SLOVENSKI STANDARD
SIST-TP CEN/TR 16251:2016

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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

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

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ICS:

45.060.01	Železniška vozila na splošno	Railway rolling stock in general

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TECHNICAL REPORT

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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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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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.

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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.

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.

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^3 and can go up to 350 kg/m^3 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 µm or more

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

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

3.7
rain
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**	**X**	**X**
Sub systems								
Snow plough	6.1		X	X				
Bogie and running gear	6.2	X	X	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				
Tilting system	6.7	X	X	X				X
Flange lubrication system	6.8						X	X
Windscreen	6.9	X	X	X	X	X		X
Side mirrors/cameras	6.10	X				X		X
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							X
External cabinets, boxes for equipment, cables and connectors	6.21	X	X	X	X	X		

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

5.3.1 Ice related

The vehicle should be designed to avoid damage to, 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 vehicle documentation in order to ensure intended functionality of the components.

5.4 Humidity related

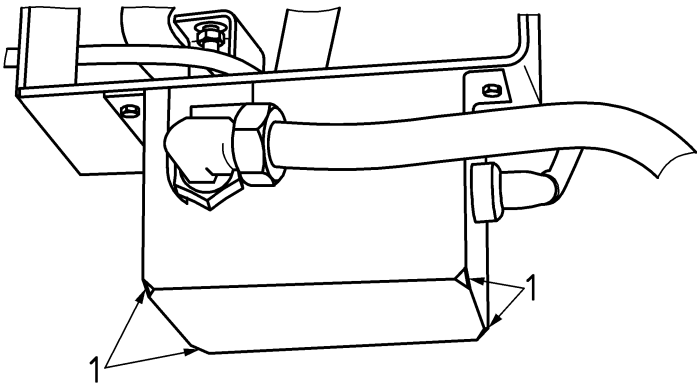
5.4.1 General

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.

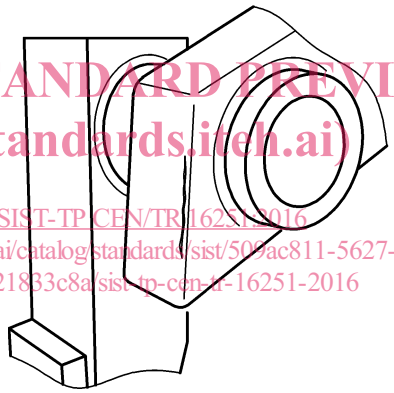


Figure 2 — Frost action in a closed beam without drainage

5.4.2 Test description

The vehicle should be soaked at temperatures < −10 °C over a minimum of 5 h with all systems in operation. Then the vehicle should be shunted into an environment with temperatures > +20 °C and dew point > +15°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 °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;