

BS 6440:2011



BSI Standards Publication

Powered vertical lifting platforms having non-enclosed or partially enclosed liftways intended for use by persons with impaired mobility – Specification

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Contents

Foreword *iv*

Introduction 1

1	Scope	2
2	Normative references	2
3	Terms and definitions	3
4	General requirements for lifting platforms	6
4.1	General	6
4.2	Pattern of use	6
4.3	Guarding	6
4.4	Rated speed	6
4.5	Rated load	7
4.6	Load control	7
4.7	Carrier floor dimensions	7
4.8	Mechanical strength of the lifting platform	7
4.9	Resistance to operating forces	8
4.10	Protection of equipment against harmful external influences	9
4.11	Lifting platform support/guide system	9
4.12	Safety gear and over-speed governor	10
5	Access for maintenance, repair and inspection	11
5.1	Working areas on the carrier	11
5.2	Working areas under the carrier	12
5.3	Access to equipment and machinery	12
6	Driving units and drive systems	12
6.1	General requirements	12
6.2	Braking system	13
6.3	Stopping/levelling accuracy	14
6.4	Emergency/manual operation	14
6.5	Additional requirements for rack and pinion drive	15
6.6	Additional requirements for rope and chain suspension drive	16
6.7	Additional requirements for screw and nut drive	17
6.8	Additional requirements for hydraulic drive	18
7	Electrical equipment	24
7.1	Power supply	24
7.2	Conductors of different circuits	24
7.3	Insulation resistance of the electrical installation	24
7.4	Drive contactors	25
7.5	Motor and brake supply	25
7.6	Enclosure requirements and electrical creepage and clearance distances	25
7.7	Electromagnetic compatibility	26
7.8	Protection against electrical faults	26
7.9	Electric safety devices	26
7.10	Protection of the driving motor	29
7.11	Electrical wiring	29
7.12	Additional requirements for battery-powered supply	29
7.13	Control devices	30
8	Liftways	32
8.1	Liftway floor	32
8.2	Top clearances	32
8.3	Adjacent surfaces	32
8.4	Inspection doors and traps	33
8.5	Liftway entrances	33
8.6	Construction of boarding point gates	33
8.7	Boarding point gate unlocking zone	34
8.8	Boarding point locking devices	34
8.9	Boarding point gate emergency unlocking	34

8.10	Protection during boarding point gate operation	35
8.11	Bridging steps	35
9	Carrier construction	36
9.1	Protection of access sides	36
9.2	Protection of non-access sides	36
9.3	Tip-up seat	37
9.4	Guardrail/hand hold	37
9.5	Toe guard	37
9.6	Floor covering	37
9.7	Lowest level carrier access ramp	37
9.8	Glass	39
9.9	Edge and surface protection	39
9.10	Carrier construction of lifting platforms for the personal use of trained persons (domestic use) using wheelchairs	40
10	Information	40
10.1	General	40
10.2	Signals and warning devices	41
10.3	Documents	42
10.4	Verification tests on each machine before first use	43
10.5	Dismantling	44

Annexes

Annex A (informative)	List of significant hazards	45
Annex B (informative)	Guidance for the exchange of information between manufacturer/supplier and specifier	49
Annex C (informative)	Recommendations for the provisions and use of specially adapted control devices, switches and sensors	51
Annex D (normative)	Verification of safety requirements and/or protective measures	52
Annex E (informative)	In-use periodic examinations, servicing and tests	55
Annex F (informative)	Certificate of acceptance from end user	56
Annex G (informative)	Certificate for test and examination after installation of lifting platform	57

Bibliography	60
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List of figures

Figure 1	Examples of vertical lifting platforms with non-enclosed liftways	6
Figure 2	Graphical representation of relationship between carrier floor area and minimum static load	8
Figure 3	Charging supply for battery-powered lifting platforms	30
Figure 4	Dimensions of permissible projections on adjacent surfaces	33
Figure 5	Unlocking triangle	35
Figure 6	Example of bridging steps	36
Figure 7	Dimensions and clearances for lifting platforms with non-enclosed liftway and carrier without walls and ceiling	38
Figure 8	Typical load plate	41
Figure 9	Typical manual lowering legend	41
Figure 10	Typical safety notice	42
Figure F.1	Typical certificate of acceptance	56
Figure G.1	Example of a certificate for test and examination after installation of lifting platform	57

List of tables

Table 1 – Minimum plan dimensions of the carrier floor	7
Table 2 – Mechanical strength of the lifting platform	8
Table 3 – Insulation resistance	24
Table 4 – Electrical safety devices	27
Table 5 – Push button control devices	31
Table 6 – Joystick control devices	31
Table 7 – Rocker switch control devices	32
Table 8 – Glass panels	39
Table A.1 – Significant hazards relating to the general design and construction of lifting platforms	45
Table D.1 – Means of verification of the safety requirements and/or measures	52

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 60, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 31 August 2011. It was prepared by Technical Committee MHE/4, *Lifts, hoists and escalators*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 6440:1999, which is withdrawn.

Relationship with other publications

Related standards for similar devices for use by persons with impaired mobility are BS EN 81-40, BS EN 81-41 and BS 5900 (the latter relates to private dwellings only).

