



BSI Standards Publication

Safety rules for the construction and installation of lifts — Special lifts for the transport of persons and goods

Part 43: Lifts for cranes

National foreword

This British Standard is the UK implementation of EN 81-43:2025. It supersedes BS EN 81-43:2009, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MHE/4, Lifts, hoists and escalators.

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

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von Aufzügen - Besondere Aufzüge für den Transport
von Personen und Gütern - Teil 43: Kranführeraufzüge

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European foreword

This document (EN 81-43:2025) has been prepared by Technical Committee CEN/TC 10 “Lifts, escalators and moving walks”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2025, and conflicting national standards shall be withdrawn at the latest by March 2027.

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

This document supersedes EN 81-43:2009.

This document is part of the EN 81 series of standards. The structure of the EN 81 series is described in CEN/TR 81-10:2008.

EN 81-43:2025 includes the following significant technical changes with respect to EN 81-43:2009:

- revision of requirements for design/calculation (4.2) and integration of requirements for earthquakes;
- performance level in accordance with EN ISO 13849-1:2023 have been added;
- a new Annex B (informative) providing information about differences between temporarily installed lifts/permanent installed lifts has been added;
- a new Annex C (normative) for lifts installed on tower cranes have been added.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For the relationship with EU Legislation, see informative Annex ZA, which is an integral part of this document.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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

Introduction

This document is a type-C standard as stated in EN ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

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

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

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

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

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

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

1 Scope

1.1 This document specifies the safety requirements for the construction and installation of power operated lifts attached to cranes and intended for access to workplaces on cranes. The lift serves defined landing levels and has a car which is:

- a) designed for the transportation of persons and goods;
- b) guided;
- c) travelling vertically or along a path within 15 degrees maximum from the vertical;
- d) supported by rack and pinion or suspended by steel wire ropes;
- e) travelling with a speed not more than 1,0 m/s for permanent installed lifts and not more than 0,4 m/s for temporarily installed lifts.

1.2 This document identifies hazards as listed in Annex A that arise during the various phases in the life of such equipment and describes methods for the elimination or reduction of these hazards when used as intended by the manufacturer.

This document deals with significant hazards, hazardous situations and events relevant to lifts for cranes, when it is used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer. This document specifies the appropriate technical measures to eliminate or reduce risks arising from the significant hazards (see Annex A).

1.3 This document does not specify requirements for:

- a) noise;
- b) lightning;
- c) potentially explosive atmospheres;

NOTE Directive 2014/34/EU concerning equipment and protective systems intended for use in potentially explosive atmospheres can be applicable to the type of machine or equipment covered by this document. The present standard is not intended to provide means of complying with the essential health and safety requirements of Directive 2014/34/EU.

- d) electromagnetic compatibility (emission, immunity);
- e) handling of loads the nature of which could lead to dangerous situations (e.g. molten metal, acids/bases, radiating materials, fragile loads);
- f) the use of combustion engines;
- g) hydraulic drive units.

1.4 This document is not applicable to:

- a) builders hoists according to EN 12158-1:2021, EN 12158-2:2000+A1:2010 and EN 12159:2024 and transport platforms according to EN 16719:2018;
- b) elevating control stations according to EN 14502-2:2005+A1:2008;

c) lifts according to EN 81-20:2020.

1.5 This document deals with the complete lift design but excludes the design of the crane. It includes the base frame and base enclosure of the lift but excludes the design of any concrete, hard core, timber or other foundation arrangement. It includes the design of mast ties and the design of anchorage parts between the mast tie and the crane structure. This document also includes the design of the landing gates and their fixings.

1.6 This document does not apply to lifts for cranes manufactured before the date of publication of this document by CEN.

