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Interested committees:

Title: Draft BS EN 280-1 BS Mobile elevating work platforms. Part 1: Design calculations. Stability criteria. Construction. Safety. Examinations and tests.

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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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UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- 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.	

English Version

**Mobile elevating work platforms - Part 1: Design
calculations - Stability criteria - Construction - Safety -
Examinations and tests**

Plates-formes élévatrices mobiles de personnel - Partie
1: Calculs de conception - Critères de stabilité -
Construction - Sécurité - Examens et essais

Fahrbare Hubarbeitsbühnen - Teil 1: Berechnung -
Standssicherheit - Bau - Sicherheit - Prüfungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 98.

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

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 280-1:2024) has been prepared by Technical Committee CEN/TC 98 “Lifting platforms”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 280-1:2022.

This document includes the following major changes with respect to EN 280-1:2022:

- 3.12: definition of “travelling” has been specified;
- 3.32: new definition of “lowered travel position”;
- 3.30: new definition of “Safety function”;
- 3.31: new definition “Elevated travel position”;
- 4.4.1.2: requirements for the load sensing system were amended and specified;
- 4.6.1: requirements for manual adjustment of the work platform exceeding 5° was amended;
- 4.6.9: protection of hands was totally reworded with regard to different requirements for the different types of MEWPs;
- 4.7.2: the restriction was added: “when the work platform is out of the lowered travel position and/or transport position”;
- 5.1.4.2.2.2: depression tests for MEWPs of type 2 and 3 was restructured and amended;
- Annex F (informative): the calculation example for the dynamic factor “z” for kerb obstacle collisions was totally revised;
- Annex ZA: Adoption of the annex to new CEN-Guide 414:2017.

Various editorial changes were made for better reading and understanding of the document.

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

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

Introduction

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

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

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

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

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

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

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

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

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

The object of this document is to define rules for safeguarding persons and objects against the risk of accidents associated with the operation of Mobile Elevating Work Platforms (MEWPs).

- This document does not repeat all the general technical rules applicable to every electrical, mechanical or structural component.
- The safety requirements of this document have been drawn up on the basis that MEWPs are periodically maintained according to manufacturers' instructions, working conditions, frequency of use and national regulations.

It is assumed that MEWPs are used only by qualified and trained operators.

It is also assumed that MEWPs are checked for function daily by the operator before start of work and are not put into operation unless all required control and safety functions are available and in working order.

It is assumed, if a MEWP is seldom used, the checks are carried out before start of work.

- As far as possible this document sets out only the requirements that materials and equipment need to meet in the interest of safety, and it is assumed that persons operating MEWPs are adequately trained.

- Where for clarity an example of a safety measure is given in the text, this does not need to be considered as the only possible solution. Any other solution leading to the same risk reduction is permissible if an equivalent level of safety is achieved.
- As no satisfactory explanation could be found for the dynamic factors used for stability calculations in previous national standards, the results of the tests carried out by the former CEN/TC 98/WG 1 to determine a suitable factor and stability calculation method for MEWPs have been adopted. The test method is described in Annex C (informative) as a guide for manufacturers wishing to use higher or lower operating speeds and to take advantage of developments in control systems.

Similarly, to avoid the unexplained inconsistencies in coefficients of utilization for wire ropes found in other standards for lifting devices, appropriate extracts of the widely accepted standard DIN 15020-1 have been taken into 4.5.2 and Annex D (normative) with a worked example in Annex E (informative).

1 Scope

1.1 This document specifies safety requirements and measures for all types and sizes of Mobile Elevating Work Platform (MEWP, see 3.1) intended to move persons to working positions where they are carrying out work from the work platform (WP) with the intention that persons are getting on and off the work platform only at access positions at ground level or on the chassis

NOTE Machines designed for the handling of goods such as a variable reach truck which are equipped with work platforms as interchangeable equipment are regarded as MEWPs.

1.2 This document is applicable to the structural design calculations and stability criteria, construction, safety examinations and tests before MEWPs are first put into service. It identifies the hazards arising from the use of MEWPs and describes methods for the elimination or reduction of these hazards.

It does not cover the hazards arising from:

- a) use in potentially explosive atmospheres;
- b) work from the platform on external live electric systems;
- c) use of compressed gases for load bearing components;
- d) getting on and off the work platform at changing levels;
- e) specific applications (e.g. railway, ships) covered by National or local regulations.

1.3 This document does not apply to:

- a) machinery serving fixed landings (see e.g. EN 81-20:2020 and EN 81-50:2020, EN 12159:2024);
- b) fire-fighting and fire rescue appliances (see e.g. EN 1777:2010);
- c) unguided work cages suspended from lifting appliances (see e.g. EN 1808:2015);
- d) elevating operator position on rail dependent storage and retrieval equipment (see EN 528:2021+A1:2022);
- e) tail lifts (see EN 1756-1:2021 and EN 1756-2:2004+A1:2009);
- f) mast climbing work platforms (see EN 1495:1997+A2:2009);
- g) fairground equipment;
- h) lifting tables (see EN 1570-1:2024 and EN 1570-2:2016);
- i) aircraft ground support equipment (see e.g. EN 1915-1:2023 and EN 1915-2:2001+A1:2009);
- j) elevating operator positions on industrial trucks (see EN ISO 3691-3:2016).

1.4 Classification of MEWPs:

MEWPs are divided into two main groups:

- a) Group A: MEWPs where the vertical projection of the centre of the area of the platform in all platform configurations at the maximum chassis inclination indicated in the information for use is always inside the tipping lines.

b) Group B: All other MEWPs.

Relating to travelling, MEWPs are divided into three types:

- 1) Type 1: Travelling is only allowed with the MEWP in its transport position, or no travelling of the MEWP is possible due to only being moveable (3.1.3) by design;
- 2) Type 2: Travelling with lifted work platform is controlled from a point of control at the chassis;
- 3) Type 3: Travelling with lifted work platform is controlled from a point of control at the work platform.

NOTE Type 2 and type 3 can be combined.

2 Normative references

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

EN 12385-4:2002+A1:2008, *Steel wire ropes - Safety - Part 4: Stranded ropes for general lifting applications*

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

EN 13001-3-6:2018+A1:2021, *Cranes - General design - Part 3-6: Limit states and proof of competence of machinery - Hydraulic cylinders*

EN 14033-1:2017, *Railway applications - Track - Railbound construction and maintenance machines - Part 1: Technical requirements for running*

EN 14033-2:2017, *Railway applications - Track - Railbound construction and maintenance machines - Part 2: Technical requirements for travelling and working*

EN 14033-3:2017, *Railway applications - Track - Railbound construction and maintenance machines - Part 3: General safety requirements*

EN 14033-4:2019, *Railway applications - Track - Railbound construction and maintenance machines - Part 4: Technical requirements for running, travelling and working on urban rail*

EN 15746-1:2020, *Railway applications - Track - Road-rail machines and associated equipment - Part 1: Technical requirements for travelling and working*

EN 15746-2:2020, *Railway applications - Track - Road-rail machines and associated equipment - Part 2: General safety requirements*

EN 15954-1:2013, *Railway applications - Track - Trailers and associated equipment - Part 1: Technical requirements for running and working*

EN 15954-2:2013, *Railway applications - Track - Trailers and associated equipment - Part 2: General safety requirements*

EN 15955-1:2013, *Railway applications - Track - Demountable machines and associated equipment - Part 1: Technical requirements for running and working*

EN 15955-2:2013, *Railway applications - Track - Demountable machines and associated equipment - Part 2: General safety requirements*

EN 61310-1:2008, *Safety of machinery - Indication, marking and actuation - Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN 60204-1:2018, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:2016)*

EN 60529:1991,¹ *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989+A2:2013)*

EN IEC 62061:2021,² *Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061:2021)*

EN 62745:2017,³ *Safety of machinery - Requirements for cableless control systems of machinery (IEC 62745:2017)*

EN ISO 3744:2010, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

EN ISO 4871:2009, *Acoustics - Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 11201:2010, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

EN ISO 11688-1:2009, *Acoustics - Recommended practice for the design of low-noise machinery and equipment - Part 1: Planning (ISO/TR 11688-1:1995)*

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

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

EN ISO 13850:2015, *Safety of machinery - Emergency stop function - Principles for design (ISO 13850:2015)*

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

ISO 4305:2014,⁴ *Mobile cranes - Determination of stability*

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

¹ As impacted by EN 60529:1991/AC:1993-05, EN 60529:1991/A1:2000, EN 60529:1991/A2:2013, EN 60529:1991/A2:2013/AC:2019-02 and EN 60529:1991/AC:2016-12.

