
**Mobile elevating work platforms —
Design, calculations, safety requirements
and test methods**

*Plates-formes élévatrices mobiles de personnel — Conception, calculs,
exigences de sécurité et méthodes d'essai*

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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 16368 was prepared by Technical Committee ISO/TC 214, *Elevating work platforms*.

This second edition cancels and replaces the first edition (ISO 16368:2003), which has been technically revised.

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Introduction

The object of this International Standard is to define rules for safeguarding persons and objects against the risk of accident associated with the operation of mobile elevating work platforms (MEWPs). MEWPs are assemblies of one or more sub-assemblies produced by one or more manufacturers. A MEWP is the product of activities that include design, production and testing, as well as the provision of information on the MEWP itself.

This International Standard does not repeat all the general technical rules applicable to every electrical, mechanical or structural component. Its safety requirements have been drawn up on the basis that MEWPs are periodically maintained according to given instructions, working conditions, frequency of use and national or other regulations. It is assumed that MEWPs are checked for function before start of work, whether used daily or seldom used, and are not put into operation unless all the required control and safety devices are available and in working order. Where, for clarity, an example of a safety measure is given in the text, it is not intended as the only possible solution. Any other solution leading to the same risk reduction is permissible if an equivalent level of safety is achieved.

Annex A explains the choice of Beaufort Scale 6 as the maximum wind speed.

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 TC 98/WG 1 of the European Committee for Standardization (CEN) to determine a suitable factor and stability calculation method for MEWPs have been adopted. That test method is described in Annex B as a guide for the responsible entity 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 from the widely accepted DIN 15020^[31] have been included both in the body of this International Standard and in Annex C, with a worked example given in Annex D.

Annex E gives kerb test calculations, Annex F provides information on the instruction handbook, and Annex G specifies additional requirements for cableless controls and control systems.

Annex H presents the list of significant hazards dealt with by this International Standard.

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Mobile elevating work platforms — Design, calculations, safety requirements and test methods

1 Scope

This International Standard specifies safety requirements and preventive measures, and the means for their verification, for all types and sizes of mobile elevating work platforms (MEWPs) intended for moving persons to working positions. It gives the structural design calculations and stability criteria, construction, safety examinations and security tests to be applied before a MEWP is first put into service, identifies the hazards arising from the use of MEWPs and describes methods for the elimination or reduction of those hazards.

This International Standard is not applicable to

- a) permanently installed personnel-lifting appliances serving defined levels,
- b) fire-fighting and fire rescue appliances,
- c) unguided work cages suspended from lifting appliances,
- d) elevating operator position on rail-dependent storage and retrieval equipment,
- e) tail lifts,
- f) mast-climbing work platforms (see ISO 16369),
- g) fairground equipment,
- h) lifting tables with a lifting height of less than 2 m,
- i) builder's hoists for persons and materials,
- j) aircraft ground-support equipment,
- k) digger derricks,
- l) elevating operator positions on industrial trucks,
- m) under-bridge inspection and maintenance devices,
- n) certain requirements for insulating aerial devices on a chassis for use in live work on electrical installations.

It does not cover hazards arising from

- use in potentially explosive atmospheres,
- use of compressed gases for load-bearing components,
- work on live electrical systems.

NOTE 1 Hazards arising from work on live electrical systems are addressed in IEC 61057. MEWPs equipped with certain non-conductive (insulating) components can provide some protection from hazards associated with inadvertent contact with such systems (see ISO 16653-2).

NOTE 2 For MEWPs that employ aerial devices used for live working, this International Standard will need to be used in conjunction with IEC 61057, taking into consideration the potential exceptions from this International Standard that are specified in IEC 61057.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3864 (all parts), *Graphical symbols — Safety colours and safety signs*

ISO 4305, *Mobile cranes — Determination of stability*

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

ISO 13850, *Safety of machinery — Emergency stop — Principles for design*

ISO 13854, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

ISO 18893, *Mobile elevating work platforms — Safety principles, inspection, maintenance and operation*

ISO 20381, *Mobile elevating work platforms — Symbols for operator controls and other displays*

IEC 60068-2-64, *Environmental testing — Part 2-64: Tests — Test Fh: Vibration, broadband random and guidance*

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IEC 60204-1:2000, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

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

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

IEC 60947-5-1:2000, *Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18893 and the following apply.

3.1

access position

normal position which provides access to and from the **work platform** (3.40)

NOTE The access position, **lowered travel position** (3.18), **stowed position** (3.34) and **transport position** (3.35) can be identical.

3.2

aerial device

any device, extensible, articulating or both, which is primarily designed and used to position personnel

NOTE This does not include the **chassis** (3.5). When an aerial device is mounted on a mobile chassis it becomes a component of a **MEWP** (3.19). The device can also be used to handle material, if designed and equipped for that purpose.

