



DPC: 23/30420135 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

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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.

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Submission of Comments

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- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

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.	

DRAFT INTERNATIONAL STANDARD

ISO/DIS 8100-2

ISO/TC 178

Secretariat: AFNOR

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2023-11-30

Voting terminates on:
2024-02-22

Lifts for the transport of persons and goods —

Part 2: Design rules, calculations, examinations and tests of lift components

Elévateurs pour le transport de personnes et d'objets —

Partie 2: Règles de conception, calculs, examens et essais des composants pour élévateurs

ICS: 91.140.90

This document is circulated as received from the committee secretariat.

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Reference number
ISO/DIS 8100-2:2023(E)

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Phone: +41 22 749 01 11
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European Foreword

This document (prEN ISO 8100-2:2023) has been prepared by Technical Committee CEN/TC 10 “Lifts, escalators and moving walks”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 81-20:2020.

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.

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

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

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

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 178, *Lifts, escalators, passenger conveyors*.

This second edition cancels and replaces the first edition (ISO 8100-2:2019), which has been technically revised.

The main changes are as follows:

- editorial revision of the document structure according to the ISO/IEC Directives, part 2;
- mechanical tests and temperature tests of safety circuits and SIL-rated circuits are updated;
- errors in the formulae for traction calculation are corrected;
- verification methods for suspension and compensation means other than steel wire ropes are added;
- discard criteria for suspension means and power transmission contact are added,
- Requirements for SIL-rated circuits (previously called PESSRAL) have been revised,

For relationship with this document and ISO 8100-20, see informative Annex G, which is an integral part of this document.

A list of all parts in the ISO 8100 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

**FprEN 81-50:2013 (E) 511 Règles de sécurité pour la construction et l'installation des élévateurs — Examens et essais —
 Partie 50 : Règles de conception, calculs, examens et essais des composants pour élévateurs Sicherheitsregeln für die Konstruktion und den Einbau von Aufzügen — Prüfungen —
 Teil 50: Konstruktionsregeln, Berechnungen und Prüfungen von Aufzugskomponenten Safety rules for the construction and installation of lifts — Examinations and tests — Part 50: Design rules, calculations, examinations and tests of lift components E0
 00 201310 Formal Vote CEN 1 European Standard EN 81-50 FprEN 81-50:2013 0 Vrai 50 AFNOR Lifts, escalators and moving walks 10
 2 Titre 2 Titre 1 0 STD Version 2.4a 50 EN 81-1:1985 1C:\Documents and Settings\xdmr\My Documents\NORMES\NORMALISATION\CEN TC 10\TASK FORCE\ANSWER TO PQ COMMENTS\TEXTES MODIFIES\prEN 81-50 - modified after PQ - 2013 09.doc Introduction**

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

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

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

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

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

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

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

When 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.

The object of this document is to define safety rules related to lifts with a view to safeguarding persons and objects against the risk of accidents associated with the use, maintenance and emergency operations of lifts.

Reference is made to the respective introductions of the standards (e.g. ISO 8100-1:2023) calling for the use of this document with regard to persons and objects to be safeguarded, assumptions, principles, etc.

Lifts for the transport of persons and goods —

Part 2:

Design rules, calculations, examinations and tests of lift components

1 Scope

This document specifies for passenger lifts and goods passenger lifts:

- the verification of door locking devices;
- the verification of safety gears;
- the verification of overspeed governors;
- the verification of buffers;
- the verification of safety circuits and SIL-rated circuits;
- the verification of ascending car overspeed protection means;
- the verification of unintended car movement protection means;
- the verification of rupture valves and one-way restrictors;
- the verification of suspension and compensation means;
- the discard criteria for suspension means and power transmission contact;
- the calculation of guide rails;
- the calculation of rams, cylinders, rigid pipes and fittings;
- the evaluation of the traction;
- the evaluation of the safety factor on suspension means;
- the pendulum shock tests;
- fault exclusion for electric and electronic components;
- the design rules for SIL-rated circuits.

This document is not applicable to passenger lifts, goods passenger lifts or lift components, which are installed or manufactured before the date of its publication.

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.

ISO 3108:2017, *Steel wire ropes — Test method — Determination of measured breaking force*

ISO 4344:2022, *Steel wire ropes for lifts — Minimum requirements*

ISO 8100-1:2023, *Lifts for the transport of persons and goods — Part 1: Safety rules for the construction and installation of passenger and goods passenger lifts*

ISO 8100-33:2022, *Lifts for the transport of persons and goods — Part 33: T-type guide rails for lift cars and counterweights*

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

ISO 29584:2015, *Glass in building — Pendulum impact testing and classification of safety glass*

IEC 60068-2-6:2007, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)*

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

IEC 60068-2-27:2008, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock*

IEC 60112:2020, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems — Part 1: Principles, requirements and tests*

IEC 60893-3-1:2012, *Insulating materials — Industrial rigid laminated sheets based on thermosetting resins for electrical purposes — Part 3-1: Specifications for individual materials - Types of industrial rigid laminated sheets*

IEC 60947-4-1:2018, *Low-voltage switchgear and control gear — Part 4-1: Contactors and motor-starters — Electromechanical contactors and motor-starters*

IEC 60947-5-1:2016, *Low-voltage switchgear and control gear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices*

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

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

IEC 61558-1:2017, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

IEC 61709:2017, *Electric components - Reliability - Reference conditions for failure rates and stress models for conversion*

EN 10025-2:2019, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

EN 12385-1:2002+A1:2008, *Steel wire ropes – Safety — Part 1: General requirements*

EN 12385-5:2021, *Steel wire ropes - Safety — Part 5: Stranded ropes for lifts*

EN 13411-6:2004+A1:2008, *Terminations for steel wire ropes — Part 6: Safety. Asymmetric wedge socket*

EN 13411-7:2021, *Terminations for steel wire ropes — Part 7: Safety. Symmetric wedge socket*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8100-1:2023 apply.

