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Part 3: General safety and environmental requirements

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National foreword

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European foreword

This document (EN 16727-3:2017) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2017 and conflicting national standards shall be withdrawn at the latest by July 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This European Standard is one of the series EN 16727 “Railway applications — Track — Noise barriers and related devices acting on airborne sound propagation — Non-acoustic performance” as listed below:

— *Part 1: Mechanical performance under static loadings — Calculation and test methods*

— *Part 2-1: Mechanical performance under dynamic loadings due to passing trains — Resistance to fatigue*

— *Part 2-2: Mechanical performance under dynamic loadings caused by passing trains — Calculation method*

— *Part 3: General safety and environmental requirements*

It should be read in conjunction with:

prEN 16727-1, *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 methods*

prEN 16727-2-1, *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*

EN 16727-2-2, *Railway applications — Track — Noise barriers and related devices acting on airborne sound propagation — Non-acoustic performance — Part 2-2: Mechanical performance under dynamic loadings caused by passing trains — Calculation method*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

While performing their primary function, noise barriers and related devices acting on airborne sound propagation installed along railways should not pose hazards to rail users or other people in the vicinity or to the environment at large. Noise barriers and related devices should not assist the spread of fire from adjacent verges or nearby land. Fire resistance in accordance with particular standards can in addition be required to minimize risk to adjacent premises, or to rail users in confined corridors. Noise barriers and related devices should not reflect light towards train drivers in such a way as to compromise rail safety. They should be made from materials which do not emit noxious fumes or leachates as the result of natural or industrial processes, or as the result of fire. Noise barriers should allow a means of escape by rail users and access by operatives in the event of an emergency.

Noise barriers and related devices acting on airborne sound propagation are not, in general, expected to resist the impact of vehicles, but designers can utilize information about the consequences of such impact load to establish the requirements for protection of rail users and passers-by.

1 Scope

This European Standard specifies minimum requirements and other criteria for assessing the general safety and environmental performance of noise barriers and related devices acting on airborne sound propagation under typical rail-side conditions. Requirements for more onerous conditions are a matter for consideration by the designer. Appropriate test methods are provided where these are necessary, but for some aspects a declaration of material characteristics may be required for the information of designers. The treatment of each topic is covered separately in Annexes A to G.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

prEN 16727-1:2015, *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 methods*

EN 50122-1, *Railway applications - Fixed installations - Electrical safety, earthing and the return circuit - Part 1: Protective provisions against electric shock*

EN ISO 2813, *Paints and varnishes - Determination of gloss value at 20°, 60° and 85° (ISO 2813)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
noise barrier
noise reducing device, which obstructs the direct transmission of airborne sound emanating from railways and which will typically span between posts and also may overhang the railway

Note 1 to entry: Noise barriers are generally made of acoustic and structural elements (see 3.3 and 3.4).

3.2
cladding
noise reducing device, which is attached to a wall or other structure and reduces the amount of sound reflected

Note 1 to entry: Claddings are generally made of acoustic and structural elements (see 3.3 and 3.4).

3.3
acoustic element
element whose primary function is to provide the acoustic performance of the device

3.4
structural element
element whose primary function is to support or hold in place acoustic elements

Note 1 to entry: In some noise barriers, the acoustic function and the structural function cannot be clearly separated and attributed to different components.

3.5
added device
added component that influences the acoustic performance of the original noise-reducing device (acting primarily on the diffracted energy)

3.6
rail side exposure
use of the product as a noise barrier installed alongside railways

4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

Table 1 — Symbols and abbreviations

Symbol or abbreviation	Designation	Unit
r	Radius of curvature in a vertical section of the impact surface of the impactor described in Annex B	mm
α	Aperture angle in a vertical section of the impactor described in Annex B	degrees

5 Requirements

5.1 Reaction to brush fire

The noise reducing device shall be classified in accordance with Annex A.

This European Standard permits specifying authorities to indicate that there is no requirement for resistance to brush fire.

5.2 Secondary safety (shatter properties)

When secondary safety has to be assessed, this shall be done in accordance with Annex B.

This European Standard permits specifying authorities to indicate that there is no requirement for secondary safety.

5.3 Environmental protection

The constituent materials and their breakdown products shall be identified in accordance with Annex C.

This European Standard permits specifying authorities to indicate that there is no requirement for environmental protection.

5.4 Means of access or escape in emergency

The acoustic and mechanical performances of doors or other means of access or escape shall be assessed in accordance with Annex D.

