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STANDARDS Australia

Lifts, escalators and moving walks

Part 1.3: Safety rules for the construction and installation of lifts — Examinations and tests — Design rules, calculations, examinations and tests of lift components

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Lift Engineering Society of Australia

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Lifts, escalators and moving walks

Part 1.3: Safety rules for the construction and installation of lifts — Examinations and tests — Design rules, calculations, examinations and tests of lift components

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Preface

This Standard was prepared by the Standards Australia Committee ME-004, Lift Installations.

The objective of this document is to specify the design rules, calculations, examinations and tests of lift components which are referred to by other standards used for the design of passenger lifts, goods passenger lifts, goods only lifts, and other similar types of lifting appliances.

This document is identical with, and has been reproduced from, 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.*

As this document has been reproduced from an International Standard, a full point substitutes for a comma when referring to a decimal marker.

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The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

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European foreword

This document (EN 81-50:2020) 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of an identical text or by endorsement, at the latest by August 2020, and conflicting national standards shall be withdrawn at the latest by February 2022.

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 81-50:2014.

This document is a revision of EN 81-50:2014. Significant changes made are as follows:

— All externally referenced standards have now been dated

— A new Annex ZA has been developed in order to be aligned with the requirements of the EU Commission Standardization Request "M/549 C(2016) 5884 final"

No technical changes have been made during this revision

This standard is the culmination of the progressive development of the EN standards for lifts. Previous versions of the EN 81-1 and EN 81-2 standards incorporated into EN 81-20:2020 and EN 81-50:2020 include:

— EN 81-1:1985, Safety rules for electric lifts;

— EN 81-1:1998, Safety rules for electric lifts;

— EN 81-1:1998, Corrigendum No 1:1999;

— EN 81-1:1998/A1:2005, incorporating programmable electronic system in safety related applications for lifts;

— EN 81-1:1998/A2:2004, incorporating machine-room-less lifts;

— EN 81-1:1998+A3:2009, Incorporating unintended car movement with open doors;

— EN 81-2:1987, Safety rules for hydraulic lifts;

— EN 81-2:1998, Safety rules for hydraulic lifts;

— EN 81-2:1998, Corrigendum No 1:1999;

— EN 81-2:1998/A1:2005, incorporating programmable electronic system in safety related applications for lifts;

— EN 81-2:1998/A2:2004, incorporating machine-room-less lifts;

— EN 81-2:1998+A3:2009, incorporating unintended car movement with open doors.

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The content of this standard provides the design rules, calculations, examinations and tests for lifts component, the requirements of which are specified in other EN 81 series of standards. Therefore this standard can only be used in conjunction with the standards for specific lift types, e.g. EN 81-20 for passenger and goods passenger lifts.

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

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

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

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

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Introduction

The object of this standard is to define safety rules related to lifts with a view to safeguarding persons and objects against the risk of accidents associated with the user-, maintenance- and emergency operation of lifts.

Reference should be made to the respective introductions of the standards calling for the use of this standard with regard to persons and objects to be safeguarded, assumptions, principles, etc.

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1 Scope

This document specifies the design rules, calculations, examinations and tests of lift components which are referred to by other standards used for the design of passenger lifts, goods passenger lifts, goods only lifts, and other similar types of lifting appliances.

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 10025 (series), *Hot rolled products of non-alloy structural steels - Technical delivery conditions*

EN 12385-5:2002, *Steel wire ropes - Safety - Part 5: Stranded ropes for lifts*

EN 60068-2-6:2008, *Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)*

EN 60068-2-14:2009, *Environmental testing - Part 2-14: Tests - Test N: Change of temperature*

EN 60068-2-27:2009, *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock*

EN 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

EN 60664-1:2007, *Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests*

EN 60947-4-1:2010, *Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters*

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

EN 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements*

EN 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

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

EN 61508-7:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 7: Overview of techniques and measures*

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

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3 Terms and definitions

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

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

• IEC Electropedia: available at http://www.electropedia.org/

• ISO Online browsing platform: available at http://www.iso.org/obp

3.1
approved body
organization or manufacturer, operating an approved full quality assurance system to undertake testing of safety components

3.2
safety component
component provided[1)] to fulfil a safety function when in use

3.3
type examination certificate
document issued by an approved body carrying out a type-examination in which it certifies that the product example under consideration complies with the provisions applicable to it

4 List of significant hazards

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

[1)] Under the Lifts Directive there is a list of items considered as safety components including safety gear, speed governor, landing door locks, etc. For the purposes of this standard other components may also be regarded as safety components where the aim is to certify their safe operation by type testing.