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 81-20:2020, *Safety rules for the construction and installation of lifts - Lifts for the transport of persons and goods - Part 20: Passenger and goods passenger lifts*

EN 81-50:2020, *Safety rules for the construction and installation of lifts - Examinations and tests - Part 50: Design rules, calculations, examinations and tests of lift components*

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

EN 1808:2015, *Safety requirements for suspended access equipment - Design calculations, stability criteria, construction - Examinations and tests*

EN 1998-1:2004, *Eurocode 8: Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings*

EN 1999-1-1:2023, *Eurocode 9 - Design of aluminium structures - Part 1-1: General rules*

EN 13001-1:2015, *Cranes - General design - Part 1: General principles and requirements*

EN 13001-2:2021, *Crane safety - General design - Part 2: Load actions*

EN 13001-3-1:2012+A2:2018, *Cranes - General Design - Part 3-1: Limit States and proof competence of steel structure*

EN 13586:2020, *Cranes - Access*

EN 14439:2006+A2:2009, *Cranes - Safety - Tower cranes*

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

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

EN IEC 60947-4-1:2019, *Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters (IEC 60947-4-1:2018)*

EN 60947-5-1:2017, *Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices*

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

EN ISO 13849-1:2023, *Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2023)*

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

EN ISO 13856-3:2013, *Safety of machinery - Pressure-sensitive protective devices - Part 3: General principles for design and testing of pressure-sensitive bumpers, plates, wires and similar devices (ISO 13856-3:2013)*

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

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

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

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

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

ISO 4309:2017, *Cranes — Wire ropes — Care and maintenance, inspection and discard*

ISO 6336-1:2019, *Calculation of load capacity of spur and helical gears — Part 1: Basic principles, introduction and general influence factors*

ISO 6336-2:2019, *Calculation of load capacity of spur and helical gears — Part 2: Calculation of surface durability (pitting)*

ISO 6336-3:2019, *Calculation of load capacity of spur and helical gears — Part 3: Calculation of tooth bending strength*

ISO 6336-5:2016, *Calculation of load capacity of spur and helical gears — Part 5: Strength and quality of materials*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010 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

lift

machine with a car which is guided and intended for transport between different levels

3.2

rated load

maximum load for which the lift has been designed to carry in service

3.3

rated speed

travelling speed of the car in m/s for which the equipment has been designed

3.4

wire rope lift

lift which uses a wire rope as an element in the drive system to move the car

3.5

supporting structure

crane and its foundations, giving vertical or horizontal support to the mast of the lift

3.6

rack and pinion lift

lift which uses a toothed rack and pinion as the load suspension and drive system

3.7

base frame

lowest framework of the lift, upon which the mast is supported

3.8

guide rails

rigid elements which determine the travel way of the car, that can form part of the mast

3.9

mast

structure that supports and guides the car

3.10

mast section

indivisible piece of mast between two adjacent mast joints

3.11

mast tie

connection system between the mast of the lift and the supporting structure, providing horizontal support for the mast

3.12

liftway

total space which is travelled by the car

3.13

car

hoist cage including floor, walls, gates and roof

3.14

stopping distance

distance the car moves from the moment when the control or safety circuit is broken until the car has come to a full stop

3.15**overspeed safety device**

combination of overspeed detecting device (3.17) and safety gear (3.18)

3.16**overspeed detecting device**

device which, when the lift attains a predetermined speed in downwards direction, causes the safety gear to be triggered/applied

3.17**safety gear**

mechanical device for stopping and maintaining stationary the lift car on the guide rail, rack or rope

3.18**slack rope**

rope, normally under tension, from which all external loads have been removed

3.19**wire rope termination**

adaptation at the end of a wire rope permitting attachment

3.20**landing**

level in the crane structure intended for loading and unloading the car

3.21**guard rail**

fixed equipment, other than gates, which is used to prevent people from falling or from reaching hazardous areas

3.22**normal operation**

usual operating conditions for the lift when in use for carrying loads but excluding routine maintenance, erection, dismantling etc. of the lift

3.23**in service**

condition during use of the lift when the car is in any position, loaded or unloaded, moving or stationary

3.24**out of service**

installed condition when the unloaded car is positioned such that it is provided with the most shelter from the wind (normally, but not necessarily, ground level)

3.25**overrun**

travel of the car beyond the normal stopping positions at its uppermost and its lowermost landing

3.26**temporarily installed lift for cranes**

lift attached to or installed inside tower cranes for temporary construction

Note 1 to entry: A lift installed inside a crane is considered temporarily installed even if it remains inside the structural elements of the crane but the crane is regularly assembled and disassembled.