Those items relevant to lifting platforms referenced within BS EN 81-70 have been included within this edition of BS 6440.

Information about this document

This is a full revision of the standard, and introduces the following principal changes:

- change from a code of practice to a specification;
- changes to meet the essential health and safety requirements of Machinery Directive 2006/42/EC [1] as enacted as the Supply of Machinery (Safety) Regulations 2008 [2].

BS 6440:1999 applied to lifting platforms with fully and partially enclosed liftways travelling over stated distances. A new standard, BS EN 81-41, applies to lifting platforms with enclosed liftways. However, BS EN 81-41 does not specify requirements for lifting platforms with a non-enclosed liftway, which are common on the UK market. The revised BS 6440 specifies requirements for lifting platforms with non-enclosed and partially enclosed liftways.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

BSI permits the reproduction of Figure F.1 and Figure G.1. This reproduction is only permitted where it is necessary to use the sample certificates given in these figures during each application of the standard.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

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

Compliance with a British Standard cannot confer immunity from legal obligations.

Introduction

This British Standard may be used as a means to address relevant health and safety requirements of Machinery Directive 2006/42/EC [1], and additionally specifies minimum requirements for the provision of lifting platforms in buildings/constructions.

It is assumed that the lifting platform operates in an ambient temperature in the range 5 °C to 40 °C. For temperatures outside this range, additional measures might be necessary.

This British Standard does not specify requirements for:

- severe conditions (e.g. extreme climates, strong magnetic fields);
- lightning protection;
- potentially explosive atmospheres;
- the handling of materials, the nature of which could lead to dangerous situations;
- lifting platforms of which the primary function is the transportation of goods;
- lifting platforms prone to vandalism;
- earthquakes or flooding;
- fire-fighting, evacuation and behaviour during a fire;
- vibrations;
- the design of concrete, hardcore, timber or other foundation or building arrangement;
- the design of anchorage bolts to the supporting structure;
- type C wheelchairs as defined in BS EN 12183 and/or BS EN 12184;
- balancing weights or counterweights.

This revision of BS 6440 deals with all significant hazards relevant to lifting platforms, when they are used as intended and under the conditions foreseen by the manufacturer. A list of significant hazards is given in Annex A.

In order to determine the specific characteristics of the lifting platform, at least the following issues need to be discussed between the supplier and the specifier:

- environmental conditions;
- civil engineering considerations;
- other aspects related to the place of installation, including safe use of the lifting platform;
- the use and places of use of the machinery;
- fire protection requirements;
- suitability for the user.

Annex B gives information on issues which specifiers are expected to discuss with the supplier in order to select and specify a suitable powered lifting platform.

It is assumed that a powered lifting platform conforming to this standard is for the use of persons either:

- capable of using the lifting platform safely and unaided, either after having been fully instructed in its use, or having observed clear and simple instructions permanently displayed on the equipment; or
- if not capable of safe unaided use of the lifting platform, transported under the care of a fully instructed able-bodied accompanying person for whom additional control facilities can be provided if required. Recommendations for specially adapted control devices are given in Annex C.

1 Scope

This British Standard specifies requirements for the design, manufacture, installation, commissioning, testing, maintenance and dismantling of new permanently installed electrically powered vertical lifting platforms with the following characteristics:

- travelling vertically between predefined levels along a guided path where the inclination to the vertical does not exceed 15°;
- supported or sustained by wire ropes, chains, rack and pinion, hydraulic cylinder (direct or indirect), screw and nut or scissors mechanisms;
- having non-enclosed or partially enclosed liftways;
- having non-enclosed or partially enclosed carriers;
- having a rated speed that is not greater than 0.15 m/s;
- having a travel distance that is not greater than 3.0 m;
- sized for use with type A or type B wheelchairs conforming to BS EN 12183 and/or BS EN 12184.

It is applicable to lifting platforms that are intended primarily for the transport of persons with impaired mobility, with or without a wheelchair.

NOTE 1 The lifting platforms specified in this standard can be used in domestic or non-domestic premises, and can be installed indoors or outdoors. Their installation in some premises might not be practicable.

NOTE 2 Although this British Standard is applicable to new lifting platforms, it can also be used as guidance for the refurbishment and re-installation of existing lifting platforms.

2 Normative references

The following referenced documents may be used in the application of this British Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 7671, *Requirements for electrical installations – IEE Wiring Regulations – Seventeenth edition*

BS EN 81-1:1998+A3:2009, *Safety rules for the construction and installation of lifts – Part 1: Electric lifts*

BS EN 81-2:1998+A3:2009, *Safety rules for the construction and installation of lifts – Part 2: Hydraulic lifts*

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

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

BS EN 12015, *Electromagnetic compatibility – Product family standard for lifts, escalators and moving walks – Emission*

BS EN 12016, *Electromagnetic compatibility – Product family standard for lifts, escalators and moving walks – Immunity*

BS EN 12183, *Manual wheelchairs – Requirements and test methods*

BS EN 12184, *Electrically powered wheelchairs, scooters and their chargers – Requirements and test methods*