3.3**cableless control**

means by which an operator's commands are transmitted without any physical connection for at least part of the distance between the control console and the **MEWP** (3.19)

3.4**chain-drive system**

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

3.5**chassis**

base of a **MEWP** (3.19)

See Figure 1.

NOTE The chassis can be pulled, pushed, self-propelled, etc.

3.6**ductile material**

material that has a minimum elongation before failure of 10 % and adequate notch impact strength at the lowest operating temperature for which the **MEWP** (3.19) is rated

3.7**elevated travel position**

configuration of the **MEWP** (3.19) for travel outside of the **lowered travel position** (3.18)

3.8**extending structure**

structure connected to the **chassis** (3.5) that supports the **work platform** (3.40) and allows the work platform's movement to the required position

See Figure 1.

NOTE It can, for example, be a single, telescoping or articulating boom or ladder, a scissor mechanism or any combination of these, and might or might not slew on the base.

3.9**fall arrest system**

fall protection system designed to arrest a fall by a worker

3.10**fall restraint system**

fall protection system that restrains or prevents a worker from being exposed to a fall from the **work platform** (3.40)

3.11**finite element analysis model****FEA model**

computerized method of idealizing a real model for the purposes of performing structural analysis

3.12**indoor use**

operation in areas shielded from wind so that there is no wind force acting on the **MEWP** (3.19) being operated

3.13**instability**

condition of a **MEWP** (3.19) in which the sum of the moments tending to overturn the unit exceeds the sum of the moments tending to resist overturning

**3.14
installer**

entity that installs an aerial device on a **chassis** (3.5)

NOTE The installer can also be the **responsible entity** (3.27).

**3.15
load cycle**

cycle starting from an **access position** (3.1) and completed by the carrying out of work and return to the same access position

**3.16
load-sensing system**

system of monitoring the vertical load and vertical forces on the **work platform** (3.40)

NOTE The system includes the measuring device(s), the method of mounting the measuring devices and the signal processing system.

**3.17
lowering**, noun

all operations, other than **travelling** (3.36), for moving the **work platform** (3.40) to a lower level

See Figure 1.

**3.18
lowered travel position**

configuration(s) of the **MEWP** (3.19), as defined by the **responsible entity** (3.27), for travel at maximum travel speed

NOTE The lowered travel position, **access position** (3.1), **stowed position** (3.34), and **transport position** (3.35) can be identical.

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**3.19
mobile elevating work platform
MEWP**

machine/device intended for moving persons, tools and material to working positions, consisting of at least a **work platform** (3.40) with controls, an **extending structure** (3.8) and a **chassis** (3.5)

**3.19.1
group A**

MEWPs on which the vertical projection of the centre of the platform area, in all platform configurations at the maximum **chassis** (3.5) inclination specified by the manufacturer, is always inside the tipping lines

**3.19.2
group B**

MEWPs not in **group A** (3.19.1)

**3.19.3
type 1 MEWP**

MEWP for which **travelling** (3.36) is only allowed when in the **stowed position** (see 3.34)

**3.19.4
type 2 MEWP**

MEWP for which **travelling** (3.36) with the **work platform** (3.40) in the **elevated travel position** (3.7) is controlled from a point on the **chassis** (3.5)

NOTE Type 2 and type 3 MEWPs can be combined.

3.19.5**type 3 MEWP**

MEWP for which **travelling** (3.36) with the **work platform** (3.40) in the **elevated travel position** (3.7) is controlled from a point on the work platform

NOTE Type 2 and type 3 MEWPs can be combined.

3.19.6**pedestrian-controlled MEWP**

MEWP whose controls for powered travel can be operated by a person walking close to the MEWP

3.19.7**rail-mounted MEWP**

MEWP whose travel is guided by rails

3.19.8**self-propelled MEWP**

MEWP whose **travelling** (3.36) controls are located on the **work platform** (3.40)

3.19.9**totally manually operated MEWP**

MEWP whose movement is powered only by manual effort

3.19.10**vehicle-mounted MEWP**

MEWP whose aerial device is designed for and installed on a vehicle chassis

3.20**moment-sensing system**

system of monitoring the moment acting about the tipping line tending to overturn the **MEWP** (3.19)

NOTE The system includes the measuring device(s), the method of mounting the measuring devices and the signal processing system.

3.21**non-conductive components****insulating components**

components composed of materials selected for their electrical properties, used on a **MEWP** (3.19) for the purpose of potentially providing electrical protection from inadvertent contact of certain parts of the MEWP with overhead electrical lines

NOTE See ISO 16653-2.

