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Railway applications — Polymeric composite sleepers, bearers and transoms —

Part 3: General requirements

Applications ferroviaires — Traverses et supports en matériaux composites à matrice polymère —

Partie 3: Exigences générales

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Foreword

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This document was prepared by Technical Committee ISO/TC 269, *Railway applications*, Subcommittee SC 1, *Infrastructure.*

A list of all parts in the ISO 12856 series can be found on the ISO website.

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Introduction

This document is used as the technical basis for transaction between corresponding parties (purchaser – supplier).

Railway applications — Polymeric composite sleepers, bearers and transoms —

Part 3: General requirements

1 Scope

This document specifies general requirements of polymeric composite railway sleepers. It is applicable to the sleepers, bearers and transoms to be installed in all tracks (both heavy and urban rail) with or without ballast.

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 12856-1, *Railway applications — Polymeric composite sleepers, bearers and transoms — Part 1: Material characteristics*

ISO 12856-2, *Railway applications — Polymeric composite sleepers, bearers and transoms — Part 2: Product testing*

3 Terms and definitions

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

ISO and IEC maintain terminological 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
purchaser
body responsible for purchasing the product on the network company's behalf

3.2
supplier
body responsible for the use of the International Standard in response to the *purchaser's* (3.1) requirement

Note 1 to entry: The supplier is also responsible for requirements which apply to the product of the *manufacturer* (3.3).

3.3
manufacturer
organization which produces the *sleepers* (3.4), the *bearers* (3.5) and the *transoms* (3.6)

3.4
sleeper
transverse component of the track which controls the *gauge* (3.29) and transmits loads from the rail to the ballast or other sleeper support

3.5
bearer
transverse component of switches and crossings which controls the relative geometry of two or more running rails and different pieces of special track work, and transmits loads from the rails to the ballast or other bearer support

3.6
transom
transverse component of track on bridges with open deck which controls the *gauge* (3.29) and transmits loads from the rail to the bridge structure

3.7
longitudinal beams for ballastless track on bridges
longitudinal component of *ballastless track* (3.27) on bridges which supports several *fastening systems* (3.28) for one rail

3.8
bending moment
moment applied on the polymeric composite *sleeper* (3.4), *bearer* (3.5) or *transom* (3.6) which produces tension and compression in the element

3.9
positive bending moment
moment which produces tension at the bottom of the polymeric composite *sleeper* (3.4), *bearer* (3.5) or *transom* (3.6)

3.10
negative bending moment
moment which produces tension at the top of the polymeric composite *sleeper* (3.4), *bearer* (3.5) or *transom* (3.6)

3.11
rail seat
area on which a running rail rests

3.12
rail seat area
rail seat (3.11) and the immediate area around the *fastening system* (3.28)

3.13
rail seat bending moment
moment under the centre line of the rail

3.14
centre bending moment
moment at the centre part of a *monoblock sleeper* (3.15)

3.15
monoblock sleeper
sleeper (3.4) consisting of one element of material

3.16
twin-block sleeper
sleeper (3.4) in which two *blocks* (3.17) are connected by a connecting bar

3.17
block
short polymeric composite element which transmits loads from one rail to the ballast or other support

3.18
test load
load applied during testing

3.19
dynamic rail seat load
P_k
characteristic load on a *rail seat* (3.11) of the *sleeper* (3.4) for normal service dynamic loading

Note 1 to entry: Usually the characteristic load corresponds to the mean value plus "n" standard deviations of the dynamic wheel load.

Note 2 to entry: The term "dynamic load" used within this series, with respect to tests, should be interpreted as "cyclic load".

