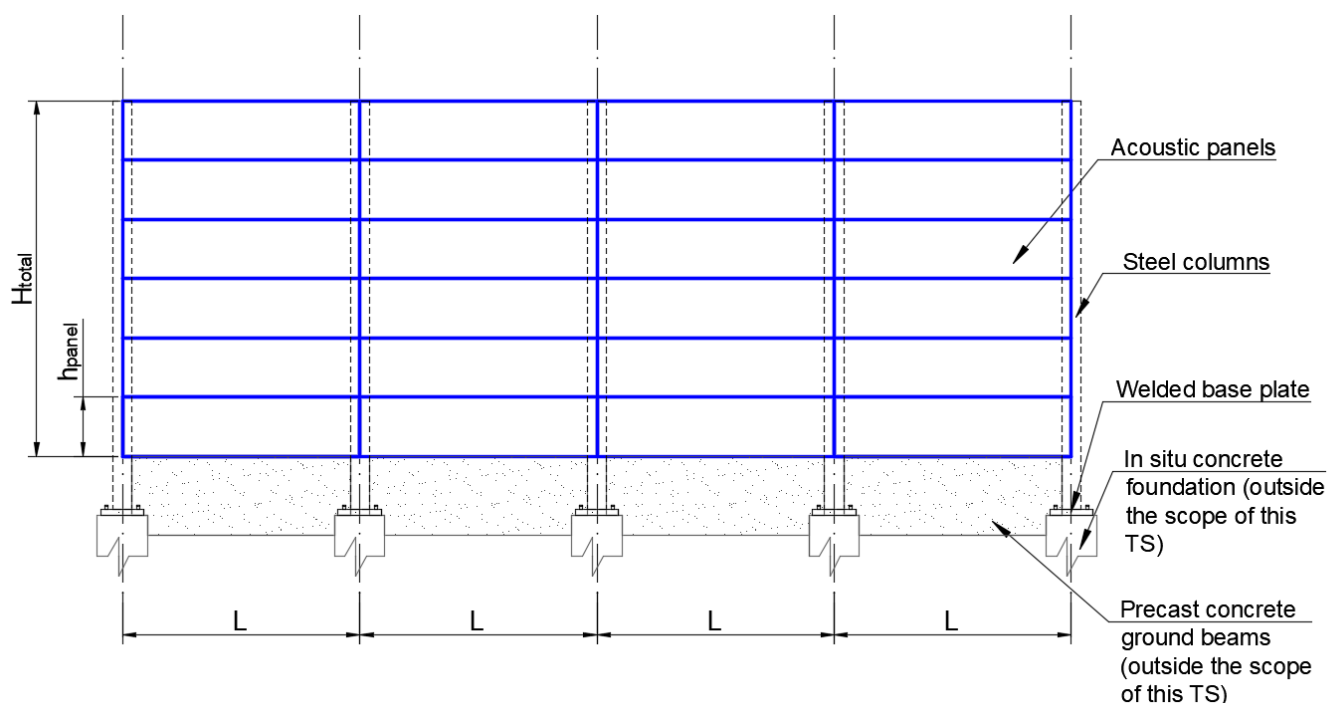


Figure 1: General layout of Noise Barriers

12. Specific geometry requirements for each kind of noise barrier are included in sections 3.1.1., 3.1.2. and 3.1.3.

3.1.1 Metal Absorbing Noise Barriers

13. Metal Absorbing Noise Barriers shall consist of vertical steel posts (including caps) with sandwich type metal modular panels fixed between them. The design and geometrical characteristics of the modular panels may vary depending on the data provided in Annex 1.
14. Distance between vertical structural posts (L) shall vary according to the data provided in Annex 1, length of the modular panels should be fitted to match the appropriate distances between the support structure elements.

The total height of noise barriers (H_{total}) may vary according to the data provided in Annex 1. The barrier height shall constitute of the appropriate number of acoustic panels with the defined height (h_{panel}) – see Annex 1.

15. Dimensions and geometrical parameters of up to 30% of all panels can vary according to mainline detailed technical design changes.

3.1.2 Wooden Absorbing Noise Barriers

16. Wooden Absorbing Noise Barriers shall consist of vertical steel posts (including caps) with sandwich type wooden modular panels fixed between them. The design and geometrical characteristics of the modular panels may vary depending on the data provided in Annex 1.
17. Length of the modular panels shall vary in order to match the distance between vertical posts (L) (defined in design).
18. The total height of noise barriers (H_{total}) may vary according to the data defined in Annex 1. The barrier height shall constitute of the appropriate number of acoustic panels with the defined height (h_{panel}) – see Annex 1.
19. Dimensions and geometrical parameters of up to 30% of all panels may vary according to mainline detailed technical design changes.

