



BSI Standards Publication

Railway applications — Track — Road-rail machines and associated equipment

Part 2: General safety requirements

National foreword

This British Standard is the UK implementation of EN 15746-2:2020. It supersedes BS EN 15746-2:2010+A1:2011, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RAE/2, Railway Applications - Track.

A list of organizations represented on this committee can be obtained on request to its committee manager.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

This publication has been prepared under a mandate given to the European Standards Organizations by the European Commission and the European Free Trade Association and is intended to support essential requirements of the EU legislation detailed in the European foreword. Annex ZA/ZZ describes how the publication relates to the legislation.

For the Great Britain market (England, Scotland and Wales), if the UK Government has designated this publication for conformity with UKCA marking legislation and has not amended the essential requirements of that legislation, Annex ZA/ZZ and any references to EU law in the publication should be read in accordance with the designation as applying to UK legislation in the same way as to EU law. Further information on designated standards can be found at www.bsigroup.com/standardsandregulation.

For the Northern Ireland market, UK law will continue to implement relevant EU law subject to periodic confirmation. References to EU legislation are therefore still valid.

More information on legislation can be found at www.gov.uk.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 539 00963 7

ICS 93.100

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2021.

Amendments/corrigenda issued since publication

Date	Text affected
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English Version

Railway applications - Track - Road-rail machines and associated equipment - Part 2: General safety requirements

Applications ferroviaires - Voie - Machines rail route et équipements associés - Partie 2 : Prescriptions générales pour la sécurité

Bahnwendungen - Oberbau - Zweiwege-Maschinen und zugehörige Ausrüstungen - Teil 2: Allgemeine Sicherheitsanforderungen

This European Standard was approved by CEN on 9 November 2020.

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European foreword

This document (EN 15746-2:2020) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2021, and conflicting national standards shall be withdrawn at the latest by June 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15746-2:2010+A1:2011.

Principal amended clauses compared to EN 15746-2:2010+A1:2011:

- general All references updated to latest issue;
- 5.2.3 Requirements for walkways simplified;
- 5.4.6 Visibility requirements separated for running, travelling and working modes;
- 5.6.2 New requirements for risk of falling;
- 5.11.3 New requirements for operator protection;
- 5.12 Greater clarity provided for emergency stopping devices;
- 5.14.2 Requirements for control systems enhanced;
- 5.16.8 Alternative requirements for equipotential bonding on urban rail added;
- 5.18 Requirements for emissions enhanced;
- 5.20 Requirements for tanks enhanced;
- 5.23 Protection from risk of fire revised;
- 5.24 Braking requirements amended to accommodate urban rail;
- 5.29 New requirements for moveable components;
- 5.30 New requirements for environment;
- 5.31 New requirements for substances hazardous to health;
- 6.5 New requirements for rail profiling machines;
- Annexes All annexes reviewed and updated;
- Annex C Noise test code amended;
- Annex D New annex for vibration test.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

EN 15746, *Railway applications — Track — Road-rail machines and associated equipment*, is currently composed with the following parts:

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

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document is the second of a series of four parts of the European Standard: *Railway applications — Track — Road-rail machines and associated equipment*, dealing with railway specific risks of the road-rail machines when running, travelling and working on railway infrastructures:

- Part 1 covers the technical requirements for the machines in travelling and working modes, and is applicable for all machines.
- Part 2 covers the safety requirements for the machines in travelling and working modes; this is a document harmonized with the European Machinery Directive 2006/42/EC.
- Part 3 covers the essential requirements for the machines that have a running mode and run on tracks within the scope of the Railway Directive 2007/58/EC; this is a document harmonized with the Railway Interoperability Directive 2008/57/EC and its associated Technical Specifications for Interoperability (TSI).
- Part 4 covers the technical requirements for the machines that have a running mode on urban rail and/or for machines intended to have travelling and working modes on urban rail.

Part 1 defines requirements for approval of the machine for use on the railway. Depending on the decision of the Infrastructure Manager or National rules, the assessment of conformance could be by the Infrastructure Manager concerned, by a third party assessor or declaration of conformity by the manufacturer.

Part 2 defines requirements for the machine to be declared conformant by the manufacturer, except in the case of machines classified under Annex 4 of the Machinery Directive, which requires a conformity check in conjunction with a notified body.

Part 3 defines requirements for running on the European railway network. Assessment of conformity is by a notified body as prescribed in the Railway Interoperability Directive.

Part 4 defines requirements for approval of the machine for use on urban rail. Depending on the decision of the Urban Rail Manager or National rules the assessment of conformance could be by the Urban Rail Manager concerned, by a third party assessor or declaration of conformity by the manufacturer.

