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Date: 14 November 2024

Origin: European

Latest date for receipt of comments: 07 January 2025

Project No. 2021/02298

Responsible committee: RAE/2 Railway Applications - Track

Interested committees:

Title: Draft BS EN 14033-1 BS Railway applications - Infrastructure - Railbound construction and maintenance machines. Part 1: Technical requirements for running.

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Introduction

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

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

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

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Template for comments and secretariat observations

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

English Version

**Railway applications - Infrastructure - Railbound
construction and maintenance machines - Part 1:
Technical requirements for running**

Applications ferroviaires - Voie - Machines de
construction et de maintenance empruntant
exclusivement les voies ferrées - Partie 1 :
Prescriptions techniques pour la circulation

Bahnanwendungen - Oberbau - Schienengebundene
Bau- und Instandhaltungsmaschinen - Teil 1:
Technische Anforderungen an das Fahren

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

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

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

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European foreword

This document (prEN 14033-1:2024) has been prepared by Technical Committee CEN/TC 256 “Railway Applications”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN14033-1:2017.

Amended clauses compared to EN 14033-1:2017 are shown in informative Annex H.

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

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

Introduction

This document is the first of a series of four parts of the European Standard: Railway applications - Infrastructure - Railbound construction and maintenance machines:

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

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

1 Scope

This document defines the specific technical railway requirements for running of machines and other vehicles used for construction, maintenance and inspection of track, structures, track formation and fixed electric traction equipment. Special national conditions applicable to specific member states are shown in Annex B.

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

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

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

This document is written for 1 435 mm nominal track gauge; special requirements can apply for running on infrastructures with narrow gauge or broad gauge lines, urban railways, railways utilizing other than adhesion between the rail and wheels and road-rail machines which are not included in this standard.

This document covers the railway specific requirements for movements of the machine as a train and movements to reach work sites.

This document applies to equipment and systems which are operational on machines in running mode.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 286-3:1995, *Simple unfired pressure vessels designed to contain air or nitrogen — Part 3: Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock*

EN 286-4:1995, *Simple unfired pressure vessels designed to contain air or nitrogen — Part 4: Aluminium alloy pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock*

EN 12080:2017+A1:2022, *Railway applications - Axleboxes - Rolling bearings*

EN 12663-1:2010+A2:2023, *Railway applications - Structural requirements of railway vehicle bodies - Part 1: Locomotives and passenger rolling stock (and alternative method for freight wagons)*

EN 12663-2:2010+A1:2023, *Railway applications - Structural requirements of railway vehicle bodies - Part 2: Freight wagons*

EN 13103-1:2017+A1:2022, *Railway applications - Wheelsets and bogies - Part 1: Design method for axles with external journals*

CEN/TS 13103-2:2020, *Railway applications - Wheelsets and bogies - Part 2: Design method for axles with internal journals*

EN 13260:2020, *Railway applications - Wheelsets and bogies - Wheelsets - Product requirements*

EN 13261:2020, *Railway applications - Wheelsets and bogies - Axles - Product requirements*

EN 13262:2020, *Railway applications - Wheelsets and bogies - Wheels - Product requirements*

EN 13715:2020, *Railway applications - Wheelsets and bogies - Wheels - Tread profile*

EN 13749:2021+A1:2023, *Railway applications - Wheelsets and bogies - Method of specifying the structural requirements of bogie frames*

EN 13979-1:2023, *Railway applications - Wheelsets and bogies - Monobloc Wheels - Technical approval procedure - Part 1: Forged and rolled wheels*

prEN 14033-2:2024, *Railway applications — Track — Railbound construction and maintenance machines — Part 2: Technical requirements for travelling and working*

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

EN 14067-4:2024, *Railway applications — Aerodynamics — Part 4: Requirements and test procedures for aerodynamics on open track*

EN 14067-6:2018+A1:2022, *Railway applications — Aerodynamics — Part 6: Requirements and test procedures for cross wind assessment*

EN 14198:2016+A2:2021, *Railway applications — Braking — Requirements for the brake system of trains hauled by locomotives*

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

EN 14531-1:2015+A1:2018, *Railway applications — Methods for calculation of stopping and slowing distances and immobilization braking — Part 1: General algorithms utilizing mean value calculation for train sets or single vehicles*

EN 14601:2005+A2:2021, *Railway applications — Straight and angled end cocks for brake pipe and main reservoir pipe*

EN 14813-1:2006+A1:2010, *Railway applications — Air conditioning for driving cabs — Part 1: Comfort parameters*

EN 15152:2019+A1:2023, *Railway applications — Windscreens for trains*

EN 15153-1:2020, *Railway applications — External visible and audible warning devices — Part 1: Head, marker and tail lamps for heavy rail*

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

EN 15220:2016, *Railway applications — Brake indicators*

EN 15227:2020, *Railway applications — Crashworthiness requirements for rail vehicles*

EN 15273-1:2013+A1:2016, *Railway applications — Gauges — Part 1: General — Common rules for infrastructure and rolling stock*

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

- EN 15355:2019+A1:2023, *Railway applications — Braking — Distributor valves and distributor-isolating devices*
- EN 15437-1:2009+A1:2022, *Railway applications — Axlebox condition monitoring — Interface and design requirements — Part 1: Track side equipment and rolling stock axlebox*
- EN 15528:2021, *Railway applications — Line categories for managing the interface between load limits of vehicles and infrastructure*
- EN 15551:2022, *Railway applications — Railway rolling stock — Buffers*
- EN 15566:2022, *Railway applications — Railway Rolling stock — Draw gear and screw coupling*
- EN 15595:2018+A1:2023, *Railway applications — Braking — Wheel slide protection*
- EN 15624:2021, *Railway applications — Braking — Empty-loaded changeover devices*
- EN 15663:2017+A1:2018, *Railway applications — Vehicle reference masses*
- EN 15807:2021, *Railway applications — Pneumatic half couplings*
- EN 15827:2011, *Railway applications — Requirements for bogies and running gears*
- EN 15877-1:2012+A1:2018, *Railway applications — Marking on railway vehicles - Part 1: Freight wagons*
- EN 15877-2:2013, *Railway applications — Markings of railway vehicles — Part 2: External markings on coaches, motive power units, locomotives and on track machines*
- FprEN 15839:2024, *Railway applications — Testing for the acceptance of running characteristics of railway vehicles — Testing of running safety under longitudinal compressive force*
- FprEN 15955-2:2024, *Railway applications — Infrastructure — Demountable machines, trailers and associated equipment — Part 2: General safety requirements*
- EN 16116-2:2024, *Railway applications — Design requirements for steps, handrails and associated access for staff — Part 2: Freight wagons*
- EN 16186-1:2014+A1:2018, *Railway applications — Driver's cab — Part 1: Anthropometric data and visibility*
- EN 16207:2024, *Railway applications — Braking — Functional and performance criteria of Magnetic Track Brake systems for use in railway rolling stock*
- EN 16404:2016, *Railway applications — Re-railing and recovery requirements for railway vehicles*
- EN 16452:2015+A1:2019, *Railway applications — Braking — Brake blocks*
- EN 16834:2019, *Railway applications — Braking — Brake performance*
- EN 16839:2022, *Railway applications — Rolling stock — Head stock layout*
- EN 17343:2023, *Railway applications — General terms and definitions*

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

EN 50119:2020, *Railway applications — Fixed installations — Electric traction overhead contact lines*

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

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

EN 50153:2014,² *Railway applications — Rolling stock — Protective provisions relating to electrical hazards*

EN 50206-1:2010, *Railway applications — Rolling stock — Pantographs: Characteristics and tests - Part 1: Pantographs for main line vehicles*

EN 50367:2020,³ *Railway Applications — Fixed installations and rolling stock — Technical criteria to achieve interoperability between pantographs and overhead contact line*