3.20
characteristic bending moment
M_k
bending moment (3.8) from the *dynamic rail seat load* (3.19)

3.21
characteristic positive bending moment for rail seat section
$M_{k,r,pos}$
positive bending moment (3.9) at the *rail seat* (3.11) from the *dynamic rail seat load* (3.19)

3.22
characteristic negative bending moment for rail seat section
$M_{k,r,neg}$
negative bending moment (3.10) at the *rail seat* (3.11) from the *dynamic rail seat load* (3.19)

3.23
characteristic negative bending moment for centre section
$M_{k,c,neg}$
negative bending moment (3.10) at the centre section from the *dynamic rail seat load* (3.19)

3.24
characteristic positive bending moment for centre section
$M_{k,c,pos}$
positive bending moment (3.9) at the centre section from the *dynamic rail seat load* (3.19)

3.25
thermal expansion
elongation of the *sleeper* (3.4), *bearer* (3.5) or *transom* (3.6) as a result of increasing temperature

3.26
bedding modulus
pressure (force per surface area) per unit deflection and measured under a uniaxial load

3.27
ballastless track
high fixity track constrained by means other than ballast

3.28
fastening system
any device used to secure running rails into chairs or baseplates or directly to *sleepers* (3.4), *bearers* (3.5), *transoms* (3.6) or other rail supports

3.29
gauge
lateral distance between the running edges of rails in track

3.30
lateral track resistance
ability of a *sleeper* (3.4) to resist movement, perpendicular to rail, under lateral loading

3.31
conductor rail
rigid metallic section or rail mounted on insulators to distribute electrical energy to trains

3.32
geometric ballast plate
GBP
rigid steel plate with geometrically structured surface simulating ballast contact

Note 1 to entry: See ISO 12856-2:2020, Annex A.

3.33
flat plate
FP
rigid steel plate with flat surface with dimension 300 mm by 300 mm

3.34
design approval test
test on a polymeric composite *sleeper* (3.4), *bearer* (3.5) or *transom* (3.6) or part of it to demonstrate compliance with the acceptance criteria

3.35
routine test
quality control test in terms of regular manufacturing

4 Symbols

For the purposes of this document, the symbols and abbreviated terms listed in Table 1 apply.

Table 1 — Symbols

Symbol	Description	Unit
b_1	Maximum bottom width of the polymeric composite sleeper, bearer or transom.	m
b_2	Top width of the polymeric composite sleeper, bearer or transom.	m
b_3	Top width of the polymeric composite sleeper, bearer or transom at the axis of the rail seat.	m
d_{0s}	Deformation of the sleeper in the strength test under F_{r0}.	mm
d_{1s}	Deformation of the sleeper in the strength test under $k_{1s} \times F_{r0}$.	mm
d_{2s}	Deformation of the sleeper in the strength test under $k_{2s} \times F_{r0}$.	mm
$d_{1s,lim}$	Upper limit for the sleeper deformation in the strength test at exceptional load level.	mm
$d_{2s,lim}$	Upper limit for the sleeper deformation in the strength test at accidental load level.	mm
F	Planeness of each rail seat area: with regard to two points 150 mm apart.	—
F_{c0}	Positive reference test load at the centre section of the sleeper.	kN
F_{c0n}	Negative reference test load at the centre section of the sleeper	kN
F_{r0}	Positive reference test load for the rail seat section.	kN
F_{cB}	Maximum positive test load at centre of sleeper, bearer or transom.	kN
F_{cBn}	Maximum negative test load at centre of sleeper, bearer or transom.	kN