² As impacted by EN IEC 62061:2021/A1:2024.

³ As impacted by EN 62745:2017/A11:2020.

⁴ As impacted by ISO 4305:2014/A1:2016.

3 Terms and definitions

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

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

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

3.1

mobile elevating work platform

MEWP

EWP that is either propelled, or moveable, or both

3.1.1

elevating work platform

EWP

machine that is intended to move persons to working positions where they are carrying out work from the work platform with the intention that persons are getting on and off the work platform only at access positions at ground level or on the chassis and which consists as a minimum of a work platform with controls, an extending structure and a chassis

3.1.2

propelled

intended to perform changes of location along the ground by integrated mobility devices following a surface

Note 1 to entry: Mobility is independent from the nature of the propulsion, whether self-propelled, pulled or pushed.

Note 2 to entry: Integrated mobility devices include for example wheels, tracks, casters, and air cushion systems

3.1.3

moveable

intended to be relocated by external means, through the use of integrated moving points, from one location to another, where no re-build or commissioning is required after relocation

Note 1 to entry: Integrated moving points include for example lifting points, lugs, and fork pockets

3.2

work platform

fenced platform or a cage which can be moved under load to the required working position and from which erection, repair, inspection or similar work can be carried out

Note 1 to entry: See Figure 1.

3.3

work platform levelling system

system to maintain the level of the work platform within a specified tilting angle

3.4**extending structure**

structure which is connected to the chassis and supports the work platform and which allows movement of the work platform to its required position

Note 1 to entry: See Figure 1.

Note 2 to entry: It can, for example, be a single or a telescoping or an articulating boom or ladder, or a scissors mechanism or any combination of them, and can or cannot slew on the base.

3.5**chassis**

base of the MEWP, which can contain integrated mobility devices and/or integrated moving points

Note 1 to entry: Integrated mobility devices include for example wheels, tracks, casters, and air cushion systems.

Note 2 to entry: Integrated moving points include for example lifting points, lugs, and fork pockets

Note 3 to entry: See Figure 1

3.6**stabilisers**

devices and systems used to stabilise MEWPs by supporting and/or levelling the complete MEWP or the extending structure, e.g. jacks, suspension locking devices, extending axles

Note 1 to entry: See Figure 1.

3.7**access position**

position(s) to provide access to and from the work platform

Note 1 to entry: Access position and transport position can be identical.

3.8**transport**

delivery of a MEWP to its place of use

3.9**transport position**

configuration(s) of the MEWP prescribed by the manufacturer in which the MEWP is intended to be transported

Note 1 to entry: Access position and transport position can be identical.

3.10**lowering**

operations to move the work platform to a lower level

Note 1 to entry: See Figure 2.

3.11**lifting**

operations to move the work platform to a higher level

Note 1 to entry: See Figure 2.

3.12

rotating

circular movement of the work platform about a vertical axis

Note 1 to entry: See Figure 2.

3.13

slewing

circular movement of the extending structure about a vertical axis

Note 1 to entry: See Figure 2.

3.14

travelling

movements of the chassis along the ground by integrated mobility devices following a surface, except movements during transport

Note 1 to entry: See Figure 2.

3.15

vehicle mounted MEWP

MEWP where the chassis is a road vehicle, designed to be or to become EU type-approved for operation on public roads, and where travelling controls are located within the cab of the vehicle

3.16

pedestrian controlled MEWP

MEWP where the controls for powered movement in the transport position are located so that they are capable of being operated by a person walking close to the MEWP

3.17

self-propelled

able to perform travelling and transport with an integrated propulsion system

3.18

rated load

load for which the MEWP has been designed for normal operation and which is composed of persons, tools and material acting vertically on the work platform

Note 1 to entry: A MEWP can have more than one rated load.

3.19

load cycle

cycle starting from the access position, carrying out work and returning to the access position

3.20

wire rope drive system

system that comprises one or more wire rope(s) running on rope drums and on or over rope pulleys as well as any associated rope drums, rope pulleys and compensating pulleys

3.21

chain drive system

system that comprises one or more chain(s) running on chain sprockets and on or over chain pulleys as well as any associated chain sprockets, chain pulleys and compensating pulleys

3.22**type test**

test on the representative model of a new design or one incorporating significant changes to an existing design, carried out by or on behalf of the manufacturer or their authorised representative

3.23**totally manually powered MEWP**

MEWP with movement powered only by manual effort

3.24**rail mounted MEWP**

MEWP where travelling is guided by rails

3.25**load sensing system**

system of monitoring the vertical load and vertical forces on the work platform

Note 1 to entry: The system includes the measuring device(s), the way the measuring devices are incorporated in the machinery and the signal processing system.

3.26**moment sensing system**

system of monitoring the moment acting about the tipping line tending to overturn the MEWP

Note 1 to entry: The system includes the measuring device(s), the way the measuring devices are incorporated in the machinery and the signal processing system.

3.27**cabless control**

transmission of the machine operator's commands without any wired connection

3.28**cabless control system****CCS**

system consisting of at least one remote station and one base station, which uses cabless control to transmit commands between them

[SOURCE: EN 62745:2017³, 3.2]

3.29**self-revealing failure or fault**

failure or fault of a component where the failure or fault is apparent to the MEWP operator and can be revealed without the use of monitoring services

Note 1 to entry: Failure or fault can be apparent to the MEWP operator through:

- changes of operating characteristics, and/or
- visual evidence, and/or
- audible evidence, and/or
- other evidence.

3.30

working envelope

space in which the work platform is designed to work within the specified loads and forces under normal operating conditions

Note 1 to entry: MEWPS can have more than one working envelope.

3.31

exchangeable work platform

work platform according to 3.2 which is intended to be exchanged without using tools

Note 1 to entry: Such platforms can be of different sizes and/or capacities.

Note 2 to entry: Such platforms do not modify the original function of the MEWP.

Note 3 to entry: Work platforms which are interchangeable equipment intended to be fitted on machines other than MEWPs are not covered by this definition. For the combination refer to note in 1.1.

3.32

lowered travel position

configuration(s) of the MEWP for travel up to maximum travel speed

Note 1 to entry: The lowered travel position, access position (3.7) and transport position (3.9) can be identical.

3.33

safety function

function of a machine whose failure can result in an immediate increase of the risk(s)

Note 1 to entry: A safety function can be composed of safety devices (e.g. actuators, sensors, logic units and switching components) and software as well as interconnecting means.

3.34

elevated travel position

configuration of the MEWP (3.1) for travel outside the lowered travel position (3.32)

3.35

personal fall protection system

assembly of components intended to protect the user against falls from a height, including a body holding device and an attachment system, which can be connected to a reliable anchorage point. Personal fall protection systems can be fall arrest systems (3.36) or fall restraint systems (3.37)

3.36

fall arrest system

personal fall protection system to arrest a free fall and limit the impact force on the body of the person during fall arrest

3.37

fall restraint system

personal fall protection system which prevents the occupant from reaching locations where the risk of a fall from height exists

3.38

occupant(s)

all persons in the work platform (3.2)

3.39

first descent limit

position where the vertical distance between the outer ends of the extending structure scissors mechanism is not less than 50 mm, so that crushing and shearing of fingers cannot occur

3.40

variable operating parameters

operating parameters of the MEWP (e.g. working envelope, rated load, maximum allowable slope, wind, n. of people, etc.) whose combination generates different operating conditions