3.1.3 Transparent Reflective Noise Barriers

20. Transparent Reflective Noise Barriers shall consist of vertical steel posts with polymeric (Polymethyl methacrylate (PMMA) or Polycarbonate (PC)) panels attached between them. The transparent panels shall be fixed to a support frame made up by extruded aluminium alloy profile system. The design and geometrical characteristics of the transparent panels may vary depending on the design solution defined in Annex 1.
21. Distance between vertical posts (L) may vary according to the data provided in Annex 1, length of the transparent panels should be fitted to match the appropriate distances between the support structure elements.
22. The total height of noise barriers (H_{total}) may vary according to the data provided in Annex 1. The barrier height shall constitute of the appropriate number of acoustic panels with the defined height (h_{panel}) – in case of placing panels with different heights on top of each other in a vertical line, the panels with bigger height should be placed on bottom.
23. Dimensions and geometry of the transparent panels shall allow for easy assembly and disassembly in the support profiles and the constructive solutions of the frame, the design solution must allow easy repairs and/or replacement of the affected section in the event of damage.
24. Dimensions and geometrical parameters of up to 30% of all panels can vary according to mainline detailed technical design changes.

3.2 Technical requirements

3.2.1 Maximum design loads

25. The Noise Barrier structure shall withstand the design loads which shall be calculated by using the appropriate load cases and partial factors according to EN 1990 for the characteristic load values listed in Table 1.
26. Producer shall carry out static calculations for the whole structure and Noise Barrier elements and fastenings for the specific geometries, including distance between structural posts and height of Noise Barrier.

Table 1: Characteristic loads acting on Noise Barriers

Load type	Characteristic load value
Self-weight	Depends on panel type
Wind load	Shall be calculated according to EN 1991-1-4.
Dynamic load of snow clearance	Load of 15 kN applied to a 2x2m surface area (worst case scenario)
Dynamic loads due to passing trains	Shall be calculated according to Section 6.6. of EN 1991-2.

27. ULS and SLS load cases with appropriate partial factors shall be considered.

3.2.2 Steel Columns with Welded Base Plate

28. All structural steel parts are designed in accordance with the provisions of EN 1993-1-1 and/or EN 1993-2.
29. The steel profiles should conform with and shall be executed according to the provisions of EN 1090-1 and EN 1090-2.
30. Structural steel columns shall be made of hot-rolled structural steel of grade S275 or higher, the column profile shall be HEB/HEM (profiles with dimensions according to EN 10365) – the profile type and dimensions vary according to the design calculations (see Annex 1 for required profile type). Length of steel profiles shall be according to the design solution - see Annex 1.
31. For corner locations – UPE profile must be welded to HEB profile – according to the design solutions.
32. Base plate shall be made of steel grade S275 or higher, its thickness, dimensions and anchor layout shall be verified by calculation report. The base plate shall have pre-drilled holes for anchors placed and sized according to the design calculation.
33. A calculation report checking the resistance of the vertical posts with baseplate and the maximum design loads on anchors shall be provided by the Producer.
34. The steel parts and structures shall be designed considering atmospheric corrosion class C4 according to ISO 9223. Higher requirements might be requirement for specific location as per environmental conditions.
35. Structural steel must be anti-corrosion treated with hot dip galvanizing (thickness of coating at least 85 µm) according to the provisions of ISO 1461 and EN 15773.
36. Metal arc welding shall be carried out in accordance with the procedures and requirements specified by EN 1011-1 and ISO 15609-1.
37. Producer shall issue inspection documents of the provided structural steel elements – according to EN 10204 – Type 2.2.

3.2.3 Metal Absorbing Acoustic Panels

38. The panel should consist of 2 metal sheets of the same material/alloy with insulating infill material between the sheets.
39. Only the inner face panel regarding the noise source shall be perforated. The perforation should be done with holes of round shape and maximum diameter of 10 mm, each perforated panel sheet must have 50% of open percentage (may vary according to acoustic design solutions). The level and placement of perforation should be done in a manner to ensure the required acoustic parameters in the defined frequency ranges.

40. The metal sheets used as outer shell for the infill material shall be corrosion resistant according to the provisions for corrosion class C4 – respective protective measures shall be applied by the Producer to ensure the required Working Design Life and Acoustic Design Life of the panels.
41. The external panel material shall withstand atmospheric agents and water as well as chemical agents used for cleaning and maintenance. The Producer shall issue a Maintenance manual listing all chemical components that shall be used for cleaning operations without causing damage to the panel components and their coating.
42. Mineral wool should be used as infill material for the metal panels.
43. A protective layer must be placed between the infill material and the perforated sheet.
44. A cover profile for the top panel shall be foreseen.