ISO and IEC maintain terminological 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/>

4 Design rules, calculations, verifications and tests

4.1 General

Passenger and goods passenger lifts shall comply with the safety requirements and/or protective measures of the following clauses. In addition, the passenger and goods passenger lifts shall be designed according to the principles of ISO 12100:2010 for hazards relevant but not significant that are not dealt with by this document (e.g. sharp edges).

The precision of the instruments shall allow measurements to be made within the following accuracy:

- a) ± 1 % for masses, forces, distances, speeds;
- b) ± 2 % for accelerations, retardations;
- c) ± 5 % for voltages, currents;
- d) ± 5 °C for temperatures;
- e) recording equipment shall be capable of detecting signals, which vary in time of 0,01 s;
- f) $\pm 2,5$ % for flow rate;
- g) ± 1 % for pressure, P , below 200 kPa;
- h) ± 5 % for pressure, P , above 200 kPa.

4.2 Verification of landing and car door locking devices

4.2.1 Verifications and tests

4.2.1.1 Verification of operation

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

4.2.1.2 Mechanical tests

4.2.1.2.1 General

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 stressed condition 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.

4.2.1.2.2 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.

4.2.1.2.3 Static test

The test shall be made consisting of the application of a force, increasing gradually to the value laid down in the standard calling for the use of this standard (e.g. ISO 8100-1:2023, 4.3.9.1.6) between 30 s to 60 s. The force shall be applied for a period of 300 s.

4.2.1.2.4 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.

4.2.1.3 Criteria for the mechanical tests

After the endurance test ([4.2.1.2.2](#)), the static test ([4.2.1.2.3](#)) and the dynamic test ([4.2.1.2.4](#)), there shall not be any wear, deformation or breakage, which could affect safety.

4.2.1.4 Electrical test

4.2.1.4.1 Endurance test of contacts

This test is included in the endurance test laid down in [4.2.1.2.2](#).

4.2.1.4.2 Test of ability to break circuit

4.2.1.4.2.1 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 IEC 60947-4-1 and IEC 60947-5-1. The values of current and rated voltage serving as a basis for the tests shall be those specified for the device.

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

- a) alternating current: 230 V, 2 A;
- b) direct current: 200 V, 2 A.

The capacity to break circuit shall be examined for both A.C. and D.C. conditions.

The tests shall be carried out with the locking device in all working positions.

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

4.2.1.4.2.2 A.C. 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 $0,7 \pm 0,05$ and the test current shall be 11 times the rated current indicated by the manufacturer of the device.

4.2.1.4.2.3 D.C. 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.

4.2.1.4.2.4 The tests are considered satisfactory if no tracking or arcing is produced and if no deterioration occurs which can affect safety.

4.2.1.4.3 Test for resistance to leakage currents

This test shall be made in accordance with the procedure in IEC 60112:2020. The electrodes shall be connected to a source providing an A.C. voltage which is sinusoidal at 175 V, 50 Hz.

4.2.1.4.4 Verification 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 document (e.g. ISO 8100-1:2023, 4.11.2.2.4).

4.2.1.4.5 Verification of the requirements appropriate to safety contacts and their accessibility

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

4.2.2 Test particular to certain types of locking devices

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

Devices providing direct mechanical linkage between panels shall be included in the tests mentioned in [4.2.1](#). The number of cycles per minute in endurance tests shall be between 45 – 60.

NOTE ISO 8100-1:2023, 4.3.14.1 and ISO 8100-1:2023, 4.3.14.2 specify direct and indirect mechanical linkage.

4.2.2.2 Flap type locking device for hinged door

The conditions of ISO 8100-1:2023, 4.3.9.1.12 b) to f) shall be verified.

The locking force limiter according to ISO 8100-1:2023, 4.3.9.1.12 f) shall be tested on an operationally constructed door by pushing open the door panels with a steadily increasing force until the locking force limiter releases the flap. The force is applied according to ISO 8100-1:2023, 4.3.9.1.12 f). The flap shall not release before the force exceeds the force according to ISO 8100-1:2023, 4.3.9.1.12 f).

The test shall be carried out on a door with the largest width.

In the case of elements to limit the load on the flap that are triggered via a predetermined breaking point, the locked door shall be force-opened at least three times, each time with renewed trigger elements. In the case of non-destructive release elements, a limited endurance test with at least 50 force openings is required.

There shall be no permanent deformation or breakage on the locking device after the test.

4.2.3 Verification report

The report shall indicate:

- a) type and application of locking device;
- b) type (A.C. and/or D.C.) and values of the rated voltage and rated current;
- c) in the case of flap type door locking devices: the necessary force to actuate the locking force limiter.

4.3 Verification of safety gear

4.3.1 General provisions

The following information shall be provided:

- minimum and maximum masses;
- maximum rated speed and maximum tripping speed;
- the type of guide rails and their surface condition (drawn, milled, ground) and materials used.

4.3.2 Instantaneous safety gear

4.3.2.1 Test samples

Two gripping assemblies with wedges or clamps and two lengths of guide rail shall be provided.

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

If the same gripping assemblies can be used with different types of guide rails, 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.

4.3.2.2 Test

4.3.2.2.1 Method of test

The test shall be made using a press or similar device, which moves continuously. 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.

4.3.2.2.2 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 documents. 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.

4.3.2.2.3 Documents

4.3.2.2.3.1 Two charts shall be drawn up as follows:

- a) the first one 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.

4.3.2.2.3.2 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;
- 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.

4.3.2.3 Determination of the permissible mass

4.3.2.3.1 Energy absorbed by the safety gear

The distance of free fall in metres, h , shall be taken as [Formula \(1\)](#):

$$h = \left(\frac{v_1^2}{2 \cdot g_n} \right) + 0,1 + 0,03 \quad (1)$$

where

- g_n is the standard acceleration of free fall in metres per square second;
- v_1 is the maximum tripping speed of the safety gear expressed in metres per second;
- 0,1 corresponds to the distance travelled during the response time, in metres;
- 0,03 corresponds to the travel during take-up of clearance between the gripping elements and the guide rails, in metres.