3.41

monitored variable operating parameters

variable operating parameters that are controlled by a safety function

3.42

pothole protection

means to mitigate the effect of entering a depression

3.43

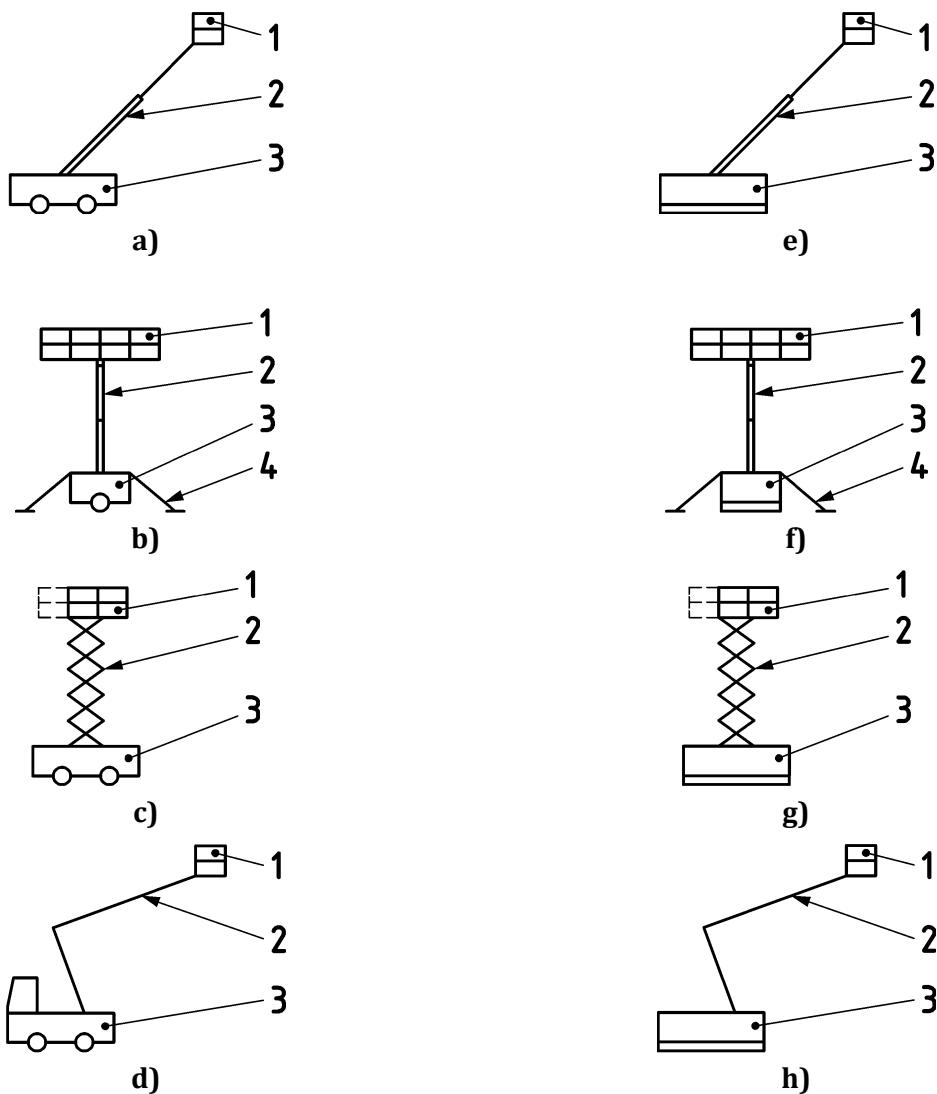
oscillating axle

supporting structure which allows mainly vertical movement of the end wheel assemblies independently or in relation to each other

3.44

projecting extremity

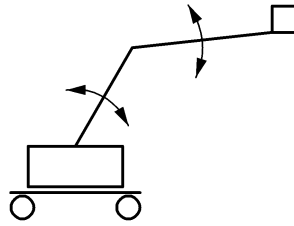
part of the MEWP protruding beyond the chassis in any direction



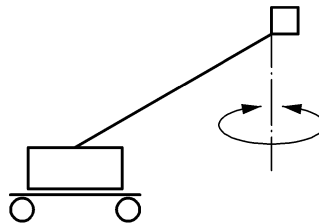
Key

- 1 work platform (see 3.2)
- 2 extending structure (see 3.3)
- 3 chassis (see 3.4)
- 4 stabilisers (see 3.5)

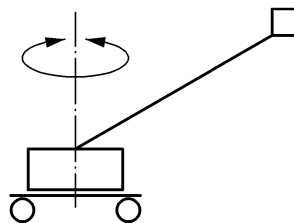
Figure 1 — Illustration of some definitions (1)



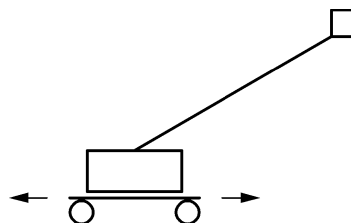
a) lowering/lifting (see 3.8 and 3.9)



b) rotating (see 3.10)



c) slewing (see 3.11)



d) travelling (see 3.12)

Figure 2 — Illustration of some definitions (2)

4 Safety requirements and/or measures

4.1 General

4.1.1 Machinery shall comply with the safety requirements and/or protective measures of this clause. For significant hazards, hazardous situations and events, as far as they are dealt with in this document, see Annex A. In addition, the machine shall be designed according to the principles of EN ISO 12100:2010 for relevant but not significant hazards, which are not dealt with by this document.

4.1.2 Totally manually powered MEWPs of Group A type 1 having a height of the floor of the work platform above ground level not exceeding 3 m are exempted from all safety requirements (see Table 4) which cannot be met without power supply.

4.2 Structural and stability calculations

4.2.1 General

- a) For structural calculations, the individual loads and forces in their positions, directions and combinations producing the least favourable stresses in the components shall be evaluated and applied.
- b) For stability calculations, the various positions of the MEWP and combinations of loads and forces creating together conditions of minimum stability shall be identified and applied.

4.2.2 Loads and forces

The following loads and forces shall be taken into account:

- a) rated load (see 4.2.3.1);
- b) dead weights (see 4.2.3.2);
- c) wind loads (see 4.2.3.3);
- d) manual forces (see 4.2.3.4);
- e) special loads and forces (see 4.2.3.5).

4.2.3 Determination of loads and forces

4.2.3.1 Rated load

The rated load m is:

$$m = n \cdot m_p + m_e \quad (1)$$

where

m_p is 80 kg (mass of a person);

m_e is ≥ 40 kg (minimum mass of tools and material);

n is the permitted number of persons on the work platform.

The mass of each person is assumed to act as a point load on the work platform and any platform extension at a horizontal distance of 0,1 m from the upper inside edge of the top rail. The distance between the point loads shall be 0,5 m (see Figure 3 as an example).

The mass of equipment is assumed to act as an evenly distributed load on 25 % of the floor of the work platform. If the resulting pressure exceeds 3 kN/m² the figure of 25 % may be increased to a figure giving a pressure of 3 kN/m² (see Figure 4 as an example).

All these loads are assumed to be located in the positions giving the most severe results.

The above rated load refers to the maximum people and materials loads that can be placed on the deck including any extension. Lower rated loads can be specified for extension(s) and under these circumstances the load distributions specified in 5.1.4.2.1, 5.1.4.2.2 and 5.1.4.3 will need to be taken into account.

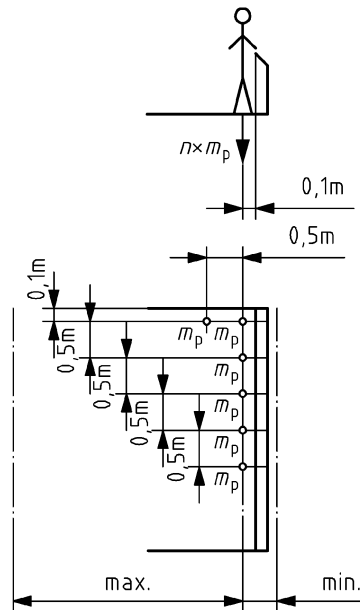
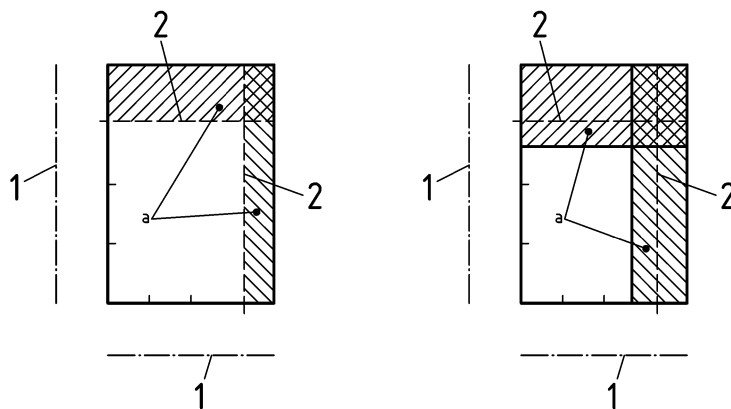


Figure 3 — Rated load - persons

a) load pressure $\leq 3 \text{ kN/m}^2$ over 25 % area b) load pressure $> 3 \text{ kN/m}^2$ over 25 % area

Key

- 1 tipping line
- 2 25 % area boundary
- a Examples of allowable rated load distribution
- b Rated load acting centre of gravity

Figure 4 — Rated load - equipment

4.2.3.2 Dead weights

The masses of the components of the MEWP when they are not moving shall be taken to be static dead weights.

The masses of the components of the MEWP when they are moving shall be taken to be dynamic dead weights.

4.2.3.3 Wind loads

4.2.3.3.1 All MEWPs used out-of-doors are regarded as being affected by wind at a pressure of 100 N/m^2 , equivalent to a wind speed of $12,5 \text{ m/s}$ (Beaufort Scale 6).

