BS EN 15955-2:2013

BSI Standards Publication

Railway applications — Track — Demountable machines and associated equipment

Part 2: General safety requirements

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National foreword

This British Standard is the UK implementation of EN 15955-2:2013.

The UK committee draws users' attention to the distinction between normative and informative elements, as defined in Clause 3 of the CEN/CENELEC Internal Regulations, Part 3.

Normative: Requirements conveying criteria to be fulfilled if compliance with the document is to be claimed and from which no deviation is permitted.

Informative: Information intended to assist the understanding or use of the document. Informative annexes do not contain requirements, except as optional requirements, and are not mandatory. For example, a test method may contain requirements, but there is no need to comply with these requirements to claim compliance with the standard.

When rounded values require unit conversion for use in the UK, users are advised to use equivalent values rounded to the nearest whole number. The use of absolute values for converted units should be avoided in these cases. For the values used in this standard:

4 km/h has an equivalent value of 3 mile/h
5 km/h has an equivalent value of 3 mile/h
20 km/h has an equivalent value of 10 mile/h
25 km/h has an equivalent value of 15 mile/h
160 km/h has an equivalent value of 100 mile/h
200 km/h has an equivalent value of 125 mile/h

In 'Table 6 — Stopping distances' the following equivalent values should be used:

8 km/h has an equivalent value of 5 mile/h
16 km/h has an equivalent value of 10 mile/h
24 km/h has an equivalent value of 15 mile/h
32 km/h has an equivalent value of 20 mile/h
40 km/h has an equivalent value of 25 mile/h

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 secretary.

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

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This European Standard was approved by CEN on 10 February 2013.

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Foreword

This document (EN 15955-2:2013) 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 October 2013, and conflicting national standards shall be withdrawn at the latest by October 2013.

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

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 15955, *Railway applications — Track — Demountable machines and associated equipment,* consists of the following parts:

— *Part 1: Technical requirements for running and working*;

— *Part 2: General safety requirements* (the present document).

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard is a type C standard as stated in EN ISO 12100.

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

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.

1 Scope

This European Standard specifies the technical requirements to deal with the significant hazards, hazardous situations and events, common to demountable machines, as defined in EN 15955-1:2013, intended for construction, maintenance inspection of the railway infrastructure, shunting and emergency rescue vehicles.

This European Standard specifies the technical requirements to deal with the common hazards during transport, assembly and installation, commissioning, running on track, use including setting, programming, and process changeover, operation, cleaning, fault finding, maintenance and de-commissioning of the machines when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer; see Clause 4.

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

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

— excavation;

— ballast tamping, ballast cleaning, ballast regulating, ballast consolidating;

— track renewal;

— rail maintenance;

— craning;

— catenary renewal / maintenance;

— maintenance of the components of the infrastructure;

— inspection and measurement of the components of the infrastructure;

— tunnel inspection / ventilation;

— shunting;

— emergency rescue and recovery;

during commissioning, use, maintenance and servicing.

This European Standard applies to self-propelled machines that are not intended to operate signalling and control systems. Other similar machines are dealt with in other European Standards; see Annex D.

It is assumed that a finished standard automotive chassis used as a host for a demountable machine will offer an acceptable safety level for its designed functions before conversion. This specific aspect is not dealt with in this European Standard.

This European Standard does not deal with:

a) requirements with regard to the quality of work and the performance of the machine;

b) machines that utilise the catenary for traction purposes;

c) specific requirements established by a railway infrastructure manager;

d) negotiations between the manufacturer and the machine operator for additional or alternative requirements;

e) hazards due to air pressure caused by the passing of high-speed trains at more than 200 km/h;

f) requirements which could be necessary in case of use in extreme conditions, such as:

1) extreme ambient temperatures (below − 20 °C or above + 40 °C);

2) highly corrosive or contaminating environment, e.g. due to the presence of chemicals;

3) potentially explosive atmospheres.

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

2 Normative references

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

EN 280, *Mobile elevating work platforms — Design calculations — Stability criteria — Construction — Safety — Examinations and tests*

EN 349, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 474-1:2006+A1:2009, *Earth-moving machinery — Safety — Part 1: General requirements*

EN 547-1, *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, *Safety of machinery — Human body measurements — Part 2: Principles for determining the dimensions required for access openings*

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

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

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

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

EN 619, *Continuous handling equipment and systems — Safety and EMC requirements for equipment for mechanical handling of unit loads*

EN 620, *Continuous handling equipment and systems — Safety and EMC requirements for fixed belt conveyors for bulk materials*

EN 842, *Safety of machinery — Visual danger signals — General requirements, design and testing*

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

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

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

EN 953, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

EN 981, *Safety of machinery — System of auditory and visual danger and information signals*

EN 1032, *Mechanical vibration — Testing of mobile machinery in order to determine the vibration emission value*

EN 1037:1995+A1:2008, *Safety of machinery — Prevention of unexpected start-up*

EN 1088, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

EN 1837, *Safety of machinery — Integral lighting of machines*

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

EN 12999, *Cranes — Loader cranes*

EN 13000, *Cranes — Mobile cranes*

EN 13001-1, *Cranes — General design — Part 1: General principles and requirements*

EN 13135-1:2003+A1:2010, *Cranes — Equipment — Part 1: Electrotechnical equipment*

EN 13135-2:2004+A1:2010, *Cranes — Equipment — Part 2: Non-electrotechnical equipment*

EN 13478:2001+A1:2008, *Safety of machinery — Fire prevention and protection*

EN 13557, *Cranes — Controls and control stations*

EN 14033-1:2011, *Railway applications — Track — Railbound construction and maintenance machines — Part 1: Technical requirements for running*

EN 14033-2:2008+A1:2011, *Railway applications — Track — Railbound construction and maintenance machines — Part 2: Technical requirements for working*

EN 15955-1:2013, *Railway applications — Track — Demountable machines and associated equipment — Part 1: Technical requirements for running and working*

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

EN 50153:2002, *Railway applications — Rolling stock — Protective provisions relating to electrical hazards*

EN 50239, *Railway applications — Radio remote control system of traction vehicle for freight traffic*

EN 60204-1:2006,[1)] *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

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1) This document is impacted by the amendment EN 60204-1:2006/A1:2009.

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

EN 60529, *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*

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

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

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

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

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

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

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

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

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)*

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

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

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

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

EN ISO 6682, *Earth-moving machinery — Zones of comfort and reach for controls (ISO 6682)*

EN ISO 7096:2008, [2)] *Earth-moving machinery — Laboratory evaluation of operator seat vibration (ISO 7096:2000)*

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

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)*

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2) This document is impacted by the corrigendum EN ISO 7096:2008/AC:2009.

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

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

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

EN ISO 13850, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

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

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

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

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

ISO 3864 (all parts), *Graphical symbols — Safety colours and safety signs*

ISO 4305, *Mobile cranes — Determination of stability*

ISO 4310, *Cranes — Test code and procedures*

ISO 5006:2006,[3)] *Earth-moving machinery — Operator's field of view — Test method and performance criteria*

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

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

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

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

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

ISO 10567, *Earth-moving machinery — Hydraulic excavators — Lift capacity*

ISO 11112:1995,[4)] *Earth-moving machinery — Operator's seat — Dimensions and requirements*

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3) This document is impacted by the corrigendum ISO 5006:2006/Cor 1:2008.

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010, EN 15955-1:2013 and the following apply.

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
working place
driving cabs, working cabs, combined working and driving cabs, operator positions situated outside cabs and places situated at control or maintenance locations including areas for conveyance of personnel

3.3
continuous brake
brake used in dynamic conditions, for which the brake force can be infinitely varied, or stepped, by the operator using a control to simultaneously apply brakes on all connected vehicles

3.4
parking brake
brake capable of operation and function without power from the machine

3.5
rated capacity indicator
RCI
device which gives, within specified tolerance limits, at least a continuous indication that the rated capacity is exceeded

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

3.6
machine operator
private or public undertaking who operates machines for the construction and maintenance of the infrastructure

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 European Standard, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

4) This document is impacted by the amendment ISO 11112:1995/Amd 1:2001.

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 for relevant but not significant hazards, which are not dealt with by this European Standard.

This standard gives the general/common requirements for demountable machines. Specific machines, such as cranes, shall comply with relevant standards for these specific machines as modified by the requirements of this standard.

When a standard for the specific machinery is not available or does not fully cover the significant hazards, the manufacturer should carry out a complete risk assessment to identify the specific hazards for the particular machine and the corresponding protective measures that may be required. These additional hazards and requirements will be outside the scope of this standard.

Requirements for specific machinery functions are given in for example:

— For “road” earth moving machinery: series EN 474;

— For cranes: EN 13001-1;

— For cranes on trucks: EN 12999;

— For mobile cranes: EN 13000;

— For mobile elevating work platforms: EN 280.

Where there is a conflict between the requirements of this European Standard and another European Standard, then this standard shall take precedence.

Where this European Standard requires the application of type B standards (e.g. EN 60204-1, EN ISO 4413, EN ISO 4414) but the applicable specific requirements are not identified, the manufacturer shall carry out a risk assessment to determine which requirements apply.

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 European Standard),

or

— this European Standard.

It is assumed that a finished standard automotive chassis used as a host for a demountable machine will offer an acceptable safety level for its designed functions before conversion. This specific aspect is not dealt with in this European Standard and in this case the manufacturer shall carry out an appropriate risk assessment.

5.2 Access and egress to and from working places

5.2.1 Cabs

Except as shown below where a demountable machine is fitted with driving cabs, working cabs and/or combined working and driving cabs access and egress, when on the track, this 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 this requirement and access is only available from one side of the machine then the instruction handbook shall detail the restriction of use; see 8.2.1 (26).

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 demountable machine open to rail traffic shall be provided to prevent people leaving the machine on the side open to traffic by mistake e.g. a door with a latch, a chain and hook. 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 the host vehicle they shall:

— 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;

— not project beyond the loading gauge when open;

— make opening quickly and easily possible by the design and position of the door handles, but the design should prevent unintentional opening of the door. The door handles shall be easily accessible and ergonomically shaped and safe;

— be possible, without difficulty, to open and close 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 1 500 mm above rail level or step level where this is provided to gain access. An additional handle shall be provided at a height of 700 mm to 1 100 mm above the cab floor level;

— the door opening shall comply with the requirements of EN ISO 2867.

Where doors which are part of the host vehicle do not comply with the clause above, a note shall be made in the instruction manual; see 8.2.1 (25).

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

Where reasonably practical, working places shall be positioned within the machine running gauge, as defined in EN 14033-1:2011, Annex C.

Where it is not reasonably practical 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 (25). In addition, a fixed warning notice according to 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 8.2.1 (26).

5.2.3 Walkways on the machine

Where fitted, the walkways on the machine shall have a minimum width of 500 mm and a headroom of 2 000 mm free of obstacles. Floors shall not present a tripping hazard and their coverings shall be anti-slip in conformance with the requirements of EN ISO 14122-2.

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

5.3 Ergonomics

Machines shall be designed according to the principles of EN 614-1 and EN 614-2.

5.4 Requirements for cabs

5.4.1 General

Except as shown below, all demountable machines shall be fitted with an enclosed cab.

It is permitted for all type C machines and also type A and type B machines of gross laden weight less than 3,5 t, and where the environmental conditions allow, to be exempt from the mandatory requirements of 5.4, except 5.4.6 and 5.4.7; however it is recommended that the requirements are met as far as reasonably practicable.

5.4.2 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.

For cabs with limited headroom (measured from the seat index point, as specified in EN ISO 5353, to the roof) caused by technical requirements, the minimum space envelope height (dimension R_1 according to EN ISO 3411:2007, Figure 4) is permitted to be reduced to 920 mm.

The minimum space and location of the controls at the operator's station shall meet the requirements specified in EN ISO 6682.

5.4.3 Cab floors

The floor of cabs shall be constructed in conformance with the requirements of EN ISO 14122-2.

5.4.4 Emergency exit

An alternative opening as emergency exit shall be provided as specified in EN 474-1:2006+A1:2009, 5.3.2.4.

5.4.5 Climatic conditions in cab

Where an enclosed cab is fitted, this sub-clause shall be applicable in all cases.

Cabs shall protect the operator against foreseeable adverse climatic conditions.

Cabs shall be thermally insulated and shall be equipped with an adjustable heating and ventilation system, which, if not already fitted to the host vehicle the system, shall be according to EN 474-1:2006+A1:2009, 5.3.2.6.

