

### SLOVENSKI STANDARD SIST-TP CEN/TR 16251:2016

01-april-2016

## Železniške naprave - Okoljski pogoji - Načrtovanje in preskušanje železniških vozil v težkih razmerah

Railway application - Environmental conditions - Design and test of rolling stock under severe conditions

Bahnanwendungen - Umweltbedingungen - Konstruktion und Prüfung für Fahrzeugen für strenge Bedingungen  $iTeh\ STANDARD\ PREVIEW$ 

Applications ferroviaires - Conditions d'environnement - Conception et essais pour véhicules ferroviaires pour conditions rigoureuses

https://standards.iteh.ai/catalog/standards/sist/509ac811-5627-49c6-a5ce-

Ta slovenski standard je istoveten z: CEN/TR 16251-2016

ICS:

45.060.01 Železniška vozila na splošno Railway rolling stock in general

SIST-TP CEN/TR 16251:2016 en,fr,de

**SIST-TP CEN/TR 16251:2016** 

# iTeh STANDARD PREVIEW (standards.iteh.ai)

<u>SIST-TP CEN/TR 16251:2016</u> https://standards.iteh.ai/catalog/standards/sist/509ac811-5627-49c6-a5ce-e7e221833c8a/sist-tp-cen-tr-16251-2016 TECHNICAL REPORT
RAPPORT TECHNIQUE
TECHNISCHER BERICHT

**CEN/TR 16251** 

February 2016

ICS 45.060.01

#### **English Version**

## Railway applications - Environmental conditions - Design guidance for rolling stock

Applications ferroviaires - Conditions d'environnement - Lignes directrices pour la conception du matériel roulant

Bahnanwendungen - Umweltbedingungen -Konstruktionsempfehlungen für Schienenfahrzeuge

This Technical Report was approved by CEN on 15 January 2015. It has been drawn up by the Technical Committee CEN/TC 256.

CEN members are the national standards bodies of 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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

<u>SIST-TP CEN/TR 16251:2016</u> https://standards.iteh.ai/catalog/standards/sist/509ac811-5627-49c6-a5ce-e7e221833c8a/sist-tp-cen-tr-16251-2016



EUROPEAN COMMITTEE FOR STANDARDIZATION COMITÉ EUROPÉEN DE NORMALISATION EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Con	tents	Page
Europ	oean foreword	5
Intro	duction	6
1	Scope	6
2	Normative references	6
3	Terms and definitions	
4	Overview - List of covered topics	
5	Design guidance for vehicle	
5 5.1	General	
5.2	Temperature related	
5.3	Snow and ice related	
5.3.1	Ice related	
5.3.2	Snow related	
5.3.3	Anti-icing and de-icing	
5.4	Humidity related	
5.4.1		
5.4.2	General Ten STANDARD PREVIEW Test description	11
5.4.3	Evaluation criteria	11
5.5	Evaluation criteria (standards.itch.ai)	12
5.6	Mechanical fixations of inner structures to the car body, have to be thermally	
	interrupted by insulating spacers to avoid thermal bridges. Collision with animals	12
5.7	interrupted by insulating spacers to avoid thermal bridges. Collision with animals  Condensation	12
5.7.1	General	12
5.7.2	Recommendations	13
5.7.3	Test description	
5.7.4	Evaluation criteria	
6	Design guidance for sub systems	
6.1	Snow plough	
6.1.1	General	
6.1.2	Design guidance	
6.1.3	Proposal for evaluation	
6.2 6.2.1	Bogie and running gearGeneral	
_		
6.2.2 6.2.3	Winter conditions Summer conditions	
6.2.4	Design guidance	
6.3	Brake components integrated in bogie	
6.3.1	General	
6.3.2	Design guidance	
6.3.3	Proposal for evaluation	
6.4	Compressed air	
6.4.1	General	
6.4.2	Design guidance	
6.5	Sanding equipment	
6.5.1	General	