This document is a type C standard as stated in EN ISO 12100:2010. This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.)

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate in the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

As far as possible this document sets out only the requirements that materials and equipment need to meet in the interest of safety, and it is assumed that persons operating machines are adequately trained.

1 Scope

This document specifies the significant hazards, hazardous situations and events, common to self-propelled road-rail machines – henceforward referred to as machines – and associated equipment, arising due to the adaptation for their use on railway networks and urban rail networks. These machines are intended for construction, maintenance and inspection of the railway infrastructure, shunting and emergency rescue vehicles, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer; see Clause 4.

This document deals with the common hazards during assembly and installation, commissioning, travelling on and off track, use including setting, programming, and process changeover, operation, cleaning, fault finding, maintenance and de-commissioning of the machines.

NOTE Specific measures for exceptional circumstances are not dealt with in this document. They can be subject to negotiation between manufacturer and the machine operator.

The common hazards dealt with include the general hazards presented by the machines, also the hazards presented by the following specific machine functions:

- a) excavation;
- b) ballast tamping, ballast cleaning, ballast regulating, ballast consolidating;
- c) track construction, renewal, maintenance and repair;
- d) lifting;
- e) overhead contact line system renewal / maintenance;
- f) maintenance of the components of the infrastructure;
- g) inspection and measurement of the components of the infrastructure;
- h) working in tunnels;
- i) shunting;
- j) vegetation control;
- k) emergency rescue and recovery;

during commissioning, use, maintenance and servicing.

For a road-rail machine it is assumed that an EU road permissible host vehicle will offer an accepted safety level for its designed basic functions before conversion. Unless explicitly stated otherwise in a particular clause this specific aspect is not dealt with in this document.

This document does not deal with:

- 1) requirements with regard to the quality of work and the performance of the machine;
- 2) machines that utilize the contact line system for traction purposes;
- 3) specific requirements established by a railway Infrastructure Manager or Urban Rail Manager;
- 4) negotiations between the manufacturer and the machine operator for additional or alternative requirements;

- 5) requirements for use and travel of the machine on public highway;
- 6) hazards due to air pressure caused by the passing of high-speed trains at more than 190 km/h;
- 7) requirements which could be necessary in case of use in extreme conditions, such as extreme ambient temperatures (tropical or polar); see 5.30;
- 8) highly corrosive or contaminating environment, e.g. due to the presence of chemicals;
- 9) potentially explosive atmospheres.

Other special machines used on railway tracks are dealt with in other European Standards, see Annex E.

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 2:1992, *Classification of fires*

EN 3-7:2004+A1:2007, *Portable fire extinguishers — Part 7: Characteristics, performance requirements and test methods*

EN 280:2013+A1:2015, *Mobile elevating work platforms — Design calculations — Stability criteria — Construction - Safety - Examinations and tests*

EN 403:2004, *Respiratory protective devices for self-rescue — Filtering devices with hood for escape from fire — Requirements, testing, marking*

EN 474-1:2006+A6:2019, *Earth-moving machinery — Safety — Part 1: General requirements*

EN 547-1:1996+A1:2008, *Safety of machinery — Human body measurements — Part 1: Principles for determining the dimensions required for openings for whole body access into machinery*

EN 547-2:1996+A1:2008, *Safety of machinery — Human body measurements — Part 2: Principles for determining the dimensions required for access openings*

EN 547-3:1996+A1:2008, *Safety of machinery — Human body measurements — Part 3: Anthropometric data*

EN 614-1:2006+A1:2009, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 614-2:2000+A1:2008, *Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks*

EN 618:2002+A1:2010, *Continuous handling equipment and systems — Safety and EMC requirements for equipment for mechanical handling of bulk materials except fixed belt conveyors*

EN 619:2002+A1:2010, *Continuous handling equipment and systems — Safety and EMC requirements for equipment for mechanical handling of unit loads*

EN 620:2002+A1:2010, *Continuous handling equipment and systems — Safety and EMC requirements for fixed belt conveyors for bulk materials*

EN 842:1996+A1:2008, *Safety of machinery — Visual danger signals — General requirements, design and testing*

EN 894-1:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*

EN 894-2:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*

EN 894-3:2000+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*

EN 981:1996+A1:2008, *Safety of machinery — System of auditory and visual danger and information signals*

EN 1032:2003+A1:2008, *Mechanical vibration — Testing of mobile machinery in order to determine the vibration emission value*