Table 2: Acoustic requirements for metal Absorbing Acoustic Panels

Parameter	Requirement	Normative references for test method
Sound absorption	$DL\alpha \geq 11 \text{ dB}$	EN 16272-1 EN 1793-1
Sound insulation	$DLR \geq 24 \text{ dB}$ $DLSI, G \geq 34 \text{ dB}$	EN 16272-2 EN 1793-2 EN 16272-6
Sound reflection	$DLRI \geq 7 \text{ dB}$	CEN/TS EN 16272-5

Table 3: Non-acoustic requirements for metal Absorbing Acoustic Panels

Parameter	Requirement	Normative references for test method/calculation
Dry weight of the acoustic element	-	EN 1794-1 Annex B EN 16727-1
Performance of acoustic elements under their own self-weight	The acoustic panels shall withstand its own wet weight and the influence of environmental effects (wind, rain, snow, icing, etc). 1) Local torsion instability: horizontal deflection $d_{h,max} \leq h/50$ 2) With the element supported as it is used in practice: vertical deflection $v_{h,max} \leq h/500$ Both calculation report and test report according to the defined standards shall be provided by Producer.	EN 1794-1 EN 16727-1
Performance of acoustic and structural elements under combined self-weight, wind, and dynamic loads from passing vehicles	Elements shall withstand the combined design loads without failure. Both calculation report and test report according to the defined standards shall be provided by Producer for combined self-weight, wind, and aerodynamic design loads.	EN 1794-1 EN 16727-1 EN 16727-2-2

Performance of acoustic and structural elements under combined self-weight and dynamic snow clearance load	Elements shall withstand the combined design loads without failure. Both calculation report and test report according to the defined standards shall be provided by Producer.	EN 1794-1 EN 16727-1
Mechanical performance of acoustic panels under dynamic loading due to passing trains - Resistance to fatigue* *For high-speed parts only (speed of train ≥ 160 km/h /distance between barrier and nearest track ≤ 6 m)	Real life scale test and report according to Section 8 Procedure C of EN 16727-2-1 must be provided by the Producer. *	EN 16727-2-1 DB RIL 804.5501
Stone's effect: damage caused by the controlled effects	Satisfactory Test report according to the defined standards must be provided by Producer.	EN 1794-1 Annex C EN 16727-1
Resistance to fire	Class ≥ 2	EN 1794-2 Annex A EN 16727-3 Annex A
Falling debris risk	\geq Class 3	EN 1794-2 Annex B EN 16727-3 Annex B
Environmental protection	Not release dangerous substances	EN 1794-2 Annex C EN 16727-3 Annex C
Emergency access / exits	Minimum height: 2.1 m Minimum width 1.5 m	EN 1794-2 Annex D EN 16727-3 Annex D
Light reflection, reflectance value	Class ≥ 2	EN 1794-2 Annex E EN 16727-3 Annex E

Note1: The Producer shall provide the declaration of performance in accordance with the relevant (road or railway) standard in case of two specified regulations for each of the specified parameters.

Note 2: For the acoustic performances, standards 16727-1 and 16727-2 will be applied at noise barriers located in diffuse conditions and standards CEN/TS EN 16727-5 and EN 16727-6 will be applied at noise barriers located in direct field conditions.

* With the design working life indicated in Section 1.3. and considering the following hypothesis:

- (a) Design speed of the trains: 250 km/h
- (b) 8 HST train pairs per day
- (c) 24 h of operation per day
- (d) 365 days per year
- (e) 2 million cycles

Table 4: Durability requirements for metal Absorbing Acoustic Panels

Parameter	Requirement	Normative references for test method
Acoustic performance	Environmental classification according to EN 16951-1:2018 Table A.2: 4K2; 4M4; 4C3 ≥ 25 years	EN 14389-2 EN 16951-2
Non acoustic properties	Environmental classification according to EN 16951-2:2018 Table A.2: 4K2; 4M4; 4C3 ≥ 25 years	EN 14389-2 EN 16951-2

3.2.4 Wooden Absorbing Acoustic Panels

45. The panels should consist of 2 timber layers with infill material between the layers.
46. The inner face panel regarding the noise source shall be slatted (the distances and layout may vary according to acoustic design solutions). The layout of the slats shall be done in a manner to ensure the required acoustic parameters in the defined frequency ranges.
47. The timber used in panels must be impregnated by autoclaving in an appropriate manner to ensure the defined Working Design Life and Acoustic Design life of the panels.
48. The external panel material shall withstand atmospheric agents, water and the various chemical components used for cleaning operations.
49. Mineral or glass wool should be used as infill material for the wooden panels.
50. A hydrophobic layer must be placed between the infill material and the layer of timber slats.

Table 5: Acoustic requirements for wooden Absorbing Acoustic Panels

Parameter	Requirement	Normative references for test method
Sound absorption	$DL\alpha \geq 8\text{ dB}$	EN 16272-1 EN 1793-1
Sound insulation	$DLR \geq 24\text{ dB}$ $DLSI, G \geq 34\text{ dB}$	EN 16272-2 EN 1793-2 EN 16272-6
Sound reflection	$DLRI \geq 3\text{ dB}$	CEN/TS EN 16272-5