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Table 1 — List of significant hazards

No	Hazards as listed in Annex B of EN ISO 12100:2010	Relevant clauses
1	**Mechanical hazards** due to:	
	Acceleration, deceleration (kinetic energy)	5.3; 5.4; 5.5; 5.7; 5.8; 5.9
	Approach of a moving element to a fixed part	5.2
1	**Mechanical hazards** due to: *(continued)*	
	Elastic elements	5.10; 5.11; 5.12; 5.13
	Falling objects	5.3; 5.4; 5.5; 5.9
	Gravity (stored energy)	5.3; 5.4; 5.5; 5.9
	Height from the ground	5.3; 5.4; 5.5; 5.9
	High pressure	5.13
	Moving elements	5.2; 5.3; 5.4; 5.5; 5.6; 5.7; 5.8; 5.9; 5.10; 5.11; 5.12; 5.13; 5.14; 5.15; 5.16
	Rotating elements	5.4; 5.11; 5.12
	Stability	5.10; 5.11; 5.12; 5.13; 5.14
	Strength	5.10; 5.11; 5.12; 5.13; 5.14
2	**Electrical hazards**	
	Arc	5.2; 5.4; 5.6; 5.7; 5.8; 5.15; 5.16
	Electrostatic phenomena	5.2; 5.4; 5.6; 5.7; 5.8; 5.15; 5.16
	Live parts	5.2; 5.4; 5.6; 5.7; 5.8; 5.15; 5.16
	Not enough distance to live parts under high voltage	5.2; 5.4; 5.6; 5.7; 5.8; 5.15; 5.16
	Overload	5.2; 5.4; 5.6; 5.7; 5.8; 5.15; 5.16
	Parts which have become live under faulty conditions	5.2; 5.4; 5.6; 5.7; 5.8; 5.15; 5.16
	Short-circuit	5.2; 5.4; 5.6; 5.7; 5.8; 5.15; 5.16
6	**Hazards generated by radiation**	
	Low frequency electromagnetic radiation	5.6; 5.15; 5.16
	Radio frequency electromagnetic radiation	5.6; 5.15; 5.16
9	**Hazards associated with the environment in which the machine is used**	5.2; 5.3; 5.4; 5.5; 5.6; 5.7; 5.8; 5.9; 5.10; 5.11; 5.12; 5.13; 5.14; 5.15; 5.16

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5 Design rules, calculations, examinations and tests

5.1 General provisions for type examinations of safety components

5.1.1 Object and extent of the tests

The safety component/device is submitted to a test procedure to verify that insofar as construction and operation are concerned, it conforms to the requirements imposed by this standard. It shall be checked in particular that the mechanical, electrical and electronic components of the device are properly rated and that in the course of time the device does not lose its effectiveness, particularly through wear or aging. If the safety component is needed to satisfy particular requirements (waterproof, dust proof or explosion proof construction) supplementary examinations and/or tests under appropriate criteria shall be made.

5.1.2 General provisions

5.1.2.1 For the purposes of this standard it is assumed that the laboratory undertakes both the testing and the certification as an approved body. An approved body may be that of a manufacturer operating an approved full quality assurance system. In certain cases the test laboratory and the body approved for the issue of type examination certificates may be separate. In these cases the administrative procedures may differ from those described in this standard.

5.1.2.2 The application for type examination shall be made by the manufacturer of the component or their authorized representative and shall be addressed to an approved test laboratory.

5.1.2.3 The despatch of samples for examination shall be made by agreement between the laboratory and the applicant.

5.1.2.4 The applicant may attend the tests.

5.1.2.5 If the laboratory entrusted with the complete examination of one of the components requiring the supply of a type examination certificate has not available appropriate means for certain tests or examinations, it may under its responsibility have these made by other laboratories with the agreement of the applicant.

5.1.2.6 The precision of the instruments shall allow, unless specified, measurements to be made within the following accuracy:

a) ± 1 % masses, forces, distances, speeds;

b) ± 2 % accelerations, retardations;

c) ± 5 % voltages, currents;

d) ± 5 °C temperatures;

e) recording equipment shall be capable of detecting signals, which vary in time of 0,01 s;

f) ± 2,5 % flow rate;

g) ± 1 % pressure $P \leq 200$ kPa;

h) ± 5 % pressure $P > 200$ kPa.

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5.2 Type examination of landing and car door locking devices

5.2.1 General provisions

5.2.1.1 Field of application

These procedures are applicable to locking devices for landing and car doors. It is understood that each component taking part in the locking of doors and in the checking of the locking forms part of the locking device.

5.2.1.2 Documents to be submitted

5.2.1.2.1 Schematic arrangement drawing with description of operation

This drawing shall show clearly all the details relating to the operation and the safety of the locking device, including:

a) the operation of the device in normal service showing the effective engagement of the locking elements and the point at which the electrical safety device operates;

b) the operation of the device for mechanical checking of the locking position if this device exists;

c) the control and operation of the emergency unlocking device;

d) the type (AC and/or DC) and the rated voltage and rated current.

5.2.1.2.2 Assembly drawing with key

This drawing shall show all parts, which are important to the operation of the locking device, in particular those required to conform to requirements of this standard. A key shall indicate the list of principal parts, the type of materials used, and the characteristics of the fixing elements.

5.2.1.3 Test samples

One door locking device shall be submitted to the laboratory.

If the test is carried out on a prototype, it shall be repeated later on a production model.

If the test of the locking device is only possible when the device is mounted in the corresponding door the device shall be mounted on a complete door in working order. However, the door dimensions may be reduced by comparison with a production model, on condition that this does not falsify the test results.

5.2.2 Examination and tests

5.2.2.1 Examination of operation

This examination has the aim of verifying that the mechanical and electrical components of the locking device are operating correctly with respect to safety, and in conformity with the requirements of this standard, and the standard calling for this locking device and that the device is in conformity with the particulars provided in the application.

In particular it shall be verified that:

a) there is at least 7 mm engagement of the locking elements before the electric safety device operates;

b) it is not possible from positions normally accessible to persons to operate the lift with a door open or unlocked, after one single action, not forming part of the normal operation.