The total energy the safety gear is capable of absorbing is calculated with [Formulae \(2\)](#) and [\(3\)](#):

$$2 \cdot K = (P + Q)_1 \cdot g_n \cdot h \quad (2)$$

$$\text{from which: } (P + Q)_1 = \frac{2 \cdot K}{g_n \cdot h} \quad (3)$$

where

- K 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, compensation means (if any), etc., in kilograms;
- Q is the rated load, in kilograms;
- $(P + Q)_1$ is the permissible mass, in kilograms.

4.3.2.3.2 Permissible mass

- a) If the elastic limit has not been exceeded, the permissible mass in kilograms, $(P + Q)_1$, is calculated with [Formula \(4\)](#):

$$(P + Q)_1 = \frac{2 \cdot K}{2 \cdot g_n \cdot h} \quad (4)$$

where

- K is calculated by the integration of the area defined in [4.3.2.2.3.2 a\)](#);
- 2 is taken as the dividing safety coefficient.
- b) If the elastic limit has been exceeded, [Formulae \(5\)](#) and [\(6\)](#) shall be used and the higher permissible mass may be selected.

$$(P + Q)_1 = \frac{2 \cdot K_1}{2 \cdot g_n \cdot h} \quad (5)$$

where

- K_1 is calculated by the integration of the area defined in [4.3.2.2.3.2 b\) 1\)](#);
- 2 is taken as the dividing safety coefficient.

$$(P + Q)_1 = \frac{2 \cdot K_2}{3,5 \cdot g_n \cdot h} \quad (6)$$

where

- K_2 is calculated by the integration of the area defined in [4.3.2.2.3.2 b\) 2\)](#);
- 3,5 is taken as the dividing safety coefficient.

4.3.3 Progressive safety gear

4.3.3.1 Test

4.3.3.1.1 Method of test

4.3.3.1.1.1 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.

4.3.3.1.1.2 The following shall be determined:

- a) the average braking force;
- b) the greatest instantaneous braking force;
- c) the smallest instantaneous braking force.

4.3.3.1.2 Test procedure

4.3.3.1.2.1 Safety gear certified for a single mass

Four tests with the mass $(P + Q)_1$ shall be carried out. Between each test, the friction parts shall be allowed to return to their normal temperature.

If during the tests, the friction parts are replaced, each set 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.

4.3.3.1.2.2 Safety gear certified for different masses

Adjustment in stages or continuous adjustment.

Two series of tests according to [4.3.3.1.2.1](#) shall be carried out for:

- a) the maximum; and
- b) the minimum values applied for.

A formula or a chart shall be provided showing the variation of the braking force as a function of a given parameter.

The validity of the supplied formula or chart shall be verified by additional tests.

4.3.3.1.3 Determination of the braking force of the safety gear

4.3.3.1.3.1 Safety gear certified for a single mass

The braking force that the safety gear is capable of 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 $\pm 25\%$ in relation to the value of the braking force defined above.

NOTE Tests have shown that the coefficient of friction can be considerably reduced if several successive tests are 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.

4.3.3.1.3.2 Safety gear verified for different masses

Adjustment in stages or continuous adjustment.

The braking force that the safety gear is capable of, shall be calculated as laid down in [4.3.3.1.3.1](#) for the maximum and minimum values applied for.

4.3.3.1.4 Checking after the tests

After the tests, it shall be checked that:

- a) the hardness of the block and the gripping elements are compared with the original values submitted by the documents;
- b) the deformations and modifications (for example, cracks, deformations or wear of the gripping elements, appearance of the rubbing surfaces) are checked;
- c) if necessary, the safety gear assembly, the gripping elements and the guide rails are photographed in order to reveal deformations or fractures.

4.3.3.2 Calculation of the permissible mass

4.3.3.2.1 Safety gear verified for a single mass

The permissible mass shall be calculated using [Formula \(7\)](#):

$$(P+Q)_1 = \frac{F_B}{16} \quad (7)$$

where

- F_B is the braking force in newtons, determined in accordance with [4.3.3.1.3](#);
- P is the masses of the empty car and components supported by the car, i.e. part of the travelling cable, compensation means (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 $1,0 g_n$.

4.3.3.2.2 Safety gear certified for different masses

4.3.3.2.2.1 Adjustment in stages

The permissible mass shall be calculated for each adjustment as laid down in [4.3.3.2.1](#).

4.3.3.2.2 Continuous adjustment

The permissible mass shall be calculated as laid down in [4.3.3.2.1](#) for the maximum and minimum values applied for, and in accordance with the formula supplied for the intermediate adjustments.

4.3.4 Additional verifications

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 [4.3.3.2](#) by $\pm 7,5\%$.

b) A check shall be made that the possible stroke of the gripping elements covers the accumulation of design tolerances.

4.3.5 Verification report

The report shall indicate:

- a) the type and the application of the safety gear;
- b) the limits of the permissible masses [see [4.3.4 a\)](#)];
- c) the maximum tripping speed of the safety gear;
- d) the type of guide rail;
- e) the permissible thickness of the guide rail blade;
- f) the minimum width of the gripping areas;

and, for progressive safety gear only:

- g) the surface condition of the guide rails (drawn, milled, ground);
- h) the state of lubrication of the guide rails. If they are lubricated, the category and specification of the lubricant.

4.4 Verification of overspeed governors

4.4.1 General provisions

The following shall be provided:

- 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 specified for the governor;
- c) the anticipated value of the tensile force produced in the rope by the overspeed governor when tripped;
- d) detailed and assembly drawings showing the construction, operation, materials used, dimensions and tolerances of the construction components.

4.4.2 Check on the characteristics of the overspeed governor

4.4.2.1 Test samples

The following shall be provided:

- a) one overspeed governor;
- b) one rope of the type used for the overspeed governor;
- c) a tensioning pulley assembly of the type used for the overspeed governor.

