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Plastic railway sleepers (railroad ties)

Traverses de chemin de fer en matières plastiques

ICS 45.080; 83.140.99

Member bodies are reminded to consult relevant national interests in each of the technical fields concerned [*Plastics* (ISO/TC 61), *Products* (SC 11), and *Plastics* (ISO/TC 61), *Burning behaviour* (SC 4)] before returning ballots to the ISO Central Secretariat.

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Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 12856 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

Introduction

Railway sleepers are mainly made of pre-stressed concrete, steel or timber. Timber sleepers have been used for many years and have the attributes of being lightweight and workable. However, they have a number of disadvantages including being subject to decay as well as the concerns over the supply from a continuing depletion of forest resources.

In recent years there have been increasing demands for alternative materials that can be used for making sleepers. A sleeper made from plastic is one such alternative material. Plastic/composite sleepers offer similar advantages as timber sleepers (lightness, workability and durability) without some of the disadvantages (decay and environmental impact).

There are many types of plastics and manufacturing processes which could have various effects on the in service performance. This standard has therefore been introduced in order to specify the performance for plastic/composite sleepers.

This Standard applies to the sleepers in conventional shapes such as rectangular and to the sleepers composed of uniform materials including those partly reinforced by filling agents or fibre. Sleepers in other shapes or the sleepers composed of multiple materials can be included in the Standard when the full-sized sleepers are prepared for testing.

Plastic railway sleepers (railroad ties)

1 Scope

This International Standard specifies the requirements of plastic/composite sleepers for railway applications.

This Standard is applicable to the full-sized sleepers and the test specimens properly cut out from the full-sized sleepers both in rectangular shapes and with the cross sections composed of uniform materials. This International Standard is also applicable to sleepers in other shapes or with the cross sections composed of several kinds of material, when the test specimens are cut into rectangular shapes.

This Standard deals with the following three types (categories) of plastic/composite sleepers and stipulates each requirement for railway applications.

(Type A) Light weight sleepers with high bending-properties

(Type B) Sleepers with upper properties

(Type C) Sleepers with standard properties

In using this Standard, the railway companies or other users may select the most suitable type (category) of requirements among the A, B and C in accordance with their schedules. The Annex A will be supplementary information for the use of this Standard.

2 Normative references

The following referenced documents are indispensable for the application 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 62, *Plastics — Determination of water absorption*

ISO 75, *Plastics — Determination of temperature of deflection under load (all parts)*

ISO 178, *Plastics — Determination of flexural properties*

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 306, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST)*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 527-4, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

ISO 877-1, *Plastics — Methods of exposure to solar radiation — Part 1: General guidance*

ISO 877-2, Plastics — *Methods of exposure to solar radiation — Part 2: Direct weathering and exposure behind window glass*

ISO 2578, *Plastics — Determination of time-temperature limits after prolonged exposure to heat*

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 3611, *Geometrical product specifications (GPS) – Dimensional measuring equipment: Micrometers for external measurements – Design and metrological characteristics*

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 4892-4, *Plastics — Methods of exposure to laboratory light sources — Part 4: Open-flame carbon-arc lamps*

ISO 5003, *Flat bottom railway rails and special rail sections for switches and crossings of non-treated steel — Technical delivery requirements*

ISO 8256, *Plastics — Determination of tensile-impact strength*

ISO 10640, *Plastics — Methodology for assessing polymer photoageing by FTIR and UV/visible spectroscopy*

ISO 11357-6, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)*

ISO 13385-1, *Geometrical product specifications (GPS) – Dimensional measuring equipment - Part 1: Calipers; Design and metrological characteristics*

ISO 13385-2, *Geometrical product specifications (GPS) - Dimensional measuring equipment - Part 2: Caliper depth gauges; Design and metrological characteristics*

ISO 14125, *Fibre-reinforced plastic composites — Determination of flexural properties*

ISO/TR 19032, *Plastics — Use of polyethylene reference specimens (PERS) for monitoring laboratory and outdoor weathering conditions*

IEC 60695-11-20, *Fire hazard testing - Part 11-20: Test flames - 500 W flame-test methods*

EN 13230-2, *Railway applications - Track - Concrete sleepers and bearers - Part 2: Pre-stressed monoblock sleepers*

EN 13450-2002, *Aggregates for railway ballast*

EN 14617-2, *Agglomerated stone — Test methods — Part 2: Determination of flexural strength (bending)*

EN 14617-15, *Agglomerated stone — Test methods — Part 15: Determination of compressive strength*

3 Requirements

3.1 Dimensional tolerance

The dimensional tolerance shall be as specified in Table 1 when the measurement is conducted using the method as in 4.2 of this Standard.

Table 1 — Dimensional Tolerance

Item	Unit	Tolerances			Test Methods		
Category		Type A	Type B	Type C	Type A	Type B	Type C
Thickness	mm	± 2	± 2	± 3	4.2 a)		
Width	mm	± 3	± 3	± 6			
Length	mm	± 5	± 10	± 10			
Camber and Bend	—	≤ 2/1000	—		4.2 b) and c)	—	
Torsion	—	≤ 1/1000	—		4.2 d)	—	

3.2 Bending strength and Young's modulus in flexure

The requirements of bending strength and Young's modulus in flexure shall be as specified in Table 2 and 3 when the test is conducted using the methods as in 4.3 a) or b) of this Standard.

