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

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 14033-2

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ICS

English version

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

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

Bahnanwendungen - Oberbau - Schienengebundene Bau- und Instandhaltungsmaschinen - Teil 2: Technische Anforderungen an den Arbeitseinsatz

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.

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

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Foreword

This document (prEN 14033-2:2005) 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.

Deviations or special national conditions are given in Annex A.

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 working;

— Part 3: General safety requirements.

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Introduction

This European Standard (EN) was prepared to meet the basic requirements of EU Directives to facilitate an open market for goods and services.

Railway machines used for construction and maintenance form the object of this standard.

This standard deals with railway specific risks of the machines, as specified in 1.1, when working on railway infrastructures.

For safety requirements in relation to the Machinery Directive, see prEN 14033-3.

For deviations or special national conditions, see Annex A.

The risks which exist in all mechanical, electrical, hydraulic, pneumatic and other components of machines and which 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.

If the provisions of this type C standard are different from those which are stated in type A or B standards, the provision of this type C standard take precedence.

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1 Scope

1.1 General

This European Standard defines the specific technical railway requirements for working with machines and other vehicles used for construction, maintenance and inspection of track, structures, track formation and fixed electric traction equipment as specified in prEN 14033-1.

This European Standard applies to all railbound machines and other vehicles - referred to as machines - working exclusively on the railway (utilising friction between the rail and rail wheels) and used for construction, maintenance and inspection of track, structures, infrastructure and fixed electric traction equipment.

Different regulations are applicable for working on infrastructures with narrow gauge or broad gauge lines, lines of tramways, railways utilising other than adhesion between the rail and rail wheels and underground infrastructures.

This standard covers the safety requirements for the railway specific problems for working on different infrastructures. These application of these requirements is the object of a verification procedure which does not form part of this standard, but an Annex J is included for information. In all cases an authorisation to work is required to access the infrastructure.

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

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This standard does not apply to

— the requirements with regard to the quality of work, including the related measuring methods, and the performance of the machine;

— 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 infrastructure manager.

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This standard 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 freezer applications, high temperatures, corrosive environment, tropical environment, contaminating environments, 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;

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

1.2 Validity of this standard

This European Standard applies to all machines, which are ordered after one year from the publication date of this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

prEN 14033-1:2003, *Railway Applications – Track - Technical requirements for railbound construction and maintenance machines- Part 1: Running of railbound machines*

prEN 14033-3:2004, *Railway Applications – Track – Railbound construction and maintenance machines – Part 3: General safety requirements*

EN 3-4, *Portable fire extinguishers. Part 4: charges, minimum required fire*

EN 280, *Mobile elevating work platforms - Design calculation - Stability criteria; Construction; Safety; Examinations and tests*

EN 457, *Safety of machinery; auditory danger signals; general requirements, design and testing*

EN 791, *Drill rigs-safety*

EN ISO 12100-2, *Safety of Machinery-Basic concepts, general principles for design-Technical principles*

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

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

EN 50122-1, *Railway applications - Fixed installations - Part 1: Protective provisions relating to electrical safety and earthing*

EN 50153, *Railway applications – Rolling stock – Protective provisions relating to electrical hazards*

ISO 4305, *Mobile cranes; determination of stability*

ISO 4310, *Cranes; Test code and procedures*

UIC 505-1:2003[1)], *Railway transport stock - Rolling stock construction gauge (9TH Edition August 2002)*

UIC 505-4:1977[1)], *Effects of the application of the kinematic gauges defined in the 505 series of leaflets on the positioning of structures in relation to the tracks and of the tracks in relation to each other*

UIC 644:1980[1)], *Warning devices used on tractive units employed on international services*

UIC 702:2003[1)], *Static loading diagrams to be taken into consideration for the design of rail carrying structures on lines used by international services*

1) To be purchased from: Editions Techniques Ferroviaires (ETF), 16 rue Jean Rey, F-75015 Paris.