4.4.2.2 Test

4.4.2.2.1 Method of test

The following shall be checked:

- a) the speed of tripping is within the specified range;
- b) the operation of the electric safety device initiating the stopping of the lift machine before the car speed, either up or down, reaches the tripping speed of the governor [e.g. ISO 8100-1:2023, 4.6.2.2.1.6 a)], if this device is mounted on the overspeed governor;
- c) if after release of the safety gear the overspeed governor does not automatically reset itself, the operation of the electric safety device preventing the starting of the lift while the overspeed governor is not in the reset position [e.g. ISO 8100-1:2023, 4.6.2.2.1.6 b)];
- d) the tensile force produced in the rope by the overspeed governor when tripped.

4.4.2.2.2 Test procedure

Twenty tests shall be made in the speed range for tripping, corresponding to the range of rated speeds of the lift, indicated in [4.4.1 b\)](#).

Six tests shall be made for the minimum and six tests shall be made for the maximum values of the range.

The acceleration to reach the tripping speed of the overspeed governor shall not exceed $0,1 \text{ m/s}^2$.

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

4.4.2.2.3 Assessment of the test results

In the twenty tests, the tripping speeds shall lie within the specification for overspeed governors.

In the twenty tests, the operation of the devices for which the test is required in [4.4.2.2.1 b\)](#) and c) shall occur as specified [e.g. ISO 8100-1:2023, 4.6.2.2.1.6 a) and 4.6.2.2.1.6 b)].

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

In the case of a device which operates by gripping the rope, there shall be no permanent deformation of the rope.

4.4.3 Verification report

The report shall indicate:

- e) the type and application of overspeed governor;
- a) the maximum and minimum rated speeds of the lift for which the overspeed governor may be used;
- b) the diameter of the rope to be used and its construction;
- c) in the case of an overspeed governor with traction pulley, the minimum tensioning force;
- d) the tensile force in the rope which can be produced by the overspeed governor when tripped.

4.5 Verification of buffers

4.5.1 General provisions

The following shall be provided:

- a) maximum impact speed, minimum and maximum masses;
- b) detailed and assembly drawings showing the construction, operation, materials used, dimensions and tolerances of the construction components.

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;

- c) specifications for the liquid used;
- d) information regarding environmental conditions for use (temperature, humidity, pollution, etc.) and of life cycle (aging, rejection criteria).

4.5.2 Samples subject to test

The following shall be provided:

- a) one buffer;
- b) liquid, in the case of hydraulic buffers.

4.5.3 Test

4.5.3.1 Energy dissipation buffers

4.5.3.1.1 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 the maximum speed called for at the moment of impact.

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.

4.5.3.1.2 Equipment to be used

4.5.3.1.2.1 Weights falling in free fall

The weights shall correspond, with the tolerances of [4.1](#), to the maximum and minimum masses. They shall be guided vertically ensuring acceleration in free fall condition of at least $0,9 g_n$.

4.5.3.1.2.2 Recording equipment

The recording equipment shall be able to detect signals with the tolerances of [4.1](#). 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 1 000 Hz.

4.5.3.1.2.3 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 [4.1](#).

4.5.3.1.2.4 Measurement of the retardation

If there is a device for measuring retardation (see [4.5.3.1.1](#)), it shall be placed as close as possible to the axis of the buffer, and shall be capable of measurement with the tolerances of [4.1](#).

4.5.3.1.2.5 Measurement of time

Time pulses of duration of 0,01 s shall be recorded and measured with the tolerances of [4.1](#).

4.5.3.1.3 Ambient temperature

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

The temperature of the liquid shall be measured with the tolerances of [4.1](#).

4.5.3.1.4 Mounting of the buffer

The buffer shall be placed and fixed in accordance with its installation instructions.

4.5.3.1.5 Filling of the buffer

The buffer shall be filled up in accordance with its instructions.

4.5.3.1.6 Checks

4.5.3.1.6.1 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. ISO 8100-1:2023, 4.8.2.2.2).

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/s².

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.

4.5.3.1.6.2 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 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 allow the liquid to return to the tank and for air bubbles to escape.

4.5.3.1.6.3 Checking of the liquid losses

The level of liquid shall be checked after having made the two retardation tests required in [4.5.3.1.6.1](#). After an interval of 30 min, the level of liquid shall again be sufficient to ensure normal operation of the buffer.

4.5.3.1.6.4 Checking of the condition of the buffer after tests

After the two retardation tests required in [4.5.3.1.6.1](#), no part of the buffer shall show any permanent deformation, or be damaged, so that its condition shall guarantee normal operation.

4.5.3.2 Energy accumulation buffers with non-linear characteristics

4.5.3.2.1 Test procedure

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

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

The masses shall correspond to the maximum and minimum masses called for. They shall be guided vertically ensuring acceleration in free fall condition of at least $0,9 g_n$.

4.5.3.2.2 Equipment to be used

The equipment shall correspond to [4.5.3.1.2](#).

4.5.3.2.3 Ambient temperature

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

4.5.3.2.4 Mounting of the buffer

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

4.5.3.2.5 Number of tests

Three tests shall be made with the maximum mass and the minimum mass called for.