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5.2.2.2 Mechanical tests

5.2.2.2.1 General

These tests have the purpose of verifying the strength of the mechanical locking components and the electrical components.

The sample of the locking device in its normal operating position is controlled by the devices normally used to operate it.

The sample shall be lubricated in accordance with the requirements of the manufacturer of the locking device.

When there are several possible means of control and positions of operation, the endurance test shall be made in the arrangement which is regarded as the most unfavourable from the point of view of the forces on the components.

The number of complete cycles of operation and the travel of the locking components shall be registered by mechanical or electrical counters.

5.2.2.2.2 Endurance test

The locking device shall be submitted to 1 000 000 (±1 %) complete cycles; one cycle comprises one forward and return movement over the full travel possible in both directions.

The driving of the device shall be smooth, without shocks, and at a rate of 60 (±10 %) cycles per minute.

During the endurance test the electrical contact of the lock shall close a resistive circuit under the rated voltage and at a current value double that of the rated current.

If the locking device is provided with a mechanical checking device for the locking pin or the position of the locking element, this device shall be submitted to an endurance test of 100 000 (±1 %) cycles.

The driving of the device shall be smooth, without shocks, and at a rate of 60 (±10 %) cycles per minute.

5.2.2.2.3 Static test

For locking devices intended for hinged doors, a test shall be made consisting of the application over a total period of 300 s of a static force increasing progressively to a value of 3000 N.

This force shall be applied in the opening direction of the door and in a position corresponding as far as possible to that which may be applied when a user attempts to open the door. The force applied shall be 1 000 N in the case of a locking device intended for sliding doors.

5.2.2.2.4 Dynamic test

The locking device, in the locked position, shall be submitted to a shock test in the opening direction of the door.

The shock shall correspond to the impact of a rigid mass of 4 kg falling in free fall from a height of 0,50 m.

5.2.2.3 Criteria for the mechanical tests

After the endurance test (5.2.2.2.2), the static test (5.2.2.2.3) and the dynamic test (5.2.2.2.4), there shall not be any wear, deformation or breakage, which could adversely affect safety.

5.2.2.4 Electrical test

5.2.2.4.1 Endurance test of contacts

This test is included in the endurance test laid down in 5.2.2.2.2.

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5.2.2.4.2 Test of ability to break circuit

5.2.2.4.2.1 General

This test shall be carried out after the endurance test. It shall check that the ability to break a live circuit is sufficient. This test shall be made in accordance with the procedure in EN 60947-4-1:2010 and EN 60947-5-1:2017, the values of current and rated voltage serving as a basis for the tests shall be those indicated by the manufacturer of the device.

If there is nothing specified, the rated values shall be as follows:

a) Alternating current: 230 V, 2 A;

b) Direct current: 200 V, 2 A.

In the absence of an indication to the contrary, the capacity to break circuit shall be examined for both AC and DC conditions.

The tests shall be carried out with the locking device in the working position. If several positions are possible, the test shall be made in the most unfavourable position.

The sample tested shall be provided with covers and electric wiring as used in normal service.

5.2.2.4.2.2 AC locking devices shall open and close an electric circuit under a voltage equal to 110 % of the rated voltage 50 times, at normal speed, and at intervals of 5 s to 10 s. The contact shall remain closed for at least 0,5 s.

The circuit shall comprise a choke and a resistance in series. Its power factor shall be 0,7 ± 0,05 and the test current shall be 11 times the rated current indicated by the manufacturer of the device.

5.2.2.4.2.3 DC locking devices shall open and close an electric circuit under a voltage equal to 110 % of the rated voltage 20 times, at normal speed, and at intervals of 5 s to 10 s. The contact shall remain closed for at least 0,5 s.

The circuit shall comprise a choke and a resistance in series having values such that the current reaches 95 % of the steady-state value of the test current in 300 ms.

The test current shall be 110 % of the rated current indicated by the manufacturer of the device.

5.2.2.4.2.4 The tests are considered as satisfactory if no tracking or arcing is produced and if no deterioration occurs which could adversely affect safety.

5.2.2.4.3 Test for resistance to leakage currents

This test shall be made in accordance with the procedure in EN 60112:2003. The electrodes shall be connected to a source providing an AC voltage which is sinusoidal at 175 V, 50 Hz.

5.2.2.4.4 Examination of clearances and creepage distances

The clearances in air and creepage distances shall be in accordance with the requirements laid down in the standards calling for the use of this standard (e.g. EN 81-20:2020, 5.11.2.2.4).

5.2.2.4.5 Examination of the requirements appropriate to safety contacts and their accessibility

This examination shall be made taking account of the mounting position and the layout of the locking device, as appropriate.

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5.2.3 Test particular to certain types of locking devices

5.2.3.1 Locking device for horizontally or vertically sliding doors with several panels

According to the requirements laid down in the standards calling for the use of this standard the devices providing direct mechanical linkage between panels (e.g. EN 81-20:2020, 5.3.14.1) or indirect mechanical linkage (e.g. EN 81-20:2020, 5.3.14.2) are considered as forming part of the locking device.

These devices shall be submitted to the tests mentioned in 5.2.2. The number of cycles per minute in such endurance tests shall be suited to the dimensions of the construction.

