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Personal equipment for protection against falls — Descending devices

Équipement personnel de protection contre les chutes — Dispositifs de descente

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Contents

Page

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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 22159 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 4, *Personal equipment for protection against falls*.

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Introduction

Descending devices conforming to this International Standard are intended to be used in conjunction with an appropriate descent line and other equipment, e.g. an appropriate harness or rescue loop and a reliable anchor, to enable a person to descend from one position to another, either on their own or assisted by another person. Typical uses are emergency egress and work positioning. In addition to their primary function of allowing access to a lower point, descending devices and descent lines have a fall protection function.

Descending devices in this International Standard have been divided into six types. Types 1 and 2 are further divided into four classes.

Type 1 descending devices have an integrated descent line and are intended for multiple evacuations to a safe lower place when users do not need to control their descent speed. The descent speed is automatically controlled, i.e. without the need for intervention by the user.

Type 2 descending devices have an integrated descent line and are manually controlled. They are generally more suitable for single person evacuations to a safe lower place when users may need to control their descent speed and may need to stop somewhere on the descent line.

Types 3 and 4 descending devices are not required to have an integrated descent line. The descent line can be fitted to the descending device on site. These types of descending device are equipped with a manually operated descent control device which, when it is let go, will automatically lock to the descent line and stop the descent (hands-free locking element). In addition, type 3 descending devices will “fail to the locked position” and the descent will stop if the descent control device is moved beyond its descent control parameters, e.g. in a panic situation when the user squeezes the descent control device too far (panic locking element).

Types 5 and 6 descending devices do not have a hands-free automatic locking element or a panic locking element. These descending devices rely on the user to stop the descent manually and to lock off manually, too, typically by wrapping the descent line around the descending device to create enough friction to stop movement. These types are also not required to have an integrated descent line: the descent line can be fitted to the descending device on site.

Descending devices types 1 and 2, which are typically intended primarily for emergency egress, have been classified further by performance. A value, called descent energy, is calculated based on the product of the mass of the user, the maximum descent height for the descending device and the number of descents for which the descending device is designed. In practice, descending devices are subjected to different loads, e.g. a descending device for descending 100 passengers from a cable car at a height of 100 m needs to conform to more stringent requirements than a descending device used by a crane driver to descend from a height of 20 m. The descent energy provides an indication of the appropriateness of a descending device and its descent line for a given application. The descent energy may be used to calculate the maximum combination of descent height and number of descents for a particular use. The classes are A, B, C and D, which are explained in more detail within this International Standard.

Type 2 class D descending devices deserve special mention because they are intended for a specific purpose, i.e. for single use emergency egress only, by trained and competent personnel who, as part of their training, have experienced a descent using this type of descending device.

Descent lines are a necessary component in a descending system and need to meet some basic requirements to ensure that they are suitable for use with relevant descending devices. This International Standard therefore includes such basic requirements for descent lines.

This International Standard recognizes that a descending device could not only travel with the user (normal in rope access, for example) but could also in some circumstances be designed to operate from a fixed position (e.g. at the top of the descent). The test methods reflect this. Operating from a fixed position is normal for type 1 descending devices. It is perhaps not so normal for other types, but is possible.

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This International Standard presumes that the manufacturer of the descending device, subsystems or components will, for the sake of consistency and traceability, operate a quality management system which will comply with national and regional regulations in force at the time. Guidance on the form this quality management system may take can be found in ISO 9001.

It is highly advisable that manufacturers claiming conformity of their descending devices with this International Standard have their claims verified by an independent, nationally recognized test organisation.

Note the points below.

— It is essential that users of all types of descending devices and their descent lines are trained and assessed as competent before using them unsupervised. This applies even to the totally automatic descending devices of type 1. It applies particularly to types 5 and 6 descending devices, where any mismanagement could have disastrous results. It is advisable that training be ongoing and not just a one-off at the first introduction to the equipment.

— This International Standard does not encompass all foreseeable uses of descending devices or requirements for all possible descending devices. Manufacturers, specifiers and end users can identify uses for which descending devices that are outside the scope of this International Standard are appropriate.

— The requirements specified are generally minimum requirements.

Annex A provides advice on the packaging of descending devices and Annex B gives functional recommendations for the use of descending devices in the workplace.

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Personal equipment for protection against falls — Descending devices

1 Scope

This International Standard specifies requirements, test methods, marking and information to be supplied by the manufacturer for descending devices. It also specifies some basic requirements for the descent lines to be used with the descending devices.

This International Standard is applicable to automatic and manually operated descending devices intended for use in the workplace in access, egress, work positioning and rescue systems. Various types and classes of descending devices are defined according to function and performance. These descending devices can be used in situations other than the workplace if adequate training and/or supervision are provided.

This International Standard is not intended to apply to descending devices used in leisure activities such as recreational climbing and caving, although its requirements can be useful in specifying such equipment.

NOTE Descending devices conforming to this International Standard can be designed for use by one or two persons simultaneously.

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 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Terms, definitions and classifications

3.1 Terms and definitions

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

3.1.1
anchor point
secure place of attachment to which the descent line or descending device is connected

3.1.2
attachment element
primary point of connection to the descending device, as specified by the manufacturer

3.1.3
automatic descending device
device that enables a person or persons to descend at a controlled rate without any intervention once the descent has commenced

NOTE Automatic descending devices are also known as controlled descent devices.

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3.1.4
competent person for periodic detailed inspection
person who knows the current periodic detailed inspection requirements, recommendations and instructions issued by the manufacturer applicable to the descending device, subsystem or system, and who has the authority, skills and resources to initiate corrective action

3.1.5
competent person for repair
person authorized by the manufacturer to repair the descending device, subsystem or system

3.1.6
descending device
automatic or manually operated device used in conjunction with an appropriate descent line, which allows the user, either individually or assisted by another person, to achieve a descent with a controllable velocity

NOTE A descending device can be used for self-descent, self-rescue, rescue by a second person or for rescue by a rescuer and rescuee in a tandem descent.

3.1.7
descent control element
integral element of the descending device, normally operated by hand, used to control the velocity of descent down the descent line

3.1.8
descent energy
W
energy measured in joules which results from the product of descent height, descent load and number of descents

3.1.9
descent line
flexible line for descending, used in conjunction with a descending device

3.1.10
emergency egress
evacuation from a location in the event of an emergency

3.1.11
hands-free locking element
integral part or function of the descent control element which stops the descent and thereby prevents an uncontrolled descent or a fall if the user fails to engage the device

NOTE Some creep of the descending device along the descent line can occur (see 4.6).

3.1.12
integrated descent line
descent line assembled by the manufacturer with a compatible descending device such that the descent line can only be removed by the use of a tool, and in such a way that removal would be clearly evident

3.1.13
manually operated descending device
descending device that allows a person or persons to descend at a rate that is controlled manually

NOTE 1 Some creep of the descending device along the descent line can occur (see 4.6).

NOTE 2 Manually operated descending devices are also known as descent control devices.

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3.1.14
manufacturer
maker, authorized representative of a maker or an assembler responsible, where relevant, for the design, test and release of the completed component, subsystem or system placed on the market

3.1.15
maximum rated load
maximum mass of person(s), including tools and equipment, to be used with the descending device, as specified by the manufacturer

NOTE Maximum rated load is specified in kilograms.

3.1.16
minimum rated load
minimum mass of person(s), including tools and equipment, to be used with the descending device, as specified by the manufacturer

NOTE Minimum rated load is specified in kilograms.

3.1.17
panic locking element
integral part or function of the descent control element which stops the descent and thereby prevents an uncontrolled descent or a fall if the user panics and operates the descending device beyond its intended descent control parameters

NOTE Some creep of the descending device along the descent line can occur (see 4.6).

3.2 Classifications

3.2.1 Classification by type

Descending devices are classified by type, as described below (see Figure 1 for generic examples of the different types of descending device and Figure 2 for their characteristics):

a) type 1: automatically operated descending device with integrated descent line;

b) type 2: manually operated descending device with integrated descent line;

c) type 3: manually operated descending device with mechanically variable friction, hands-free locking and panic locking features;

d) type 4: manually operated descending device with mechanically variable friction and hands-free locking features;

e) type 5: manually operated descending device with mechanically variable friction and non-automatic locking;

f) type 6: manually operated descending device with non-mechanically variable friction and non-automatic locking.

NOTE Descending devices can conform to the requirements of more than one type.

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3.2.2 Classification by performance

Descending devices of types 1 and 2 are classified by performance, as follows (see 4.9):

a) class A for a descent energy, W, up to $7{,}5 \times 10^6$ J;

b) class B for a descent energy, W, up to $1{,}5 \times 10^6$ J;

c) class C for a descent energy, W, up to $0{,}5 \times 10^6$ J;

d) class D for one descent only; the descent energy, W, depends on the maximum descent height and the maximum rated load.

NOTE In practice, descending devices are subjected to different loads, e.g. a descending device for descending 100 passengers from a cable car at a height of 100 m conforms to more stringent requirements than a descending device used by a crane driver to descend from a height of 20 m. The descent energy can be used to calculate the maximum combination of descent height and number of descents for a particular use.

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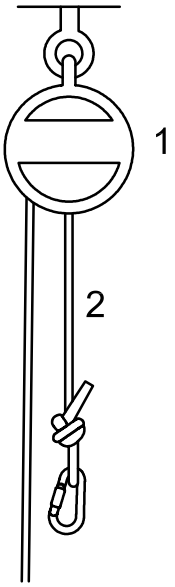
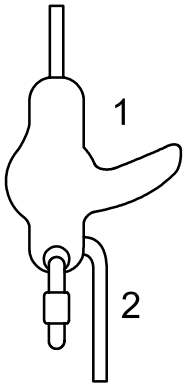
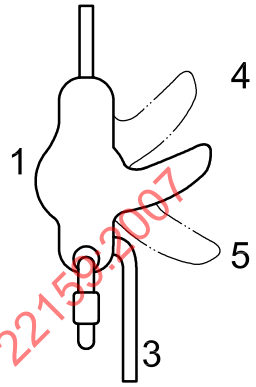


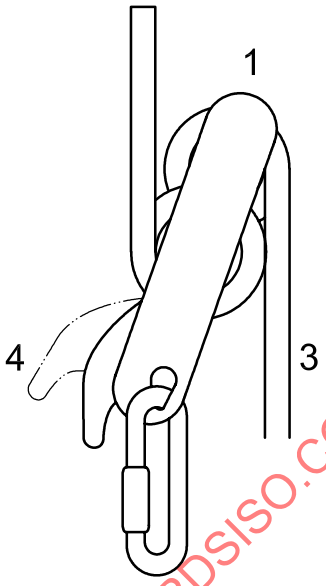
a) Type 1



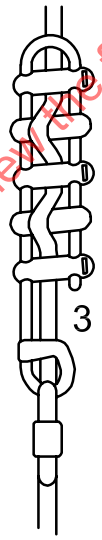
b) Type 2



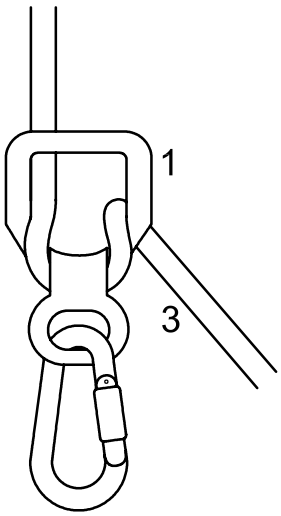
c) Type 3



d) Type 4



e) Type 5



f) Type 6

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Key

1 descending device
2 integrated descent line
3 descent line
4 descent control element in hands-free locking position
5 descent control element in panic locking position