This European Standard permits specifying authorities to indicate that there is no requirement for means of access or escape in emergency.

5.5 Reflection of light

The results of a standard test of reflectivity shall be quoted in accordance with Annex E.

This European Standard permits specifying authorities to indicate that there is no requirement for light reflection to be mitigated.

5.6 Electric ground connection of noise barriers on electrified lines

The provisions in Annex F shall be applied.

This European Standard permits specifying authorities to indicate that there is no requirement for electric ground connection.

5.7 Electrolytic corrosion

The provisions in Annex G shall be applied.

This European Standard permits specifying authorities to indicate that there is no requirement for electrolytic corrosion to be mitigated.

6 Test report

6.1 Information to be reported

Every test report on aspects of performance shall include the following information:

a) number and year of this European Standard;

b) full description of the element or system tested, including manufacturer(s), part numbers, place and date of origin;

c) description of the method of sampling, if parts of manufactured elements are evaluated by testing;

d) place and date of assessment, and the name of the assessor;

e) sufficient description of any tests carried out, any results measured and the conclusions drawn about the product together with any illustrations or photographs, all as specified in the appropriate annex.

6.2 Summary report

A summary report shall be produced, identifying the aspects of performance for which detailed reports are available and the level of performance assessed, where appropriate.

Annex A
(normative)

Reaction to brush fire

A.1 General

Noise barriers and related devices acting on airborne sound propagation can be exposed to fire arising from dry vegetation or other material in close proximity. Where a noise reducing device is in close proximity to property it can also be necessary to consider the need to ensure that fire is not spread from the railway.

Where flammable systems are used, it is recommended that firebreaks of fire resistant materials or other design are incorporated into the noise reducing device in order to prevent the propagation of fire. This annex is not applicable to such fire resistant materials.

This annex describes a test for a representative panel of a vertical noise barrier under normal exposure to brush fires at the rail side.

It does not provide information on the results of exposure to more severe conditions, e.g. ignition by burning spilt fuel. The test should not be used to provide information on the fire safety of claddings used for tunnels or partial covers over the railway.

The acoustic elements shall be installed as in the intended use.

A.2 Requirements

The noise reducing device, after being tested by the method given in A.3, shall be classified as follows:

— class 1: if the panel has been damaged to a greater extent than as defined for classes 2 and 3;

— class 2: if the damaged area above either source is less than 0,06 m^2 and extends to no more than 200 mm above the base of the panel, and the panel has not been burnt through to the other side;

— class 3: if there is no damage other than discoloration.

A.3 Fire test

A.3.1 Acoustic elements of at least 2 m long by 1,5 m high shall be tested by exposure to localized sources of fire at their base next to the front and rear faces independently. Panels shall be free of absorbed water before testing; in the case of timber components, the moisture content shall be reduced to 18 % by an approved drying method.

The mass and dimensions of the panel to be tested shall be measured and the panel shall be photographed. An identical panel shall be examined to determine its construction; the dimensions of its elements, including wall thickness of hollow sections, shall be measured and noted on a sketch at 1:20 scale.

A.3.2 Testing shall be carried out in an enclosed fireproof and draught-free chamber having a volume of at least 150 m^3.

Fume extraction devices may be installed in or near the ceiling, but shall be prevented from fanning any flames during the test.

The temperature of the chamber, including the floor, before the test begins shall be between 15 °C and 25 °C. The chamber should be fitted with an observation port or window in a suitable position to observe the panel during the test.

A.3.3 Two identical sources of fire shall be prepared as follows:

a) a rectilinear wire mesh basket 300 mm by 200 mm by 300 mm high shall be made from welded steel wire mesh, having a square mesh of 3 mm diameter drawn steel wire at 50 mm centre;

b) in addition, three 3 mm diameter wires 300 mm long shall be secured with a vertical orientation inside the basket, equispaced along the central line of the shorter dimension.

The flammable material shall comprise shavings of spruce, 0,2 mm thick by 2 mm wide, and approximately 50 mm long. The material shall be free from splinters and have a maximum moisture content of 30 %; it shall be acclimatized at 20 °C and 65 % relative humidity until its weight is constant.

600 g of shavings shall be lightly pressed down into each basket so that it is just filled.

