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Date: 14 November 2024

Origin: European

Latest date for receipt of comments: 07 January 2025

Project No. 2021/02297

Responsible committee: RAE/2 Railway Applications - Track

Interested committees:

Title: Draft BS EN 14033-2 BS Railway applications - Infrastructure - Railbound construction and maintenance machines. Part 2: Technical requirements for travelling and working.

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

English Version

Railway applications - Infrastructure - Railbound construction and maintenance machines - Part 2: Technical requirements for travelling and working

Applications ferroviaires - Voie - Machines de
construction et de maintenance empruntant
exclusivement les voies ferrées - Partie 2 : Exigences
techniques pour le déplacement et le travail

Bahnanwendungen - Oberbau - Schienengebundene
Bau- und Instandhaltungsmaschinen - Teil 2:
Technische Anforderungen an die Versetzfahrt und die
Arbeitsstellung

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 256.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (prEN 14033-2:2024) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 14033-2:2017.

Amended clauses compared to EN 14033-2:2017 are shown in informative Annex K.

This series of standards EN 14033, Railway applications — Track — Railbound construction and maintenance machines, consists of the following parts:

- Part 1: Technical requirements for running;
- Part 2: Technical requirements for travelling and working;
- Part 3: General safety requirements;
- Part 4: Technical requirements for running, travelling and working on urban rail.

Introduction

This document is the second of a series of four parts of the European Standard: *Railway applications — Track — Railbound construction and maintenance machines*:

- Part 1 covers the safety and technical requirements for the machines in running mode;
- Part 2 covers the technical requirements for the machines in working and travelling modes;
- Part 3 covers the safety requirements for the machines in working and travelling modes; this is a harmonized standard with the European Machinery Directive 2006/42/EC;
- Part 4 covers requirements for the machines in running, working and travelling modes when used on urban rail.

For deviations or special national conditions, see Annex A.

The risks that exist in all mechanical, electrical, hydraulic, pneumatic and other components of machines and that are dealt with in the relevant European Standards are not within the scope of this European Standard. If necessary, references are made to appropriate standards of this type.

1 Scope

1.1 General

This document defines the specific technical railway requirements for travelling and working with railbound machines and other vehicles – referred to as machines – used for construction, maintenance and inspection of track, structures, track formation and fixed electric traction equipment as specified in prEN 14033-1:2024.

This document applies to all machines working exclusively on the railway (utilizing adhesion between the rail and rail wheels) and used for construction, maintenance and inspection of track, structures, infrastructure and fixed electric traction equipment.

This document applies to machines that are intended to operate signalling and control systems.

NOTE Other rail mounted railway maintenance and infrastructure inspection machines are dealt with in other European Standards, see Technical Report CEN/TR 17498:2020.

This document is applicable to 1 435 mm nominal track gauge. Some requirements may be applicable for working on infrastructures with nominal narrow track gauge or nominal broad track gauge lines, tramways, railways utilizing other than adhesion between the rail and rail wheels and underground infrastructures.

This document covers the safety requirements for the railway specific problems for travelling and working on different infrastructures. The application of these requirements will be the subject of a verification procedure, which is not part of this document. Annex I is included for information for the potential content of a verification procedure. In all cases an authorization to work is needed to access the infrastructure.

This document is also applicable for machines that in working position are partly supported on the ballast or the formation.

This document does not apply to:

- the requirements with regard to the quality of work, including the related measuring methods, and the performance of the machine; ¹⁾
- the specific requirements established by each railway infrastructure manager for the use of machines which will be the subject of negotiation between the manufacturer and the machine keeper.

This document does not deal with the following additional requirements:

- working methods;
- operation in severe working conditions requiring special measures (e.g. work in tunnels or in cuttings, extreme environmental conditions such as corrosive conditions, tropical conditions, contaminating conditions, strong magnetic fields);
- operation subject to special rules (e.g. potentially explosive atmospheres);
- hazards due to errors in software;
- hazards occurring when used to handle suspended loads which may swing freely;

1) Parameters to evaluate the track quality are dealt with in EN 13231-1 and in the EN 13848 series.

- hazards due to wind pressure greater than normal e.g. pressures caused by the passing of trains at speed in excess of 190 km/h.

1.2 Validity of this European Standard

This document applies to all machines that are ordered one year after the publication date of this European Standard.

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.

EN 280-1:2022, *Mobile elevating work platforms - Part 1: Design calculations - Stability criteria - Construction - Safety - Examinations and tests*

EN 280-2:2022, *Mobile elevating work platforms - Part 2: Additional safety requirements for load lifting appliances on the extending lifting structure and work platform*

EN 1991-2:2023, *Eurocode 1 - Actions on structures - Part 2: Traffic loads on bridges and other civil engineering works*

EN 12077-2:1998+A1:2008, *Cranes safety - Requirements for health and safety - Part 2: Limiting and indicating devices*

EN 12999:2020, *Cranes - Loader cranes*

EN 13848-5:2017, *Railway applications - Track - Track geometry quality - Part 5: Geometric quality levels - Plain line, switches and crossings*

prEN 14033-1:2024, *Railway applications — Track — Railbound construction and maintenance machines — Part 1: Technical requirements for running*

prEN 14033-3:2024, *Railway applications — Track — Railbound construction and maintenance machines — Part 3: General safety requirements*

EN 14363:2016+A2:2022, *Railway applications - Testing and Simulation for the acceptance of running characteristics of railway vehicles - Running Behaviour and stationary tests*