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

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

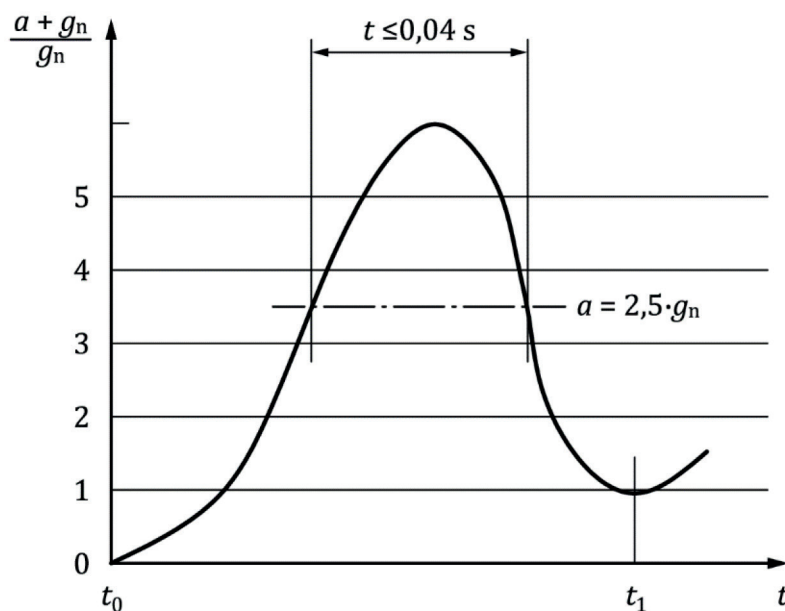
Within 30 min before the test, the buffer shall be once loaded, either statically or dynamically, in order to prevent further settlement and deviations during the test.

4.5.3.2.6 Checks

4.5.3.2.6.1 Checking of retardation

The retardation “a”, shall conform to the following requirements:

- 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. [e.g. ISO 8100-1:2023, 4.8.2.1.2.1 a)];
- Peaks duration of retardation above a value specified by the standard calling for this device shall not exceed the maximum duration of these peaks as required by the standard calling for this device [e.g. ISO 8100-1:2023, 4.8.2.1.2.1 b)];
- The maximum peak retardation shall not exceed the maximum as required by the standard calling for this device [e.g. ISO 8100-1:2023, 4.8.2.1.2.1 e)];
- The return speed shall not exceed the maximum as required by the standard calling for this device. [e.g. ISO 8100-1:2023, 4.8.2.1.2.1 c)].



Key

- a retardation in metres per square second
- g_n standard acceleration of free fall in metres per square second
- t time in seconds
- t_0 moment of hitting the buffer (first absolute minimum)
- t_1 second absolute minimum

Figure 1 — Retardation graph — Example using ISO 8100-1 requirements

4.5.3.2.6.2 Checking of the condition of the buffer after tests

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

4.5.4 Verification report

The report shall indicate:

- a) the type and application of buffer;
- b) the dimensions of the buffer;
- c) the maximum impact speed;
- d) the maximum mass;
- e) the minimum mass;
- f) the kind of fixation;
- g) the specification of the liquid in the case of hydraulic buffers;
- h) the environmental conditions for use of buffer according to instructions (temperature, humidity, pollution, etc.).

4.6 Verification of safety circuits and SIL-rated circuits

4.6.1 General provisions

4.6.1.1 General

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.

4.6.1.2 Documentation

The following shall be provided:

- a) identification on the board;
- b) environmental working conditions;
- c) list of components used;
- 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) method of failure analysis employed and documented results.

4.6.1.3 Documentation for SIL-rated circuits

In addition to [4.6.1.2](#), the following documentation shall be provided:

- a) documents and descriptions relating to the measures referenced in [4.18](#);
- 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.

4.6.2 Samples subject to test

The following shall be provided:

- a) one printed circuit board;
- b) one bare printed circuit board (without components).

4.6.3 Tests

4.6.3.1 Mechanical tests

4.6.3.1.1 General

During the tests, the equipment shall be kept under operation. During and after the tests, no unsafe operation and condition shall appear within the safety-related circuit.

After the test the safety-related circuit shall operate as intended.

4.6.3.1.2 Vibration and shocks

Equipment shall be tested according to:

- a) IEC 60068-2-6:2007, Vibration test:
 - 1) 20 sweep cycles in each axis;
 - 2) amplitude 0,35 mm;
 - 3) frequency range 10 Hz–55 Hz.
- b) IEC 60068-2-27:2008, Non-repetitive shocks:
 - 1) peak acceleration 300 m/s^2 or $30 g_n$;
 - 2) duration of pulse 11 ms;
 - 3) pulse shape: half sine;
 - 4) number of shocks per each axis and direction: 3;
 - 5) three axis and two directions.
- c) IEC 60068-2-27:2008, Repetitive shocks:
 - 1) peak acceleration: 100 m/s^2 or $10 g_n$;
 - 2) duration of pulse: 16 ms;
 - 3) pulse shape: half sine;
 - 4) number of shocks per each axis and direction: $1\,000 \pm 10$;
 - 5) repetition rate: 2/s;
 - 6) three axis and two directions.

NOTE Where shock absorbers are fitted, they are considered as part of the equipment.

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

4.6.3.2 Temperature tests

Equipment shall be tested according to IEC 60068-2-14:2009 Test Nb with following severity parameters:

- lower temperature T_A : 0 °C;
- higher temperature T_B : + 65 °C;
- temperature change rate: 1 +/-0,2 °C /min;
- exposure time to each of the two temperatures: 4 h;
- number of cycles: 2

Test conditions:

- the lower and higher temperatures are to be understood as the ambient temperature of the equipment;
- the printed circuit board shall be in operational position;
- the printed circuit board shall be supplied with rated operational voltage;
- during and after the test, the safety device shall operate correctly when demanded. Demand rate minimum once in 10 min;
- if the printed circuits board includes components other than safety circuits, they also shall operate during the test (their failure is not considered);
- if the equipment is designed to operate within wider temperature limits, it shall be tested for these values.

4.6.3.3 Failure analysis of electric safety circuits

The failure analysis as required by the relevant standard calling for the use of this document shall be validated. (e.g. ISO 8100-1:2023, 4.11.2.3).

4.6.3.4 Functional and safety test of SIL-rated circuit

In addition to the verification of the measures selected according to [4.18](#), the following shall be validated:

- a) Software design and coding: Inspect all code statements using methods such as formal design reviews, FAGAN, test cases etc.;
- b) Software and hardware inspection: Verify selected measures by using, for example, fault insertion testing.
- c) Verification of both PFD_{avg} and PFH calculations.