6.5.2	Design guidance	22
6.5.3	Proposal for evaluation	22
6.6	Suspension level control system	23
6.6.1	General	
6.6.2	Design guidance	
6.6.3	Proposal for evaluation	
6.7	Tilting system	
6.7.1	General	
6.7.2	Design guidance	
6.7.3	Proposal for evaluation	
6.8	Flange lubrication system	
6.8.1	General	
6.8.2	Design guidance	
6.9	Windscreen	
6.9.1	General	
6.9.2	Design guidance	
6.9.3	Proposal for evaluation	
6.10	Side mirrors/cameras	
	General	
	Design guidance	
	Proposal for evaluation	
6.11	Lights	
6.11.1	General  Design guidance En STANDARD PREVIEW	28
6.11.2	Design guidance Ell STANDARD FREVIEW	28
6.11.3	Proposal for evaluation standards item ai) Horns	28
6.12	Horns(StandardS.iten.ar)	29
6.12.1	General	29
6.12.2	Design guidance SIST-TP CEN/TR 16251:2016	29
6.12.2 6.13	Design guidance https://standards.iteh.av/catalog/standards/sist/309ac811-3627-49c6-a5ce-	29 30
6.12.2 6.13 6.13.1	Design guidance https://standards.iteh.a/catalog/standards/sist/509ac811-5627-49c6-a5ce- Doors General e/e221833c8a/sist-tp-cen-tr-16251-2016	29 30 30
6.12.2 6.13 6.13.1 6.13.2	General  Design guidance https://standards.iteh.avcatalog/standards/sist/509ac811-5627-49c6-a5ce- Doors General  Design guidance  Design guidance	30 30 30
6.13.2	Design guidance https://standards.iteh.a/catalog/standards/sist/509ac811-5627-49c6-a5ce-Doors e/e221833c8a/sist-tp-cen-tr-16251-2016  Design guidance Proposal for evaluation	30
6.13.2 6.13.3	Proposal for evaluation	30 30
6.13.2 6.13.3 6.14	Proposal for evaluation  Moveable steps	30 30 31
6.13.2 6.13.3 6.14 6.14.1	Design guidance	30 30 31
6.13.2 6.13.3 6.14 6.14.1 6.14.2	Design guidance	30 31 31 31
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3	Design guidance	3031313131
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3	Design guidance	303131313131
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1	Design guidance	30313131313131
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1	Design guidance	303131313131313232
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3	Design guidance	3031313131323232
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16	Design guidance	303131313132323232
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1	Design guidance	30313131313232323333
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1 6.16.2	Design guidance	3031313131323232333333
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1 6.16.2 6.16.3	Design guidance	3031313131323233333333
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1 6.16.2 6.16.3 6.17	Design guidance	303131313132323333333333434
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1 6.16.2 6.16.3 6.17 6.17.1	Design guidance Proposal for evaluation Moveable steps General Design guidance Proposal for evaluation Pantograph General Design guidance Proposal for evaluation Automatic couplers General Design guidance Proposal for evaluation Automatic souplers General Design guidance Proposal for evaluation Cooling systems General	30313131313232333333333435
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1 6.16.2 6.16.3 6.17 6.17.1	Design guidance	303131313132323333333333333435
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1 6.16.2 6.16.3 6.17 6.17.1 6.17.2 6.17.3	Design guidance Proposal for evaluation Moveable steps General Design guidance Proposal for evaluation Pantograph General Design guidance Proposal for evaluation Automatic couplers General Design guidance Proposal for evaluation Cooling systems General Design guidance Proposal for evaluation Cooling systems General Design guidance Proposal for evaluation	3031313132323333333333333333535
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.3 6.16 6.16.1 6.16.2 6.16.3 6.17 6.17.1 6.17.2 6.17.3 6.18	Design guidance	3031313132323333333333333535
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1 6.16.2 6.17.1 6.17.1 6.17.2 6.17.3 6.18 6.18.1	Design guidance	303131313132323233333334353535
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1 6.16.2 6.17.1 6.17.1 6.17.2 6.17.3 6.18 6.18.1	Design guidance	303131313232323333333334353535
6.13.2 6.13.3 6.14 6.14.1 6.14.2 6.14.3 6.15 6.15.1 6.15.2 6.15.3 6.16 6.16.1 6.16.2 6.16.3 6.17 6.17.1 6.17.2 6.17.3 6.18.1 6.18.2 6.19	Design guidance	303131313232323333333334353535363636