3.22**non-ductile materials****brittle materials**

fibreglass reinforced plastic materials and other materials that do not meet the requirement for ductile materials

3.23**oscillating axle**

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

3.24**outdoor use**

use of a **MEWP** (3.19) in an environment that can be exposed to wind

3.25

raising, noun

any operation, other than **travelling** (3.36), that moves the **work platform** (3.40) to a higher level

See Figure 1.

3.26

rated load

load for which the **MEWP** (3.19) has been designed in normal operation, comprising persons, tools and materials, acting vertically on the **work platform** (3.40)

NOTE A MEWP can have more than one rated load.

3.27

responsible entity

person or entity with responsibility for the design, specification, procurement, fabrication, manufacture, assembly, provision of information and testing of a **MEWP** (3.19) sub-assembly or ready-for-use MEWP.

NOTE Depending on national regulations or local practice, this term can refer to one or more of the following entities: manufacturer, installer, custodian, dealer, designer or entity placing the product on the market.

3.28

rotation

circular movement of the **work platform** (3.40) about a vertical axis

See Figure 1.

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3.29

secondary work platform

platform attached to the **work platform** (3.40) or the **extending structure** (3.8), and able to be moved separately

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3.30

slab

substantially level surface of asphalt, concrete or equivalent supporting material

3.31

slewing, noun

circular movement of the **extending structure** (3.8) about a vertical axis

See Figure 1.

3.32

stability

condition of a **MEWP** (3.19) in which the sum of the moments which tend to overturn the unit is less than or equal to the sum of the moments tending to resist overturning

3.33

stabilizer

any device or system used to stabilize a **MEWP** (3.19) by supporting and/or levelling the complete MEWP or the **extending structure** (3.8)

See Figure 1.

EXAMPLE Outrigger, jack, suspension-locking device, extending axle, torsion bar.

3.34**stowed position**

configuration of the **MEWP** (3.19) as defined by the responsible entity, in which the **extending structure** (3.8) is lowered and retracted and **stabilizers** (3.33) are retracted

NOTE The stowed position, **access position** (3.1), **lowered travel position** (3.18) and **transport position** (3.35) can be identical.

3.35**transport position**

configuration of the **MEWP** (3.19) prescribed by the responsible entity in which the MEWP is to be transported

NOTE The transport position, **access position** (3.1), **lowered travel position** (3.18) and **stowed position** (3.34) can be identical.

3.36**travelling**

any movement of the **chassis** (3.5) except when the MEWP is being transported

See Figure 1.

3.37**type test**

test on a representative model of a new design, or a model incorporating significant changes to an existing design, carried out by or on behalf of the **responsible entity** (3.27) or his authorized representative

3.38**wire rope drive system**

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

3.39**working envelope**

space in which the **work platform** (3.40) is designed to work within the specified loads and forces, under normal operation conditions

NOTE A **MEWP** (3.19) can have more than one working envelope.

3.40**work platform**

movable component of the **MEWP** (3.19), other than the **chassis** (3.5), intended for carrying personnel with or without material

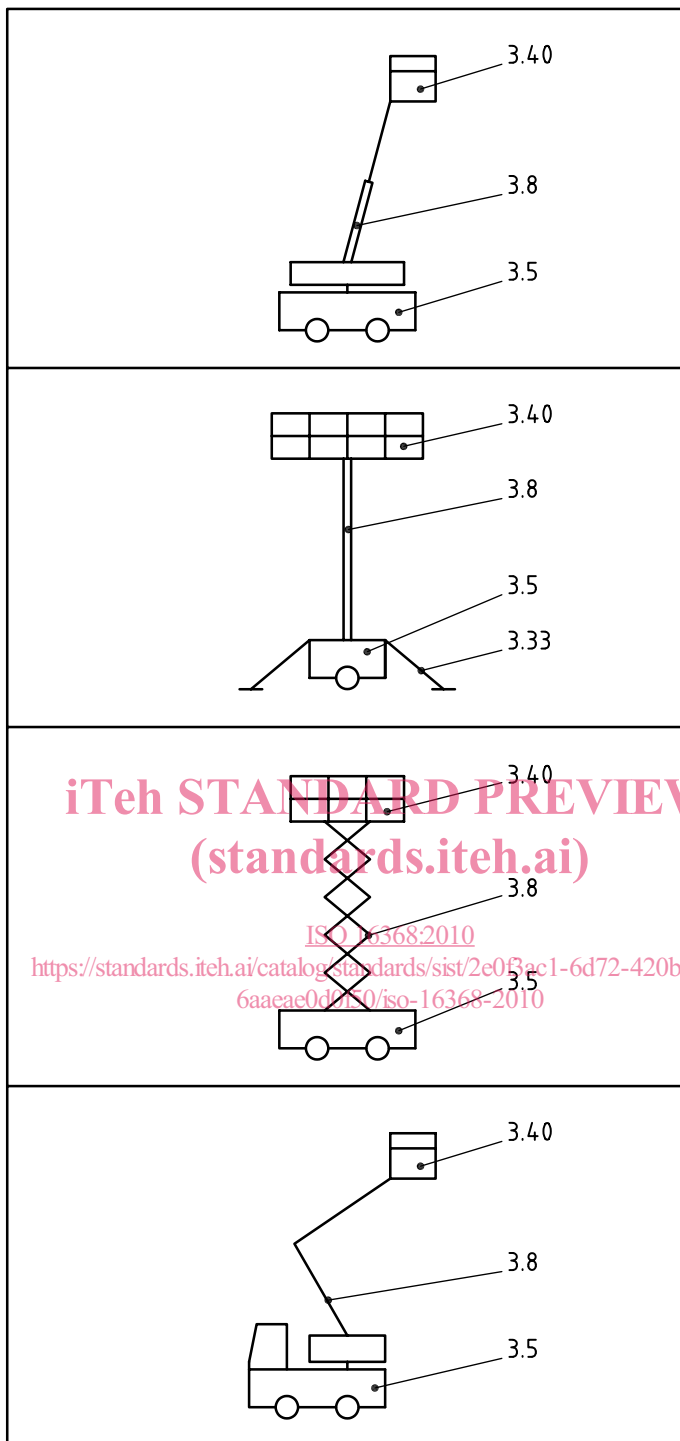
EXAMPLE Cage, bucket, basket.