Table 6: Non-acoustic requirements for wooden Absorbing Acoustic Panels

Parameter	Requirement	Normative references for test method/calculation
Dry weight of the acoustic element	-	EN 1794-1 Annex B EN 16727-1
Performance of acoustic elements under their own self-weight	The acoustic panels shall withstand its own wet weight and the influence of environmental effects (wind, rain, snow, icing, etc). 1) Local torsion instability: horizontal deflection $d_{h,max} \leq h/50$ 2) With the element supported as it is used in practice: vertical deflection $v_{h,max} \leq h/500$ Both calculation report and test report according to the defined standards shall be provided by Producer.	EN 1794-1 EN 16727-1
Performance of acoustic and structural elements under combined self-weight, wind, and dynamic loads from passing trains	Elements shall withstand the combined design loads without failure. Both calculation report and test report according to the defined standards shall be provided by Producer for combined self-weight, wind, and aerodynamic design loads.	EN 1794-1 EN 16727-1 EN 16727-2-2
Performance of acoustic and structural elements under combined self-weight and dynamic snow clearance load	Elements shall withstand the combined design loads without failure. Both calculation report and test report according to the defined standards shall be provided by Producer.	EN 1794-1 EN 16727-1
Mechanical performance of acoustic panels under dynamic loading due to passing trains - Resistance to fatigue* *For high-speed parts only (speed of train ≥ 160 km/h /distance between barrier and nearest track ≤ 6 m)	Real life scale test and report according to Section 8 Procedure C of EN 16727-2-1 must be provided by the Producer. *	EN 16727-2-1 DB RIL 804.5501
Stone's effect: damage caused by the controlled effects	Satisfactory Test report according to the defined standards has to be provided by Producer.	EN 1794-1 Annex C EN 16727-1
Resistance to fire	Class ≥ 1	EN 1794-2 Annex A EN 16727-3 Annex A
Falling debris risk	\geq Class 2	EN 1794-2 Annex B EN 16727-3 Annex B
Environmental protection	Not release dangerous substances	EN 1794-2 Annex C EN 16727-3 Annex C
Emergency access / exits	Minimum height: 2.1 m	EN 1794-2 Annex D

	Minimum width 1.5 m	EN 16727-3 Annex D
Light reflection, reflectance value	Class ≥ 2	EN 1794-2 Annex E EN 16727-3 Annex E

Note1: The Producer shall provide the declaration of performance in accordance with the relevant (road or railway) standard in case of two specified regulations for each of the specified parameters.

Note 2: For the acoustic performances, standards 16272-1 and 16727-2 will be applied at noise barriers located in diffuse conditions and standards CEN/TS EN 16272-5 and EN 16727-6 will be applied at noise barriers located in direct field conditions.

* With the design working life indicated in Section 1.3. and considering the following hypothesis:

- (a) Design speed of the trains: 250 km/h
- (b) 8 HST train pairs per day
- (c) 24 h of operation per day
- (d) 365 days per year
- (e) 2 million cycles

Table 7: Durability requirements for wooden Absorbing Acoustic Panels

Parameter	Requirement	Normative references for test method
Acoustic performance	Environmental classification according to EN 16951-1:2018 Table A.2: 4K2; 4M4; 4C3 ≥ 25 years	EN 14389-2 EN 16951-2
Non acoustic properties	Environmental classification according to EN 16951-2:2018 Table A.2: 4K2; 4M4; 4C3 ≥ 25 years	EN 14389-2 EN 16951-2

3.2.5 Transparent Reflective Acoustic Panels

51. The reflective panels shall be made of a durable transparent polymer-based material meeting the requirements listed in this document.
52. All transparent acoustic sheets must be attached to a 4-sided aluminium alloy (in accordance with EN 573-3) profile frame.
53. The aluminium alloy profiles and fasteners used for the supporting frame shall be corrosion resistant according to the provisions for corrosion class C4. Aluminium alloys shall be powder coated according to the provisions of EN 12206-1.
54. The panels shall present the following properties:
 - 54.1. Required quality and dimensions, of a single piece, of uniform thickness and without defects, with perfectly parallel flat faces.
 - 54.2. Withstand atmospheric agents, water and the various chemical components used for cleaning operations.
 - 54.3. Particular attention should be given to minimizing light reflections that are potentially dangerous for drivers of vehicles in transit.

54.4. Protective bird protection measures – see Section 3.3.4. of this document for specific requirements.

Table 8: Acoustic requirements for transparent Reflective Acoustic Panels

Parameter	Requirement	Normative references for test method
Sound absorption	Not required	
Sound insulation	DLR \geq 24 dB DLSI, G \geq 32 dB	EN 16272-2 EN 16272-6
Sound reflection	DLRI \geq 7dB	CEN/TS EN 16272-5

