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Personal fall-arrest systems —

Part 4: Vertical rails and vertical lifelines incorporating a sliding-type fall arrester

Systèmes individuels d'arrêt de chute —

Partie 4: Rails et cordes d'assurance verticaux incorporant un dispositif d'arrêt de type coulissant

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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 3.

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 part of ISO 10333 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10333-4 was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 4, *Personal equipment for protection against falls*.

ISO 10333 consists of the following parts, under the general title *Personal fall-arrest systems*:

— *Part 1: Full-body harnesses*

— *Part 2: Lanyards and energy absorbers*

— *Part 3: Self-retracting lifelines*

— *Part 4: Vertical rails and vertical lifelines incorporating a sliding-type fall arrester*

— *Part 5: Connectors with self-closing and self-locking gates*

Systems performance tests will be the subject of a future part 6 to ISO 10333.

Annex A forms a normative part of this part of ISO 10333.

Introduction

In cases where the hazard of falling from a height exists and where, for technical reasons or for work of very short duration, safe access cannot be otherwise provided, it is necessary to consider the use of personal fall-arrest systems (PFAS). Such use should never be improvised and its adoption should be specifically provided for in the appropriate formal provisions for safety in the work place.

PFAS complying with this part of ISO 10333 should satisfy ergonomic requirements and should only be used if the work allows means of connection to a suitable anchor device of demonstrated strength and if it can be implemented without compromising the safety of the user. Personnel should be trained and instructed in the safe use of the equipment and be observant of such training and instruction.

This part of ISO 10333 is based on current knowledge and practice concerning the use of PFAS that incorporate a full-body harness as specified in ISO 10333-1.

This part of ISO 10333 presumes that the manufacturer of the PFAS, 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 9000, *Quality management systems — Fundamentals and vocabulary*.

Personal fall-arrest systems —

Part 4: Vertical rails and vertical lifelines incorporating a sliding-type fall arrester

1 Scope

This part of ISO 10333 specifies requirements, test methods, instructions for use and maintenance, marking, labelling and packaging, as appropriate, for vertical rails and vertical lifelines which incorporate a sliding-type fall arrester.

When connected to a full-body harness as specified in ISO 10333-1, vertical rails and vertical lifelines which incorporate a sliding-type fall arrester constitute a personal fall-arrest system (PFAS), which will be specified in a future International Standard.

Vertical rails and vertical lifelines which incorporate a sliding-type fall arrester in accordance with this part of ISO 10333 are limited to use by a single person of total mass not exceeding 100 kg.

NOTE 1 Users of PFAS whose total mass (which includes attached tools and equipment) exceeds 100 kg are advised to seek advice from the equipment manufacturers regarding the suitability of the equipment, which may need additional testing.

NOTE 2 PFAS using vertical rails and permanent vertical lifelines inherently limit the user's horizontal movement, whereas PFAS using a temporary vertical lifeline permit significant horizontal movement by the user. Special notice should be given to the requirements which accommodate this difference.

The scope of this part of ISO 10333 does not extend to:

a) inclined rails and lifelines, i.e. those which are installed at an angle between the true vertical and the lifeline or rail of more than 15° when viewed from the side elevation;

b) the horizontally installed elements of compound rails or lifelines, i.e. those which have both vertically and horizontally installed elements linked by junctions.

This part of ISO 10333 does not specify those additional requirements that would apply when PFAS are subjected to special conditions of use (where, for example, there exist unusual limitations concerning access to the place of work and/or particular environmental factors). Thus treatments to ensure the durability of the materials of construction (such as heat treatment, anti-corrosion treatment, protection against physical and chemical hazards) are not specified in this part of ISO 10333, but should comply with appropriate International Standards or, failing that, with national standards or other specifications dealing with relevant physical characteristics and/or the safety of users.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10333. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 10333 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1140:1990, *Ropes — Polyamide — Specification*

ISO 1141:1990, *Ropes — Polyester — Specification*

ISO 9227:1990, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 10333-1:2000, *Personal fall-arrest systems — Part 1: Full-body harnesses*

ISO 10333-5:2001, *Personal fall-arrest systems — Part 5: Connectors with self-closing and self-locking gates*

ISO 14567:1999, *Personal protective equipment for protection against falls from a height — Single-point anchor devices*

EN 892:1996, *Mountaineering equipment — Dynamic mountaineering ropes — Safety requirements and test methods*

EN 1891:1998, *Personal protective equipment for prevention of falls from a height — Low stretch kernmantel ropes*

3 Terms and definitions

For the purposes of this part of ISO 10333, the following terms and definitions apply.

3.1
vertical rail
rigid track which is permanently fastened by a number of brackets at intervals along its length to a fixed ladder or other structure, and to which a sliding-type fall arrester can be attached

See Figure 1.

NOTE The rail may consist of a number of sections held together by joining plates.

3.2 Vertical lifelines

3.2.1
vertical lifeline
flexible line which is either permanently or temporarily installed

3.2.2
permanent vertical lifeline
tensioned line which is permanently fastened to at least one position at its upper end, to act as a reliable anchor point

See Figure 2.

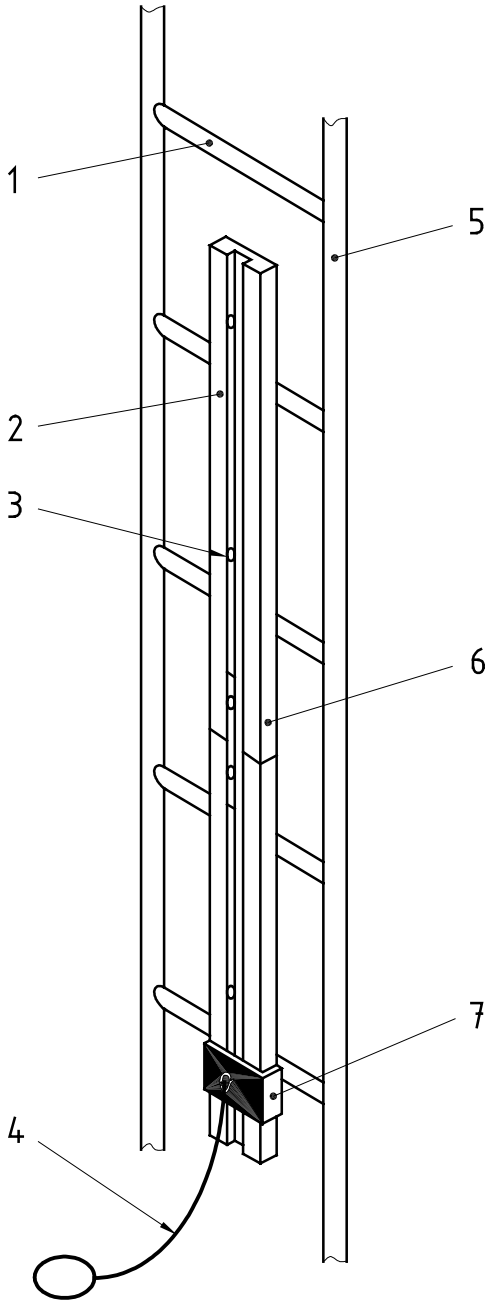
NOTE 1 It is permanently fastened to a position at its lower extremity to a fixed ladder or other structure, to which a sliding-type fall arrester can be attached.

NOTE 2 The permanent vertical lifeline may additionally be attached to the fixed ladder or other structure at a number of locations at intervals along its length.

3.2.3
temporary vertical lifeline
suspended line, which is temporarily fastened at its upper extremity to an overhead anchoring point, to which a sliding-type fall arrester can be attached

See Figure 3.

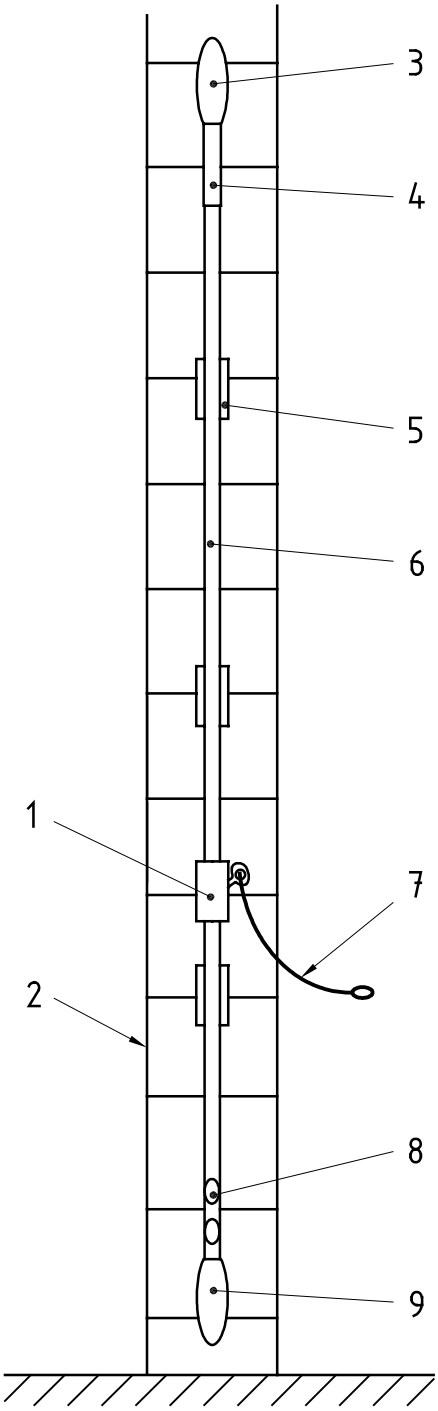
NOTE The temporary vertical lifeline may have a small weight fitted to the lower extremity to keep a nominal amount of tension in the line.