BS EN 12385-4, *Steel wire ropes – Safety – Part 4: Stranded ropes for general lifting applications*

BS EN 13411 (all parts), *Terminations for steel wire ropes*

BS EN 50214, *Flat polyvinyl chloride sheathed flexible cables*

BS EN 60204-1:2006+A1:2009, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

BS EN 60529:1992, *Specification for degrees of protection provided by enclosures (IP code)*

BS EN 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*

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

BS EN 60947-5-1:2004+A1:2009, *Low-voltage switchgear and controlgear – Part 5-1: Control/circuit devices and switching elements – Electromechanical control circuit devices*

BS EN ISO 12100, *Safety of machinery – General principles for design – Risk assessment and risk reduction*

BS EN ISO 13857:2008, *Safety of machinery – Safety distances to prevent hazard zones being reached by upper and lower limbs*

BS ISO 6336 (all parts), *Calculation of load capacity of spur and helical gears*

ISO 606, *Short-pitch transmission precision roller and bush chains, attachments and associated chain sprockets*

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS EN ISO 12100 and the following apply.

- 3.1 barrier**
bar or similar device so arranged as to provide protection against persons falling from the carrier
- 3.2 boarding point**
space at the entrance to a lifting platform (at any level) to permit manoeuvring, boarding and alighting of users, with or without wheelchairs
- 3.3 carrier**
part of a lifting platform by which persons are supported in order to be lifted or lowered

- 3.4 competent person**
person, suitably trained and qualified by knowledge and practical experience, and provided with the necessary instructions to enable the required work to be carried out safely
- 3.5 down direction valve**
electrically controlled valve in a hydraulic circuit for controlling the descent of a lifting platform
- 3.6 drive system**
system that causes a lifting platform to move under power input
- 3.7 driving unit**
unit, including the motor, which drives and stops a lifting platform
- 3.8 electrical safety contact**
contact in which the separation of the circuit-breaking elements is made by positive means
- 3.9 full load pressure**
static pressure exerted on the piping directly connected to the hydraulic cylinder, when a lifting platform with the rated load is at rest at the highest boarding point level
- 3.10 liftway**
space through which a carrier and its load travels
- 3.11 load-carrying nut**
internally threaded component which carries the load in conjunction with a screw
- 3.12 load cycle**
start (acceleration from rest to rated speed), over the total travel, stop (deceleration from rated speed) and return travel (start and stop) to the initial position
- 3.13 minimum static load**
load that a lifting platform and its associated suspension attachments have been designed to support
- 3.14 mechanical blocking device**
device that, when set in position, guarantees a minimum safety space beneath the carrier for the purposes of maintenance and inspection
- 3.15 over-speed governor**
device that, when the carrier attains a pre-determined speed, causes the lifting platform to stop and if necessary causes the safety gear to be applied
- 3.16 person with impaired mobility**
person for whom stairs are a barrier to vertical travel
NOTE This could include persons with a permanent or increasing walking impairment; persons who are carrying luggage, cycles or heavy shopping; persons who are using prams, child buggies, wheeled shopper bags, or for other reasons are temporarily impeded when using long ramps or steep stairs; and persons using wheelchairs.
- 3.17 pressure relief valve**
valve which limits the pressure to a pre-determined value by exhausting fluid

- 3.18 rack**
bar with teeth with which a driving pinion engages to form a slip-free driving means of converting rotary motion into linear motion
- 3.19 rated load**
load for which a lifting platform has been designed
- 3.20 rated speed**
design speed of the carrier
- 3.21 safety circuit**
electrical or electronic circuit with an equivalent degree of safety to a circuit containing electrical safety contacts
- 3.22 safety gear**
mechanical device for stopping and maintaining the carrier stationary in case of over-speeding in the downward direction and/or breaking of the suspension
- 3.23 safety nut**
internally threaded component, which is linked to a load-carrying nut but is unloaded during normal service, and which is capable of carrying the load if the load-carrying nut breaks
- 3.24 screw**
external threaded component, which carries the load in conjunction with a load-carrying nut, and which in certain circumstances carries the load imposed by a safety nut
- 3.25 sensitive edge**
device to provide protection against a trapping, shearing or crushing hazard
- 3.26 sensitive surface**
device similar in effect to a sensitive edge (3.25) but so arranged as to protect a surface
- 3.27 shut-off valve**
manually operated two-way valve which can permit or prevent flow in either direction
- 3.28 toe guard**
vertical component extending downwards from a lifting platform entrance
- 3.29 travel**
vertical distance between the top and bottom boarding point levels served by a lifting platform
- 3.30 unlocking zone**
zone, extending above and below a boarding point, in which the carrier floor has to be positioned to enable the corresponding gates/doors/ramps or barriers to be unlocked
- 3.31 vertical lifting platform**
device permanently installed to serve fixed boarding points, comprising a guided carrier whose dimensions and means of construction are primarily intended to permit the access of persons with impaired mobility