EN 1837:1999+A1:2009, *Safety of machinery — Integral lighting of machines*

EN 12999:2011+A2:2018, *Cranes — Loader cranes*

EN 13000:2010+A1:2014, *Cranes — Mobile cranes*

EN 13135:2013+A1:2018, *Cranes — Safety — Design — Requirements for equipment*

EN 14033-1:2017, *Railway applications — Track — Railbound construction and maintenance machines — Part 1: Technical requirements for running*

EN 14033-2:2017, *Railway applications — Track — Railbound construction and maintenance machines — Part 2: Technical requirements for travelling and working*

EN 14033-3:2017, *Railway applications — Track — Railbound construction and maintenance machines — Part 3: General safety requirements*

EN 15153-2:2020, *Railway applications — External visible and audible warning devices — Part 2: Warning horns for heavy rail*

EN 15746-1:2020, *Railway applications — Track — Road-rail machines and associated equipment — Part 1: Technical requirements for travelling and working*

EN 15746-3:2020, *Railway applications — Track — Road-rail machines and associated equipment — Part 3: Technical requirements for running*

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

EN 16704-2-1:2016, *Railway applications — Track — Safety protection on the track during work — Part 2-1: Common solutions and technologies — Technical requirements for Track Warning Systems (TWS)*

EN 28662-1:1992, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 1: General (ISO 8662-1:1988)*

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

EN 50153:2014,¹ *Railway applications — Rolling stock — Protective provisions relating to electrical hazards*

EN 60204-1:2018, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2016)*

EN 60204-32:2008, *Safety of machinery — Electrical equipment of machines — Part 32: Requirements for hoisting machines (IEC 60204-32:2008)*

EN 60529:1991,² *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 61310-1:2008, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN 61310-2:2008, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310-2:2007)*

EN 61310-3:2008, *Safety of machinery — Indication, marking and actuation — Part 3: Requirements for the location and operation of actuators (IEC 61310-3:2007)*

EN 61496-1:2013, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests (IEC 61496-1:2012)*

EN 61508-3:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 3: Software requirements (IEC 61508-3:2010)*

EN 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code) (IEC 62262:2002)*

EN ISO 2860:2008, *Earth-moving machinery — Minimum access dimensions (ISO 2860:1992)*

EN ISO 2867:2011, *Earth-moving machinery — Access systems (ISO 2867:2011)*

EN ISO 3411:2007, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope (ISO 3411:2007)*

EN ISO 3471:2008, *Earth-moving machinery — Roll-over protective structures — Laboratory tests and performance requirements (ISO 3471:2008)*

EN ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

¹ As impacted by EN 50153:2014/A1:2017.

² As impacted by EN 60529:1991/AC:2006-12, EN 60529:1991/A1:2000, EN 60529:1991/A2:2013 and EN 60529:1991/A2:2013/AC:2019-02.

EN ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components (ISO 4413:2010)*

EN ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components (ISO 4414:2010)*

EN ISO 4871:2009, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 5353:1998, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point (ISO 5353:1995)*

EN ISO 6682:2008, *Earth-moving machinery — Zones of comfort and reach for controls (ISO 6682:1986, including Amd 1:1989)*

EN ISO 6683:2008, *Earth-moving machinery — Seat belts and seat belt anchorages — Performance requirements and tests (ISO 6683:2005)*

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

EN ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

EN ISO 12001:2009, *Acoustics — Noise emitted by machinery and equipment — Rules for the drafting and presentation of a noise test code (ISO 12001:1996)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13732-1:2008, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2015)*

EN ISO 13849-2:2012, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation (ISO 13849-2:2012)*

EN ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design (ISO 13850:2015)*

EN ISO 13854:2019, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body (ISO 13854:2017)*

EN ISO 13855:2010, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body (ISO 13855:2010)*

EN ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2019)*

EN ISO 14118:2018, *Safety of machinery — Prevention of unexpected start-up (ISO 14118:2017)*

EN ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection (ISO 14119:2013)*

EN ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)*

EN ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2016)*

EN ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2016)*

ISO 3795:1989, *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials*

ISO 3864-1:2011, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 3864-2:2016, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

ISO 3864-3:2012, *Graphical symbols — Safety colours and safety signs — Part 3: Design principles for graphical symbols for use in safety signs*

ISO 3864-4:2011, *Graphical symbols — Safety colours and safety signs — Part 4: Colorimetric and photometric properties of safety sign materials*

ISO 5006:2017, *Earth-moving machinery — Operator's field of view — Test method and performance criteria*

ISO 6405-1:2017, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 7000:2019, *Graphical symbols for use on equipment — Registered symbols*

ISO 10263-2:2009, *Earth-moving machinery — Operator enclosure environment — Part 2: Air filter element test method*

ISO 10263-3:2009, *Earth-moving machinery — Operator enclosure environment — Part 3: Pressurization test method*

ISO 10263-5:2009, *Earth-moving machinery — Operator enclosure environment — Part 5: Windscreen defrosting system test method*

ISO 11112:1995,³ *Earth-moving machinery — Operator's seat — Dimensions and requirements*

³ As impacted by ISO 11112:1995/AMD 1:2001.