Key

1 Rung
2 Rail
3 Intermediate fastening to rung
4 Connecting line
5 Permanently installed ladder
6 Joint between rail sections
7 Sliding-type fall arrester

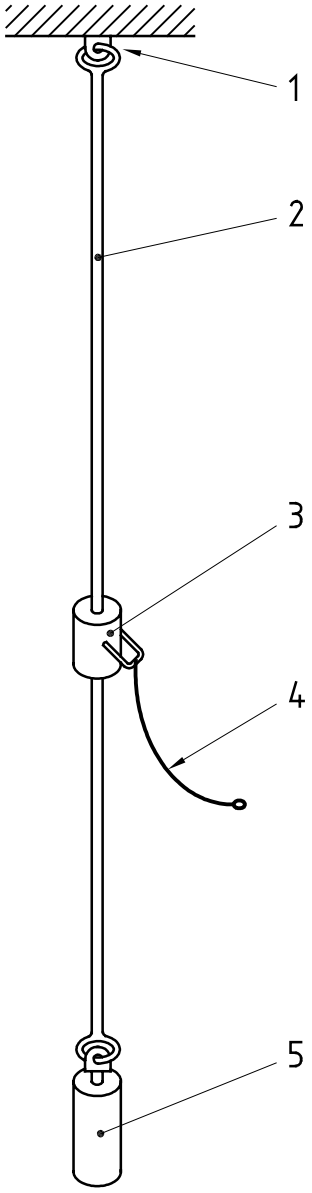
Figure 1 — Example of a vertical rail



Key

1 Sliding-type fall arrester
2 Permanently installed ladder
3 Upper fastening
4 Vertical-lifeline energy absorber
5 Intermediate fastening to rung
6 Lifeline
7 Connecting line
8 Tensioning device
9 Lower fastening

Figure 2 — Example of a permanent vertical lifeline



Key

1 Overhead anchoring point
2 Lifeline
3 Sliding-type fall arrester
4 Connecting line
5 Tensioning mass

Figure 3 — Example of a temporary vertical lifeline

3.3
sliding-type fall arrester
device which is designed to be attached to and to slide up and down the vertical rail or vertical lifeline in response to climbing movements, but locks automatically onto the vertical rail or vertical lifeline in response to the sudden motion of a fall

3.4 Connecting-line definitions

3.4.1
connecting line
line, attached to the sliding-type fall arrester, which is designed to link the sliding-type fall arrester to a fall-arrest attachment point on the full-body harness

NOTE The connecting line may be a lanyard, an energy absorber, a connector, or any combination of lanyard, energy absorber and connector.

3.4.2
connecting-line length
shortest distance measured between the bearing point of one connecting-line extremity to the other, with the connecting line held taut

3.4.3
lanyard
finished length of flexible material which may be utilized as a part or the whole of the connecting line

3.4.4
connecting-line energy absorber
component which may be utilized as a part or the whole of the connecting line, which is designed to dissipate the kinetic energy generated during a fall, and which limits the arresting forces exerted on the vertical rail or vertical lifeline and faller

3.4.5
connector
component which may be utilized as a part or the whole of the connecting line, and which is used to link the connecting line to the fall-arrest attachment point on the full-body harness

3.5
anchor connector
component which is used to connect a temporary vertical lifeline directly to an overhead anchoring point

3.6
vertical-lifeline energy absorber
component which may or may not be included at the upper fastening point of a permanent vertical lifeline, or at the overhead anchoring point of a temporary vertical lifeline, designed to dissipate the kinetic energy generated during a fall and limit the arresting forces exerted on the lifeline, upper fastening/anchoring point and faller

3.7
opening point
specially designed point on a vertical rail or permanent vertical lifeline, other than the extremities, where a sliding-type fall arrester may be attached or detached

3.8
opening device
device on a sliding-type fall arrester which allows the arrester to be attached and detached at any intermediate point on a vertical rail or vertical lifeline

3.9
post-fall arrest suspension
state in which, after having being brought to a complete stop by a fall-arresting means, the faller remains suspended in the full-body harness

3.10
total mass
sum of the user's mass and all attached clothing and equipment

3.11
minimum locking-test mass
smallest mass, to the nearest whole kilogram, which, when attached to the raised free end of the connecting line and then released, will cause the fall arrester to lock on to the vertical rail or vertical lifeline and stay locked

3.12 General definitions

3.12.1
component
constituent part of a PFAS or subsystem that has completed the manufacturer's production cycle and is available for purchase

3.12.2
subsystem
constituent part of a PFAS which may consist of one or more components, and is used to connect the user from the fall-arrest attachment element of the full-body harness to the anchor device

NOTE A subsystem performs the two essential functions of

a) connecting;

b) fall arrest and energy absorption.

3.12.3
personal fall-arrest system
PFAS
assembly of components and subsystems, including a full-body harness worn by the user, which when linked together in series and when connected to a suitable anchor device will arrest a fall from a height

NOTE A PFAS minimizes the fall-arrest forces, controls the total fall distance to prevent collision with the ground or other obstruction, and maintains the user in a suitable post-fall arrest suspension attitude for rescue purposes.

4 Requirements

4.1 General

4.1.1 The design of working parts, their location and the protection afforded to them shall be such as to prevent the possibility of performance being impaired by casual interference.

4.1.2 The working parts shall be smoothly finished and free from defects due to faulty material and manufacture; there shall be no sharp or rough edges that may cut, abrade or otherwise damage material or cause injury to the user.

4.1.3 The anchor point for a temporary vertical lifeline shall comply with ISO 14567.

4.2 Requirements for vertical rails

4.2.1 Rail design

A vertical rail shall be so designed as to:

a) be capable of being fastened to a ladder or other structure by a number of brackets at intervals as recommended by the manufacturer's installation instructions;

b) enable the sliding-type fall arrester to be attached and detached at least at the two extremities of the rail length, unless the sliding-type fall arrester is designed to be integral with the rail;

c) permit movement of the sliding-type fall arrester in an upward and a downward direction without impeding movement, especially at joints and at intermediate fastenings;

d) prevent unintentional separation of the sliding-type fall arrester from the rail.

4.2.2 Attachment and detachment points for the sliding-type fall arrester

4.2.2.1 Where utilized as attachment and detachment points for a sliding-type fall arrester, the upper and lower extremities of the rail span shall be fitted with an end stop to prevent the sliding-type fall arrester from running off the rail unintentionally.

4.2.2.2 Where opening points are in place between the upper and lower extremities of the rail span, they shall be so designed that they can only be opened by at least two consecutive deliberate manual actions. Upon closing, the point shall be designed to be automatically locked in place by the engagement of a locking device, and so that, in normal use, the sliding-type fall arrester cannot become unintentionally separated from the rail.

4.3 Requirements for permanent vertical lifelines

4.3.1 Design

A permanent vertical lifeline shall be so designed as to:

a) be capable of being fastened to a ladder or other structure at the upper and lower extremity and additionally, if required, by a number of brackets at intervals as recommended by the manufacturer's installation instructions;

b) once installed, be capable of being tensioned as recommended by the manufacturer's installation instructions;

c) enable the sliding-type fall arrester to be attached and detached at points along the lifeline unless the sliding-type fall arrester is designed to be integral;

d) permit movement of the sliding-type fall arrester in an upward and a downward direction without impeding movement, especially at intermediate fastenings;

e) prevent unintentional separation of the fall arrester from the lifeline.

4.3.2 Attachment and detachment points for the sliding-type fall arrester

Where opening points are in place between the upper and lower extremities of the lifeline, they shall be so designed that they can only be opened by at least two consecutive deliberate manual actions. Upon closing, the point shall be designed to be automatically locked in place by the engagement of a locking device so that, in normal use, the sliding-type fall arrester cannot become unintentionally separated from the lifeline.

4.4 Requirements for temporary vertical lifelines

A temporary vertical lifeline shall be so designed as to:

a) be capable of being fastened to an overhead anchoring point in accordance with the manufacturer's installation instructions;

b) enable the sliding-type fall arrester to be attached and detached at least at the lower extremity of the lifeline, unless the sliding-type fall arrester is designed to be integral;

c) permit movement of the sliding-type fall arrester in an upward and a downward direction, without impeding movement;

d) prevent unintentional separation of the fall arrester from the lifeline;

e) be capable of being fitted with a tensioning weight or other stabilizing means at the lower extremity.

4.5 Vertical-lifeline materials and construction

4.5.1 Fibre ropes and webbing

4.5.1.1 Fibre ropes, webbing and sewing threads for lifelines shall be made from virgin filament or multi-filament synthetic fibre or fibres suitable for the intended use. The breaking strength of the synthetic fibres shall be known to be at least 0,6 N/tex.

4.5.1.2 The number of strands of a laid lifeline shall be at least three. Three-strand polyamide lifelines shall comply with ISO 1140, three-strand polyester lifelines with ISO 1141.

4.5.1.3 Lifelines constructed from braided rope shall comply with EN 892 (single rope) or EN 1891, type A. Any equivalent material is acceptable.

4.5.1.4 Where lifelines are specified for, or when it is known that lifelines will be used in, work carried out near welding or oxy-cutting stations, or heat sources, they shall be protected by suitable heat-protective means.

4.5.2 Wire ropes

The minimum diameter of wire rope material used in the construction of lifelines shall be 8 mm.

4.5.3 Terminations

4.5.3.1 Eye splices in laid fibre rope shall consist of four tucks using all the yarns in the strands and two tapered tucks. The length of the splicing tails emerging after the last tuck shall be at least one rope diameter. Tails shall be whipped to the rope and protected with a rubber or plastic sleeve, or otherwise integrally finished to prevent the termination or splice from unravelling. Sealing compounds used shall be compatible with the rope material. Eyes shall be formed around a plastic or metal thimble of size and strength in accordance with the rope manufacturer's recommendations.

4.5.3.2 Stitched eye terminations on webbing lifelines shall be sewn using lock stitching. Thread shall be compatible with the webbing material and shall be a contrasting colour to facilitate inspection. Reinforcement or another method shall be used to protect terminations from concentrated wear at all webbing to metal fitting interfaces. Webbing ends shall be seared or otherwise prevented from unravelling.

4.5.3.3 Eye terminations of wire rope lifelines shall be manufactured with:

a) either a spliced eye with one compression swage with thimble;

b) or a return eye with a minimum of two compression swages with thimble.

4.5.3.4 Selection of swage fitting, size, material type, compression die size/pressure, position of swage(s) on rope, and thimble size, shall be done in accordance with the rope manufacturer's recommendations. In particular, aluminium swages are recommended for steel wire ropes and copper swages for stainless steel wire ropes.

4.5.3.5 Wire rope ends shall be brazed, whipped or have an equivalent finish to prevent unravelling. Brazing shall be carried out prior to forming the eye.

4.5.3.6 Knots shall not be used to form lifeline terminations, unless these terminations are permanent, sealed and made by the manufacturer. The minimum tensile strength of such a termination shall be in accordance with 4.14.1.

4.6 Vertical-lifeline energy absorbers

4.6.1 Materials and mechanisms for vertical-lifeline energy absorbers shall be protected from external contaminants, sharp objects and adverse climate by a protective cover.

4.6.2 Where energy absorbers are specified for, or when it is known that energy absorbers will be used in, work carried out near welding or oxy-cutting stations, or heat sources, they shall be protected by suitable heat-protective means.

4.7 Sliding-type fall arrester requirements

4.7.1 Design

4.7.1.1 The sliding-type fall arrester shall incorporate an automatic locking feature which is capable of preventing further plummeting of the arrester down the vertical rail or vertical lifeline during a fall by engaging a braking device. The automatic locking function shall not rely solely on inertia sensing.