EN 50388-1:2022, *Railway Applications — Fixed installations and rolling stock — Technical criteria for the coordination between electric traction power supply systems and rolling stock to achieve interoperability — Part 1: General*

EN 50463-1:2017, *Railway applications — Energy measurement on board trains — Part 1: General*

EN 50463-2:2017, *Railway applications — Energy measurement on board trains — Part 2: Energy measuring*

EN 50463-3:2017, *Railway applications — Energy measurement on board trains — Part 3: Data handling*

EN 50463-4:2017, *Railway applications — Energy measurement on board trains — Part 4: Communication*

EN 50463-5:2017, *Railway Applications — Energy measurement on board trains — Part 5: Conformity assessment*

EN 50617-2:2015, *Railway Applications — Technical parameters of train detection systems for the interoperability of the trans-European railway system - Part 2: Axle counters*

EN 50716:2023, *Railway Applications — Requirements for software development*

EN 60077-1:2017, *Railway applications — Electric equipment for rolling stock — Part 1: General service conditions and general rules*

EN 60077-2:2017, *Railway applications — Electric equipment for rolling stock — Part 2: Electrotechnical components — General rules*

EN IEC 60077-3:2019, *Railway Applications — Electric equipment for rolling stock — Part 3: Electrotechnical components — Rules for DC circuit breakers*

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

² As impacted by EN 50153:2014/A1:2017 and EN 50153:2014/A2:2020.

³ As impacted by EN 50367-1:2020/A1:2022.

EN IEC 60077-4:2019, *Railway Applications — Electric equipment for rolling stock — Part 4: Electrotechnical components — Rules for AC circuit breakers*

EN IEC 60077-5:2019, *Railway Applications — Electric equipment for rolling stock — Part 5: Electrotechnical components — Rules for HV fuses*

EN 60310:2016, *Railway applications — Traction transformers and inductors on board rolling Stock*

EN 62625-1:2013,⁴ *Electronic railway equipment — On board driving data recording system — Part 1: System specification (IEC 62625-1:2013)*

EN ISO 7010:2020,⁵ *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 4975:2022, *Railway applications — Braking system — Quality of compressed air for pneumatic apparatus and systems*

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

⁴ As impacted by EN 62625-1:2013/AC:2016-10 and EN 62625-1:2013/A11:2017.

⁵ As impacted by EN ISO 7010:2020/A1:2020, EN ISO 7010:2020/A2:2022, EN ISO 7010:2020/A3:2022, EN ISO 7010:2020/A4:2023, EN ISO 7010:2020/A5:2023 and EN ISO 7010:2020/A6:2023.

3 Terms and definitions

For the purposes of this document, the terms and definitions in EN 17343 and the following apply.

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

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

3.1

railbound construction and maintenance machine

on-track machines and infrastructure inspection machines

Note 1 to entry: A similar definition is given in EN 17343:2023, 3.1.7.8.1.

3.2

on-track machines

OTM

machine specially designed for construction and maintenance of the track and infrastructure and used in different modes: working configuration, travelling configuration, running configuration as a self-propelled vehicle, or running configuration as a hauled vehicle, when:

- it is running on its own rail wheels,
- it is designed to have characteristics necessary for the operation of track based train detection systems

Note 1 to entry: A similar definition is given in EN 17343:2023, 3.1.7.8.1.1.

3.3

infrastructure inspection machine

machine used to monitor the condition of the infrastructure which, with the exception of machines which are incorporated into passenger trains, are considered to be on track machines

Note 1 to entry: Infrastructure inspection machines designed to be incorporated into passenger trains are not considered as railbound construction machines and will meet passenger car standards.

Note 2 to entry: A similar definition is given in EN 17343:2023, 3.1.7.8.1.2.

3.4

demountable module

removable unit which is capable of being attached with dedicated fastening system to a machine, to perform a specific function

3.5

semi-permanently coupled machines

machines which require a workshop environment to couple and uncouple (because there is no operational need or requirement to couple or uncouple between the machines)

3.6

running mode

configuration of a machine when it allows movement along the track, all moveable parts stowed within the applicable gauge, with the machine interacting with the signalling and control systems

3.7

travelling mode

configuration of a machine when it allows movement along the track closed for work, all moveable parts stowed (but not secured) within the applicable gauge, and when the machine does not require to interact with the signalling and control systems (in this condition there is no need to ensure operation of signalling systems or for cab based signalling equipment)

Note 1 to entry: A machine in travelling mode does not need to meet the operational requirements for the movement of trains on the railway network.

3.8

working mode

mode when the machine is used to perform any of its permitted designed working tasks

3.9

handrail

barrier used to demark edge of platform or assistance on steps, as shown in Figure E.2

Note 1 to entry: Handrails are also referred to as 'guard rail' in prEN 14033-3.

4 Machine categorization

4.1 General rules

The application of all requirements of this document is not possible in every case because of the differences in the design of machines. The machines are therefore divided into seven categories as shown in Table 1.

In order to use this document, it is necessary to identify to which category the machine belongs. The corresponding requirements for each category are defined in Annex A.

Table 1 — Machine categories by maximum running speed

		Self-propelled machine running speed (v)		Non-self-propelled machine ^b
		≥ 100 km/h	< 100 km/h	
Can be incorporated in a hauled formation ^a with a speed (v) of	≥ 100 km/h	Category 1	Category 2	Category 3
	< 100 km/h	--	Category 4	Category 5
Cannot be incorporated into a hauled formation ^c		--	Category 6	Category 7
^a These categories of machines could have restrictions for their position in a train or may require a protection wagon. ^b These categories of machines are permitted to have a self-propelling function in travelling and working mode only. ^c These categories of machines only move by themselves or coupled to category 6 or 7 machines				

Note 1 The categories are aligned with commission implementing regulation (EU) 2019/773.

Note 2 The Category 1 would be better as $v > 100$ km/h and categories 2, 4 and 6 v “less than and equal to” 100 km/h (a request has been made to update the EU document).

When a machine is restricted to have a specific position within a hauled formation this shall be described in the documentation, see 20.4, Table 10, Line a).

4.2 Demountable modules

A demountable module shall be checked for conformity as part of the machine to all relevant clauses in all parts of EN 14033 when any of the following apply:

- a) It has been manufactured or modified to suit the particular machine or type of machine.
- b) It is used to carry personnel during running or travelling.
- c) It is positioned on the machine by other than gravity or twist locks.
- d) It has electrical, pneumatic or hydraulic connections to the machine.
- e) It is connected to the machine by twist locks and is used for lifting any load.
- f) It is connected to the machine by twist locks and has moveable components which are able to exceed the gauge profile of the machine.

5 Rolling stock gauge

5.1 General rules

The maximum dimensions of the machine shall correspond to the rules of EN 15273-2:2013+A1:2016 in accordance with the basic principles set up in EN 15273-1:2013+A1:2016.

The associated rules for each gauge, the corresponding reference profile (e.g. G1) and the critical points near the limits of this gauge shall be shown in the documentation in accordance with EN 15273-2:2013+A1:2016, Annex R.

The machine reference profile as shown in EN 15877-2:2013, 4.5.35 shall be marked on both sides of the machine.

Machines intended to run on infrastructures with a gauge different to the kinematic gauge G1 from EN 15273-2:2013+A1:2016 shall conform to the specific rules of those infrastructures and the corresponding restrictions shall be shown in the documentation.

NOTE The G1 profile in EN 15273-2:2013+A1:2016, Figure A.4, meets the cross acceptance gauging requirements for the majority of mainland European countries.

The details of the running gauge including calculation of the reductions at critical points shall be declared in the documentation see 20.2, Table 8 Line a) and Line b). All critical points shall be detailed and dimensioned, an example diagram is given in Annex C.

