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Railway applications — Coating of passenger rail vehicles

Applications ferroviaires — Peinturage des véhicules ferroviaires destinés au transport de passagers

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Foreword

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This document was prepared by Technical Committee ISO/TC 269, *Railway applications*, Subcommittee SC 2, *Rolling stock*. in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 256, *Railway applications,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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Railway applications — Coating of passenger rail vehicles

1 Scope

This document establishes the performance requirements and acceptance criteria for coating material used for passenger rolling stock, locomotives and components.

This document also provides guidance on the coating application processes, product selection, surface preparation, coating application, verification and inspection methods, repairs, refurbishment (refresh, etc.), and tests to measure the minimum performance for the final product.

This document applies to all types of coating materials (liquid, powder, etc.) used on

— railway vehicle bodies, and

— on-board equipment and constituent parts.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1518-1, *Paints and varnishes — Determination of scratch resistance — Part 1: Constant-loading method*

ISO 1519, *Paints and varnishes — Bend test (cylindrical mandrel)*

ISO 2409:2020, *Paints and varnishes — Cross-cut test*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 2811-1, *Paints and varnishes — Determination of density — Part 1: Pycnometer method*

ISO 2812-3, *Paints and varnishes — Determination of resistance to liquids — Part 3: Method using an absorbent medium*

ISO 2813, *Paints and varnishes — Determination of gloss value at 20°, 60° and 85°*

ISO 3233-3, *Paints and varnishes — Determination of the percentage volume of non-volatile matter — Part 3: Determination by calculation from the non-volatile-matter content determined in accordance with ISO 3251, the density of the coating material and the density of the solvent in the coating material*

ISO 3251:2019, *Paints, varnishes and plastics — Determination of non-volatile-matter content*

ISO 3668, *Paints and varnishes — Visual comparison of colour of paints*

ISO 4545-1:2023, *Metallic materials — Knoop hardness test — Part 1: Test method*

ISO 4618:2023, *Paints and varnishes — Vocabulary*

ISO 4624:2023, *Paints and varnishes — Pull-off test for adhesion*

ISO 4628-2:2016, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering*

ISO 4628-3:2016, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 3: Assessment of degree of rusting*

ISO 4628-4:2016, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 4: Assessment of degree of cracking*

ISO 4628-5:2022, *Paints and varnishes — Evaluation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 5: Assessment of degree of flaking*

ISO 4628-8, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 8: Assessment of degree of delamination and corrosion around a scribe or other artificial defect*

ISO 6270-2, *Paints and varnishes — Determination of resistance to humidity — Part 2: Condensation (in-cabinet exposure with heated water reservoir)*

ISO 6272-1, *Paints and varnishes — Rapid-deformation (impact resistance) tests — Part 1: Falling-weight test, large-area indenter*

ISO 6344-2:2021, *Coated abrasives — Determination and designation of grain size distribution — Part 2: Macrogrit sizes P12 to P220*

ISO 6344-3, *Coated abrasives — Determination and designation of grain size distribution — Part 3: Microgrit sizes P240 to P5000*

ISO 6504-3:2019, *Paints and varnishes — Determination of hiding power — Part 3: Determination of hiding power of paints for masonry, concrete and interior use*

ISO 6507-1:2023, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 7784-1, *Paints and varnishes — Determination of resistance to abrasion — Part 1: Method with abrasive-paper covered wheels and rotating test specimen*

ISO 8130-1, *Coating powders — Part 1: Determination of particle size distribution by sieving*

ISO 8130-13, *Coating powders — Part 13: Particle size analysis by laser diffraction*

ISO 8130-8:2021, *Coating powders — Part 8: Assessment of the storage stability of thermosetting powders*

ISO 8501-1:2007, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

ISO 8502-3, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)*

ISO 8503-1, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 9514, *Paints and varnishes — Determination of the pot life of multicomponent coating systems — Preparation and conditioning of samples and guidelines for testing*