4.7.1.2 Sliding-type fall arresters shall be capable of locking onto the vertical lifeline irrespective of whether the lifeline is tight or slack.

4.7.1.3 If the sliding-type fall arrester has a manual locking feature, the design shall be such that it shall not be possible for the automatic locking function to be overridden.

4.7.1.4 If the sliding-type fall arrester is equipped with an opening device, it shall be designed so that it can only be detached from the vertical rail or vertical lifeline by at least two consecutive deliberate manual actions. Upon engaging the vertical rail or vertical lifeline, the opening device shall be designed to become automatically locked by the activation of a locking device so that, in normal use, the sliding-type fall arrester cannot become unintentionally separated from the vertical rail or vertical lifeline.

4.7.1.5 If the sliding-type fall arrester is capable of being attached to the vertical rail or vertical lifeline upside down in error, at either extremity, or at any other point on the vertical rail or vertical lifeline such that the automatic arrest function becomes impaired or disabled, then the sliding-type fall arrester or vertical rail or vertical lifeline shall be so designed to prevent this possibility, or the arrester shall be clearly marked to warn the climber of this danger.

4.7.2 Requirements for connecting lines

4.7.2.1 Connecting-line length

The connecting-line length for vertical rails and permanent vertical-lifeline systems shall not exceed 23 cm. The connecting-line length for temporary vertical-lifeline systems shall not exceed 1,0 m.

4.7.2.2 Materials and construction

Fibre ropes, webbing and sewing threads for connecting lines shall comply with 4.5.1. Terminations shall comply with 4.5.3.

4.7.2.3 Connecting-line energy absorbers

4.7.2.3.1 Materials and mechanisms for connecting-line energy absorbers shall be protected from external contaminants, sharp objects and adverse climate by a protective cover.

4.7.2.3.2 Where energy absorbers are specified for, or when it is known that energy absorbers will be used in, work carried out near welding or oxy-cutting stations, or heat sources, they shall be protected by suitable heat-protective means.

4.8 Requirements for connectors

Where connectors can be removed without the use of a tool, they shall meet the requirements of ISO 10333-5:2001. Where connectors require the use of a tool for removal, they shall meet the requirement of 4.3 (static strength) and 4.4 (corrosion resistance) of ISO 10333-5:2001.

4.9 Corrosion resistance

4.9.1 When tested in accordance with 5.2.1, all metallic materials shall be free from corrosion of the base metal, as visible to the unaided eye. A sliding-type fall arrester shall not show signs of corrosion that could affect the automatic locking function. Where necessary to gain access to internal elements, the device shall be dismantled in accordance with the manufacturer's instructions. The post-test presence of white scale or tarnishing is acceptable.

4.9.2 Repeat tests shall be carried out for each type/size of rail or lifeline specified for use with the sliding-type fall arrester.

4.10 Locking performance after conditioning

4.10.1 A section of vertical rail or vertical lifeline including the sliding-type fall arrester shall be heat conditioned in accordance with 5.2.2.2, after which the arrester shall lock without subsequent slippage, and shall be capable of being unlocked when tested in accordance with 5.2.2.7.

4.10.2 A section of vertical rail or vertical lifeline including the sliding-type fall arrester shall be cold conditioned in accordance with 5.2.2.3, after which the arrester shall lock without subsequent slippage, and shall be capable of being unlocked when tested in accordance with 5.2.2.7.

4.10.3 A section of vertical rail or vertical lifeline including the sliding-type fall arrester shall be wet spray conditioned in accordance with 5.2.2.4, after which the arrester shall lock without subsequent slippage, and shall be capable of being unlocked when tested in accordance with 5.2.2.7.

4.10.4 A section of vertical rail or vertical lifeline including the sliding-type fall arrester shall be dust conditioned in accordance with 5.2.2.5, after which the arrester shall lock without subsequent slippage, and shall be capable of being unlocked when tested in accordance with 5.2.2.7.

4.10.5 A section of vertical rail or vertical lifeline (excluding the sliding-type fall arrester) shall be oil conditioned in accordance with 5.2.2.6, after which it shall lock without subsequent slippage, and shall be capable of being unlocked when tested in accordance with 5.2.2.7.

4.10.6 Repeat tests of 4.10.1 to 4.10.5 shall be carried out for each type/size of rail or lifeline specified for use with the sliding-type fall arrester.

4.11 Locking reliability

4.11.1 When tested in accordance with 5.2.3, the vertical rail or vertical lifeline including the sliding-type fall arrester shall lock without subsequent slippage in each of 1 000 operations.

4.11.2 Repeat tests of 4.11.1 shall be carried out for each type/size of rail or lifeline specified for use with the sliding-type fall arrester.

4.12 Dynamic performance

4.12.1 A vertical rail or vertical lifeline including a sliding-type fall arrester and its connecting line shall be incorporated into a full PFAS for the purpose of dynamic performance testing.

4.12.2 When tested in accordance with annex A:

a) a system including any vertical rail or vertical lifeline shall have a maximum arrest force of 6 kN;

b) a system including a vertical rail or permanent vertical lifeline shall have a recorded fall distance H_D not exceeding 1,5 m;

c) a system including a temporary vertical lifeline shall have a recorded fall distance H_D not exceeding 2,0 m;

In each case, with the torso test mass in the drop position there shall not be:

d) tearing, rupture or fracture of any component (except where such tearing is designed to contribute to energy dissipation);

e) partial or inadvertent opening of any connector gate.

4.13 Tensile strength of vertical rails

4.13.1 When tested in accordance with 5.2.4, the vertical rail, sliding-type fall arrester and connecting line shall sustain a force of 15 kN, and, with the exception of energy-dissipating devices, without tearing or rupture of any part.

4.13.2 Repeat tests of 4.13.1 shall be carried out for each type/size of vertical rail specified for use with the sliding-type fall arrester.

4.14 Tensile strength of vertical lifelines

4.14.1 When tested in accordance with 5.2.4, the vertical lifeline, sliding-type fall arrester and connecting line shall sustain a force as described in Table 1 and, with the exception of energy-dissipating devices, without tearing or rupture of any part.

4.14.2 Repeat tests of 4.14.1 shall be carried out for each type/size of vertical lifeline specified for use with the sliding-type fall arrester.

Table 1 — Test forces for vertical lifeline (VLL)

Type	Force exerted kN
Wire-rope-based VLL	15
Fibre-rope-based VLL	22
Webbing-based VLL	22
NOTE The higher strength requirement for textile materials is necessary as these materials are more prone to wear and are more vulnerable to damage than their metallic counterparts.	

5 Apparatus and test methods

5.1 Apparatus

5.1.1 Tensile test apparatus

A test frame, winch or hydraulic puller and load indicator is required, with sufficient traverse to load the components under test.

5.1.2 Test masses

A range of steel masses from 5 kg to 10 kg in 1 kg increments is required, as appropriate to the particular test, rigidly connected to an eyebolt which provides a secure connection point.

5.1.3 Apparatus for corrosion-resistance test

The apparatus shall be capable of performing the neutral salt spray test procedure described in ISO 9227.

5.1.4 Apparatus for conditioning tests

5.1.4.1 Heat

The chamber shall be capable of control at (40 ± 2) °C at a relative humidity of (85 ± 5) %.

5.1.4.2 Cold

The refrigerated chamber shall be capable of control at (– 30 ± 2) °C.

5.1.4.3 Wet spray

The water spray apparatus shall be capable of delivering the rate of approximately 70 l/h within a temperature range of 10 °C to 30 °C.

5.1.4.4 Dust

The apparatus shall consist of a box of 1 m^3 internal capacity with provision for agitating dust with blasts of air from a 6 bar supply. The box shall be provided with a vent and air filter. There shall also be a provision for a cord to be passed vertically through the top of the box for operation of the mechanism under test.

5.1.5 Apparatus for locking reliability test

The apparatus shall be capable of repeatedly locking and unlocking the sliding-type fall arrester in each of 1 000 operations, under the gravitational acceleration of a falling mass.

5.2 Test methods

NOTE A new specimen may be supplied for each test.

5.2.1 Corrosion-resistance test

5.2.1.1 The apparatus shall comply with 5.1.3.

5.2.1.2 Where made from metal, a sample of vertical rail or vertical lifeline, sliding-type fall arrester and fastening brackets shall be submitted to the neutral salt spray test in accordance with ISO 9227 for an initial exposure of 24 h, followed by 1 h of drying, followed by a second exposure of 24 h.

5.2.1.3 After the test, if necessary dismantled in accordance with manufacturer's instructions, the items shall be examined for evidence of corrosion against the criteria in 4.9.

5.2.2 Locking tests after conditioning

5.2.2.1 Establishing the size of the locking-test mass

5.2.2.1.1 Temporarily fasten a 1,0 m section of vertical rail or vertical lifeline to a suitable structure and attach the sliding-type fall arrester. Connect a 5 kg test mass to the free end of the connecting line. Manually raise the mass by its eyebolt so that the arrester is pulled to a position high up on the section. With the mass at its highest position relative to the arrester, allow it to fall and observe to see if it is arrested.

5.2.2.1.2 In the distance available, the 5 kg mass may be insufficient to activate the sliding-type fall arrester locking mechanism, or the mass may bounce several times before being finally arrested. In such cases, increase the test mass by increments of 1 kg, until the arrester successfully arrests the mass. In no case shall the test mass exceed 30 kg.

5.2.2.1.3 The established size of locking-test mass shall be used to assess the locking ability in the conditioning tests.

5.2.2.2 Heat conditioning

5.2.2.2.1 The heat-conditioning apparatus shall comply with 5.1.4.1 and the test mass with 5.2.2.1.

5.2.2.2.2 With a sliding-type fall arrester attached, place a 1,0 m section of vertical rail or vertical lifeline in the chamber for a period of 2 h at a temperature of (40 ± 2) °C and a relative humidity of (85 ± 5) %. Remove the items and, before 90 s has elapsed, test with the minimum locking-test mass in accordance with 5.2.2.7.

5.2.2.3 Cold conditioning

5.2.2.3.1 The cold-conditioning apparatus shall comply with 5.1.4.2 and the test mass with 5.2.2.1.

5.2.2.3.2 With a sliding-type fall arrester attached, place a 1,0 m section of vertical rail or vertical lifeline in the chamber for a period of 2 h at a temperature of (– 30 ± 2) °C. Remove the items and, before 90 s has elapsed, test with the minimum locking-test mass in accordance with 5.2.2.7.