Figure 1 — Generic examples of different types of descending device

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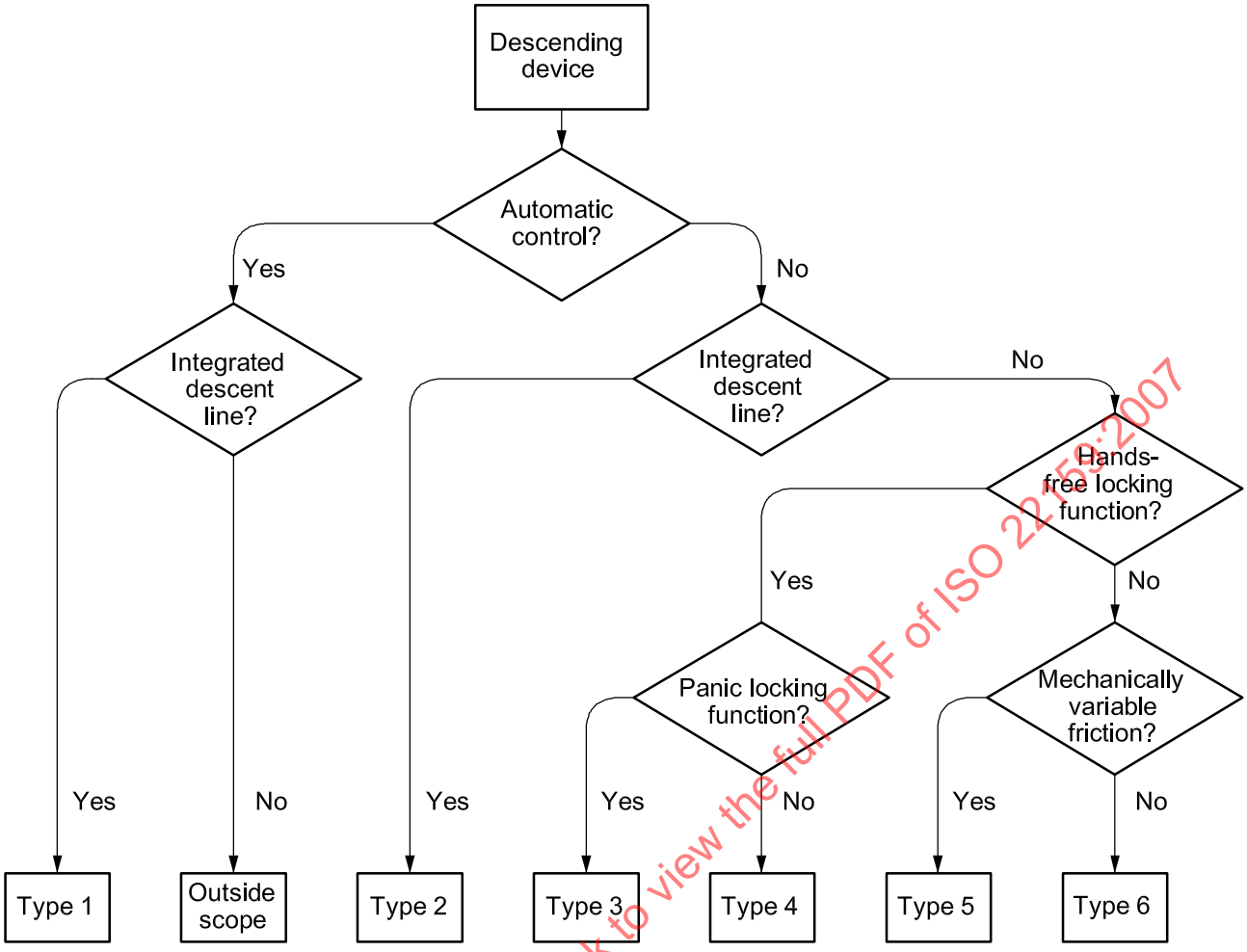

Figure 2 — Characteristics of different types of descending device

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Table 1 — Requirements related to descending device type and class

Clause No.	Requirement	Conditioning				Type and class							
		General 4.15.2	Wet 4.15.3	Wet & cold 4.15.4	Very cold 4.15.5	1A, 1B, 1C	1D	2A, 2B, 2C	2D	3	4	5	6
4.1	General requirements	a	a	a	a	b	b	b	b	b	b	b	b
4.2	Descent lines: basic requirements	a	a	a	a	b	b	b	b	b	b	b	b
4.3	Descent line stopper	b	a	a	a	b	b	b	b	a	a	a	a
4.4	Descent line residual static strength	b	a	a	a	b	b	b	b	b	b	b	b
4.5	Rated loads	a	a	a	a	b	b	b	b	b	b	b	b
4.6.1	Holding load: hands-free locking	b	a	a	a	a	a	b	b	b	b	a	a
4.6.2	Holding load: panic locking	b	a	a	a	a	a	b	b	b	a	a	a
4.6.3	Holding load: locked	b	a	a	a	a	a	a	a	a	a	b	b
4.7	Static strength	b	a	a	a	b	b	b	b	b	b	b	b
4.8	Dynamic performance	b	b	c	c	b	b	b	b	b	b	b	b
4.9	Descent energy	b	a	a	a	b	b	b	b	a	a	a	a
4.10	Descent velocity	b	b	c	c	b	b	b	b	b	b	b	b
4.11	Temperature rise	b	a	a	a	b	b	b	b	b	b	b	b
4.12	Special requirements for class D	a	a	a	a	a	b	a	b	a	a	a	a
4.13	Function	b	b	c	a	b	b	b	b	b	b	b	b
4.14	Corrosion resistance	a	a	a	a	b	b	b	b	b	b	b	b
4.16.1	Marking	a	a	a	a	b	b	b	b	b	b	b	b
4.16.2	Information	a	a	a	a	b	b	b	b	b	b	b	b

NOTE All tests are carried out on the minimum and maximum diameters of descent line of the range marked on the descending device, except the corrosion test and where otherwise stated.

[a] No requirement.

[b] Requirement.

[c] Optional.

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4 Requirements

NOTE A list giving an overview of the requirements relating to each individual type/class of descending device is given in Table 1.

4.1 General

4.1.1 The material specification of all components, including the descent line recommended for use with the descending device, shall be known to be durable at temperatures in which the descending device may be used.

4.1.2 Components made of materials that may degrade due to exposure to sunlight or other environmental factors shall be protected against such degradation, either by proper shielding of the components, e.g. by the use of UV inhibitors in textiles, or by other suitable means, e.g. a protective coating.

4.1.3 Descending devices intended to allow removal of the descent line shall have a mechanism or function to prevent the descent line from being detached unintentionally. The descending device shall have a mechanism or shall function to prevent it being detached from the descent line without at least two consecutive deliberate manual actions.

4.1.4 Descending devices shall not have sharp or rough edges that may cut, abrade or otherwise damage ropes or webbing or cause injury to the user.

4.1.5 Types 1 and 2 descending devices shall be tested in combination with any descent line with which they will be placed on the market.

4.1.6 Types 3, 4, 5 and 6 descending devices for use with descent lines that conform to a recognized and appropriate standard, e.g. EN 1891, CI-1801, AS/NZS 4142.3, as specified in the information supplied by the manufacturer of the descending device, shall be tested with the minimum and maximum diameters of descent line for the range marked on the descending device for each standard claimed by the manufacturer. The exception shall be where a particular test method specifies that the test shall be carried out only at either a minimum or a maximum diameter.

4.1.7 Types 3, 4, 5 and 6 descending devices that do not specify a recognized and appropriate standard to which the descent line shall conform shall be tested on the minimum and maximum diameters of descent line marked on the descending device of every model of the type of descent line which the manufacturer of the descending device claims is appropriate for use with the descending device. The exception shall be where a particular test method specifies that the test shall be carried out only at either a minimum or a maximum diameter.

4.1.8 Metals which could react together galvanically in normal use to the detriment of the descending device or descent line shall not be used in descending devices and descent lines.

4.1.9 Connectors supplied with descending devices shall conform to an appropriate standard, e.g. ISO 10333-5, EN 362, CAN/CSA Z259.12, and shall have a manual or an automatic locking gate.

4.2 Descent lines: basic requirements

4.2.1 General

4.2.1.1 Descent lines shall be made from textile rope or webbing or from steel wire rope or any other appropriate material.

4.2.1.2 Descent lines shall be capable of visual inspection or else subjected to manufacturers' guidance for appropriate examination to confirm that the descent line is satisfactory for continued use.

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4.2.2 Textile descent lines

4.2.2.1 Descent lines made from textiles shall be made from virgin filament or multi-filament synthetic fibres suitable for the use intended. The breaking tenacity of the synthetic fibre shall be known to be at least 0,6 N/tex.

4.2.2.2 The materials used for the construction of textile descent lines shall be known to have a melting point of more than 195 °C. Ropes or webbing made from polypropylene or polyethylene shall not be used for descent lines.

4.2.2.3 Descent lines made from textiles supplied with, or recommended for use with, types 3, 4, 5 and 6 descending devices shall have a minimum static strength of 18 kN. If the minimum static strength of the textile descent line is not specified by the manufacturer, it shall be tested in accordance with 5.5.4.

4.2.2.4 When tested in accordance with 5.5.6, descent lines containing aramid fibres shall not break when the test in 5.5.6.6 is carried out with forces equivalent to those specified in 4.7.

4.2.2.5 When descent lines made from textiles are supplied with permanent end terminations, the eyes formed shall be protected from wear.

4.2.3 Wire rope descent lines

4.2.3.1 Wire rope descent lines made from steel shall be known not to work-harden unduly under foreseeable conditions of use and shall have an appropriate degree of protection against corrosion for such conditions of use. They shall be made from one piece (i.e. no joins in the rope).

NOTE It is advisable that manufacturers of descending devices be particularly careful when selecting or recommending descent lines made from stainless steel as some types of stainless steel can have unpredictable fatigue and corrosion characteristics.

4.2.3.2 Descent lines made from wire rope supplied with, or recommended for use with, types 3, 4, 5 and 6 descending devices shall be known to have a minimum static strength of 15 kN.

4.2.3.3 When tested in accordance with 5.5.6, descent lines made from stainless steel wire shall not break when the test in 5.5.6.6 is carried out with forces equivalent to those specified in 4.7.

4.2.3.4 Wire rope descent lines shall be supplied with permanent end terminations. Eyes formed on wire rope or webbing descent lines shall incorporate a thimble and a termination that has a rated strength of at least 90 % of the descent line nominal strength.

4.3 Descent line stopper

For types 1 and 2 descending devices (i.e. descending devices with integrated descent lines), the free or tail end of the descent line shall be protected against slipping through the descending device. Stopper knots (see Figure 3 and 5.5.3.1 b) or clamps with or without stopper devices (see Figure 4 and 5.5.3.1 b) used as protection on textile descent lines shall be made at a distance of at least 0,5 m from the end of the descent line.

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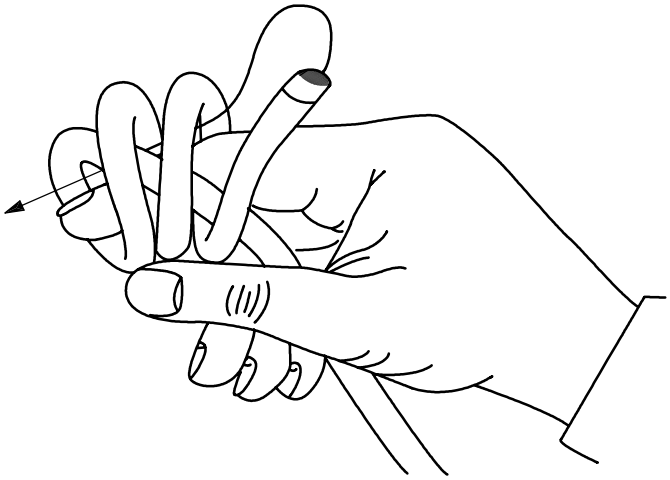
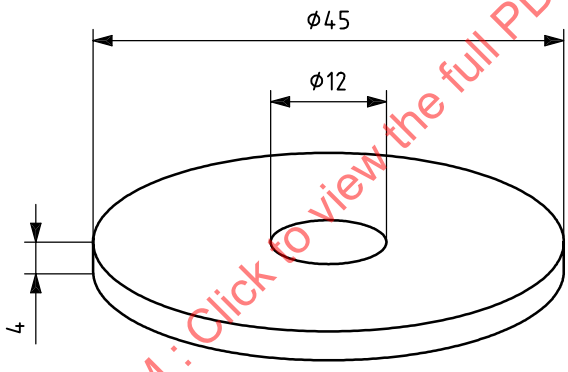


Figure 3 — Stopper knot

Dimensions in millimetres



NOTE The dimensions indicated are examples only.

Figure 4 — Example of stopper device

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4.4 Descent line residual static strength

The descent line shall meet the static strength requirement given in 4.7 when tested in accordance with 5.5.5 after the following tests have been carried out:

a) types 1 and 2 descending devices: the tests in accordance with 5.7.2 and 5.8;

b) types 3, 4, 5 and 6 descending devices: the tests in accordance with 5.7.3.

4.5 Rated loads

4.5.1 Maximum rated load

The maximum rated load shall be specified by the manufacturer and shall be at least 100 kg. For testing purposes, the maximum rated load shall have a tolerance of $\left(\begin{smallmatrix}+2\\0\end{smallmatrix}\right)$ %.

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4.5.2 Minimum rated load

The minimum rated load shall be specified by the manufacturer. For testing purposes, the minimum rated load shall have a tolerance of $\left(^{+2}_{0}\right)$ %.