ISO 12117-2:2008,⁴ *Earth-moving machinery — Laboratory tests and performance requirements for protective structures of excavators — Part 2: Roll-over protective structures (ROPS) for excavators of over 6 t*

ISO 12508:1994, *Earth-moving machinery — Operator station and maintenance areas — Bluntness of edges*

ISO 15817:2012, *Earth-moving machinery — Safety requirements for remote operator control systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010, EN 15746-1:2020 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 rail configuration

state of the machine when it is in place on the track ready to work or travel along the track

Note 1 to entry: Rail configuration does not include the transient state during getting on and off the track.

3.2 road configuration

state of the machine when it is on the ground, i.e. not on the track

Note 1 to entry: It does not imply that the machine is suitable for use on the public highway.

3.3 working place

driver's cab, working cabs, combined driver's and working cabs, operator's places situated outside cabs and places situated at control or maintenance locations

3.4 rated capacity indicator / limiter RCI/RCL

device which gives within specified tolerance limits, at least a continuous indication of the load being lifted and a continuous indication that the rated capacity is exceeded, and another continuous indication of the approach to the rated capacity and prevents the machine from movement into a worse condition as it reaches the overload condition, as described in this document

Note 1 to entry: For rated capacity, see EN 12077-2.

⁴ As impacted by ISO 12117-2:2008/A1:2016.

3.4.1**rated capacity indicator****RCI**

device which gives within specified tolerance limits, at least a continuous indication of the load being lifted and a continuous indication of the approach of the rated capacity, and another continuous indication that the rated capacity is exceeded

3.4.2**rated capacity limiter****RCL**

device which prevents the machine from movement into a worse condition as it reaches the overload condition, as described in this document

Note 1 to entry: For rated capacity, see EN 12077-2.

3.5**assistant**

person to provide help or guidance to the driver of the machine, this document does not specify duties for the assistant

4 List of significant hazards

Table A.1 contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this document, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

For a particular machine, a risk assessment should be carried out by the manufacturer of the machine to identify the hazards present on the machine and any additional significant hazards so that suitable protective measures can be taken. Additional hazards are outside the scope of this document.

5 General safety requirements and/or measures**5.1 General**

Machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of EN ISO 12100:2010 for hazards relevant but not significant, which are not dealt with by this document.

This document formulates general / common requirements for the machines and associated equipment in the scope of this document, and arising due to the adaptation for their use on rail.

The function(s) of machines which is (are) dealt with in another European Standard for machinery safety shall comply with that standard as far as applicable taking account of the additional requirements and deviations of this document. This applies to both configurations “rail” and “road”.

NOTE 1 This document covers hazards common to the adaption of self-propelled machines and equipment for use on rail. Risk assessment is an essential tool in this situation for identifying additional hazards arising for specific machinery or equipment when a road going machine, equipment or chassis is modified for use on rail, irrespective of whether a harmonized standard exists for the machine or chassis in road configuration. For hazards not covered by this document, the manufacturer is responsible for applying suitable risk reduction measures for these additional hazards, which are outside the scope of this document.

NOTE 2 Relevant standards for road going machines that are adapted for road-rail machine functions are for example:

- for earth moving machinery: EN 474-1:2006+A6:2019;
- for cranes: EN 13001-1;
- for cranes on trucks: EN 12999:2011+A2:2018;
- for mobile cranes: EN 13000:2010+A1:2014;
- for mobile elevating work platforms: EN 280:2013+A1:2015;
- for self-propelled variable reach trucks: EN 1459 (all parts).

Where there is a conflict between the requirements of this document and the other above-mentioned European Standard(s), then this document shall prevail.

If the machine is constructed on the basis of a host vehicle this host vehicle shall comply with one of the following:

- the European Standard for machinery safety relevant for that host vehicle (as far as not explicitly required otherwise in specific clauses of this document);

or

- this document.

It is assumed that a finished automotive chassis or a chassis complying with the same rules, used as a host for a road-rail machine will offer an acceptable safety level for its designed functions before conversion. Unless otherwise specified this specific aspect is not dealt with in this document.

NOTE 3 The basis of this document is that a machine will comply with its own standard and then have the requirements of this document applied. For example, a road-rail excavator will be constructed to EN 474-1:2006+A6:2019 and EN 474-5:2006+A3:2013 and then the requirements of this document are applicable. The requirements in this document are additional to the requirements in the host machine standard.