5.2.2.4 Wet spray

5.2.2.4.1 The wet-spray-conditioning apparatus shall comply with 5.1.4.3 and the test mass with 5.2.2.1.

5.2.2.4.2 With a sliding-type fall arrester attached, place a 1,0 m section of vertical rail or vertical lifeline in the apparatus, and spray water on it within the temperature range of 10 °C to 30 °C, for 3 h at a rate of approximately 70 l/h. Remove the items and, before 90 s has elapsed, test with the minimum locking-test mass in accordance with 5.2.2.7.

5.2.2.5 Dust

5.2.2.5.1 The dust-conditioning apparatus shall comply with 5.1.4.4 and the test mass with 5.2.2.1.

5.2.2.5.2 With a sliding-type fall arrester attached, secure a 1,0 m section of vertical rail or vertical lifeline in the box so that the section is vertical. Attach a cord to the arrester and insert the cord through the lid of the box, so that the arrester can be raised and lowered on the vertical rail or vertical lifeline with the lid on the box.

5.2.2.5.3 Introduce (4,5 ± 0,5) kg of dry cement on the floor of the box and, at intervals of 5 min, agitate it by projecting blasts of air for a 2 s period in a downward direction. After 1 h, beginning at the same time as an air blast, perform the following movement sequence.

5.2.2.5.4 Raise the arrester as far as the lid will permit, and lower to the floor of the box. Repeat this operation 10 times. Repeat this movement sequence at intervals of 1 h until five such movement sequences have been completed.

5.2.2.5.5 After the final movement sequence, stop the blasts of air. Allow the dust to settle for a minimum of 15 min, and remove the items from the box. Before 90 s has elapsed, test with the minimum locking-test mass in accordance with 5.2.2.7.

5.2.2.6 Oil conditioning

5.2.2.6.1 The test mass shall comply with 5.2.2.1.

5.2.2.6.2 Immerse a 1,0 m section of vertical rail or vertical lifeline (without the sliding-type fall arrester) in commercial-grade diesel oil at a temperature of (20 ± 2) °C for a period of not less than 30 min. Allow the vertical rail or vertical lifeline to hang freely and to drain for 24 h. Within 1 h of the 24 h draining period, test with the minimum locking-test mass in accordance with 5.2.2.7.

5.2.2.7 Locking test

Temporarily fasten a section of vertical rail or vertical lifeline to a suitable structure and attach the sliding-type fall arrester. Connect the minimum locking-test mass as established in 5.2.2.1 to the free end of the connecting line. Manually raise the mass by its eyebolt so that the arrester is pulled to a position high up on the section. With the mass at its highest position relative to the arrester, allow it to fall and observe that the arrester locks and arrests the mass and that the arrester can be unlocked after test.

5.2.3 Locking-reliability test

5.2.3.1 The apparatus shall comply with 5.1.5 and the test mass with 5.2.2.1.

5.2.3.2 With a sliding-type fall arrester attached, secure a section of vertical rail or vertical lifeline in the apparatus so that the section is vertical. Connect the minimum locking-test mass as established in 5.2.2.1 to the free end of the connecting line. Cause the mass to be raised so that the arrester is moved over a minimum distance of 300 mm, and at the end of each movement cause the arrester to lock by allowing the mass to fall.

5.2.3.3 Repeat for a total of 1 000 relative movements. Ensure that the arrester locks on during each movement.

5.2.4 Tensile-strength test

5.2.4.1 The apparatus shall comply with 5.1.1.

5.2.4.2 Fix a section of the vertical rail or vertical lifeline in the vertical plane to a suitable structure as shown in Figure 4, and in accordance with manufacturer's installation instructions. Attach the matching sliding-type fall arrester and is lock it onto the vertical rail or vertical lifeline. If the test specimen is a vertical rail, include a joint as a part of the specimen, and lock the arrester on over the joint.

5.2.4.3 Attach the tensile test apparatus to the free end of the arrester's connecting line as shown so that, when applied, the test force is:

a) reacted against by the locking action of the arrester;

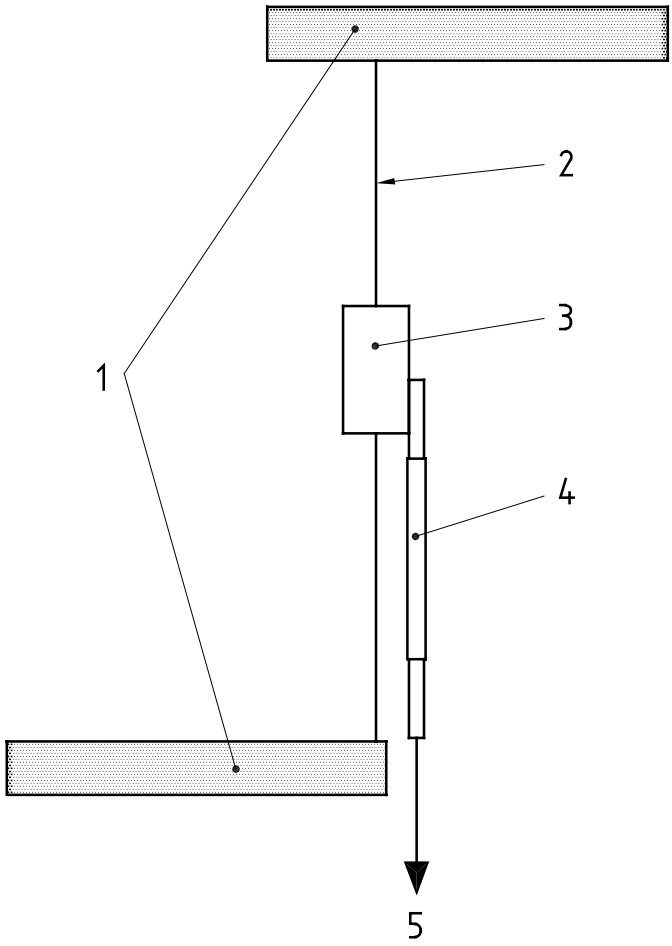
b) applied to the vertical rail or vertical lifeline, arrester and connecting line simultaneously;

c) applied parallel to the vertical rail or vertical lifeline.

5.2.4.4 Apply a suitable initial tensile force to deploy fully any energy-dissipating material or mechanism that is integral to the connecting line or arrester, then apply a test force of 15 kN in the case of a vertical rail, or in accordance with Table 1 for a vertical lifeline. The rate of stressing shall not exceed (150 $\pm$ 10) mm/min.

5.2.4.5 Maintain the test force for a period of 5 min. Observe whether there is fracture or rupture of any element in the load-bearing path.

Once the test force has been sustained for the 5 min period, it is permissible, in order to assess the failure load and mode, to progress the test to destruction.



Key

1 Test fixtures
2 Vertical rail or lifeline
3 Sliding-type fall arrester locked onto rail or lifeline
4 Connecting line
5 Test force

Figure 4 — Tensile-strength test arrangement

6 Instructions for general use, marking and packaging

6.1 Instructions for general use

Clear instructions, in the appropriate national language, for fitting, adjustment and use shall be supplied with each vertical rail or vertical lifeline and matching sliding-type fall arrester. Such instructions shall also include the following information:

a) the name of the manufacturer;

b) where appropriate, the name and address of the supplier or such other information as enables the supplier to be traced;

c) a statement concerning the application, purposes and limitations of the product, and that it should only be used by a person who has been trained in its safe use;

d) a warning against making any alterations or additions to the product;

e) a warning against the danger that may arise from the use of combinations of components and/or subsystems in which the safe functioning of any one component and/or subsystem is affected by or interferes with the safe functioning of another;

f) a warning to the effect that arresters are only to be used with the vertical rail or vertical lifeline that they have been tested in combination with;

g) an instruction to make a visual inspection of the equipment immediately before use and to ensure that the equipment is in a serviceable condition and operates correctly;

h) a list of instructions and pass/fail criteria so that the user can ensure that the equipment is in a serviceable condition and is operating correctly before use;

i) advice on the limitations of the materials used in the product which may affect its performance, e.g. temperature, the effect of sharp edges, chemical reagents, cutting, abrasion and UV degradation, and that the user should consult the manufacturer in case of doubt;

j) a warning to the effect that a fall arrester is not suitable for use in situations when the user is, or may become, positioned on unstable surfaces, fine-grain material or particulate solids such as sand or coal;

k) storage instructions;

l) instructions for cleaning and/or washing;

m) instructions for maintenance;

n) advice that the equipment be inspected periodically, at intervals in keeping with the conditions of use but at least once a year, by a competent person in accordance with the manufacturer's instructions;

o) a warning that repairs to the equipment should be carried out only by the manufacturer or by a competent person appropriately authorized by the manufacturer;

p) guidance concerning the inspection of the equipment and those factors that should cause the equipment to be discarded;

q) an instruction that any equipment that has been used to arrest a fall be removed from service and subjected to inspection and approval by a competent person before re-use;

r) advice that, before and during use, consideration should be given as to how any rescue could safely and efficiently be carried out;

s) an instruction that, when a fall arrester is issued for use, the user should be informed that it will be part of a system which will ensure that the arrest force will not exceed 6 kN;

t) a warning that vertical rails or vertical lifelines with sliding-type fall arresters in accordance with this part of ISO 10333 are limited to use by a single person of total mass not exceeding 100 kg;

u) instructions on how to install temporary vertical lifelines and how to connect them to anchor points, with reference to ISO 14567 as necessary;

v) instructions on how to connect the connecting line of the arrester properly to a full-body harness;

w) a warning that clearances have to be observed to ensure that there is sufficient distance available to allow an arrested fall to take place without the faller colliding with the ground or the nearest obstacle in the fall path (this shall include information regarding the construction of vertical lifelines and their elongation characteristics);

x) a warning to the effect that the connecting line used with the arrester should not under any circumstances exceed the connecting-line length specified by the manufacturer (the maximum connecting-line length shall be included in the instructions);

y) a warning and instructions as appropriate in regard to the correct orientation and procedure when attaching the arrester to the vertical rail or vertical lifeline, either at the extremities of the system or at opening points or when using opening devices.

6.2 Marking

6.2.1 Sliding-type fall arresters shall be clearly and indelibly marked or permanently labelled with the following information:

a) a reference to this part of ISO 10333, i.e. ISO 10333-4;

b) the name, trade mark or other means of identification of the manufacturer or supplier;

c) the manufacturer's product identification information, including the manufacturer's batch or serial number that enables the origin of the item to be traced;

d) the year of manufacture;

e) a warning to read the manufacturer's instructions for use;

f) a statement that the sliding-type fall arrester is intended for use only with the specific vertical rail or vertical lifeline identified as such by the manufacturer;

g) markings to indicate the correct orientation when in use;

h) the maximum connecting-line length as specified by the manufacturer.