5.2 Stowing of moveable machine parts in running positions

5.2.1 Component locks

Except as shown in 5.2.2 all moveable parts of the machine that can exceed the gauge defined in 5.1, including those parts that are prevented from abnormal movement by their operating mechanism safety features, shall be stowed and held by efficient red painted locks. It is not permitted to paint the machine red in the areas of the locks. The locks shall be designed so that foreign objects such as pieces of ballast cannot prevent their locking function. There shall either be two independent locking devices or the

devices shall be designed as a failsafe concept. The locking arrangement shall be described in the documentation, see 20.2, Table 8, Line c).

When in use all locks shall withstand the foreseeable forces encountered during normal operation or exceptional operation of the equipment being retained.

The operation of component locks should preferably be controlled from the operator's working or running position.

5.2.2 Exemption from locking

Pantographs used for traction and insulated pantographs used for measuring are permitted not to have locks.

5.2.3 Secondary support

Where a part is able to fall onto the track, slings, chains or similar devices shall be fitted in order to prevent them from falling onto the track in case of a failure.

5.2.4 Indication of locked state

It shall be obvious when checking the machine that moveable parts of the machine are locked in their stowed position. This check shall be possible either by direct sight from one side of the track or by other means. Furthermore, for machines with a running mode driving cab an indication to the driver of the machine shall show when a moveable part of the machine is not stowed and locked.

5.2.5 Running

When in running mode all control circuits not related to running shall be deactivated.

Locking devices shall not require power to remain locked when running.

It shall not be possible to open the locks in the running mode.

6 Frame

6.1 Design of the machine frame and attachments

6.1.1 Category 1, 2, 3, 4 and 5 machines

The structural integrity of machine frame shall be demonstrated in accordance with the corresponding structural categories of EN 12663-1:2010+A2:2023 or EN 12663-2:2010+A1:2023 as follows:

- for machines not permitted to be loose shunted or hump shunted: category F-II;
- for all other machines: category F-I.

For category 1 to 5 machines, the machine frame shall be able to withstand either the static loads of EN 12663-1:2010+A2:2023, 6.1 to 6.5, or the static loads in accordance with EN 12663-2:2010+A1:2023, 5.2.1 to 5.2.4, without exceeding the permissible values given therein except for the acceleration in x-direction in accordance with EN 12663-1:2010+A2:2023, Table 13 or EN 12663-2:2010+A1:2023, Table 10, which shall be ± 3 g.

For machines with a maximum speed greater than 100 km/h and with a driving cab closer than 2,5 m to the buffer face shall meet the requirements of EN 12663-1:2010+A2:2023, 6.2.3, and for Table 6 and Table 7 only shall be considered as category L.

To provide a similar level of cab's resistance for machines with a speed ≤ 100 km/h the compressive force applied on the front wall of the cab can be reduced to:

- 160 kN for speeds up to 100 km/h and 80 kN for speeds up to 80 km/h with the force applied 150 mm above of structural floor, and
- 120 kN for speeds up to 100 km/h and 60 kN for speeds up to 80 km/h with the force applied at waist rail level.

Dimensioned drawings shall be shown in the documentation, see 20.2, Table 8, line d).

To demonstrate compliance with EN 12663 series, physical testing is not mandatory and numerical methods for calculation are permitted to demonstrate compliance of the machine structure. The structural integrity of the connection of critical attachments, as defined in Annex K, shall be verified by numerical methods for calculation as set out in EN 12663-1:2010+A2:2023 or EN 12663-2:2010+A1:2023.

For machines with a maximum speed greater than 140 km/h, the fatigue strength of the machine frame and attachments shall comply with EN 12663-1:2010+A2:2023, 6.6 and 6.7.

For machines with a maximum speed ≤ 140 km/h and > 100 km/h the fatigue life of the machine frame and attachments shall be determined by the manufacturer based on the intended use and mileage declared in the documentation, see 20.2, Table 8, line e). This is permitted to be assessed by a comparison with existing machines of the same type.

For machines with a maximum speed ≤ 100 km/h a fatigue strength assessment is not needed.

For articulated machines, the joint between two parts of a machine which share the same running gear shall comply with the requirements of EN 12663-1:2010+A2:2023, 6.5.3. For machines with a maximum speed greater than 140 km/h a fatigue strength assessment with the fatigue loads in accordance with EN 12663-1:2010+A2:2023, 6.7.5, shall be made.

NOTE There are additional strength requirements for travelling and working modes which are described in prEN 14033-2.

6.1.2 Category 6 and 7 machines

Category 6 and 7 machines shall meet the requirements of FprEN 15955-2:2024, 5.8.1.

6.2 Lifting and jacking points

The machine frame shall incorporate jacking points and optionally also lifting points by which the whole machine is capable of being safely lifted or jacked. The location of the lifting and jacking points shall be defined. EN 16404:2016 is permitted to be used as guidance on how to achieve these requirements. Brackets used for re-railing shall either conform to the choices given in EN 16404:2016 or, if different from those choices, be carried on the machine.

To facilitate the work during repair or inspection or when re-railing the machine, the machine shall be provided on both long sides with at least two lifting or jacking points, at which the machine can be lifted in empty or laden condition. These lifting or jacking points shall be identified in accordance with 19.1.

If it is intended to use bogie drop equipment it is recommended to provide these lifting points at a minimum distance of 1 400 mm in the longitudinal direction from the centre line of individual wheelsets.

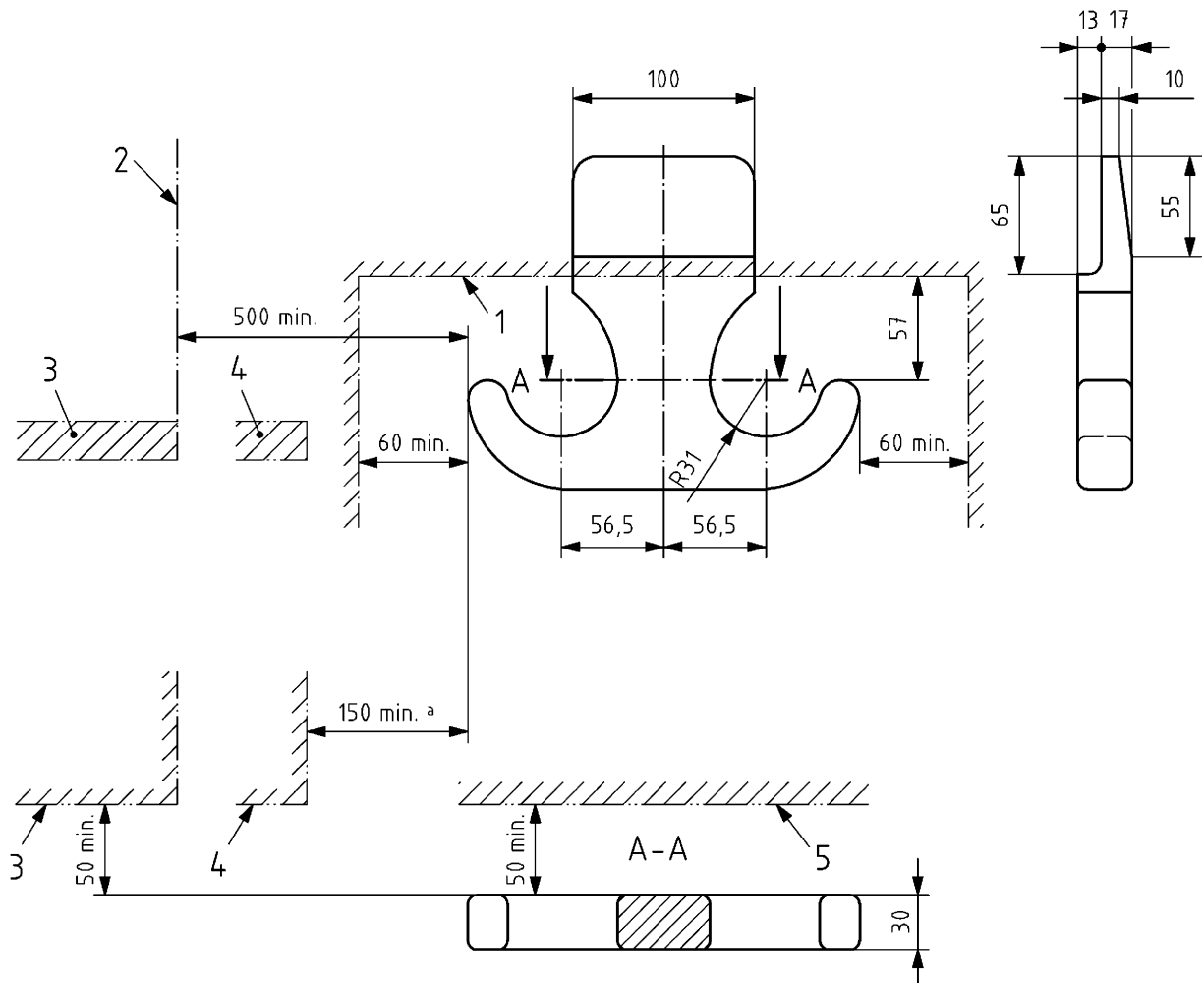
NOTE Laden is equivalent to maximum mass as defined in 7.7.3.