5.2 Access and egress to and from working places

5.2.1 Cabs

Except as shown below access and egress from all driving cabs, working cabs and combined working and driving cabs shall be from both sides of the machine or directly into the area between the rails of the working track.

If it is not possible to comply with the above, and access is only available from one side of the machine then the instruction handbook shall detail the restriction of use, see 8.2.2, g).

In rail configuration the ground position will vary depending on the location, therefore the ground position for the first step in rail configuration shall be taken as rail level. Signs, complying with the requirements of 8.3, shall be fixed at each egress point to warn personnel of the dangers from passing traffic.

A device for restricting egress from the side of the machine open to rail traffic shall be provided to prevent people leaving the machine on the side open to traffic by mistake. Where possible this shall require the operator to carry out an intentional action to leave the machine.

Where doors are fitted as an addition to doors on the host vehicle they shall:

- a) be maintained in the fully open and closed positions by automatic latches suitable for the foreseen forces. It shall be possible to lift the latches by means of the inside and outside handles;
- b) not exceed the running gauge in open state, but during the opening process it is permitted to exceed the running gauge providing the door does not remain in the exceeded position;
- c) make opening quickly and easily possible by the design and position of the door handles, but the design shall mitigate against the unintentional opening of the door. The door handles shall be easily accessible and ergonomically shaped and safe;
- d) allow opening and closing without difficulty, from both outside and inside the cab. A lock and a handle shall be arranged on the outside of the doors at a height of 1 250 mm to 1 700 mm above rail level or step level where this is provided to gain access;
- e) have a door opening that shall comply with the requirements of EN ISO 2867:2011.

Where doors which are part of the host vehicle do not comply with this clause a note shall be made in the instruction manual, see 8.2.1, y).

Machines without access directly into the area between the rails may be prohibited when working in areas which only provide restricted side access.

5.2.2 Working places, places for control and maintenance outside of cabs

Where reasonably practicable working places shall be positioned within the machine running gauge, as defined in EN 14033-1:2017, Annex C or for machines designed and intended for use on urban rail the Urban Rail Manager concerned shall specify the running gauge. The manufacturer shall state in the instruction handbook the system(s) on which the machine is intended to operate, see 8.2.1, ee).

Where it is not reasonably practicable to position work places within the running gauge the manufacturer shall inform the user, in the instruction handbook, of the inherent risks with regard to working places located outside the running gauge, see 8.2.1, y). In addition a fixed warning notice, complying with the requirements of 8.3, shall be displayed adjacent to each such working place.

Except as shown below access and egress from all working places outside of cabs shall be from both sides of the machine or directly into the area between the rails of the working track.

If it is not possible to comply with the above, and access is only available from one side of the machine then the instruction handbook shall detail the restriction of use, see 8.2.9).

Access hatches shall comply with the requirements in 5.2.1, a), b) and c).

5.2.3 Walkways on the machine

Where fitted, walkways on the machine shall be in accordance with the requirements of EN ISO 2867:2011. Floors shall not present a tripping hazard and their coverings shall be anti-slip in conformance with the requirements of EN ISO 14122-2:2016.

Guard rails shall be provided in accordance with the requirements of EN ISO 2867:2011.

5.3 Ergonomics

Machines shall be designed according to the principles of EN 614-1:2006+A1:2009 and EN 614-2:2000+A1:2008.

5.4 Cabs

5.4.1 Minimum dimensions in cabs

Except under the conditions of the following paragraph the minimum space available to the operator shall be as defined in EN ISO 3411:2007.

For working cabs with limited headroom (measured from the seat index point, as specified in EN ISO 5353:1998, to the roof) caused by technical requirements, the minimum space envelope height (dimension R1 in EN ISO 3411:2007, Figure 4) is permitted to be reduced to 920 mm.

The minimum space and location of the controls at the working place shall meet the requirements specified in EN ISO 6682:2008.

5.4.2 Cab floors

Where reasonably practicable the floor of cabs shall be constructed in conformance with the requirements of EN ISO 14122-2:2016.

5.4.3 Emergency exit

An alternative opening (emergency exit) shall be provided as specified in EN 474-1:2006+A6:2019, 5.3.2.4.

For machines intended for use on urban rail, the Urban Rail Manager may specify additional or more prescriptive requirements to suit the local environment. This is particularly applicable where single bore tunnels could obstruct emergency egress from the sides of machines. The manufacturer shall state in the instruction handbook the system(s) on which the machine is intended to operate, see 8.2.1, ee).

5.4.4 Climatic conditions in cab

Where an enclosed cab is fitted, this subclause (5.4.4) shall be applicable in all cases.