#### SIST-TP CEN/TR 16251:2016

#### CEN/TR 16251:2016 (E)

6.19.2	Design guidance	37
6.20	Toilet and water systems	38
6.20.1	General	38
6.20.2	Design guidance	38
6.20.3	Proposal for evaluation	38
6.21	External cabinets, boxes for equipment, cables and connectors	40
6.21.1	General	40
6.21.2	Design guidance	40
6.21.3	Proposal for evaluation	40
Annex	A (informative) Examples of protection for electrical and pneumatic connections	41
Annex	B (informative) Examples for snow ploughs	43
Bibliog	graphy	45

## iTeh STANDARD PREVIEW (standards.iteh.ai)

<u>SIST-TP CEN/TR 16251:2016</u> https://standards.iteh.ai/catalog/standards/sist/509ac811-5627-49c6-a5ce-e7e221833c8a/sist-tp-cen-tr-16251-2016

### **European foreword**

This document (CEN/TR 16251:2016) has been prepared by Technical Committee CEN/TC 256 "Railway applications", the secretariat of which is held by DIN.

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.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

<u>SIST-TP CEN/TR 16251:2016</u> https://standards.iteh.ai/catalog/standards/sist/509ac811-5627-49c6-a5ce-e7e221833c8a/sist-tp-cen-tr-16251-2016

#### Introduction

In this Technical Report, environmental conditions are related to climate and big animals. Separately and in combination environmental conditions can represent considerable challenges to the railway sector as availability, economy, reputation and safety can be severely affected. Both severe summer and winter conditions occur, and more intense weather is predicted for the future.

The intention of this Technical Report is to help reduce technical risks related to environmental conditions.

All tests of the different clauses in this Technical Report can be performed either in a climate chamber or on track, if the corresponding test conditions are given.

#### 1 Scope

This Technical Report gives guidance for designing rolling stock for its specified ranges of environmental conditions according to EN 50125-1. This guidance covers environmental conditions in Europe.

The relevant clauses for the particular vehicle should be chosen and described in the vehicle specification. Depending on the ranges selected, design and/or testing provisions described in this Technical Report should be taken into account. This Technical Report is a collection of existing test descriptions and design guidance based on long lasting experience of operators, test centres and industry.

ITCH STANDARD PREVIEW

### 2 Normative references (standards.iteh.ai)

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.

EN 50125-1, Railway applications — Environmental conditions for equipment — Part 1: Equipment on board rolling stock

#### 3 Terms and definitions

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

#### 3.1

#### environmental conditions

physical, chemical or biological conditions external to a product to which it is subject at a certain time

[SOURCE: EN 50125-1]

#### 3.2

#### winter conditions

conditions with temperatures below freezing point of water, where snow and ice can accumulate on the vehicle

#### 3.3

#### summer conditions

conditions with temperatures above 35 °C in addition to intensive solar radiation and hot ballast effect

#### 3.4

#### ice

is considered as glaze ice or clear ice

Note 1 to entry: It tends to accumulate rapidly and is very hard and therefore more difficult to remove. Such ice forms when large drops of water strike and spread over a surface whose temperature is below the freezing point. Mechanical components and the windscreen are elements typically tested with ice. For the test, a certain thickness of the ice layer is defined.

#### 3.5

#### dry snow

form of precipitation where tiny ice crystals bond together into flakes, which have little to no liquid water content and a particle size of about 20 µm MVD (Median Volumetric Diameter)

Note 1 to entry: The density of this snow is about 200 kg/m<sup>3</sup> and can go up to 350 kg/m<sup>3</sup> if wind pressed.

Note 2 to entry: The snow intensity in  $kg/m^3$  is defined.

#### 3.6

#### wet snow

form of precipitation where tiny ice crystals bond together into flakes, which have a high liquid content and a particle size of  $50~\mu m$  or more

Note 1 to entry: The density of this snow is about  $350 \text{ kg/m}^3$  to  $500 \text{ kg/m}^3$ .

Note 2 to entry: The snow intensity in kg/m3 are defined. teh.ai)

#### 3.7 <u>SIST-TP CEN/TR 16251:2016</u>

#### rain https://standards.iteh.ai/catalog/standards/sist/509ac811-5627-49c6-a5ce-

precipitation in the form of water drops; both the amount that falls and the actual falling action of the water drops are often called rainfall

Note 1 to entry: Rain intensity is measured in mm/min.

Note 2 to entry: This standard does not scope with tests concerning water tightness of the vehicle and components.