EN 15273-2:2013+A1:2016, *Railway applications - Gauges - Part 2: Rolling stock gauge*

EN 15877-1:2012+A1:2018, *Railway applications - Marking on railway vehicles - Part 1: Freight wagons*

EN 17343:2023, *Railway applications - General terms and definitions*

EN 45545-1:2013, *Railway applications - Fire protection on railway vehicles - Part 1: General*

EN 45545-2:2020+A1:2023, *Railway applications - Fire protection on railway vehicles - Part 2: Requirements for fire behaviour of materials and components*

EN 50121-3-1:2017,² *Railway applications — Electromagnetic compatibility — Part 3-1: Rolling stock — Train and complete vehicle*

EN 50121-3-2:2016,³ *Railway applications — Electromagnetic compatibility — Part 3-2: Rolling stock — Apparatus*

EN 50125-1:2014, *Railway applications - Environmental conditions for equipment - Part 1: Rolling stock and on-board equipment*

EN 50153:2014,⁴ *Railway applications — Rolling stock — Protective provisions relating to electrical hazards*

EN 50317:2012,⁵ *Railway applications — Current collection systems — Requirements for and validation of measurements of the dynamic interaction between pantograph and overhead contact line*

EN 60077 (series), *Railway applications — Electrical equipment for rolling stock*

EN ISO 7010:2020,⁶ *Graphical symbols — Safety colours and safety signs — Registered safety signs (ISO 7010:2011)*

EN ISO 7731:2008, *Ergonomics - Danger signals for public and work areas - Auditory danger signals (ISO 7731:2003)*

ISO 4305:2014,⁷ *Mobile cranes — Determination of stability*

ISO 4310:2009, *Cranes — Test code and procedures*

ISO 16754:2008, *Earth-moving machinery — Determination of average ground contact pressure for crawler machines*

3 Terms and definitions

For the purposes of this document, the terms and definitions in prEN 14033-1:2024, EN 17343:2023 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

working places

working cabs, combined working and driving cabs, operator's places situated outside cabs, welfare areas, locations where staff are permitted on the machine and places situated at control or maintenance locations

² As impacted by EN 50121-3-1:2017/A1:2019.

³ As impacted by EN 50121-3-2:2016/A1:2019.

⁴ As impacted by EN 50153:2014/A1:2017 and EN 50143:2014/A2:2020.

⁵ As impacted by EN 50317:2012/A1:2022 and EN 50317:2012/AC:2012.

⁶ As impacted by EN ISO 7010:2020/A1:2020, EN ISO 7010:2020/A2:2022, EN ISO 7010:2012/A3:2022, EN ISO 7010:2012/A4:2023, EN ISO 7010:2012/A5:2023, EN ISO 7010:2012/A6:2023.

⁷ As impacted by ISO 4305:2014/A1:2016.

3.2

working gauge

limit in which a machine can work without interfering with the kinematic envelope of vehicles on adjacent operating tracks

3.3

operating track

track corresponding to the criteria of the infrastructure manager on which vehicles may run under normal signalling arrangements (with or without a speed limit)

3.4

track closed for work

track used only by machines and engineering trains under special operating conditions, closed for normal passenger and freight trains

3.5

degraded working track

track that is being maintained for which one or several of the geometrical parameters may reach the limiting values as specified in Annex F and for which special operational restrictions may apply

3.6

authorized acceptance body

organisation appointed by the infrastructure manager

3.7

authorization to work

authorization which is given by the infrastructure manager and which permits a machine to work on the railway infrastructure in accordance with the specific requirements of the infrastructure manager (method of work, quality, output)

3.8

working agreement

procedure that enables a machine to work on each railway infrastructure manager's network

Note 1 to entry: This procedure consists of two parts:

- 1) the proof of conformity with the safety requirements, as specified in prEN 14033-3 (EC declaration of conformity), given by the manufacturer;
- 2) the authorization to work that is given at the end of the working agreement. It is also permissible to give a preliminary authorization to work if some requirements are not yet fulfilled or have yet to be proved that they are fulfilled.

4 Field of use of machines

Machines shall in accordance with their proper use either:

— be designed to travel and work on all tracks within the geometric limits as specified in Annex F;

or

— travel and work on tracks within the geometric limits of the operating track only and shall then display at each operating position the warning plate as shown in Annex C. This shall be shown in the documentation, see 7.4, Table 12, line a).

5 Specific railway requirements and/or measures

5.1 Interaction with the infrastructure

5.1.1 General

The wheels, supports and working tools shall not generate harmful stresses in the infrastructure components, e.g. rail, fastenings, sleepers, ballast, structures and formation.

Furthermore, it is necessary to take into consideration the maximum wheel load onto the rail, the permissible bending of the rail, the transverse forces on the sleeper fastenings, the surface pressure on the ballast as well as the load carrying ability of the formation and structures.

If the machine contains devices for levelling and lining of the track the maximum forces generated by these devices shall be stated in the documentation, see 7.2 Table 10, line a).

5.1.2 Stress induced into the rails

Any tool shall not generate stresses in the rail higher than the following values given in Table 1 expressed as a percentage of the minimum ultimate tensile strength of the rail.

The calculations shall be based on a 60E1 rail section with a maximum tensile strength of 880 N/mm² and a 49E1 rail section with a maximum tensile strength of 680 N/mm². The documentation shall state the limitations of use for both these rail types, see 7.4, Table 12, line b).