Cabs shall protect the operator against foreseeable adverse climatic conditions.

Cabs shall be heat insulated and shall be equipped with an adjustable heating and ventilation system. If not already fitted to the host vehicle the system shall be according to EN 474-1:2006+A6:2019, 5.3.2.6.

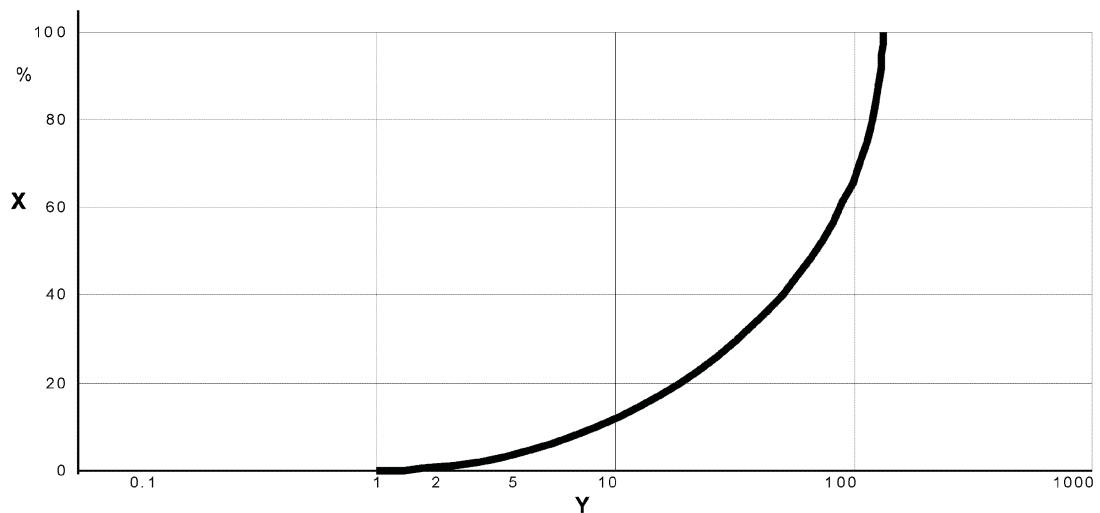
The doors and windows shall protect against rain, snow, ice, exhaust gases and wind. Where fitted, pipes, cable ducting, and valves shall not compromise this requirement.

5.4.5 Protection from dust

Where practicable, on machines with devices that create a dust hazard, e.g. grind rails or transfer ballast, the permanent places of work shall be in enclosed cabs. These cabs shall be equipped with devices to prevent the ingress of dust. The air in-take shall be positioned as far as is practicable to minimize the intake of dust.

Where the intended use of the machine causes dust ingress to the cab the manufacturer shall use particle filters designed to be sufficient to prevent a minimum of 95 % dust, as specified below, into the cab; this particle filter shall be tested according to ISO 10263-2:2009. The position of the particle filter shall enable as far as is practicable the routine inspection and changing of the filter.

The composition of the dust used for calculation of particle filter selection shall be in accordance with Figure 1.

**Key**

X percentage by weight

Y particle diameter (micrometres)

Figure 1 — Distribution of particle size for dust used in filter testing

The ventilation system shall be capable of providing the cab with filtered fresh air at a minimum of 43 m³/h.

Where a cab is provided with a pressurization system, the system shall be tested according to ISO 10263-3:2009 and shall provide an interior positive pressure of at least 50 Pa.

5.4.6 Visibility from cabs and other permanent work places**5.4.6.1 General**

The requirements of this clause shall be applicable in all cases.

From working cabs and cabs combined for work and travelling/running, as well as from permanent work places outside of cabs, operators shall have a direct or indirect view, e.g. by means of a monitor in accordance with EN ISO 16001:2017, of the working tools that they control and along the track as far as needed for safe operation. This includes that the operator shall have direct or indirect visibility of any part of the track where persons can be endangered during intended use, and as far forward as necessary to stop before an obstacle. Camera-monitoring systems for indirect view shall fulfil the requirements according to EN 14033-3:2017, Annex D. The working tools and working area shall be in visibility sector A as far as technically possible and otherwise in visibility sectors B and C in accordance with ISO 5006:2017, Figure 2 and Table 1.

5.4.6.2 In running mode

Where the machine has a running mode, the track and signals shall be visible by the driver and assistant by direct line of sight when in running mode. From the driver's seated position and the assistant's seated position the following shall be visible by direct line of sight:

- signals, a maximum of 6,3 m above rail level, from 10 m and beyond in front of the machine and at a distance up to 2,5 m on either side of the centre line of the track, along a straight track and on a curve having a minimum radius of 300 m. This area of visibility is based on an eye level of between 740 mm to 855 mm above the seat level.