5.2.3.2 Flap type locking device for hinged door

If this device is provided with an electric safety device required to check the possible deformation of the flap and if, after the static test envisaged in 5.2.2.2.3 there are any doubts on the strength of the device, the load shall be increased progressively until the safety device begins to open. No component of the locking device or of the door shall be damaged or permanently deformed by the load applied.

If, after the static test, the dimensions and construction leave no doubt as to its strength, it is not necessary to proceed to the endurance test on the flap.

5.2.4 Type examination certificate

The certificate shall indicate the following:

a) information according to Annex A;

b) type and application of locking device;

c) the type (AC and/or DC) and values of rated voltage and rated current;

d) in the case of flap type door locking devices: the necessary force to actuate the electric safety device for checking the elastic deformation of the flap.

5.3 Type examination of safety gear

5.3.1 General provisions

The applicant shall state the range of use provided, i.e.:

— minimum and maximum masses;

— maximum rated speed and maximum tripping speed.

Detailed information shall be provided on the materials used, the type of guide rails and their surface condition (drawn, milled, ground).

The following documents shall be attached to the application:

a) detailed and assembly drawings showing the construction, operation, materials used, the dimensions and tolerances on the construction components;

b) in the case of progressive safety gear, also a load diagram relating to elastic parts.

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5.3.2 Instantaneous safety gear

5.3.2.1 Test samples

Two gripping assemblies with wedges or clamps and two lengths of guide rail shall be submitted to the laboratory.

The arrangement and the fixing details for the samples shall be determined by the laboratory in accordance with the equipment that it uses.

If the same gripping assemblies can be used with different types of guide rail, a new test shall not be required if the thickness of the guide rails, the width of the grip needed for the safety gear and the surface state (drawn, milled, ground) are the same.

5.3.2.2 Test

5.3.2.2.1 Method of test

The test shall be made using a press or similar device, which moves without abrupt speed change. Measurements shall be made of:

a) the distance travelled as a function of the force;

b) the deformation of the safety gear block as a function of the force or as a function of the distance travelled.

5.3.2.2.2 Test procedure

The guide rail shall be moved through the safety gear.

Reference marks shall be traced onto the blocks in order to be able to measure their deformation.

The distance travelled shall be recorded as a function of the force.

After the test:

a) the hardness of the block and the gripping element shall be compared with the original values quoted by the applicant. Other analyses may be carried out in special cases;

b) if there is no fracture, deformations and other changes shall be examined (for example, cracks, deformations or wear of the gripping elements, appearance of the rubbed surfaces);

c) if necessary, photographs shall be taken of the block, the gripping elements and the guide rail for evidence of deformations or fractures.

5.3.2.2.3 Documents

5.3.2.2.3.1 Two charts shall be drawn up as follows

a) the first shall show the distance travelled as a function of the force;

b) the other shall show the deformation of the block. It shall be done in such a way that it can be related to the first chart.

5.3.2.2.3.2 The capacity of the safety gears shall be established by integration of the area of the distance-force chart

The area of the chart to be taken into consideration shall be:

a) the total area if there is no permanent deformation;

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b) if permanent deformation or rupture has occurred, either:

1) the area up to the value at which the elastic limit has been reached; or

2) the area up to the value corresponding to the maximum force.

5.3.2.3 Determination of the permissible mass

5.3.2.3.1 Energy absorbed by the safety gear

A distance of free fall, calculated with reference to the maximum tripping speed of the overspeed governor fixed in the requirements laid down in the standards calling for the use of this standard (e.g. EN 81-20:2020, 5.6.2.2.1.2) shall be adopted.

The distance of free fall in metres shall be taken as: $h = \frac{v_1^2}{2 \cdot g_n} + 0{,}1 + 0{,}03$

where:

g_n	is the standard acceleration of free fall in metres per square second;
v_1	is the tripping speed of overspeed governor in metres per second;
0,10 m	corresponds to the distance travelled during the response time;
0,03 m	corresponds to the travel during take-up of clearance between the gripping elements and the guide rails.

The total energy the safety gear is capable of absorbing: $2 \cdot K = (P + Q)_l \cdot g_n \cdot h$

from which: $(P + Q)_l = \frac{2 \cdot K}{g_n \cdot h}$

where:

K, K_1, K_2	is the energy absorbed by one safety gear block in joules (calculated in accordance with the chart);
P	are the masses of the empty car and components supported by the car, i.e. part of the travelling cable, compensating ropes/chains (if any), etc. in kilograms;
Q	is the rated load in kilograms;
$(P+Q)_l$	is the permissible mass in kilograms.

5.3.2.3.2 Permissible mass

The permissible mass in kilograms will be:

a) If the elastic limit has not been exceeded: $(P + Q)_l = \frac{2 \cdot K}{2 \cdot g_n \cdot h}$

K	is calculated by the integration of the area defined in 5.3.2.2.3.2 a);
2	is taken as the dividing safety coefficient.

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b) If the elastic limit has been exceeded, two calculations shall be made and the higher permissible mass may be selected:

1) $$(P + Q)_1 = \frac{2 \cdot K_1}{2 \cdot g_n \cdot h}$$

K_1 is calculated by the integration of the area defined in 5.3.2.2.3.2 b) 1);

2 is taken as the dividing safety coefficient;

2) $$(P + Q)_1 = \frac{2 \cdot K_2}{3{,}5 \cdot g_n \cdot h}$$

K_2 is calculated by the integration of the area defined in 5.3.2.2.3.2 b) 2);

3,5 is taken as the dividing safety coefficient.