4.6.4 Verification report

The report shall indicate:

- a) the type and application of the circuitry;
- b) the conditions for safe use;
- c) the operating voltages.

4.7 Verification of ascending car overspeed protection means

4.7.1 General provisions

4.7.1.1 This specification does not apply to speed monitoring elements which are overspeed governors, subject to verifications according to [4.4](#).

4.7.1.2 The following information shall be provided:

- a) minimum and maximum masses, or torque;
- b) minimum (if applicable) and maximum rated speed;
- c) use in installations with compensation means.

4.7.1.3 The following documents shall be provided:

- a) detailed and assembly drawings showing the construction, operation, materials used, dimensions and tolerances of the construction components;
- b) a load diagram relating to elastic parts;
- c) detailed information on the materials used, the type of part on which the ascending car overspeed protection means acts, and its surface condition (drawn, milled, ground, etc.).

4.7.2 Statement and test sample

4.7.2.1 It shall be stated for what mass (in kilograms) and tripping speed (in meters per second) the test will be carried out. If the device shall be verified for various masses, it shall be stated and indicated whether the adjustment for various masses is by stages or continuous.

4.7.2.2 As defined for the test, either:

- a complete assembly consisting of both elements, braking device and speed monitoring device; or
- only that device which was not subject to verifications according to [4.3](#) or [4.4](#);

shall be provided.

The number of sets of gripping elements necessary for all the tests shall be attached. The type of part on which the device acts, shall also be provided.

4.7.3 Test

4.7.3.1 Test method

The test method shall be defined depending on the device and its function. Measurements shall be made of:

- a) the acceleration and speed;
- b) the braking distance;
- c) the retardation.

Measurements shall be recorded as a function of the time.

4.7.3.2 Test procedure

4.7.3.2.1 General

Twenty tests shall be made with the speed monitoring element in the speed range for tripping, corresponding to the range of rated speeds of the lift indicated in [4.7.1.2](#).

The acceleration of the mass to reach the tripping speed shall not exceed $0,1 \text{ m/s}^2$.

4.7.3.2.2 Device verified for a single mass

Four tests shall be carried out with the system mass representing an empty car.

Between each test, the friction parts shall be allowed to return to their normal temperature.

If during the test the friction parts are replaced, each set 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 test shall be made at the maximum tripping speed for which the device is specified.

4.7.3.2.3 Device verified for different masses

Adjustment in stages or continuous adjustment.

A series of tests shall be carried out for the maximum value specified, and a series for the minimum value. A formula, or a chart shall be provided, showing the variation of the braking force as a function of a given parameter.

The validity of the supplied formula or chart shall be verified by additional tests.

4.7.3.2.4 Overspeed monitoring device

4.7.3.2.4.1 Test procedure

Twenty tests shall be made in the speed range for tripping without applying the braking device.

Twelve of those tests shall be made at the extreme values of the range.

4.7.3.2.4.2 Assessment of the test results

In the twenty tests, the tripping speeds shall lie within the specification.

4.7.3.2.5 Test procedure for self-monitoring

Ten tests shall be made to verify the operation of the device. All tests shall be positive to verify correct operation.

4.7.3.3 Checking after the tests

After the test:

- a) the hardness of the gripping element shall be compared with the original values quoted by the documents;
- 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 rubbing surfaces);

- c) if necessary, photographs shall be taken of the gripping elements and the parts on which the device acts for evidence of deformations or fractures;
- d) it shall be checked that the retardation with the minimum mass has not exceeded $1,0 g_n$.

4.7.4 Test report

In order to achieve reproducibility, the verification shall be recorded in all details, such as:

- the method of test;
- the description of the testing arrangement;
- the location of the device to be tested in the testing arrangement;
- the number of tests carried out;
- the record of measured values;
- the report of observations during the test;
- the evaluation of the test results to show compliance with the requirements.

4.7.5 Verification report

The report shall indicate:

- a) the type and application of overspeed protection means;
- b) the limits of the permissible masses;
- c) the tripping speed range of the overspeed monitoring device;
- d) the type of parts on which the braking elements act.

4.8 Verification of unintended car movement protection means

4.8.1 General provisions

The unintended car movement protection means shall be verified as a complete system. Alternatively, the subsystems for detection, activation and stopping shall be verified individually. The verification of subsystems shall define interface conditions and the relevant parameters of each subsystem if integrated in a complete system.

The following key parameters for use of the system or subsystem that form part of the verification shall be stated:

- minimum and maximum masses;
- minimum and maximum force or torque or fluid pressure, if applicable;
- individual response times of detector, control circuit and stopping element(s);
- highest speed anticipated before deceleration occurs (see NOTE 1);
- distance from the floor at which the detector device will be installed;
- test speed(s) (see NOTE 2);
- limits of temperature and humidity of the design.

NOTE 1 As an example and indication, for traction lifts, where the natural acceleration is $1,5 \text{ m/s}^2$ and without any torque contribution from the motor, the maximum speed attainable would be in the magnitude of 2 m/s . This is based on the speed attained at start of deceleration e.g. being the result of a “natural” acceleration of $1,5 \text{ m/s}^2$ through the response times of the unintended car movement protection device, control circuit and stopping elements, assuming that the movement detector operates when the car reaches the limit of the unlocking zone.

In case of electric failure, it can be assumed that, for traction lifts due to internal control means, the acceleration which can be achieved is not greater than $2,5 \text{ m/s}^2$.

NOTE 2 Test speed(s): a speed to establish a distance moved by the lift (verification distance) so that the unintended movement system is verified for correct operation during verifications and tests before putting into service at site. This can be the inspection speed or any other speed determined by the manufacturer and agreed by the laboratory.

The distance the car is permitted to move during unintended movement is defined in the requirements laid down in the standards calling for the use of this document (e.g. ISO 8100-1:2023, 4.6.7.5).

The following documents shall be provided:

- a) Detailed and assembly drawings showing the construction, operation, dimensions and tolerances of the components;
- b) a load diagram relating to elastic parts;
- c) Detailed information of the materials used, the type of part on which the means acts, and its surface condition, if relevant (drawn, milled, ground, etc.).