Table 1 *(continued)*

Symbol	Description	Unit
$F_{c,\mathrm{perm,n}}$	Constant load applied for permanent deformation test at the centre section for negative bending moments.	kN
$F_{r\mathrm{B}}$	Maximum positive test load at the rail seat section which cannot be increased.	kN
h	Depth at any position along the total length of the polymeric composite sleeper, bearer or transom measured in accordance with the quality plan.	m
$k_{1\mathrm{s}}$	Coefficient used for calculation of static test load for the exceptional load level. This factor is applied to initial reference test load.	—
$k_{2\mathrm{s}}$	Coefficient used for calculation of static test load for the accidental load level. This factor is applied to initial reference test load.	—
k_3	Coefficient to be used for calculation of F_{rB} at the end of the fatigue test.	—
$k_{\mathrm{c,dyn1}}$	Dynamic low frequency stiffness at the centre section for the positive bending moment in between the loads 0,1 × F_{c0} and 0,5 × F_{c0}.	MN/m
$k_{\mathrm{c,dyn2}}$	Dynamic low frequency stiffness at the centre section for the positive bending moment in between the loads 0,1 × F_{c0} and F_{c0}.	MN/m
$k_{\mathrm{c,stat1}}$	Static stiffness at the centre section for the positive bending moment in between the loads 0,1 × F_{c0} and 0,5 × F_{c0}.	MN/m
$k_{\mathrm{c,stat2}}$	Static stiffness at the centre section for the positive bending moment in between the loads 0,1 × F_{c0} and F_{c0}.	MN/m
$k_{\mathrm{cn,dyn1}}$	Dynamic low frequency stiffness at the centre section for the negative bending moment in between the loads 0,1 × $F_{c0\mathrm{n}}$ and 0,5 × $F_{c0\mathrm{n}}$.	MN/m
$k_{\mathrm{cn,dyn2}}$	Dynamic low frequency stiffness at the centre section for the negative bending moment in between the loads 0,1 × $F_{c0\mathrm{n}}$ and $F_{c0\mathrm{n}}$.	MN/m
$k_{\mathrm{cn,stat1}}$	Static stiffness at the centre section for the negative bending moment in between the loads 0,1 × $F_{c0\mathrm{n}}$ and 0,5 × $F_{c0\mathrm{n}}$.	MN/m
$k_{\mathrm{cn,stat2}}$	Static stiffness at the centre section for the negative bending moment in between the loads 0,1 × $F_{c0\mathrm{n}}$ and $F_{c0\mathrm{n}}$.	MN/m
$k_{\mathrm{dyn,5Hz}}$	Low frequency dynamic stiffness of polymeric composite sleeper or bearer measured with GBP at (5 ± 1) Hz.	MN/m
k_{max}	Static stiffness of polymeric composite sleeper, bearer or transom measured with GBP between F_{max} and F_{min}.	MN/m
$k_{\mathrm{r,dyn1}}$	Dynamic low frequency stiffness at the rail seat section in between the loads 0,1 × F_{r0} and 0,5 × F_{r0}.	MN/m
$k_{\mathrm{r,dyn2}}$	Dynamic low frequency stiffness at the rail seat section in between the loads 0,1 × F_{r0} and F_{r0}.	MN/m
$k_{\mathrm{r,stat1}}$	Static stiffness at the rail seat section in between the loads 0,1 × F_{r0} and 0,5 × F_{r0}.	MN/m
$k_{\mathrm{r,stat2}}$	Static stiffness at the rail seat section in between the loads 0,1 × F_{r0} and F_{r0}.	MN/m
k_{stat}	Static stiffness of polymeric composite sleeper, bearer or transom measured with GBP between F_{test} and F_{min}.	MN/m
k_{t}	Coefficient used for the degradation during service life of the sleeper.	—
L	Overall length of the polymeric composite sleeper, bearer or transom.	m
L_1	Distance between the rail fastening gauge points.	m
L_2	Position of the rail fastening gauge point with regard to the end of the polymeric composite sleeper, bearer or transom.	m
L_3	Total length of reinforced polymeric composite block.	m
L_{c}	Design distance between centre lines of the rail seats.	m
L_{el}	Elastic length of the Winkler beam.	m
L_{p}	Design distance between the centre line of the rail seat to the edge of the sleeper at the bottom.	m
m	Mass of the sleeper (variation with regard to nominal mass).	kg

Table 1 *(continued)*

Symbol	Description	Unit
M_k	Characteristic bending moment.	kNm
$M_{k,c,neg}$	Characteristic negative bending moment for centre section.	kNm
$M_{k,c,pos}$	Characteristic positive bending moment for centre section.	kNm
$M_{k,r,neg}$	Characteristic negative bending moment for rail seat section.	kNm
$M_{k,r,pos}$	Characteristic positive bending moment for rail seat section.	kNm
P_k	Dynamic rail seat load.	kN
T	Relative twist between two rail seats (see Annex A).	°
Δu	Deformation for permanent deformation test of screw/insert in function of temperature.	mm
α	Inclination of the rail seat (see Annex A).	°
$\alpha_{T,bottom}$	Linear thermal expansion coefficient for the bottom.	K^{-1}
$\alpha_{T,top}$	Linear thermal expansion coefficient for the top.	K^{-1}
λ	Lever length of resulting internal forces $P_k/2$.	m
ξ	Position of unit wheel load Q in function of the deflection of rail.	rad
η	Influence of adjacent axles.	—