3.27

permanently installed lift for cranes

lift attached to cranes, not covered by 3.26

3.28

safety rope

steel wire rope, only carrying the load when the safety device is activated

3.29

lift landing platform

platform and access means intended to provide access and rest at a landing level located between the tower crane own accesses and the landing gate of a lift

Note 1 to entry: The lift landing platform can be integrated into the rest platform of the tower crane

3.30

unlocking zone

zone, extending above and below the landing level, in which the car floor has to be to enable the corresponding landing gate to be unlocked

3.31

buffer

resilient stop at the end of travel, and comprising a means of braking using fluids or springs (or other similar means)

4 Safety requirements and/or protective measures

4.1 Design consideration

The design of the lift shall consider normal operation, erection, dismantling, inspection and maintenance.

In addition, the machine shall be designed according to the principles of EN ISO 12100:2010 for hazards relevant but not significant, which are not dealt with by this document (e.g. sharp edges).

The design of all components that have to be handled during erection e.g. mast sections, shall have their weight assessed against manual handling.

All removable and detachable covers shall be retained by captive fastenings.

Specific design requirements for the installation of lift on tower cranes are given in Annex C, C.2.

4.2 Load actions and proof of competence

4.2.1 General

The proof of competence shall be made according to EN 13001-1:2015 using load actions and load combinations according to this standard amended by information given in EN 13001-2:2021 and EN 13001-3-1:2012+A2:2018. If specific values are given in the product standards of the crane, those shall be taken.

The design of the structure of the lift as a whole and each part of it shall be based on the effects of any possible combination of loads as specified in this clause. The load combinations shall consider the least favourable locations of the car and load relative to the mast and its ties, both during the vertical passage of the car and any horizontal movement of the car. Ties between the mast and the supporting structure are considered to be part of the lift structure.

The structure of the lift shall be designed in such a way that the proof of competence is fulfilled under all conditions, including erection and dismantling.

These load combinations are summarized in Table 2.

Use of forces, load combinations and formulas in accordance with EN 81-20:2020, 5.7 is accepted for permanent installed lifts. Forces and load combinations not covered by EN 81-20:2020 such as mobility, wind forces and rated load shall be calculated according to this document.

The impact factors μ_1 and μ_2 shall be applied the in the same way as the dynamic factors ϕ_i as described in EN 13001-1:2015.

Table 2 — Load combinations and safety factors

Categories of loads	Clause in this document	Loads	No.	Load combinations A		Load combinations B			Load combinations C										
				γ_p	A1	A2	γ_p	B1	B2	γ_p	C1	C2	C3	C4	C5	C6	C7	C8	C9
Regular loads	4.2.2	All dead weights with the exception of the car a)	1	1,22	ϕ_1	ϕ_1	1,16	ϕ_1	ϕ_1	1,1	1	ϕ_1	1	ϕ_1	1	1	1	1	1
	4.2.2 4.2.4.1	Dead weight of the unloaded car	2	1,22	μ_1	1	1,16	μ_1	1	1,1	1	1	1	1	1	1	μ_1	μ_2	μ_1
	4.2.3.1 4.2.4.1	Rated load evenly distributed	3	1,34	μ_1		1,22	μ_1		1,1	1	1	1	1	1	1	μ_1	μ_2	
	4.2.3.2	Rated load during loading and unloading	4	1,34		1	1,22		1	1,1									
	4.2.5.1	Vertical forces due to mobility	5	1,34	ϕ_4	ϕ_4	1,22	ϕ_4	ϕ_4	1,1						-			
	4.2.5.2	Horizontal forces due to mobility	6	1,34	ϕ_5	ϕ_5	1,22	ϕ_5	ϕ_5	1,1						-			
Occasional loads	4.2.6.2	Wind in service a)	7				1,22	1	1	1,1									
	-	Snow and ice b)	8				1,22	1	1	1,1	1								
	-	Temperature c)	9				1,16	1	1	1,05	1								
Exceptional loads	4.2.6.3	Wind out of service a)	10							1,1	1								
	4.2.4.3	Forces created by the buffers of the lift	11							1,1		ϕ_7							
	4.2.5.3	Forces created by the buffers of the crane a)	12							1,1		ϕ_7							
	4.9.5 4.2.4.2	Forces created by emergency stop of the lift	13							1,1			ϕ_5						
	4.2.5.2	Forces created by emergency stop of the crane a)	14							1,1				ϕ_5					
	4.2.7	Forces due to seismic accelerations a)	15							1,1					1				