To allow positioning of jacking devices, clearances shall be provided under the lifting points which shall not be blocked by the presence of non-removable parts. The lifting and jacking load cases in accordance with EN 12663-2:2010+A1:2023 shall apply for lifting and jacking under workshop and servicing conditions.

6.3 Hook for stowage on boats and for towing

Machines suitable for transport on boats shall be fitted with stowage hooks in accordance with Figure 1. It is permitted to use this hook for towing within depots. Each installed hook shall be capable of withstanding a force of 50 kN exerted outwards from the centre line of the track at an angle of 30° measured from the vertical.

Dimensions in millimetres



Key

- | | | | |
|---|--|------|--|
| 1 | space required for projecting parts | 4 | gangway or end platform step board |
| 2 | buffer fixing plane | 5 | other projecting parts, e.g. control-handles |
| 3 | step board | min. | minimum value |
| a | If the dimension cannot be complied with, protective plates shall be mounted above the draw-hook | | |

Figure 1 — Stowage and towing hook

7 Bogie and running gear

7.1 General

The performance requirements for bogies and running gear fall into two related areas, covering functionality and safety, as required by TSI essential requirements. Functionality relates to such things

as speed, load capacity, ride quality and operating life. Safety covers gauging, structural integrity, dynamic performance, resistance to derailment and maintenance, etc. In this document, for bogies and running gear, essential safety requirements are addressed in Clause 5 (gauging), 7.2 (structural design), Clause 8 (running safety i.e. dynamic performance and resistance to derailment) and subclause 20.5 (maintenance).

A validation plan, see 20.2 Table 8 line f), covering all necessary validation activities and the strategy for demonstrating compliance shall be established. For machines, which are often produced in small numbers and derived from previous designs, EN 15827:2011, 9.1, 9.2 (structural integrity design), 9.3 (dynamic performance validation) and 9.4 (use of existing validation record), provides useful guidance in order to complete this validation plan.

NOTE Using this guidance can lead to, for example:

- using simulation in support of, or in place of, testing;
- using evidence that a component has functioned in a comparable operating environment with only the planned level of scheduled attention to demonstrate the performance without any further analysis or test data;
- using a large reserve of safety to cover small changes to avoid further testing.

The requirements of this clause do not concern wheels or rollers used for specific working conditions and which are retracted during running.

The running gear shall be able to negotiate the horizontal and vertical radii given in Table B.2 and values recorded in the documentation, see 20.2 Table 8 line g).

7.2 Structural design

7.2.1 Structural design of the bogie frame

For machines which include a bogie frame, the integrity of the structure of a bogie frame, all attached equipment and body to bogie connection, shall be demonstrated based on calculations as set out in EN 13749:2021+A1:2023, 6.2.2.

The hypothesis (formulas and coefficients) taken to evaluate the loads due to bogie running in line with the standard EN 13749:2021+A1:2023, Annex C, shall be justified and documented in the technical documentation, see 20.2, Table 8 Line h).

Machine bogies are considered to be produced in “small numbers” within the meaning of EN 13749:2021+A1:2023, 6.2.1.

7.2.2 Other components

Body/bogie connection, axleboxes, axles, wheels, suspension components and attachments and connections shall meet the requirements listed in EN 15827:2011. It is permitted to replace the validation methods of EN 15827:2011 by the validation methods described in the following standards:

- EN 13979-1:2023: monobloc-wheels;
- EN 13103-1:2017+A1:2022: approval process for axles with external journals;
- CEN/TS 13103-2:2020: approval process for axles with internal journals;
- EN 14363:2016+A2:2022: running characteristics of vehicles;
- FprEN 15839:2024: test of running safety under longitudinal compressive forces.

7.3 Wheel diameter

The minimum worn diameter shall not be smaller than 330 mm.

7.4 Static wheelset loading

The maximum permissible static wheelset load depends on the wheel diameter. In the running condition, the limits shall comply with the values given in Table 2.

Table 2 — Static wheelset loading

Wheel diameter $\varnothing$ d^a mm	Maximum permissible static wheelset load t
$\varnothing \geq 840$	25
$840 > \varnothing \geq 760$	20
$760 > \varnothing \geq 680$	18,5
$680 > \varnothing \geq 630$	17
$630 > \varnothing \geq 550$	14,5
$550 > \varnothing \geq 470$	12,5
$470 > \varnothing \geq 390$	10,5
$390 > \varnothing \geq 330$	9
^a d = minimum worn diameter, $\varnothing$ = diameter	

NOTE There are lines in existence where higher wheelset loads are permitted.

7.5 Wheel profile

The wheel profile shall comply with the requirements of EN 13715:2020 or another profile if satisfactory riding as required in Clause 8 of this document can be achieved. The wheel profile shall be recorded in the documentation, see 20.2 Table 8 Line i).

7.6 Shape and dimensions of the axles and wheelsets

The axles shall comply with the requirements of EN 13261:2020, EN 13103-1:2017+A1:2022 and CEN/TS 13103-2:2020. The design of the axles shall additionally take into account the forces generated when working.

Except as shown below, the wheels shall comply with the requirements of EN 13262:2020 and EN 13979-1:2023.

Other types of wheels made of ferromagnetic steel may also be used, if verification can be provided of the ability to safely transmit horizontal, vertical and braking forces.

The wheelsets shall comply with the requirements of EN 13260:2020. The design of the wheelsets shall additionally take into account the forces generated when working.

The axlebox bearings shall, as a minimum, be in accordance with the requirements of EN 12080:2017+A1:2022. It is permissible to use bearings with higher requirements where it is technically required (e.g. high lateral forces or high wheelset loads in working mode).