The limits a) and b) in Table 1 are permitted to be exceeded in machines specifically designed for straightening or bending rails.

Table 1 — Stress limit in the rails

Bending stress	Measure points	Ultimate tensile strength of the rail %
a) Maximum permissible tensile bending stress	middle of the head ^(A) and middle of the foot ^(B) of the rail	45
	at the corner of the head ^(C) of the rail	50
	at the foot ^(D) of the rail	60
b) Maximum permissible compressive bending stress	head ^(E) and foot ^(D) of the rail	65
^(A) to ^(E) are shown diagrammatically in Figure 1.		

The values above allow for safety in particular conditions, e.g. heavy rail use, joints with big gaps, non-standard sleeper spacing, residual stresses in the rails.

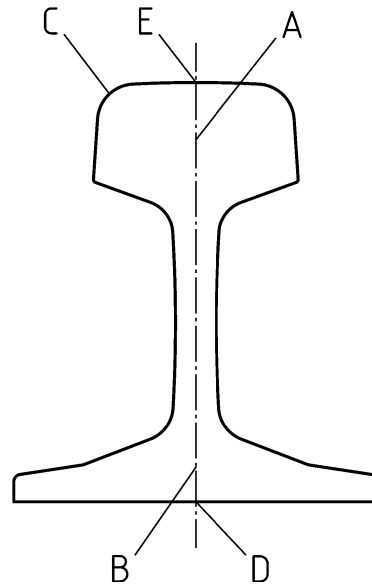


Figure 1 — Cross section of rail showing stress points given in Table 1

5.1.3 Auxiliary wheels, auxiliary guides and working parts

The auxiliary wheels and guides referred to in this clause are for the support and guidance of assemblies associated with the operation of the machine and not for running.

The construction and positioning of any auxiliary wheels and/or guides shall provide satisfactory guidance on rails and shall not cause damage to the rail or any associated part of the railway infrastructure.

The devices for the vertical and lateral positioning of the rails not placed on sleepers, e.g. guiding rollers, rail hooks, shall be designed in order to prevent dangerous movements of rail in case of fracture of the rails or fishplates.

Any additional supporting elements necessary to ensure stability or assist the work process shall also comply with the above requirements.

5.1.4 Maximum wheel loads

5.1.4.1 General

The wheels referred to in this clause are the wheels used for travelling and working.

5.1.4.2 Machines without wheel load control devices

Wheel loads Q_{max} of the main wheels or auxiliary wheels in relation to the diameter of the wheel and the rail material are given in Table 2 or are able to be calculated as shown in Annex J.

The calculation of the vertical loads applied to the wheels shall take into account all the factors that can produce variations, i.e.:

- a) due to the machine:
 - 1) eccentricity of the centre of gravity;
 - 2) torsional flexibility;
 - 3) hysteresis of the suspension;

- 4) eccentric load;
- 5) application of an eccentric force;
- b) due to the track:
 - 1) maximum cant;
 - 2) maximum twist.

Table 2 — Maximum wheel load with the machine in travelling and working mode for machines without wheel load control devices

d mm	$Q_{\max}$ kN	
	Rail ^a with $\sigma_B = 880 \text{ N/mm}^2$	Rail ^b with $\sigma_B = 680 \text{ N/mm}^2$
$\phi \geq 920$	222	136
$920 > \phi \geq 840$	222	136
$840 > \phi \geq 760$	201	120
$760 > \phi \geq 680$	179	107
$680 > \phi \geq 630$	167	99
$630 > \phi \geq 550$	146	89
$550 > \phi \geq 470$	124	74
$470 > \phi \geq 390$	103	62
$390 > \phi \geq 330$	87	52
σ_B = maximum tensile strength of rail material d = worn diameter limit ϕ = wheel diameter		
^a Corresponds e.g. to rails 60E1, 54E3, 49E1 (880 N/mm ²).		
^b Corresponds e.g. to rails 49E1 (680 N/mm ²).		

If, in working mode, the maximum static wheel load exceeds the values shown in Table 2 for rails with $\sigma_B = 680 \text{ N/mm}^2$, it shall be stated in the documentation, see 7.2, Table 10, line b) and 7.4, Table 12, line b).

5.1.4.3 Machines that do not lift a load or lift a load with wheel load control devices

The maximum wheel loads $Q_{\max}$ for machines, notably railway cranes, for which the loads on the wheel are controlled by means of a device, e.g. device for limiting of overturning moment, which prevents the maximum value of the wheel load being exceeded, are given in Table 3 or are able to be calculated as shown in Annex J.

Reductions of the maximum load shall be applied when the working conditions are imprecise or difficult to determine, such as:

- lifting of the load from underneath;

- indeterminate break out forces;
- overload due to unequal distribution of the load within the lifting tackle;
- oblique lifting of the load;
- dynamic movements of the load, e.g. swinging or vertical movements of the load.

Table 3 — Maximum wheel load with the machine in working and travelling mode for machine that do not lift a load or machine that lift a load with wheel load control devices

d mm	$Q_{\max}$ kN	
	Rail^a with $\sigma_B = 880 \text{ N/mm}^2$	Rail^b with $\sigma_B = 680 \text{ N/mm}^2$
$\phi \geq 920$	243	170
$920 > \phi \geq 840$	243	170
$840 > \phi \geq 760$	243	154
$760 > \phi \geq 680$	230	138
$680 > \phi \geq 630$	213	127
$630 > \phi \geq 550$	186	111
$550 > \phi \geq 470$	159	95
$470 > \phi \geq 390$	132	79
$390 > \phi \geq 330$	112	67
d = worn diameter limit ϕ = wheel diameter σ_B = maximum tensile strength of rail material		
^a Corresponds e.g. to rails 60E1, 54E3, 49E1 (880 N/mm ²). ^b Corresponds e.g. to rails 49E1 (680 N/mm ²).		