6.2.2 The vertical rail or vertical lifeline shall be clearly and indelibly marked or permanently labelled with the following information:

a) the identity of the material of construction;

b) the rail or lifeline length;

c) a warning to read the manufacturer's instructions for use;

d) a warning that the anchor line should be inspected periodically, at intervals in keeping with the conditions of use but at least once a year, by a competent person in accordance with the manufacturer's instructions.

6.3 Packaging

6.3.1 Textile elements of safety equipment shall be supplied wrapped, but not necessarily sealed, in material which provides some resistance against moisture.

6.3.2 Manufacturers and suppliers shall take all reasonable care to ensure that their product is sufficiently packaged to prevent damage and deterioration during transportation.

6.3.3 Where severe environmental conditions exist, or special conditions of supply are detailed for long-term storage or to meet special transportation requirements, the packaging shall be specified by the purchaser and agreed by the supplier.

Annex A
(normative)

Dynamic performance testing

A.1 General

This annex specifies dynamic performance tests for vertical rails and vertical lifelines which incorporate a sliding-type fall arrester. Examples of personal fall-arrest systems incorporating vertical rails and vertical lifelines are shown in Figure A.1 which shows how components and systems may be connected together.

A.2 Apparatus

A.2.1 Torso test mass, with the dimensions specified in Figure A.2. The suspension eyebolts shall have an inside diameter of 40 mm and a maximum cross-sectional diameter of 16 mm. The surface shall be smooth and, if of timber construction, shall be shellacked or varnished.

A.2.2 Test structure, of rigid construction, with a natural frequency of vibration in the vertical axis where the personal fall-arrest system anchor device is to be fixed of not less than 100 Hz, and such that the application of a force of 20 kN at that point does not cause a deflection greater than 1 mm.

The test structure may 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. Where necessary to accommodate specific anchor devices and subsystems, alternative methods of fixing to the test structure are acceptable.

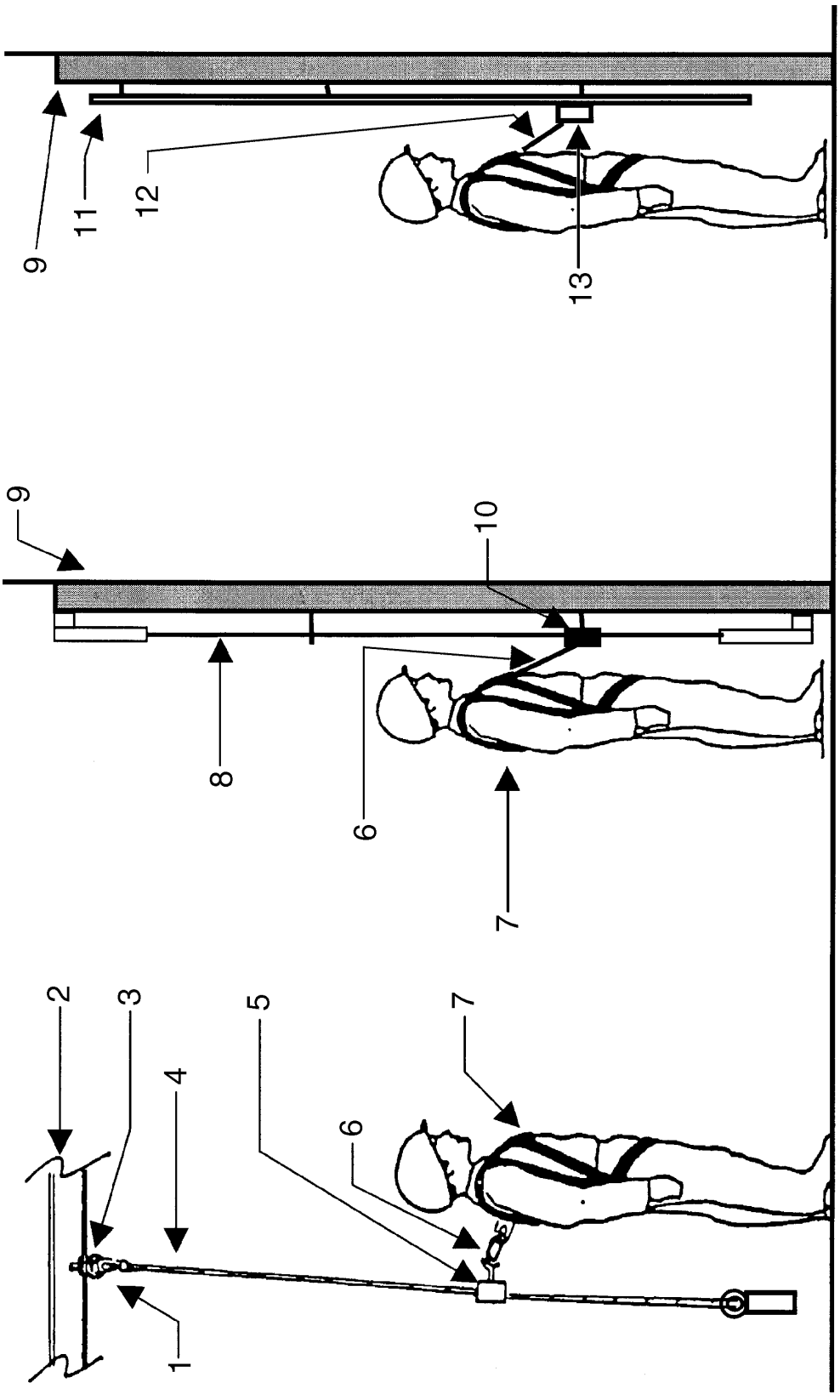
The test structure shall be at such a height to prevent the torso test mass from striking the floor during dynamic testing. There shall be sufficient space underneath the pre-release position of the torso test mass to allow for factors such as free fall, personal fall-arrest system length, personal fall-arrest system extension, full-body harness stretch and the height of the torso test mass.

A.2.3 Quick-release device, compatible with the eyebolt of the torso test mass or connectors, which ensures the release of the torso test mass without any initial velocity.

A.2.4 Force-measuring instrumentation, capable of measuring forces from 1,2 kN to 20 kN with an accuracy of $\pm$ 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.

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 A.3.

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



a) PFAS based on a temporary VLL

b) PFAS based on a permanent VLL

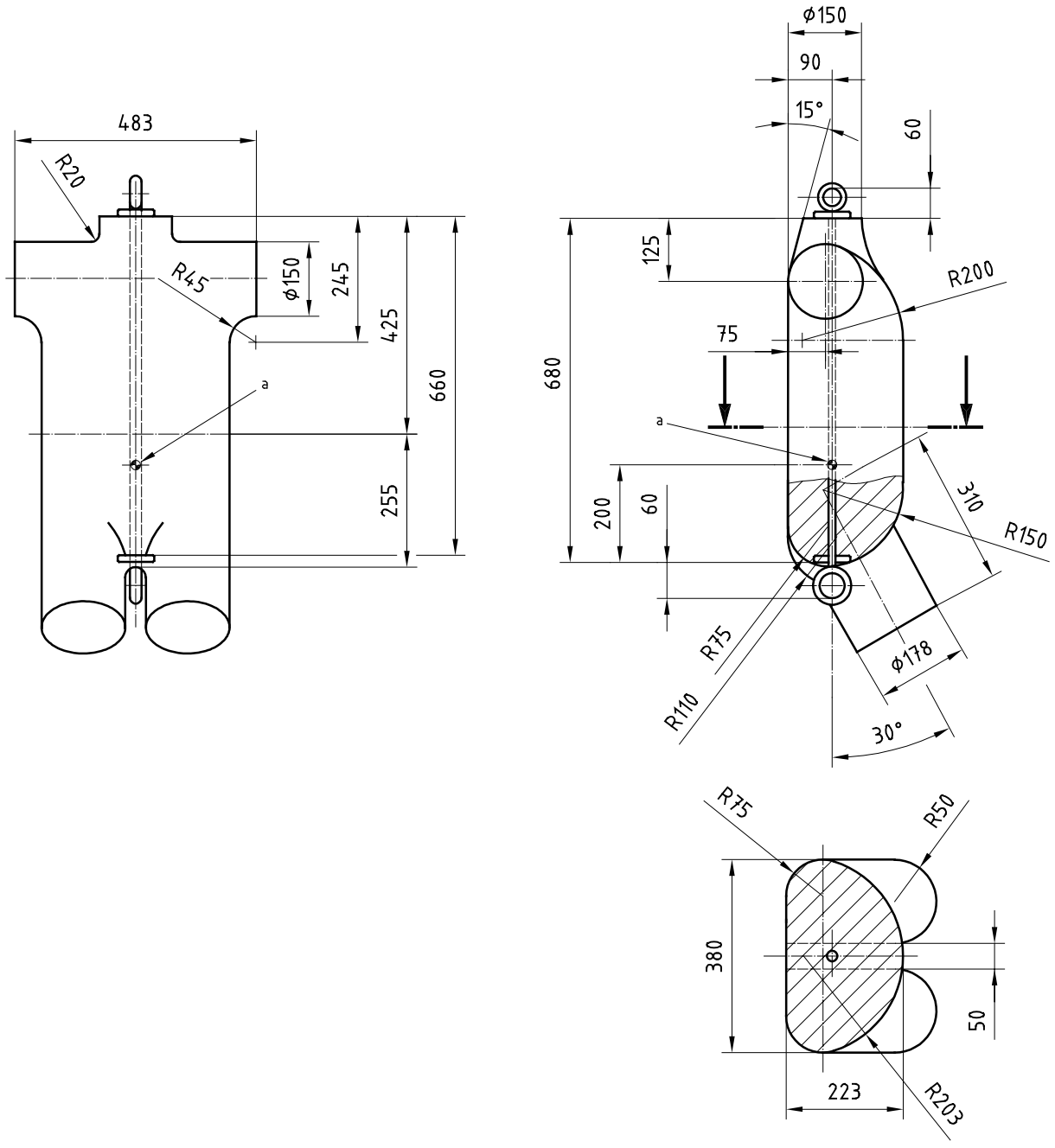
c) PFAS based on a VR

Key

1 Connector
2 Structure
3 Anchor device
4 Lifeline
5 Sliding-type fall arrester on lifelin
6 Connecting line, connected to fall-arrest attachment on full-body harness
7 Full-body harness worn by worker
8 Tensioned lifeline
9 Permanently installed ladder
10 Sliding-type fall arrester on lifeline
11 Vertical rail
12 Connecting line, connected to fall-arrest attachment on full-body harness
13 Sliding-type fall arrester on rail