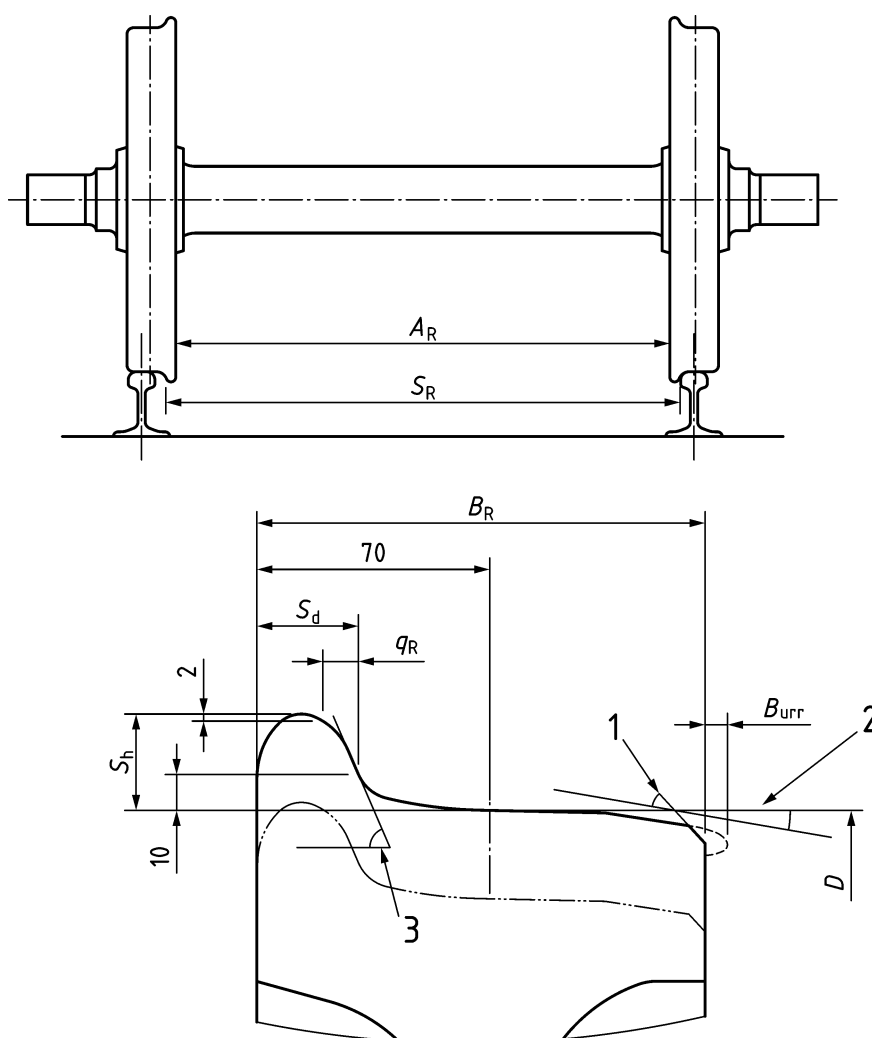
The dimensions of the wheelset shall comply with Table 3, as explained in Figure 2.

Table 3 — Wheelset dimension

Designation		Wheel diameter D [mm]	Minimum value [mm]	Maximum value [mm]
1 435 mm	Front-to-front dimension (S_R) $S_R = A_R + S_{d, \text{left}} + S_{d, \text{right}}$	$330 \leq D \leq 760$	1 415	1 426
		$760 < D \leq 840$	1 412	
		$D > 840$	1 410	
	Back to back distance (A_R)	$330 \leq D \leq 760$	1 359	1 363
		$760 < D \leq 840$	1 358	
		$D > 840$	1 357	

NOTE This table originates from LocPas TSI:2023, 4.2.3.5.2.1 (6) Table 1.

Dimensions in millimetres

**Key**

- 1 chamfer
- 2 reverse slope
- 3 flange angle

Figure 2 — Wheelset dimensions

NOTE Figure 2 above originates from the LocPas TSI:2023, 4.2.3.5.2.1 (6) and 4.2.3.5.2.2 (2).

7.7 Machine mass measurement**7.7.1 Wheelset arrangement and wheelset loads**

In running configuration the distribution of the wheelsets and their loads shall comply with the requirements of EN 15528:2021, and recorded in the documentation, see 20.2, Table 8, Line j).

Except as shown in 10.4 of this document, the distance from the buffer face to the first wheelset shall be less than or equal to 3 830 mm for machines with individual wheelsets and for machines with bogies, the distance from the buffer face to the bogie centre shall be less than or equal to 3 830 mm.

NOTE It is common practice to design the machine for compliance with line category C2 in accordance with EN 15528:2021.

The distances between the axles of machines shall comply with the conditions shown in Table 4.

Table 4 — Distance between wheelsets

Characteristics	Minimum	Maximum
Machines with bogies		
Distance between wheelsets of 2 axle bogies	1 800 mm ^a	
Distance between the wheelset of a bogie		4 500 mm
Distance between wheelsets of a bogie having more than 2 wheelsets	1 500 mm ^a	
Machines with individual wheelsets		
Distance between outside wheelsets		
- 2 axle machine	6 000 mm ^b	10 000 mm ^b
- 3 axle and single underframe machine	f	f
- 3 axle and articulated underframe machine	2 × 6 000 mm	c
Ratio: C/L	≥ 0,54 ^e	
C = distance between axles L = length of vehicles over uncompressed buffers d		
Articulated underframe machines		
Machines with bogies	c	c
Machines with individual wheelsets	c	c
Machines with bogies and individual wheelsets	g	g
^a Bogies are permitted to be designed with smaller axle spacing providing the machine meets the running safety requirements in Clause 8, the train detection requirements in Clause 11 and the wheels meet the requirements of EN 13715:2020, EN 13260:2020 and EN 15528:2021. ^b This distance is permitted to be different if dynamic stability is proven in accordance with EN 14363:2016+A2:2022. ^c For articulated machines, the ability to negotiate curves shall be demonstrated. ^d In case of asymmetry, L = the distance between the wheelsets plus twice the value of the greatest of the two overhang lengths. ^e Limiting value of 0,45 is acceptable for machines of categories 4, 5, 6 and 7. ^f A 3-axle machine is acceptable if the central wheelset does not transmit lateral guiding force to the rails. ^g The ability to negotiate curves shall be demonstrated.		

Machines which are required to operate spring operated points without risk of derailment shall have wheelset loads of at least 5 t.

7.7.2 Dead mass of the machine

The dead mass of the machine shall be indicated as MU in accordance with EN 15663:2017+A1:2018 Table 5; it represents the mass of the machine in as built condition without consumables and corresponds to the following conditions:

- hydraulic tank and hydraulic circuits full;
- cooling and heating fluids full;

- oils, greases, insulating fluids, transmission fluids, battery electrolyte;
- fixtures and fittings in cabins, tools and emergency equipment
- all other tanks empty;
- without any loads in areas designed to carry such loads;
- without staff on-board.

7.7.3 Operational mass in working order

The operational mass of the machine shall be indicated as MVO in accordance with EN 15663:2017+A1:2018 Table 5 and corresponds to the 'dead mass of the machine', as shown in 7.7.2, with the following conditions:

- fuel and AUS 32 tanks 2/3 full;
- water tanks (for example dust suppression, fire extinguishing, domestic supply) 2/3 full;
- without any loads in areas designed to carry such loads;
- personnel on-board required for operation in running mode (mass per person = 80 kg).

7.7.4 Design mass in working order

The design mass of the machine shall be indicated as MVD in accordance with EN 15663:2017+A1:2018 Table 5 and corresponds to the 'dead mass of the machine', as shown in 7.7.2, with the following conditions:

- all tanks and sand boxes 100 % full;
- the permanent tools on board;
- the maximum number of authorized operators on board in running mode (mass per person = 80 kg);
- without any loads in areas designed to carry such loads.

For machines that do not carry a payload the design mass of the machine in working order shall be displayed on the side of the machine as "maximum machine mass" in accordance with EN 15877-2:2013, 4.5.4.2 and recorded in the documentation, see 20.2, Table 8, Line k).

The term 'working order' should not be confused with 'working mode'. The working order is a term referenced in EN 15663 and defined here in 7.7.4 and is applicable to machines in running mode.

7.7.5 Design mass under normal payload

The design mass of the machine under normal payload shall be indicated as MND in accordance with EN 15663:2017+A1:2018 Table 5 and corresponds to the design mass of machine in working order, as shown in 7.7.4, and the maximum design payload which is the maximum permitted load plus the maximum permitted number of personnel.