4 General requirements for lifting platforms

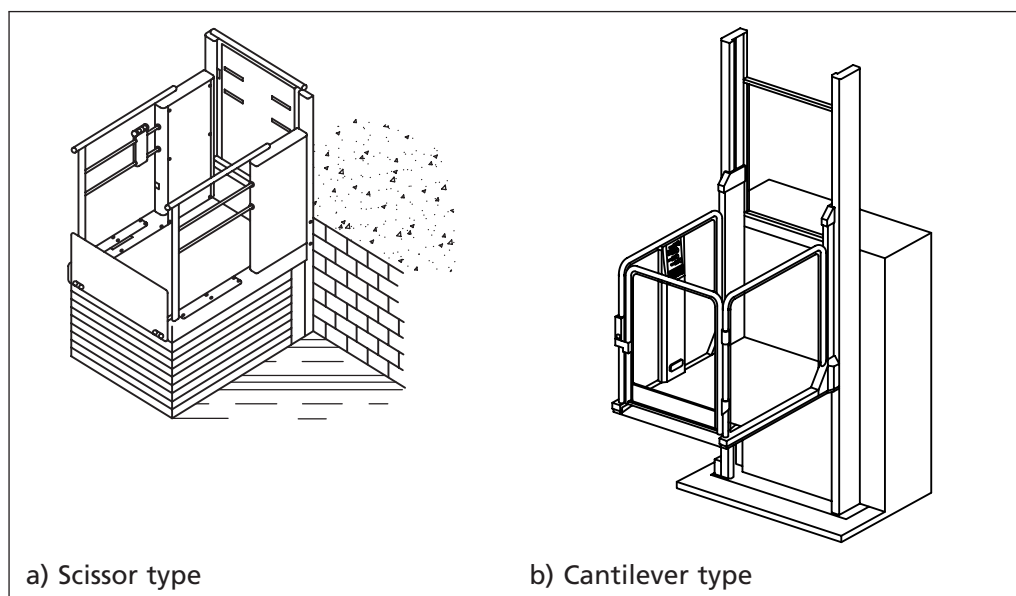
4.1 General

Machinery shall be designed in accordance with this British Standard, and shall be verified in accordance with Annex D and with the principles of BS EN ISO 12100.

NOTE 1 BS EN ISO 12100 covers hazards that are relevant, but not significant, which are not dealt with in this British Standard (e.g. sharp edges).

NOTE 2 Figure 1 shows two different examples of typical lifting platform arrangements. Others are possible.

Figure 1 Examples of vertical lifting platforms with non-enclosed liftways



4.2 Pattern of use

The design of the lifting platform shall be such that it can perform at least ten load cycles (see 3.12) per hour with maximum rated load.

NOTE Higher numbers of load cycles per hour are subject to negotiation in accordance with the guidance given in Annex B.

4.3 Guarding

Exposed rotating or moving parts (e.g. gearing of the drive unit) with the potential to cause personal injury shall be guarded. Access panels shall be secured by means requiring the use of a tool or key for their release.

Guarding shall be designed and constructed in accordance with BS EN 953, BS EN ISO 13857:2008 and BS EN 349.

4.4 Rated speed

The lifting platform shall have a rated speed not greater than 0.15 m/s.

4.5 Rated load

The rated loads shall be as follows:

- a) at least 205 kg, but not more than 500 kg, for a lone user: either standing, or in a type A or type B wheelchair, or in any other wheelchair able to be accommodated on the carrier;
- b) at least 280 kg, but not more than 500 kg, for a user: in a type A or type B wheelchair, or in any other wheelchair able to be accommodated on the carrier, with an accompanying person.

NOTE Type A and type B wheelchairs are defined in BS EN 12183 and BS EN 12184.

4.6 Load control

The lifting platform shall meet one of the following requirements:

- a) either the lifting platform shall be fitted with a device to prevent normal starting (excluding re-levelling of hydraulic drives) in the event of an overload on the carrier (i.e. when the rated load is exceeded by 75 kg), and in this event the users shall be informed by an audible and visible signal on the carrier; or
- b) where the lifting platform is not fitted with an overload device, it shall not be possible to travel in the upwards direction (with 75 kg overload); however, safe travel in the downwards direction shall be possible with the minimum static load (4.8).

In either case the gates shall remain unlocked or unlockable (without the use of a tool) in the unlocking zone.

4.7 Carrier floor dimensions

The clear loading area of the carrier, including any sensitive edge, photo cell or light curtain, but excluding hand rails, shall not exceed 2.0 m².

For new buildings, the plan dimensions of the carrier floor (including any sensitive edges, photo cells or light curtains, but excluding guardrails/hand holds) shall accommodate a wheelchair and shall be equal to or greater than the minimum dimensions given in Table 1.

NOTE These carrier floor dimensions can accommodate a type A or type B wheelchair as defined in BS EN 12183 and/or BS EN 12184. For existing buildings where space is not available, or non-standard wheelchairs are to be accommodated, other non-standard dimensions may be used.

Table 1 Minimum plan dimensions of the carrier floor

Dimensions in millimetres		
Minimum plan dimensions (width × length)	Provision of adjacent entrances	Principal use ^{A)}
1 100 × 1 400	With an adjacent entrance	Alone or with an accompanying person
800 × 1 400	Without an adjacent entrance	
750 × 1 250	With or without an adjacent entrance	Alone (domestic premises only)

^{A)} Person either standing, sitting or in a wheelchair.