4.6 Holding load

4.6.1 Hands-free locking position: types 2, 3 and 4 descending devices

When type 2 descending devices incorporating a hands-free locking element and types 3 and 4 descending devices are tested in accordance with 5.5.2 with a force of $\left(3\ ^{+0,1}_{0}\right)$ kN or a force equivalent to 1,5 times the maximum rated load, whichever is the greater, to a tolerance of $\left(^{+0,1}_{0}\right)$ kN, the descending device shall sustain the load for $\left(3\ ^{+0,5}_{0}\right)$ min with a maximum of 300 mm slippage of the descent line through the descending device. After this test, the descending device shall still function properly, i.e. it shall be possible to operate the descending device in accordance with the information supplied by the manufacturer.

4.6.2 Panic locking position: types 2 and 3 descending devices

When type 2 descending devices incorporating a panic-locking element and type 3 descending devices are tested in accordance with 5.5.2 with a force of $\left(450\ ^{0}_{-10}\right)$ N applied to the panic locking element and with a force applied to the descending device of $\left(3\ ^{+0,1}_{0}\right)$ kN or a force equivalent to 1,5 times the maximum rated load, whichever is the greater, to a tolerance of $\left(^{+0,1}_{0}\right)$ kN, the descending device shall sustain the load for $\left(3\ ^{+0,5}_{0}\right)$ min with a maximum of 300 mm slippage of the descent line through the descending device. After this test, the descending device shall still function properly, i.e. it shall be possible to operate the descending device in accordance with the information supplied by the manufacturer.

4.6.3 Types 5 and 6 descending devices

When types 5 and 6 descending devices are tested in accordance with 5.5.2 with a force of $\left(3\ ^{+0,1}_{0}\right)$ kN or a force equivalent to 1,5 times the maximum rated load, whichever is the greater, to a tolerance of $\left(^{+0,1}_{0}\right)$ kN, the descending device shall sustain the load for $\left(3\ ^{+0,5}_{0}\right)$ min with a maximum of 300 mm slippage of the descent line through the descending device. After this test, the descending device shall still function properly, i.e. it shall be possible to operate the descending device in accordance with the information supplied by the manufacturer.

4.7 Static strength

4.7.1 All types and classes of descending device except class D

4.7.1.1 When tested in accordance with 5.5.3, descending devices with a maximum rated load of not more than 100 kg shall withstand a force of $\left(12\ ^{+0,5}_{0}\right)$ kN applied at each attachment element of the descending device for 3 min and shall not release the load.

4.7.1.2 For each 10 kg or part of 10 kg increase in the maximum rated load above 100 kg, descending devices shall withstand an increase in force of 0,3 kN (see Table 2 for examples). The tolerance shall remain the same as that for a maximum rated load of 100 kg.

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Table 2 — Examples of static test forces applicable to different maximum rated loads for all types and classes of descending device except class D

Maximum rated load kg	Static test force kN
100	12,0
110	12,3
120	12,6
130	12,9
140	13,2
150	13,5
160	13,8
170	14,1
180	14,4
190	14,7
200	15,0

4.7.2 Descending devices class D

When tested in accordance with 5.5.3, descending devices of Class D shall withstand a force applied at each attachment element for 3 min equal to at least twice the maximum dynamic force recorded in the dynamic performance tests of 5.6 and shall not release the load.

4.8 Dynamic performance

When tested in accordance with 5.6 with a mass equivalent to the maximum rated load, descending devices shall not release the mass and, with the exception of type 1 descending devices, shall not exceed an arrest distance of 2,0 m. No part of the descending device shall show any signs of permanent deformation that could affect its function and the descent line shall not show any signs of tearing or breaking. Minor glazing of the descent line may occur. For class D descending devices, the maximum impact force in each dynamic performance test shall be measured and recorded.

4.9 Descent energy

4.9.1 Descent energy, W, expressed in J, is calculated by the following equation:

$$W = m \times g \times h \times n$$

where

m is the maximum rated load expressed in kg;

g is gravity, 9,81 m/s^2;

h is the descent height, expressed in m;

n is the number of descents.

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When tested in accordance with 5.7.2 (with testing in succession), types 1 and 2 descending devices and the descent line shall resist the descent energy determined for their class without any impairment of safety, as follows:

a) for descending devices class A, $W \geqslant 7{,}5 \times 10^6$ J;

b) for descending devices class B, $W \geqslant 1{,}5 \times 10^6$ J;

c) for descending devices class C, $W \geqslant 0{,}5 \times 10^6$ J;

d) for descending devices class D, $W \geqslant m \times g \times h_{max}$, where h_{max} is the maximum descent height, expressed in m.

4.9.2 Throughout the tests of the descent energy, descent velocity and temperature rise in accordance with 5.7, types 1 and 2 descending devices and their descent lines shall function properly, i.e. it shall be possible to operate the descending device in accordance with the information supplied by the manufacturer, without showing any changes affecting their safety.

4.10 Descent velocity

4.10.1 When tested in accordance with 5.7.3 with a mass equivalent to the maximum rated load, type 1 descending devices shall not allow the test mass to descend at a rate exceeding 2 m/s.

4.10.2 For types 2, 3, 4, 5 and 6 descending devices, when tested in accordance with 5.7.3 with a mass equivalent to the maximum rated load, it shall be possible to maintain a descent velocity of a maximum of 2 m/s for at least a period of 5 s.

4.10.3 When tested in accordance with 5.7.3 with a mass equivalent to the minimum rated load, it shall be possible to keep the descent velocity of types 1 and 2 descending devices classes A, B and C above 0,5 m/s. For types 1 and 2 descending devices, class D, and for types 3 to 6 descending devices, it shall be possible to maintain a descent velocity of more than 0,1 m/s.

NOTE It is recognized that during certain sections of the descent, or for particular specialized applications, speeds higher than 2 m/s can be justified. However, it is advisable that the descending devices still be capable of being kept to a maximum of 2 m/s.

4.11 Temperature rise

4.11.1 When tested in accordance with 5.7.4 with a mass equivalent to the maximum rated load, the temperature due to friction shall not rise to a point where it affects the safe function of the descending device and the descent line.

4.11.2 When tested in accordance with 5.7.4 with a mass equivalent to the maximum rated load, none of the parts of the descending device handled by the user to control the descents shall develop a temperature higher than 48 °C during the descents.

4.11.3 When tested in accordance with 5.7.4 with a mass equivalent to the maximum rated load, the maximum recorded temperature of any accessible surface during normal use of types 1 and 2 descending devices shall not exceed the relevant temperature specified in Table 4.

4.11.4 If the maximum recorded temperature of any external or internal surface accessible during normal use of types 3 to 6 descending devices exceeds the relevant temperature specified in Table 4 when the descending device is tested with a mass equivalent to the maximum rated load in accordance with 5.7.4, a warning shall be given in the information supplied by the manufacturer [see 7.2.2 u)].

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4.12 Special requirements for descending devices class D

4.12.1 Class D descending devices shall indicate clearly when they have been used.

4.12.2 Class D descending devices shall be configured to prevent re-use after one descent without reconfiguration by the manufacturer or the manufacturer's authorized representative.

4.13 Function

4.13.1 Types 1 and 2 descending devices

4.13.1.1 When tested in accordance with 5.8.1, descending devices shall function in accordance with the information supplied by the manufacturer.

4.13.1.2 When types 1 and 2 descending devices (all classes) are tested in accordance with 5.8.1 with a mass equivalent to the maximum rated load plus 25 %, it shall be possible to maintain a descent velocity of a maximum of 2 m/s. The descent shall be as continuous as possible.

4.13.1.3 When type 2 descending devices (all classes) are tested in accordance with 5.8.1 with a mass equivalent to the maximum rated load plus 25 %, they shall not allow the test mass to descend at a rate exceeding 2 m/s in the hands-off position.

4.13.1.4 When types 1 and 2 descending devices are tested in accordance with 5.8.1 with a mass equivalent to the minimum rated load, it shall be possible to keep the descent velocity of descending devices classes A, B and C above 0,5 m/s. For descending devices class D, shall be possible to maintain a descent velocity of more than 0,1 m/s. The descent shall be as continuous as possible.

4.13.2 Types 2, 3, 4, 5 and 6 descending devices

4.13.2.1 When tested in accordance with 5.8.2, types 2, 3, 4, 5 and 6 descending devices that normally travel with the user and that are intended to be controlled manually by the tail of the descent line shall not move down the descent line at a rate of more than 0,1 m/s.

4.13.2.2 When tested in accordance with 5.8.2, types 2, 3, 4, 5 and 6 descending devices that normally travel with the user and that are normally not intended to be controlled manually by the tail of the descent line shall not move down the descent line at a rate of more than 2 m/s.

4.13.2.3 When tested in accordance with 5.8.3, types 2, 3, 4, 5 and 6 descending devices that normally do not travel with the user and that are intended to be controlled manually by the tail of the descent line shall not allow the descent line to move through the descending device at a rate of more than 0,1 m/s.

4.13.2.4 When tested in accordance with 5.8.3, types 2, 3, 4, 5 and 6 descending devices that normally do not travel with the user and that are normally not intended to be controlled manually by the tail of the descent line shall not allow the descent line to move through the descending device at a rate of more than 2 m/s.

4.14 Corrosion resistance

When tested in accordance with 5.9 for two periods of 24 h exposure and 1 h drying, metal parts of descending devices shall show no evidence of corrosion which may affect their function. (White scaling and tarnishing is acceptable if the function is not impaired.)

NOTE Even though the descending device is required to be resistant to corrosion when subjected to a neutral salt spray test, this does not necessarily mean that it is suitable for use in a marine environment.

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4.15 Conditioning

4.15.1 Tests applicable to conditioning

4.15.1.1 General conditioning of the descending device including descent line(s) (see 4.15.2) shall be applicable to all the tests.

4.15.1.2 Conditioning to wet (see 4.15.3) shall be applicable for the tests relating to the requirements of 4.8, 4.10 and 4.13.

4.15.1.3 Conditioning to wet and cold (see 4.15.4) shall be applicable for the tests relating to the requirements of 4.8, 4.10 and 4.13 only if the manufacturer claims that the descending devices and their descent lines can be used in such conditions.

4.15.1.4 Conditioning to very cold (see 4.15.5) shall be applicable for the tests relating to the requirements of 4.8 and 4.10 only if the manufacturer claims that the descending devices and their descent lines can be used in such conditions.

4.15.2 General conditioning

Descending devices and their descent lines shall be conditioned in accordance with 5.3.

4.15.3 Conditioning to wet

Descending devices and their descent lines shall be conditioned to wet in accordance with 5.3.

4.15.4 Conditioning to wet and cold

If the manufacturer claims that the descending device and descent lines can be used in the temperature range between −4 °C and +2 °C, descending devices and their descent lines shall be conditioned to wet and cold, as specified in 5.3.

4.15.5 Conditioning to very cold

If the manufacturer claims that the descending device and descent lines can be used at temperatures lower than −4 °C, descending devices and their descent lines shall be conditioned to very cold, as specified in 5.3, to the lowest temperature specified by the manufacturer.

4.16 Marking and information

4.16.1 Marking of the descending device shall be in accordance with Clause 6.

4.16.2 Information shall be supplied with the descending device in accordance with Clause 7.

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5 Test methods

5.1 Test apparatus

5.1.1 Test structure

5.1.1.1 The rigid structure shall be constructed so that its natural frequency (of vibration) in the vertical axis at the anchor point is not less than 100 Hz and so that the application of a force of 20 kN on the anchor point does not cause a deflection greater than 1 mm.

5.1.1.2 The test structure shall provide a rigid anchor point consisting of a ring of (20 ± 1) mm bore and (15 ± 1) mm diameter cross section, or a rod of the same diameter cross section.

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5.1.1.3 The height of the rigid anchor point shall be such that no part of the descending device or of the rigid steel mass shall strike the floor during the test.

5.1.2 Force measurement instrumentation

5.1.2.1 The force measuring instrumentation shall be capable of measuring forces from 1,2 kN to 20 kN with an accuracy of ± 2 % and of withstanding a force of 50 kN without damage, and arranged so that measurements are carried out with a continuously active band up to 100 Hz but with a minimum sampling rate of 1 000 Hz.

5.1.2.2 The arrest force measurement system shall have a corner frequency of 100 Hz with frequency response characteristics which fall within the shaded area illustrated in Figure 5.

5.1.2.3 A recorder shall be used to obtain the time trace of the force, either at the actual time (when recording with the auxiliary measuring device) or at a later time, after storage of the information.

5.1.2.4 The calibration of the force measuring apparatus shall be traceable to an approved physical properties laboratory or approved calibration service in accordance with the accuracy required for the test (see ISO/IEC 17025).