Wind forces are assumed to act horizontally at the centre of area of the parts of the MEWP and persons and equipment on the work platform and shall be taken to be dynamic forces.

This does not apply to MEWPs intended for indoor use only (see 6.2.7).

4.2.3.3.2 Shape factors applied to areas exposed to wind:

- a) L-, U-, T-, I-sections: 1,6;
- b) box sections: 1,4;
- c) large flat areas: 1,2;
- d) circular sections, according to size: 0,8/1,2;
- e) persons directly exposed: 1,0.

If additional information is needed, especially concerning shielded structural areas, see ISO 4302:2016. For shielded persons see 4.2.3.3.3.4.

4.2.3.3.3 Area of persons on a work platform exposed to wind:

4.2.3.3.3.1 The full area of one person shall be $0,7 \text{ m}^2$ ($0,4 \text{ m}$ average width $\times$ $1,75 \text{ m}$ height) with the centre of area $1,0 \text{ m}$ above the work platform floor.

4.2.3.3.3.2 The exposed area of one person standing on a work platform behind an imperforate section of fencing $1,1 \text{ m}$ high shall be $0,35 \text{ m}^2$ with the centre of area $1,45 \text{ m}$ above the work platform floor.

4.2.3.3.3.3 The number of persons directly exposed to the wind shall be calculated as:

- a) the length of the side of the work platform exposed to the wind, rounded to the nearest $0,5 \text{ m}$, and divided by $0,5 \text{ m}$, or
- b) the number of persons allowed on the work platform if less than the number calculated in a).

4.2.3.3.3.4 If the number of persons allowed on the work platform is greater than in 4.2.3.3.3.3 a) a shape factor of 0,6 shall be applied to the extra number of persons.

4.2.3.3.4 The wind force on exposed tools and materials on the work platform shall be calculated as 3 % of their mass, acting horizontally at a height of $0,5 \text{ m}$ above the work platform floor.

4.2.3.4 Manual force

The minimum value for the manual force M shall be taken as 200 N for MEWPs designed to carry only one person and 400 N for MEWPs designed to carry more than one person, applied at a height of $1,1 \text{ m}$ above the work platform floor.

4.2.3.5 Special loads and forces

Special loads and forces are created by special working methods and conditions of use of the MEWP such as objects carried on the outside of the work platform and wind forces on large objects carried on the work platform.

If a MEWP is intended for such special working methods and/or conditions of use, the loads and forces resulting from that shall be taken into consideration as a modification to the rated load, dead weight, wind load (see also Annex B) and/or hand forces as appropriate.

4.2.4 Stability calculations

4.2.4.1 Forces created by structural masses and rated load

Forces created by structural masses and rated load, causing overturning or stabilizing moments, shall be multiplied by a factor of 1,0 and calculated as acting vertically downwards.

In the case of movement of the extending structure these forces shall be multiplied by a factor of 0,1 and applied as additional forces acting in the direction of movement creating the greatest overturning moment.

Factors lower than 0,1 may be used, provided they have been verified through measurements of the effects of acceleration and deceleration.

For the travelling movements of MEWP of type 2 and type 3 the factor of 0,1 shall be replaced by a factor 'z' representing the forces produced by acceleration and deceleration or by performing the kerb and depression tests (see 5.1.4.2.2.2). This factor shall be determined by calculation or tests (see Annex F (informative) for a calculation example).

4.2.4.2 Wind forces

Wind forces shall be multiplied by a factor of 1,1 and taken to be acting horizontally.

4.2.4.3 Manual forces

Manual forces applied by persons on the work platform shall be multiplied by a factor of 1,1 and taken to be acting in the direction creating the greatest overturning moment.

NOTE Examples for forces are given in Figures 5 to 12.

4.2.4.4 Determination of actual activation load of the load sensing system

The actual activation load of the load sensing system (a) in kg is:

$$a = L_n (1 + e)$$

where:

$$L_n \geq m$$

$$m \leq a \leq 1.2 \cdot m$$

and where:

L_n in kg – nominal load defined for intended actuation of the load sensing system

m in kg – rated load

e in % (as a decimal) – maximum total error of the load sensing system, including for example component tolerances, thermal properties and production variance

4.2.4.5 Calculation of overturning and stabilizing moments

The maximum overturning and corresponding stabilizing moments shall be calculated about the least favourable tipping lines.

Tipping lines shall be determined in accordance with ISO 4305:2014 but for solid and foam-filled tyres the tipping lines may be taken at 1/4 of the tyre ground contact width from the outside of the ground contact width.

The calculations shall be made with the MEWP in the least favourable extended and/or retracted positions with the maximum allowable inclination of the chassis defined indicated in the Information for Use. All loads and forces, which can act simultaneously, shall be taken into account in their least favourable combinations. An allowance of 0,5° for inaccuracy in setting-up the MEWP shall be added to the maximum allowable inclination of the chassis permitted indicated in the Information for Use. Examples are shown in Table 1 and Figure 5 to Figure 12. Graphical methods may be used.

In each case the calculated stabilizing moment shall be greater than the calculated overturning moment.

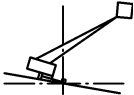
In the calculation the following influences shall be taken into account:

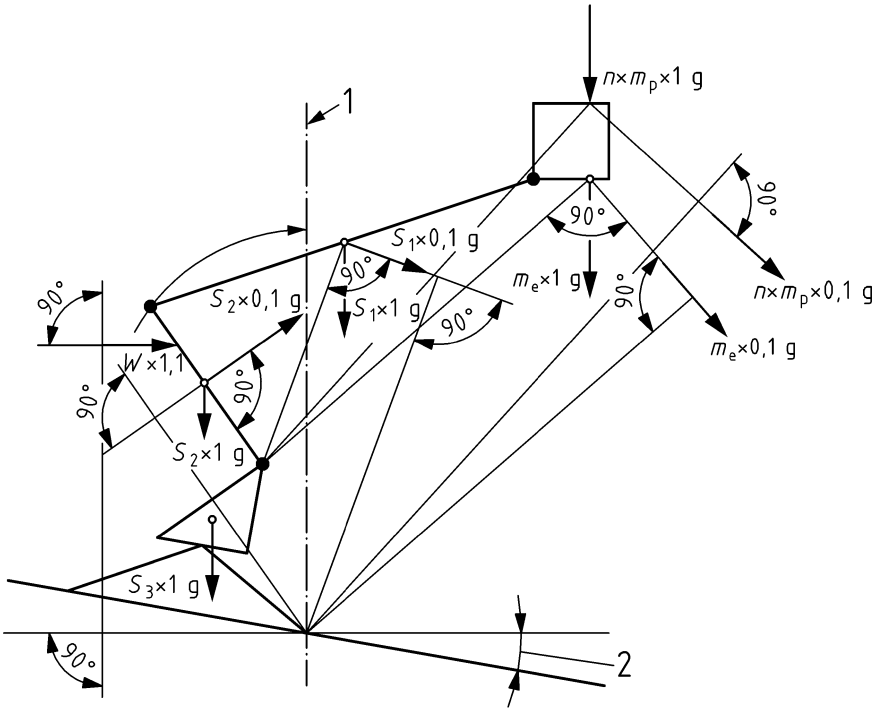
- a) tolerances in the manufacture of the components;
- b) play in the connections of the extending structure;
- c) elastic deformations due to the effects of forces;
- d) failure of any one tyre in the case of MEWPs supported by pneumatic tyres in the working position;
- e) performance characteristics of the load sensing system, moment sensing system and position control. This shall include at least the following:
 - 1) transitory peaks caused by short term dynamic effects;
 - 2) hysteresis;
 - 3) chassis inclination;
 - 4) ambient temperature;
 - 5) different positions and distribution of load on work platform;
 - 6) accuracy of the system and for load sensing, the actual activation load(s) as defined in 4.2.4.4 when contributing to the overturning moment;
- f) effects of deflection of suspensions.

The determination of the elastic deformations shall be obtained by experiment or by calculation.