If, in working mode, the maximum static wheel load exceeds the values for rails with $\sigma_B = 680 \text{ N/mm}^2$ given in Table 3 it shall be stated in the documentation, see 7.2, Table 10, line b) and 7.4, Table 12, line b).

5.1.5 Loads applied to the ballast

The surface pressure applied to the ballast shall not exceed $0,3 \text{ MN/m}^2$.

In the case of a tracked machine the surface pressure shall be calculated as specified in ISO 16754:2008.

5.1.6 Loads applied to the formation

The manufacturer shall declare in the documentation, see 7.2, Table 10, line c), the value of the maximum force applied to the formation by any part of the machine in direct contact and additionally declare the maximum pressure applied by the sets of stabilizers supplied with the machine.

NOTE A guide value of $0,1 \text{ MN/m}^2$ pressure will suit the majority of infrastructures.

In the case of a tracked machine the surface pressure shall be calculated as specified in ISO 16754:2008.

5.1.7 Loads applied to structures

The load applied by machines in travelling mode, on bridges and at the approaches to bridges, shall not exceed those resulting from load model 71 with a factor of 1,0 (relating to point loads only without taking into consideration the cases of distributed loads) as specified in EN 1991-2:2023.

The loads generated by machines in their various working modes, on bridges and at the approaches to bridges, should not exceed those resulting from load model 71 (relating to point loads only without taking into consideration the cases of distributed loads) as specified in EN 1991-2:2023. If the loads are in excess of load model 71 shown in EN 1991-2:2023, an analysis shall be carried out in each case for each load configuration, and permission necessary from the responsible expert of the infrastructure manager concerned. This is particularly necessary for work on bridges or lines having axle load restrictions.

The loading configurations of the possible and most unfavourable working configurations shall be specified with loads and distances in the documentation, see 7.2 Table 10, line b).

5.2 Stability and safety against derailment

5.2.1 Proof of overturning stability, machine stationary

5.2.1.1 General

Stability is defined as prevention of overturning. Except as shown in 5.2.3.3, a machine is considered stable if, even in the most unfavourable loading conditions and track parameters as detailed in 5.2.2 and 5.2.3, all the wheels remain in contact with the rails. The stability of a machine shall not depend on any devices attaching to the rail.

Machines that lift loads shall be fitted with appropriate load limiting devices. Simple cantilever or knuckle boom cranes shall, as minimum, be fitted with a rated capacity limiter (RCL) conforming to the requirements of EN 12077-2:1998+A1:2008 where no combination of load and radius will cause instability.

All other lifting equipment shall be fitted with a rated capacity indicator/rated capacity limiter (RCI/RCL) in accordance with the requirements of EN 12077-2:1998+A1:2008. Where the RCI/RCL is capable of being overridden, for example during set-up or recovery, the status of the RCI/RCL shall be recorded on the data recorder. After the specific activity the RCI/RCL shall automatically return to normal operation. There shall be a means to prevent the unintentional overriding of the RCI/RCL, for example by a separate key switch or electronic devices. The arrangements for using the override shall be described in the documentation, see 7.3 Table 11, Line a).

Note There are more specific requirements for cranes shown in EN 13000.

5.2.1.2 Proof of stability by calculation

For railway cranes other than loader cranes, or other types of machines which may have their centre of gravity displaced or where the wheels can be unloaded, overturning stability shall be calculated in accordance with the requirements given in Table 4. Calculations shall be in accordance with the requirements of ISO 4305:2014⁷. In each case the calculated stabilizing moment shall be greater than the calculated overturning moment.

Loader cranes mounted on railway vehicles shall meet the requirements of EN 12999:2020.

Table 4 — Load cases for calculating stability

Load case	Use of machine	Cant mm	Load coefficient	Requirements	Comments
with stabilizers	on operating track	180	$1,25 P + 0,1 F$	15 % of the machine weight as minimal wheel forces in relation to the tilting edge. See ISO 4305:2014+A1:2016, Table 2	
	on degraded working track	200			
free wheels on – verification across the track	on operating track	180	$1,33 P + 0,1 F$		
	on degraded working tracks	200	$1,33 P + 0,1 F$		$P > 12 \text{ t}$
			$P + 4 \text{ t} + 0,1 F$		$8 \text{ t} < P < 12 \text{ t}$
			$1,50 P + 0,1 F$		$P < 8 \text{ t}$
on wheels without propping-direction along the track	on operating tracks	180	$1,25 P + 0,1 F$		surveillance of the allowable lifting load in longitudinal direction by comparison of the boom setting angle of the crane with the position of the boom angle in the horizontal (momentum equilibrium at the boom pivot point)
	on degraded working tracks	200			
backward stability	no load on hook, pulley block on the ground		$- 0,15 P$		backward stability should be calculated assuming no load on hook, etc.
P = Load with lifting tackle in accordance with ISO 4310:2009 F = Mass of the jib, lifting ropes and the pulley block in accordance with ISO 4310:2009 The tilting edge should be taken as all the wheels on the track of the side affected by the load.					