4.8.2 Statement and test sample

4.8.2.1 The intended duty of the means shall be stated.

4.8.2.2 Test samples shall be provided as complete assembly of unintended car movement detection device, control circuit (actuator), stopping elements and any monitoring device(s) if applicable.

The number of sets of gripping elements necessary for all the tests shall be attached.

The type of part on which the device acts, shall also be provided.

4.8.3 Test

4.8.3.1 Test method

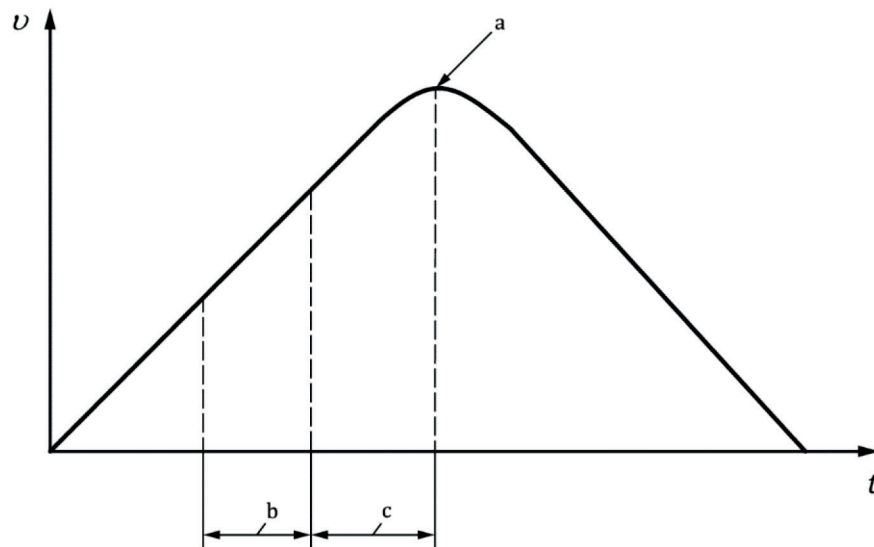
The test method shall be defined depending on the device and its function.

Measurements shall be made of:

- the stopping distance;
- the average retardation;
- the response time of the detection, actuation, stopping element and control circuits (see [Figure 2](#));
- the total distance travelled (sum of acceleration and stopping distances).

The test shall also include:

- the operation of the unintended car movement detection device; and
- any automatic monitoring system, if applicable.

**Key**

- v speed in meters per second
- t time in seconds
- a Point at which stopping elements start to cause a reduction in speed.
- b Response time of unintended car movement detection and any control circuits.
- c Response time of actuation circuits and stopping elements.

Figure 2 — Response times**4.8.3.2 Test procedure****4.8.3.2.1 General**

Twenty tests shall be made on the stopping element with:

- no result outside the specification;
- each result within $\pm 20\%$ of the average value.

4.8.3.2.2 Device verified for a single mass or torque or fluid pressure

The following tests shall be carried out:

- 10 tests with the system mass or torque or fluid pressure representing an empty car in the upward direction; and
- 10 tests with the system mass or torque or fluid pressure representing a car carrying the rated load in the downward direction.

Between each test, the friction parts shall be allowed to return to their normal temperature.

If during the test the friction parts are replaced, each set shall be capable of minimum five tests.

4.8.3.2.3 Device verified for different masses or torques or fluid pressures

A series of tests shall be carried out for the maximum value specified for and a series for the minimum value.

A formula or a chart shall be provided, showing the variation of the braking force or torque or fluid pressure as a function of a given adjustment. The results is expressed in distance travelled.

The validity of the supplied formula or chart shall be verified.

4.8.3.2.4 Test procedure for unintended movement detection means

Ten tests shall be made to verify the operation of the device. All tests shall be positive to verify correct operation.

4.8.3.2.5 Test procedure for self-monitoring

Ten tests shall be made to verify the operation of the device. All tests shall be positive to verify correct operation.

In addition, the capability of the self-monitoring to detect loss of redundancy of the stopping element before a critical situation occurs, shall be verified.

4.8.3.3 Checks after the test

After the test:

- a) the mechanical characteristics of the stopping element(s) shall be compared with the original values quoted by the documents. Other analyses may be carried out in special cases;
- b) it shall be checked that there are no fractures, deformations or any other changes (e.g. cracks, deformations or wear of the gripping elements, appearance of the rubbing surfaces);
- c) if necessary, photographs shall be taken of the gripping elements and the parts on which the device acts for evidence of deformations or fractures.

4.8.4 Test report

In order to achieve reproducibility, the verification shall be recorded in all details, such as:

- the method of test;
- the description of the testing arrangement;
- the location of the device to be used when installed in the testing arrangement;
- the number of tests carried out;
- the record of all measured values;
- the report of observations during the test;
- the evaluation of the test results to show compliance with the requirements.

4.8.5 Verification report

The report shall indicate:

- a) the type and application of the unintended car movement protection system/subsystem;
- b) the limits of the key parameters;
- c) the test speed with relevant parameters for final inspection use;
- d) the type of parts on which the stopping elements act;

- e) the combination of “detecting” device and “stopping” element of the means in the case of complete systems;
- f) the interface conditions in case of subsystems.

4.9 Verification of rupture valve/one-way restrictor

4.9.1 General provisions

4.9.1.1 General

In the following, the term “rupture valve” means “rupture valve/one-way restrictor with mechanical moving parts”.

The following information shall be provided:

- a) the range of:
 - 1) flow;
 - 2) pressure;
 - 3) viscosity;
 - 4) ambient temperature; and
- b) the method of mounting;
- c) detailed and assembly drawings showing the construction, operation, adjustment, materials, dimensions and tolerances of the rupture valve and the construction components.