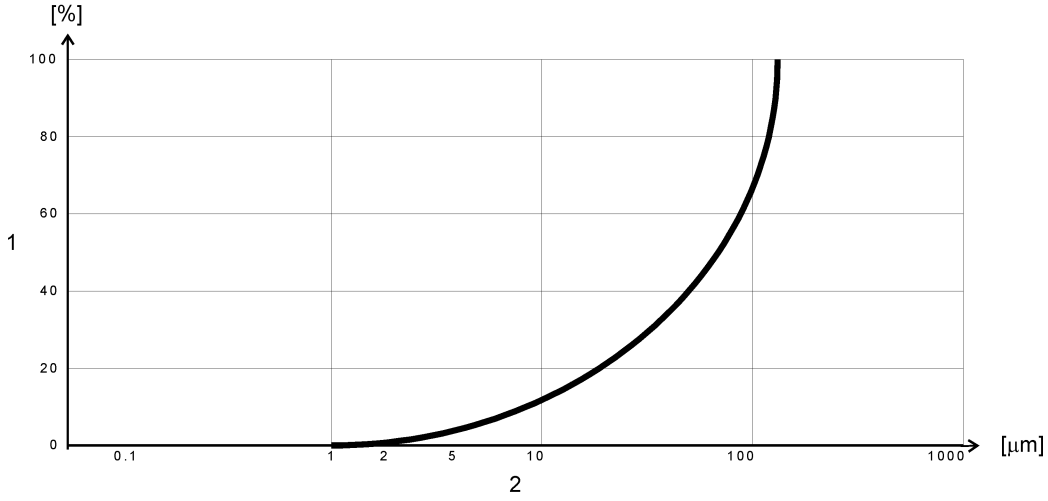
The doors and windows shall protect against rain, exhaust gases and wind. Where fitted, pipes, cable ducting, and valves shall not compromise this requirement.

5.4.6 Protection from dust

Where practicable, machines with devices that grind rails, transfer ballast or work on the formation shall have the permanent places of work in enclosed cabs. These cabs shall be equipped with devices to prevent the ingress of dust. Where it is not practicable to provide cabs, dust, sparks etc shall be directed away from any possible position where personnel need to be, and personal protective equipment (PPE) identified and stated in the instruction handbook; see 8.2.1, 2).

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 95 % of dust, as specified below, into the cab; this particle filter shall be tested according to ISO 10263-2.

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



Key

1 percentage by weight
2 particle diameter

Figure 1 — Distribution of particle size of dust used in filter selection

The ventilation system shall be capable of providing the cab with filtered fresh air at the minimum of 60 m^3 per person per hour, with a minimum of 120 m^3/h.

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

5.4.7 Visibility from driving position

5.4.7.1 General

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

From working cabs and cabs combined for work and 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 ISO 16001, 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. 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 5006:2006, Table 1.

5.4.7.2 In running configuration

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

— 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 clear of any track obstruction. If the working place is a standing position, it shall meet the requirements of 5.6.

or

— 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. The camera/screen shall be capable of distinguishing between red, yellow and green lights in all lighting conditions. Where the view along the track in the direction of movement is achieved by the use of CCTV then the machine shall be designed so as to limit the speed to not greater than 20 km/h.

The infrastructure manager may require lower maximum speeds for particular applications.

For type A and type B demountable machines, the following shall be visible, in the direction of travel, from the driver's and the assistant's seated positions:

— signals at track 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 down to a curve having a 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 down to a curve having a 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. 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).

5.4.7.3 In working configuration

In working configuration, the operator shall have a clear view from the cab of the work being undertaken and, where this cab also has controls for movement along the track,

— 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 configuration speed, measured in accordance with ISO 5006. The track shall be in visibility sector A according to ISO 5006:2006, Table 1;

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 configuration speed;

or

— closed circuit television (CCTV) shall be provided in the cab with a 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 track obstruction when travelling at maximum working speed defined by the manufacturer for the work to be performed. The camera/screen shall be capable of distinguishing between red, yellow and green lights in all lighting conditions. Where the view along the track in the direction of movement is achieved by the use of CCTV then the machine shall be designed so as to limit the speed of the machine to not greater than 20 km/h.

The infrastructure manager may require lower maximum speeds for particular applications,

or

— devices, e.g. ultrasonic devices, shall be placed at each machine end which stop the movement, if persons or obstacles in the movement area are detected;

or

in the event of technical impossibility of all the preceding choices:

— means of communication with another operator on the ground to control movement along the track in conjunction with the operator, with the speed limited to 4 km/h.

5.4.8 Windows

5.4.8.1 General

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

5.4.8.2 Windscreens

Except as shown below, windscreens shall comply with EN 14033-1:2011, 14.3.4.

Demountable machines equipped with a road standard windscreen, e.g. ECE R 43, are not permitted to work on lines with adjacent lines open to traffic at line speeds greater than 160 km/h. They shall be labelled "not to work adjacent to lines open to traffic at line speeds greater than 160 km/h", the labels being displayed on both sides of the machine and detailed in the instruction handbook, see 8.2.2 (6). Alternatively, the manufacturer shall state the permitted adjacent 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 lines 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 (6), where *x* is the speed decided by the manufacturer.

5.4.8.3 Side windows

Except as shown below, side windows shall be made of safety glass with a minimum thickness of 6 mm or provide equivalent protection.

Where side windows comply with road standards the manufacturer shall state the permitted adjacent line speed taking into account air pressure inside tunnels, impact damage etc, assuming the typical minimum track spacing in the infrastructure or country where the machine is to be used. There shall be a notice "Not to work adjacent to lines 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 (6), where *x* is the speed decided by the manufacturer.

5.4.8.4 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.

5.4.8.5 Deterioration of view

Deterioration of the view of the track or working area 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. Where systems for defrosting of windows are fitted, they shall be tested in accordance with the requirements of ISO 10263-5.

NOTE The area of the windscreen to be defrosted is determined by the manufacturer in order to meet the requirements of 5.4.7 of this European Standard.

5.4.9 Storage for instruction handbook

A space intended for the safekeeping of the instruction handbook shall be provided in at least one of the working cabs of each machine. The working cab shall be lockable or the storage space shall be lockable.

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.

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

Operator seats shall be in accordance with EN ISO 7096:2008, 1.2.2, spectral class EM6 with regard to its ability to reduce the vibration transmitted to the operator.

NOTE Requirements related to vibration at operator seats are contained in 5.22 of this European Standard.

5.5.2 Additional seats

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

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

5.6 Standing places

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.

5.7 Edges and corners

The radius of edges and corners in working places shall be in accordance with the requirements of ISO 12508.

5.8 Pipes and hoses

Pipes and hoses in working cabs and other permanent working places, outside of cabins shall be avoided as far as technically possible. If connections and hoses at these places are closer than 1 m to the normal operator position and contain fluids that are at a pressure greater than 50 bar or temperature greater than 60 °C, guards without openings shall be provided.

5.9 Communications between work positions

Where working cabs and cabs combined for both work and travel, as well as permanent work places outside of cabs are designed for simultaneous occupation, they shall have a means of voice communication with each other, e.g. intercom.

5.10 Prevention of derailment

5.10.1 General

The manufacturer shall ensure by design that the machine does not derail when it is in rail configuration in its intended use. This shall be verified by calculation or testing.

NOTE A method of testing is given in EN 15955-1:2013, 5.4.

Prevention of derailment calculations and testing shall assume that all tanks containing consumable fluids are in their least favourable condition, and all moveable components are in their least favourable position.

5.10.2 Lifeguards

Type A and type B machines shall be equipped with lifeguards at both ends in front of the outer axles. They shall be installed such that at all possible conditions of suspension movement and wheel wear the lifeguard retains a clearance of 15 mm to 30 mm from the top of the rail.

It is permissible for type C machines to have lifeguards fitted.

5.11 Stability and measures preventing overturning

5.11.1 Proof of stability against overturning, machine stationary

5.11.1.1 General

Stability shall be provided under all intended operating conditions, as specified by the manufacturer in the instruction handbook, see 8.2.4.

If a machine has a structure that can move and influence the static stability, then the proof of stability shall be established by calculation and if necessary by testing as specified in the following subclauses. This includes demountable cranes, cranes fixed to the machine and other types of machines, including excavators when used for lifting, which may have their centre of gravity displaced or where the wheels can be unloaded. In considering the stability of a machine, the tests and/or calculations shall be considered with respect to the assembled machine in working configuration and not to any individual component or sub-assembly of the machine. Stationary in this context means that the machine is working but not moving along the track and the rail wheels shall be braked.

For all machines, overturning stability calculations and testing shall assume that all tanks containing consumable fluids are in their least favourable condition, and all moveable components are in their least favourable position.

5.11.1.2 Conditions for stationary stability

A machine is considered stable if, in the most unfavourable structural position, loading and track conditions, the centre of gravity does not cross the tipping line as specified in ISO 4305 and ISO 10567.

5.11.1.3 Load cases for calculating stability

The calculations required in 5.11.1.1 shall be made with the machine on the worst-case combination of track cant, twist and gradient, according to EN 14033-2:2008+A1:2011, Annex F.

The calculations shall be made in accordance with the requirements of:

— EN 280 for mobile elevated work platforms;

— EN 12999 for loader cranes;

— EN 13000 for mobile cranes.

All other machines to be calculated using overturning loads given in Table 1. Tests shall be as specified in ISO 4305.

Table 1 — Load cases for calculating stability (cranes)

Loadcase	Use of machine	Overturning load	Unloaded side
With stabilisers	On track	1,25 *P* + 0,1 *F*	Residual wheel / stabiliser load at unloaded side > 15 % machine weight
Free on wheels	On track	1,33 *P* + 0,1 *F*	
Backward stability	On track, no load on hook and loose lifting equipment, including pulley block on ground		
P = Maximum allowed load *F* = Equivalent mass of jib, lifting ropes and pulley block			

In addition, at the most unfavourable track condition, with a maximum load of 1,0 *P* no wheel shall unload by more than 60 % of its normal load.

5.11.1.4 Rail clamps and stabilisers

Clamping onto the rail is not allowed and thus overturning stability shall be achieved without consideration of any clamping of the machine to the track. The machine shall be designed such that any stabilisers (if part of the design) can be used without coming into contact with the sleepers or rails.

5.11.1.5 Requirement for testing

If the calculated safety factor (ratio of stabilising moment to overturning moment) is ≥ 2 in all positions of the machine with the most unfavourable track conditions, it is not necessary to prove stability by testing. If the safety factor is < 2, testing shall be carried out in accordance with 5.11.1.6.

5.11.1.6 Proof of stability by test

5.11.1.6.1 General

Except as specified in 5.11.1.5 testing is required. All the possibilities of movement and unfavourable positions of the machine and load, and most unfavourable combination of track cant, gradient and twist shall be considered, as defined in EN 14033-2:2008+A1:2011, Annex F.

The testing shall be made in accordance with the requirements of the following standards as applicable:

— EN 280 for mobile elevated work platform;

— EN 12999 for loader crane;

— EN 13000 for mobile crane;

— EN 13001-1 for cranes.

All other machines shall either be proof load tested or absolute load tested as shown in 5.11.1.6.2 or 5.11.1.6.3.

5.11.1.6.2 Proof load testing

Machines shall be tested in accordance with ISO 4310, by load testing in accordance with Table 2.

Table 2 — Load cases for testing prevention of overturning

Working configuration	Load conditions	Standard	Proof load
Proof load with or without stabilisers	Static	ISO 4310	1,25 *P*
P = Maximum allowed load, including lifting accessories, in accordance with EN ISO 12100			

If the test load given in Table 2 cannot be achieved on the most unfavourable track conditions, it is permitted to use more favourable values of track cant and gradient, however in this case a notice shall be displayed on the machine indicating the maximum cant and gradient on which the machine is permitted to be used. Such limitations that need to be placed on the operation of the machine to ensure safety, and stability shall be clearly defined in the instruction handbook; see 8.2.4.

5.11.1.6.3 Absolute load testing

Stability shall be proved by tests. All the possibilities of movement and unfavourable positions of the machine and load, and most unfavorable combination of track cant, twist and gradient shall be considered. The machine shall lift an increasing load or pull against a fixed object until the rail wheels start to lift from the track. The rated load in each position is either 90 % of the load that causes the first rail wheel to leave the track or 75 % of the load that causes the second rail wheel to leave the track, whichever is the less.

Sufficient tests shall be carried out to develop a rated lift capacity chart.

5.11.2 Prevention of derailment during running and when moving along the track in working configuration

5.11.2.1 General

When moving along the track in running and working configurations, a machine shall have all rail wheels loaded sufficiently to avoid derailment.

5.11.2.2 Verification of prevention of derailment

5.11.2.2.1 General

In addition to the testing set out in 5.10.1, a machine that has moving parts that can influence the potential of the machine to derail shall have additional verification according to either 5.11.2.2.2 or 5.11.2.2.3 as appropriate.

5.11.2.2.2 Machines with only one suspension arrangement when stationary and moving along the track

The safety against derailment in the foreseen working conditions is deemed to be proven when the following conditions are observed simultaneously:

— on a level track without super elevation, the relative unloading of the guiding wheel of the machine is ≤ 20 %;

— the height of the centre of gravity of the machine from the head of the rail is ≤ 2,20 m;

— the suspension is not blocked out or the machine has a three-point suspension where at least one of the three support points can turn freely and absorb the twist or the machine including the wheelsets is flexible enough to absorb the track twist;

— there is no rigid connection between several connected machine parts that would obstruct the turning freedom or the free movement in vertical and cross-wise direction within the freedom of movement necessary for the threshold parameters between the machine parts.