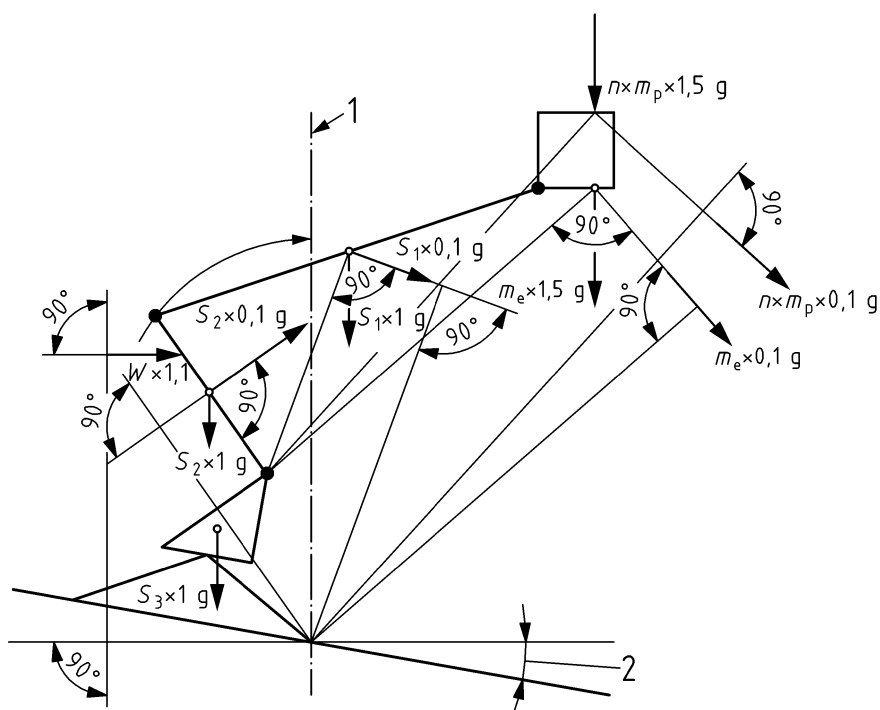
Table 1 — Examples of load and force directions and combinations for stability calculations
(see Figure 5 to Figure 12)

Example	Working condition	80 kg up to rated load		Dead weights (Sn)		Manual force (M)		Wind loads (W)		Diagram
		× 1,0 (1,5) _a	× 0,1	× 1,0	× 0,1	× 1,0	× 0,1	× 1,0	× 0,1	
1	lifting (lowering)	V	A	V	A	-	-	H	H	
2	travelling	V	S	V	S	-	-	H	H	
3	travelling	V	S	V	S	-	-	H	H	
4	forwards stability, stationary on slope	V	-	V	-	A	A	H	H	
5	backwards stability, stationary on slope	V	-	V	-	A	A	H	H	
6	with limited reach, forwards stability, stationary on slope, lowering	V	A	V	A	-	-	H	H	
7	on slope stationary	V	-	V	-	A	A	H	H	
8	level ground stationary	V	-	V	-	A	A	H	H	

Example	Working condition	80 kg up to rated load		Dead weights (Sn)		Manual force (M)		Wind loads (W)		Diagram
		$\times 1,0$ ^a (1,5)	$\times 0,1$	$\times 1,0$	$\times 0,1$	$\times 1,0$	$\times 0,1$	$\times 1,0$	$\times 0,1$	
9	Supported by pneumatic tyres, one tyre deflated	V	-	V	-	-	-	-	-	
Key V vertical H horizontal A angular S at slope angle										
^a 1,5 instead of 1,0 to be considered if enhanced stability criteria are applicable according to 4.4.1.5.										



a) EXAMPLE 1a — Load sensing

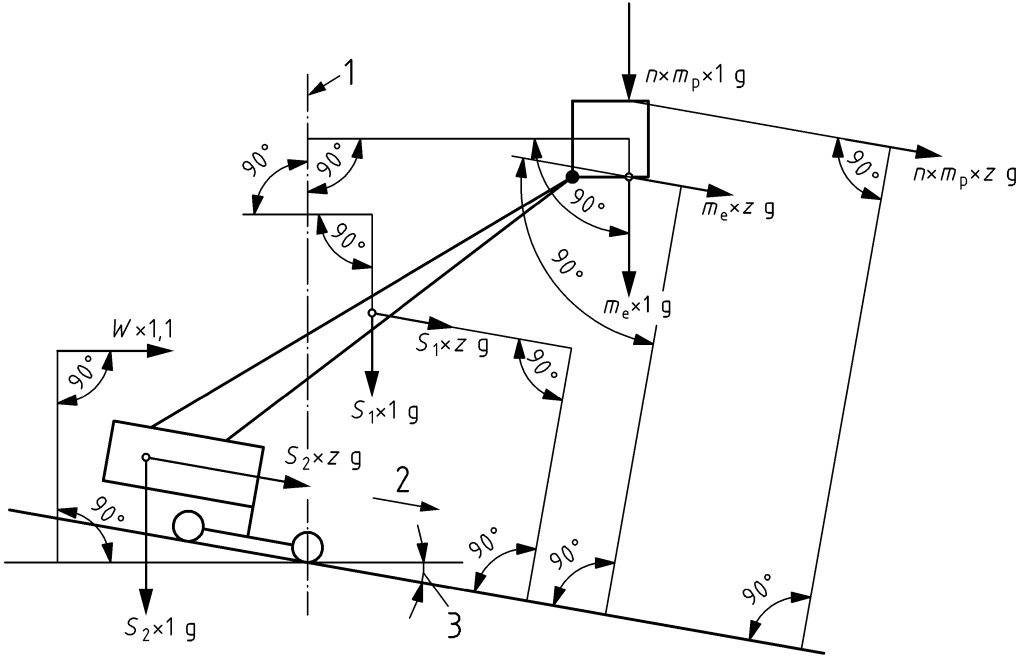


b) EXAMPLE 1b — Enhanced stability and overload criteria

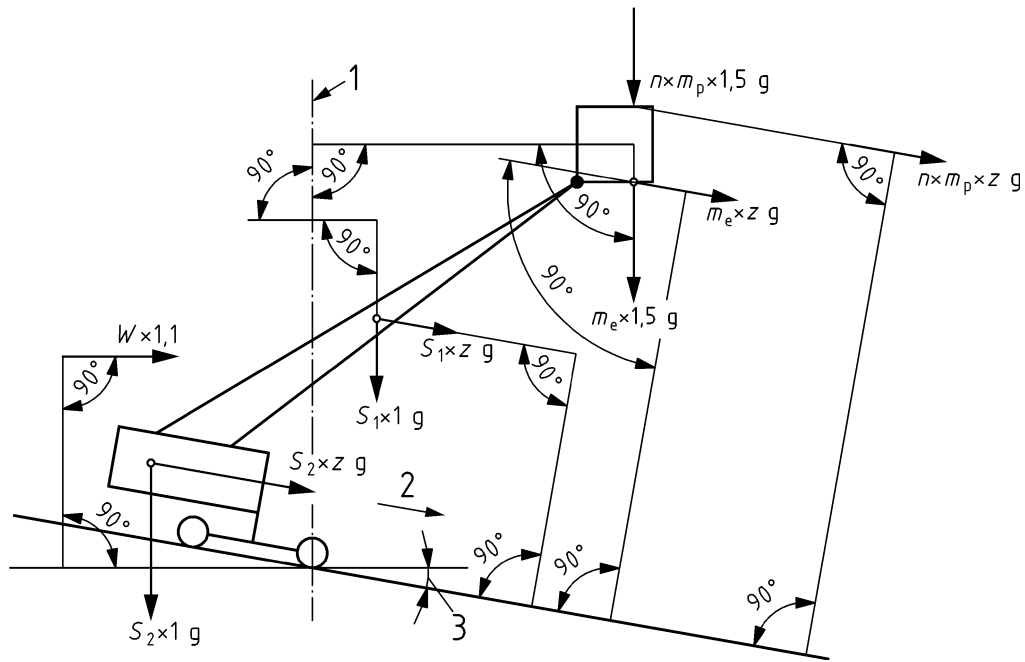
Key

- 1 tipping line
- 2 maximum slope + 0,5°
- g gravity acceleration
- m_e 40 kg (min. mass of tools and material)
- m_p 80 kg (mass of a person)
- n permitted number of persons on the work platform
- S_n structural loads ($n = 1, 2, 3...$)
- W wind loads