Categories of loads	Clause in this document	Loads	No.	Load combinations A			Load combinations B			Load combinations C									
				γ_p	A1	A2	γ_p	B1	B2	γ_p	C1	C2	C3	C4	C5	C6	C7	C8	C9
	4.2.6.4	Forces due to erection and dismantling of the lift, incl. wind loads a)	16								1,1						1		
	4.2.8	Evenly distributed test load	17								1,1								μ_1
Overall safety factor γ_f (for allowable stress design)		Steel		1,48			1,34			1,22									
		Aluminium		1,71			1,55			1,41									
Resistance coefficient γ_m		Steel		1,1			1,1			1,1									
		Aluminium		1,28			1,28			1,28									

Index:	
a)	Load according to EN 13001-2:2021 or the product standard of the crane
b)	Load according to EN 13001-2:2021, 4.2.3.2 or the product standard of the crane
c)	Load according to EN 13001-2:2021, 4.2.3.3 or the product standard of the crane
Parameter:	
γ_p	Partial safety factor
γ_m	Resistance coefficient
γ_f	Overall safety factor
μ_1	Impact factor on moving loads in case of normal travelling (4.2.4.1)
μ_2	Impact factor on moving loads in case of activation of overspeed safety device (4.2.4.2)
ϕ_1	Dynamic factor for hoisting and gravity effects acting on the mass of the crane (EN 13001-2:2021)
ϕ_4	Dynamic factor for loads caused by travelling on uneven surface (EN 13001-2:2021)
ϕ_5	Dynamic factor for loads caused by acceleration of all crane drives (EN 13001-2:2021)
ϕ_7	Dynamic factor for loads due to buffer forces (EN 13001-2:2021)
Load combination definitions:	
A – Load combinations A contain loads for normal use of crane and lift	
A1	Normal use of the lift and normal use of the crane (lifting and lowering of crane load)
A2	Loading and unloading of the lift and normal use of the crane
B – Load combinations B contain loads for normal use combined with occasional loads	
B1	A1+ wind in service, snow and ice and temperature
B2	A2+ wind in service, snow and ice and temperature
C – Load combinations C contain loads for normal use combined with exceptional loads	
C1	Lift and crane out of service
C2	Lift contacts the buffer
C3	Crane contacts the buffer
C4	Emergency-stop of the lift
C5	Emergency-stop of the crane
C6	Excitation of lift and crane due to seismic loads, where applicable
C7	Erection and dismantling of the lift
C8	Triggering of overspeed safety device of the lift
C9	Overload test with 1,25-times of rated load

4.2.2 Dead weight

When calculating the lift structure and every related component, the gravity forces of following masses shall be taken into account:

- all masses with the exception of the car and equipment which moves together with the car;
- mass of the unloaded car and all equipment which moves together with the car;
- mass of landing platforms and gates, if supported by the lift.

4.2.3 Rated load

4.2.3.1 Rated load during normal use

Rated load evenly distributed over the floor area of the car shall be considered. Where the uniform distribution of the rated load over the full area of the car floor is less than $4,0 \text{ kN/m}^2$ then, for calculation purposes a minimum of $4,0 \text{ kN/m}^2$ shall be placed over the whole area of the car floor.