5.3.3 Progressive safety gear

5.3.3.1 Statement and test sample

The applicant shall state for what mass in kilograms and tripping speed in metres per second of the overspeed governor the test will be carried out. If the safety gear shall be certified for various masses, the applicant shall specify them and indicate in addition whether adjustment is by stages or continuous.

The applicant should choose the suspended mass in kilograms by dividing the anticipated braking force in newtons by 16 to aim at an average retardation of 0,6 g_n.

A complete safety gear assembly as agreed with the laboratory, together with the number of brake shoes necessary for all the tests shall be placed at the disposal of the laboratory. The number of sets of brake shoes necessary for all the tests shall be attached. For the type of guide rail used, the length specified by the laboratory shall also be supplied.

5.3.3.2 Test

5.3.3.2.1 Method of test

5.3.3.2.1.1 The test shall be carried out in free fall. Direct or indirect measurements shall be made of:

a) the total height of the fall;

b) the braking distance on the guide rails;

c) the sliding distance of the overspeed governor rope, or that of the device used in its place;

d) the total travel of the elements forming the spring.

Measurements a) and b) shall be recorded as a function of the time.

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5.3.3.2.1.2 The following shall be determined:

a) the average braking force;

b) the greatest instantaneous braking force;

c) the smallest instantaneous braking force.

5.3.3.2.2 Test procedure

5.3.3.2.2.1 Safety gear certified for a single mass

The laboratory shall carry out four tests with the mass $(P+Q)_1$. Between each test the friction parts shall be allowed to return to their normal temperature.

During the tests several identical sets of friction parts may be used.

However, one set of parts shall be capable of:

a) three tests, if the rated speed does not exceed 4 m/s;

b) two tests, if the rated speed exceeds 4 m/s.

The height of free fall shall be calculated to correspond to the maximum tripping speed of the overspeed governor for which the safety gear can be used.

The engagements of the safety gear shall be achieved by a means allowing the tripping speed to be fixed precisely.

For example, a rope may be used, the slack of which should be carefully calculated, fixed to a sleeve which can slide with friction over a fixed smooth rope. The friction effort should be the same as the effort applied to the operating rope by the governor attached to this safety gear.

5.3.3.2.2.2 Safety gear certified for different masses

Adjustment in stages or continuous adjustment.

Two series of tests shall be carried out for:

a) the maximum; and

b) the minimum value applied for.

The applicant shall supply a formula, or a chart, showing the variation of the braking force as a function of a given parameter.

The laboratory shall verify by suitable means (in the absence of anything better, by a third series of tests for intermediary points) the validity of the supplied formula.

5.3.3.2.3 Determination of the braking force of the safety gear

5.3.3.2.3.1 Safety gear certified for a single mass

The braking force of which the safety gear is capable for the given adjustment and the type of guide rail is taken as equal to the average of the average braking forces determined during the tests. Each test shall be made on an unused section of guide rail.

A check shall be made that the average values determined during the tests lie within a range of ± 25 % in relation to the value of the braking force defined above.

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NOTE Tests have shown that the coefficient of friction could be considerably reduced if several successive tests were carried out on the same area of a machined guide rail. This is attributed to a modification in the surface condition during successive safety gear operations.

It is accepted that, on an installation, an inadvertent operation of the safety gear would have every chance of occurring at an unused section of guide rail.

It is necessary to consider that if, by chance, this were not the case, the braking force would have a lower value until an unused portion of guide rail surface was reached. Hence, greater sliding than normal.

This is a further reason for not permitting any adjustment causing too small a retardation at the beginning.

5.3.3.2.3.2 Safety gear certified for different masses

Adjustment in stages or continuous adjustment.

The braking force of which the safety gear is capable shall be calculated as laid down in 5.3.3.2.3.1 for the maximum and minimum values applied for.

5.3.3.2.4 Checking after the tests

After the tests it shall be checked:

a) the hardness of the block and the gripping elements shall be compared with the original values submitted by the applicant;

b) the deformations and modifications (for example, cracks, deformations or wear of the gripping elements, appearance of the rubbing surfaces) shall be checked;

c) if necessary, the safety gear assembly, the gripping elements and the guide rails shall be photographed in order to reveal deformations or fractures.

5.3.3.3 Calculation of the permissible mass

5.3.3.3.1 Safety gear certified for a single mass

The permissible mass shall be calculated using the following formula:

$$(P+Q)_1 = \frac{F_B}{16}$$

where

F_B	is the braking force in newtons determined in accordance with 5.3.3.2.3;
P	is the masses of the empty car and components supported by the car, i.e. part of the travelling cable, compensating ropes/chains (if any), etc. in kilograms;
Q	is the rated load in kilograms;
$(P+Q)_1$	is the permissible mass in kilograms.

If the calculated permissible mass is larger than the tested mass, the tested mass may be taken as permissible mass provided that the average retardation of each test did not exceed 1 g_n.

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5.3.3.3.2 Safety gear certified for different masses

5.3.3.3.2.1 Adjustment in stages

The permissible mass shall be calculated for each adjustment as laid down in 5.3.3.3.1.