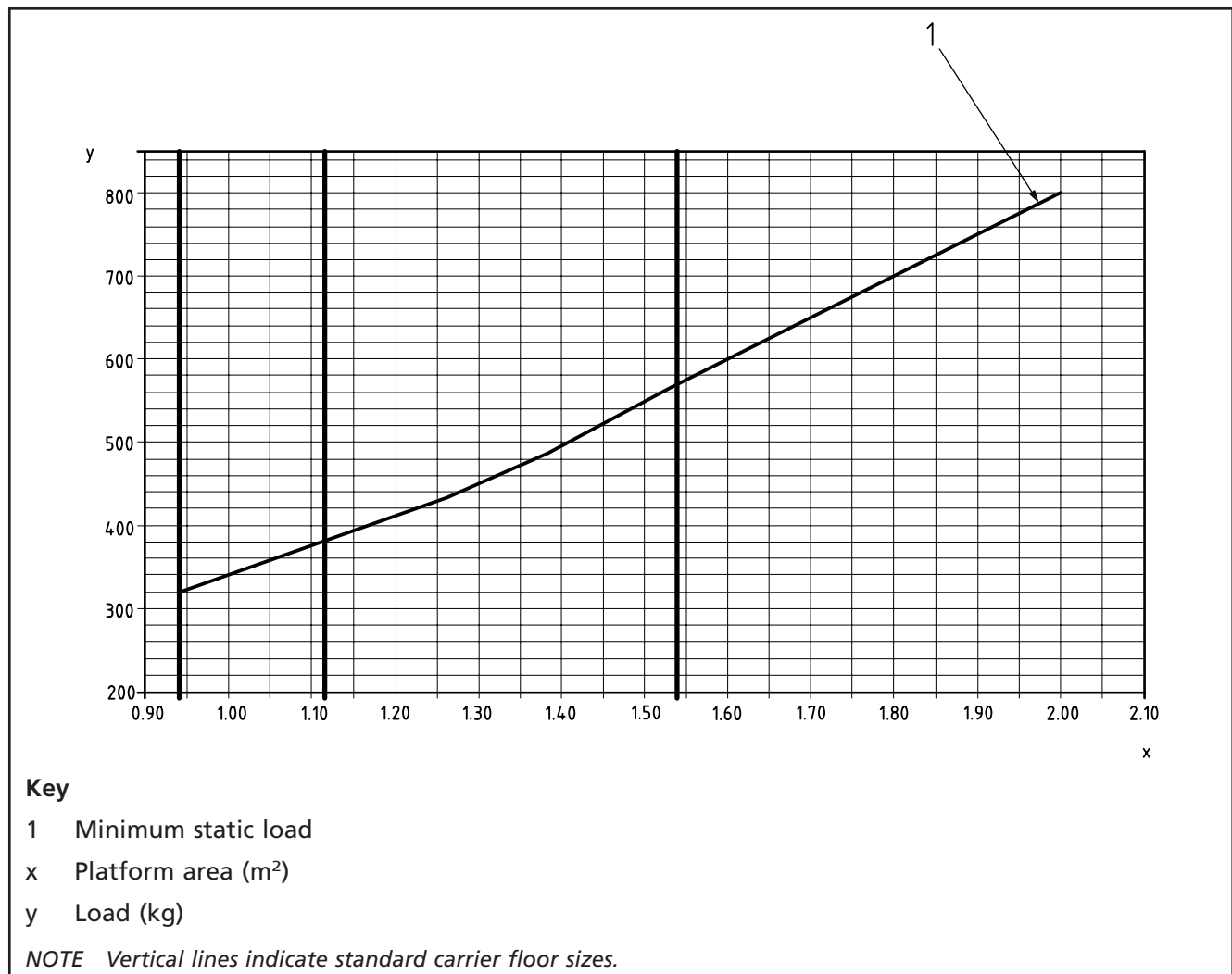
4.8 Mechanical strength of the lifting platform

The carrier and its associated suspension attachments shall be designed to support the minimum static load, as determined in Table 2 and shown in Figure 2, multiplied by a coefficient of 1.25.

Table 2 Mechanical strength of the lifting platform

Minimum static load kg	Maximum available carrier floor area m ²
340	1.00
450	1.30
600	1.60
750	1.90
800	2.00

Figure 2 Graphical representation of relationship between carrier floor area and minimum static load



4.9 Resistance to operating forces

The complete lifting platform installation shall resist, without permanent deformation, the forces imposed on it during normal operation, during the application of the safety devices and at impact on mechanical stops when travelling at the rated speed and 110% rated load. However, local deformation is permissible provided that it does not affect the operation of the lifting platform or any of its safety devices arising from the safety gear gripping device.

Guiding components, their attachments and joints shall withstand deflections due to uneven loading without affecting operation.

When the following fatigue stress test is carried out, there shall be no deterioration to the lifting platform that could adversely affect its normal use. If necessary, friction components shall be replaced.