If one of these conditions is not observed, the proof of derailment safety shall be achieved by stationary tests according to 5.11.2.3.

5.11.2.2.3 Machines with different axle and suspension arrangement when stationary and moving along the track

For machines which have different axle or suspension configurations when stationary and when moving along the track, the proof of derailment safety shall be achieved by stationary tests taking into account the work configurations according to 5.11.2.3.

If the machine has a different axle or suspension configuration when stationary and when moving along the track, it shall not be possible to change from one configuration to the other if this would cause the load moment to reach or exceed 90 % of the rated load moment for the new configuration.

5.11.2.3 Load cases for prevention of derailment of lifting machines during moving along the track in working configuration

For demountable cranes, cranes fixed to the machine or other types of machines which may have their centre of gravity displaced, wheel unloading shall be proven by stationary tests. With all the possible unfavourable positions of the machine and load, and worst combination of track cant, gradient and twist, as defined in EN 14033-2:2008+A1:2011, Annex F, no rail wheel shall leave the rail when the maximum load given in Table 3 is applied.

Table 3 — Load cases for testing stability (cranes)

Load case	Use of machine	Proof load
Free on wheels	On track	1,50 P + 0,1 F
Tests according to ISO 4310 *P* = Maximum allowed load including lifting accessories according to EN ISO 12100 *F* = Equivalent mass on the jib, lifting ropes and pulley block		

In addition, at the most unfavourable track condition, with a maximum load of 1,0 *P* no wheel shall unload by more than 60 % of its wheel load before applying test load.

5.11.2.4 Limiting use of the machine due to derailment requirements

If the prevention of derailment is not guaranteed for all working configurations, the intended use of the machine shall be limited by appropriate measures and shall be indicated in the instruction handbook, see 8.2.2, 7), and displayed on notices on the machine.

5.11.3 Rated capacity indicator (RCI)

5.11.3.1 General

Demountable machines that are permitted to be used as cranes or lifting machines shall either have a load limiting device which prevents overload in all conditions, or shall have a rated capacity indicator (formerly known as the safe load indicator) fitted, which will indicate to the operator the rated load that can be lifted in

the current machine position (cant and gradient) and configuration of the machine. RCI shall be in accordance with EN 12077-2:1998+A1:2008, 5.3 and 5.5.

NOTE Additional design guidance is given in BS 7262:1990.

5.11.3.2 Indication of state of RCI

Where fitted, the RCI device shall be permanently operational when the machine is used for lifting a load. Where the machine has other functions than load lifting, it is permitted for the RCI to be switched off when not used for lifting by means of a key switch where the key can be removed with the RCI in operation. In both cases there shall be a continuous blue light fitted to the machine, visible externally from all sides of the machine, indicating when the RCI is operational.

The information for use shall indicate the occasions where the RCI is permitted to be switched off (in principle during emergency recovery or whilst an excavator is in digging configuration). The information shall reinforce the importance that the RCI is operational during lifting operations; see 8.2.1, 27).

5.11.3.3 Warning of impending overload

Where fitted with a RCI device, there shall be an audible and visual warning to the operator when the load reaches 90 % to 97,5 % of the rated load and the machine shall cease to continue lifting or increasing the load moment, when the load reaches 102,5 % to 110 % of the rated load. Where the 102,5 % has been reached, the machine shall still be capable of reducing the load moment.

The 90 % warning and 102,5 % movement lock shall operate for all movements, e.g. boom movements and turret rotation.

5.12 Emergency stopping devices

5.12.1 Emergency stopping devices for movement of the machine and working equipment

The manufacturer shall determine the number, the location and the effect of emergency stopping devices on the basis of his risk assessment. Emergency stopping devices shall be designed in accordance with EN ISO 13850 and be placed inside the working cabs and in the vicinity of working equipment on both sides of the machine.

5.12.2 Action of emergency stopping devices

The activation of any emergency stopping device shall always cause the braking system described in 5.24 to operate. The activation of any emergency stopping device located on the outside of a machine shall cause the brakes to apply and the machine to stop moving along the track within the distances shown in Table 6.

If an emergency stopping device does not act on all movements of the machine it shall be clear by marking close to the emergency stopping device which movements will be stopped and these shall be described in the instruction handbook; see 8.2.1, 4).

Where the risk assessment required in 5.12.1 shows the necessity to stop the engine, after stopping the engine by the activation of an emergency stopping device it shall still be possible to

a) lower any equipment (including lifting equipment) or load to a safe position and observe the equipment lowering from the operating position,

b) release the residual pressure in each hydraulic and pneumatic circuit, which can cause a risk of harm to persons.

The means to lower the attachment and the device to release the residual pressure shall be described in the instruction handbook; see 8.2.1, 29).

5.13 Moving parts and materials

The design shall ensure that during normal operation no persons are required to be in a dangerous area due to moving work equipment, e.g. tamping tools, conveyors and transfer tools for sleepers, ballast excavating chains and conveyor belts.

Inadvertent contact with moving parts, e.g. wheels, working devices, or moving material, sleepers shall not be possible. Crushing points shall be eliminated where possible by minimum gaps in accordance with EN 349. Accessible moving parts shall be guarded in compliance with the requirements of EN ISO 13857, EN 953 and EN 1088 as appropriate. If electro-sensitive protective equipment is used it shall be in accordance with EN 61496-1 and shall be positioned in accordance with EN ISO 13855. Guards or casing providing the function of a guard shall be removable only with the use of a tool. Whenever possible fixed guards, or casing providing the function of a fixed guard, shall be incapable of remaining in place without their fixings. The fixing system for fixed guards shall, when their removal is necessary for routine maintenance, be retained by fixings that are retained in the guard or machine when the guard is removed.

In addition to the lifeguards fitted in compliance with 5.10.2, the manufacturer shall make an assessment of the possibility for personnel to be in the vicinity of the area between the rail wheel and the machine. Where there is a risk of personnel being behind the rail wheel then lifeguards shall be fitted on both sides of each wheel or on both ends of a bogie.

Devices for elimination of foreseeable malfunctioning of work devices, e.g. jamming of the transfer tools for sleepers by a twisted sleeper, shall be constructed as far as technically possible so that the removal of the obstruction is possible without entering the danger zone. If it is necessary to enter the danger zone, e.g. to manually adjust a twisted sleeper, prevention of movement of work devices shall be assured by electro-sensitive protective devices according to EN 61496-1 whilst anyone is in the danger zone or by devices according to EN 1037:1995+A1:2008, 6.3.2 that prevent unexpected starting of the machine.

5.14 Operator’s controls and indicators

5.14.1 General requirement

Where the host vehicle is a road vehicle, it is assumed that controls and indicators in the host vehicle comply with the relevant European Standard for that road vehicle type. If these controls and indicators are in direct contradiction to as the requirements shown in 5.14.2 to 5.14.7, they shall be replaced or isolated when in rail configuration. In all other cases the following applies.

Other operator’s controls and indicators for working devices shall be in accordance with the requirements of EN 474-1:2006+A1:2009, 5.5.1, EN 894-1, EN 894-2, EN 894-3 and EN 61310-3.

Safety related parts of control systems shall meet the requirements of EN ISO 13849-1 with a performance level of at least c.

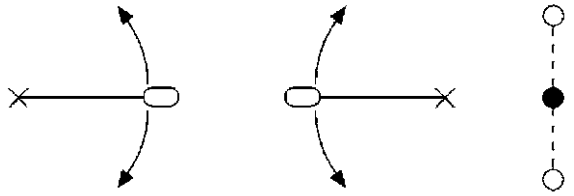
Where a machine does not have an enclosed cab, or controls are located on the outside of the machine, unauthorised use of the controls shall be prevented by locking of the operating levers, except for emergency stop commands, or disabling the function.

The controls shall be functionally grouped in a manner which minimises the risk of unintended operation or confusion. Except for emergency stops, emergency brakes and warning devices, where duplicate control positions are provided only one control position shall be active.

Those controls which are most frequently operated shall be arranged in areas that have optimum access.

Controls which need to be operated quickly in a dangerous situation shall be arranged in such a way that they can be operated correctly, even in the dark. The controls shall be indicated as to their use, preferably by pictograms, in accordance with ISO 7000, EN 61310-2 and ISO 6405-1, if applicable.

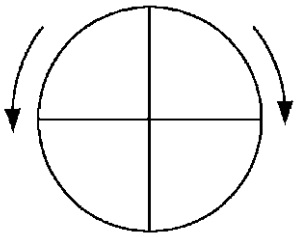
The movement of the controlled items shall correspond with the direction of movement of the controls shown in Figure 2.



Drive forwards
Increase tractive effort
Release brake

Drive backwards
Reduce tractive effort
Brake

Slow down
Drive backwards
Apply air brake
Release parking brake



Start
Accelerate
Drive forward
Release air brake
Apply parking brake

Figure 2 — Control directions

The designer shall limit the number of indication lamps and audible signals in the cab to avoid sensorial saturation of the operator by too many indications.

If the machine contains some functions concerning indicator lamps, these functions shall comply with the requirements of EN 61310-1 and Table 4.

If the machine contains some functions concerning audible signals, these signals shall comply with EN ISO 7731 and/or EN 981 and Table 4, and be clearly distinguishable from each other, the ambient noise and other warning signals.

Table 4 — Warning and display indications

Function	Visual indication (lamps, LED, VDU, etc.)	Siren	Display
Lift height limiter active	Green permanent light		
Slew limiter active	Green permanent light		
Approach to overload warning	Yellow permanent light	Buzzer for operator	
Over-ridden lift height limiter	Red flashing light	Buzzer Intermittent	
Over-ridden slew limiter	Red flashing light	Buzzer Intermittent	
Speed – in both directions of travel			Digital or analogue display
Brake pressure gauge			Double gauge

More than one message can be shown via the same indicator providing that the colour can be distinguished clearly.

5.14.2 Starting system

Starting systems for work devices, driving and combined movements for working and driving shall be in accordance with EN 474-1:2006+A1:2009, 5.5.2.

5.14.3 Inadvertent activation

To avoid inadvertent activation, controls shall meet the requirements of EN 474-1:2006+A1:2009, 5.5.3.

5.14.4 Pedals

Pedals shall meet the requirements of EN 474-1:2006+A1:2009, 5.5.4.

5.14.5 Protection against uncontrolled motion in working configuration

Movements of machine and equipment from a holding position, other than intended or by actuation of the controls by the operator, due to creep, e.g. by leaking or when the power supply stops, shall be prevented.

Controls for movements along the track shall be hold-to-run control devices as defined in EN ISO 12100:2010, 3.28.3.

Except as shown below, controls for working devices shall be hold-to-run control devices as defined in EN ISO 12100:2010, 3.28.3.

Controls for working devices with movements that are continually or automatically controlled are exempt from the above requirement.

If a control has a detent in a position allowing movement, there shall be a device to detect that the operator remains in position as long as the movement takes place, e.g. a seat contact switch could be used which stops the endangering movement if the seat is vacated.

Where the detection device has detected that the operator has left his operating position and then returned, it shall be necessary for an additional action before further movement can be initiated.

5.14.6 Control panels and indicators

Control panels shall be according to EN 474-1:2006+A1:2009, 5.5.8.1. Indicators shall be according to EN 474-1:2006+A1:2009, 5.5.8.2.

5.14.7 Remote controls

5.14.7.1 General

The machine is permitted to be moved and the working equipment operated by means of remote controls if additional safety measures are provided. As a minimum these shall include:

— deactivation of controls on the machine itself;

— remote controls that are carried shall be fail-safe (stop machine) when dropped, the operator falls over, or the machine moves out of range;

— remote controls for working equipment shall not affect safe operation of all functions of the working equipment, including the deliberate exceedance of movement limiting devices;

— overriding limiting devices shall not be possible from the remote control. The status of limiting devices that can be switched off shall be indicated on the remote control.

Operation of the machine shall be possible from one control panel at a time only. A remote control shall include both wireless devices and control boxes on wander lead/umbilical cords.

Wireless remote controls shall comply with EN ISO 12100:2010, 6.2.11.8.h and EN 60204-1:2006, 9.2.7.

5.14.7.2 Moving the machine along the track by remote control

During remote control operation:

— If the operator is travelling with the machine, the speed shall be limited by engineering means to a maximum speed of 25 km/h and complies with the requirements of EN 50239;

or

— if the remote control is operated by pedestrian the speed shall be limited by engineering means to 5 km/h and comply with the requirements of EN 13557.

For the application of EN 60204-1:2006, 9.2.7.3, the machine shall be brought to a standstill as quickly as possible without damage to the infrastructure.

5.15 Thermal hazards

To avoid burns on touchable parts of the machine at a temperature higher than the limits as specified in EN ISO 13732-1, the following shall apply:

— either such parts shall be insulated;

or

— touching of these parts of the machine shall be avoided with enclosing guards, e. g. perforated metal sheet in front of an exhaust, in accordance with EN 953 and EN ISO 13857;

or

where the above two options are not possible or not sufficient:

— warning pictogram to EN 61310-1 shall be provided adjacent to the area.