A.3.4 The test sample shall be supported in a vertical position corresponding to its orientation in use, on a plinth supporting the full length of the panel. The plinth shall be of masonry or concrete and have a vertical step to a level of 250 mm above the floor of the chamber. The base of the test sample shall be completely in contact with the plinth and the face to be tested shall be flush with the edge. The two sources of fire shall be placed on the floor of the chamber with their longer dimension flush against the plinth and the face of the test panel. Both sources shall be lit simultaneously, and the time taken for the test shall start at this point.

A.3.5 The performance of the sample shall be observed during the test and the time at which any significant change takes place recorded. After the sources of fire and any part of the sample which may have ignited have burnt out, the sample shall be examined and the extent of any damage photographed and measured. The opposite face of the sample shall not be tested until it and the floor of the chamber have cooled to below 25 °C.

A.4 Test report

A.4.1 The test procedure shall be described together with the timing of significant stages, an indication of, for example, maximum intensity of flames, the incidence of any observed changes to the test sample and the number of samples tested.

The test report shall record the nature and extent of any flames and smoke produced during the test.

A.4.2 Photographs of the test sample before, during and after the test shall be supplied and shall include an appropriate means of judging scale.

Annex B
(normative)

Secondary safety: shatter properties

B.1 General

Noise barriers and related devices acting on airborne sound propagation can be mounted on structures or in such a way that if damaged they could pose a hazard to rail workers or to others. In particular, if the noise reducing device is on an elevated structure, there is a possibility of pieces or whole elements from a noise barrier becoming detached as the result of a violent collision and for the debris to fall, endangering those below.

Noise reducing devices which are to be used in a vulnerable position may be required to be restrained by internal or external linkage between elements to prevent them from becoming detached and falling.

The standard provides some general indications of factors which need to be considered and also provides a method of establishing the resistance of a product to a severe blow.

NOTE It is principally the responsibility of the specifying authority to consider the potential consequences of a barrier becoming damaged and to provide protection accordingly.

Alternatively, a means of catching falling pieces detached from vulnerable barriers may be specified for barrier systems which are not so restrained.

B.2 Requirements

B.2.1 Behaviour under impact

Where it is known that any component of a device is liable to shatter if struck or subject to shock, this shall be clearly stated.

NOTE Such a statement can be qualified by further evidence of the effectiveness of any restraining mechanism.

B.2.2 Fastening of structural and acoustical elements

B.2.2.1 A noise reducing device shall be assumed to be safely fastened if the elements are secured in such a way that they do not fall when they are deformed or broken. The restraint systems shall be designed to withstand the self-weight of the relevant falling parts, multiplied by a load factor of 4. The wet self-weight shall be used in this calculation, calculated in accordance with Annex B of prEN 16727-1:2015.

B.2.2.2 If structural and acoustical elements of this category of noise reducing device are prevented from falling by a system of restraint linking them together, each link shall take the load of all adjoining elements. It shall be assumed that the load applied by broken pieces of a device is the weight of a single element acting at the most unfavourable position on the restraint system.

B.3 Test method

B.3.1 Scope

This is the test method to establish the characteristics of the falling debris produced by fixed energy impacts.

B.3.2 Principle

The method of testing is to cause a heavy mass to strike normally at the centre or the most sensitive point of the test specimen or other tested element or system, so that the test specimen is destroyed or pushed out of the holding structure or, alternatively, to show its behaviour during the test.

B.3.3 Test equipment

The test equipment comprises:

— impactor;

— structure holding the test specimen;

— structure used to produce the impact;

— high speed video camera to record the test.

B.3.4 Impactor

The impactor consists of a rotationally symmetrical full steel double cone.

The impactor shall be of type I or type II according to Table B.1 and shall conform to the shape and details shown in Figure B.1.

Table B.1 — Impactor and test types

Property	Impactor / test type	
	Type I	Type II
Impactor mass	400 kg	45 kg
Impact energy	6,0 kJ	0,5 kJ
Fall height	1,50 m	1,10 m
Speed	19,5 km/h	16,7 km/h

B.3.5 Test specimen

The test specimen shall be assembled in the supporting structure in the way intended by the manufacturer, including: dimensions, fixings, seals and any connecting systems. Elements or systems with integrated or attached restraint structure shall be tested as complete units.

B.3.6 Structure holding the test specimen

The structure holding the test specimen shall be designed to be able to withstand the whole impact energy as described in B.3.7. In all cases, the structure shall allow a good camera position for proper documentation.