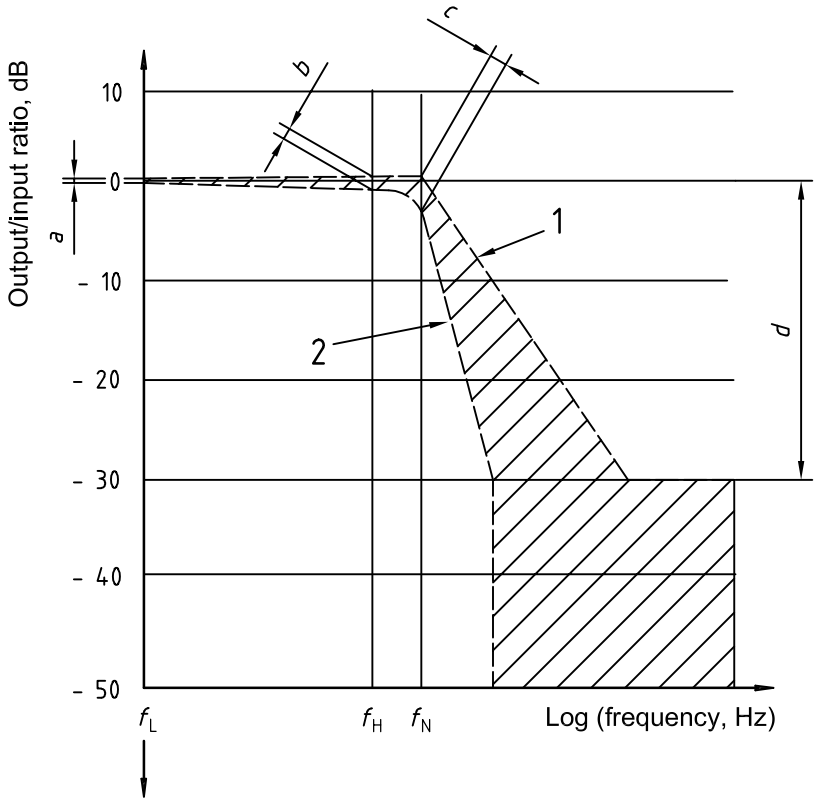
Figure A.1 — Examples of personal fall-arrest systems

Dimensions in millimetres



[a] Centre of gravity

Figure A.2 — Torso test mass



Frequency response values:

a = ± 1/4 dB f_L = 0,1 Hz

b = + 1/2 dB, – 1 dB f_H = 60 Hz

c = + 1/2 dB, – 3 dB f_N = 100 Hz

d = – 30 dB

Key

1 Slope = – 9 dB per octave

2 Slope = – 24 dB per octave

Figure A.3 — Frequency response characteristics of the force-measuring instrumentation

A.3 Performance test for a personal fall-arrest system including a temporary vertical lifeline

A.3.1 Preparation

A.3.1.1 The specific components/subsystems submitted for testing shall include:

a) an anchor device;

b) a temporary vertical lifeline and sliding-type fall arrester;

c) a full-body harness;

d) the required number of connectors.

A.3.1.2 Secure the anchor device to the test structure, and assemble the components/subsystems into the intended personal fall-arrest system in accordance with the manufacturer's instructions.

A.3.2 Testing

A.3.2.1 Fit the supplied full-body harness onto the torso test mass as it would be worn by a human wearer, in accordance with the manufacturer's instructions. All adjustments shall be made to ensure a snug fit of the full-body harness to the torso test mass.

A.3.2.2 Raise the torso test mass in an upright posture. Attach the sliding-type fall arrester to the temporary vertical lifeline in accordance with the manufacturer's instructions. Attach the connecting line of the sliding-type fall arrester to the full-body harness fall-arrest attachment point using a connector, and attach the upper end of the vertical lifeline to the load cell which shall be attached to the anchor device secured to the test structure.

A.3.2.3 Raise the torso test mass to the maximum height permitted by the length of the sliding-type fall arrester's connecting line, and secure to the quick-release device [see Figure A.4 a)], so that the sliding-type fall arrester is a maximum of 300 mm from where the vertical lifeline connects to the load cell. Measure and record height H_Q (the distance from the underside of the torso test mass to the floor). Ensure that the lifting eyebolt on the torso test mass is at a maximum horizontal distance of 300 mm from the vertical axis of the anchor device personal fall-arrest system attachment point before release.

A.3.2.4 Release the torso test mass. Measure and record the force with respect to time. With the torso test mass at rest [Figure A.4 b)], measure and record height H_G (the distance between the underside of the torso test mass and the floor). Calculate and record the fall distance H_D:

$$H_D = H_Q - H_G$$

A.3.2.5 With the torso test mass remaining in post-drop suspension, observe and record whether there is any tearing or rupture of the temporary vertical lifeline or sliding-type fall arrester, except where such tearing was deliberately designed to contribute to energy dissipation. Repeat the examination with the personal fall-arrest system dismantled.

A.3.2.6 Repeat the performance test described in A.3.2.1 to A.3.2.5 for each type or size of lifeline specified for use with the sliding-type fall arrester. A new set of components/subsystems shall be submitted in each case.

A.4 Performance test for a personal fall-arrest system including a permanent vertical lifeline

A.4.1 Preparation

A.4.1.1 The specific components/subsystems submitted for testing shall include:

a) the required number of anchor devices;

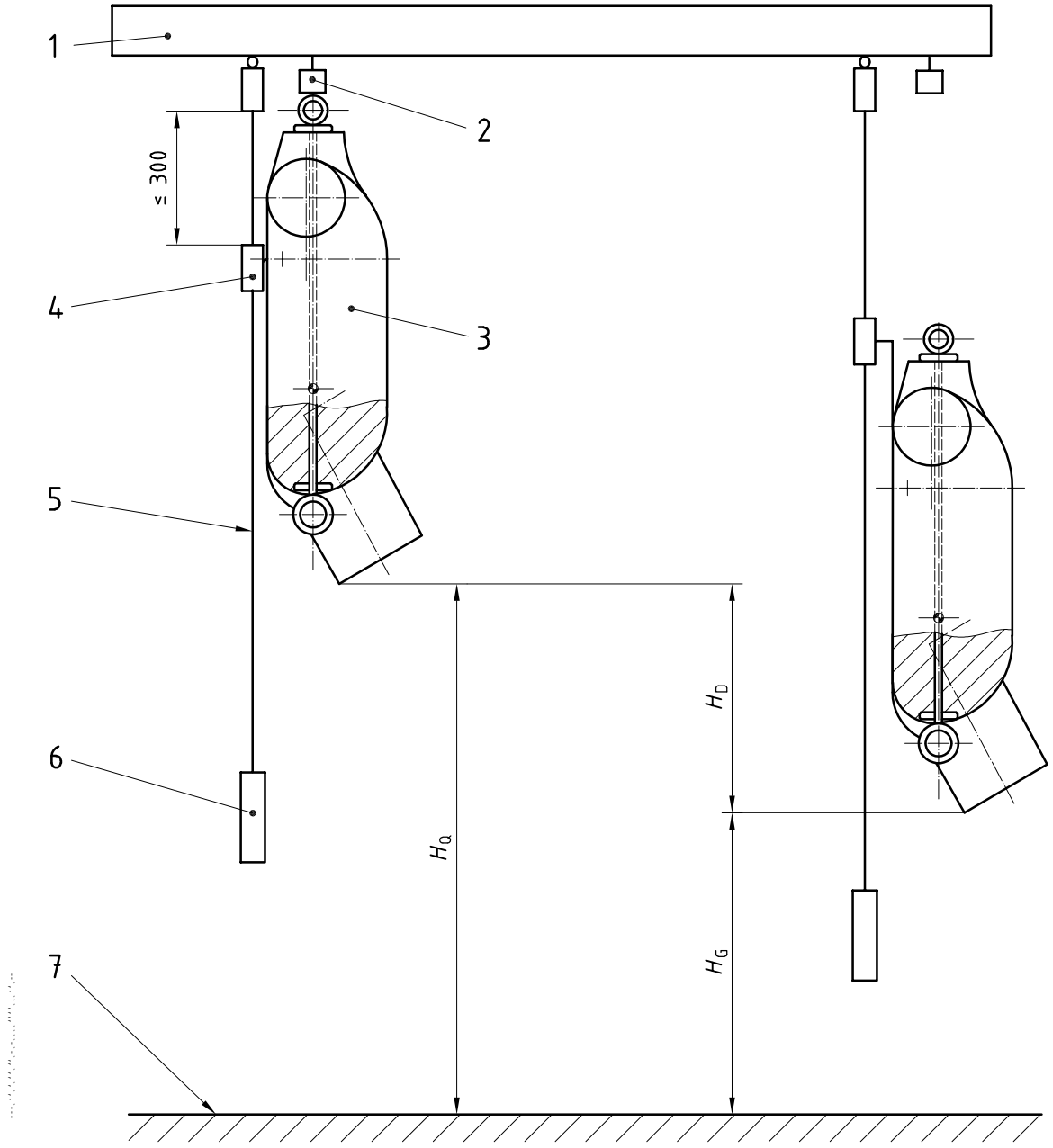
b) a permanent vertical lifeline and sliding-type fall arrester;

c) a full-body harness;

d) the required number of connectors.

A.4.1.2 Secure the permanent vertical lifeline and any intermediate brackets to the test structure, and assemble the components/subsystems into the intended personal fall-arrest system in accordance with the manufacturer's instructions.

Dimensions in millimetres



a) Torso test mass at maximum height (pre-release position)

b) Torso test mass at rest (post-drop)

Key

1 Test structure
2 Quick-release device
3 Torso test mass
4 Sliding-type fall arrester
5 Temporary vertical lifeline
6 Tensioning mass
7 Floor

Figure A.4 — Performance test arrangement for personal fall-arrest system including a temporary vertical lifeline

A.4.2 Testing

A.4.2.1 Fit the supplied full-body harness onto the torso test mass as it would be worn by a human wearer, in accordance with the manufacturer's instructions. All adjustments shall be made to ensure a snug fit of the full-body harness to the torso test mass.

A.4.2.2 Raise the torso test mass into an upright posture. Attach the sliding-type fall arrester to the permanent vertical lifeline in accordance with the manufacturer's instructions. Connect one end of the load cell to the connecting line of the sliding-type fall arrester and the other to the full-body harness sternal fall-arrest attachment point, using the supplied connectors.

A.4.2.3 With the sliding-type fall arrester positioned mid-way between the top and next intermediate permanent vertical-lifeline fastening point, raise the torso test mass to the maximum height permitted by the length of the sliding-type fall arrester's connecting line, with the load cell hanging downwards [see Figures A.5 a) and A.6)], and secure to the quick-release device.