Table 9: Non-acoustic requirements for transparent Reflective Acoustic Panels

Parameter	Requirement	Normative references for test method/calculation
Dry weight of the acoustic element	-	EN 1794-1 Annex B EN 16727-1
Performance of acoustic elements under their own self-weight	The acoustic panels shall withstand its own wet weight and the influence of environmental effects (wind, rain, snow, icing, etc). 1) Local torsion instability: horizontal deflection $d_{h,max} \leq h/50$ 2) With the element supported as it is used in practice: vertical deflection $v_{h,max} \leq h/500$ Both calculation report and test report according to the defined standards shall be provided by Producer.	EN 1794-1 EN 16727-1
Performance of acoustic and structural elements under combined self-weight, wind, and dynamic loads from passing trains	Elements shall withstand the combined design loads without failure. Both calculation report and test report according to the defined standards shall be provided by Producer for combined self-weight, wind, and aerodynamic design loads.	EN 1794-1 EN 16727-1 EN 16727-2-2
Performance of acoustic and structural elements under combined self-weight and dynamic snow clearance load	Elements shall withstand the combined design loads without failure. Both calculation report and test report according to the defined standards shall be provided by Producer.	EN 1794-1 EN 16727-1
Mechanical performance of acoustic panels under dynamic loading due to passing trains – Resistance to fatigue* *For high-speed parts only (speed of train ≥ 160 km/h /distance between barrier and nearest track ≤ 6 m)	Real life scale test and report according to Section 8 Procedure C of EN 16727-2-1 must be provided by the Producer. *	EN 16727-2-1 DB RIL 804.5501

Stone's effect: damage caused by the controlled effects	Satisfactory Test report according to the defined standards must be provided by Producer.	EN 1794-1 Annex C EN 16727-1
Resistance to fire	Class ≥ 2	EN 1794-2 Annex A EN 16727-3 Annex A
Falling debris risk	\geq Class 3 In case of PMMA panels, the panels must contain reinforcement to fulfil the requirements for Class 3. Low temperatures ($\leq -20^{\circ}\text{C}$) and UV radiation shall not make the panel brittle. Reinforcement shall be used, if necessary, however, polyamide threads shall be avoided.	EN 1794-2 Annex B EN 16727-3 Annex B
Environmental protection	Not release dangerous substances	EN 1794-2 Annex C EN 16727-3 Annex C
Emergency access / exits	Minimum height: 2.1 m Minimum width 1.5 m	EN 1794-2 Annex D EN 16727-3 Annex D
Light reflection, reflectance value	Class ≥ 2	EN 1794-2 Annex E EN 16727-3 Annex E

Note1: The Producer shall provide the declaration of performance in accordance with the relevant (road or railway) standard in case of two specified regulations for each of the specified parameters.

Note 2: For the acoustic performances, standards 16272-1 and 16727-2 will be applied at noise barriers located in diffuse conditions and standards CEN/TS EN 16272-5 and EN 16727-6 will be applied at noise barriers located in direct field conditions.

* With the design working life indicated in Section 1.3. and considering the following hypothesis:

- (a) Design speed of the trains: 250 km/h
- (b) 8 HST train pairs per day
- (c) 24 h of operation per day
- (d) 365 days per year
- (e) 2 million cycles

Table 11: Durability requirements for transparent Reflective Acoustic Panels

Parameter	Requirement	Normative references for test method
Acoustic performance	Environmental classification according to EN 16951-1:2018 Table A.2: 4K2; 4M4; 4C3 ≥ 25 years Producer must issue a report for durability assessment and maintenance manuals according to the provisions of Section 5 of EN 14389-1/ EN 16951-1.	EN 16951-1 EN 14389-1

Non acoustic properties	Environmental classification according to EN 16951-2:2018 Table A.2: 4K2; 4M4; 4C3 ≥ 25 years Producer must issue a report for durability assessment and maintenance manuals according to the provisions of Section 5 of EN 14389-2/ EN 16951-2.	EN 16951-2 EN 14389-2
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3.2.6 Infill materials

55. Infill materials shall be tested by an accredited and approved registered testing laboratory and certified by an accredited certification body and thus have proof of compliance with the relevant EN standards (Table 12).
56. Infill materials provided by Producer shall be certified by EUCEB.
57. The sound-absorbing material shall be secured in such a way to avoid displacement and bending and shall be protected so that it cannot become impregnated with water.
58. In addition to the requirements, the properties of infill materials should allow them to guarantee the properties of the metal and wooden absorbing acoustic panels.

Table 12: Infill Material requirements for metal and wooden Absorbing Acoustic Panels

Feature and test mode	Requirements
Apparent volume mass	It is recommended that the apparent density shall be greater than 90 kg/m ³ depending on whether it is rock/stone or glass wool.
Fire resistance	Non-flammable. Class A1 fire rating classified by EN 13501-1.
Water absorption (short term)	≤ 1.0 g/m ² (to be tested according to ISO 29767).
Water absorption (long term)	≤ 3.0 g/m ² (to be tested according to ISO 16535).

3.2.7 Sealants, Gaskets and Fasteners for Acoustic Panels

59. The sealants and gaskets shall guarantee that the barrier is acoustically sealed (in a manner so that no direct sound transmission between both sides of the noise barrier is possible) throughout the whole Acoustic Working Life and shall, therefore, withstand aging from natural agents (UV rays, temperature changes, cold climate, vibrations).
60. The Producer shall notify the Principal of the technical characteristics of the materials used for the sealants and gaskets before installation. The Principal shall approve the proposed sealants and gaskets in written form before initiation of production. Producer shall define the classification of the proposed sealants according to ISO 11600.
61. The profile of the gasket shall be designed and produced in such a way to dampen its vibration to an appropriate level while keeping it in place.
62. In case of metallic fasteners, stainless steel fasteners shall be used to prevent galvanic corrosion.