4.2.3.2 Loads during loading and unloading

For rated loads greater than $5,0 \text{ kN}$ the forces during loading and unloading (see Figure 1) shall be considered as the concurrent effect of a vertical force and a horizontal force, each calculated as follows:

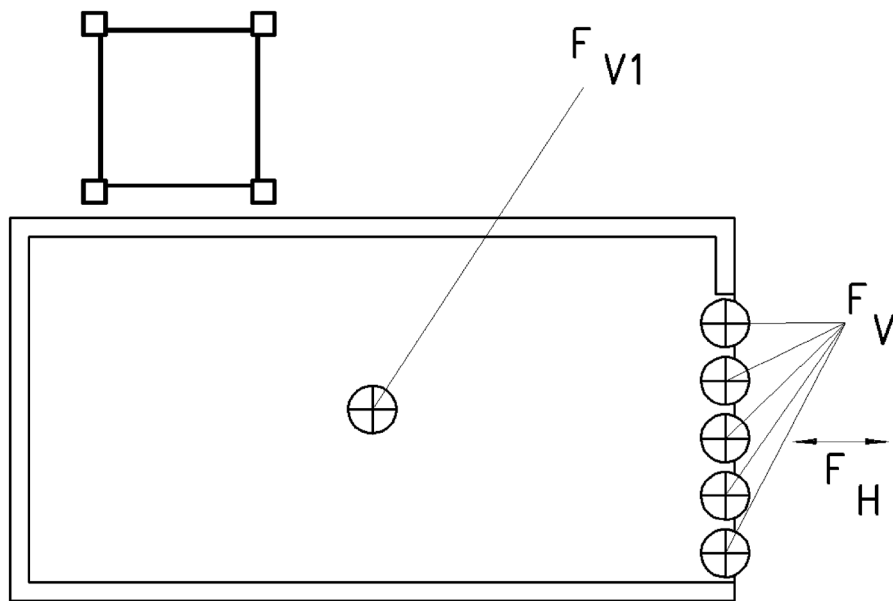
- a vertical force F_V of $2,0 \text{ kN}$ per $1,0 \text{ m}$ width of the car entrance, but not less than $1,5 \text{ kN}$;
- a horizontal force F_H of 10% of the rated load, but not less than $0,3 \text{ kN}$;

both forces acting in the middle of the width of the car entrance, at floor level. The stresses in the mast and also in the car shall be calculated for at least the following application points of the loading and unloading forces:

- a) the car threshold;
- b) the leading edge of any ramp or other extension, which is not supported by the landing.

At the same time any remaining part of the rated load shall be applied in the centre of the car floor (F_{V1}).

Equivalent forces shall be used to design the landing threshold and all relevant supporting structures. Information shall be given in the instruction handbook with regard to these forces.

**Key**

- F_h horizontal force
- F_v vertical force
- F_{v1} rated load in the centre

Figure 1 — One example of forces during loading and unloading

4.2.4 Impact and dynamic factors due to movement of the lift car

4.2.4.1 The effect of moving loads shall be determined by taking the weight of all masses (car, rated load, wire ropes etc.) and multiplying them by an impact factor $\mu_1 = (1,1 + 0,264v)$ where v is the rated speed in m/s.

4.2.4.2 To determine the forces produced by an operation of the overspeed safety device, the sum of the travelling weight shall be multiplied by the factor according to EN 81-20:2020, 5.7.4.4.

A lower factor, but not less than 1,2 can be used if it may be verified by test under all conditions of loading up to 1,3 times rated load including any inertia effects of the drive unit.

4.2.4.3 Forces created by driving against the buffers shall be calculated correspond to a retardation of 1 g .

4.2.5 Loads due to movements and deflection of the crane

4.2.5.1 A vertical force depending on the speed of the crane caused by travelling on uneven surface shall be taken into account according to EN 13001-2:2021, 4.2.2.4.