NOTE 1 The load cell can be maintained in this position prior to release of the torso test mass by using a small cord. This is tied to the top of the load cell and to the connector or other equipment that holds the torso test mass to the quick-release device, and is released at the same time as the torso test mass.

NOTE 2 The load cell has to be maintained in the pre-release position otherwise its physical length could significantly contribute to the free fall of the torso test mass during the performance test.

A.4.2.4 Measure and record height H_Q (the distance from the underside of the torso test mass to the floor). Ensure that the lifting eyebolt on the torso test mass is at a maximum horizontal distance of 300 mm from the permanent vertical lifeline before release.

A.4.2.5 Release the torso test mass. Measure and record the force with respect to time. With the torso test mass at rest [Figure A.5 b)], measure and record height H_G (the distance between the underside of the torso test mass and the floor). Calculate and record the fall distance H_D:

$$H_D = H_Q - H_G$$

A.4.2.6 With the torso test mass remaining in post-drop suspension, observe and record whether there is any tearing or rupture of the permanent vertical lifeline or sliding-type fall arrester (except where such tearing was deliberately designed to contribute to energy dissipation). Repeat the examination with the personal fall-arrest system dismantled.

A.4.2.7 Repeat the performance test described in A.4.2.1 to A.4.2.6 for each type or size of lifeline specified for use with the sliding-type fall arrester. A new set of components/subsystems shall be submitted in each case.

A.5 Performance test for a personal fall-arrest system including a vertical rail

A.5.1 Preparation

A.5.1.1 The specific components/subsystems submitted for testing shall include:

a) the required number of anchor devices;

b) a permanent vertical lifeline and sliding-type fall arrester;

c) a full-body harness;

d) the required number of connectors.

A.5.1.2 Secure the vertical rail and intermediate brackets to the test structure, and assemble the components/subsystems into the intended personal fall-arrest system in accordance with the manufacturer's instructions.

A.5.2 Testing

A.5.2.1 Fit the supplied full-body harness onto the torso test mass as it would be worn by a human wearer, in accordance with the manufacturer's instructions. All adjustments shall be made to ensure a snug fit of the full-body harness to the torso test mass.

A.5.2.2 Raise the torso test mass in an upright posture. Attach the sliding-type fall arrester to the vertical rail in accordance with the manufacturer's instructions. Connect one end of the load cell to the connecting line of the sliding-type fall arrester and the other to the full-body harness sternal fall-arrest attachment point using the supplied connectors.

A.5.2.3 With the sliding-type fall arrester positioned mid-way between the top and next intermediate vertical rail fastening point, raise the torso test mass to the maximum height permitted by the length of the sliding-type fall arrester's connecting line, with the load cell hanging downwards [see Figures A.7 a) and A.8], and secure to the quick-release device.

NOTE 1 The load cell can be maintained in this position prior to release of the torso test mass by using a small cord. This is tied to the top of the load cell and to the connector or other equipment that holds the torso test mass to the quick-release device, and is released at the same time as the torso test mass.

NOTE 2 The load cell has to be maintained in the pre-release position otherwise its physical length could significantly contribute to the free fall of the torso test mass during the performance test.

A.5.2.4 Measure and record height H_Q (the distance from the underside of the torso test mass to the floor). Ensure that the lifting eyebolt on the torso test mass is at a maximum horizontal distance of 300 mm from the vertical rail before release.

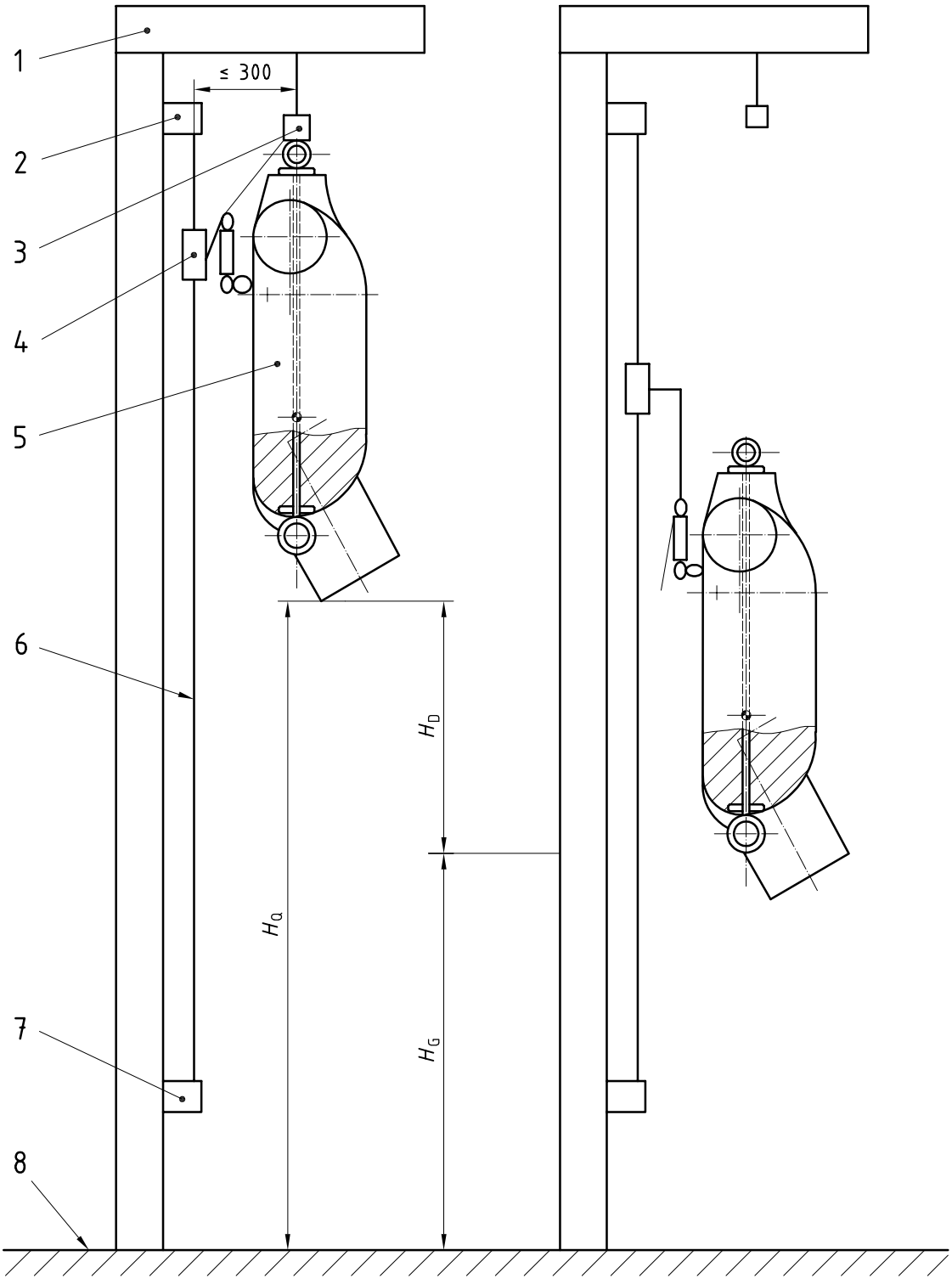
A.5.2.5 Release the torso test mass. Measure and record the force with respect to time. With the torso test mass at rest (Figure A.7 b), measure and record height H_G, (the distance between the underside of the torso test mass and the floor). Calculate and record the fall distance H_D:

$$H_D = H_Q - H_G$$

A.5.2.6 With the torso test mass remaining in post-drop suspension, observe and record whether there is any tearing or rupture of the vertical rail or sliding-type fall arrester (except where such tearing was deliberately designed to contribute to energy dissipation). Repeat the examination with the personal fall-arrest system dismantled.

A.5.2.7 Repeat the performance test described in A.5.2.1 to A.5.2.6 for each type or size of rail specified for use with the sliding-type fall arrester. A new set of components/subsystems shall be submitted in each case.

Dimensions in millimetres



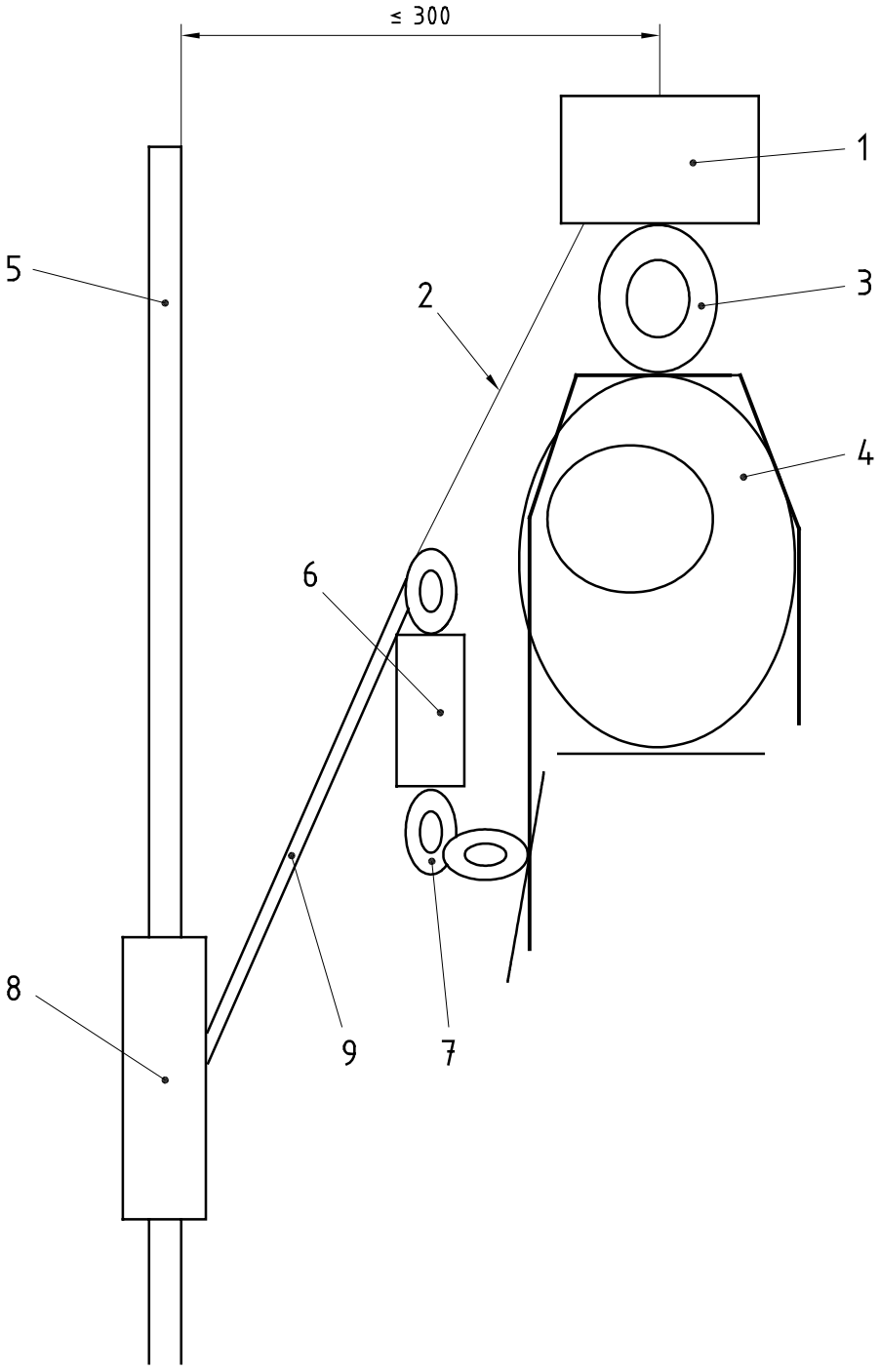
a) Torso test mass at maximum height (pre-release position) **b) Torso test mass at rest (post-drop)**