Figure 5 — Examples 1a/1b of maximum overturning load and force moment combinations (see Table 1)



a) EXAMPLE 2a — Load sensing

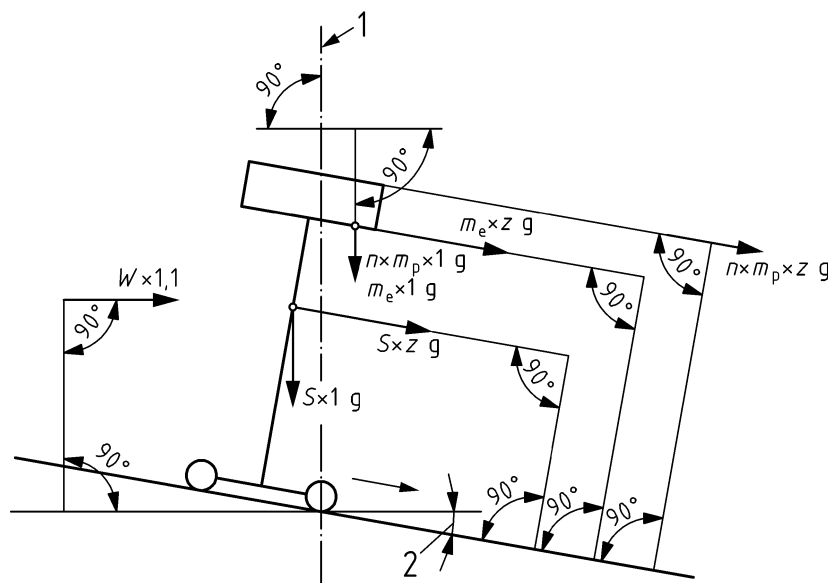


b) EXAMPLE 2b — Enhanced stability and overload criteria

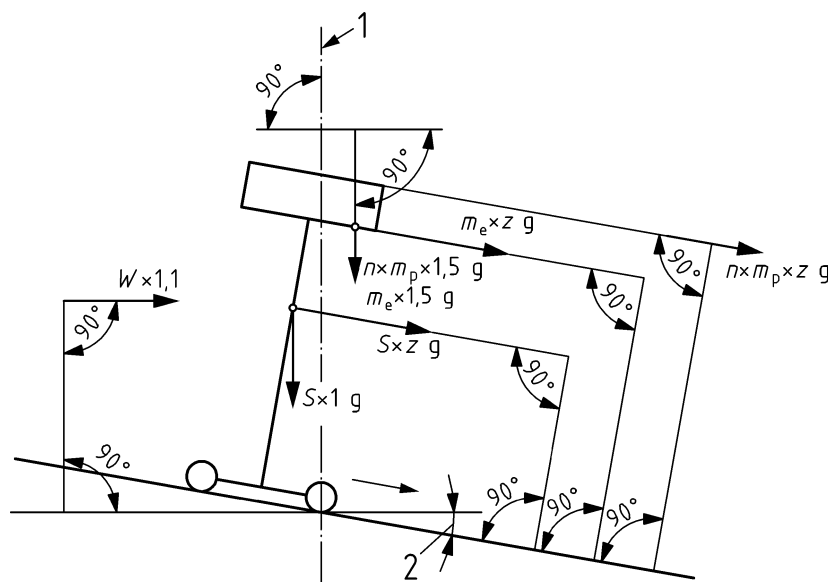
Key

- 1 tipping line
- 2 travelling direction
- 3 maximum slope + 0,5°
- g gravity acceleration
- m_e 40 kg (min. mass of tools and material)
- m_p 80 kg (mass of a person)
- n permitted number of persons on the work platform
- S_n structural loads ($n = 1, 2, 3...$)
- W wind loads
- z factor which represents the forces produced by acceleration and deceleration

Figure 6 — Examples 2a/2b of maximum overturning load and force moment combinations (see Table 1)



a) EXAMPLE 3a — Load sensing

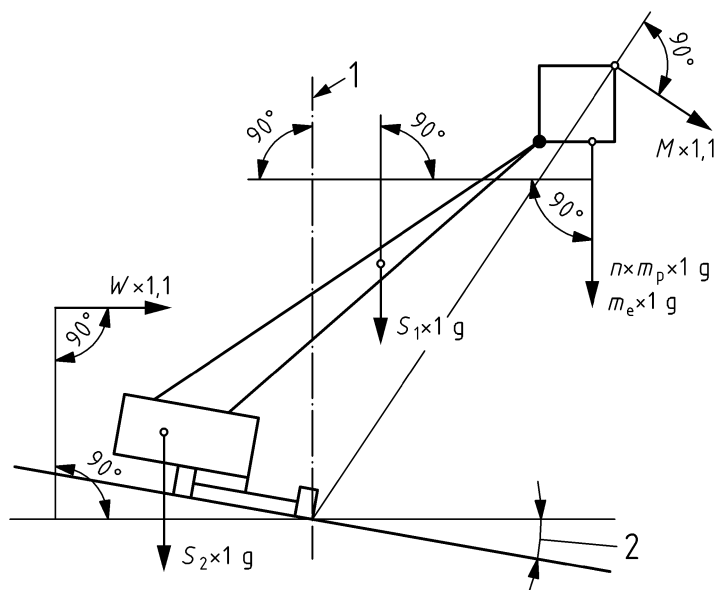


b) EXAMPLE 3b — Enhanced stability and overload criteria

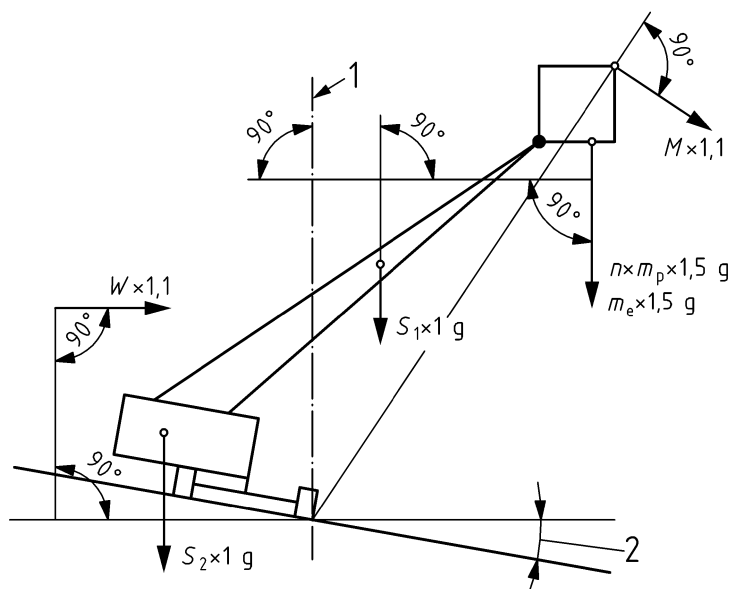
Key

- 1 tipping line
- 2 maximum slope + 0,5°
- g gravity acceleration
- m_e 40 kg (min. mass of tools and material)
- m_p 80 kg (mass of a person)
- n permitted number of persons on the work platform
- S structural loads
- W wind loads
- z factor which represents the forces produced by acceleration and deceleration

Figure 7 — Examples 3a/3b of maximum overturning load and force moment combinations (see Table 1)



a) EXAMPLE 4a — Load sensing

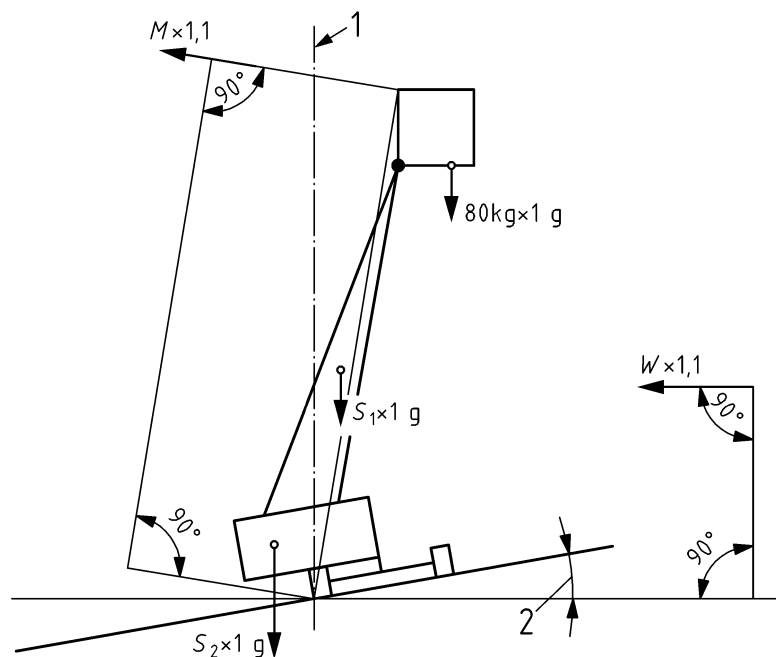


b) EXAMPLE 4b — Enhanced stability and overload criteria

Key

- 1 tipping line
- 2 maximum slope + 0,5°
- g gravity acceleration
- M manual force
- m_e 40 kg (min. mass of tools and material)
- m_p 80 kg (mass of a person)
- n permitted number of persons on the work platform
- S_n structural loads ($n = 1, 2, 3...$)
- W wind loads