B.3.7 Structure used to produce the impact

The impact shall be produced by a pendulum. The impactor (type I or type II) shall swing on 2 wires fixed at 2 points above the structure holding the test sample as shown in Figure B.2. In order to reach the impact energy of 6,0 kJ (type I) or 0,5 kJ (type II), the height of the fall of the impactor shall be 1,50 m or 1,10 m respectively, corresponding to a speed of 19,5 (16,7) km/h (see Table B.1).

The radius of the pendulum shall be greater or equal to 4 m.

B.3.8 Evaluation

B.3.8.1 General

Only the falling debris caused by the first impact shall be taken into account.

NOTE This can be achieved for example by restraining the pendulum after the first impact or by proper analysis of the video documentation.

B.3.8.2 Assessment criteria for free pieces

No rigid pieces of test specimen larger than 2 500 mm^2 weighing more than 0,100 kg.

No rigid pieces of test specimen longer than 150 mm.

No rigid pieces with angles of less than 15° and weighing more than 0,100 kg.

No pieces weighing more than 0,400 kg.

No rigid sharp pieces thinner than 1 mm and weighing more than 0,100 kg.

B.3.8.3 Results

A: Free pieces not meeting the criteria

B: Free pieces meeting the criteria

C: No pieces at all

B.3.8.4 Classification

Five classes are considered (see Table B.2).

Table B.2 — Classification

Class	Test (kJ)	Result
0	Not tested	
1	0,5	B
2	0,5	C
3	6,0	B
4	6,0	C

B.3.9 Test report

The test report shall include a full description of the test arrangement, including details of supports, procedures and location of points of impact.

It shall also include:

a) number and year of this European Standard;

b) name and address of the testing institute with a dated signature of the person responsible;

c) exact identification of the tested element, the name and address of the manufacturer;

d) full description of the materials and their thicknesses;

e) drawing showing the cross section of the tested element;

f) results of tests and the resulting classification; any pieces not meeting the criteria shall be reported;

g) documentation by means of high-speed video and photos of the effect of every impact;

h) description and documentation of any damage to the sample such as cracks or deformations;

i) test temperature and valid temperature range of the test results.

Dimensions in millimetres

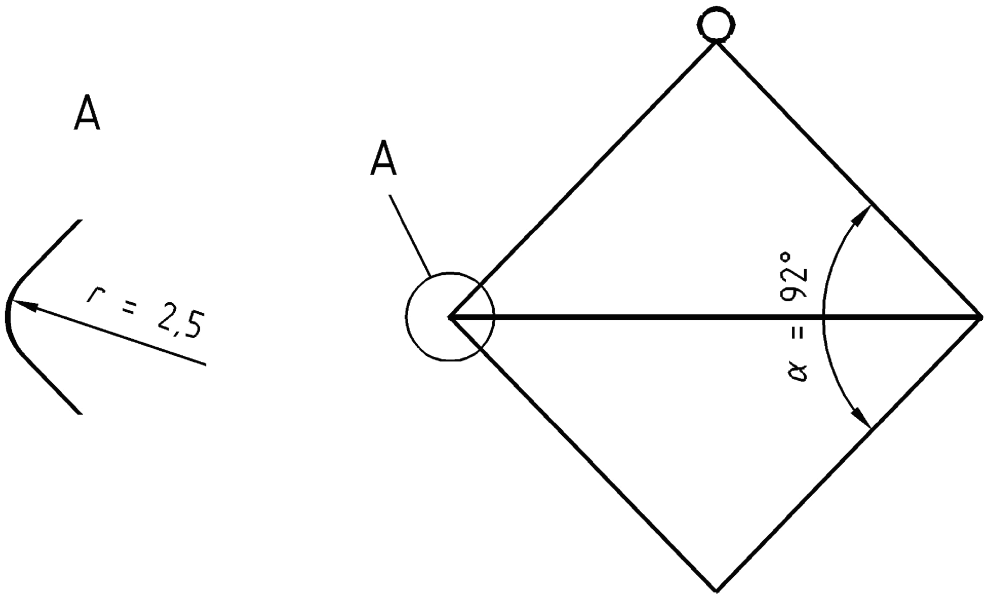
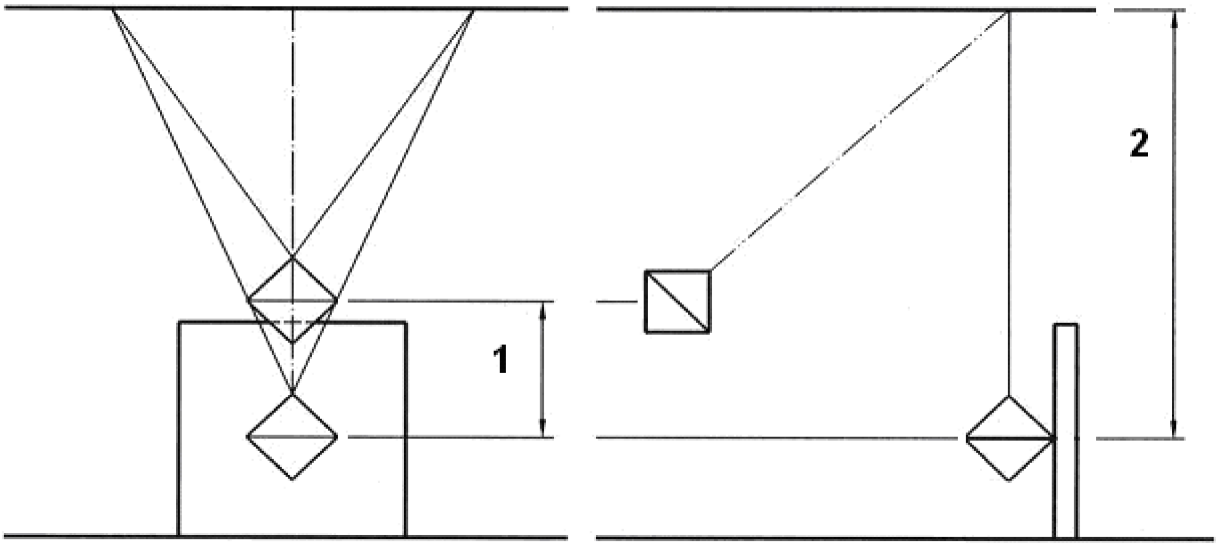