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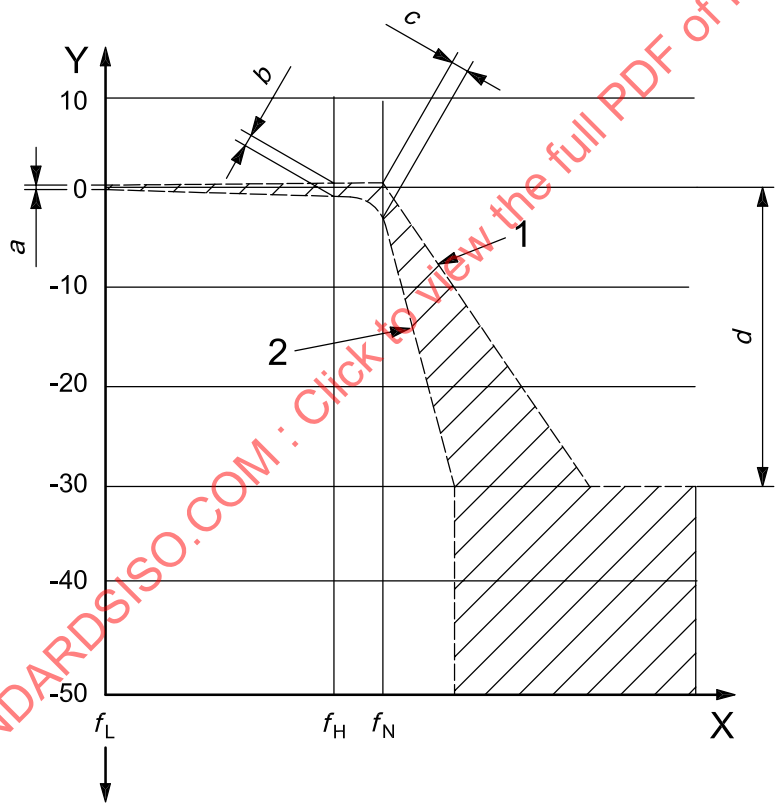

Frequency response values:

$a = \pm$ ¼ dB	$f_L = 0{,}1$ Hz
$b = +$ ½ dB, – 1 dB	$f_H = 60$ Hz
$c = +$ ½ dB, – 3 dB	$f_N = 100$ Hz
$d = -$ 30 dB	

Key

X	log, f (Hz)	1	slope = –9 dB per octave
Y	output/input ratio (dB)	2	slope = –24 dB per octave

Figure 5 — Frequency response characteristics of the force measuring instrumentation

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5.1.3 Rigid steel mass

The rigid steel mass (see Figure 6) shall be equivalent to the maximum rated load of the descending device (min. 100 kg), except for the tests in 5.7.3.2, when it shall be equivalent to the minimum rated load. The rigid steel mass shall have a maximum width or diameter of 250 mm and shall incorporate a rigid connection point, which shall be central at one end. An optional offset additional connection point is also permissible to accommodate horizontal dimensional constraints of relevant testing procedures and equipment.

Dimensions in millimetres

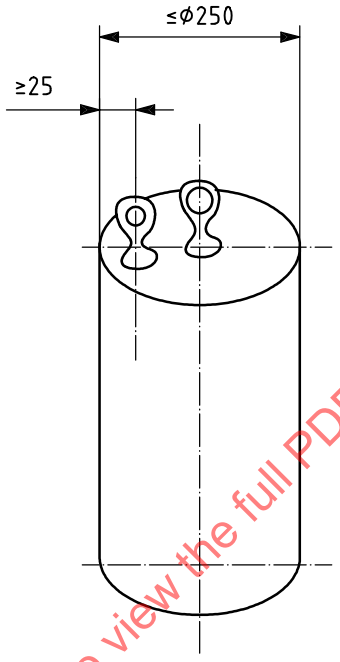

Figure 6 — Rigid steel mass

5.1.4 Quick release device

The quick release device shall be compatible with the connection point of the steel masses. It shall ensure the release of a rigid steel mass with no initial velocity.

5.1.5 Corrosion resistance test apparatus

The apparatus for the corrosion resistance test (see 5.9) shall be capable of carrying out the neutral salt spray test procedure described in ISO 9227.

5.2 General

5.2.1 For descending devices for use with descent lines that conform to a recognized and appropriate standard (e.g. EN 1891 type A, CI-1801 and AS/NZ 4142.3 for descent lines made from textile rope) as specified in the information supplied by the manufacturer of the descending device, unless a particular clause specifies otherwise, perform all the tests on two descent lines, one to the minimum and one to the maximum diameter as marked on the descending device. If the information supplied by the manufacturer clearly specifies that the descending device is to be used with only one defined descent line, carry out the test with the defined descent line.

5.2.2 For descending devices for use with descent lines that do not conform to a recognized and appropriate standard, perform all the tests on every model of that type of descent line which the manufacturer of the descending device claims is appropriate for use with the descending device. If the information supplied by the manufacturer clearly specifies that the descending device is to be used with only one defined descent line, carry out the test with the defined descent line.

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5.2.3 If the descending device and the descent line are not supplied as an integrated unit, install the descent line specified by the manufacturer of the descending device in the descending device and attach an appropriate connector to the attachment element in accordance with the information supplied by the manufacturer.

5.3 Conditioning

5.3.1 General conditioning

5.3.1.1 If the information supplied by the manufacturer of the descent line recommends that the descent line be preconditioned before use (e.g. soaked in water), precondition the descent line accordingly.

5.3.1.2 Condition the descending device and descent line in an atmosphere of $\left(10\ {}^{0}_{-1}\right)$ % humidity for $\left(24\ {}^{+1}_{0}\right)$ h. Store at a temperature of (20 ± 2) °C and a humidity of (65 ± 5) % for at least 72 h. Tests made after general conditioning may be carried out in a relative humidity outside that specified but within the temperature range of (23 ± 5) °C. Complete each of these tests within 30 min of removal from the conditioned chamber.

5.3.2 Conditioning to wet

Immerse the descending device and descent line in fresh water for a minimum of 2 h at a temperature of (20 ± 2) °C. Remove from the water and allow to drain for (15 ± 1) min. Commence the next stage of conditioning or testing, as appropriate, within 2 min of completion of the draining procedure.

5.3.3 Conditioning to wet and cold

If the manufacturer claims that the descending device and descent line can be used in the temperature range between −4 °C and +2 °C, first condition the descending device and descent line to wet in accordance with 5.3.2. After conditioning to wet, wrap the descending device and descent line in an insulating blanket (not specified) and subject them to a temperature of $\left(-4\ {}^{0}_{-2}\right)$ °C for a minimum of 4 h. Commence each test to be carried out (see 4.8, 4.10 and 4.13) within 2 min of removal from the conditioned atmosphere. The insulating blanket may be removed at the start of the test.

NOTE The insulating blanket is required to enable the descending device and descent line to be within the conditioned temperature range at the time the test is carried out.

5.3.4 Conditioning to very cold

If the manufacturer claims that the descending device and descent line can be used in temperatures less than −4 °C, first condition the descending device and descent line to wet in accordance with 5.3.2. After conditioning to wet, wrap the descending device and descent line in an insulating blanket (not specified) and subject them to the lowest temperature specified by the manufacturer (see 4.15.5) with a tolerance of $\left({}^{0}_{-5}\right)$ °C for a minimum of 4 h. Commence each test to be carried out (see 4.8 and 4.10) within 2 min of removal from the conditioned atmosphere. The insulating blanket may be removed at the start of the test.

NOTE The insulating blanket is required to enable the descending device and descent line to be within the conditioned temperature range at the time the test is carried out.

5.4 Examination of design

Confirm by reference to appropriate documentation accompanying the descending device and descent line(s) and by normal or corrected vision and/or tactile examination of the descending device and the descent line(s) that they conform to 4.1, 4.2.1, 4.2.2, 4.2.3, 4.3, 4.12 and 4.16. If it is necessary to examine internal components, dismantle the descending device.

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5.5 Static tests

5.5.1 Rate of stressing for static tests

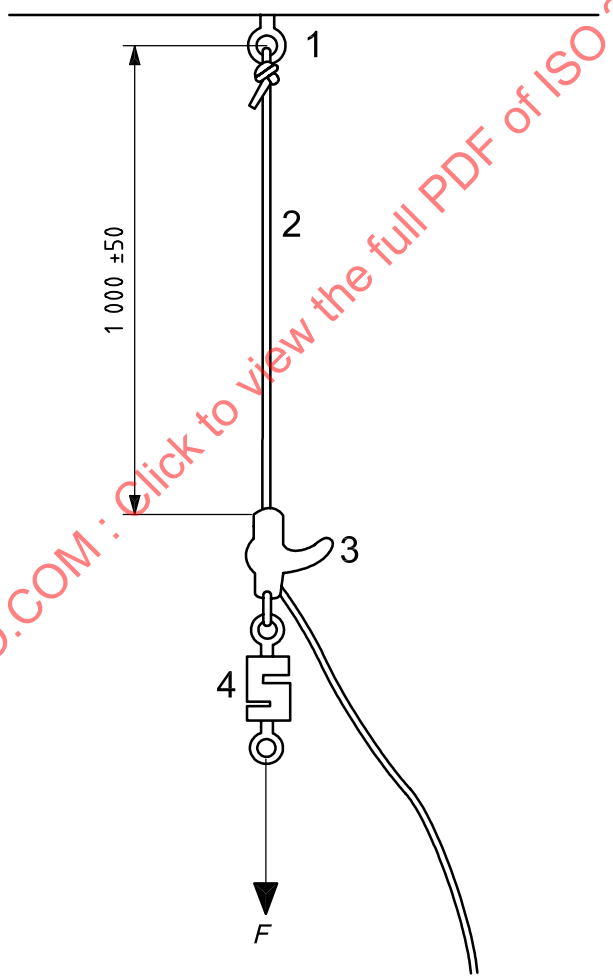
Use a rate of stressing within the range of (150 ± 10) mm/min.

5.5.2 Holding load

5.5.2.1 Descending devices that normally travel with the user

5.5.2.1.1 If the design of the descending device is such that it normally travels with the user during a descent, attach the up-line end of the descent line to the anchor point on the test apparatus (see Figure 7). Position the descending device on the descent line so that the top of it is (1000 ± 50) mm down-line from the anchor point of the test apparatus.

Dimensions in millimetres



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Key

1 anchor point
2 descent line
3 descending device
4 force measurement device
F direction of force

Figure 7 — Holding load test for descending devices that normally travel with the user

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5.5.2.1.2 If a type 2 descending device is provided with a hands-free locking element or a panic locking element, proceed as for types 3 and 4 descending devices, as appropriate.

5.5.2.1.3 For types 3 and 4 descending devices, arrange the descent control element in the hands-free engaged position. For types 5 and 6 descending devices and for type 2 descending devices without a hands-free locking element, lock off the descending device in accordance with the information supplied by the manufacturer.

5.5.2.1.4 Apply to the descending device, via the descending device attachment element, a force equal to that specified in 4.6. Confirm that the requirements of 4.6 are met.

5.5.2.1.5 For type 3 descending devices, repeat the test, this time with the panic locking element engaged and ensuring that the force specified in 4.6.2 is applied to it. Confirm that the requirements of 4.6 are met.

5.5.2.2 Descending devices that normally do not travel with the user

5.5.2.2.1 If the design of the descending device is such that it normally does not travel with the user during a descent, attach the descending device by its attachment element to the anchor point of the test apparatus, using an appropriate connector (see Figure 8). Withdraw (1000 ± 50) mm of descent line from the down-line end of the descending device.

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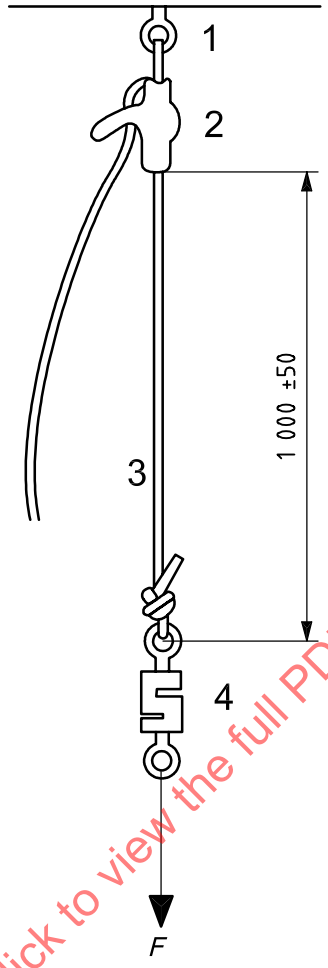
Dimensions in millimetres



Key

1 anchor point
2 descending device
3 descent line
4 force measurement device
F direction of force

Figure 8 — Holding load test for descending devices that normally do not travel with the user

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5.5.2.2.2 If a type 2 descending device is provided with a hands-free locking element or a panic locking element, proceed as for types 3 and 4 descending devices, as appropriate.