- a) The test shall be carried out for all load-bearing components and joints that are critical to fatigue. The test shall take into account the degree of stress fluctuation and the number of stress cycles, which can be a multiple of the number of load cycles.
- b) The test shall be carried out over the maximum travel with one third of the load cycles at no load, one third of the load cycles at half the rated load, and one third of the load cycles at rated load.
- c) At least 50 000 load cycles shall be tested.

4.10 Protection of equipment against harmful external influences

4.10.1 Protection for outdoor use

For outdoor use, lifting platforms shall have a sufficient degree of protection for electrical equipment depending on site conditions, which shall be not less than class IP54 as defined in BS EN 60529:1992.

4.10.2 Other protections

If a lifting platform is to be installed in an adverse environment, the specifier and supplier shall determine the measures needed to ensure that safe operation is achieved.

NOTE Adverse environments are those that could affect safe operation. Examples include:

- the effects of humidity, atmospheric pollution, solar radiation, swimming pool environs, rain/ice/high wind, etc.;
- the actions of flora and fauna.

4.11 Lifting platform support/guide system

NOTE 1 Scissor mechanisms are considered as guided systems.

The lifting platform support system shall be such that the carrier edges cannot tilt more than ± 10 mm from the horizontal when supporting an evenly distributed load of 1.25 times the rated load.

Lifting platform support/guide system structural members shall meet the design requirements of this British Standard.

NOTE 2 Generally the support/guide structural members are made of metals such as steel, cast iron, aluminium alloy or other equivalent malleable and ductile metals/alloys.

NOTE 3 The effects of ageing, operating temperature range and fire resistance should be taken into account.

The guide rails, their joints and attachments shall be designed according to the minimum static load in order to withstand the loads and forces imposed on them.

NOTE 4 Attention is drawn to the recommended working coefficients given in Machinery Directive 2006/42/EC [1].

Deflections of the guide rails during operation shall be such that:

- a) unintended unlocking of the gates does not occur;
- b) the operation of the safety devices is not affected; and
- c) collision of moving parts with other parts is not possible.

4.12 Safety gear and over-speed governor

4.12.1 Safety gear

4.12.1.1 General

The lifting platform shall be provided with a safety gear meeting the requirements of BS EN 81-1:1998+A3, F.4. The safety gear shall operate to stop and sustain the carrier with the minimum static load as defined in Table 2, multiplied by a coefficient of 1.25, except in the following circumstances:

- a) on direct acting hydraulic drives; and/or
- b) when the carrier is driven by a self-sustaining rotating screw and nut, together with a safety nut.

The safety gear shall be fitted to the carrier.

When the safety gear is applied, no decrease in the tension of any rope or chain or other mechanism used for applying the safety gear or motion of the carrier in the downward direction shall cause the safety gear to be released from its operation.

The safety gear shall be capable of stopping and sustaining the carrier, carrying its rated load, within a distance of 150 mm from where the safety gear is engaged.

The safety gear shall grip the guide rail, or equivalent element, securely.

Any shaft, jaw, wedge or support that forms part of the safety gear and that is stressed during its operation shall be made entirely of a material that meets the design requirements of this British Standard.

NOTE 1 Generally any shaft, jaw, wedge or support is made of metals such as steel, cast iron or other equivalent malleable and ductile metals/alloys.

NOTE 2 The effects of ageing, operating temperature range and fire resistance should be taken into account.

The application of the safety gear shall not cause the carrier to change inclination by more than 56 mm.

4.12.1.2 Actuation

The safety gear shall be either:

- a) mechanically tripped before the carrier exceeds a speed of 0.3 m/s by an over-speed governor; or
- b) on indirectly suspended hydraulic lifts only, tripped by a safety rope which is independent of the means of suspension, or by slackening or breaking of a suspension rope or chain.

If the over-speed governor derives its drive from a main suspension chain or rope, the safety gear shall be operated by a mechanism actuated by the breaking or slackening of the means of suspension.

4.12.1.3 Release

Release of the safety gear shall be possible only by raising the carrier. It shall not be possible for the lifting platform to be put back into service without manual resetting.

4.12.1.4 Access to the safety gear

The safety gear shall be so positioned that it is accessible for inspection, testing and resetting. It shall be protected by covers, which shall be removable only with a tool or key.

4.12.1.5 Electrical checking

When the safety gear is engaged, a bistable electrical device conforming to 7.9 and activated by the safety gear shall immediately initiate stopping and shall prevent the further starting of the machine.

4.12.2 Over-speed governor

4.12.2.1 General

The over-speed governor shall meet the requirements of BS EN 81-1:1998+A3, F.4.

Any friction drive to the over-speed governor shall be independent of the main friction drive on friction drive lifting platforms.

The over-speed governor or another device shall, by means of an electric safety device conforming to 7.9, initiate the stopping of the lifting machine no later than the moment the tripping speed of the over-speed governor is reached.

If, after release of the safety gear (4.12.1.3), the over-speed governor does not automatically reset itself, an electric safety device conforming to 7.9 shall prevent the starting of the lifting platform.