ISO 11890-1, *Paints and varnishes — Determination of volatile organic compounds (VOC) and/or semi volatile organic compounds (SVOC) content — Part 1: Gravimetric method for VOC determination*

ISO 11890-2, *Paints and varnishes — Determination of volatile organic compounds(VOC) and/or semi volatile organic compounds (SVOC) content — Part 2: Gas-chromatographic method*

ISO 16276-2, *Corrosion protection of steel structures by protective paint systems — Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating — Part 2: Cross-cut testing and X-cut testing*

ISO 16474-2:2013/Amd 1:2022, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps — Amendment 1: Classification of daylight filters*

ISO 16862:2003, *Paints and varnishes — Evaluation of sag resistance*

ISO 17872, *Paints and varnishes — Guidelines for the introduction of scribe marks through coatings on metallic panels for corrosion testing*

ISO 18768-1, *Organic coatings on aluminium and its alloys — Methods for specifying decorative and protective organic coatings on aluminium — Part 1: Powder coatings*

ISO 19840, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces*

ISO 20567-1:2017, *Paints and varnishes — Determination of stone-chip resistance of coatings — Part 1: Multi-impact testing*

ISO 22163:2023, *Railway applications — Railway quality management system — ISO 9001:2015 and specific requirements for application in the railway sector*

ISO/CIE 11664-1, *Colorimetry — Part 1: CIE standard colorimetric observers*

ISO/CIE 11664-2, *Colorimetry — Part 2: CIE standard illuminants*

ISO/CIE 11664-3, *Colorimetry — Part 3: CIE tristimulus values*

ISO/CIE 11664-4, *Colorimetry — Part 4: CIE 1976 L*a*b* colour space*

ISO/CIE 11664-5, *Colorimetry — Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram*

ISO/CIE 11664-6, *Colorimetry — Part 6: CIEDE2000 colour-difference formula*

3 Terms, definitions, abbreviations and symbols

For the purposes of this document, the terms and definitions given in ISO 4618 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms and definitions

3.1.1
coater
paint applicator
operator which applies the *coating material* (3.1.2)

3.1.2
coating material
product, in liquid, paste or powder form, that, when applied to a substrate, forms a layer possessing protective, decorative and/or other specific properties

[SOURCE: ISO 4618:2023, 3.48]

3.1.3
technical data sheet
document released by the *coating material* (3.1.2) supplier which details all the technical parameters needed to prepare and apply the coating material

3.1.4
coating system
layer combined of all coats of the same or multiple coating materials

[SOURCE: ISO 4618:2023, 3.51]

3.1.5
qualification
process that proves that a set of technical requirements are fulfilled

3.1.6
refurbishment time
expected duration of use not linked to warranty time

3.1.7
work sample
representative part (same material, same pretreatment) which is produced under qualified production conditions

3.1.8
standard atmosphere
atmosphere for conditioning or testing according to ISO 554:1976, 2.2 (ordinary tolerances) with 23 °C ± 2 °C and 50 % ± 5 % of relative humidity

3.2 Abbreviated terms and symbols

3.2.1 Abbreviated terms

AASS	acetic acid salt spray
AHT	alternating humidity and air temperature
CH	constant humidity
FRP	fibre reinforced plastic
GU	gloss unit
NSS	neutral salt spray
SCI	specular component included
VOC	volatile organic compound

3.2.2 Symbols

a	thickness	µm
C^*	colourimetric variance according to the chroma axis	
R_a	arithmetic mean height of the roughness according to ISO 21920-2	
R_z	roughness based on themaximum height according to ISO 21920-2	
Ri	degree of rusting according to ISO 4628-3	
g_{spe}	specific gravity	
Sa	surface preparation by blast-cleaning according to ISO 8501-1 (the optional number following Sa refers to ISO 8501-1:2007, Table 1)	

St surface preparation by hand and power tool cleaning according to ISO 8501-1 (the optional number following St refers to ISO 8501-1:2007, Table 2)

4 Coating systems, locations and environment and design recommendations

4.1 General

The coating system shall be qualified based on its location within the vehicle.