5.5.2.2.3 For types 3 and 4 descending devices, arrange the descent control element in the hands-free engaged position. For types 5 and 6 descending devices and for type 2 descending devices without a hands-free locking element, lock off the descending device in accordance with the information supplied by the manufacturer.

5.5.2.2.4 Apply a force equal to that specified in 4.6 to the descending device via the terminated down-line end of the descent line [which has been withdrawn from the descending device by (1000 ± 50) mm]. Confirm that the requirements of 4.6 are met.

5.5.2.2.5 For type 3 descending devices, repeat the test, this time with the panic locking element engaged and ensuring that the force specified in 4.6.2 is applied to it. Confirm that the requirements of 4.6 are met.

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5.5.3 Static strength

5.5.3.1 Use one of the three test methods described below which is appropriate to the construction of the descending device being tested.

a) **Method 1** Attach the up-line end of the descent line to the anchor point on the test apparatus. Position the descending device on the descent line so that the top of it is (1000 ± 50) mm down-line from the anchor point of the test apparatus. To the same anchor point or to an anchor point that is at the same level as the first anchor point and a maximum distance of 300 mm from it, attach the tail end of the descent line to form a loop in the descent line so that when the specified force is applied, the descending device is pulled against the loop [see Figure 9 a)]. Connect the force measurement device to the attachment element of the descending device.

b) **Method 2** Attach the up-line end of the descent line to the anchor point on the test apparatus. Position the descending device on the descent line so that the top of it is (1000 ± 50) mm down-line from the anchor point of the test apparatus. Make a termination on the descent line below the descending device fitted to it [e.g. by a stopper knot (see Figure 3) or a clamp], to prevent the descending device sliding off the descent line [see Figure 9 b)]. If necessary, an appropriate stopper device may be inserted above the stopper knot or clamp to prevent the termination from entering the descending device (see Figure 4 for an example). Ensure that the design of the stopper device is such that it does not affect the strength of the descending device.

c) **Method 3** For descending devices where the descent line is contained within the body of the descending device, fully extract the descent line. For the test, terminate the descent line approximately 1 m from the descending device [see Figure 9 c)], using a termination of the same construction as that fitted to the end of the descent line supplied with the descending device. Alternatively, the manufacturer is permitted to supply specimen(s) with the descent line terminated ready for test.

5.5.3.2 Apply the force specified in 4.7 between the attachment element of the descending device and the test termination(s) of the descent line at the anchor point(s) on the test apparatus. Maintain the force for $\left(3\ ^{+0,5}_{0}\right)$ mm and confirm that the requirements of 4.7 are met.

5.5.3.3 Repeat the test for each attachment element.

5.5.3.4 For descending devices with an integrated descent line that have been tested to Method 1, take an appropriate length of unused descent line and terminate it at both ends with the same type of terminations as those used in Method 1. The manufacturer is permitted to supply specimen(s) of the descent line terminated ready for test.

Install the terminated length of descent line in a standard static testing machine of appropriate range, using appropriate connectors.

Apply the force specified in 4.7 between the terminations of the descent line. Maintain the force for $\left(3\ ^{+0,5}_{0}\right)$ mm and confirm that the requirements of 4.7 are met. The crosshead velocity is specified in 5.5.1.

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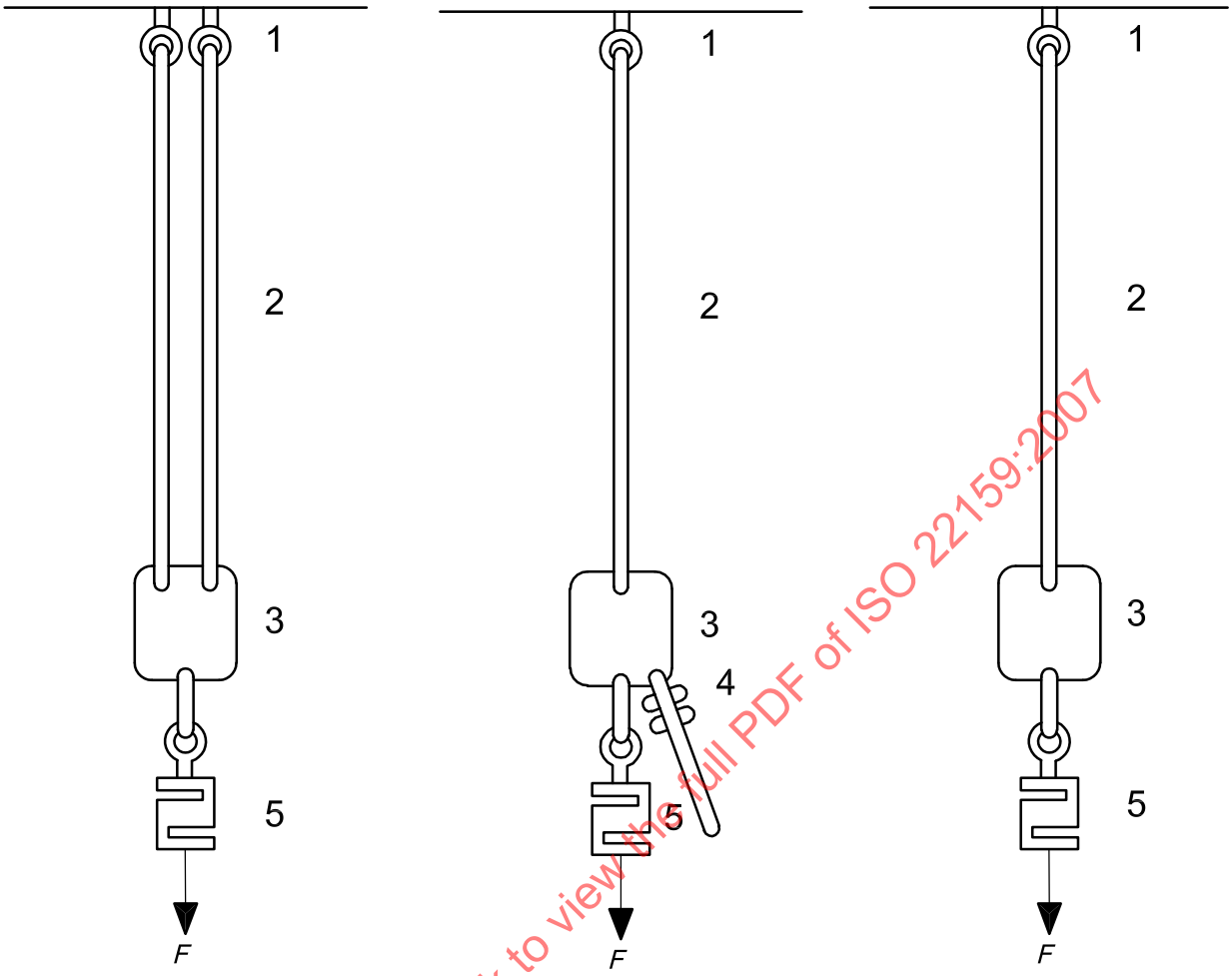

a) Method 1 b) Method 2 c) Method 3

Key

1 anchor point(s)
2 descent line
3 descending device
4 stopper knot
5 force measurement device
F direction of force

Figure 9 — Static strength test

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5.5.4 Textile descent line strength

Install an appropriate length of the unused textile descent line (the “test piece”) in a standard static testing machine of appropriate range, so that the distance between the clamps or other types of fastening arrangement is $\left(1\,000\ {}^{+100}_{0}\right)$ mm. Attach the test piece in such a manner that the fastening arrangement does not affect the results of the test. Test the test piece to break and record the result. The crosshead velocity is specified in 5.5.1. The test is invalid if a break of the test piece is within 100 mm of the fastening arrangement. Confirm that the requirements of 4.2.2.3 are met.

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5.5.5 Descent line residual static strength

After the tests described in 5.7 (and in the case of types 1 and 2 descending devices, after the tests described in 5.8), take an appropriate length of the descent line from between 5 m and 10 m of its bottom end (the "test piece") and install it in a standard static testing machine of appropriate range so that the distance between the clamps or other types of fastening arrangement is $\left(1\,000\ {}^{+100}_{0}\right)$ mm. Attach the test piece in such a manner that the fastening arrangement does not affect the results of the test. Test the test piece to break and record the result. The crosshead velocity is specified in 5.5.1. The test is invalid if a break of the test piece is within 100 mm of the fastening arrangement. Confirm that the requirements of 4.4 are met.

5.5.6 Stainless steel wire or aramid textile descent line integrity

5.5.6.1 Carry out the test with the stainless steel or aramid descent line conditioned in accordance with 4.15.2. Other conditioning is not necessary.

5.5.6.2 Set up the test in accordance with Figure 13 or Figure 14, depending on the type of descending device being used in the test.

5.5.6.3 Attach the descending device by its attachment element to a test mass equivalent to the maximum rated load (see 5.1.3) by means of an appropriate connector, and lanyard if necessary. Ensure that the descent line is long enough to allow a pass of the descent line through the descending device of at least 2 m. Suspend the test mass and descending device from the test machine by the descent line through a free-running pulley attached to the test machine at an appropriate height. Connect the free end of the descent line to the descent line pull-through system, e.g. a powered capstan. See Figure 13 for type 1 descending devices and Figure 14 for types 2 to 6 descending devices. Ensure that the direction of travel of the descent line is the same as that in practice, as described in the information supplied by the manufacturer. Test bi-directional descending devices in both directions.

5.5.6.4 Operate the descent line pull-through system so that the test mass is maintained off the ground within a range between 0 mm and 1000 mm of movement. Carry out the test so that the same section of descent line passes through the descending device by at least 2 m each pass.

5.5.6.5 Carry out a number of passes equal to the maximum number of descents specified for the descending device by the manufacturer. Carry out the repeat passes with as short an interval as possible between them and in one continuous operation, but account may be taken of what the chronological intervals would be in practice.

5.5.6.6 Install the 2 m length of descent line used in the passes in a standard static testing machine of appropriate range so that the distance between the clamps or other types of fastening arrangement is $\left(1\,000\ {}^{+100}_{0}\right)$ mm. Attach the test piece in such a manner that the fastening arrangement does not affect the results of the test. Apply the force specified in 4.7. Maintain the force for a period of $\left(3\ {}^{+0,5}_{0}\right)$ mm and verify that the descent line does not break. The crosshead velocity is specified in 5.5.1. The test is invalid if a break of the test piece is within 100 mm of the fastening arrangement. Confirm that the requirements of 4.2.2.4 and 4.2.3.3 are met.

5.6 Dynamic performance

5.6.1 Descending devices that normally travel with the user

5.5.1.1 If the design of the descending device is such that it normally travels with the user during a descent, secure the up-line end of the descent line to the anchor point on the test apparatus (see Figure 10). If the descent line is not supplied with terminations, terminate the descent line by a figure of eight knot as shown in Figure 11. Position the descending device so that the point at which the descent line enters the descending device (up-line) is $\left(600\ {}^{+30}_{0}\right)$ mm vertically down-line from the anchor point of the test apparatus.