5.3.3.3.2.2 Continuous adjustment

The permissible mass shall be calculated as laid down in 5.3.3.3.1 for the maximum and minimum values applied for and in accordance with the formula supplied for the intermediate adjustments.

5.3.3.4 Possible modification to the adjustments

If, during the tests, the values found differ by more than 20 % from those expected by the applicant, other tests may be made with their agreement, after modification of the adjustments if necessary.

5.3.4 Comments

a) Applicable mass

   The applicable mass used for a lift shall not exceed the permissible mass for instantaneous safety gear.

   In the case of progressive safety gear, the mass stated may differ from the applicable mass stated in 5.3.3.3 by ± 7,5 %. It is accepted in these conditions that the requirements laid down in the standards calling for the use of this standard (e.g. EN 81-20:2020, 5.6.2.1) are met on the installation, notwithstanding the usual tolerances on the thickness of the guide rails, the surface conditions, etc.;

b) To evaluate the validity of welded parts, reference shall be made to standards on this subject;

c) A check shall be made that the possible travel of the gripping elements is sufficient under the most unfavourable conditions (accumulation of manufacturing tolerances);

d) The friction parts shall be suitably retained so that it can be certain that they will be in place at the moment of operation;

e) In the case of a progressive type safety gear, it shall be checked that the travel of the components forming the spring is sufficient.

5.3.5 Type examination certificate

The certificate shall indicate the following:

a) information according to Annex A;

b) type and application of safety gear;

c) the limits of the permissible masses (see 5.3.4 a);

d) the tripping speed of the overspeed governor;

e) the type of guide rail;

f) the permissible thickness of the guide rail blade;

g) the minimum width of the gripping areas;

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and, for progressive safety gear only:

h) the surface condition of the guide rails (drawn, milled, ground);

i) the state of lubrication of the guide rails. If they are lubricated, the category and specification of the lubricant.

5.4 Type examination of overspeed governors

5.4.1 General provisions

The applicant shall indicate the following to the laboratory:

a) the type (or the types) of safety gear which will be operated by the governor;

b) the maximum and minimum rated speeds of lifts for which the governor may be used;

c) the anticipated value of the tensile force produced in the rope by the overspeed governor when tripped.

Detailed and assembly drawings showing the construction, operation, materials used, the dimensions and tolerances on the construction components shall be attached to the application.

5.4.2 Check on the characteristics of the overspeed governor

5.4.2.1 Test samples

The following shall be submitted to the laboratory:

a) one overspeed governor;

b) one rope of the type used for the overspeed governor and in the normal condition in which it should be installed. The length to be supplied is fixed by the laboratory;

c) a tensioning pulley assembly of the type used for the overspeed governor.

5.4.2.2 Test

5.4.2.2.1 Method of test

The following shall be checked:

a) the speed of tripping is within the range stated by the applicant;

b) the operation of the electric safety device called for in the standards calling for the use of this standard (e.g. EN 81-20:2020, 5.6.2.2.1.6 a) causing the machine to stop, if this device is mounted on the overspeed governor;

c) the operation of the electric safety device called for in the standards calling for the use of this standard (e.g. EN 81-20:2020, 5.6.2.2.1.6 b) preventing all movement of the lift when the overspeed governor is tripped;

d) the tensile force produced in the rope by the overspeed governor when tripped.

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5.4.2.2.2 Test procedure

At least twenty tests shall be made in the speed range for tripping corresponding to the range of rated speeds of the lift, indicated in 5.4.1 b).

The majority of tests should be made at the extreme values of the range.

The acceleration to reach the tripping speed of the overspeed governor should be as low as possible, in order to eliminate the effects of inertia.

In addition a minimum of two tests shall be made with an acceleration of between 0,9 g_n and 1 g_n in order to simulate a free fall situation and prove no deterioration of the governor has been caused.

5.4.2.2.3 Interpretation of the test results

In the course of twenty tests the tripping speeds shall lie within the limits laid down for overspeed governors in the standards calling for the use of this standard.

NOTE If the limits laid down are exceeded, an adjustment may be made by the manufacturer of the component and 20 new tests carried out.

In the course of the twenty tests the operation of the devices for which the test is required in 5.4.2.2.1 b) and c) shall occur within the limits laid down in the standards calling for the use of this standard (e.g. EN 81-20:2020, 5.6.2.2.1.6 a) and 5.6.2.2.1.6 b).

The tensile force in the rope produced by the overspeed governor when tripped shall be at least 300 N or any higher value which is specified by the applicant.

Unless otherwise requested by the manufacturer of the device and specified in the test report, the arc of engagement should be 180°.

In the case of a device, which operates by gripping the rope, it should be checked that there is no permanent deformation of the rope.

5.4.3 Type examination certificate

The certificate shall indicate the following:

a) information according to Annex A;

b) type and application of overspeed governor;

c) the maximum and minimum rated speeds of the lift for which the overspeed governor may be used;

d) the diameter of the rope to be used and its construction;

e) in the case of an overspeed governor with traction pulley, the minimum tensioning force;

f) the tensile force in the rope which can be produced by the overspeed governor when tripped.

5.5 Type examination of buffers

5.5.1 General provisions

The applicant shall state the range of use provided, i.e. maximum impact speed, minimum and maximum masses. The following shall be attached to the application:

a) Detailed and assembly drawings showing the construction, operation, materials used, the dimensions and tolerances on the construction components.