3.2.8 Deflection Limits

63. Deflections of structural elements should not exceed the limit values defined by section A.3 of EN 1794-1, requirements for type d2 structure should be assumed.
64. Overall deflections due to the defined design loads should be minimized in the supporting structure to avoid damage of the acoustic panels.
65. Deflection limits for acoustic elements under their own weight shall not exceed the limit values provided by section B.3.2. of EN 1794-1.
66. The deflections of the noise reducing barrier under the defined loadings should not reduce its effectiveness during its Working Design Life.

3.2.9 Geometric Tolerances

Table 13: Geometric tolerances for acoustic panels

Element	Tolerance requirements on shape and dimensions	Tolerance limit
Vertical steel profiles	Deviation between the bottom and the top of the profile axis	According to provisions of EN 10034
Acoustic panels	Element geometric dimensions deviation (length, height, thickness)	± 5 mm
	Squareness (the difference between the diagonals)	± 5 mm
Upper part of noise barriers	At the top of the post, the height difference between the acoustic element and the profile	± 10 mm
Acoustic panels	Flatness of panel surface	Panel shall be flat

3.2.10 Durability

67. The Noise Barrier support structure in combination with acoustic panels shall be designed and executed with appropriate degree of reliability and in an economical way, it shall resist all project-defined actions, loads, and influences likely to occur during execution and use and remain fit for the intended use. The structure shall be designed for structural resistance, serviceability, and durability.

3.2.11 Electrical Protection

68. The electrical protection for Noise Barriers which are close to the electrical elements shall be guaranteed, such as the catenary mast.
69. In case of modular noise barriers at the end railway structure zone, the metal conductive parts of these noise barriers will be sectioned from the earthing and bonding system of the railway structure. Beyond the railway structure zone, an earth conductor (bare copper conductor) with a diameter of 50mm² buried at a depth of 50 cm beneath finished ground level will run along the entire barriers and each vertical steel profile of the barrier will be connected to the earth conductor by a copper conductor with the same characteristics (Cu, d=50mm²).
70. The following connection elements will be made - connection to the noise barrier steel support using a compression clamp for Cu, d=50 mm² earth conductor.

3.2.12 Vandalism Protection

- 71. The modular panels shall be impenetrable by handheld tools, e.g., sharp knife, etc.
- 72. Protective devices shall be provided to prevent the panels from being easily removed (each Producer shall describe theirs).
- 73. The Noise Barriers shall contain tamperproof fastenings, where applicable.
- 74. Protection against damage to the infill materials of Noise Barriers shall be provided.

3.3 Visual and Appearance-Related Requirements

- 75. The railway network identity is defined by using Rail Baltica patterns on acoustic screens. The branding implementation of transparent noise barriers shall follow the technical design drawings as close as possible and shall simultaneously serve as bird anti-collision measure.

3.3.1 Metallic Absorbing Noise Barriers

- 76. The metal sheets of modular panels shall be in uniform colour obtained by powder coating.
- 77. RAL + gloss level for powder coating shall be defined by Principal in later stages.

3.3.2 Wooden Absorbing Noise Barriers

- 78. Timber slats of modular panels shall be applied on the barrier panels following the pattern for the branding implementation.
- 79. The impregnation material shall be colourless.

3.3.3 Transparent Reflective Noise Barriers

- 80. The panels shall be non-tinted and with the defined transparency level.
- 81. The colour defined for the supporting frame of the panels and exit door framing – RAL 7016.
- 82. A striped pattern shall be applied on the panel surface for transparent panels will be defined by client in later stages.
- 83. The pattern marking stripes shall be in light grey colour.
- 84. Marking strips should be 20 mm wide with a 100 mm distance between the strips.
- 85. The bird deterring pattern must be an integral part of the panel, capable of withstanding graffiti removal efforts. Application of films in a secondary, post-production process, are not allowed due to the tendency of these films to delaminate, haze, or otherwise prematurely degrade the visual performance of the panel.

3.3.4 Vertical Structural Posts

- 86. Vertical structural posts shall be coloured after hot-dip galvanizing, the defined colour – RAL 7016.

3.4 Exit-doors

- 87. The exit door system shall provide overall acoustic properties of the Noise Barrier.
- 88. See Figure 3 for a schematic representation of the exit door layout.