Where a machine carries a payload, the maximum mass of the machine with payload shall be displayed on the side of the machine as 'maximum machine mass with payload' in accordance with EN 15877-1:2012+A1:2018, Figure 19 and recorded in the documentation, see 20.2, Table 8, Line l).

NOTE The term exceptional payload is not applicable for OTM, therefore the field MXD (Exceptional Mass) required by ERA TV is the 'maximum mass of the machine with payload' for OTM, which is the same as field MND (Design mass under normal payload).

7.7.6 Weighing method

For the first machine of a type, the result of the weighing will be the arithmetic average value of a minimum of three successive mass measurements, in the same condition.

For the following machines of the same type, the result of the weighing will be the arithmetic average value of a minimum of two successive mass measurements in the same condition.

The weighing procedure shall give the following values:

- the mass of the machine in at least one of the conditions described in 7.7.2 to 7.7.5;
- the wheelset load of each wheelset;
- the wheel load of each axle.

When measuring the mass, the machine shall be free of all outside influence:

- no scotching of the wheels;
- all internal equipment stopped;
- no contact on the buffer plates;
- no brakes applied;
- machine in running mode.

It is permitted for the determination of the mass conditions as set out in 7.7.2, to 7.7.5 to be obtained by weighing a machine in a known state and by calculating the variables.

Further guidance is provided in EN 15654-2:2019.

7.8 Design for longitudinal compressive forces

Except as shown below, the requirements for designing for longitudinal compressive forces shall comply with FprEN 15839:2024 for running machines in any position in regular freight trains:

- Where a machine with 2 axle bogies and wheelset load ≥ 12 t exceeds an overhang of 4 430 mm and/or a bogie centre spacing of 19 500 mm the machine shall either be restricted from incorporation into a goods train next to a two axle wagon, or tests in accordance with FprEN 15839:2024 or calculations shall be carried out to establish whether the longitudinal compressive forces are acceptable. This restriction shall be stated in the documentation, see 20.4, Table 10, line b).
- Where buffers and screw couplings are in use or the automatic traction coupling (Z-AK) the machine shall be designed to transmit longitudinal compressive forces ≥ 200 kN. The mandatory conditions for machines $\leq 10\,000$ mm wheelset spacing and with an overhang between 2 520 mm and 3 830 mm are the requirements of FprEN 15839:2024 and for machines $> 10\,000$ mm wheelset spacing and/or with an overhang greater than 3 830 mm a compression test in accordance with the requirements of FprEN 15839:2024 or a calculation shall be effected.
- Where automatic couplings (AK) are in use the machine shall be constructed to transmit longitudinal compressive forces ≥ 500 kN.

- Within a train consisting of railbound machines the internal couplings between the machines are considered satisfactory for incorporation in goods trains with the brake position in the passenger (P) or goods (G) mode without any restrictions for accommodating longitudinal compressive forces.

The track twist used for consideration of longitudinal compressive force shall be shown in the documentation, see 20.2, Table 8, line m).

7.9 Lifeguards

Machines with a running mode driving cab shall be equipped with lifeguards at the leading end in front of the outer wheels. They shall be installed with the aim of reducing the risk of derailment due to impact with small obstacles on the line.

A lifeguard shall comply with EN 15227:2020, 6.6.1.

7.10 Obstacle deflector

Machines with a running mode driver's cab designed with a maximum speed above 140 km/h shall be fitted with obstacle deflectors complying with EN 15227:2020, 6.5 and Table 3, to limit the consequences of hitting a track obstruction.

7.11 Minimum curve radius

The machine shall be capable of being able to negotiate a minimum horizontal curve radius of 150 m, and the actual value recorded in the documentation, see 20.2 Table 8 line g).

NOTE 1: Minimum radius curves for different countries are shown in Annex B, Table B.2, line 3.

NOTE 2: The ability of the machine to negotiate a smaller radius does not infer that the body of the machine stays within the vehicle gauge whilst moving through the curve.

8 Running safety

8.1 Running tests

The running characteristics of a machine or a machine type are permitted to be determined by running tests or by reference to a similar type-approved machine or by simulation, see 8.3.

A "similar type-approved machine" is a machine with similar configuration and running under similar conditions, and can be used as a reference for the test exemption of a new machine, in accordance with the requirements of EN 14363:2016+A2:2022, 5.3.1 and Table U.1 (the column for freight stock is applicable unless the special vehicle is similar to a locomotive, multiple unit or a passenger coach).

NOTE It is common practice that when running tests are required, they are carried out by an authorized testing body or by the manufacturer of the machine, if the manufacturer is authorized as a testing body.

For railbound machines running at a speed of $v \leq 120$ km/h, the requirements for special vehicles in accordance with EN 14363:2016+A2:2022, Annex S are applicable. These requirements also apply to machines running at a speed $v > 120$ km/h, when the conditions of EN 14363:2016+A2:2022 allow the use of an accelerometric simplified method for the type of vehicle to which the machine is similar.

Special vehicles may be designed with very high or low wheelset loads, unusual wheelset arrangements or distances, non-standard suspensions, moveable or retractable running gear, etc. If, owing to such design features and lacking positive operating experience the machine could be considered as a new technology vehicle, it shall be tested as such. If not, the requirements in accordance with EN 14363:2016+A2:2022 for special vehicles apply.

Possible fault modes of the machine which adversely affect the running behaviour shall be identified. Some of these fault modes could need to be submitted to specific running tests, the extent, conditions and assessment of which shall be defined.

The following deviations from EN 14363:2016+A2:2022 apply:

- a) when running tests in accordance with EN 14363:2016+A2:2022 are done with conical wheel profile in a new condition, these are valid for a maximum distance of 50 000 km. After 50 000 km, it is necessary to:
 - 1) either reprofile the wheels;
 - 2) or calculate the equivalent conicity of the worn profile and check that it does not differ more than 50 % from the value of the test of EN 14363:2016+A2:2022 with a maximum difference of 0,05;
 - 3) or make a new test in accordance with EN 14363:2016+A2:2022 with a worn wheel profile;
- b) normally, EN 14363:2016+A2:2022, 5.3.1 is not applicable because the machine tested is the first of type;
- c) if the required test speed cannot be obtained by the machine itself, the machine shall be hauled for the tests.

8.2 Safety on track twists

Safety against derailment when running on track twists shall be proven by a method in accordance with prEN 14033-2:2024, 5.2.3.2.2 for the machine in its running mode using the track parameters given in prEN 14033-2:2024 Table 6 “Normal Track EN14363” column.

A decision chart for the demonstration in running mode for safety against track twist is given in informative Annex I.

8.3 Running simulation

Running behaviour is permitted to be proven by simulation when there is a proven model of the machine.

A model of a machine for simulation of running characteristics shall be proven by comparing the model results against the results of running tests when the same input of track characteristic is used.

A proven model is a simulation model that has been verified by an actual running test that excites the suspension sufficiently and where there is a close correlation between the results of the running test and the predictions from the simulation model over the same test track.

Further guidance on the use of simulation is set out in EN 14363:2016+A2:2022, Annex T.

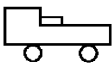
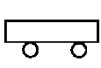
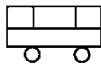
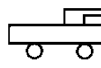
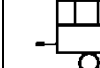
9 Brakes

9.1 General

The main brake system shall comply with EN14198:2016+A2:2021 Clauses 5.1, 5.2, 5.3, 5.6, 5.7 and 5.8, and described in the documentation, see 20.2, Table 8, line n).

For EN14198 requirements, machine category 1, 2, 4 and 6 are considered as locomotives and category 3, 5 and 7 are considered as wagons.