#### 3.8

#### condensation

precipitation of water vapour on a surface when the surface temperature is lower than the dew point temperature of the ambient air whereby water is transformed from vapour to the liquid state of aggregation

#### 3.9

#### temperature class

classification system defined in EN 50125-1

#### 3.10

#### hot ballast effect

heat accumulation of the ballast caused by solar radiation

Note 1 to entry: Heat accumulation of the ballast is caused not only by solar radiation but also by exhausts from cooling systems, braking resistors or similar devices and subsystems along the train.

### 4 Overview - List of covered topics

The following Table 1 is an overview of the covered topics of this document and helps to identify the relevant clause for the user.

Table 1 — System overview

System/ component	Clause/ Sub- clause	Ice	Dry snow	Wet snow	Rain	Humidity	High temperature	Low temperature
Design guidance for vehicle	5	X	X	X	X	X	х	X
Sub systems								
Snow plough	6.1		X	X				
Bogie and running gear	6.2	X	Х	X	X	X	X	X
Brakes	6.3	X	X	X			X	X
Compressed air	6.4					X	X	X
Sanding equipment	6.5	X	X	X	X	X		X
Suspension level control system	6.6	X	X	X	DD			
Tilting system	6.7	X	X	ATXUA	KD			X
Flange lubrication system	6.8		(st	andar	ds.it	eh.ai)	X	Х
Windscreen	6.9	X	<u> </u>	SIST-TOP CEN				X
Side mirrors/cameras	6.10	nttps://star X	dards.iteh.a e7e22	/catalog/stand 1833c8a/sist-	tp-cen-tr-	509ac811-5627 16251-2016	-49c6-a5ce-	Х
Lights	6.11	X		X				X
Horns	6.12	X	X	X				X
Doors	6.13	X	X	X	X	X		X
Moveable steps	6.14	X	X	X	X	X		X
Pantograph	6.15	X		X				X
Automatic couplers	6.16	X	X	X				X
Cooling systems	6.17		X	X		X		X
Traction	6.18						X	
Battery	6.19							X
Toilet and water systems	6.20							Х
External cabinets, boxes for equipment, cables and connectors	6.21	Х	X	X	X	Х		

#### 5 Design guidance for vehicle

#### 5.1 General

This clause includes vehicle design guidance related to environmental conditions.

The environmental conditions in Table 2 are covered.

Table 2 — Design guidance for vehicle

Ice	Dry snow	Wet snow	Rain	Humidity	High temperature	Low temperature
X	X	X	X	X	X	X

#### 5.2 Temperature related

When choosing materials and their combinations, thermal expansion characteristics should be considered, e.g. aluminium car bodies have approximately 3 times the thermal expansion compared to steel bodies.

Bending and/or tension caused due to thermal expansion differences can be avoided by e.g. arranging gaps between interior panels and at the ends of floor elements which take care of the expansion movement. Material used for components for underframe and bogie should withstand temperatures higher than the upper extreme temperatures which are caused by e.g. hot ballast.

Materials used for components outside of the vehicle body and bogies can be exposed to temperatures lower than the lowest and higher than the highest specified extreme temperatures (see EN 50125-1).

#### 5.3 Snow and ice related

## (standards.iteh.ai)

#### 5.3.1 Ice related

#### SIST-TP CEN/TR 16251:2016

https://standards.iteh.ai/catalog/standards/sist/509ac811-5627-49c6-a5ce-The vehicle should be designed to avoid damage to 1 E.g. side walls, underframe equipment, cables, hoses, windows and doors from:

- ice falling down from accumulations in underframe and running gear;
- ballast stones lifted by the ice falling down from underframe and running gear;
- ice lumps from the snow plough thrown into, for instance cutting walls reflected back to the train;
- ice build-ups falling from tunnel roofs and walls;
- ice lumps lifted by the air turbulence generated by the movement of the train.

#### 5.3.2 Snow related

Bogies, coupler and its ancillaries, roof, cab and underframe are areas, which are exposed to snow accumulation. As measurement of thickness or weight of snow and ice layers is difficult to perform in service to get limit values, design should be chosen in such a way that accumulation is minimised and preferably avoided.

This can be achieved by protection or enclosure of components, geometric shape or choice of materials, which have reduced adhesion.