5.16 Electrical system

5.16.1 Electrical equipment

The electrical equipment shall be in accordance with all applicable clauses of EN 474-1:2006+A1:2009, 5.17, of EN 60204-1 or of EN 60204-32.

5.16.2 Disconnection devices

All machines electrical circuits shall be fitted with an isolation device, to avoid an unexpected start-up or electric shock; see EN 60204-1:2006, 5.4.

Each major electrical system shall be fitted with supply disconnection devices as specified in EN 60204-1:2006, 5.3 and 5.5.

5.16.3 Working environment

The manufacturer shall provide electrical enclosures appropriate for the intended use. The IP ratings shall be chosen in accordance with the requirements of EN 60529. Electrical equipment shall not be installed within contact of moving material where such contact would damage the equipment. For all electric components

arranged outside the machine or exposed directly to climatic influences, the minimum protection shall be IP 55 as specified in EN 60529.

If there is a risk by mechanical impact, the IK rating for the protection from mechanical impact shall be chosen in accordance with the requirements of EN 62262.

5.16.4 Conductors, cables and wiring practices

Identification of conductors and cables shall meet the requirements of EN 60204-1:2006, 13.2.

Wires/cables shall be protected from damage.

Electric wires/cables shall either not be arranged in the vicinity of inflammable materials including pipes and hoses containing fuel or if this is unavoidable, the wires/cables shall be protected in accordance with EN 60204-1:2006, Clauses 12 and 13.

The use of ducts and conduits shall be in accordance with EN 60204-1:2006, 12.6, 13.3 and 13.4.

Incorrect connections shall either be avoided by the design of the connectors or, if this is not possible, electrical wires and cables used to connect components in electrical circuits shall be marked and identified in accordance with EN 60204-1:2006, 13.2.

NOTE ISO 9247 gives guidance for marking and identification of electrical wires and cables.

5.16.5 Batteries

Batteries shall be firmly attached in a ventilated space. The location shall have an easy access. Batteries shall be easily removable. The batteries shall be provided with grips. Batteries and/or battery locations shall be designed or covered to minimise any hazard to the operator caused by acid vapours in areas occupied by operators or by ejection of battery acid caused by a tipping-over of the machine.

The pole not connected to the machine frame and associated connectors shall be covered with insulation material.

It shall be possible to disconnect batteries by an easily accessible device, e.g. an isolator switch.

5.16.6 Catenaries

Moving parts of a machine intended to work under a powered overhead catenary wire (including all possible movements on the track conditions shown in EN 14033-1:2011, Annex F) shall not be moved closer than a specified safety distance from the live electrified parts of the overhead traction system. The requirements are given in Table 5. Table A.1 of EN 15955-1:2013, gives the minimum height of the contact wire above rail level.

Table 5 — Safety distance between machine parts and catenary

Voltage (V)	**Minimum distance between machine parts and catenary (mm)**
≤ 3 000 DC	200
≤ 15 000 AC	300
> 15 000 ≤ 25 000 AC	600
DC = direct current AC = alternating current	

Control of this distance shall either be achieved as a result of the geometry of the machine or shall be achieved by movement limiting stops according to EN 15955-1:2013, 5.1.3.2.2.

A machine not fitted with movement limiting stops and which has parts that can infringe these distances is not permitted to work under live overhead equipment. An easily visible sign at the operating position stating "Not for use under live overhead equipment" shall be provided. The instruction handbook shall be endorsed with this restriction. The manufacturer shall decide the limitation of the machine and describe this in the instruction handbook; see 8.2.2 (3).

Where a demountable machine is fitted with an all-over metal roof, without open holes, suitably bonded to earth and the movable parts of the machine under all conditions of use (including on and off tracking) move greater than 600 mm from the catenary at all times, it shall be deemed suitable for use under live overhead line electrification equipment (catenary).

Where a demountable machine is not fitted with an all-over metal roof but is compliant with all the following conditions, it shall be deemed suitable for use under live catenary:

a) the machine is fitted with movement limiting stops, see EN 15955-1:2013, 5.1.3.2.2, to prevent any moveable part or load getting closer to any live part than the distances shown in Table 5 or the moveable parts of the machine under all conditions of use are at a distance greater than that shown in Table 5 from the live parts of the catenary at all times;

b) all access points to the superstructure and cab, or to platforms, work surfaces, footboards or steps are at or below a height above rail level defined in national conditions; see EN 15955-1:2013, Annex A, for the intended country of use of the machine.

The assessments for condition a) or b) shall be made assuming the lowest overhead wire height.

NOTE 1 Information on wire height is given in EN 15955-1:2013, Annex A.

Where the conditions in either section a) or section b) are not met, the machine is not suitable for operation under live catenary equipment and this limitation shall be stated in the instruction handbook, and shown on the machine identification plate shown in EN 15955-1:2013, Annex G.

Where a machine is deemed suitable for use under live catenary, the instruction handbook shall be endorsed with appropriate information.

NOTE 2 Normal practice is that the instruction handbook is endorsed as follows: "This machine is suitable for use under the live catenary when used in conjunction with a safe system of work determined and authorised following the requirements of the infrastructure manager".

Overhead live wires' warning notices according to EN 14033-2:2008+A1:2011, Figure G.1 shall be fixed adjacent to all access points to the superstructure and cab or to platforms, work surfaces, foot boards or steps above a height of 1 400 mm above rail level.

5.16.7 Equipotential bonding

All metallic parts of the machine shall be equipotential bonded and connected to rail potential. Parts which are not electrically connected, i.e. separated by means of elastic supports, rubber springs, intermediate mountings made of plastic material, etc, shall be connected by means of bonding according to EN 50153.

The electrical resistance from the highest point on the machine to the running rails shall not be more than 0,05 Ω and shall be demonstrated by measurement according to the requirements of EN 50153:2002, 6.4.3.

Rail wheel axles shall not be insulated.

5.16.8 Antennae

The installation of antennae fitted to the outside of machines shall comply with either of the following two conditions:

— the conducting parts of antennae shall be completely protected from voltage from the overhead line by a protective device made of impact proof insulating material and the antenna system shall form a unit connected to the machine frame at a single point (antenna with static earthing);

or

— an antenna fitted to the outside of the machine and not complying with the conditions above shall be separated from parts connected to the inside of the machine by means of high voltage condensers combined with surge absorbers.

5.17 Machine safety requirements related to electromagnetic compatibility

The machines shall have sufficient immunity to electromagnetic disturbances to enable them to operate safely as intended and not fail to danger when exposed to the levels and types of disturbances intended by the manufacturer.

The manufacturer of the machines shall design, install and wire the equipment and sub-assemblies taking into account the recommendations of the suppliers of these sub-assemblies.

Examples of possible malfunctioning which shall not occur due to radiation in the electromagnetic environment conditions foreseen by the manufacturer of the machine include:

— unexpected start-up;

— prevention of the stop command, if the stop command is already given;

— resetting of the emergency stop function;

— reduction in fault detection capacity;

— the inhibition of the operation of any safety or interlocking device;

— exceeding the safe (reduced) speed of machine parts.

NOTE General requirements for electromagnetic compatibility are defined in EN 15955-1:2013, 5.17. Additional guidance is given in IEC/TS 61000-1-2.

5.18 Emission of gas and particles

Machines shall have the exhaust outlet arranged away from all potential work positions.

Gasses and particles generated by work processes and the exhaust gasses from combustion engines shall be directed clear of the zone of air supplies of work and drive cabs, and where possible clear of the catenary and the work areas. For machines which have no raised working positions, the exhaust outlet shall be directed towards the top of the machine.

Machines shall minimise the emissions of diesel engines. The manufacturer shall consider the requirements necessary for use of the machine in a tunnel.

NOTE Limits for exhaust emissions are set out in the Directive for non-road mobile machinery 2004/26/EC.

5.19 Pressurised systems

Hydraulic systems shall be in accordance with the requirements of EN ISO 4413. Pneumatic systems shall be in accordance with the requirements of EN ISO 4414.

Only biodegradable oils shall be used for hydraulic systems where reasonably practicable.

5.20 Fuel tanks and hydraulic tanks

Fuel and hydraulic tanks shall be provided with a fluid level indicator. Pressure in the tanks exceeding the specified pressure shall be automatically compensated by a suitable device, e.g. vent, safety valve. Where the suitable device expels fluid from the system, the fluid shall be retained within a closed container.

Filler openings of tanks shall:

— have an easy access for filling;

— be located outside the cab;

— have provisions for lockable filler caps. Filler caps located inside lockable compartments, e.g. engine compartment or caps which can only be opened with a special tool, do not need a lockable provision.

Fuel tanks shall withstand an internal pressure difference of 0,3 bar without permanent deformation or leakage.

Non-metallic fuel tanks shall be made of flame retardant material. The speed of flame spread shall not exceed 50 mm/min when tested according to ISO 3795. Non-metallic fuel tanks shall be constructed of materials which do not cause electrostatic currents.

5.21 Noise reduction

The manufacturer shall give information about the noise emission values according to Annex C.

Noise reduction shall be an integral part of the design process for demountable machines thus specifically taking into account technical progress and measures at source as given in EN ISO 11688-1.

The success of the applied noise reduction measures is assessed on the basis of the actual noise emission values (see Annex C) in relation to other machines of the same family.

EN ISO 11688-2 gives further useful information on noise generation mechanisms in machinery.

Examples of the major sound sources of demountable machines are listed below:

— the power generation and transmission equipment such as combustion engines;

— the cooling system;

— the tools to work on the rails (such as grinding tools);

— tamping tools;

— tools to work on the ballast (such as ballast broom);

— tools to work on vegetation control (such as flails).

NOTE Examples of measures for noise reduction are:

— enclosed power generation and transmission equipment, capsulated cooling system;

— exhaust silencers.

Sound pressure levels at workstations of the machine where employees are carrying out work which demands and/or needs high levels of mental concentration should not exceed 65 dB(A).

5.22 Vibration

5.22.1 General

The working positions shall be designed so that the vibration emission level is as low as possible.

The manufacturer shall state the values for vibration at the working places; see 8.2.14.

5.22.2 Whole body vibration

The manufacturer shall design the machine to reduce vibration levels, in areas that could have persons present, as far as reasonably practical. Guidance for manufacturers on design to reduce whole body vibration is given in CEN/TR 15172-1.

5.22.3 Hand arm vibration

The manufacturer shall design the machine to reduce vibration levels of hand held components as far as reasonably practical. Guidance for manufacturers on design to reduce hand arm vibration is given in CR 1030-1.

5.23 Protection from the risks of fire

5.23.1 General risk assessment

The manufacturer shall make an assessment of the fire-related hazards of the complete machine in accordance with EN 13478:2001+A1:2008, Clause 5.

5.23.2 Fire fighting equipment

Machines shall have space for the installation of a fire extinguisher(s) easily accessible to the operator, or a built-in fire extinguishing system to permit personnel a safe exit from the machine.

5.23.3 Material requirements

The material, upholstery and insulation of the cab and other parts of the machine where insulation materials are used, shall be made of flame retardant materials.

NOTE In the absence of appropriate harmonised standards, guidance can be found in the rules of some of the member states of the EEA. For example, the High Speed Rolling Stock TSI states that “Conformity with the material requirements shall be deemed to be satisfied by the verification of conformity to the material fire safety requirements of one of the following sets of standards:

— United Kingdom: BS 6853, GM/RT 2130 issue 1;

— France: NF F 16-101:1988 and NF F 16-102:1992;

— Germany: DIN 5510-2:2007;

— Italy: UNI CEI 11170-1:2005 and UNI CEI 11170-3:2005.

Protective and partition walls shall be arranged between hydraulic components, e.g. pipelines and hoses, and hot zones of internal combustion engines to prevent leakage of oil onto sources of ignition.

5.23.4 Fire extinguishing system

Should an extinguishing system be fitted, the system shall be designed for the maximum travelling speed. The extinguishing system shall be designed to operate automatically but there shall also be a possibility for the operator to override this to enable moving the machine from an unsafe location, e.g. tunnel or viaduct.

5.24 Braking systems

5.24.1 General

— Where the manufacturer's intent is to allow the towing machine to tow unbraked trailers with a gross weight less than the gross weight of the machine itself, the braking system shall be designed for this purpose. The manufacturer shall also decide the type of braking fitted to the machine.

— Where the manufacturer's intent is to allow the towing machine to tow trailers that exceed the unbraked towing capacity of the towing machine, or where machines are required to travel at speeds greater than 25 km/h, they shall be equipped with a continuous brake. Where a continuous brake is fitted the braking system of the towing machine and trailer shall be compatible.

— In all cases the machine shall comply with 5.24.2 and 5.24.3.