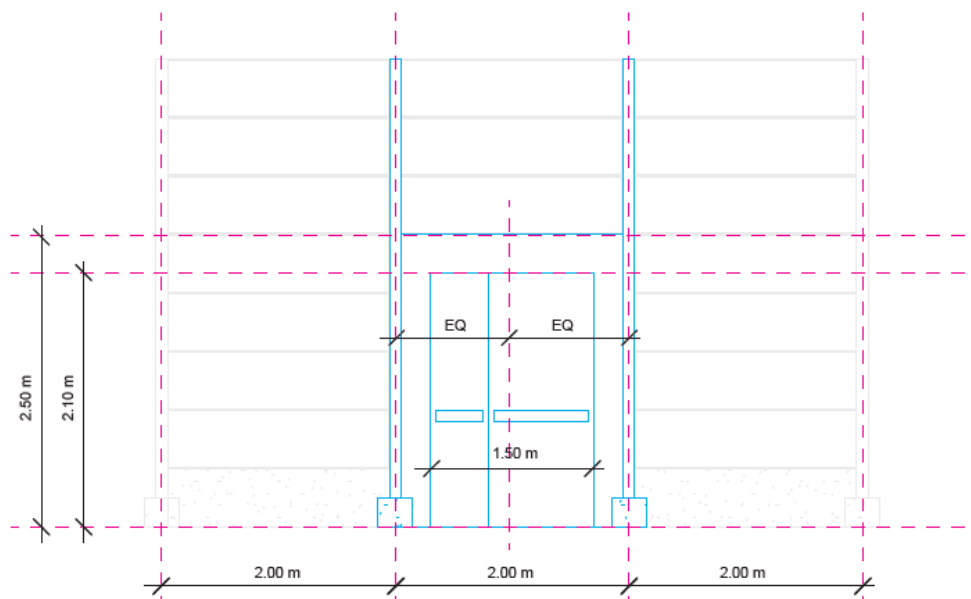


Figure 3: Schematic representation of the exit door layout

4 Sampling, Testing & Acceptance

- 89. All testing shall be done in accredited laboratories (accreditation as per EN ISO/IEC 17025).
- 90. All testing must be conducted without undue delay and test results must be promptly tabulated and Principal must be advised of any failures or trends.
- 91. The Producer is responsible for any costs related to any kind of material/structure testing.
- 92. All test and inspection reports shall be provided by the Producer to the Principal.
- 93. Principal reserves the right to inspect the manufacturing plants and take part in test procedures to ensure compliance with this specification and related standards. Principal shall be notified of any planned testing at least 4 weeks prior to it.

5 Commencement of Production

- 94. Commencement of production tests shall be carried out in accordance with the respective standards mentioned for each structure/material.
- 95. At least one full size Mock-up Model for each element/acoustic panel type supplied by the Producer shall be assembled as a prototype and accepted by the Principal prior to mass production.
- 96. The Mock up model shall be assembled and tested for acoustic performance according to EN 16272-6. The same model shall also be tested for non-acoustic performance according to EN 1794-1 and EN 16727-1, it shall also serve as a visual Mock-up Model for the provisions of Section 3.3. of this technical specification.
- 97. QA/QC plan must be presented to the Principal for approval prior to mass production.
- 98. The producer shall submit detailed drawings of the Noise Barrier elements to Principal prior to commencement of production. All drawings shall be submitted both in paper and electronic document formats. All drawings must be approved by Principal before production of the noise barrier elements.
- 99. The Producer must retain all primary quality records in accordance with the statutory requirements, contract conditions and company policy and make these available to Principal at all reasonable times. These must include all the requirements of the approved Project Quality Plan.
- 100. If not otherwise required, records must be kept for at least 5 (five) years after the date of issue of the final certificate.
- 101. Prior to commencement of production, the Supplier shall submit manufacturer's samples of product, certified test data, and shop drawings of framing and connection details for approval

6 Packaging

- 102. All parts shall be clearly and durably marked and labelled for assembly.
- 103. The Goods shall be packed with special care to prevent damage.
- 104. Each shipment of Goods shall contain a packing list, the following detailed drawings:
general layout drawings, part assembly drawings, sections drawings for all supplied assemblies,

detailed instructions for the assembly of the Noise Barriers and all additional documentation as necessary and/or as requested by the Principal in the order. All the aforementioned documents shall be supplied in hard and digital copy.

105. Fastenings shall be supplied by the Producer with the according Noise Barriers. Fastenings which are to be supplied as detached parts shall be supplied in a separate package, clearly marked.
106. The Producer shall submit handling instructions for the Noise Barriers and parts.
107. Each element shall have a barcode on it according to RR Rail AS guidelines.

7 Transport and storage

108. Noise Barriers elements shall be transported and stored in accordance with the instructions provided by the Producers and shall comply with Local Regulation.
109. Acoustic elements shall be supplied only with the Producer's declaration of performance (with translation into the official national language).
110. All packaging dimensions of finished Goods shall be agreed with Principal before transportation to Principal material delivery points.
111. Goods shall be delivered in volumes not less than a fully loaded truck, except if the Producer proposes a more cost-efficient delivery way to the Principal.
112. The Producer shall retain complete responsibility for the quality of the Goods pursuant the terms of the Agreement but, in any case at least until they are finally accepted by the Principal upon the delivery at the delivery point.
113. All finished products must be stored in conditions to ensure the product conformity with Principal requirements until the product is delivered. Upon delivery the product will conform to all the requirements laid out in this Specification and Standards.
114. All the damage incurred during storage and delivery shall be assessed to check if the delivered product is still conforming with Principal Specifications and Standards. If the product is not conforming, it shall be removed from Purchaser's stockpile and new unit shall be delivered.
115. Products supplied for Principal shall be stored separately from any other Principal's products according to the provisions included in the Contract. This shall include physical separation as well as separation of stockpile usage record keeping.
116. During storage seals should be kept in environmental conditions laid out in documentation provided by Producer.