5 General characteristics

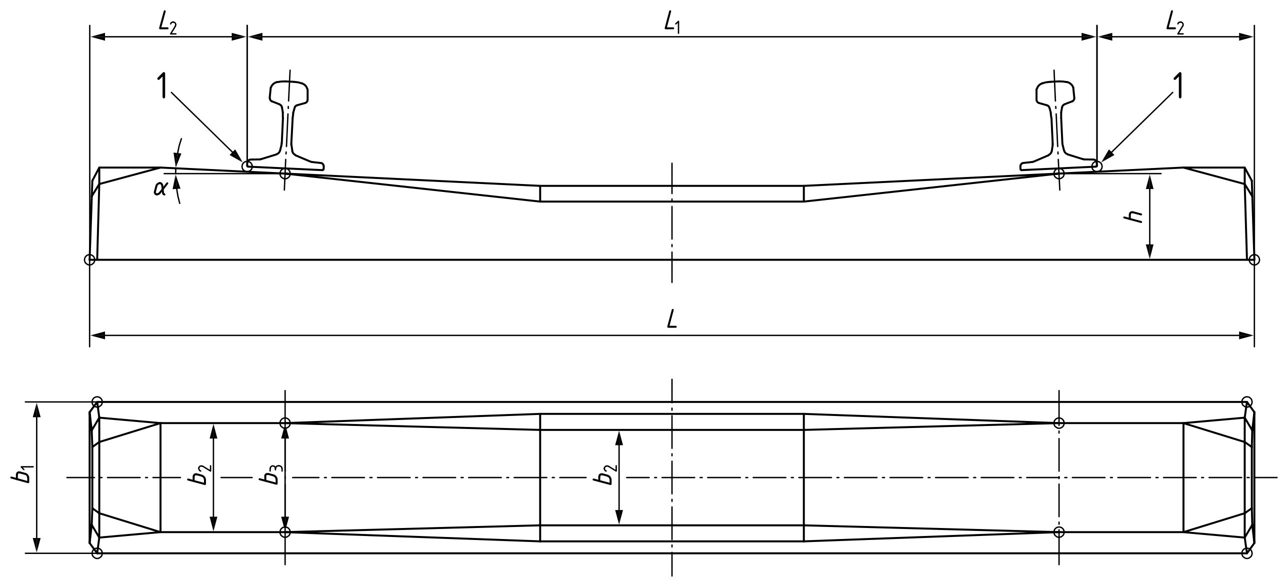
5.1 General

The track, including switches and crossings, is an assembly of transverse sleepers, bearers or transoms secured to the rails by means of a fastening system and supported by ballast or other support. It is characterized by the gauge of the track, the rail profile, the inclination of the rails and the spacing of the polymeric composite sleepers, bearers and transoms.

5.2 Geometrical design, mass and tolerances

The relevant dimensions of polymeric composite sleepers, bearers and transoms are shown in Figures 1, 2 and 3.

NOTE 1 In case of sleepers with rectangular cross-section over the total length, b_3 is only applied on the rail seat. b_1, b_2, b_3 are all equal and $\alpha = 0$.