For machines with mobile elevating work platforms, the overturning safety calculations shall be done in accordance with EN 280-1:2022 and EN 280-2:2022.

If the requirements of Table 4 are fulfilled with load $2P + 0,1F$, it is not necessary to prove stability in accordance with the requirements of 5.2.1.3.

The maximum wheel loads and/or stabilizer pressure shall be stated in the documentation, see 7.2, Table 10, line d).

5.2.1.3 Proof of stability by test

Proof of stability shall be proved as specified in ISO 4310:2009, before putting into service by load testing in accordance with the requirements given in Table 5. All the possibilities of movement and unfavourable positions of the load shall be considered in the most unfavourable track parameters as shown in Annex F.

Stability is considered proven if both the following parts are complied with:

- a) under the rated load and the most unfavourable load position no wheel leaves the rail;
- and
- b) under the test load and the most unfavourable load position it does not overturn, but one or more wheels may lift by no more than 5 mm.

Table 5 — Load cases for testing prevention of overturning

Working configuration	Load conditions	Standard	Load coefficient
Proof load	Static	ISO 4310:2009	1,25 P
	Dynamic		1,10 P
P = Load + lifting tackle in accordance with the requirements of ISO 4310:2009			
NOTE For these proof tests higher wheel loads than those given in Table 3 may have to be applied on the test track.			

The requirements for the stabilizer's contact surface area and/or the maximum load of stabilizers shall be indicated.

5.2.2 Prevention of derailment in travelling mode

The proof of the ability of machine to move without derailling in travelling mode shall be shown by using the test methods set out in prEN 14033-1:2024, Clause 8, using the track geometry parameters either as shown in Table 6 for degraded working track, or if the machine is not intended for use on degraded working track the parameters specified for operating track. Where the machine is not intended for use on degraded working track the actual track parameters permitted shall be recorded in the documentation, see 7.2 Table 10, line e) and a limitation shall be stated in the documentation, see 7.4, Table 12, line a).

5.2.3 Prevention of derailment during working movements

5.2.3.1 General

In the working conditions detailed in the documentation, see 7.2, Table 10, line e) a machine shall not derail when moving so that persons on the machine or around adjacent tracks shall not be endangered and/or the infrastructure damaged. Small forward / backward movements to adjust loads or close gaps during a working movement with the whole machine are not intended as working movements in the scope of the following sections because this can be considered as a nearly static situation. In this situation the movement of the whole machine shall not exceed more than half of one revolution of the rail wheel.

Where the machine is moved in this exceptional condition there shall be an engineering control to limit the distance moved.

A lifeguard is provided in running mode, see prEN 14033-1:2024, 7.9. Where the machine is intended to move along the track in working mode with a foreseeable increased risk of obstacles on the track a means of clearing the railhead shall be provided.

5.2.3.2 Verification of prevention of derailment

5.2.3.2.1 General

Safety against derailment shall be proven for travel on a track with the geometrical threshold parameters corresponding to the field of use of machines (operating track or degraded working track).

If the machine is intended for use on degraded working track, it is necessary to apply the column “Degraded working track EN14033” of the Table 6.

Where machines are only intended for use on operating track, the track parameters shall be as shown in the column “Operating track EN 14363” of the Table 6.

Table 6 — Comparison of track parameters

	Operating track EN 14363:2016+A2:2022	Degraded working track prEN 14033-2:2024
Track twist limit	EN 13848-5:2017, 7.6 $g_{lim} = \min \left(7 \text{ ‰}; \frac{20 \text{ mm}}{2a} + 3 \text{ ‰} \right)$ For speed $V \leq 200 \text{ km/h}$ NOTE: EN 13848 replaces ‘2a’ by ‘l’	prEN 14033-2:2024 $g_{lim} = \min \left(10 \text{ ‰}; \frac{20 \text{ mm}}{2a} + 3 \text{ ‰} \right)$
Method 1: Bogie test twist	EN 14363:2016+A2:2022, 6.1.5.1.2 $g_{lim}^+ = 7 \text{ ‰} \text{ for } 2a^+ < 4 \text{ m}$	prEN 14033-2:2024 $g_{lim}^+ = 10 \text{ ‰} \text{ for } 2a^+ < 2,5 \text{ m}$
	$g_{lim}^+ = 2 \text{ ‰} + 20 \text{ mm} / 2a^+ \text{ for } 2a^+ \geq 4 \text{ m}$	$g_{lim}^+ = 2 \text{ ‰} + 20 \text{ mm} / 2a^+ \text{ for } 2a^+ \geq 2,5 \text{ m}$
Vehicle body test twist	$g_{lim}^* = 7 \text{ ‰} \text{ for } 2a^* < 4 \text{ m}$	$g_{lim}^* = 10 \text{ ‰} \text{ for } 2a^* < 2,5 \text{ m}$
	$g_{lim}^* = 2 \text{ ‰} + 20 \text{ mm} / 2a^* \text{ for } 4 \text{ m} \leq 2a^* \leq 20 \text{ m}$	$g_{lim}^* = 2 \text{ ‰} + 20 \text{ mm} / 2a^* \text{ for } 2,5 \text{ m} \leq 2a^* \leq 20 \text{ m}$
	$g_{lim}^* = 3 \text{ ‰} \text{ for } 20 \text{ m} < 2a^* \leq 30 \text{ m}$	$g_{lim}^* = 3 \text{ ‰} \text{ for } 20 \text{ m} < 2a^* \leq 30 \text{ m}$
	$g_{lim}^* = 90 \text{ mm} / 2a^* \text{ for } 2a^* > 30 \text{ m}$	$g_{lim}^* = 90 \text{ mm} / 2a^* \text{ for } 2a^* > 30 \text{ m}$
Method 2: Bogie test twist	EN 14363:2016+A2:2022, 6.1.5.2.2.2 $g_{lim}^+ = 7 \text{ ‰} - 5 \text{ mm} / 2a^+ \text{ for } 2a^+ < 4 \text{ m}$	prEN 14033-2:2024 $g_{lim}^+ = 10 \text{ ‰} - 5 \text{ mm} / 2a^+ \text{ for } 2a^+ < 2,5 \text{ m}$