4.12.2.2 Over-speed governor ropes and safety ropes

The minimum breaking load of the rope shall have a safety factor of at least 8, which shall be calculated as 8 times either:

- a) the tensile force produced in the rope of the over-speed governor, or the safety rope, when tripped (using a friction factor $\mu_{\max}$ equal to 0.2) for traction type over-speed governors; or
- b) the tensile force specified by the manufacturer that is required to operate the safety gear, or the clamping device for safety ropes.

The ratio of the pitch diameter of the pulleys for the over-speed governor rope to the nominal rope diameter shall be not less than 30:1.

In the event of breakage or excessive rope stretch of the over-speed governor rope, the machine shall be stopped by an electric safety device conforming to 7.9.

The tensile force in the over-speed governor rope produced by the governor, when tripped, shall be not less than the greater of the following two values:

- 1) twice that necessary to engage the safety gear; or
- 2) 300 N.

5 Access for maintenance, repair and inspection

5.1 Working areas on the carrier

Where machinery is to be maintained or inspected from the carrier, the following requirements shall be met.

- a) Where there is a risk of crushing, a mechanical device shall be fitted and shall ensure a minimum 300 mm clear space between the parts of the carrier and rigid parts of the liftway.
- b) Any necessary devices for emergency operation and for dynamic tests (such as brake tests, safety gear tests) shall be arranged so that they can be operated from outside the liftway.

Where a risk assessment indicates that there is a risk of injury to persons through open inspection panels, these panels shall be interlocked.

5.2 Working areas under the carrier

Where the design of the lifting platform requires that it is to be maintained or inspected from underneath the carrier, the following requirements shall be met.

- a) A manually positioned mechanical blocking device shall be provided to enable the carrier to be held in a raised position.
 - 1) The blocking device shall stop the carrier travelling downwards at rated speed with a load of 1.1 times the rated load.
 - 2) The blocking device shall be clearly marked with its intended purpose and position.
- b) Any necessary devices for emergency operation and for dynamic tests (such as brake tests, safety gear tests) shall be arranged so that they can be operated from outside the liftway.

5.3 Access to equipment and machinery

Machinery and equipment shall be located inside the machinery cabinet, which shall consist of imperforate walls, floor, roof and access panels or door(s).

Any door(s) shall:

- a) not open towards the inside of the cabinet;
- b) be provided with a key-operated lock;
- c) be capable of being re-closed and re-locked without a key.

Any access panels shall be capable of being removed only using a key or a tool.

There shall be no openings other than:

- 1) ventilation openings for cooling;
- 2) necessary openings for the functioning of the lifting platform between the non-enclosed liftway and the machinery cabinet;
- 3) ventilation openings for escape of gases and smoke in the event of fire.

The machinery cabinet openings shall conform to the following requirements.

- i) The openings shall be protected in accordance with BS EN ISO 13857:2008.
- ii) The ingress protection shall be at least IP2X as specified in BS EN 60529:1992 for indoor installations (see 4.10.1 for outdoor installations).

6 Driving units and drive systems

6.1 General requirements

Drive systems shall meet the requirements in 6.1 to 6.4 for all systems, together with the additional requirements in 6.5, 6.6, 6.7 or 6.8 as appropriate for the specific type of system.

All types of drive systems, except hydraulic, shall be powered in both directions of travel.

After the fatigue test specified in 4.9 has been carried out, the safety factors of geared drive units shall remain within the specified limits.

Unless forming an integral part of the shaft or other driving unit, every sheave, rope drum, spur gear, worm and worm wheel, pinion or brake drum shall be fixed to the shaft or driving unit by one of the following methods:

- a) sunk keys;

- b) splines;
- c) cross pinning.

If single chain or belt intermediate drives are employed, then the output drive gearing shall be on the load side of the chain or belt intermediate drive, and either:

- 1) the output drive gearing shall be self-sustaining; or
- 2) the brake shall be on the load side of the chain or belt intermediate drive, and a minimum of two belts or chains shall be used. The integrity of the chain or belt shall be monitored electrically by an electric safety device according to 7.9 that disconnects the supply to the motor and brake in the event of breakage of any chain.

If a system with a two-chain intermediate drive is used, the intermediate chain shall be monitored by an electric safety device according to 7.9 that disconnects the supply to the motor and brake in the event of breakage of any chain.

Exposed rotating or moving parts, such as sheaves, pulleys, chain wheels and sprockets, with the potential to cause injury, shall be guarded. The protection devices used shall be constructed so that the rotating parts are visible, and that they do not hinder examination and maintenance operation. If protection devices are perforated, the gaps shall conform to BS EN ISO 13857:2008, Table 4.

When a self-sustaining system is tested under free running conditions (i.e. with the brake released), when carrying the minimum static load multiplied by a coefficient of 1.1, the carrier shall decelerate.

6.2 Braking system

Except on hydraulically driven lifting platforms which conform to 6.8, an electro-mechanical friction brake shall be fitted, which shall be capable of:

- a) bringing the carrier smoothly to rest and holding it firmly in position, when loaded with the rated load plus 75 kg;
- b) holding the carrier firmly with the minimum static load stated in Table 2; and
- c) being mechanically applied and electrically held off.

The brake shall be designed not to release in normal operation unless the electrical supply is simultaneously applied to the lifting platform motor.