The manufacturer shall ensure that machines and their permitted unbraked trailing loads meet the requirements for slowing down, stopping, braking and immobilisation so as to ensure safety under all the operating, load, speed and gradient conditions allowed for. As a minimum, machines shall conform to one of the two following options:

— the machine shall have two separate and independent braking systems (one of which may be the parking brake, providing it is purely mechanically applied) each capable of stopping the fully loaded machine and any unbraked trailing load permitted by the manufacturer, on level track, in dry conditions, in accordance with Table 6. At least one of the independent braking systems has to work independently of the engine power source;

or

— the machine shall have a single braking system that can be demonstrated to be fail safe (i.e. a system where no single point failure, including the absence of energy supply, leads to an unbraked machine where the single failure is normally rapidly detected and the probability of a second failure following a detectable initial failure is low). The braking system shall be capable of stopping the fully loaded machine and any unbraked trailing load permitted by the manufacturer, on level track, in dry conditions, in accordance with Table 6.

Table 6 — Stopping distances

Machine speed km/h	Maximum stopping distance on level track of machine and any permitted (by the manufacturer) unbraked trailing load m
8	6
10	9
16	18
20	27
24	36
30	55
32	60
40	90
50	155
60	230
70	300
80	400
90	500
100	620

It is permissible for alternative tests to be carried out on a known slope and to calculate the equivalent stopping distance on flat track.

NOTE Some infrastructure managers do not accept the alternative tests.

5.24.2 Holding on gradients

A parking brake capable of operation and function without power from the machine shall be provided capable of holding the machine, on a gradient corresponding to the intended use of the machine with a factor of safety of 1,4, with a maximum gradient of 40 ‰., and without requiring a coefficient of friction between the rail and braked steel wheel greater than 0,15, with maximum permitted un-braked trailing load. Only the wheels that are in contact with the rail and braked by the parking brake shall be taken into account for these calculations. A test shall be carried out with the machine unloaded and fully loaded to verify performance.

Certain railway infrastructures may prescribe higher values, as defined in special national conditions. Additionally, certain railway infrastructure may have different operating requirements for trailing loads on gradients, however the minimum requirements for the parking brake are given in this text, as defined in EN 15955-1:2013, Annex A.

5.24.3 Braking of trailers

Where machines are designed to haul unbraked trailers in rail configuration with a total weight of less than 100 % of the towing machine, the maximum towing weight shall be specified and justified by calculation.

The unbraked trailing load may be increased for defined gradient and speeds. The manufacturer shall provide a table to show the maximum permitted unbraked trailing load for different gradients and limitations of speed, and calculation method, see 8.2.13. This weight shall be such that the stopping distance of the machine and trailer(s) shall meet the requirements given in Table 6. The method of connecting trailer(s) shall be such that

the driver is made aware of a breakaway and that the trailer parking brakes automatically apply in the event of a breakaway.

NOTE The permission to exceed the 100 % trailing load is given by the infrastructure manager for the infrastructure concerned.

Where a machine is to haul a trailer(s) in rail configuration with a total weight of more than 100 % of the towing machine or at speeds greater than 25 km/h, it shall be equipped with continuous brake.

5.24.4 Air continuous brake for trailers

Within the limits of the manufacturer's intended use, the following apply:

— design of the system shall ensure braking on all machines connected together, the manufacturer shall state in the instruction handbook the intended use for towing, e.g. type of trailers and maximum number of trailers allowed;

— system shall be compatible with other railway vehicles;

— there shall be sufficient air capacity to operate the brake system reliably. An example of an air continuous brake is shown in EN 15955-1:2013, 5.11.2.

5.25 Lighting

Machines shall be fitted with sufficient fixed lighting equipment for access, walking routes, working places and areas in accordance with the requirements of EN 1837. The minimum illuminance of lighting provided shall meet the requirements of Table 7.

Table 7 — Minimum illuminance

Location	**Illuminance** (lux)
Working place	60
Area for reading documents	250
Access, walkway	30
Areas beside the machine where persons are normally present but which are not work places	50

5.26 Warning systems

The machine shall be provided with an acoustic warning system in accordance with EN 981 and EN ISO 7731. It shall be possible to activate the warning system from all points from which it is possible to initiate and/or control working movements or start the work equipment with a warning of a potential danger, e.g. indicating an intention to move.

If systems with visual danger signals are provided, they shall be in accordance with the requirements of EN 842 except where this conflicts with railway signalling.

NOTE There are also additional requirements for systems for warning of movement on adjacent lines required by some infrastructure managers detailed in EN 15955-1:2013, 5.16.

5.27 Maintenance

5.27.1 General

Machines shall be designed and built so that the routine lubrication and maintenance operations can be carried out safely, whenever possible with the engine stopped. Where it is only possible to undertake checks or maintenance with the engine running, the manufacturer shall define safe procedures which shall be described in the instruction handbook; see 8.2.12. Where it is only possible to undertake checks or maintenance with the engine running, the manufacturer shall so far as possible provide protection against contact with moving machinery, e.g. fans, fan belts, and define safe procedures which shall be described in the instruction handbook; see 8.2.12.

Openings intended for maintenance purposes shall comply with EN ISO 2860, EN 547-1, EN 547-2 and EN 547-3 as appropriate.

The design of the machine shall permit lubrication and filling of tanks from the ground or from a safe standing position on the machine.

5.27.2 Frequent maintenance

Components, e.g. batteries, lubrication fittings, filters, that require frequent maintenance shall be easily accessible for checking and changing.

A lockable storage box shall be provided on the machine for safety-critical tools and accessories required to be carried as recommended by the manufacturer.

5.27.3 Support devices

On machines where maintenance can only be performed with equipment in a raised position, there shall be support devices for making such equipment mechanically secure.

If the support devices are required for daily maintenance, they shall be permanently affixed to the machine or be stored on a safe place on the machine.

Engine access panels shall be provided with a device to hold them in the open position.

5.27.4 Unauthorised access to the engine compartment

The engine compartment shall be enclosed sufficient to prevent unauthorised access by one of the following means:

a) an installation that requires the use of a tool or key to gain access,

b) a guard latch with a release control inside a lockable compartment, e.g. cab.

5.28 Safe handling

The manufacturer shall define procedures and make provisions in accordance with EN ISO 12100:2010, 5.5.5, for the safe handling of machine components.

6 Additional safety requirements or measures for specific machine functions

6.1 Conveyors

Conveyors, e.g. for ballast or sleepers, shall comply with the following requirements:

a) design and construction shall meet the requirements of EN 618 or EN 620 (bulk loads such as ballast) or EN 619 (unit loads such as sleepers);

b) design shall ensure that the transported material, e.g. ballast, sleepers, cannot be ejected from the conveyor belts or chains, e.g. by enclosing the conveyor;

c) reduce the risk of entrainment at pinch points, e.g. by safeguarding in accordance with 5.13:

   1) between conveyed material, e.g. sleepers, and components of the machine;

   2) between fixed and moving parts of the machine, e.g. self-actuating slewing conveyor belts for distribution of ballast between the sleepers and components of the machine;

d) for lateral slewing conveyor belts, the stability as set out in EN 14033-2:2008+A1:2011, 5.2 shall be ensured at the maximum slewed position on the most unfavourable track conditions defined in EN 14033-2:2008+A1:2011, Annex F;

e) conveyor belts that have variable height settings shall have a height limiting device to ensure conformance to the safety distances from the catenary as set out in 6.16.6.

6.2 Cranes and lifting devices fixed on the machine

Cranes and lifting devices fixed on the machine shall comply with the following requirements:

— design shall meet the requirements of the relevant standards which shall be chosen from EN 13135-1:2003+A1:2010, Annex A for electrotechnical equipment and EN 13135-2:2004+A1:2010, Annex A for non-electrotechnical equipment;

— limitation of the lifting height shall be adjustable to accord with the safety clearances from the catenary according to 6.16.6;

— the limitation rotation shall be limited as defined in EN 15955-1:2013, 5.2.3;

— work places and their access of cranes and lifting devices shall comply with the requirements of 5.2;

— worst permissible combination of track conditions, as defined in EN 14033-2:2008+A1:2011, Annex F, on which the machine is permitted to work shall be defined by the manufacturer and shall be taken into account for defining the safe load moment.

6.3 Transport of loads by machines used for lifting

There shall be devices to assist the operator in the prevention of the unintentional movement of long suspended loads from machines used for lifting when transporting the loads in front of the machine, e.g. sockets or brackets to fix the ends of the loads.

6.4 Elevating work platforms

Elevating work platforms shall meet the requirements of EN 280. The worst permissible combination of track conditions, as defined in EN 14033-2:2008+A1:2011, Annex F on which the machine is permitted to work shall be taken into account by the manufacturer.

7 Verification of the conformity to the requirements and/or particular safety measures

7.1 General

This section contains the methods for verification of the compliance with the safety requirements and/or measures of the standard.

7.2 Methods of examination

7.2.1 General

The methods of examination are indicated in Table B.1, which consists of visual examinations, measurements, functional tests, load test(s), specific verification/measurements and other controls.

7.2.2 Visual check

The intention of which is to establish whether all elements of the machine, systems or components, e.g. protective devices, visual warning devices, markings, are present and that documents and drawings correspond to the requirements as shown in Table B.1.

7.2.3 Measurement

The intention of which is to establish whether the stated measurable parameters, e.g. geometric dimensions, safety distances, insulation resistance of electric circuits, noise, vibration, have met the requirements of this European Standard.

7.2.4 Functional test

The intention of which is to establish whether, in unloaded working condition the machine, including all safety devices, works as intended and all functions comply with the requirements and with the technical documentation.

7.2.5 Load test(s)

The intention of which is to establish whether the strength and stability of the equipment under load together with all safety devices and adjustments meets the requirements of this standard.

7.2.6 Specific verification/measurements and other controls

The intention of which is to establish whether conformity with the stated requirements of this standard has been achieved. These are, e.g. calculations, technical documentation and specific documents of this European Standard.

8 Information for use

8.1 General

The information for use shall be given in accordance with EN ISO 12100:2010, Clause 6. In particular, the following points shall be taken into consideration when considering EN ISO 12100:2010, Clause 6:

— operating criteria for railway environment;

— environmental conditions, e.g. wind, temperature, humidity;

— restrictions of use.

The detail of the safety functions, the list and the positions of the safety devices shall also be indicated.

If necessary, specific instructions should also be supplied for particular national conditions featuring as given in EN 15955-1:2013, Annex A.

8.2 Instruction handbook

8.2.1 Specific information in instruction handbook

Further to the requirements for the instruction handbook contained in EN ISO 12100:2010, 6.4.5, the instruction handbook shall also include the following information:

1) only authorised staff may start, operate or use the machine;

2) specification of personal protective equipment required when the machine is working and the risks for which the equipment is required;

3) method of stopping the machine and the means for doing so, in particular instruction for the use of normal and emergency stopping devices; that their access shall be kept free from obstacles and their function is to be periodically checked;

4) emergency stopping devices shall not be used for stopping normally; and full description of functions inhibited by operation of emergency stopping device, as described in 5.12.2;

5) information for cleaning the machine;

6) details for restarting the machine after an emergency or accidental stop;

7) user of the machine shall only operate the machine under normal conditions and avoid overloading;

8) user shall take due care when making changes to the machine to ensure the safety level is not compromised (it is recommended that the user should not make changes without having consulted the manufacturer or his representative);

9) information about function checks of the safety devices carried out before the beginning of working;

10) instruction to use only the suitable and permissible places for driving on the machine;

11) information about adjustment of the operators' seats in relation to height and weight of the operator;

12) information about the necessary safety measurements when removing and replacing parts of the machine;

13) information about adjustment of the limiting devices;

14) description of instrumentation and operators controls;

15) safety relevant technical data including noise emission values in accordance with Annex C;

16) advice that operator and other personnel fully acquaint themselves with the operation manual before operating the machine;

17) instructions on the position of the control to lower attachments and release residual pressure and how they should be used;

18) range of temperature in which the machine is intended to operate or be stable;

19) guidance for the selection of the ventilation filter element;

20) safety instructions for securing of portal cranes for transportation;

21) safety instructions for lifting the machine, parts of the machine and attachments;

22) safety instructions for stabling;

23) safety instructions on precautions to minimise possible chemical hazards during operation, maintenance and disposal;

24) intended use for towing, e.g. type of hauled machines and maximum number of hauled machines allowed;

25) details of non-compliant door design; see 5.2.2;

26) if access is only available from one side of the machine an instruction shall be made that the machine is not allowed beside a line open to rail traffic on that side without other operational instruction; see 5.2.1 and 5.2.2;

NOTE Operational instructions will vary according to the requirements of individual infrastructure managers and probably will vary according to local conditions.

27) indicate the occasions where an RCI (if fitted) is permitted to be isolated, e.g. during emergency recovery or whilst an excavator is in digging configuration; see 5.11.3.2. The information shall reinforce the importance that the RCI is operational during lifting operations. Describe function of blue indicator lamp;

28) safety instructions for lifting the machine, parts of the machine and attachments;

29) instructions for lowering equipment in the event of emergency stop activation; see 5.12.2.

The instruction handbook shall equally draw attention to the user of his obligation to take precautions given by the railway infrastructure manager concerned.

The instructions in the instruction handbook for using the machine shall also indicate the ways in which the machine shall not be used.