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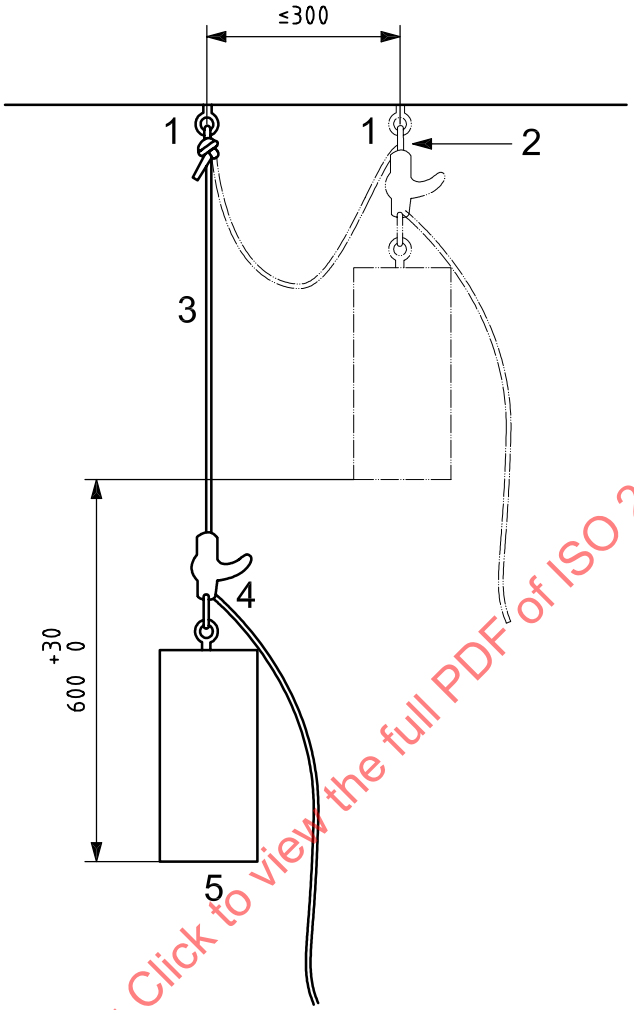
Dimensions in millimetres



Key

1 anchor point
2 quick release device
3 descent line
4 descending device
5 test mass

Figure 10 — Dynamic performance test for descending devices that normally travel with the user

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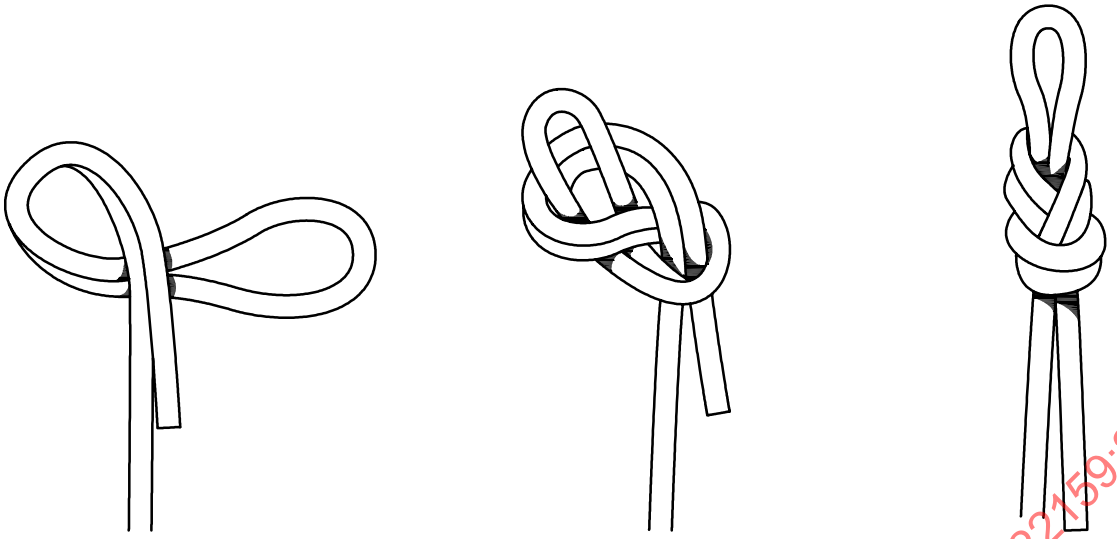

Figure 11 — Method of tying a figure of eight knot

5.6.1.2 If a type 2 descending device is provided with a hands-free locking element or a panic locking element, proceed as for types 3 and 4 descending devices, as appropriate.

5.6.1.3 For types 3 and 4 descending devices, arrange the descent control element in the hands-free engaged position. For type 5 descending devices and for type 2 descending devices without a hands-free locking element, where the information supplied by the manufacturer allows users to configure the descent line to provide different frictional resistance through the descending device, configure for the maximum frictional resistance. For type 6 descending devices, lock off the descending device in accordance with the information supplied by the manufacturer.

5.6.1.4 Allow a minimum clearance distance of 3 m from the test apparatus anchor point to the ground. Attach the test mass specified in 5.1.3 to the attachment element of the descending device using an appropriate connector. Suspend the test mass for (60 ± 5) s to pre-tension the descent line. Raise the descending device and the test mass and attach it to the test apparatus by the quick release device specified in 5.1.4 in such a way that the anchor point of the test apparatus is level with the point at which the descent line enters the descending device, i.e. so that there will be a 600 mm minimum free fall. Ensure that the attachment point of the test mass is a maximum horizontal distance of 300 mm from the attachment element of the descending device. Release the test mass without initial velocity. Confirm that the requirements of 4.8 are met.

5.6.1.5 For type 3 descending devices, repeat the test, this time with the panic locking element engaged. This may necessitate fixing the panic locking element in place. Confirm that the requirements of 4.8 are met.

5.6.1.6 For types 3 and 4 descending devices, if the manufacturer recommends descent line locking additional to that provided by the hands-free locking and panic locking elements, e.g. by wrapping or knotting the descent line around the descending device, repeat the test with the descending device locked off in accordance with the information supplied by the manufacturer. Confirm that the requirements of 4.8 are met.

5.6.1.7 For type 5 descending devices, if the manufacturer recommends descent line locking additional to that provided by the maximum friction position, e.g. by wrapping or knotting the descent line around the descending device, repeat the test with the descending device locked off in accordance with the information supplied by the manufacturer. Confirm that the requirements of 4.8 are met.

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5.6.1.8 For class D descending devices, if the information supplied by the manufacturer states that the descending device can be locked off or if there are no specific instructions concerning locking off, carry out each test with the descending device locked off. If the information supplied by the manufacturer states that the class D descending device must not be locked off, carry out each test in the maximum friction position. Carry out each test three times and record the maximum impact force in each case. A new descent line shall be used for each test but the same descending device may be used.

5.6.1.9 Repeat the tests with the descending device and descent line conditioned to wet (see 4.15.3), unless the tests conforming to 5.6.1.10 or 5.6.1.11 are to be carried out. Confirm that the requirements of 4.8 are met.

5.6.1.10 If the manufacturer claims that the descending device and descent line can be used in the temperature range between −4 °C and +2 °C, repeat the tests with the descending device and descent line conditioned to wet and cold (see 4.15.4). Confirm that the requirements of 4.8 are met.

5.6.1.11 If the manufacturer claims that the descending device and descent lines can be used in temperatures less than −4 °C, repeat the tests with the descending device and descent line conditioned to very cold (see 4.15.5). Confirm that the requirements of 4.8 are met.

5.6.2 Descending devices that normally do not travel with the user

5.6.2.1 If the design of the descending device is such that it normally does not travel with the user during a descent, attach the descending device by its attachment element to the anchor point of the test apparatus, using an appropriate connector (see Figure 12). Allow a minimum clearance distance of 3 m from the test apparatus anchor point to the ground. Attach the test mass specified in 5.1.3 to the terminated down-line end of the descent line and adjust the descent line so that test mass is suspended from the descending device by the descent line with a vertical distance of $\left(600\ ^{+30}_{0}\right)$ mm vertically down-line between the attachment point on the test mass and the point at which the descent line leaves the descending device. Suspend the test mass for (60 ± 5) s.

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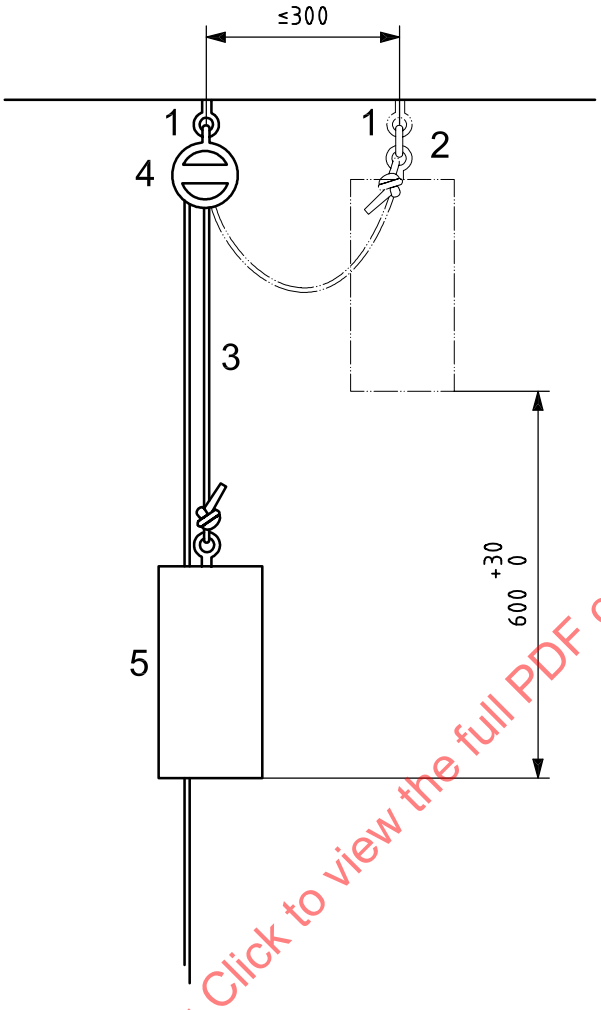
Dimensions in millimetres



Key

1 anchor point
2 quick release device
3 descent line
4 descending device
5 test mass

Figure 12 — Dynamic performance test for descending devices that normally do not travel with the user

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5.6.2.2 If a type 2 descending device is provided with a hands-free locking element or a panic locking element, proceed as for types 3 and 4 descending devices, as appropriate.

5.6.2.3 For types 3 and 4 descending devices, arrange the descent control element in the hands-free engaged position. For type 5 descending devices and for type 2 descending devices without a hands-free locking element, where the information supplied by the manufacturer allows users to configure the descent line to provide different frictional resistance through the descending device, configure for the maximum frictional resistance. For type 6 descending devices, lock off the descending device in accordance with the information supplied by the manufacturer.

5.6.2.4 Raise the test mass specified in 5.1.3 and attach it to the test apparatus by the quick release device specified in 5.1.4 in such a way that the attachment point of the test mass is level with the point at

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which the descent line exits the descending device, i.e. so that there will be a 600 mm minimum free fall. Ensure that the attachment point of the test mass is a maximum horizontal distance of 300 mm from the attachment element of the descending device. Release the test mass without initial velocity. Confirm that the requirements of 4.8 are met.

5.6.2.5 For type 3 descending devices, repeat the test, this time with the panic locking element engaged. This may necessitate fixing the panic locking element in place. Confirm that the requirements of 4.8 are met.

5.6.2.6 For types 3 and 4 descending devices, if the manufacturer recommends descent line locking additional to that provided by the hands-free locking and panic locking elements, e.g. by wrapping or knotting the descent line around the descending device, repeat the test with the descending device locked off in accordance with the information supplied by the manufacturer. Confirm that the requirements of 4.8 are met.

5.6.2.7 For type 5 descending devices, if the manufacturer recommends descent line locking additional to that provided by the maximum friction position, e.g. by wrapping or knotting the descent line around the descending device, repeat the test with the descending device locked off in accordance with the information supplied by the manufacturer. Confirm that the requirements of 4.8 are met.

5.6.2.8 For class D descending devices, if the information supplied by the manufacturer states that the descending device can be locked off or if nothing is said about locking off, carry out each test with the descending device locked off. If the information supplied by the manufacturer states that the class D descending device must not be locked off, carry out each test in the maximum friction position. Carry out each test three times and record the maximum impact force in each case. A new descent line shall be used for each test but the same descending device may be used.

5.6.2.9 Repeat the tests with the descending device and descent line conditioned to wet (see 4.15.3), unless the tests conforming to 5.6.2.10 or 5.6.2.11 are to be carried out. Confirm that the requirements of 4.8 are met.

5.6.2.10 If the manufacturer claims that the descending device and descent line can be used in the temperature range between –4 °C and +2 °C, repeat the tests with the descending device and descent line conditioned to wet and cold (see 4.15.4). Confirm that the requirements of 4.8 are met.

5.6.2.11 If the manufacturer claims that the descending device and descent lines can be used in temperatures less than –4 °C, repeat the tests with the descending device and descent line conditioned to very cold (see 4.15.5). Confirm that the requirements of 4.8 are met.