4.2.5.2 Horizontal forces due to the movements of the crane structure to which the lift is fitted (e.g. travelling, etc. as well as emergency stops) shall be taken into account according to EN 13001-2:2021, 4.2.2.5 and 4.2.4.7.

4.2.5.3 Buffer forces due to the crane movements shall be taken into account according to EN 13001-2:2021, 4.2.4.4.

4.2.5.4 Loads due to deflection of the crane structure to which the lift is fitted, see 4.4.2 and 6.1.2.3 h).

NOTE For lifts installed on tower cranes, see Annex C.

Information shall be given in the instruction handbook with regard to these forces.

4.2.6 Loads due to wind

4.2.6.1 General

Loads due to wind shall be calculated according to EN 13001-2:2021.

When calculating wind load on the car it shall be assumed that the car walls are solid and an aerodynamic coefficient of $c = 1,2$ shall be applied.

The aerodynamic wind pressure $q(z)$ is calculated by the general equation:

$$q(z) = \rho / 2 * v(z)^2$$

where

$q(z)$ is the equivalent static wind pressure in $[N/m^2]$;

$\rho = 1,25$ is the density of the air $[kg/m^3]$;

$v(z)$ is the equivalent static wind velocity corresponding to the 3 s gust wind velocity in $[m/s]$;

z is the height above the surrounding ground level in $[m]$.

NOTE In all cases it is reminded that the wind can blow horizontally in any direction.

4.2.6.2 In service wind loads

Irrespective of the height above ground, the minimum value of the wind pressure shall be $q(3) = 250 N/m^2$, which corresponds to a gust wind velocity of $v(3) = 20,0 m/s$.

4.2.6.3 Out of service wind loads

For out of service wind condition, regional storm wind velocities according to EN 13001-2:2021, 4.2.4.2 shall be applied. As a minimum requirement, the wind velocity of region C shall be used.

In EN 13001-2:2021, 4.2.4.2, the reference wind velocity to consider the regional meteorological conditions is given with a recurrence interval of once in 50 years as the basic value. Depending on the installation time of the crane and the lift different recurrence periods shall be selected:

- for permanently installed lifts a recurrence period $R = 50$ years shall be used;
- for temporarily installed lifts a recurrence period $R = 25$ years may be used.

If specific values are given in the product standards of the crane, those shall be taken

4.2.6.4 Wind loads during erection and dismantling

Irrespective of the height above ground, the minimum value of the wind pressure shall be $q(3) = 100 N/m^2$, which corresponds to a gust wind velocity of $v(3) = 12,5 m/s$.

4.2.7 Loads due to seismic accelerations

Loads due to seismic accelerations shall be calculated according to EN 1998-1:2004. Thereby the crane location, i.e. the regional seismic conditions and the local subsoil conditions, and the dynamic

characteristics of the crane together with the lift, i.e. the natural frequency and the damping characteristics, shall be taken into account.

In EN 1998-1:2004, the reference peak ground acceleration to consider the regional seismic conditions is given with a recurrence interval of once in 475 years as the basic value. Depending on the installation time of the crane and the lift different recurrence periods may be selected:

- For permanently installed lifts a recurrence period $R = 475$ years shall be used.
- For temporarily installed lifts, loads due to seismic accelerations to be considered only on request of the users. A recurrence period $R = 100$ years may be used.

4.2.8 Test loads

For overload testing a load of 1,25 rated load shall be used evenly distributed on the lift car floor.

4.2.9 Special load actions acting on parts of the lift car

The car roof, if intended to be accessible during erection, dismantling, maintenance or emergency escape, shall be designed to withstand a load of at least 2,0 kN impacting a square area of 1,0 m². The roof shall also withstand a load of 1,2 kN applied on any area of 0,1 × 0,1 m.

4.2.9.2 The car floor surface shall be designed considering a static force of 1,5 kN or 25 % of the rated load whichever is the greater impacting a square, area of 0,1 m × 0,1 m.