8 Installation and maintenance

117. The infill material shall be secured in such a way to avoid displacement and bending and shall be protected so that it cannot become impregnated with water. Devices shall be provided to prevent the panels from being easily removed.

118. The Producer shall provide the installation instructions that shall describe the way in which the Noise Barrier elements (acoustic and non-acoustic elements) shall be installed to obtain the behaviour measured in the initial type test.
119. The Producer shall provide a report on the maintenance rules for the Noise Barriers for a period of at least 10 years. This manual shall specify the measures that are necessary, or that should be avoided, to maintain the durability of acoustic behaviour, structural resistance, transparency, etc.
120. The intended maintenance cycle, as well as any replacement of panels damaged by accidents or vandalism, shall be possible to be carried out by simple means without compromising the static structure and rail traffic. Therefore, this report shall set out in a clear and schematic form the maintenance operations envisaged as well as the operations required for the easy and quick replacement of the panels or other components of the barrier, as well as a list of chemicals and tools that shall be used for maintenance.

9 Required declarations and certificates

121. The producer shall have a Certificate of Conformity of Factory Production Control in compliance with Regulation 305/2011/EU.
122. Noise barrier elements shall have CE marking and applicable Declaration of Performance (DoP).
123. Producer shall submit to Principal all certificates and/or declarations applicable for each constituent material prior to supply of Noise Barrier elements. All requirements (properties) stated in this Technical Specification must be indicated on these declarations. The Producer must provide Declaration of Performance to the Principal in an agreed format, certifying the month's production, itemizing any failures and actions, and attaching a tabulation of inspection and test results.
124. Designation, description, marking and labelling of products shall be in according with appropriate product standards.
125. Goods shall be labelled in accordance with ISO 15459 and GS1 standards based on Principal input in later stages and coordinated prior routine production.
126. A Manufacturing Quality Plan must be prepared and be submitted to Principal for approval as a controlled document within 4 (four) weeks of the date of award of the contract.

10 Inspections and Audit

127. Principal may arrange inspections or audits to ensure that the Producer is complying with the requirements stated in this technical specification.
128. The Producer must, upon being given reasonable notice, make or arrange to make available all facilities, documentation records, and personnel details, including those of any subcontractors, that are reasonably required for the audit or surveillance to be undertaken.
129. Principal reserves the right to arrange or carry out additional independent quality control with destructive testing. Specimens and transportation to designated location will be included in tendered price. Maximum amount of additional tested products 0.5% from number of produced units.

130. In addition to the mandatory requirements outlined in this specification, Principal reserves the right to request from the Producer any other information pertaining to the performance of their product under similar service conditions.

11 Documentation

11.1 Installation, Storage, Maintenance Manuals

131. The Producer shall provide to the Principal a Manual including the installation, operation, repair and maintenance of acoustic panels, steel posts with base plates.
132. The Manuals shall be provided in hard and soft copy and must include all drawings and information required to install, repair, and maintain acoustic panels, steel posts with base plates.
133. Drawings must include sufficient detail to enable the easy identification of all components for the ordering of spares and replacement parts.
134. The manual shall provide full instruction of the installation, geometry tolerances and adjustment of delivered components and inspection and maintenance procedures as applicable.
135. Producer shall submit storage and stockpiling instructions of Goods considering Rail Baltica project environmental conditions for outdoor storage of Goods

11.2 BIM Deliverables

136. BIM – building information management is a process which coordinates information flow in supply chain of Rail Baltica project implementation. Information provided by Producer is the base information for as-built approval. Data to be provided by the Producer for integration shall be agreed with RB Rail AS.
137. The Producer shall provide a detailed 3D model of all manufactured and delivered Goods according to Principal's requirements.

11.3 Calculation reports

138. For the noise barrier acoustic panels and steel posts, the Producer shall provide shop, general arrangement, and installation drawings in paper and electronic document (.pdf, .dxf, .dwg)
139. Detailed static calculations that demonstrate that acoustic panels and steel posts and fixings meet all the requirements and standards mentioned in this document shall be provided by the Producer.
140. The Producer shall provide calculations and justifications for the designed lifetime of acoustic panels.

11.4 Warranty

141. Minimum warranty time shall be 60 months after signing the deed of acceptance. Extended warranty time can be proposed by Producer. Warranty concerns all manufacturing and material related defects – cracks, dents, delamination, etc.

11.5 Language

142. The Producer shall ensure the availability of the Documentation in either of the following bilingual versions upon the Principals' request:

142.1.English and Estonian.

142.2.English and Latvian.

142.3.English and Lithuanian.