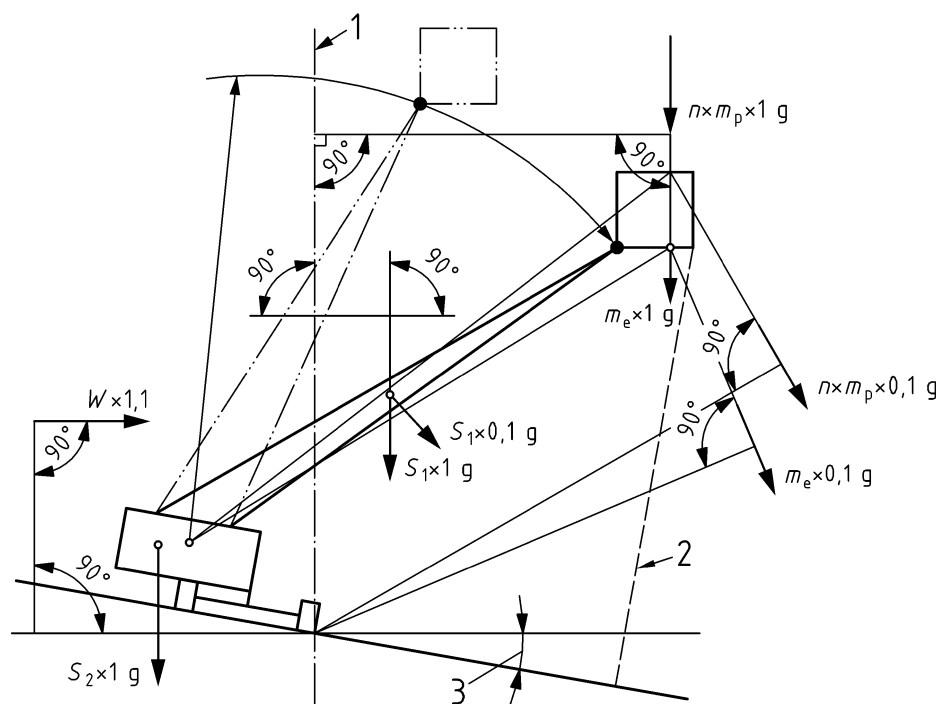
Figure 8 — Examples 4a/4b of maximum overturning load and force moment combinations (see Table 1)



Key

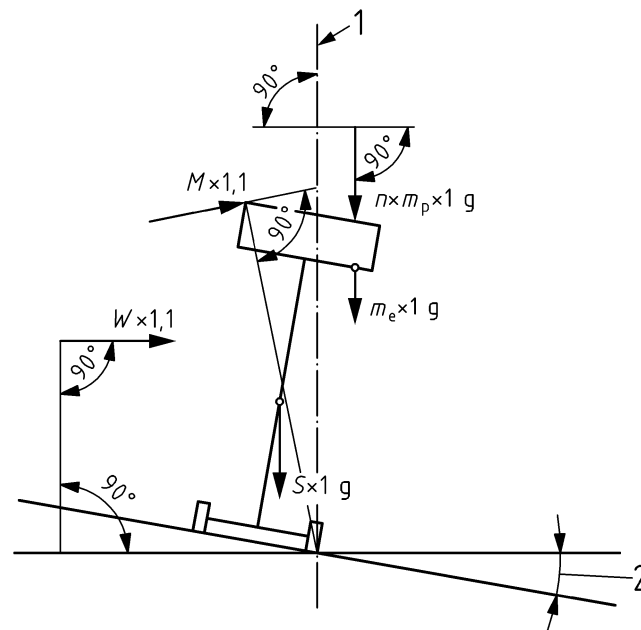
- 1 tipping line
- 2 max. slope + 0,5°
- g gravity acceleration
- M manual force
- S_n structural loads ($n = 1, 2, 3 \dots$)
- W wind loads

Figure 9 — Example 5 of overturning load and force moment combinations (see Table 1)

**Key**

- 1 tipping line
- 2 limited reach
- 3 max. slope + 0,5°
- g gravity acceleration
- m_e 40 kg (min. mass of tools and material)
- m_p 80 kg (mass of a person)
- n permitted number of persons on the work platform
- S_n structural loads ($n = 1, 2, 3 \dots$)
- W wind loads

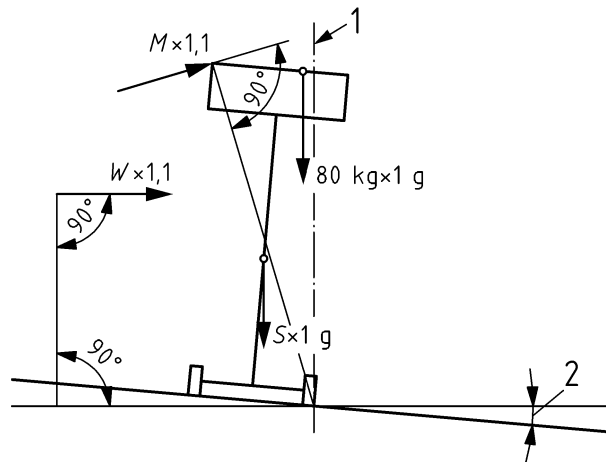
Figure 10 — Example 6 of overturning load and force moment combinations (see Table 1)



Key

- 1 tipping line
- 2 max. slope + 0,5°
- g gravity acceleration
- M manual force
- m_e 40 kg (min. mass of tools and material)
- m_p 80 kg (mass of a person)
- n permitted number of persons on the work platform
- S structural loads ($n = 1, 2, 3...$)
- W wind loads

Figure 11 — Example 7 of maximum overturning load and force moment combinations (see Table 1)



Key

- 1 tipping line
- 2 level ground $\pm 0,5^\circ$
- G gravity acceleration
- M manual force
- S structural loads
- W wind loads

Figure 12 — Example 8 of maximum overturning load and force moment combinations (see Table 1)

4.2.5 Structural calculations

4.2.5.1 General

The calculations shall conform to the laws and principles of applied mechanics and strength of materials. Sources of formulae shall be given if they are generally available. Otherwise the formulae shall be developed from first principles, so that their validity can be checked.

Except where otherwise stated the individual loads and forces shall be taken to act in the positions, directions and combinations which will produce the least favourable conditions.

For all load bearing components and joints the required information on stresses or safety factors shall be included in the calculations in a clear and verifiable form. If necessary, for checking the calculation, details of the main dimensions, cross-sections and materials for the individual components and joints shall be given.

4.2.5.2 Calculation methods

The strength of load bearing steel structures shall be calculated and conform to EN 13001-3-1:2012+A2:2018. The strength of hydraulic cylinders shall be calculated and conform to EN 13001-3-6:2018+A1:2021. When EN 13001-3-1:2012+A2:2018 is not applicable, e.g. the fatigue strength of welded connections with plates thinner than 3 mm or other metallic materials such as aluminium, the calculation and proof of the load bearing structures shall follow the principles of EN 13001-3-1:2012+A2:2018, and appropriate limits states shall be obtained from relevant sources.

Requirements laid down in 4.2.1, 4.2.2 and 4.2.3 above are to be considered for the determination of loads and forces to be used in the calculations.

The elastic deformations of slender components shall be taken into account.

The analysis defined in 4.2.5.3 shall be made for the worst load combinations and shall include the effects of the overload test (see 5.1.4.3) and the functional test (see 5.1.4.4).

4.2.5.3 Strength analysis

4.2.5.3.1 Static strength analysis

All load bearing components and joints shall be proofed against failure by yielding or fracture. All load bearing components subjected to compressive loads shall be proofed against failure by elastic instability (e.g. buckling or crippling).

Loads can be considered to be either regular or occasional.

Regular loads occur frequently under normal operation. Regular loads are:

- rated load;
- dead weights.

Occasional loads occur infrequently and are usually neglected in fatigue assessment. Occasional loads are:

- loads due to in-service wind;
- manual force.

These loads are combined into two load combinations, load combination A comprising only regular loads and load combination B comprising both regular and occasional loads. The static strength of the structure shall be assessed for both load combination A and B. The loads and forces defined in 4.2.3 shall thereby be multiplied by the partial safety factors γ_p given in Table 2.

Table 2 — Partial safety factors

Clause	Loading	Partial safety factors γ_p	
		Load combination A	Load combination B
4.2.3.1	Rated load	1,34	1,22
4.2.3.2	Dead weights	1,22	1,16
4.2.3.3	Wind loads	–	1,22
4.2.3.4	Manual force	–	1,22

Dead weights that are acting favourably (e.g. counterweights that reduce forces and stresses) in some load carrying parts, shall be assigned the value $\gamma_P = 1$ when calculating those load-carrying parts.