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In the case of hydraulic buffers, the graduation (openings for the passage of the liquid), in particular, shall be shown as a function of the stroke of the buffer;

b) Specifications for the liquid used;

c) Information regarding environmental conditions for use (temperature, humidity, pollution, etc.) and of life-cycle (aging, rejection criteria).

5.5.2 Samples to be submitted

The following shall be submitted to the laboratory:

a) one buffer;

b) in the case of hydraulic buffers, the necessary liquid sent separately.

5.5.3 Test

5.5.3.1 Energy dissipation buffers

5.5.3.1.1 Test procedure

The buffer shall be tested with the aid of weights, corresponding to the minimum and maximum masses, falling in free fall to reach at the moment of impact the maximum speed called for.

The speed shall be recorded at least from the moment of impact of the weights. The acceleration and the retardation shall be determined as a function of time throughout the movement of the weights.

5.5.3.1.2 Equipment to be used

5.5.3.1.2.1 Weights falling in free fall

The weights shall correspond with the tolerances of 5.1.2.6, to the maximum and minimum masses. They shall be guided vertically with the minimum of friction possible.

5.5.3.1.2.2 Recording equipment

The recording equipment shall be able to detect signals with the tolerances of 5.1.2.6. The measuring chain, including the recording device for the recording of measured values as a function of time, shall be designed with a system frequency of at least 1000 Hz.

5.5.3.1.2.3 Measurement of speed

The speed shall be recorded at least from the moment of impact of the weights on the buffer or throughout the travel of the weights with the tolerances of 5.1.2.6.

5.5.3.1.2.4 Measurement of the retardation

If there is a device for measuring retardation (see 5.5.3.1.1), it shall be placed as near as possible to the axis of the buffer, and shall be capable of measurement with the tolerances of 5.1.2.6.

5.5.3.1.2.5 Measurement of time

Time pulses of duration of 0,01 s shall be recorded and measured with the tolerances of 5.1.2.6.

5.5.3.1.3 Ambient temperature

The ambient temperature shall lie between + 15 °C and + 25 °C.

The temperature of the liquid shall be measured with the tolerances of 5.1.2.6.

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5.5.3.1.4 Mounting of the buffer

The buffer shall be placed and fixed in the same manner as in normal service.

5.5.3.1.5 Filling of the buffer

The buffer shall be filled up to the mark indicated following the instructions of the component manufacturer.

5.5.3.1.6 Checks

5.5.3.1.6.1 Checking of retardation

The height of free fall of the weights shall be chosen in such a way that the speed at the moment of impact corresponds to the maximum impact speed stipulated in the application.

The retardation shall conform to the requirements of the standard calling for this device (e.g. EN 81-20:2020, 5.8.2.2.3).

The creeping at the end of the buffer stroke for calculation of the average retardation shall be ignored where the retardation is below 0,5 m/s^2.

A first test shall be made with maximum mass with a check on the retardation.

A second test shall be made with minimum mass with a check on the retardation.

5.5.3.1.6.2 Checking of the return of the buffer to the normal position

After each test the buffer shall be held in the completely compressed position for 5 min. The buffer shall then be freed to permit its return to its normal extended position.

When the buffer is of a type with spring or gravity return, the position of complete return shall be reached in a maximum period of 120 s.

Before proceeding to another retardation test there shall be a delay of 30 min to permit the liquid to return to the tank and for bubbles of air to escape.

5.5.3.1.6.3 Checking of the liquid losses

The level of liquid shall be checked after having made the two retardation tests required in 5.5.3.1.6.1, and after an interval of 30 min the level of liquid shall again be sufficient to ensure normal operation of the buffer.

5.5.3.1.6.4 Checking of the condition of the buffer after tests

After the two retardation tests required in 5.5.3.1.6.1, no part of the buffer shall show any permanent deformation or be damaged so that its condition shall guarantee normal operation.

5.5.3.1.7 Procedure in the case of tests failing the requirements

When the test results are not satisfactory with the minimum and maximum masses appearing in the application, the laboratory may, in agreement with the applicant, establish the acceptable limits.

5.5.3.2 Energy accumulation buffers with non linear characteristics

5.5.3.2.1 Test procedure

The buffer shall be tested with the aid of masses falling in free fall from a height to reach at the moment of impact the maximum speed called for, but not less than 0,8 m/s.

The falling distance, the speed, the acceleration and retardation shall be recorded from the moment of release of the weight to the complete standstill.

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The masses shall correspond to the maximum and minimum masses called for. They shall be guided vertically with a minimum of friction possible, so that at the moment of impact at least 0,9 g_n are reached.

5.5.3.2.2 Equipment to be used

The equipment shall correspond to 5.5.3.1.2.

5.5.3.2.3 Ambient temperature

The ambient temperature shall lie between + 15 °C and + 25 °C.

5.5.3.2.4 Mounting of the buffer

The buffer shall be placed and fixed in the same manner as in normal service.

5.5.3.2.5 Number of tests

Three tests shall be made with:

a) The maximum mass;

b) The minimum mass called for.

The time delay between two consecutive tests shall lie between 5 min and 30 min.

With the three tests with maximum mass the value of reference of the buffer force at a stroke equal to 50 % of the real height of the buffer given by the applicant shall not vary by more than 5 %. With the tests with minimum mass this shall be observed in analogy.