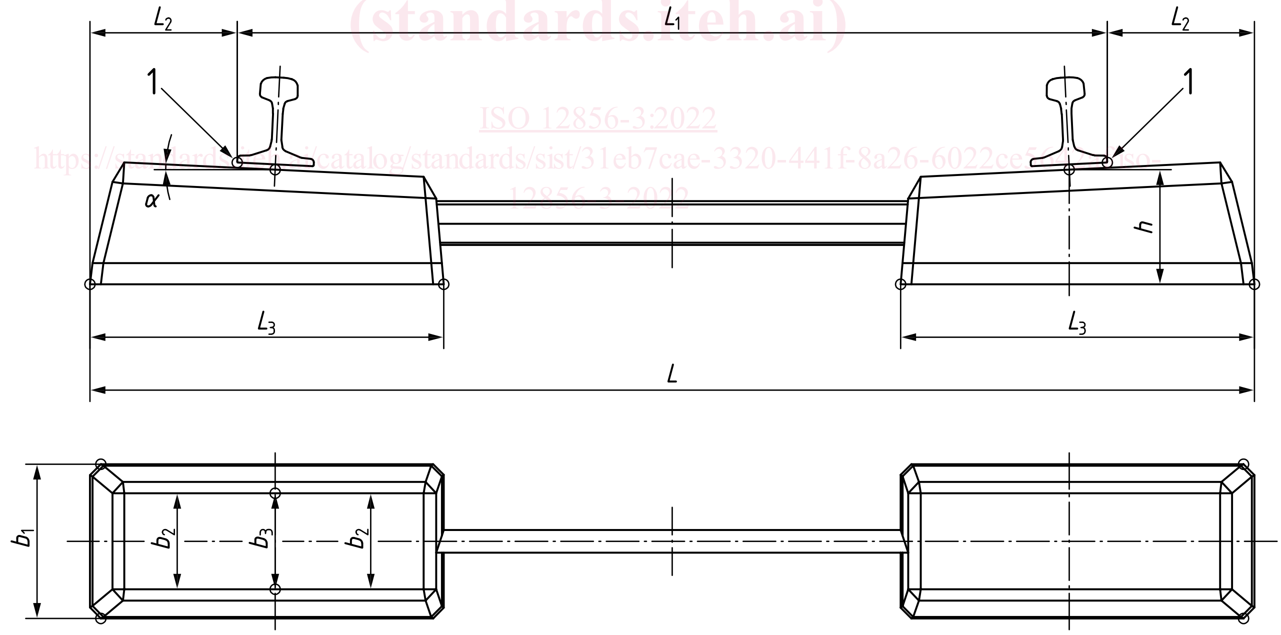


Key

1 measurement point

L_1 distance between sleeper gauge points taking into account the fastening system and track gauge

Figure 1 — Monoblock sleeper



Key

1 measurement point

L_1 distance between sleeper gauge points taking into account the fastening system and track gauge

Figure 2 — Twin-block sleeper

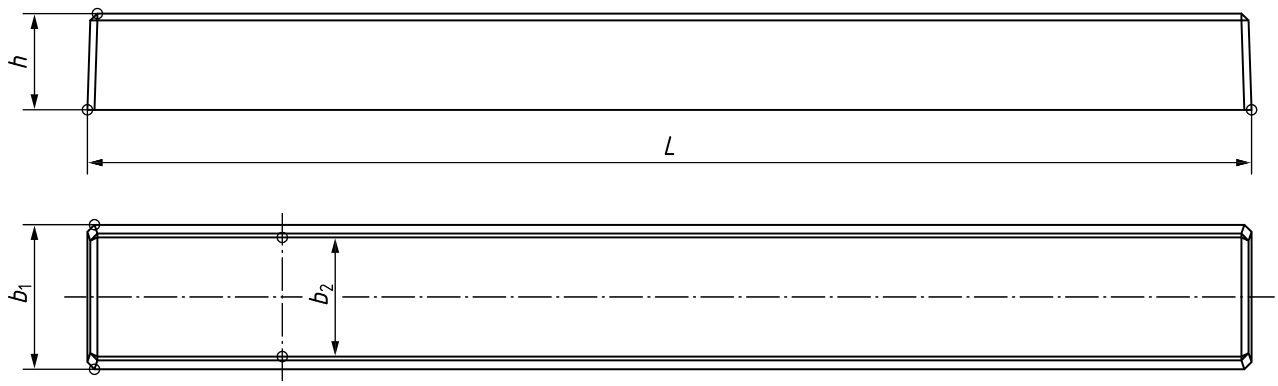


Figure 3 — Sleepers, bearers and transoms

The dimensions of the sleeper, bearer and transom shall be agreed between the purchaser and the supplier.