Some Infrastructure Managers may permit machines in running mode with a maximum speed < 20 km/h, for the driver to have visibility in the direction of movement provided by CCTV as set out in 5.4.6.3 and 5.4.6.4.

From the driver's seated position and the assistant's seated position the following should be visible:

- signals at rail level, from 15 m and beyond from the front of the machine and at a distance up to 1,75 m on either side of the centre line of the track, along a straight track and on a curve having a minimum radius of 300 m based on an eye level of between 740 mm to 855 mm above the seat level; but it is permitted to stand up and move around to achieve the required sighting.

Obstacles are acceptable providing that they do not cover the area of visibility if the driver or assistant makes a horizontal movement of 0,4 m.

5.4.6.3 In travelling mode

The track and signals shall be visible from the driving position by direct line of sight when travelling. If such visibility is not achievable in reverse direction because of the physical design of the machine, then:

- closed circuit television (CCTV) shall be provided in the cab with field of view both in the immediate vicinity of the rear of the machine and into the distance along the track sufficient to be able to stop clear of any obstruction when travelling at maximum speed.

Where the view along the track in the direction of movement is achieved by the use of CCTV then because of local conditions the Infrastructure Manager may require lower maximum speeds.

and:

- where technically possible a working place shall be provided for an assistant (provided with controls at that position for stopping the movement of the machine and for sounding a warning), who has sufficient visibility by direct line of sight to be able to stop from maximum speed clear of any track obstruction. If the working place is a standing position it shall meet the requirements of 5.6;

For machines the following shall be visible, in the direction of travel, from the driver's seated position or the assistant's positions or by CCTV:

- signals at rail level, from 15 m and beyond from the front of the machine and at a distance up to 1,75 m on either side of the centre line of the track, along a straight track and on a curve having a minimum radius of 300 m;
- signals, a maximum of 6,3 m above rail level, from 10 m and beyond in front of the machine and at a distance up to 2,5 m on either side of the centre line of the track, along a straight track and on a curve having a minimum radius of 300 m.

The use of CCTV for travelling might not be permitted by some Infrastructure Managers.

This area of visibility is based on an eye level of between 740 mm to 855 mm above the seat level. Narrow obstacles are acceptable providing that they do not cover the area of visibility if the driver or assistant makes a horizontal movement of 0,15 m.

For machines designed for shunting some Infrastructure Managers may allow different working procedures (such as shunting radios).

5.4.6.4 In working mode

In working mode the operator shall have a clear view of the work being undertaken and where this cab also controls movement along the track, including cabs on rotating superstructures in all possible rotated positions:

- sufficient forward visibility by direct line of sight to be able to stop clear of any obstruction when moving along the track at maximum working mode speed, measured in accordance with ISO 5006:2017, the track shall be in the visibility sector A according to ISO 5006:2017, Table 1;

or

- closed circuit television (CCTV) shall be provided in the cab with field of view both in the immediate vicinity around the machine and into the distance along the track sufficient to be able to stop clear of any track obstruction when moving along the track at maximum working mode speed defined by the manufacturer for the work to be performed, where the camera-monitoring system with the monitor placed in the view of the operator meeting the requirements of EN 14033-3:2017, Annex D.

or

- an active system, for example an ultrasonic detection system meeting the requirements of EN 14033-3:2017, Annex E, shall be placed at each machine end which shall stop the movement, if persons or obstacles in the movement area are detected and before they are reached;

or

- a working place shall be provided for an assistant (provided with controls at that position that stop the movement of the machine and sound a warning) who has sufficient forward visibility by direct line of sight to be able to stop clear of any track obstruction when moving along the track at maximum working mode speed together with either CCTV or an active system (as specified in the previous two bullet points);

or

- with using remote control, with the speed limited to 5 km/h.

5.4.6.5 View from driving/operating cab of machines intended for use on urban rail

In addition the viewing area shall be arranged according to the operational conditions. The driver can expect obstacles or persons in the direction of movement therefore a direct view on the complete area directly before the machine shall be ensured. This requirement is fulfilled if the parallel contour 1,2 m above top of rail at a distance of 0,3 m from the front of the machine, e.g. front side of coupling, is directly visible over the complete width of the machine by the driver.