	Operating track EN 14363:2016+A2:2022	Degraded working track prEN 14033-2:2024
	$g_{lim}^+ = 2 \text{ ‰} + 15 \text{ mm} / 2a^+$ for $2a^+ \geq 4 \text{ m}$	$g_{lim}^+ = 2 \text{ ‰} + 15 \text{ mm} / 2a^+$ for $2a^+ \geq 2,5 \text{ m}$
Vehicle body test twist	$g_{lim}^* = 7 \text{ ‰} - 5 \text{ mm} / 2a^*$ for $2a^* < 4 \text{ m}$	$g_{lim}^* = 10 \text{ ‰} - 5 \text{ mm} / 2a^*$ for $2a^* < 2,5 \text{ m}$
	$g_{lim}^* = 2 \text{ ‰} + 15 \text{ mm} / 2a^*$ for $4 \text{ m} \leq 2a^* \leq 20 \text{ m}$	$g_{lim}^* = 2 \text{ ‰} + 15 \text{ mm} / 2a^*$ for $2,5 \text{ m} \leq 2a^* \leq 20 \text{ m}$
	$g_{lim}^* = 3 \text{ ‰} - 5 \text{ mm} / 2a^*$ for $20 \text{ m} < 2a^* \leq 30 \text{ m}$	$g_{lim}^* = 3 \text{ ‰} - 5 \text{ mm} / 2a^*$ for $20 \text{ m} < 2a^* \leq 30 \text{ m}$
	$g_{lim}^* = 85 \text{ mm} / 2a^*$ for $2a^* > 30 \text{ m}$	$g_{lim}^* = 85 \text{ mm} / 2a^*$ for $2a^* > 30 \text{ m}$
Method 3: Bogie test twist	EN 14363:2016+A2:2022, 6.1.5.3.2.2 $g_{lim}^+ = 6.67 \text{ ‰}$ for $2a^+ < 5 \text{ m}$	prEN 14033-2:2024 $g_{lim}^+ = 10 \text{ ‰}$ for $2a^+ < 2,86 \text{ m}$
	$g_{lim}^+ = 3 \text{ ‰} + 20 \text{ mm} / 2a^+$ for $2a^+ \geq 5,45 \text{ m}$	$g_{lim}^+ = 3 \text{ ‰} + 20 \text{ mm} / 2a^+$ for $2a^+ \geq 2,86 \text{ m}$
Vehicle body test twist	$g_{lim}^* = 3 \text{ ‰} + 20 \text{ mm} / 2a^*$	$g_{lim}^* = 3 \text{ ‰} + 20 \text{ mm} / 2a^*$

5.2.3.2.2 Common methods for assessment of safety against derailment on track twist

The safety against derailment shall be proven using one of the four options:

- For machine suspensions of a previously proven design (examples of established suspensions such as Y25 bogie, DB661 bogie and double link single axle) calculation of derailment safety in accordance with the method in Annex H is permitted.
- Calculation of derailment safety in accordance with the method in Annex H with guiding forces (or transverse force in wheelset bearing $F_y - H$ forces) determined by corresponding simulation or test is permitted.
- Calculation using a validated simulation model, whereby the twist parameters (such as guiding forces, wheel relief, torsional resistance of the machine, etc.) characteristically measured during the stationary derailment tests in accordance with the requirements of 5.2.3.2.1, constitute the basis of the calculation or the input data for the validation of the numerical model is permitted.
- Stationary tests as defined in EN 14363:2016+A2:2022, 6.1, with parameters as shown in Table 6 are permitted.

For working and travelling modes the corresponding moments, forces and limiting conditions arising from the work and/or travelling modes shall be taken into account.

A decision chart for the safety demonstration in working mode is given in Annex E.

5.2.3.2.3 Special case for machines with the same wheelset configuration in working, travelling and running mode

The safety against derailment in the intended travelling and working modes is deemed to be proven by compliance to prEN 14033-1:2024, 8.2 and when all four following conditions are observed:

- on a level track without super elevation, the relative unloading of the guiding wheel of the machine is $\leq 20\%$;
- the height of the centre of gravity of the machine from the head of the rail is $\leq 2,20\text{ m}$;
- the machine has no suspension blocking device or has a three-point suspension with the third point able to rotate freely;
- there is no rigid connection between several connected machine parts which would obstruct the turning freedom or the free movement in vertical and cross-wise direction within the freedom of movement necessary for following the geometric limits of the track.

5.2.3.2.4 Machines with devices for reducing rail friction

If a machine is equipped with a device to reduce the coefficient of friction between the wheel and rail, e.g. a wetting system for the rail, it is permissible for this to be taken into consideration for the calculation of the derailment safety or during the stationary test. In this case, the function of the rail sprinkler unit on the machine shall be monitored by appropriate warning devices and displayed to the operator.