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3 Terms and definitions

3.1 General terms and definitions

The terms listed in the relevant railway specific documents and in particular those in the UIC leaflets apply to this European Standard.

Terms and definitions that are used in European and International Standards that are referred to in this Standard also apply.

3.2 Additional terms and definitions

For the purposes of this standard, the following definitions apply:

3.2.1
working configuration
a machine is said to be in working configuration as soon as any part of the machine is moved from its travelling position as specified in prEN 14033-1, 5.2

3.2.2
working place
working places are working cabs, combined working and driving cabs, operators places situated outside cabs and places situated at control or maintenance locations

3.2.3
working limit contour
limit in which a machine can work without interfering with the kinematic envelope of vehicles on adjacent tracks

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3.2.4
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)

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3.2.5
working track
track that is being maintained for which the geometrical parameters may reach the limiting values as specified in Annex F and for which special operational restrictions may apply

3.2.6
working agreement
working agreement is a procedure that enables a machine to work on one infrastructure. This procedure consists of two parts:

a) the proof of conformity with the safety requirements, as specified in prEN 14033-3 (EC declaration of conformity), given by the manufacturer;

b) the authorisation to work that is given at the end of the working agreement. It is also permissible to give a preliminary authorisation to work if some requirements are not yet fulfilled or have yet to be proved that they are fulfilled.

3.2.7
authorisation to work
given by the infrastructure owner it permits a machine to work on the railway infrastructure in accordance with the specific requirements of the latter (method of work, quality, output)

3.2.8
Type testing
see 14033-1

3.2.9
Type conformance testing
see 14033-1

4 Field of use of machines

Machines shall in accordance with their proper use either

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

or

— 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.

5 Specific railway requirements and/or measures

5.1 Interaction with the Infrastructure

5.1.1 General

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

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

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The parameters to consider for the calculations are listed in Annex K.

If the machines contains devices for levelling and lining of the track the maximum forces generated by these devices shall be stated in the technical documentation, see Annex E, and in the instruction handbook.

5.1.2 Main wheels

The wheels referred to in this clause are the wheels used for the running of the machine as specified in prEN 14033-1.

If the configuration of the wheels in working mode of the machine is different from the running configuration, then the changes shall not cause derailment over the full range of the machine's operational characteristics.

The wheel load shall not generate stresses in the rail higher than the following values given in Table 1 as a percentage of the minimum ultimate tensile strength of the rail.

Table 1 — Tensile limit in the rails

bending stress	measure points	ultimate tensile strength of the rail %
a) Maximum permissible tensile bending stress	middle of the head and middle of the foot of the rail	45
	at the corner of the head of the rail	50
	at the foot of the rail	60
b) Maximum permissible compressive bending stress	head and foot of the rail	65

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 etc.

5.1.3 Auxiliary wheels, auxiliary guides and working parts

The 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 transit.

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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.

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The limits a) and b) as specified in 5.1.2 shall be followed for any tool associated with the working mode but may be exceeded when placing or carrying rails. If the rail is subject to other external stresses, as for example thermal stress this shall be taken into consideration. The limits a) and b) above can be exceeded in machines specifically designed for straightening or bending rails.

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 Machines without wheel load control devices

In working configuration the maximum wheel loads Q_{max} of main the wheels or auxiliary wheels in relation to the diameter of the wheel and the rail material are given in Table 2.

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

— due to the machine:

  — excentricity of the centre of gravity;

  — torsional flexibility;

— hysteresis of the suspension;

— excentric load;

— application of an eccentric force.

— Due to the track:

— maximum cant;

— maximum twist.