With the machine in travelling mode the track and signals shall be visible from the driving position by direct line of sight when moving forwards. If such visibility is not achievable in reverse direction because of the physical design of the machine, then:

- closed circuit television (CCTV) shall be provided in the cab with field of view both in the immediate vicinity of the rear of the machine and into the distance along the track sufficient to be able to stop clear of any obstruction when travelling at maximum speed;

and

- where technically possible a working place shall be provided for an assistant (provided with controls at that position for stopping the movement of the machine and for sounding a warning), who has sufficient visibility by direct line of sight to be able to stop from maximum speed clear of any track obstruction. If the working place is a standing position it shall meet the requirements of 5.6.

Where the view along the track in the direction of movement is achieved by the use of CCTV then the Urban Rail Manager may require lower maximum speeds.

NOTE Running with a CCTV system only could be prohibited by the Urban Rail Manager. An exception could be when the machine is also equipped with a train control system and no other obstacles as detectable by the train control system will be encountered.

5.4.7 Windows

5.4.7.1 General

Where windows are fitted, the requirements of this clause shall be applicable in all cases.

5.4.7.2 Windscreens

Except as shown below windscreens shall be in accordance with EN 14033-1:2017, 14.3.4.

Category 9 machines, equipped with road standard laminated glass windscreens (e.g. ECE-R 43), shall be considered acceptable.

5.4.7.3 Side windows

Except as shown below side windows shall be made of safety glass with a minimum thickness of 6 mm, road standard laminated glass (e.g. ECE-R 43) or provide equivalent protection.

Where side windows do not comply with the above the manufacturer shall state the permitted adjacent track line speed taking into account air pressure inside tunnels, impact damage, etc. assuming a track spacing of 4 m. There shall be a notice "Not to work adjacent to tracks open to traffic at line-speeds greater than x km/h" displayed on the side of the machine and detailed in the instruction handbook, see 8.2.2, f) – where x is the speed limited by design and specified by the manufacturer.

5.4.7.4 Protection from sun

The driver and assistant shall be protected against solar radiation by means that shall not change the perception of the signal colour. It is permitted to provide an adjustable opaque sun visor to fulfil this purpose.

5.4.7.5 Deterioration of view

Deterioration of the view of the track or working areas due to dust, rain, dew, snow or ice shall be prevented by means of:

- gutters and drains;
- windscreen wipers with interval control;
- windscreen washers;
- demisters;
- defrosting equipment.

If the heating system referred to in 5.4.5 is insufficient to defrost windows, working cabs shall be equipped with a system for defrosting the windows used for the observation of work tools and during travelling. Where systems for defrosting of windows are fitted they shall be tested in accordance with the requirements of ISO 10263-5:2009.

The area of the windows to be defrosted shall be determined by the manufacturer in order to meet the requirements of 5.4.7 of this document.

5.4.8 Storage for documents and equipment

In at least one of the working cabs shall be a storage place, eg container, for required documents for operation, instruction handbook and for the required equipment by the Infrastructure Manager. The container or the working cab shall be lockable. Where there is insufficient space in the working cab, or no cab, it is permissible for the container to be fitted at the chassis and shall be weather-proof.

5.5 Seats

5.5.1 Seats for the operator(s)

Machines with provision for a seated operator(s) shall be fitted with adjustable seats that support the operator(s) in a position which allows them to control the machine under intended operating conditions.

The seat dimensions shall be in accordance with ISO 11112:1995.

All adjustments to accommodate the operator's size shall be in accordance with ISO 11112:1995, Table 1 and be adjustable without the use of any tool.

NOTE Requirements related to vibration on operator's seat are defined in 5.22 of this document.

5.5.2 Additional seats

All personnel riding on the machine shall have either a fixed seat or platform position as specified in 5.6. Additional seats shall be firmly secured.

Where the manufacturer intends the seat to be used for prolonged periods (occupied for $\geq 50\%$ of time), for example where used by an assistant, the seat shall meet the requirements of 5.5.1.

Notices indicating the maximum permitted number of persons allowed to travel shall be posted in every cab.

5.6 Standing places

5.6.1 General

Where it is technically required standing places shall be provided on the machine for operation, observation or for frequent maintenance. These standing places shall have minimum dimensions and guard rails as specified in EN ISO 2867:2011 or for MEWPs as specified in EN 280:2013+A1:2015.

5.6.2 Risk of falling

Standing working places on the machine used for operation, observation or for frequent maintenance shall have minimum dimensions of length 500 mm, and width 350 mm. Standing places shall be fitted with guard rails compliant with the requirements of EN ISO 14122-3:2016, Clause 7 and 8.2, or, if it is not possible to fit guard rails, restraint anchor points in accordance with EN 280:2013+A1:2015 shall be provided for the use of personal protective equipment to prevent falls.

Working places shall include all areas where it is reasonably foreseeable for regular maintenance or intervention work to be undertaken, for example in the area of conveyors, hoppers, etc.