Table 5 — Running mode braking equipment

	Self-propelled machine		Non-self-propelled machine, not intended to carry personnel		Non-self-propelled machine permitted to carry personnel		Non-self-propelled machine with running mode driver's cab		Permanently coupled single wheelset or bogie articulated machine not intended to carry personnel		Permanently coupled single wheelset or bogie articulated machine permitted to carry personnel	
												
Machine Category	1, 2, 4	6	3, 5	7	3, 5	7	3, 5	7	3, 5	7	3, 5	7
EN-UIC main brake system	x	(o)	x	(o)	x	(o)	x	(o)	x	(o)	x	(o)
Direct brake	x ^a	x					(o)	(o)				
Dynamic brake	(o)	(o)										
Parking brake	x	x	x	x	x	x	x	x				
x Mandatory (o) Optional												
^a When the length of inseparable multiple machines is not compatible with a direct brake system, this equipment shall not be fitted.												

If the main brake system is an EN-UIC system (see Table 5), it shall comply with EN 14198:2016+A2:2021, 5.4

Category 6 and 7 machines shall be equipped with a continuous and automatic train brake, but it is not necessary to follow the EN-UIC architecture. Category 6 and 7 machine's brakes shall have an equivalent level of safety as a EN-UIC brake. If the continuous and automatic train brake fitted to Category 6 and 7 machines is not compatible with an automatic EN-UIC brake the connections shall be designed such that it is not possible to connect them to standard EN-UIC connections.

The continuous and automatic train brake should operate on all wheelsets. If it is incompatible with working conditions, it can be acceptable that some wheelsets are not equipped with brake components, provided that the required brake performance is obtained.

Where a machine consists of two or more vehicles (elements) which are semi-permanently coupled, each element of the machine shall be fitted with a minimum of one local brake control unit and associated brake actuators.

The brake calculations shall be shown in the documentation, see 20.2, Table 8, line o).

Some requirements specific to machines are described in 9.2 to 9.11.

9.2 Safety

In addition to EN14198:2016+A2:2021, 52.1, the following requirements shall be applied.

For machines with running mode driving cab, a risk analysis shall also be undertaken to demonstrate that the emergency and parking brake functions are not susceptible to single point failure,

NOTE 1 The analysis set out in Loc&Pas TSI 6.2.3.5 of the scenarios described in Loc&Pas TSI 4.2.4.2.2 Table 3 are acceptable to meet this requirement.

An external impact with an object or animal shall not result in a total and permanent loss of emergency braking effort.

NOTE The demonstration will take into account the design of the brake system, the layout of the brake components and in particular those mounted under the body and any redundancies.

When flexible piping is used between gauges and pneumatic circuit, a restriction choke shall be inserted to minimize air flow in case of flexible piping failure.

All moving brake parts shall be designed and/or protected against falling onto the track.

For single or multiple unit of fix-formation-machines, it should be possible to indicate to the driver a fault condition of any brake system, for example as “one braking circuit not released” or “one braking circuit not braked”.

When the speed of the machine is greater than 15 km/h the service brake activation by the driver shall lead automatically to the cut-off of all tractive effort. This cut-off shall not be reset until the traction command is cancelled by the driver. The tractive effort cut off shall be initiated by the brake pipe pressure being lower than the value of the first braking step. It is permitted to provide a separate function to command the friction brake intentionally with traction at speeds greater than 15 km/h for specific purposes for example de-icing or cleaning of brake components.

The machine shall be capable of rescue, as described in Clause 18.

9.3 Trainwide brake control device

9.3.1 Pneumatic brake control device

Except as permitted by 9.3.2 and 9.3.3 the train wide EN-UIC brake control device (driver's brake valve) shall be in accordance with EN 14198:2016+A2:2021, Annex E.

9.3.2 Simplified pneumatic brake control device

A simplified pneumatic brake control device at consist level is permitted to be fitted to fixed formation machines or machines designed to tow shorter trains (< 150 m, machine included).

A simplified pneumatic brake control device shall provide at least the following functions:

- a) a running/release position with a brake pipe pressure of 5 bar $\pm$ 0,050 bar;
- b) the possibility of graduated service brake application and release:
 - 1) service brake application shall be achieved by lowering pressure in the main brake pipe;
 - 2) the first braking application shall reduce the pressure in the main brake pipe by a minimum of 0,4 bar below the rated pressure for the running position, after the first application it is permitted to be continuously variable;
 - 3) when releasing the brake as the pressure in the brake pipe rises to 0,25 bar below rated pressure (normally 4,75 bar) the pipe pressure shall automatically increase to rated pressure (normally 5 bar), to ensure that the brake distributors will correctly function when required;
 - 4) the brake release application shall be achieved by increasing the pressure in the brake pipe;
- c) emergency brake application, this is permitted to be achieved by a separate control;

- d) a neutral or shut down position which is able to be used to check for pipe leaks;
- e) a brake pipe overcharge function.

The local brake control device overcharge provision shall be made for the pressure in the brake pipe to be adjusted to that in the command reservoir, either by:

- a central command raising the brake pipe pressure to a defined value. This subsequently shall be followed by slow reduction of both the brake pipe pressure and the pressure in the command reservoir, to the nominal brake pipe pressure value or by;
- a local command with manually operated devices on both sides of the machine reducing the pressure in the command reservoir to that of the brake pipe as specified in EN 15355:2019+A1:2023 and EN 14198:2016+A2:2021;
- local solutions as specified in EN 15355:2019+A1:2023 which operate automatically after a central initiation by the train driver are permitted to be used instead.

If there are multiple driving positions it shall not be possible to release the brakes from any driving position which is not in use.

A driver's brake valve used for a machine controlling trains shorter than 150 m is permitted to be verified on the basis of the specification given in EN 14198:2016+A2:2021, Annex E.

9.3.3 Other brake control devices

For category 6 and 7 machines, including single vehicles an alternative design is permitted. Non pneumatic brake control devices and brake systems are permitted but shall meet all the principles set out in EN14198:2016+A2:2021, 5.3.2.1.

9.3.4 Emergency brake

Controls, which are capable of applying the continuous brake in an emergency, shall be fitted in all cabs where personnel are present. They shall be unique to application of emergency brake, clearly visible and easily accessible. The emergency brake application devices shall be clearly labelled as BRAKE ONLY to differentiate them from emergency stop devices as set out in 14.10.1.

The application of the emergency brake shall be possible at any time by:

- the driver (with a minimum of two separate control options);
- the machine safety system initiated by the infrastructure and signalling system;
- any other machine safety system initiated by on-board systems.

Actions of the emergency brake application shall be in accordance with EN14198:2016+A2:2021, 5.4.4.7.

The traction shall be cut off when an emergency brake demand is detected on the brake pipe. This shall be achieved by use of a brake pipe pressure switch on each powered vehicle that cuts power without use of software control.

It shall be possible for the driver to isolate the automatic emergency braking device when it is defective. In the cab, the driver shall be informed if the system is not in service.

Emergency brake valves shall be in accordance with EN 14198:2016+A2:2021, Annex F

9.4 Brake functions to keep a train stationary

9.4.1 Immobilization

In addition to EN 14198:2016+A2:2021, Clause 5.3.2.7.3 the period of immobilization for a category 1, 2, 4 and 6 machine shall align with locomotives and category 3, 5 and 7 shall align with wagons.

9.4.2 Parking brake

In addition to EN 14198:2016+A2:2021 Clauses 5.3.2.7.4, 5.3.2.9, 5.3.3.5 and 5.4.6.7, the following requirements shall be applied. The parking brake shall be described in the documentation, see 20.2, Table 8, line p).

It is permitted to extract air from the brake pipe, via a non-return valve and choke, to supply a reservoir to ensure the operation of the parking brake when the machine is being hauled.

The parking brake performance shall hold the machine on a gradient of 40 ‰ without exceeding a coefficient of friction between the rail and wheel of 0,12. If the machine is intended for use on steep sections of line, a steeper gradient may be required on specific railway infrastructures, see Annex B. Calculations shall conform with EN 14531-1:2015+A1:2018, Clause 5.

If the parking brake is applied by a hand wheel/crank and it is located outside the cab it shall at all times be accessible from both sides of the machine.