Figure B.1 — The impactor



Key

1 height for achieving 6 kJ with 400 kg impactor = 1,5 m or height for achieving 0,5 kJ with 45 kg impactor = 1,10 m

2 radius minimum = 4,0 m

Figure B.2 — Structure holding the test piece

Annex C
(normative)

Environmental protection

C.1 General

Specifying authorities should be aware of any components of noise reducing devices which might in time either have adverse effects on the environment, or on the other hand could be recycled into similar or other products. There is, consequently, a need for suppliers to identify clearly the constituent materials, so that their breakdown products under natural exposure or if subjected to fire can be identified. The extent to which they have been or can be recycled also provides helpful information to specifying authorities.

C.2 Requirements

C.2.1 All materials used in the barrier system shall be declared, using chemical rather than proprietary names to describe synthetic materials. Usage of CAS number is strongly recommended.

In this context “chemical name” is the accurate technical or engineering term that is used to describe the materials; e.g. “PVC”, “PMMA”, or similar shall be used instead of “plastics”.

C.2.2 Any physical or chemical conditions that would cause potentially toxic constituents to be released into the environment shall be declared.

C.2.3 If some of these materials are wholly or in part recycled, the percentage of such constituents shall be stated.

C.2.4 Beneficial future re-use of the barrier materials may be indicated, but any limitations on reprocessing conditions shall be noted.

Annex D
(normative)

Means of access or escape in emergency

D.1 General

Noise barriers will effectively restrict access between the railway and adjacent land. This may be acceptable where the barrier also forms the railway boundary, but direct access may be required under certain circumstances, for example:

a) for maintenance of both barrier and verge;

b) for emergency services attending an accident;

c) as a means of access or escape from the vicinity of an accident.

The requirements for access for maintenance and other means of access for emergency services shall be determined for each length of barrier; such access can also serve as a means of escape. Where these are far apart, it can be desirable to provide additional means of access or escape from the railway (e.g. in emergency).

D.2 Requirements

D.2.1 In general, any access shall have minimum dimensions as follows:

— height: 2,1 m (or full height of the barrier if lower);

— width: 0,9 m.

D.2.2 Access shall be provided with means to ensure that the overall effectiveness of the noise barrier is maintained.

Acoustic integrity may be achieved by:

a) stepping sections of barrier out of line, with sufficient overlap or other means to prevent sound escaping through the gap;

b) providing doors set into the line of the barrier and constructed to an appropriate acoustic specification.

D.2.3 The location of means of escape shall be clearly indicated by signs.