3.3 Longitudinal compressive strength

The requirement of longitudinal compressive strength shall be as specified in Table 2 and 3 when the test is conducted using the method as in 4.4 of this Standard.

3.4 Lateral compressive strength

The requirement of lateral compressive strength shall be as specified in Table 2 when the test is conducted using the method as in 4.5 of this Standard.

3.5 Shear strength

The requirement of shear strength shall be as specified in Table 2 and 3 when the test is conducted using the method as in 4.6 of this Standard.

3.6 Adhesive shear strength

The requirement of adhesive shear strength shall be as specified in Table 2 when the test is conducted using the method as in 4.7 of this Standard.

3.7 Alternating-current break down voltage

The requirement of alternating-current breakdown voltage shall be as specified in Table 2 when the test is conducted using the method as in 4.8 of this Standard.

3.8 Direct-current insulation resistance

The requirement of direct-current insulation resistance shall be as specified in Table 2 when the test is conducted using the method as in 4.9 of this Standard.

3.9 Track spike pull-out strength

The requirement of track spike pull-out strength shall be as specified in Table 2 when the test is conducted using the method as in 4.10a) of this Standard.

3.10 Screw spike pull-out strength

The requirement of screw spike pull-out strength shall be as specified in Table 2 when the test is conducted using the method as in 4.10b) of this Standard.

3.11 Water absorption

The requirement of water absorption shall be as specified in Table 2 when the test is conducted using the method as in 4.11 of this Standard.

3.12 Unit volume mass

The requirement of unit volume mass shall be as specified in Table 2 when the test is conducted using the method as in 4.12 of this Standard.

3.13 Linear expansion coefficient

The requirement of linear expansion coefficient shall be as specified in Table 2 when the test is conducted using the method as in 4.13 of this Standard.

Table 2 — Physical Properties

Item		Unit	Values of Physical Property			Test Methods		
Category			A	B	C	A	B	C
Material Strength	Bending Strength	N/mm^2	≥ 28 [1]	≥ 18	≥ 13,8	4.3 a) or 4.3 b)	4.3 a) or 4.3 b)	
	Young's Modulus in Flexure (test specimen)	N/mm^2	≥ 6 000	≥ 2 500	≥ 1 170	4.3 a)		
	Longitudinal Compression Strength	N/mm^2	≥ 40	≥ 8	— [2]	4.4		— [2]
	Lateral Compression Strength	N/mm^2	— [2]	≥ 8	≥ 6,2	4.5		
	Shear Strength	N/mm^2	≥ 7	≥ 4,5	— [2]	4.6		— [2]
	Adhesive Shear Strength	N/mm^2	≥ 7 Base-Material Breakage	— [3]	— [3]	4.7	— [3]	— [3]
Electrical Character-istics	Alternating-Current Break - down Voltage	kV	≥ 20	≥ 20	— [2]	4.8		— [2]
	Direct-Current Insulation Resistance	Ω	$\geq 1 \times 10^{10}$	$\geq 2 \times 10^{4}$	$\geq 2 \times 10^{4}$	4.9		
Pull-out Strength	Track Spike Pull-out Strength	kN	≥ 15	≥ 10	≥ 8,5	4.10 a)		
	Screw Spike Pull-out Strength	kN	≥ 30	≥ 30	≥ 22,2	4.10 b)		
Water Absorption		% [4]	≤ 2	≤ 2	— [2]	4.11		— [2]
Mass per Unit Volume		g / cm^3	≥ 0,64	≥ 0,8	≥ 0,8	4.12		
Linear Expansion Coefficient		K^{-1}	$5 \times 10^{-5} \leq$	$6 \times 10^{-5} \leq$	$1,35 \times 10^{-4} \leq$	4.13		

1) This is based on a minimum functional safety factor but a higher value may be required.

2) There may remain blanks in the table if the requirements should not necessarily be established. For the purpose of railway operation, however, the requirements may be defined as a necessity through agreement between the manufacturers and purchasers.

3) This shall remain blank because there is no part to use adhesive and hence no need to establish the requirement.

4) This unit is in weight fraction.

Table 3 — Physical Properties (dependence of temperature)

Item		Unit	Values of Physical Propertiy		Test Methods
			at -30°C (in air for 24 h)	at 60°C (in air for 24 h)	
Material Strength	Bending Strength	%[1)]	≥ 100	≥ 70	4.3 a)
	Young's Modulus in Flexure (test specimen)				
	Longitudinal Compression Strength				4.4
	Shear Strength				4.6

1) The percentage indicates the strength retention against physical property values at normal temperature.

3.14 Flame resistance

For the requirement of flame resistance, non-combustibility shall be confirmed when the test is conducted using the method as in 4.14 of this Standard.

3.15 Fatigue resistance

For the requirement of fatigue resistance, breakdown shall not take place when the test is conducted using the method as in 4.15 of this Standard.

3.16 Weather resistance

a) Products equivalent to "Type A"

The requirement of weather resistance shall be specified in Table 4 when the test is conducted using the method as in 4.16 a) of this Standard.

Table 4 — Physical Properties after Weathering

		Unit	Value of Physical Property	Test Method
Material Strength	Bending Strength	%[1)]	≥ 70	4.16 a)
	Young's Modulus in Flexure			
	Longitudinal Compressive Strength			
	Adhesive Shear Strength (base-material failure)			

1) The percentage indicates the strength retention against physical property values before acceleration of degradation in weathering resistance.