8.2.2 Restrictions of use

The instruction handbook shall give detailed information on restrictions of use of the machine in accordance with the requirements of this standard, e.g:

1) machine is not intended for passenger or freight transport;

2) machine may not circulate freely or work without restriction on switches, level crossings or other installations;

3) for particular measures under catenaries, see 5.16.6;

4) for maximum gradient on which the machine may be parked, see 5.24.2;

5) machine may adversely interfere with signalling control systems and/ or track safety systems;

6) the maximum passing speed of trains on the adjacent track, see 5.4.8.2 and 5.4.8.3;

7) details of working configurations not permitted whilst moving along the track, see 5.11.2.4.

NOTE There can also be additional requirements for systems for warning of movement on adjacent lines that is required by some infrastructure managers as detailed in EN 15955-1:2013, 5.16.

8.2.3 Mass of the machine in working condition

The instruction handbook shall indicate the distribution of the mass by wheel in the different foreseen machine working configurations.

8.2.4 Stability of the machine

The instruction handbook shall indicate the limit of cant and gradient of the track on which the stability of the machine is assured and any other factors that can influence the stability of the machine; see 5.11.1.1 and 5.11.1.6.1.

The instruction handbook shall indicate maximum stabiliser ground pressure in the permitted loaded conditions.

8.2.5 Conformance to the lateral limit of work

The instruction handbook shall indicate all lateral limits of the machine in working mode relative to the lateral limit of work given in EN 14033-2:2008+A1:2011, Annex D and all the values necessary for the verification of the lateral limiting device; see 5.1.3.1.

8.2.6 Change of configuration of the machine

The instruction handbook shall describe the work necessary to put the machine from running configuration into working condition and vice versa, with the associated minimum times, in the following cases:

— normal work situation;

— loss or breakdown affecting a part or tool of the machine to return the machine to running configuration.

The instruction handbook shall also indicate the number of persons required to carry out this work.

8.2.7 Locking of tools and equipment

The method of locking tools and equipment into the running configuration shall be described in the instruction handbook.

8.2.8 Devices to prevent access to an operating track

Safety barriers designed to prevent exiting to a side of the operating track shall be described in the instruction handbook and their use mandated.

8.2.9 Work places situated outside the running gauge

The location and use of work places outside of the running gauge shall be described in the instruction handbook. It shall also be indicated in which direction to evacuate these working places in case of dangers generated by railway operations; see 5.2.2.

8.2.10 Warning systems

The installed warning systems shall be described in the instruction handbook.

The instruction handbook shall indicate that the methods of warning of dangers arising from use in the railway environment are to be defined by agreement with the infrastructure manager.

8.2.11 Testing of warning systems

The instruction handbook shall indicate the necessity of making a test of the warning systems for audibility and visibility in the working conditions.

8.2.12 Information for maintenance

In addition to the documentation required by EN ISO 12100:2010, the instruction handbook shall particularly refer to (see 5.27.1):

— tools and accessories necessary for maintenance;

— maintenance requirements of the control devices for limiting the travel of the working parts;

— safety requirements for maintenance that is only possible to be undertaken with the engine running;

— safety instructions for maintenance and repair including energy supply disconnection, measures against re-connection, neutralisation of residual energy, testing of zero energy state;

— the maintenance method and adjustment of the movement limiting devices of any component in relation to the safety of the railway;

— instructions for the maintenance of parts related to railway running safety.

The instruction handbook shall also contain the maintenance plan, which shall include any necessary instruction for the maintenance of warning signs.

The instruction handbook shall also include a list and specification of spare parts essential for safe operation.

8.2.13 Trailing loads

Information shall be given showing the conditions for safe braked and unbraked trailing loads for differing gradients and speed limitations. This information shall be titled "Technical Capability of the machine" and shall also state that stricter conditions apply to some infrastructure; see 5.24.3.

It is recommended that the specific requirements of the infrastructure manager(s) for the intended use of the machine is shown in this information. The information is best produced in the form of a table to show the gradient, speed and permitted unbraked trailing load.

8.2.14 Vibration

8.2.14.1 Whole body vibration

8.2.14.1.1 Measurement and degree of uncertainty of whole body vibration (WBV)

Manufacturers shall either state the highest rms value of weighted acceleration to which the whole body is subjected to by the machine, if it exceeds 0,5 m/s^2 or otherwise state that it is less than 0,5 m/s^2. The manufacturer shall also state the degree of uncertainty of each vibration measurement. The degree of uncertainty can be determined either by compliance with the recommendation given in EN 12096:1997, Annex D or through an analysis of test methods and repeating results where the production run is sufficiently large to give readings from at least ten machines.

8.2.14.1.2 Whole body vibration measurement

Measurements shall be taken at locations where personnel can either stand or sit. For standing locations, the measurement shall be taken on the floor and for seated locations the measurement shall be taken on the seat cushion (there is no requirement for measurements on the seat back support). Measurements shall be made using tri-axial accelerometers, in accordance with the requirements of EN 1032. Only the largest of the three readings need to be used in the assessment process.

Measurements shall be taken under the following conditions, where these conditions are appropriate for the intended use of the machine:

— machine stationary with the engine running;

— machine at maximum permitted running speed on continuous welded rail for a statistically significant length of time as determined by the technically competent person;

— machine at maximum permitted running speed on jointed track for a statistically significant length of time as determined by the technically competent person;

— in working mode for each of the working functions for a statistically significant length of time as determined by the technically competent person.

8.2.14.1.3 Reporting whole body vibration data

Manufacturers are required to give information about the actual testing method, actual test results and degree of uncertainty of those results.

The manufacturer shall clearly state how the vibration value was derived, i.e. use being made of the machine and track being traversed. The manufacturer shall record the actual vibration levels measured and the degree of uncertainty of these results. The information shall be declared to the purchaser in the instruction handbook.

8.2.14.2 Hand arm vibration

8.2.14.2.1 Measurement and degree of uncertainty of hand arm vibration (HAV)

Manufacturers shall either state the vibration total value to which the hand/arm system is subjected by the machine, if it exceeds 2,5 m/s^2 or otherwise state that it is less than 2,5 m/s^2. The manufacturer shall also state the degree of uncertainty of each vibration measurement. The degree of uncertainty can be determined either by compliance with the recommendation given in EN 12096:1997, Annex D or through an analysis of test methods and repeating results where the production run is sufficiently large to give readings from at least ten machines.

8.2.14.2.2 HAV Vibration measurement

Measurements shall be taken for all hand held equipment. Examples of equipment that should be considered for hand-arm vibration assessment are (but not limited to):

a) hand-held tools,

b) handle bars and guard rails,

c) powered pneumatic tools,

d) control handles of machines (where the control is held for periods of operation).

Measurement shall be made by using a tri-axial accelerometer fixed to the piece of equipment being held in the hand, as shown in EN 28662-1. The method of fixing shall be carefully considered. It has been common practice to attach the measuring device to the hand grip with plastic cable ties; this shall be avoided because of the elasticity of the cable tie. It is recommended that the fixing be physically mounted, or at least a metal screw clip should be used. The vector sum of the three readings shall be used in the assessment process. The equipment to be measured shall be in use in its intended mode and in its intended environment, e.g. a hand-held ballast tamper shall be measured when in use with ballast.

8.2.14.2.3 Reporting hand arm vibration data

Manufacturers are required to give information about the actual testing method, actual test results and degree of uncertainty of those results.

The manufacturer shall clearly state how the vibration value was derived, i.e. use being made of the machine and track being traversed. The manufacturer shall record the actual vibration levels measured and the degree of uncertainty of these results. The information shall be declared to the purchaser in the instruction handbook.

8.3 Warning signs and written warnings

Where possible, warning signs shall be in the form of pictograms in compliance with ISO 7000.

Warning signs shall be permanently fixed and clearly visible. The manufacturer shall state what maintenance is required to keep the signs in an acceptable condition; see 8.2.12.

The machine shall carry all signs and written warnings required by EN ISO 12100:2010, 6.4. EN 61310-2 shall be considered. Safety signs shall comply with ISO 3864 (all parts) and EN 61310-1.

Adequate warning signs shall be fixed on the machines indicating dangerous zones, which are not protected by other safety measures including hazards generated by:

— trapping risks;

— risks from electricity;

— electrical danger zones of fixed electrical traction equipment;

— dangers from the operating track.

If movement of machines is restricted to service tracks then the pictogram shown in EN 14033-2:2008+A1:2011, Annex C shall be applied at each working mode driving position.

Fixed warning signs to warn personnel of the dangers from passing traffic shall be provided such that they are clearly visible at the egress points.

8.4 Marking

Machines shall be marked visibly, legibly and indelibly with as a minimum include the following information:

— business name and full address of the manufacturer and where applicable his authorised representative;

— designation of the machinery;

— mandatory marking[5)] ,e.g. CE marking;

— year of construction; that is the year in which the manufacturing process was completed;

— serial or identification number;

— gross weight.

The marking on the machine shall, where applicable, additionally include the following:

— rating information (mandatory for electrotechnical products: voltage, frequency, power, etc.);

— rating information (for non-electrotechnical products), e.g. working load limit, safe working load, load limits;

5) For machines and their related products intended to be put on the market in the EEA, CE marking as defined in the applicable European Directive(s), e.g. Machinery.

— designation of series or type, if any;

— mass of components that have to be moved frequently using lifting equipment;

— conditions of use;

— reference to instructions for installation, use and maintenance.

Annex A
(normative)

List of significant hazards

Table A.1 — List of significant hazards *(1 of 3)*

No.	Hazard	EN ISO 12100:2010, Clause 4	EN 15955-2:2013
1	**Mechanical hazards** due to machine parts and workpieces, accumulation of energy inside the machine	**4.2**	
1.1	Crushing hazard		5.2, 5.10, 5.11, 5.12, 5.13, 5.17, 5.19, 5.24, 5.26, 6.3
1.2	Shearing hazard		5.12, 5.13, 5.17
1.3	Cutting or severing hazard		5.2, 5.11, 5.12, 5.13, 5.17, 6.1
1.4	Drawing-in or trapping hazard		5.13, 5.11, 5.12, 5.13, 5.17, 6.1
1.5	Impact hazard		5.2, 5.4, 5.7, 5.10, 5.11, 5.13, 5.17, 5.26, 5.27, 6.1
1.6	Stabbing or puncture hazard		5.7, 5.12, 5.13, 5.17, 6.1
1.7	Friction or abrasion hazard		5.12, 5.13, 5.17, 5.27, 6.1
1.8	High pressure fluid injection or ejection hazard		5.8, 5.19
2	**Electrical hazards** due to	**4.3**	
2.1	Contact of persons with live parts		5.16, 6.1
2.2	Electrostatic phenomena		5.17
2.3	Approach to parts with high voltage		5.16, 6.1
3	**Thermal hazards** resulting in	**4.4**	
3.1	Burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by radiation of heat sources		5.4, 5.8, 5.15, 5.16, 5.18, 5.19, 5.20, 5.23
3.2	Damage to health by hot or cold working environment		5.3, 5.4

Table A.1 *(2 of 3)*

No.	Hazard	EN ISO 12100:2010, Clause 4	EN 15955-2:2013
4	**Hazards generated by noise** resulting in	**4.5**	
4.1	Hearing loss (deafness), other physiological disorders, e.g. loss of balance, loss of awareness		5.21, Annex C
4.2	Interference with speech communication, acoustic, signals		5.21, Annex C
5	**Hazards generated by vibration**	**4.6**	
5.1	Whole body vibration, particularly when combined with poor postures		5.5, 5.22
6	**Hazards generated by radiation**	**4.7**	
7	**Hazards generated by materials and substances**, processed or used by the machinery	**4.8**	
7.1	Hazards from contact with/or inhalation of harmful fluids, gases, mists, fumes and dusts		5.4, 5.8, 5.15, 5.16, 5.18, 5.20, 5.23
7.2	Fire or explosion hazard		5.15, 5.16, 5.19, 5.20, 5.23
8	**Hazards generated by neglecting ergonomic principles in machinery design** as e.g. hazards from:	**4.9**	
8.1	Unhealthy postures or excessive effort		5.3, 5.4, 5.5, 5.6, 5.14, 5.28
8.2	Inadequate local lighting		5.14, 5.25
8.3	Inadequate design or location of manual controls		5.3, 5.14, 5.16
9	**Hazards by slipping, stumbling**	**4.10**	5.2, 5.4, 5.6, 5.14
10	**Combination of hazards**	**4.11**	5.16
11	**Hazards due to surroundings of the machine**	**4.12**	5.2, 5.3, 5.6, 5.10, 5.11, 5.14, 5.19, 5.20, 5.27

Table A.1 *(3 of 3)*

No.	Hazard	EN ISO 12100:2010, Clause 4	EN 15955-2:2013
12	**Additional hazards due to mobility**		
12.1	Movement when starting the engine		5.12, 5.13, 5.14, 5.17, 5.26
12.2	Movement without a driver at the driving position		5.9, 5.12, 5.13, 5.14, 5.17
12.3	Insufficient ability of machinery to be slowed down, stopped and immobilised		5.12, 5.13, 5.14, 5.17, 5.24
12.4	Hazards by exceeding the permissible kinematic gauge		5.2, 5.13, 5.16
12.5	Hazards by insufficient running gear		5.10, 5.24
12.6	Hazards by insufficient running safety		5.10, 5.24
13	**Additional hazards due to lifting**		5.11, 5.16, 5.28, 6.2, 6.3, 6.4