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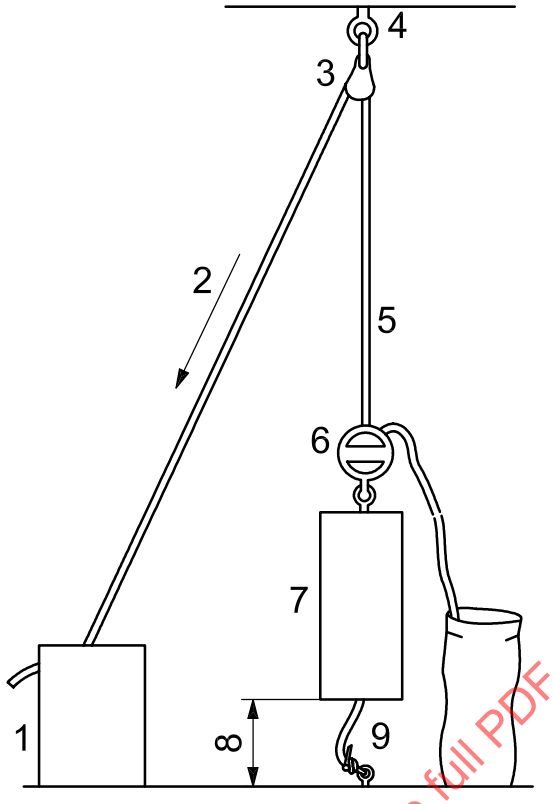

Key

1 descent line pull-through system, e.g. a powered capstan
2 direction of travel of descent line
3 free-running pulley
4 anchor point
5 descent line
6 descending device
7 test mass
8 test mass maintained off the ground within a range between 0 mm and 1 000 mm
9 test mass retention lanyard

Figure 13 — Descent energy, descent velocity and temperature rise test apparatus and set up for type 1 descending devices

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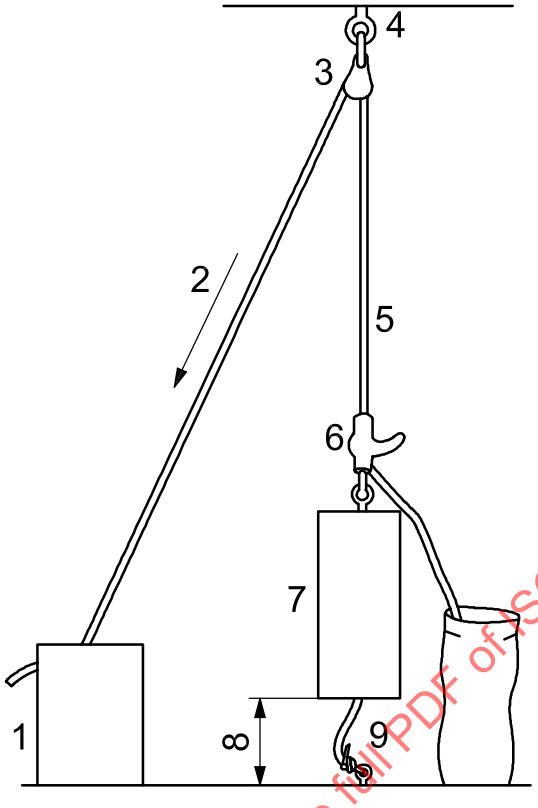

Key

1 descent line pull-through system, e.g. a powered capstan
2 direction of travel of descent line
3 free-running pulley
4 anchor point
5 descent line
6 descending device
7 test mass
8 test mass maintained off the ground within a range between 0 mm and 1 000 mm
9 test mass retention lanyard

Figure 14 — Descent energy, descent velocity and temperature rise test apparatus and set up for types 2, 3, 4, 5 and 6 descending devices

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5.7 Descent energy, descent velocity, temperature rise

5.7.1 Test set-up and operation

5.7.1.1 General

For all types and classes of descending device, tests should be performed in accordance with 5.7.1.2, at a place determined by the test house and the manufacturer to be appropriate for testing, at the maximum descent height as specified in the information supplied by the manufacturer (known as the “field test”). If the maximum descent height is not specified, use a descent line with a length of 100 m. Where it is not practicable to carry out the field test, e.g. where the maximum descent height cannot be achieved, carry out the tests with a mechanical test apparatus, as shown in Figures 13 and 14 and described in 5.7.1.3. The test apparatus, set-up and operation for the descent energy, descent velocity and temperature rise tests are essentially the same. The measurement of descent velocity and temperature may be carried out during one pass of the descent line through the descending device.

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5.7.1.2 Field tests

5.7.1.2.1 Carry out the tests using a new descending device and descent line and following the manufacturer's instructions. If the descending device is a bi-directional device, carry out the tests in both directions. Attach the descending device by its attachment element to a test mass by an appropriate connector, and lanyard if necessary. The value of the test mass is given in each test, i.e. 5.7.2, 5.7.3 and 5.7.4.

5.7.1.2.2 Carry out the descent vertically from the top to the bottom of the descent line, with the descent velocity as constant as possible. Confirm that the requirements of 4.9 (where appropriate), 4.10 and 4.11 are met.

NOTE It is highly advisable that if a person carries out the tests by accompanying the descending device during the descent, he/she be protected against a fall in case there is a failure or loss of control of the descending device and/or the descent line.

5.7.1.3 Tests using a mechanical test apparatus

5.7.1.3.1 Carry out the tests using a new descending device and descent line and following the manufacturer's instructions. If the descending device is a bi-directional device, carry out the tests in both directions. Attach the descending device by its attachment element to a test mass by means of an appropriate connector, and lanyard if necessary. The value of the test mass is given in each test, i.e. 5.7.2, 5.7.3 and 5.7.4. Ensure that the descent line is a minimum of 3 m longer than the maximum descent specified in the information supplied by the manufacturer. Suspend the test mass and descending device from the test machine by the descent line through a free-running pulley attached to the test machine at an appropriate height. Connect the free end of the descent line to the descent line pull-through system, e.g. a powered capstan. See Figure 13 for type 1 descending devices and Figure 14 for types 2 to 6 descending devices. Ensure that the direction of travel of the descent line is the same as that in practice, as described in the information supplied by the manufacturer.

5.7.1.3.2 Operate the descent line pull-through system so that the test mass is maintained off the ground within a range between 0 mm and 1000 mm of movement. Using a suitable method, control and record the speed of the descent line through the descending device at the maximum velocity specified in 4.10 or, if the maximum velocity is less than this, at the maximum velocity, with a tolerance in either case of −0,1 m/s. Carry out the test over a length of the descent line that is at least equal to that of the maximum descent specified for the descending device in the information supplied by the manufacturer (effectively the entire length of the descent line).

5.7.2 Descent energy

5.7.2.1 The descent energy tests are applicable only to types 1 and 2 descending devices. The value of the test mass and the length of the descent are given in Table 3.

5.7.2.2 Using the test set-up and operation described in 5.7.1, as appropriate, carry out the field test in accordance with 5.7.1.2 or operate the mechanical test apparatus in accordance with 5.7.1.3. Repeat the test for the maximum number of descents specified for the descending device in the information supplied by the manufacturer. Carry out the repeat tests with as short an interval as possible between them and in one continuous operation, but account may be taken of what the chronological intervals would be in practice.

NOTE The number of descents varies in accordance with the equation for descent energy (see 4.9).

Table 3 — Descent energy test

Class	Height m	Mass kg
A	100	maximum rated load
B	100	maximum rated load
C	20	maximum rated load
D	as specified by the manufacturer	maximum rated load

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5.7.2.3 If descending devices of classes A and B are intended for heights less than 100 m, carry out the descent energy test with a descent line length equivalent to the descent height specified in the information supplied by the manufacturer, plus a minimum of 3 m. Increase the number of descents in order to reach the descent energies specified in 4.9.

5.7.2.4 Confirm that the requirements of 4.9 are met.

5.7.3 Descent velocity

5.7.3.1 Using the test set-up and operation described in 5.7.1, as appropriate, carry out the field test in accordance with 5.7.1.2 or operate the mechanical test apparatus in accordance with 5.7.1.3. Carry out the test using a mass equivalent to the maximum rated load. Confirm that the requirements of 4.10.2 and 4.10.3 are met.

5.7.3.2 Using the same descending device and descent line as that used in 5.7.3.1 but this time using a mass equivalent to the minimum rated load, carry out the field test in accordance with 5.7.1.2 or operate the mechanical test apparatus so that the test mass is maintained off the ground within a range between 0 mm and 1000 mm of movement. Using a suitable method, control and record the speed of the descent line through the descending device. Carry out the test over a length of the descent line that is at least equal to that of the maximum descent specified for the descending device in the information supplied by the manufacturer (effectively the entire length of the descent line). If the maximum descent is not specified, use a descent line with a length of 100 m. Confirm that the requirements of 4.10.4 are met.

5.7.3.3 Repeat the tests with the descending device and descent line conditioned to wet (see 4.15.3), unless the tests conforming to 5.7.3.4 or 5.7.3.5 are to be carried out. Confirm that the requirements of 4.10.2 and 4.10.3 are met.

5.7.3.4 If the manufacturer claims that the descending device and descent line can be used in the temperature range between −4 °C and +2 °C, repeat the tests with the descending device and descent line conditioned to wet and cold (see 4.15.4). Confirm that the requirements of 4.10.2 and 4.10.3 are met.

5.7.3.5 If the manufacturer claims that the descending device and descent lines can be used in temperatures less than −4 °C, repeat the tests with the descending device and descent line conditioned to very cold (see 4.15.5). Confirm that the requirements of 4.10.2 and 4.10.3 are met.

5.7.4 Temperature rise

5.7.4.1 The temperature tests assume an ambient temperature in the test room of (20 ± 2) °C. Allow for this and make adjustments accordingly when recording the temperatures after each test (see 5.3.1.2).

5.7.4.2 Carry out the tests using a descending device and descent line conditioned in accordance with 4.15.2 and with a mass equivalent to the maximum rated load. Using the test set-up and operation described in 5.7.1, as appropriate, carry out the field test in accordance with 5.7.1.2 or operate the mechanical test apparatus in accordance with 5.7.1.3.

5.7.4.3 Within 20 s after the end of the descent velocity test using a mass equivalent to the maximum rated load, measure the temperature of parts of the descending device handled by the user to control the descent (see 4.11.2).

5.7.4.4 Within 40 s after the end of the descent velocity test using a mass equivalent to the maximum rated load, measure the temperature of accessible exterior surface parts of the descending device other than those handled by the user to control the descent (see 4.11.3 and 4.11.4).

5.7.4.5 Within 60 s after the end of the descent velocity test using a mass equivalent to the maximum rated load, measure the temperature of accessible interior surface parts of the descending device other than those handled by the user to control the descent (see 4.11.3 and 4.11.4).

5.7.4.6 With reference to 5.7.4.1 and Table 4, record the temperatures measured and confirm that the requirements of 4.11 are met.

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Table 4 — Maximum allowed temperature of various parts of the descending device after the velocity test using the maximum rated load

Material	Parts handled by the user to control the descent °C	Other parts (external and internal) °C
Uncoated metal	48	60 (external), 65 (internal)
Coated metal	48	65
Ceramics, glass and stone	48	66
Plastics	48	69
Wood	48	89

NOTE The information in this table is taken from EN 563:1994. The metal coating referred to in the first column is a special thermal coating (see EN 563). The figures in the second column assume a contact time of around 10 min and the figures in the third column assume a contact time of between 1 s and 10 s.

5.8 Function tests

5.8.1 Types 1 and 2 descending devices

5.8.1.1 Carry out the tests after testing to 5.6. Use the same descending device and descent line as those used in 5.6 and follow the manufacturer's instructions. Carry out the tests

a) at the maximum descent height specified by the manufacturer at an appropriate place agreed between the test house and the manufacturer; if the descending device is a bi-directional device, carry out the test in both directions;

b) with the descending device and descent line generally conditioned (see 4.15.2);

c) with the following test loads:

1) a mass equivalent to the maximum rated load plus 25 %;

2) $\left(30\ ^{+0,5}_{0}\right)$ kg or a mass equivalent to the minimum rated load, whichever is less.

5.8.1.2 Carry out the descent vertically from the top to the bottom of the descent line, with the descent velocity as constant as possible. For type 2 descending devices, by agreement between the test house and the manufacturer and after confirming by assessment that the results are unlikely to be affected, it is permitted to attach the descending device to the structure rather than to the person in order to avoid a person having to descend during the function test.

NOTE It is highly advisable that, if a person carries out the function test by accompanying the descending device during the descent, he/she be protected against a fall in case there is a failure of the descending device and/or the descent line.

5.8.1.3 Confirm that the requirements of 4.13.1 are met.

5.8.1.4 Repeat the test with the descending device and descent line conditioned to wet (see 4.15.3). Confirm that the requirements of 4.13.1 are met.

5.8.1.5 If the manufacturer claims that the descending device and descent line can be used in the temperature range between −4 °C and +2 °C, repeat the test with the descending device and descent line conditioned to wet and cold (see 4.15.4). Confirm that the requirements of 4.13.1 are met.