Table 2 — Maximum wheel load with the machine in working configuration without wheel load control devices

d mm	Q_{max} kN	
	Rail with σ_B = 880 N/mm^2 a	Rail with σ_B = 680 N/mm^2 b
∅ ≥ 920	222	136
920 > ∅ ≥ 840	222	136
840 > ∅ ≥ 760	201	120
760 > ∅ ≥ 680	179	107
680 > ∅ ≥ 630	167	99
630 > ∅ ≥ 550	146	89
550 > ∅ ≥ 470	124	74
470 > ∅ ≥ 390	103	62
390 > ∅ ≥ 330	87	52

d = worn diameter limit
∅ = wheel diameter
a corresponds e.g. to rails UIC 60, S 54, S49 (880 N/mm^2)
b corresponds e.g. to rails, rails S 49 (680 N/mm^2)

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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 etc.

If, in working mode, the maximum static wheel load exceeds the values for rails with σ_b=680N/mm^2, it shall be stated in the documentation, see Annex E, and in the instruction handbook.

5.1.4.2 Machines 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.

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;

— interdeterminate break out forces;

— overload due to unequal distribution of the load within the lifting tackle;

— oblique lifting of the load;

— dynnamic movements of the load (e.g. swinging or vertical movements of the load).

Table 3 — Maximum wheel load with the machine in working configuration with wheel load control devices

d mm	Q_{max} kN	
	Rail with σ_B = 880 N/mm^2 a	Rail with σ_B = 680 N/mm^2 b
∅ ≥ 920	243	170
920 > ∅ ≥ 840	243	170
840 > ∅ ≥ 760	243	154
760 > ∅ ≥ 680	230	138
680 > ∅ ≥ 630	213	127
630 > ∅ ≥ 550	186	111
550 > ∅ ≥ 470	159	95
470 > ∅ ≥ 390	132	79
390 > ∅ ≥ 330	112	67

d = worn diameter limit
∅ = wheel diameter
a corresponds e.g. to rails UIC 60, S 54, S49 (880 N/mm^2)
b corresponds e.g. to rails, rails S 49 (680 N/mm^2)

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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 etc.

If, in working mode, the maximum static wheel load exceeds the values for rails with σ_b = 680N/mm^2 given in Table 3 it shall be stated in the documentation, see Annex E, and in the instruction handbook.

5.1.5 Loads applied to the ballast

The surface pressure applied to the ballast shall not exceed 0,3 MN/m^2.

In the case of a tracked machine the surface pressure shall be calculated as specified in EN 791.

5.1.6 Loads applied to the formation

The maximum pressure applied directly to the formation by any part of the machine shall not exceed 0,1 MN/m^2.

In the case of a tracked machine the surface pressure shall be calculated as specified in EN 791.

5.1.7 Forces on structures as a function of axle load configurations

The stresses generated by machines in their various working configurations, in 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 UIC 702.

If the loads are in excess of load model 71 shown in UIC 702, an analysis shall be carried out each case for each load configuration. 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 technical documentation, see Annex E.

5.2 Stability and safety against derailment

5.2.1 Proof of overturning stability, machine stationary

Stability is defined as prevention of overturning. A machine is considered stable if in the most unfavourable loading conditions and track conditions it does not turn over.

The proof of stability shall be established by calculation and/or by testing.

5.2.1.1 Proof of stability by calculation

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For railway cranes, mobile gantry cranes, cranes fixed to the machine 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. Tests shall be in accordance with ISO 4305.

Table 4 — Load cases for calculating stability

Load case	Use of machine	Cant mm	Load coefficient	Unloaded
with stabilisers	on operating track	180	1,25P+0.1F	≥ 15 % Machine weight
	on working track	200	1,25P+0.1F	≥ 15 % Machine weight
free on wheels	on operating track	180	1,33P+0.1F	≥ 15 % Machine weight
	on working track	200	1,50P+0.1F	≥15 % Machine weight
backward stability	no load on hook and pulley block on the ground			≥ 15 % Machine weight on the unloaded side
P = Load with lifting tackle in accordance with EN ISO 12100-2 F = Mass of the jib, lifting ropes and the pulley block				

For machines with mobile elevating work platforms, the overturning safety calculations shall be done in accordance with EN 280.