Annex B
(normative)

Check list for conformity

Table B.1 — Verification of safety requirements and/or safety measures *(1 of 5)*

Method of examination	Type of verification to be effected				
	Visual check	**Measurements**	**Functional test**	**Load test**	**Specific verification / measurements**
	7.2.2	7.2.3	7.2.4	7.2.5	7.2.6
5.1	General				
5.1					☐
5.2	Access and egress to and from working places				
5.2.1	○	☐	☐○		☐
5.2.2					☐
5.2.3	☐○	☐			☐
5.3	Ergonomics				
5.3					☐
5.4	Requirements for cabs				
5.4.1					☐
5.4.2	☐○	☐			
5.4.3	☐○				☐
5.4.4	○	☐			☐
5.4.5	☐○		☐○		☐
5.4.6	○		☐○		☐
5.4.7.1	☐○				☐
5.4.7.2	☐○				☐
5.4.7.3	☐○				☐
5.4.8.1					
5.4.8.2	☐○				☐
5.4.8.3	☐○				☐
5.4.8.4	☐○				☐
5.4.8.5	☐○				☐
5.4.9	☐○				

☐ = 1st machine of a type

○ = successive machines of the same type

Table B.1 *(2 of 5)*

Method of examination	Type of verification to be effected				
	Visual check	**Measurements**	**Functional test**	**Load test**	**Specific verification / measurements**
	7.2.2	7.2.3	7.2.4	7.2.5	7.2.6
5.5	Seats				
5.5.1	○	☐	☐○		☐
5.5.2	○	☐	☐○		
5.6	Standing places				
5.6.	○	☐			☐
5.7	Edges and corners				
5.7.	☐○				☐
5.8	Pipes and hoses				
5.8	☐○				☐
5.9	Communications between work positions				
5.9	☐○		☐○		☐
5.10	Prevention of derailment				
5.10.1				☐	☐
5.10.2	○	☐			☐
5.11	Stability and measures preventing overturning				
5.11.1.1					☐
5.11.1.2					☐
5.11.1.3				☐	☐
5.11.1.4					☐
5.11.1.5				☐	☐
5.11.1.6.1				☐	☐
5.11.1.6.2				☐	☐
5.11.1.6.3				☐	☐
5.11.2.1					☐
5.11.2.2.1					☐
5.11.2.2.2				☐	☐
5.11.2.2.3	○		☐	☐	☐
5.11.2.3				☐	☐
5.11.2.4	○				☐

☐ = 1st machine of a type

○ = successive machines of the same type

Table B.1 *(3 of 5)*

Method of examination	Type of verification to be effected				
	Visual check	**Measurements**	**Functional test**	**Load test**	**Specific verification / measurements**
	7.2.2	7.2.3	7.2.4	7.2.5	7.2.6
5.11.3.1			☐○	☐	☐
5.11.3.2			☐○	☐	☐
5.11.3.3	☐○		☐○		☐
5.12	Emergency stopping devices				
5.12.1		☐○	☐○		☐
5.12.2		☐○	☐○		☐
5.13	Moving parts and materials				
5.13			☐○		☐
5.14	Operator's controls and indicators				
5.14.1	☐○		☐○		☐
5.14.2	☐○	☐	☐○		☐
5.14.3			☐○		☐
5.14.4	☐○				☐
5.14.5	☐○		☐○	☐○	☐
5.14.6	☐○		☐○	☐○	☐
5.14.7.1	☐○		☐○		☐
5.14.7.2	☐○				☐
5.15	Thermal hazards				
5.15	☐○				☐
5.16	Electrical system				
5.16.1	☐○		☐○		☐
5.16.2			☐○		☐
5.16.3	☐○				☐
5.16.4	☐○				☐
5.16.5	☐○		☐○		
5.16.6	☐○		☐○		☐
5.16.7	☐○	☐		☐	
5.16.8	☐○			☐	

☐ = 1st machine of a type

○ = successive machines of the same type

Table B.1 *(4 of 5)*

Method of examination	Type of verification to be effected				
	Visual check	**Measurements**	**Functional test**	**Load test**	**Specific verification / measurements**
	7.2.2	7.2.3	7.2.4	7.2.5	7.2.6
5.17	Machine safety requirements related to electromagnetic compatibility				
5.17				☐	☐
5.18	Emission of gas and particles				
5.18	☐○	☐			☐
5.19	Pressurised systems				
5.19	☐○				☐
5.20	Fuel tanks and hydraulic tanks				
5.20	☐○		☐○		☐
5.21	Noise reduction				
5.21		☐			☐
5.22	Vibration				
5.22.1		☐			☐
5.22.2		☐			☐
5.22.3		☐			☐
5.23	Protection from the risks of fire				
5.23.1	☐○				☐
5.23.2			☐○		
5.23.3	○		☐		☐
5.23.4	☐○			☐	☐
5.24	Braking systems				
5.24.1	☐○		☐○	☐○	☐
5.24.2	☐○		☐○		☐
5.24.3	○		☐		☐
5.24.4	☐○			☐	☐
5.25	Lighting				
5.25	☐○	☐	☐○		
5.26	Warning systems				
5.26	○	☐	☐○		☐

☐ = 1st machine of a type

○ = successive machines of the same type

Table B.1 *(5 of 5)*

Method of examination	Type of verification to be effected				
	Visual check	**Measurements**	**Functional test**	**Load test**	**Specific verification / measurements**
	7.2.2	7.2.3	7.2.4	7.2.5	7.2.6
5.27	Maintenance				
5.27.1	☐○				☐
5.27.2	☐○				
5.27.3			☐○		
5.27.4			☐○		
5.28	Safe handling				
5.28	○	☐			☐
6	Additional safety requirements or measure for specific machine functions				
6.1	Conveyors				
6.1	○				☐
6.2	Cranes and lifting devices fixed on the machine				
6.2	○		☐○	☐	☐
6.3	Transport of loads by machines used for lifting				
6.3	○		☐		
6.4	Elevating work platforms				
6.4	○		○	☐	☐
8	Information for use				
8.1	General				
8.1	☐○				☐
8.2	Instruction handbook				
8.2	☐○				☐
8.3	Warning signs and written warnings				
8.3	☐○				☐
8.4	Marking				
8.4	☐○				☐
☐ = 1st machine of a type ○ = successive machines of the same type					

Annex C
(normative)

Noise test code (grade of accuracy 2)

C.1 Scope

These rules for the determination and declaration of noise emission values are applicable to demountable machines.

C.2 Terms and definitions

General terms in this noise test code are defined in EN ISO 12001:2009, Clause 3.

C.2.1
work station
position defined by the manufacturer, in the vicinity of the machine or at the machine which is intended for the operator, see Table C.1

C.3 Determination of the emission sound pressure level at the work station or other specified positions

The maximum A-weighted emission sound pressure level at the work stations and at other specified positions shall be determined according to EN ISO 11201:2010, grade 2. The measurements shall be carried out at the measurement positions given in Tables C.1 and C.2, with no operator being present if not specifically required for the operation of the machine. The operating conditions are given in Table C.1.

Further specified positions for the determination of the emission sound pressure level are described by the position of axis A in Table C.2. The microphone shall be positioned above axis A at a distance of 1 m from the reference box (see EN ISO 3744:2010, 3.10), and the measurement shall be taken while the machine is passing in operating mode. For the definition of the reference box, components of the machine, which can swing out, are not to be taken into consideration.

If required the C-weighted peak sound pressure level shall be determined at the work stations or specified positions.

The duration of measurement for steady noise shall be a minimum of 15 s, according to EN ISO 11201:2010, grade 2, 10.1.2. To determine the maximum A-weighted emission sound pressure level for non-steady noise, the duration of measurement and sound pressure level obtained shall be documented for each measurement condition, e.g. full load, idle motion.

C.4 Sound power level determination

The A-weighted sound power level shall be determined in accordance with EN ISO 3744.

Because the length l_1 of the reference box of demountable machines might exceed 7 d (the measurement distance d is the perpendicular distance between the reference box and the measurement surface, see EN ISO 3744:2010, 7.3 and Figure C.4), the sound power level shall be determined as follows:

On both sides of the machine are five microphone positions on a vertical line; see Figure C.1. For machines where the noise levels are the same on both sides of the machine, measurements need to be taken only on one side. The distance between these vertical lines and the reference box shall be 1 m. The track with the

working machine on it and the adjacent track shall be on the same height and shall lie in a straight line. For the definition of the reference box, components of the machine, which can swing out, are not to be taken into consideration.

The measurement shall be taken while the machine is passing in operating mode. The measurement starts when the front of the machine, defined by the front of the reference box, is at a distance of 3 m to the axis crossing the track through the microphones. The measurement stops when the end of the machine is at a distance of 3 m to this axis.

There is no environmental correction K_2 because measurement is taken out in a free field; see EN ISO 3744:2010, A.1. As the measurements shall be taken outdoors, the test environment is considered to be an acoustic free field over a sound reflective plane. Thus the environmental correction K_2 is assumed to be less than 0,5 dB and therefore negligible. To avoid the influence of any sound-reflecting objects in the open test site, observe the requirements in EN ISO 3744:2010, A.1.

For the calculation of the sound pressure level averaged over the measurement surface, use EN ISO 3744:2010, Clause 8.

C.5 Installation and mounting conditions

The installation and mounting conditions shall be identical for the determination of both the sound power level and the emission sound pressure level at specified positions.

For the purpose of measurements, the machine shall work on a working track, which is part of a sound reflecting plane outdoors providing the necessary free field above the reflecting plane.

C.6 Operating conditions

The operating conditions shall be the same for the determination of the sound power level and of the emission sound pressure level at the work stations and specified positions. The operating conditions of the machines are defined in Table C.1.

Operating conditions “Full load” in Table C.1 require that the machine is working under full load conditions specified by the manufacturer.

Table C.1 — Typical measurement positions to determine the emission sound pressure level and the required operating conditions

Work stations	Microphone positions to determine the emission sound pressure level at the working places	Operating conditions for measurement
Working places with seats inside or outside of cabs, such as cabs for controlling ballast excavating chains or portal cranes	Measuring point at a height of 0,8 m centrally above the seat surface	Full load Portal cranes shall run at maximum speed as intended by the manufacturer.
Working places with standing positions inside or outside of cabs	Measuring point at a height of 1,60 m centrally above the standing position of the operator (inside cabs) and 1,60 m above rail level (outside cabs)	Full load
Working places beside the machine with control panels at which operators are required	Measuring point 1,60 m above rail level centrally above the control panel	Full load

Table C.2 — Typical measurement positions and operating conditions to determine the emission sound pressure level

Other specified measurement points	Microphone positions on both sides of the machine at a height of 1,60 m above rail level at a distance of 1m from the reference box above an axis which is defined as follows:	Operating conditions for measurement
Group of tamping tools (tamping machine)	Axis A at right angles to the track and on the centre line of the tamping units	The machine shall run at a mode with full depth ballast penetration
Ballast excavating chain (ballast cleaner)	Axis A at right angles to the track and on the axis of the ballast excavating chain	Full load The ballast excavating chain shall be in normal working position
Equipment for lifting sleepers (renewal train)	Axis A at right angles to the track through the axis of the sleeper being picked up	Full load
Equipment for laying down sleepers (renewal train)	Axis A at right angles to the track through the axis of the sleeper being placed	Full load
Equipment for ballast grading (ballast regulator)	Axis A at right angles to the track through the end of the plough at its most extended position	Full load The maximum speed is the one intended by the manufacturer
Group of grinding tools (grinding machine)	Axis A at right angles to the track and on the centre line of a group of grinding stones	Full load
Engine blocks or generators	Axis A at right angles to the track and on the centre line of the exhaust and through the openings of the air intake	Full load
Machines with portal cranes which move relative to the main machine	On machines with portal cranes, measurements shall be carried out at the points with peak values of noise when the portal crane is passing	Full load While the portal crane is passing by, the measurement shall be carried out both with maximum determined speed of the crane with load and without load

C.7 Measurement uncertainties

The application of the proposed noise emission measurement methods results in different measurement uncertainties. These are stated as standard deviations of reproducibility in the basic noise emission measurement standards. Thus a standard deviation of reproducibility σ_R of 0,5 dB to 2,5 dB is expected for the A-weighted emission sound pressure level determined in accordance with EN ISO 11201.

In considering the sound power level determination according to EN ISO 3744, a standard deviation of reproducibility σ_R of 0,5 dB to 1,5 dB is expected.

C.8 Information to be recorded

The information to be recorded shall cover all of the technical requirements of this noise test code. Any deviations from the noise test code or from the basic standards upon which it is based shall be recorded together with the technical justification for such deviations.

C.9 Information to be reported

The information to be included in the test report shall be at least that which the manufacturer requires to prepare a noise emission declaration or the user requires to verify the declared values.