The maximum tolerances specified in Table 2 and below Figure 4 apply to ballasted track and may be varied by the purchaser in the case of special requirements such as dedicated polymeric composite elements for ballastless track or use of a sleeper laying machine, etc.

Table 2 — Maximum tolerances

Symbol	Tolerance
L	±30 mm[a]
b_1	±5 mm
b_2	±5 mm
b_3	±5 mm
h	$\begin{pmatrix}+10\\-3\end{pmatrix}$ mm
L_1	$\begin{pmatrix}+2\\-1\end{pmatrix}$ mm
L_2	±8 mm
L_3	±8 mm
α	±0,5° [b]
F	2 mm[c]
T	0,5°
m[d]	±5 %

[a] For installation with a track laying machine, a tolerance of ±10 mm is recommended.

[b] If a baseplate is used, a tolerance of ±0,25° is recommended.

[c] If a direct fastening (fastening without baseplate) is used, a tolerance of 1 mm is recommended.

[d] The purchaser shall indicate if all or part of the fastening system is included in the mass of the polymeric composite element.

In case of embedded fastening components, the positioning of these components in the sleeper, bearer and transom shall be measured in accordance with Figure 4.

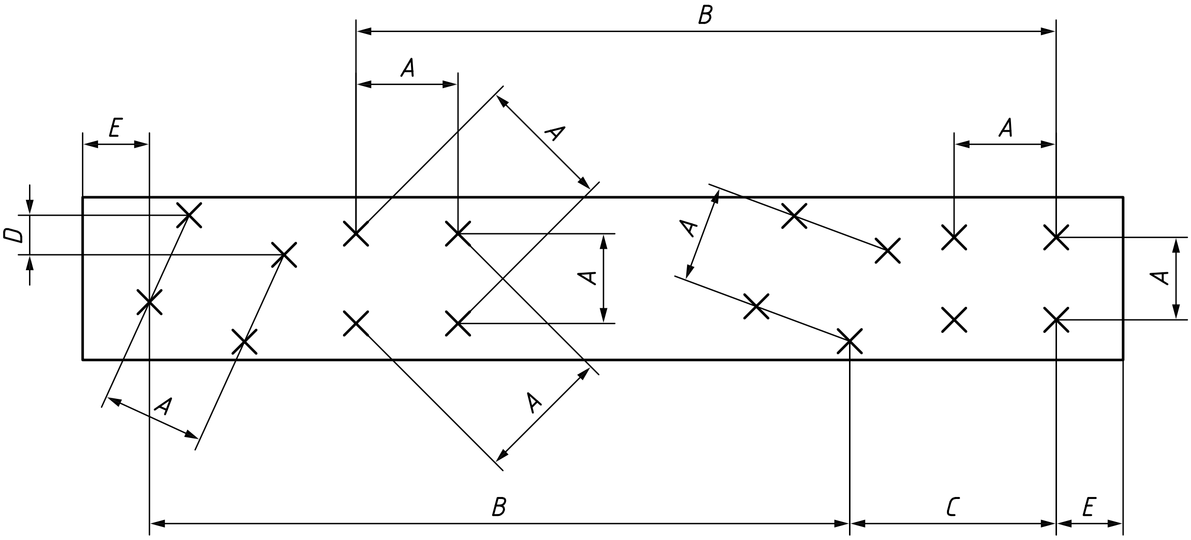


Figure 4 — Measurement of tolerances on fastening components positioning of bearer

Tolerance on dimensions A and D (on the same support area):	±1,0 mm
Tolerance on dimensions B and C (between two separate supports areas):	±1,5 mm
Tolerance between the last cast-in component and the end of the bearer (E):	±15 mm

Figure 5 shows the vertical deviation measurement of a bearer.