4.2 Types of locations

The locations are defined in Table 1.

Table 1 — Types of location

Type of location	Decorative location (visible to passengers and crew)	Non-decorative location (non-visible)
Interior (walls and ceilings) and equipment	Examples include: Ceiling Side ceiling Side walls Grab-handles Cab desk Luggage racks	Carbody side walls and ceiling Parts behind ceilings and side walls (C-rail, hooks, etc.)
Interior needing higher resistance to corrosion (floor and elements mounted on the floor)	Seating (pedestal) Mounting of seats Mounting of support bars Bottom of side of walls Vestibule	Carbody floor Toilet walls Mounting parts Interior of equipment boxes on the roof
Exterior (direct UV exposure[a])	Examples include: Carbody side Exterior doors Fairings/roof fin Carbody roof (rounded) Carbody ends (if decorative) Cab front/front end Equipment (outside window frames, door gutters, etc.) Devices (cameras, speakers, etc.)	Examples include: Carbody roof (tube) Carbody ends Equipment boxes Fairings (for HVAC unit, pantograph, insulator head, etc.) Handrail (for inspection of the roof) Drain pipe/gutter Fresh air duct Intercar barrier bracket
Exterior (indirect or no UV exposure)	No	Carbody underframe Equipment mounted on the underframe Coupler Buffer Bogie frame and bogie components Axles, wheelsets

4.3 Standard support and substrates

Table 2 lists the supports and substrates that shall be used for the tests described in Table 3, Table 4, Table 5, Table 6, Table 7 and Table 8.

For the chemical pretreatments described in Table 2, the name of each product used for pretreatment (degreasing, etching, passivation, pickling) should be included in the qualification report.

Table 2 — Standard support and substrates

Type	Standard support	Support for elasticity tests
Steel	Substrate S2 defined in this document as: Material: cold rolled steel (steel grade: DC01/SPCC-SD) Thickness: 2 mm Size: — depends on the test machine; — for corrosion tests min. 150 mm × 200 mm. Pretreatment: — powder: zinc phosphate pretreatment or abrasive blast cleaning (surface quality: Sa 21/2; roughness R_z value between 25 and 40 µm) or both — liquid: abrasive blast cleaning (surface quality: Sa 21/2; roughness fine G in accordance with ISO 8503-1)	Substrate S1 defined in this document as: Material: steel Thickness: 0,7 mm to 1 mm Size: depends on test machine Pretreatment: zinc phosphated or bare surface or both
Aluminium	Substrate A2 defined in this document as: Material: aluminium grade: AlMg3 (Al5754), AlMg2.5 (A5052), Al-Si1MgMn A6082 or AlMg1SiCu (A6061/Al6061T6) Thickness: 2 mm min. Size: — depends on the test machine; — for corrosion tests: min. 100 mm × 150 mm. Pretreatment: — powder: chemical treatment in accordance with ISO 18768-1 or abrasive blast cleaning (surface quality: Sa 21/2; roughness R_z value between 25 µm and 40 µm) or both; — liquid: abrasive blast cleaning (the degree of cleanliness shall have a flat, uniform and clean blasting pattern); roughness R_z value between 25 µm and 40 µm.	Not required

In the case of abrasive blast cleaning and if the surface is not protected from contamination and oxidation, the application should be done immediately after.

The results are not valid for other substrates (e.g. FRP or plastic). A process qualification (see 5.3) is necessary in any case on the substrate of the project and needs to be performed with the original pretreatment.

4.4 Coating system qualification

4.4.1 General

The coating system shall be qualified in accordance with Table 3, Table 4, Table 5, Table 6, Table 7 and Table 8.

All tests should be performed with the nominal thickness mentioned in Table 4. If single tests are carried out with a different nominal layer thickness, this shall be explicitly indicated in the test report.

4.4.2 Chemical and physiochemical characteristics of products for each layer