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Figure 1 — Illustration of key terms (continued)

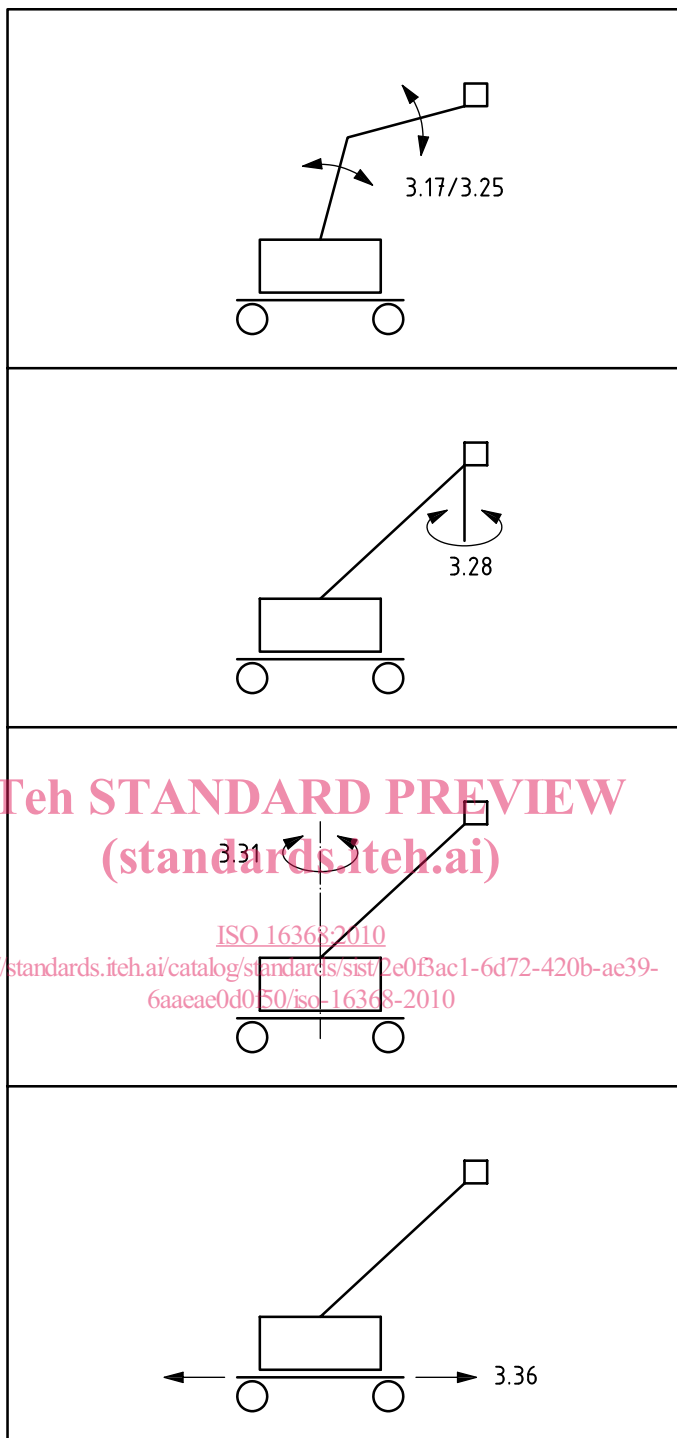


Figure 1 — Illustration of key terms