Account should be taken of special needs (e.g. minimum dimensions) where access for vehicles can be required.

If access onto the railway from the far side of the barrier is restricted, a notice should be placed on the rail side warning, that return can be prevented. Provision should be made for safe exit under adverse conditions, especially if the railway is raised above the level of the surrounding land.

D.2.4 Doors shall be fitted with a self-closing mechanism and seals to prevent excessive leakage of sound through gaps. All hinges, closing mechanisms and locks shall be designed for minimum maintenance and to remain operational in adverse weather conditions.

D.2.5 Where access to the railway from adjacent land is not restricted by other means, doors shall only be capable of being opened from the side remote from the rails by key or special tool. Doors intended for use as a means of escape should open away from the rails and be fitted with panic bolts and latches.

Annex E
(normative)

Light reflection

E.1 General

Light is reflected from any flat surface. The amount of reflection depends on the angle of incidence. At large angles of incidence, reflections of the sun, or headlights at night, can be strong enough to confuse or dazzle train drivers and also affect rail safety. Problems are likely to be specific to the interaction of products and site conditions.

This annex provides a classification system for light reflection for authorities, engineers and designers, in order to better define and assess the level of possible risks to drivers.

E.2 Requirements

E.2.1 General

Values of reflectivity measured in accordance with the test method described in E.3 shall be provided together with the resulting classification according to the Table E.1.

E.2.2 Classification

Four classes are considered (see Table E.1). The highest gloss value out of the three obtained at the three angles of incidence of 20°, 60° and 85° shall determine the resulting class.

Table E.1 — Classification

Classification	Gloss value
Class 0	Not tested
Class 1	Gloss higher than 80
Class 2	Gloss from 40 to 80 (included)
Class 3	Gloss lower than 40

E.2.3 Test method

The test apparatus described in EN ISO 2813 requires a flat surface of sufficient area to allow it to stand in several different positions.

A flat sample of the surface finish at least 150 mm by 300 mm shall be provided.

NOTE This can be defined on the face of a full size panel, or part of such, or a specially prepared flat test piece of the same material with the surface finish applied in the same way as on a non-flat product.

The apparatus shall be used in accordance with EN ISO 2813. Ten measurements of reflectivity at three angles of incidence (20°, 60° and 85°) shall be taken with different positions of the apparatus chosen at random.

The following precautions shall be adopted with transparent materials (light transmission higher than 10 %):

a) application of a black opaque tape all around the edges of specimens if the cutting surface is bright;

b) adoption of an environmental light, natural or artificial, at a normal (not intense) level of illuminance during measurements;

c) supporting of the test specimens on a black opaque plane surface.

E.3 Test report

The test sample shall be described, in particular indicating whether it was part of a panel as used or a specially prepared test piece having the same surface coating treatment.

The resulting values of gloss (mean and standard deviation) at each angle of incidence (20°, 60° and 85°) shall be listed in the test report.

The test report shall report the classification according to E.2.2.

Annex F
(normative)

Electrical ground connection of noise barriers and related devices acting on airborne sound propagation on electrified lines

On electrified lines, the protection of persons against the electrical risk due to the presence of live parts (overhead contact line, feeder, etc.) near noise barriers and related devices acting on airborne sound propagation shall be assured by appropriate devices.

The requirements to be respected are defined in EN 50122-1.

This European Standard prescribes full compliance with EN 50122-1.

According to EN 50122-1, all the parts of noise barriers and related devices acting on airborne sound propagation, either wholly or partially conductive (for example, steel or reinforced concrete), and metallic structures (posts, panels, etc.) susceptible to accidental contact with live parts, in the case of breakage of an overhead line or breakage or derailment of a pantograph, shall generally be equipped with an equipotential bonding connected to the general mass of the earth or connected to the rail.

The above requirements apply to the installed structure and also during its construction.

The equipotential bonding should be done in such a way that it is a continuous connection without any interruption over the whole length of the barrier. Furthermore, the fixing to the barrier should be done in such a way that it cannot come loose or detach under the impact of wild animals impacting directly this equipotential bonding.

Annex G
(normative)

Electrolytic corrosion of noise barriers and related devices acting on airborne sound propagation

Where different metals or materials are used in the construction of noise barriers and related devices acting on airborne sound propagation, appropriate measures shall be taken in order to avoid electrolytic corrosion or interaction that could adversely affect working life.

Bibliography

[1] EN 16272-1, *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*

[2] EN 16272-2, *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*

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