4.9.1.2 Samples subject to test

The following shall be provided:

- a) one rupture valve;
- b) a list of liquids which may be used together with the rupture valve, or a sufficient amount of special liquid to be used;

4.9.1.3 Test

4.9.1.3.1 Test installation

The rupture valve, mounted in its intended method, shall be tested in a hydraulic system, where:

- a) the required testing pressure is dependent on the mass;
- b) the flow is controlled by adjustable valves;
- c) the pressure before and behind the rupture valve can be recorded;

NOTE “Before the rupture valve” means between the cylinder and the rupture valve.

- d) means to change the ambient temperature of the rupture valve and the viscosity of the hydraulic liquid are provided.

The system shall allow recording of the flow over time. To determine the values of flow, the measurement of another figure, i.e. the speed of the ram from which the flow can be derived is permitted.

4.9.1.3.2 Measuring instruments

The measuring instruments shall have accuracy according to [4.1](#).

4.9.1.4 Test procedure

4.9.1.4.1 General

The test shall:

- a) simulate a total piping failure occurring at a moment when the speed of the car is zero;
- b) evaluate the resistance of the rupture valve against pressure.

4.9.1.4.2 Simulation of a total piping failure

4.9.1.4.2.1 Simulating a total piping failure, the flow shall be initiated from a static situation by opening a valve, on condition that the static pressure before the rupture valve decreases to less than 10 %.

The tolerances of the closing valve shall be taken into account within the stated range of:

- a) flow;
- b) viscosity;
- c) pressure;
- d) ambient temperature.

This shall be achieved by 2 test series with:

- maximum pressure, maximum ambient temperature, minimum adjustable flow and minimum viscosity;
- minimum pressure, minimum ambient temperature, maximum adjustable flow and maximum viscosity.

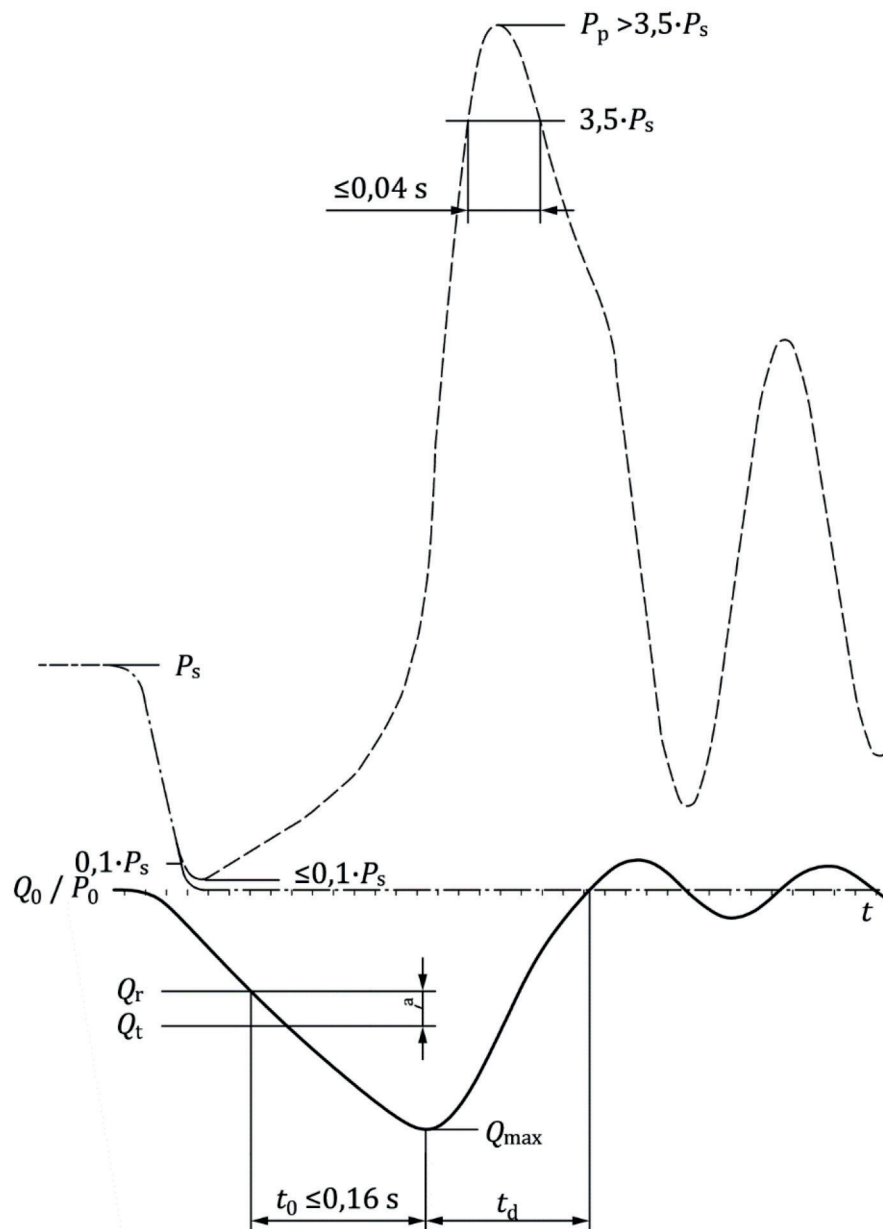
In each test series, at least 10 tests shall be carried out to evaluate the tolerances of operation of the rupture valve in these conditions.

4.9.1.4.2.2 During the tests, the relation between:

- flow and time;
- pressure before the rupture valve and time;
- pressure behind the rupture valve and time,

shall be recorded.

The typical characteristics of these curves are shown in [Figure 3](#).



Key

P_0	pressure before test
P_p	pressure peak
P_s	pressure static
Q_0	flow before test
$Q_{\max}$	maximum flow
Q_r	flow at rated speed detection point
Q_t	flow at tripping point
t	time
t_0	time between detection point and maximum flow before closing
t_d	time between maximum closing flow and zero flow before any rebound
— · — ·	pressure after rupture valve
————	hydraulic fluid flow
— — —	pressure before rupture valve