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5.8.2 Types 2, 3, 4, 5 and 6 descending devices that normally travel with the user

5.8.2.1 Test set-up

If the design of the descending device is such that it normally travels with the user during a descent, attach the up-line end of the descent line to the anchor point on the test apparatus so that the descent line is suspended vertically (see Figure 15). If the descending device is intended to accept a range of diameters of descent line, use the minimum diameter of descent line as marked on the descending device in accordance with point i) of Clause 6. If the descending device is not already attached to the descent line, attach the descending device to the descent line in accordance with the information supplied by the manufacturer. Restrain the descending device so that it cannot move along the descent line until the test commences. Attach a mass equivalent to the maximum rated load to the descending device via the descending device attachment element. Carry out the tests first with the descent line in the general condition (see 4.15.2).

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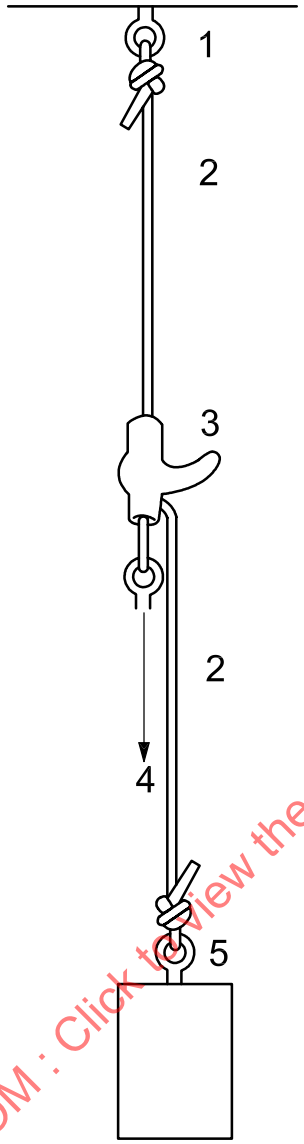

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Key

1 anchor point
2 descent line
3 descending device
4 maximum rated load
5 mass

NOTE For descending devices controlled by the tail of the descent line, the mass is (20 ± 0,25) kg. For descending devices not controlled by the tail of the descent line, the mass is (1 ± 0,25) kg (removed after marking of the descent line).

Figure 15 — Function test for types 2, 3, 4, 5 and 6 descending devices that travel with the user

5.8.2.2 Descending devices that are intended to be controlled manually by the tail of the descent line

5.8.2.2.1 For type 2 descending devices that incorporate a hands-free locking feature and for types 3 and 4 descending devices, allow the descent control element to adopt its hands-free locked position if it is going to be operated by a person during the test or, if it is not going to be operated by a person during the test, fix the descent control element by any suitable means in its fully open (minimum friction) position. In each case, take into account any specific instructions from the manufacturer relating to the diameter of the descent line.

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5.8.2.2.2 For type 2 descending devices that do not incorporate a hands-free locking feature and for types 5 and 6 descending devices, set the descent line in the descending device to the minimum friction configuration in accordance with the information supplied by the manufacturer, taking into account any specific instructions from the manufacturer relating to the diameter of the descent line.

5.8.2.2.3 Attach a mass of (20 ± 0,25) kg to the end of the descent line at a distance of (1 500 ± 100) mm beneath the descending device. Ensure that the test mass attached to the descending device does not interfere with the descent line. Place a mark at any point on the descending device. Mark the descent line at (250 ± 5) mm below the mark on the descending device. Place another mark on the descent line (500 ± 5) mm below the first mark on the descent line. Ensure that at all times during the test procedure the mass is suspended from the descent line.

5.8.2.2.4 Within 30 s of marking the descent line, remove any restraint placed earlier to stop movement of the descending device down the descent line. For type 2 descending devices that incorporate a hands-free locking feature and for types 3 and 4 descending devices, if the descent control element is to be operated by a person, operate it so that the maximum speed is obtained (e.g. with the descent control element in the fully open position). For all types of descending device, do not grip or hold the descent line.

5.8.2.2.5 Observe any movement of the descending device along the descent line and record the time taken for the mark on the descending device to pass between the two marks on the descent line. The distance between the mark on the descending device and the first mark (at 250 mm) on the descent line is used to allow the descending device or operator to settle in and is not part of the test. Confirm that the requirements of 4.13.2.1 are met.

5.8.2.2.6 Repeat the test with the descending device and descent line conditioned to wet (see 4.15.3). Confirm that the requirements of 4.13.2.1 are met.

5.8.2.2.7 If the manufacturer claims that the descending device and descent line can be used in the temperature range between −4 °C and +2 °C, repeat the test with the descending device and descent line conditioned to wet and cold (see 4.15.4). Confirm that the requirements of 4.13.2.1 are met.

5.8.2.3 Descending devices that are normally not intended to be controlled manually by the tail of the descent line

5.8.2.3.1 For type 2 descending devices that incorporate a hands-free locking feature and for types 3 and 4 descending devices, fix the descent control element by any suitable means in its fully open (minimum friction) position, taking into account any specific instructions from the manufacturer relating to the diameter of the descent line.

5.8.2.3.2 For type 2 descending devices that do not incorporate a hands-free locking feature and for types 5 and 6 descending devices, set the descent line in the descending device to the minimum friction configuration in accordance with the information supplied by the manufacturer, taking into account any specific instructions from the manufacturer relating to the diameter of the descent line.

5.8.2.3.3 Attach a mass of (1 ± 0,25) kg to the end of the descent line at a distance of (4 700 ± 100) mm beneath the descending device. Place a mark at any point on the descending device. Mark the descent line at (250 ± 5) mm below the mark on the descending device. Place another mark on the descent line (4000 ± 20) mm below the first mark on the descent line. Remove the 1 kg mass from the descent line. Ensure that the test mass attached to the descending device does not interfere with the descent line. Ensure that at all times during the test procedure the mass is suspended from the descent line.

5.8.2.3.4 Within 2 min of marking the descent line, remove any restraint placed earlier to stop movement of the descending device down the descent line. Do not grip or hold the descent line.

5.8.2.3.5 Observe any movement of the descending device along the descent line and record the time taken for the mark on the descending device to pass between the two marks on the descent line. The distance between the mark on the descending device and the first mark (at 250 mm) on the descent line is used to allow the descending device to settle in and is not part of the test. Confirm that the requirements of 4.13.2.2 are met.

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5.8.2.3.6 Repeat the test with the descending device and descent line conditioned to wet (see 4.15.3). Confirm that the requirements of 4.13.2.2 are met.

5.8.2.3.7 If the manufacturer claims that the descending device and descent line can be used in the temperature range between –4 °C and +2 °C, repeat the test with the descending device and descent line conditioned to wet and cold (see 4.15.4). Confirm that the requirements of 4.13.2.2 are met.

5.8.3 Types 2, 3, 4, 5 and 6 descending devices that normally do not travel with the user

5.8.3.1 Test set-up

For descending devices that normally do not travel with the user during a descent, if the descending device is not already attached to the descent line, attach the descending device to the descent line in accordance with the information supplied by the manufacturer. If the descending device is intended to accept a range of diameters of descent line, use the minimum diameter of descent line as marked on the descending device in accordance with point i) of Clause 6. Attach the descending device by its attachment element to the anchor point of the test apparatus, using an appropriate connector. Restrain the descent line so that it cannot move through the descending device until the test commences. Attach a mass equivalent to the maximum rated load to the down-line end of the descent line (see Figure 16).

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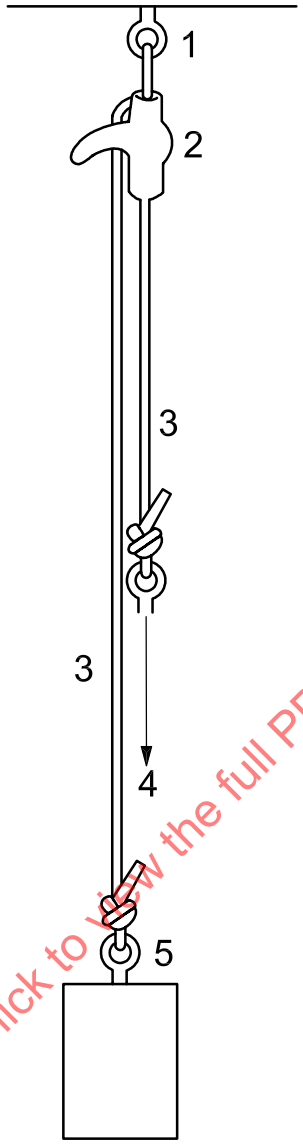

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Key

1 anchor point
2 descending device
3 descent line
4 maximum rated load
5 mass

NOTE For descending devices controlled by the tail of the descent line, the mass is (20 ± 0,25) kg. For descending devices not controlled by the tail of the descent line, the mass is (1 ± 0,25) kg (removed after marking of the descent line).

Figure 16 — Function test for types 2, 3, 4, 5 and 6 descending devices that do not travel with the user

5.8.3.2 Descending devices that are intended to be controlled manually by the tail of the descent line

5.8.3.2.1 For type 2 descending devices that incorporate a hands-free locking feature and for types 3 and 4 descending devices, allow the descent control element to adopt its hands-free locked position, if it is going to be operated by a person during the test or, if it is not going to be operated by a person during the test, fix the descent control element by any suitable means in its fully open (minimum friction) position. In each case, take into account any specific instructions from the manufacturer relating to the diameter of the descent line.

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5.8.3.2.2 For type 2 descending devices that do not incorporate a hands-free locking feature and for types 5 and 6 descending devices, set the descent line in the descending device to the minimum friction configuration in accordance with the information supplied by the manufacturer, taking into account any specific instructions from the manufacturer relating to the diameter of the descent line.

5.8.3.2.3 Attach a mass of (20 ± 0,25) kg to the up-line end of the descent line at a distance of (1 500 ± 100) mm from the descending device. Ensure that the test mass attached to the descent line does not interfere with the descending device. Place a mark at any point on the descending device. Mark the up-line descent line at (250 ± 5) mm below the mark on the descending device. Place another mark on the descent line (500 ± 5) mm below the first mark on the descent line. Ensure that at all times during the test procedure the mass is suspended from the descent line.

5.8.3.2.4 Within 30 s of marking the descent line, remove any restraint placed earlier to stop movement of the mass representing the maximum rated load. For type 2 descending devices that incorporate a hands-free locking feature and for types 3 and 4 descending devices, if the descent control element is to be operated by a person, operate the control element of the descending device so that the maximum speed is obtained (e.g. with the descent control element in the fully open position). For all types of descending device, do not grip or hold the descent line.

5.8.3.2.5 Observe any movement of the descent line through the descending device and record the time taken for the distance between the first and second marks on the descent line to pass the mark on the descending device. The distance between the mark on the descending device and the first mark (at 250 mm) on the descent line is used to allow the descending device or operator to settle in and is not part of the test. Confirm that the requirements of 4.13.2.3 are met.

5.8.3.2.6 Repeat the test with the descending device and descent line conditioned to wet (see 4.15.3). Confirm that the requirements of 4.13.2.3 are met.

5.8.3.2.7 If the manufacturer claims that the descending device and descent line can be used in the temperature range between −4 °C and +2 °C, repeat the test with the descending device and descent line conditioned to wet and cold (see 4.15.4). Confirm that the requirements of 4.13.2.3 are met.

5.8.3.3 Descending devices that are normally not intended to be controlled manually by the tail of the descent line

5.8.3.3.1 For type 2 descending devices that incorporate a hands-free locking feature and for types 3 and 4 descending devices, fix the descent control element by any suitable means in its fully open (minimum friction) position, taking into account any specific instructions from the manufacturer relating to the diameter of the descent line.

5.8.3.3.2 For type 2 descending devices that do not incorporate a hands-free locking feature and for types 5 and 6 descending devices, set the descent line in the descending device to the minimum friction configuration in accordance with the information supplied by the manufacturer, taking into account any specific instructions from the manufacturer relating to the diameter of the descent line.

5.8.3.3.3 Attach a mass of (1 ± 0,25) kg to the up-line end of the descent line at a distance of (4 700 ± 100) mm from the descending device. Place a mark at any point on the descending device. Mark the up-line descent line at (250 ± 5) mm below the mark on the descending device. Place another mark on the descent line (4 000 ± 20) mm below the first mark on the descent line. Remove the 1 kg mass from the descent line. Ensure that the test mass attached to the descent line does not interfere with the descending device. Ensure that at all times during the test procedure the mass is suspended from the descent line.

5.8.3.3.4 Within 2 min of marking the descent line, remove any restraint placed earlier to stop movement of the descent line through the descending device. Do not grip or hold the descent line.

5.8.3.3.5 Observe any movement of the descent line through the descending device and record the time taken for the distance between the first and second marks on the descent line to pass the mark on the descending device The distance between the mark on the descending device and the first mark (at 250 mm)

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