NOTE Typically the handwheel has an effective minimum diameter of 400 mm for visibility.

If other parking brake controls are located outside the cab they shall be accessible from both sides of the outside of the machine.

When the parking brake is controlled from the cab, the status of the parking brake (not released = red, released = green) shall be indicated in a clear and concise manner visible from both sides of the machine, such as described in EN 15220:2016, Annex A. The parking brake application and release status should also be indicated to the driver in the cab in use, on the control desk.

If fitted, a spring applied parking brake shall not apply in the case of:

- accidental draining of the auxiliary reservoir.
- isolating and purging of any distributor.

In case of a direct driver's command from the cab, it shall fulfil the following requirements:

- accidental application of the parking brake shall not be possible at speeds greater than 3 km/h;
- activation or deactivation of any cab shall not lead to unintended applications or releases of the parking brake;

9.5 Brake function at vehicle level

Where fitted empty-loaded changeover device shall be in accordance with EN 15624:2021.

All controls shall be able to be operated from both sides of the machine.

Where fitted composite brake blocks shall be in accordance with EN 16452:2015+A1:2019 and used in the configuration in which they have been validated.

Measures shall be taken to reduce the side play of brake blocks or brake block holders on the tread area of the wheel and to avoid mechanical interference.

9.6 Additional brake systems

9.6.1 Dynamic brake

A dynamic brake is permitted to be fitted in accordance with EN 14198:2016+A2:2021, 5.6.1.

NOTE Where there is a combined system with logic control it is normal practice that the brake force generated by the dynamic brake is used in preference to the friction brake.

Braking effects of hydrostatic transmissions shall not be considered as a dynamic brake or a contribution to an emergency brake, unless satisfied by safety assessment as set out in EN 14198:2016+A2:2021, 5.6.1.1.

9.6.2 Direct brake

In addition to EN 14198:2016+A2:2021 Clause 5.6.2, the following requirements shall apply:

A machine with a running mode driver's cab shall be equipped with an additional direct brake or alternatively two separate and independent brake control units each with the same performance.

Except in the case shown in Table 5, footnote a, the brake performance for the direct brake shall be equal to or better than that achieved with the continuous and automatic train brake in brake mode "P".

If there are multiple driving positions, it should not be possible to use the direct brake from any driving position which is not in use.

9.6.3 Magnetic track brake

Where a magnetic track brake system is fitted the design and test shall be in accordance with EN 16207:2024.

9.7 Compressed air supply

9.7.1 General requirements

In addition to the EN14198:2016+A2:2021 Clause 5.9, the following requirements shall be applied.

As a minimum, the compressed air production of self-propelled machines shall ensure sufficient air supply for the number of hauled vehicles fitted with air brakes that the machine is designed to haul.

The quantity of compressed air that can be produced and the number of braked wheelsets of hauled wagons/machines shall be recorded in the documentation, see 20.2 Table 8 line q).

The minimum capacities based on a maximum pressure of 10 bar are given in Table 6.

Table 6 — Minimum compressed air production for the number of hauled braked wheelsets

Compressed air production in l/min at the maximum speed of the compressor	300	500	800	1 000	1 250	1 500	2 000	2 500	3 000
Maximum number of braked wheelsets	6	12	28	44	52	80	104	136	160
Minimum capacity of main air reservoirs in l	200	200	280	440	520	800	800	800	800

If the same compressor fills the different air reservoirs and auxiliary air reservoirs, the filling of the brake system shall have priority.

9.7.2 Air reservoir

As a minimum the auxiliary reservoir capacity shall provide two emergency applications under maximum load conditions (with the brake pipe as the unique source of supply). If the machine is fitted with WSP the brake supply reservoirs shall be dimensioned such that the air consumption by WSP does not impair the performance of the pneumatic brake. The type and mounting of air reservoirs shall be in accordance with the requirements of EN 286-3:1995 and/or EN 286-4:1995.

The main air reservoir shall be fitted with drainage devices and shielded where necessary from loose flying ballast.

The equalizing reservoir, control reservoir, auxiliary reservoir shall either not be equipped with drainage devices, or the drainage device shall be lockable and shielded from inadvertent activation.

Brake reservoirs shall not be fitted with quick fit connections.

9.7.3 Air quality

In accordance with ISO 4975:2022, the compressed air purity produced by the Air Generation and Treatment Unit (AGTU) shall be as follows: compressed air purity (ISO 4975) 4 - 3 - 4 [-25 °C ; 50 °C] or better.

9.8 Brake hose connections

For machines fitted with EN-UIC brake, the brake half couplings shall meet the requirement of EN 15807:2021. The end cock shall be in accordance with EN 14601:2005+A2:2021 and their mountings on the machine shall be in accordance with EN 16839:2022.

When flexible brake pipes are fitted between semi-permanently coupled machines, the air shut-off cocks, if fitted, shall be capable of being locked in their opened positions.

9.9 Wheel-slide protection

Where a wheel-slide protection system is fitted it is permitted to prove the effectiveness of the wheel slide protection system either by:

- modelling the WSP system and then a functional test at 15 km/h to validate the model. The assessment method is described in EN 15595:2018+A1:2023, 7.4.2 with a maximum speed of 15 km/h; or
- by assessment method at as set out in EN 15595:2018+A1:2023.

9.10 Enhanced wheel rail adhesion devices

Where machines are fitted with enhanced wheel rail adhesion devices, intended for use during braking, they shall comply with EN 14198:2016+A2:2021, 5.10.

9.11 Performance

The brake performance shall comply with EN14198:2016+A2:2021, Clause 6.

The brake performance shall be consistent with the lines it is intended to operate on.

NOTE 1 Additional information is given in OPE TSI 4.2.2.6.2.

NOTE 2 For machines incorporated in regular freight trains (Using the General Contract for Use (GCU)), additional information on brake performance is given in Appendix C.9 (UIC brake) of the Wagon TSI.

NOTE 3 Where machines are intended to comply with Wagon TSI Appendix C.9 for their braking performance and braked using composite brake blocks on wheels with a nominal wheel diameter of max 1 000 mm, minimal worn 840 mm, a braked weight per wheelset exceeding 15,25 t (14,5 t plus 5 %) may cause thermal damage.

9.12 Testing

9.12.1 General

Type tests of the train braking system shall be specified and carried out to demonstrate compliance with the requirements of this document. These tests shall in particular verify the functionality, settings and performance of the braking system, for both the control and actuator parts of the brake.

Suitable means of measuring the physical quantities shall be used, with a measurement uncertainty consistent with the tolerances to be measured.

The tests shall cover all configurations in the case of single and multiple unit operation.

Routine tests shall be carried out on every vehicle to verify conformance with the type-tested vehicle/train.

9.12.2 Static tests

Each machine shall be statically tested in order to validate the pneumatic and electrical operation of the machine braking system. The static brake test shall be described in the documentation, see 20.5 Table 11 line a).

NOTE The contents of a typical static brake test are described in EN 15806:2010.

For subsequent machines of the same type the measurement of static forces at brake blocks or pads and the inexhaustibility check is not necessary if such a type test was previously undertaken.

9.12.3 Dynamic tests

For Category 1, 2, 4 and 6 machines, the first machine of a new design, dynamic testing in accordance with EN 16834:2019 shall be performed up to the maximum running speed.

If the speed of the machine when incorporated into a train formation is higher than the self-propelled running speed, the test shall also be performed as a hauled machine. For Category 3, 5 and 7 machines, the first machine of a type, on-track tests should be performed in accordance with the slip-test method. If the mass of the machine or safety requirements is not compatible with slip testing, a specific test procedure shall be individually defined.

Simplified dynamic brake tests are permitted for machines if the machine under consideration is of a similar design to a reference machine which has previously been tested completely to demonstrate functionality of the brake. Where the design of machine has changed and has an impact on the brake