Brake linings shall be made of flame-retardant, self-extinguishing material and shall be designed such that wear does not reduce the security of their fastenings. Residual magnetism shall not prevent the brake from being applied when the electrical supply to the driving motor is interrupted.

Except in the case of self-sustaining drive systems, all the mechanical components of the brake which take part in the application of the braking action on the drum or disk shall be installed in two sets. If one set of the components is not working, a sufficient braking effort shall still be available to slow the carrier, when travelling downwards at rated speed and with rated load.

NOTE Any solenoid plunger is considered to be a mechanical part; any solenoid coil is not.

Any brake capable of being released by hand shall require a constant force to keep the brake held off.

If coil springs are used to apply the brake shoes, such springs shall be in compression.

The component on which the brake operates shall be coupled to the drum or sprocket or nut or screw by direct and positive mechanical means, unless either the final driving element is self-sustaining, or a system with two chains intermediate drive is employed.

The supply to the brake shall be in accordance with 7.5.

Whenever the motor of the lifting platform functions as a generator, it shall not be possible for the supply to the electric device operating the brake to be fed from the driving motor.

6.3 Stopping/levelling accuracy

In use:

- a) the stopping accuracy of the carrier shall be ± 10 mm;
- b) a re-levelling accuracy of ± 20 mm shall be maintained;
- c) stopping distances, except for sensitive edges and surfaces in accordance with 9.9.2, shall be no greater than 20 mm in response to operation of an electric safety device.

6.4 Emergency/manual operation

6.4.1 General

An emergency control device shall be provided.

The time to move the carrier to the nearest boarding point where the gate can be opened shall be not more than 15 min.

This emergency operation shall be possible from a position outside the liftway (except for hydraulic lowering according to 6.8.12.1), but with full control of the movement.

The emergency control device shall be in an accessible position. It shall be protected by covers, which shall only be removable with a tool or key.

NOTE It is recommended that emergency operations are carried out by an authorized and competent person.

Emergency operation of hydraulic lifts shall conform to 6.8.12.

6.4.2 Rack and pinion drives, rope and chain suspension drives, and screw and nut drives

Emergency operation shall be achieved by means of a manually operated hand-winding device. An electric safety device shall prevent operation of the normal controls. Where the manual effort is greater than 30 N to overcome the brake by emergency hand-winding, and the lifting platform has a self-sustaining drive system, a means shall be provided of releasing the brake. The means shall not be capable of locking the brake in the released position.

Where emergency operation is achieved using a standby power supply, it shall be capable of bringing the carrier carrying the rated load to a boarding point. An electric safety device shall prevent operation of the normal controls. When on emergency electrical operation, the following conditions shall be met.

- a) The maximum speed shall not be greater than 0.05 m/s.
- b) The controls shall be hold-to-run controls.

The following electric safety devices, where necessary, shall be bridged:

- 1) slack rope device;
- 2) emergency stop;

- 3) safety gear electric safety device and over-speed governor electric safety device;
- 4) sensitive edges, photo cells or light curtains.

A label in accordance with **10.2.4**, indicating the direction of travel, shall be provided.

6.5 Additional requirements for rack and pinion drive

6.5.1 General

The carrier shall be supported, raised and lowered by means of one or more pinions, meshing with the rack. The drive shall be by means of one or more motors.

Guards or shields shall be provided to prevent the penetration of foreign bodies between each drive or safety pinion and geared rack.

6.5.2 Load distribution

When there is more than one drive pinion in mesh with the rack, then either a self-adjusting means shall be provided to effectively share the loading on each drive pinion, or the drive system shall be provided with a load sharing device so as to accommodate all normal conditions of load distribution between the pinions.

6.5.3 Pinion

The driving pinion shall be designed with a safety factor of not less than 2.0 against the endurance limit for tooth strength. Each pinion shall have a minimum safety factor of 1.4 against the endurance limit for pitting. The safety factors shall be determined after the effects of wear, and fatigue, over the life of the product have been taken into account. Gear teeth shall not be undercut.

6.5.4 Rack

The racks shall be securely attached. Joints in the rack shall be accurately aligned to avoid faulty meshing or damage to teeth.

The rack shall be made of material having properties matching those of the pinion in terms of wear, and shall be designed in accordance with BS ISO 6336, with regard to tooth strength and pitting. If the rack is subjected to a compressive load, a minimum safety factor of 3.0 shall be used in the buckling calculations.

The rack shall have a minimum safety factor of 2.0 against the static limit for tooth strength, using the maximum wear value specified by the manufacturer.

6.5.5 Rack/pinion engagement

Means shall be provided to maintain the rack and all the driving and safety device pinions in correct mesh under no load, half load and full load conditions.

The means shall not rely upon the carrier guide rollers or shoes. The mesh shall be deemed to be correct when the pitch circle diameter of the pinion is coincident with, or not more than one third of, the module beyond the pitch line of the rack.

Means shall be provided to ensure that the width of the rack is always in full lateral engagement with pinion teeth of full form.

The pinion teeth and the rack teeth shall be square to each other in all planes, within a tolerance of $\pm 0.5^\circ$.