Within 30 min before the test the buffer shall be once loaded either statically or dynamically in order to prevent further settlement and deviations during the test.

5.5.3.2.6 Checks

5.5.3.2.6.1 Checking of retardation

The retardation "a" (e.g. EN 81-20:2020, 5.8.2.1.2.1) shall conform to the following requirements:

a) The retardation will be evaluated taking into account the time between the first two absolute minima of the retardation (see Figure 1). The retardation shall not exceed the maximum as required by the standard calling for this device.

b) Peaks of retardation shall not exceed the maximum as required by the standard calling for this device.

c) The peak retardation shall not exceed the maximum as required in the standard calling for this device.

d) The return speed shall not exceed the maximum as required in the standard calling for this device.

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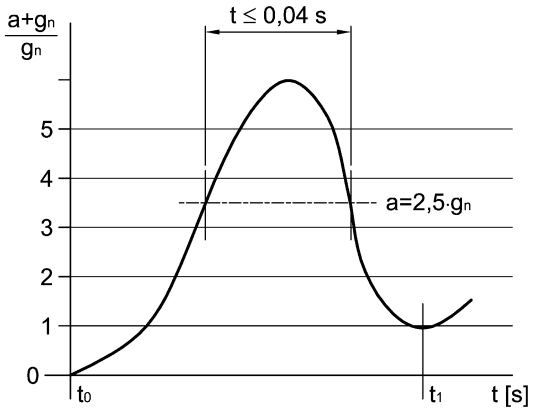

Key

t_0 moment of hitting the buffer (first absolute minimum)

t_1 second absolute minimum

Figure 1 — Retardation graph - Example using EN 81-20:2020 requirements

5.5.3.2.6.2 Checking of the condition of the buffer after tests

After the tests with the maximum mass no part of the buffer shall show any permanent deformation or be damaged so that its condition shall guarantee normal operation.

5.5.3.2.7 Procedure in the case of tests failing the requirements

When the test results are not satisfactory with the minimum and maximum masses appearing in the application, the laboratory may, in agreement with the applicant, establish the acceptable limits.

5.5.4 Type examination certificate

The certificate shall indicate the following:

a) information according to Annex A;

b) type and application of buffer;

c) dimensions of buffer;

d) the maximum impact speed;

e) the maximum mass;

f) the minimum mass;

g) kind of fixation;

h) the specification of the liquid in the case of hydraulic buffers;

i) environmental conditions for use according to instructions of the manufacturer (temperature, humidity, pollution, etc.).

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5.6 Type examination of safety circuits containing electronic components and/or programmable electronic systems (PESSRAL)

5.6.1 General provisions

5.6.1.1 General

For safety circuits containing electronic components, laboratory tests are necessary because practical checks on site, by inspectors, are impossible.

In the following, mention is made to printed circuit board. If a safety circuit is not assembled in such a manner, then the equivalent assembly shall be assumed.

5.6.1.2 Safety circuits containing electronic components

The applicant shall indicate to the laboratory:

a) identification on the board;

b) environmental working conditions;

c) listing of used components;

d) layout of the printed circuit board;

e) layout of the hybrids and marks of the tracks used in safety circuits;

f) function description;

g) electrical wiring diagram, including input and output definitions of the board;

h) the method of failure analysis employed and the documented results.

5.6.1.3 Safety circuits based on programmable electronic systems

In addition to 5.6.1.1 the following documentation shall be provided:

a) documents and descriptions relating to the measures listed in Annex B;

b) general description of the software used (e.g. programming rules, language, compiler, modules);

c) function description including software architecture and hardware/software interaction;

d) description of blocks, modules, data, variables and interfaces;

e) software listings.

5.6.2 Test samples

There shall be submitted to the laboratory:

a) one printed circuit board;

b) one printed circuit board bare (without components).

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5.6.3 Tests

5.6.3.1 Mechanical tests

5.6.3.1.1 General

During the tests, the tested object (printed circuit) shall be kept under operation. During and after the tests, no unsafe operation and condition shall appear within the safety circuit.

5.6.3.1.2 Vibration

Transmitter elements of safety circuits shall withstand the requirements of:

a) EN 60068-2-6:2008, Endurance by sweeping: Table C.2:

20 sweep cycles in each axis, at amplitude 0,35 mm, and in the frequency range 10-55 Hz;

and also to:

b) EN 60068-2-27:2009, Acceleration and duration of pulse: Table 1:

the combination of:

— peak acceleration 294 m/s^2 or 30 g_n;

— corresponding duration of pulse 11 ms; and

— corresponding velocity change 2,1 m/s half sine.

NOTE Where shock absorbers for transmitter elements are fitted, they are considered as part of the transmitter elements.

After tests, clearances and creepage distances shall not become smaller than the minimum accepted.

5.6.3.1.3 Bumping (EN 60068-2-27:2009)

5.6.3.1.3.1 General

Bumping tests shall simulate the cases when printed circuits fall, introducing the risk of rupture of components and unsafe situation.

Tests are divided into:

a) Partial shockings;

b) Continuous shockings.

The tests object shall satisfy the following minimum requirements:

5.6.3.1.3.2 Partial shocking

a) shocking shapes: half-sinus;

b) amplitude of acceleration: 15 g;

c) duration of shock: 11 ms.

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