In the absence of project specific requirements for the accumulation of snow and ice, the following additional mass to be considered.

0,5 t to 1,5 t per bogie;

NOTE The weight is based on experiences made in Sweden.

#### 5.3.3 Anti-icing and de-icing

At winter conditions with snow on the line and/or in the air and the temperature in the range of approximately –10 °C or lower, snow will accumulate primarily in the running gear and at underframe components. This will reduce the possibility to inspect the condition of safety and operational critical parts/components. Build-up of snow and ice also will reduce the possibility for free movements of parts/components in the running gear and brake system, hence causing reduced running comfort and probability for reduced or lacking braking effort. The probability for defective parts/components and for derailment is at the same time increased.

A simple and quick manual removal of snow and ice at train ends should be possible. Good accessibility should be considered.

Preventive anti-icing using chemicals like Propylene Glycol is a method which helps prevent build-up of snow and ice as well as assists with easier removal.

Another method for removing accumulated snow and ice is by hot steam or water.

#### Methods are:

- thawing by storing inside heated depots or temporary shelters;
- use of high pressure hot water or steam: When de-icing with water, the pressure should not be more than 0,6 MPa.

The vehicle should not be exposed to sub-zero temperatures before it is dried out. The functionality of the components should not be reduced due to exposure by these methods. A comprehensive maintenance instruction (details of water direction, forces, temperature, etc.) should be prepared to allow for anti- and de-icing of these components without damage.

Instructions for de-icing should be described in the wehicle documentation in order to ensure intended functionality of the components standards.iteh.ai/catalog/standards/sist/509ac811-5627-49c6-a5ce-

e7e221833c8a/sist-tp-cen-tr-16251-2016

#### **5.4 Humidity related**

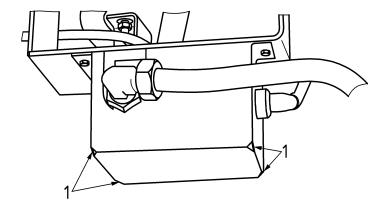
#### 5.4.1 General

Humidity reduces the effectiveness of thermal insulation. Wet or frozen insulation adversely affects the performance of thermal insulation. Wet insulation also increases the risk of fungus growth and corrosion.

Humidity may cause condensation. Condensated water may cause frost action when freezing. Structure, components and protecting hoses should therefore be made hermetic or have drainage holes at the lowest position.

Recommended diameter of the drainage holes in structures is 15 mm to 25 mm to avoid clogging by dirt. For smaller parts/components the size of the holes should be regulated by the dimension of the components.

The holes should be accessible during maintenance for cleaning and checking they are not blocked. An example of drainage holes in a small protective box is shown in Figure 1.



#### Key

1 drainage holes in all four corners

Figure 1 — Drainage holes in a protective box

An example of frost action due to sucked-in and condensed humidity in a closed fully welded part is shown in Figure 2. Rupture shall show that frost action has damaged the welding and "openend" the construction by bending of the metal cover sheet.

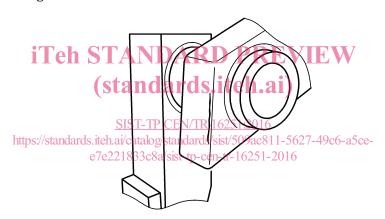


Figure 2 — Frost action in a closed beam without drainage

#### 5.4.2 Test description

The vehicle should be soaked at temperatures <  $-10\,^{\circ}\text{C}$  over a minimum of 5 h with all systems in operation. Then the vehicle should be shunted into an environment with temperatures >  $+20\,^{\circ}\text{C}$  and dew point >  $+15\,^{\circ}\text{C}$ . After an operation time of > 10 min the condensation effects of the windows and head lights (visibility) should be checked. The functional test should be followed by shunting the vehicle back into the winter environment (temperatures <  $-10\,^{\circ}\text{C}$ ).

If required in the specification, this may be repeated several times to demonstrate freeze/thaw capability of the train or component.

After a minimum of 1 h, the correct functionality of each tested component should be checked according to a client check list. It should be checked if permissible water condensation or ice accumulations on critical components are within the limits given in the check list.

#### 5.4.3 Evaluation criteria

The following pass criteria should be achieved:

operability of the vehicle under condensation effects;