Key

1 Test structure
2 Upper permanent vertical-lifeline fastening point
3 Quick-release device
4 Sliding-type fall arrester
5 Torso test mass
6 Permanent vertical lifeline
7 Lower permanent vertical-lifeline fastening point
8 Floor

Figure A.5 — Performance test arrangement for a personal fall-arrest system including a permanent vertical lifeline

Dimensions in millimetres

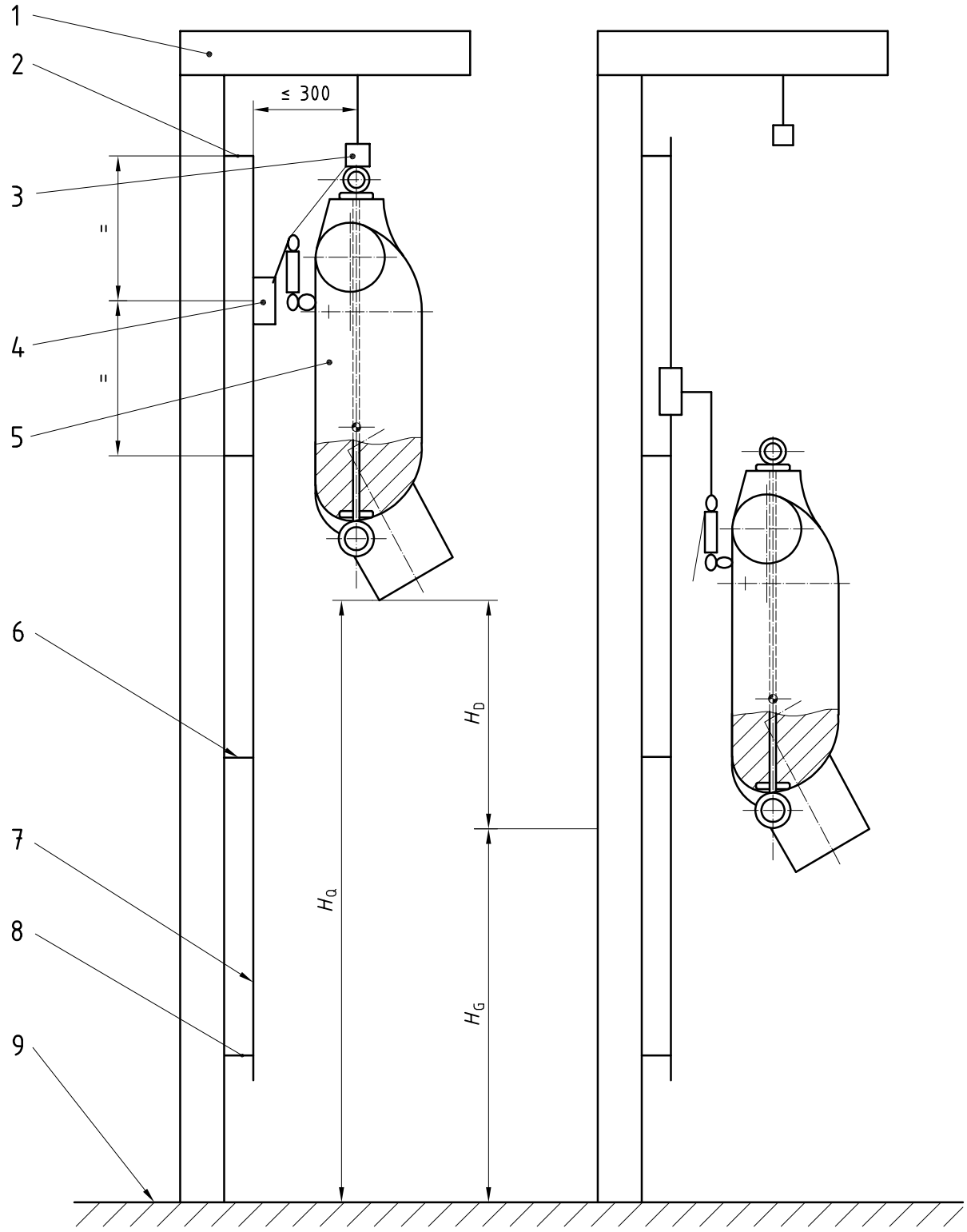


Key

1 Quick-release device
2 Small cord
3 Torso test mass eyebolt
4 Neck of torso test mass
5 Lifeline
6 Load cell (vertical)
7 Load cell connection
8 Sliding-type fall arrester
9 Connecting line

Figure A.6 — Details of load cell arrangement in the pre-release position [see Figure A.5 a)]

Dimensions in millimetres



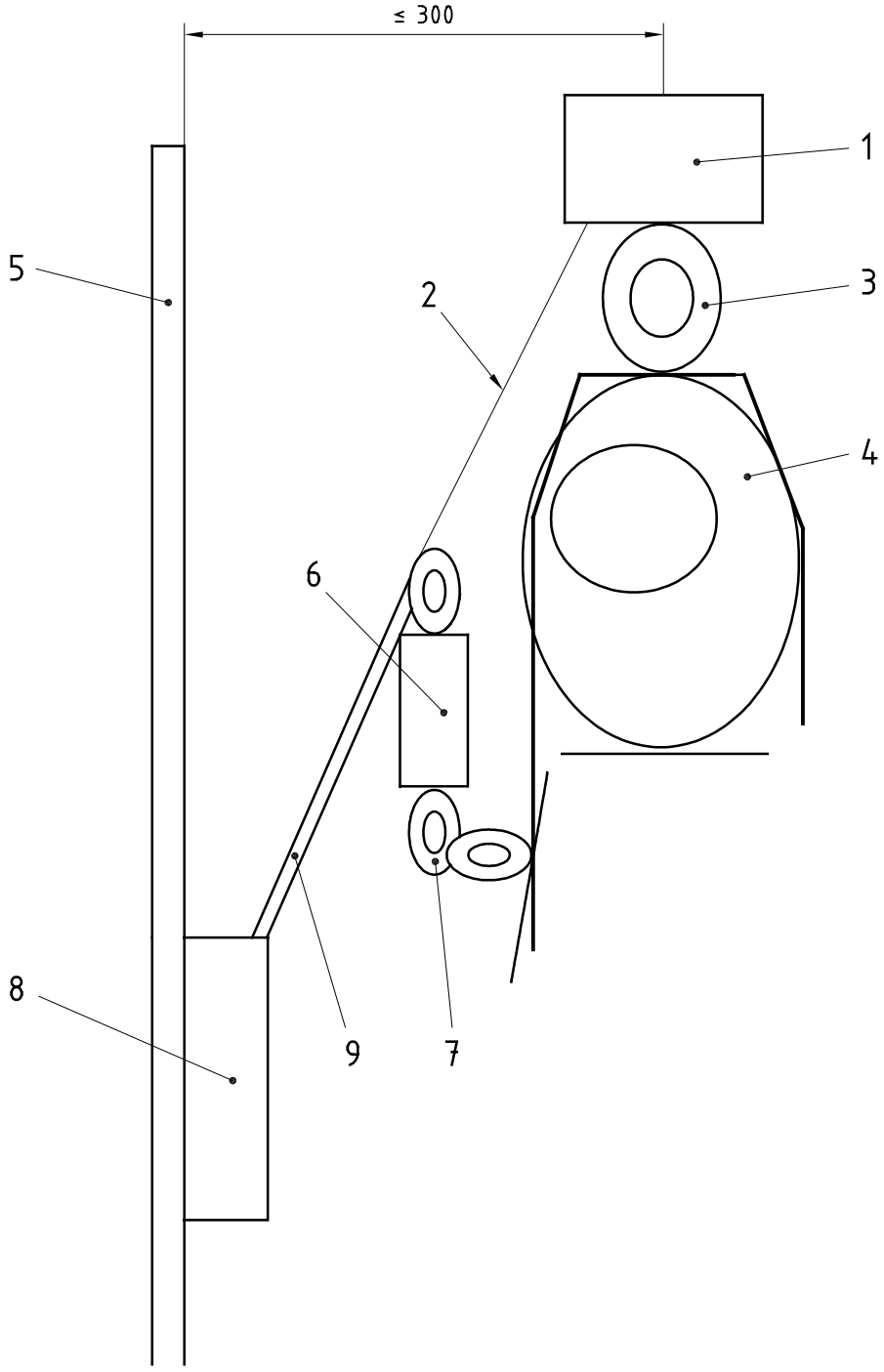
a) Torso test mass at maximum height (pre-release position) **b) Torso test mass at rest (post-drop)**

Key

1	Test structure	4	Sliding-type fall arrester	7	Vertical rail
2	Upper vertical rail fastening point	5	Torso test mass	8	Lower vertical rail fastening point
3	Quick-release device	6	Intermediate fastening point	9	Floor

Figure A.7 — Performance test arrangement for personal fall-arrest system including a vertical rail

Dimensions in millimetres



Key

1 Quick-release device
2 Small cord
3 Torso test mass eyebolt
4 Neck of torso test mass
5 Rail
6 Load cell (vertical)
7 Load cell connection
8 Sliding-type fall arrester
9 Connecting line

Figure A.8 — Details of load cell arrangement in the pre-release position [see Figure A.7 a)]

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