5.2.3.3 Rules for deviating from requirements for the prevention of derailment

If the proof of prevention of derailment is not provided for all working modes the scope of the machine shall be limited and shall be indicated in the documentation, see 7.4 Table 12, line c).

When asymmetric loads occur, when working except as shown below, it is permitted for one wheel to be completely unloaded, but not leaving the rail, on machines with very high axle loads on all remaining axles of a machine frame (for example cranes), providing that it can be demonstrated by test or calculation, that further derailment will not occur.

When the machine is not moving along the track it is permissible for one wheel to leave the rail providing this is limited to a distance of 5 mm or less.

5.3 Machine gauge

5.3.1 Stowing of moveable machine parts in travelling mode

Machines shall be designed and built so that in travelling mode all component parts of the machine can be stowed within the applicable gauge of the track it is travelling on. A drawing of the complete machine in travelling mode shall be shown in the documentation, see 7.2, Table 10, Line f).

5.3.2 Working gauge

5.3.2.1 General

Machines and their moveable component parts shall be designed and built to work without unintentional interference with the kinematic envelope necessary for the running of vehicles permitted by the infrastructure owner without running restrictions on the operating track. For the different zones of work and the zone limit between the track closed for work and the adjacent operating track in service, see Figure D.1.

5.3.2.2 Lateral limit of working zone

5.3.2.2.1 General

The lateral limit of track being worked on with respect to the tracks open to traffic depends on all the following conditions:

- the machine is moving at a working speed ≤ 20 km/h;
- the passage of traffic on adjacent lines is restricted to vehicles without running restrictions;
- the permitted speed of traffic on adjacent lines;
- the distance between the track being worked on and an adjacent track open to traffic does not get smaller.

5.3.2.2.2 Determination of the lateral working limit

The lateral working limit, depending on the operating conditions of the operating track, is given by the infrastructure manager.

Annex D provides an example of a lateral working limit line (Figure D.2). Except if the requirements of 5.3.2.2.4 are met, the tools of a machine in working configuration shall not exceed the lateral limit of work. The lateral limit of work shall be shown in the documentation, see 7.2, Table 10, line g).

5.3.2.2.3 Lateral limiting devices

The accidental intrusion into the kinematic envelope of the line open to traffic shall be made impossible by lateral limiting devices.

Parts of the machine which are susceptible during work to infringing the lateral limit of work shall be equipped with a lateral movement limiting device. This device shall be continuously adjustable or adjustable in steps up to the limit of the kinematic envelope necessary for the running of vehicles admitted by the infrastructure owner without running restrictions on the operating track.

The lateral movement limiting devices shall be described, with indication of their type and their mode of operation and a method of controlling that operation, in the documentation, see 7.3, Table 11, line b).

5.3.2.2.4 Exceeding the lateral working limit

When the working demands necessitate that the lateral limit of work is exceeded, it shall only be made possible by means of a deliberate manual action, e.g. actuating a locked switch or releasing a lock. In such situations the control device for movement as specified in 5.3.2.2.3, shall be functioning and a flashing orange light at the driver's position and working positions shall indicate this dangerous situation.

5.3.2.2.5 Determination of the lateral limiting width

The method for calculating the lateral limiting width, in accordance with local conditions, is specified in Annex D.

5.3.2.3 Working limit in the upper area

Parts of machines, which can exceed the upper limit of the running gauge of the track closed for work, shall be fitted with adjustable limiters for controlling vertical displacements.

5.3.3 Exceedance of gauge in working mode

Where the movement of components of the machine in working mode exceeds the running and travelling mode(s) swept envelope(s), then the extent by which the swept envelope is exceeded shall be stated in

the documentation, see 7.2 Table 10, line h). The instructions for use shall state, “This machine may be used with adjacent railway lines open to traffic only if the safe system of work to be adopted has taken account of swept envelope exceedance”, see 7.3, Table 11, line c).

5.4 Working places

5.4.1 General

The operation of work equipment controls (normal operation, setting up for work and packing away) shall be possible from a safe working position, i.e. from a cab or from a safe working position that is protected from traffic. Where such protection is achieved by stopping traffic, a specific reference to this requirement shall be included in the documentation, see 7.3, Table 11, line d).

5.4.2 Arrangement of working places

Preferably work places should be in cabins and be positioned within the machine vehicle gauge, see prEN 14033-1:2024, Annex C.

Where possible a free horizontal surface of minimum dimension A4 landscape should be provided, e.g. for processing documents, etc.

Except as stated below where it is not reasonably practicable to position work places within the running gauge, but within the working limit, they shall be situated in a working place area protected by guards fixed to the machine, e.g. wall, barrier, mesh. Mobile elevating work platforms do not need to meet this requirement.

The manufacturer shall inform the user, in the documentation, see 7.3 Table 11, line e), of the inherent risks with regard to work places located outside the running gauge.

5.4.3 Work positions – Visibility

Where the machine is moving along the track in working mode, an operator shall have a sufficient view of the track in the direction of movement as described in prEN 14033 3:2024, 5.13.3.

5.4.4 Cab windows used for travelling

Where cab windows used for travelling are the same as the cab windows used for running, they shall comply with prEN 14033-1:2024, 14.3.4. Where cab windows used for viewing the track in travelling mode and are different to the windscreens used to drive the machine in running mode, then as a minimum the window shall be at least 6 mm laminated safety glass with no optical or chromatic distortion.