4.2.10 Proof of competence

4.2.10.1 Proof of static strength

The proof of static strength of steel structures shall be made according to EN 13001-3-1:2012+A2:2018.

The proof of static strength of aluminium structures shall be made according to EN 1999-1-1:2023.

4.2.10.2 Proof of fatigue strength

The proof of fatigue strength shall be made for all load bearing components and joints, which are critical to fatigue, such as shafts and gears. This analysis shall take into account the degree of stress fluctuation and the number of stress cycles, which can be a multiple of the number of load cycles.

To determine the number of stress cycles, the manufacturer shall take the following into account:

- a) 50 % of the movements with 50 % of the rated load in the car;
- b) 50 % of the movements with empty car;
- c) for the calculation of the drives each movement consists of acceleration from rest to rated speed travel at rated speed for nominal travel distance – deceleration to full stop (see also 6.1.2.10).

The number of movements is based on $1,6 \times 10^5$ – intermittent duty (e.g. 20 years, 50 weeks per year, 80 hours per week, 1 movement per hour). Nominal travel distance shall be 35 m.

The number of movements for lifts installed on tower cranes under construction site conditions is based on $1,6 \times 10^4$ – intermittent duty (e.g. 10 years, 40 weeks per year, 40 movements per week). Nominal travel distance shall be 50 m.

Each shaft shall possess a minimum safety factor of 2,0 against the appropriate endurance limit, taking into account all notch effects.

4.3 Base frame

The base frame shall be designed to accommodate all forces acting on it generated by the lift and be able to transfer them onto the supporting surface.

4.4 Mast, ties and buffers

4.4.1 Guide rails and masts

4.4.1.1 The car shall be guided by rigid guide rails and elements allowing only travel of the car in the intended direction. The car shall be guided over its full length of travel including the overrun at top and bottom.

The deflection for temporarily installed lifts of any part of the car, guide rails and elements shall be limited such that no collision (e.g. with the landings) can occur (under all circumstances). The operational clearances specified in the document shall always be maintained. For permanently installed lifts the requirements in EN 81-20:2020, 5.7.4.6 applies.

The travel of the lift shall be limited at the bottom of its travel by buffers and provided with mechanical or electrical means at the top (see also 4.5.6.3). This means shall be in work as well during normal operation and maintenance.

4.4.1.2 Guide rails and elements shall be so designed that they can withstand all load cases as stipulated in 4.2.

4.4.1.3 Connections between individual lengths of guide rails shall maintain alignment. Loosening shall only be possible by an intentional manual action.

4.4.1.4 Connections between mast sections shall provide effective load transfer. Loosening shall only be possible by an intentional manual action.

4.4.1.5 Attachments of drive elements (e.g. rack) to the mast shall ensure that the drive element is kept in correct position so that the stipulated loads can be transferred to the mast and that the fixings are ensured from coming loose.

4.4.2 Ties for mast and guide rails

The ties shall be so designed that they take care of the movements of the supporting structures (e.g. tower crane mast) and withstand the load cases according to 4.2. Special attention shall be paid to forces generated during erection and dismantling.

4.4.3 Buffers

4.4.3.1 The travel of the car shall be limited at the bottom of its travel by buffers.

4.4.3.2 With rated load in the car and at a speed equal to triggering speed of the overspeed safety device, the average retardation of the car during action of the buffers shall not exceed 1 *g*, with no peak exceeding 2,5 *g* for more than 0,04 s (consider rated load in the car plus inertia effects of the motors) (see 4.2.4.3).

4.4.3.3 If fitted, oil buffers shall be provided with a means for checking the oil level. An electrical safety switch shall monitor the stroke of the oil buffer so that the car cannot be driven by the normal operating means unless the buffer is in its normal extended position.

4.4.3.4 The energy accumulation type buffers with nonlinear characteristics and energy dissipation type buffers are regarded as safety components and shall be verified according to EN 81-50:2020, 5.5.