The following minimum information shall be given:

a) identification of the manufacturer, machine type, machine model, serial number and year of production;

b) place and date of the test and personnel involved;

c) reference to this noise test code and the basic standards applied;

d) description of installation and operating conditions;

e) location of work stations and other specified positions;

f) description of microphone positions (work station and other specified positions);

g) description of the measurement instrument and year of calibration;

h) description of the test environment including background and environmental corrections;

i) determined noise emission values:

   1) maximum emission sound pressure level L_{pA} measured in dB(A) at the work stations and other specified positions;

   2) L_{pCpeak} if required;

   3) sound power level L_{WA};

j) confirmation that all requirements of this noise test code have been fulfilled, or, if this is not the case, any unfulfilled requirements have been identified. All unfulfilled requirements shall be specified; deviations from the requirements shall be stated and technical justifications for the deviations shall be given.

C.10 Declaration and verification of noise emission values

The declaration of the noise emission values shall be made as a dual number noise emission declaration according to EN ISO 4871. The declaration shall state the emission sound pressure level L_{pA} at the work stations or at other specified positions and if necessary the sound power level L_{WA} together with the respective uncertainty K (K_{pA} and K_{WA}).

If necessary, the peak sound pressure levels L_{pCpeak} shall be given together with its uncertainty K_{pCpeak}.

The uncertainties of measurement K_{pA}, K_{WA} and K_{pCpeak} are expected to have values as given in the Table C.3.

Table C.3 —Expected uncertainties

Applied measurement standard	Grade 2
EN ISO 11201	K_{pA} = 3 dB K_{pCpeak} = 3 dB
EN ISO 3744:2010	K_{WA} = 3 dB

The noise emission value shall be rounded to the nearest decibel.

The noise emission declaration shall explicitly state that the emission values have been measured according to the specification of this noise test code as well as to EN ISO 11201, respectively EN ISO 3744. If this statement is not true, the noise emission declaration shall indicate clearly what the deviations are from this noise test code and/or from the basic standards.

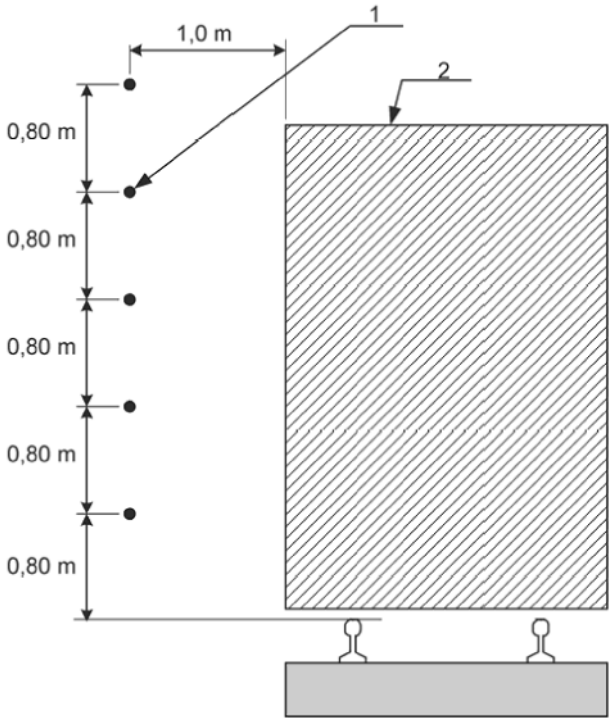
If undertaken, verification shall be done according to EN ISO 4871 by using the same mounting, installation and operating conditions as those used for the initial determination of the noise emission values.

An example of a noise emission declaration according to EN ISO 4871:2009, B.2 is given as example in Table C.4 below:

Table C.4 — Example of a noise emission declaration

Machine ... ... Type: ... ... Model:		
Declared dual-number noise emission values in accordance with EN ISO 4871		
	Load	**No Load**
Measured maximum A-weighted emission sound pressure level L_{pA} (ref. 20 µPa) at the operator's position in dB	**92**	**89**
Uncertainty K_{pA} in dB	**3**	**3**
Measured A-weighted sound power level L_{WA} (ref. 1 pW) in dB	**107**	**105**
Uncertainty K_{WA} in dB	**3**	**3**
Values determined according EN ISO 11201, EN ISO 3744 and EN 15955-2		
NOTE The sum of a measured noise emission value and its associated uncertainty represents an upper boundary of the range of values that are likely to occur in measurements.		

Note The values in this table are examples.



Key

1 microphone positions
2 reference box

Figure C.1 — Microphone positions

Annex D
(informative)

Structure of European Standards for track construction and maintenance machines

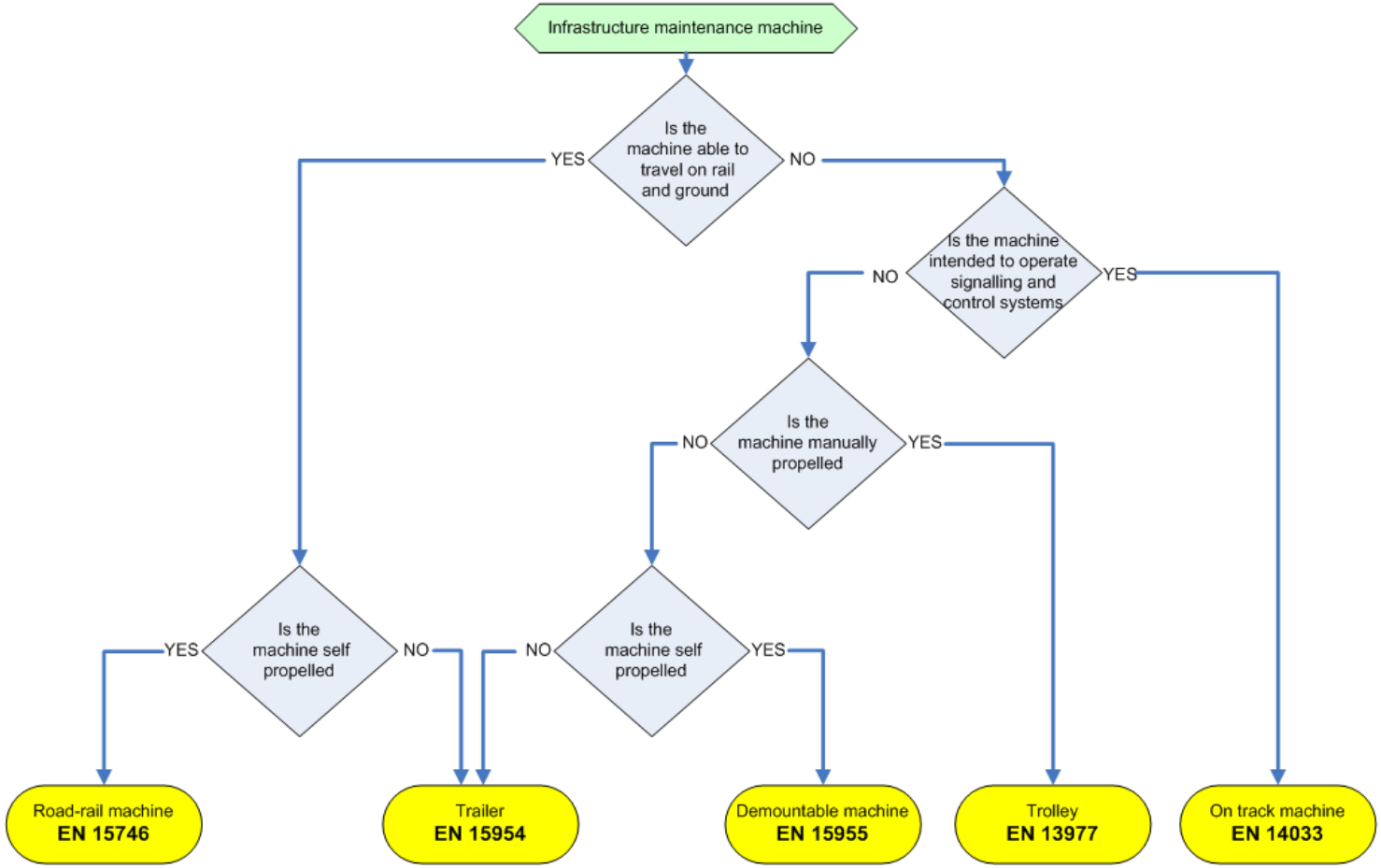


Figure D.1 — Flowchart of European Standards for track construction and maintenance machines

Table D.1 — Structure of European Standards for track construction and maintenance machines

Specifications	European Standard						
	Railbound machines **EN 14033-1:2011** **EN 14033-2:2008+A1:2011** **EN 14033-3:2009**		**Road-rail machines** **EN 15746-1:2010** **EN 15746-2:2010**		**Demountable machines** **EN 15955-1:2013** **EN 15955-2:2013**	**Trailers** **EN 15954-1:2013** **EN 15954-2:2013**	**Portable machines and trolleys** **EN 13977:2011**
Designed for rail or road	rail only		rail and road		rail only	rail only or rail and road	rail only
Designed for operating train control / signalling systems	yes		yes[c]	no[d]	no	no	no
Method of propulsion on the rails	self-propelled [a]	towed [b]	self-propelled		self-propelled	towed	manually

a Category 1, 2, 4 and 6 machines.

b Category 3, 5 and 7 machines.

c Category 8 machines as well as Category 9 machines designed to operate signalling and control systems.

d Category 9 machines.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 474 (all parts), *Earth-moving machinery — Safety*

[2] EN 12096:1997, *Mechanical vibration — Declaration and verification of vibration emission values*

[3] EN 13977:2011, *Railway applications — Track — Safety requirements for portable machines and trolleys for construction and maintenance*

[4] EN 14033-3:2009, *Railway applications — Track — Railbound construction and maintenance machines – Part 3: General safety requirements*

[5] EN 15746-1:2010, *Railway applications — Track — Road-rail machines and associated equipment — Part 1: Technical requirements for running and working*

[6] EN 15746-2:2010, *Railway applications — Track — Road-rail machines and associated equipment — Part 2: General safety requirements*

[7] EN 15954-1:2013, *Railway applications — Track — Trailers and associated equipment — Part 1: Technical requirements for running and working*

[8] EN 15954-2:2013, *Railway applications — Track — Trailers and associated equipment — Part 2: General safety requirements*

[9] EN ISO 11688-2, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design (ISO/TR 11688-2)*

[10] ISO 9247, *Earth-moving machinery — Electrical wires and cables — Principles of identification and marking*

[11] IEC/TS 61000-1-2, *Electromagnetic compatibility (EMC) — Part 1-2: General – Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena*

[12] BS 6853, *Code of practice for fire precautions in the design and construction of passenger carrying trains* [6)]

[13] BS 7262:1990, *Specification for automatic safe load indicators* [6)]

[14] DIN 5510-2:2007, *Vorbeugender Brandschutz in Schienenfahrzeugen — Teil 2: Brennverhalten und Brandnebenerscheinungen von Werkstoffen und Bauteilen — Klassifizierung, Anforderungen und Prüfverfahren* [7)]

[15] NF F16-101:1988, *Matériel roulant ferroviaire — Comportement au feu — Choix des matériaux* [8)]

[16] NF F16-102:1992, *Matériel roulant ferroviaire — Comportement au feu — Choix des matériaux, application aux équipements électriques* [8)]

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6) Can be purchased from: Rail Safety and Standards Board, Evergreen House, 106 Euston Road, London NW1 2DX, United Kingdom.

7) Can be purchased from: Deutsches Institut für Normung (DIN), Beuth Verlag GmbH, D-10772 Berlin.

8) Can be purchased from: Association Française de Normalisation (AFNOR), 11 av. Francis de Pressensé, F-93571 Saint-Denis La Plaine CEDEX, France.

[17] UNI CEI 11170-1:2005 and UNI CEI 11170-3:2005, *Guidelines for fire protection of rail and guided transport vehicles*

[18] GM/RT2130 Issue 1*, Visibility and audibility requirements for trains* [6)]

[19] NCS-Natural Color System in accordance with Swedish standard SS 019100/01/02/03 [9)]

[20] 2004/26/EC, *Directive 2004/26/EC of the European Parliament and of the Council of 21 April 2004 amending Directive 97/68/EC on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery* [10)]

[21] ECE R 43, *Uniform provisions concerning the approval of safety glazing materials and their installation on vehicles*

[22] CR 1030-1, *Hand-arm vibration — Guidelines for vibration hazards reduction — Part 1: Engineering methods by design of machinery*

[23] CEN/TR 15172-1, *Whole-body vibration — Guidelines for vibration hazards reduction — Part 1: Engineering methods by design of machinery*

[24] ISO 16001, *Earth-moving machinery — Hazard detection systems and visual aids — Performance requirements and tests*

9) May be purchased from: SKANDINAVISKA FÄRGINSTITUTET AB; SCANDINAVIAN COLOUR INSTITUTE AB; Igeldammsgaten 30, S-10028 Stockholm, Sweden.

10) Official Journal of the European Communities No L 146/1 of 30.04.04.

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