5.4.5 Cabin windows used solely for working

Work cabin windows used solely for working shall be made of safety glass of a minimum thickness of 6 mm. In this case ‘safety’ glass shall either be laminated or toughened glass. Deviations for special applications shall be established by contract.

5.4.6 Storage of tools and loose equipment

All tools and loose equipment that are intended to be carried on board the machine shall be capable of being placed or secured in a location that prevents uncontrolled movement during emergency braking. The tools and equipment with their storage locations shall be described in the documentation, see 7.3 Table 11, line f).

5.4.7 Welfare facilities

Where the design of a self-powered machine has space available welfare facilities shall be provided. As a minimum this should include toilet and hand washing facilities meeting the requirements of EN 17863:2023, Clause 6.

5.5 Access to and egress from working places

5.5.1 General

Direct access from work cabins or other working places via the sides of the machine to an adjacent track, shall either be avoided or where this is not possible it shall be recorded in the documentation as a restriction to use, see 7.4, Table 12, line d).

A suitable device shall be in place to prevent people unintentionally leaving the machine on the side of an adjacent line. Leaving the machine shall be done by a conscious and targeted action. The system shall be described in the documentation, see 7.3, Table 11, Line g).

NOTE 1 The provision of a warning label "Adjacent line open to traffic" together with a barrier device is a commonly accepted solution to fulfil this requirement.

Where only one person is able to use an exit, it is permitted for the device to be a flexible barrier (e.g. retractable belt).

Where more than one person is able to use an exit only permanently installed rigid devices of a height of at least 1 m, with an intermediate bar, e.g. gate or barrier, or a door are permitted to be used for this purpose. The default position of the barrier shall be the closed position and shall automatically or independently return to the initial closed position.

NOTE 2 It is normal practice for the barrier to be painted red or warning stripes of red and white or black and yellow.

When the entrance or exit is in use as an escape route, it shall be possible to open the device with a single movement, without tools.

5.5.2 Access to working places

Handrails used to gain access to working places shall meet the requirements of prEN 14033-3:2024, 5.14.3.

Access and exits of combined working and driving cabs shall be in accordance with the requirements of prEN 14033-1:2024.

The opening of a door or barrier shall not project beyond the working gauge of the machine as specified in 5.3.2.2.2.

5.5.3 Additional option for working adjacent to high speed lines open to traffic

It is permitted, where several exits are available on a machine with multiple occupancy to fit:

- a device in the machine operator's cab that monitors the position of the barrier and/or door and signals opening processes acoustically and visually when the adjacent line is open to traffic;
- a red visual signal near the barrier or door, visible from the inside only of the machine, which is activated when it is secured to prevent access to the line open to traffic;
- a request button or similar on every barrier or door to request the machine operator to open the exit to the line open to traffic and to confirm it by the operator. The exit may only be opened after it has been confirmed;
- an emergency device to ensure that the machine can be left at any time in an emergency;
- a means for access to the machine from trackside in an emergency.

5.6 Environment conditions and protection

5.6.1 Environmental conditions - general

5.6.1.1 Climatic conditions

In the design process for the machines and equipment on board, it shall be taken into account that machines shall be operational and function normally under the conditions and the climate zones for which the equipment is designed and where it is likely to be in operation. Guidance on the environmental requirements is given in EN 50125 1:2014. Demonstration of compliance shall be required where the manufacturer states that the machine is intended for working and travelling in conditions without a relevant experience for the machine or component concerned.

It shall be stated in the documentation, see 7.2, Table 10, line i), the environmental conditions the machine is designed and intended to be used as set out in EN 50125-1:2014.

NOTE 1 The requirements of environmental conditions for running, see prEN 14033-1:2024, 16.1.

NOTE 2 The environmental operating conditions are normally defined at specification stage of design and in cooperation between the manufacturer and the intended operators.

5.6.1.2 Severe winter climatic conditions

Machines intended for working and travelling in severe winter environmental conditions shall fulfil the demands in EN 50125-1:2014 temperature class T2, and snow and hail class S3.

NOTE Guidance on demonstration of compliance is shown CEN/TR 16251.

Machine intended to use in severe winter conditions shall be evaluated and designed against all systems and functions described in this document.

Where the machine is intended to be used in temperatures below -20°C , to maintain the function and maintain the recovery function, added equipment and conditions shall be described in the instruction handbook, see 7.3, Table 11, line h), for example, ladders, external heat system, iron skewer, ice pick or sledgehammer.

5.6.1.3 Severe summer conditions

Machines intended for working and travelling in severe summer environmental conditions shall fulfil the demands in EN 50125-1:2014, temperature class T3.

5.6.2 Exhaust gases

Except as shown below the exhaust gases from combustion engines used for working operations shall be directed upwards and /or towards the top of the machine, clear of the overhead contact line system, the position shown in the documentation, see 7.2, Table 10, line j).

Other positions are permitted to be used for machines used for construction and maintenance of the upper part of the infrastructure, e.g. overhead contact line systems, bridges and tunnels.

Where it can be demonstrated that it does not cause harm to workers at nearby workspaces or damage to the track it is also permitted to have the exhaust gasses directed towards the track. Any access restrictions (e.g. exclusion zones) shall be stated in the documentation, see 7.4, Table 12, line e).

5.6.3 Noise levels outside the machine

For the sound power levels and the machine emitted sound pressure levels, see prEN 14033-3:2024, 5.25.