NOTE Load combinations from EN 13001-2 are not applicable within this document.

4.2.5.3.2 Fatigue strength analysis

The fatigue stress analysis is the proof against failure by fatigue due to stress fluctuations (see Annex J). The analysis shall be made for all load bearing components and joints which are critical to fatigue taking into account the constructional details, the degree of stress fluctuation and the number of stress cycles. The number of stress cycles can be a multiple of the number of load cycles. Other stress variations during use, caused by movements (e.g. slewing, lifting or travelling), can also contribute to the number of stress cycles. Only regular loads need to be considered and the partial safety factors γ_p shall be set to 1. Loads due to misuse need not be considered.

NOTE 1 Due to the requirements in 4.4.6 and 4.6.10, no fatigue assessment is needed for stresses caused by vibrations during transport.

For the proof, the different parts of the load bearing structure shall be assigned to S classes in accordance with 6.3 of EN 13001-3-1:2012+A2:2018 (see also Annex I). The S classes may be established either:

- by direct selection from I.2;
- by directly applying the formulae in EN 13001-3-1:2012+A2:2018 (see also I.3.2);
- in a simplified way described in I.3.3;
- by experience with technical justification.

NOTE 2 For the design of wire rope drive systems see Annex E.

Verification of the requirements of 4.2 — by design check, static tests and overload test.

4.3 Chassis and stabilizers

4.3.1 Chassis

4.3.1.1 An safety function in accordance with 4.11 shall be fitted to prevent the travel of pedestrian controlled MEWPs and power-driven MEWPs of type 1, which are able to travel, when the work platform is out of the transport position.

This requirement does not apply to vehicle mounted MEWPs.

Travel speed of self-propelled MEWPs, when the work platform is out of the transport position, shall be restricted by a safety function in acc. with 4.11.

Verification – by design check and functional test.

4.3.1.2 Every MEWP shall have a device that gives an easily identifiable visual or acoustic signal conforming to EN 61310-1:2008 to indicate that the inclination of the chassis has reached the permitted limits.

This device shall be protected against damage, accidental change of its setting and unauthorised operation (e.g. sealed or locked).

For MEWPs of type 1, a spirit level is permitted. For MEWPs with power driven stabilizers the indication of the chassis inclination shall be clearly visible from each control position of the stabilizers.

On MEWPs of type 2 (except vehicle mounted) and type 3 a safety function according to 4.11 shall prevent the chassis exceeding the permitted limits of inclination. while travelling in the elevated travel position by preventing the continuation of travel in the selected direction when the chassis has reached the limits of inclination.

Verification – by design check and functional test.

4.3.1.3 Any locking pins shall be secured against unintentional disengagement (e.g. spring pin) and loss (e.g. chain).

Verification – by visual examination.

4.3.1.4 Control-bars of pedestrian controlled MEWPs and tow bars shall be securely fastened to the chassis; unintentional detachment shall not be possible if detachable locking pins in accordance with 4.3.1.3 are used.

Verification – by visual examination and functional test.

4.3.1.5 If control-bars and tow bars, when not in use, are raised to vertical position (e.g. by hook), an automatic device shall be provided to hold the bars in this position; unintentional release shall not be possible.

For multi-axle chassis the minimum clearance between the fully lowered control-bar or tow bar and the ground shall be 120 mm.

Verification – by visual examination, functional test and measurement.

4.3.1.6 All MEWPS except those of type 1 which are not able to travel shall be equipped with brakes to prevent from unintended movements. Self-propelled MEWPs shall be equipped with brakes on at least two wheels on the same axis which engage automatically when power to the brakes is removed or fails and shall be able to stop the MEWP in accordance with 4.3.1.10 and keep it in its stopped position.

Brakes shall not rely on hydraulic or pneumatic pressure or electric power to remain engaged.

Verification – by design check and functional test.

4.3.1.7 Vehicle mounted MEWPs shall be equipped with an indicator visible from the travelling controls within the cab to indicate if any component of the MEWP is not in its transport position.

Verification – by functional test.

4.3.1.8 MEWPs shall be equipped with a device to prevent unauthorised use (e.g. lockable switch). This shall also apply to cableless control positions (see Annex G).

Verification – by functional test.

4.3.1.9 On MEWPs of type 2 and type 3, a safety function according to 4.11 shall prevent the MEWP in the elevated travel position from exceeding the minimum of:

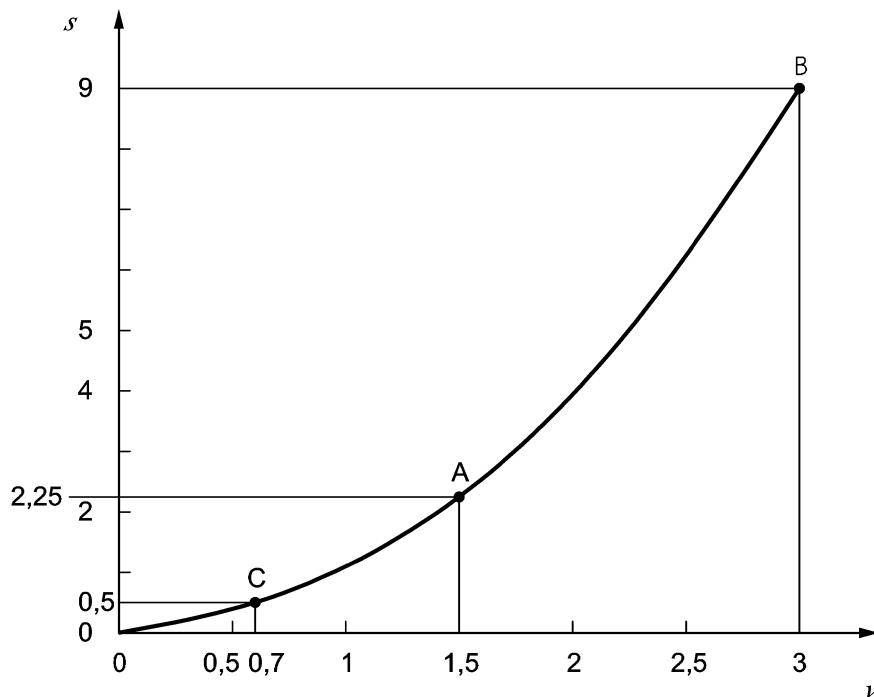
- maximum travel speeds at which the MEWP is proven to be stable by the dynamic tests defined in 5.1.4.2.2 and
- the following speeds:
 - a) 1,5 m/s for vehicle mounted MEWPs when using the travelling controls inside the cab;
 - b) 3,0 m/s for rail mounted MEWPs;
 - c) 0,7 m/s for all other self-propelled MEWPs.

Verification – by design check and functional test.

4.3.1.10 MEWPs travelling at the aforesaid maximum speeds on the maximum permitted slope shall be capable of being stopped in distances not greater than given in Figure 13. This figure is based on an average deceleration of 0,5 m/s².

NOTE Minimum braking distances depend on factor 'z' (see 4.2.4.1).

Verification – by functional test.

**Key**

- A for vehicle mounted MEWPs (controls inside cab)
- B for rail mounted MEWPs
- C for all other self-propelled MEWPs
- v speed in m/s
- s braking distance in m

Figure 13 — Maximum braking distances for MEWPS of type 2 and type 3

4.3.1.11 Maximum travel speed of pedestrian controlled MEWPs with the work platform in the transport position shall not exceed 1,7 m/s.

Verification – by measurement.

4.3.1.12 Guards shall be provided to prevent persons at control positions or standing adjacent to the MEWP at ground level or at other points of access from touching hot parts or dangerous parts of drive systems. Opening or removal of these guards shall only be possible by devices located in fully enclosed and lockable enclosures (e.g. cabs, compartments) or by the use of tools or keys provided with the MEWP. When it is foreseen (e.g. routine maintenance) that the fixed guards will be removed regularly then the fastenings shall remain attached to the guards or to the machine.

This requirement does not apply to the exhaust systems of vehicles conforming to road traffic regulations unless they are located near the control or access position.

Verification – by visual examination.

4.3.1.13 The exhaust from internal combustion engines shall be directed away from control positions.

Verification – by visual examination.

4.3.1.14 The filling points of fluid reservoirs (other than for fire resistant fluids) shall be positioned to avoid any fire from overfilling or spillage onto very hot parts (e.g. engine exhausts).

Verification – by visual examination.