INTERNATIONAL STANDARD

ISO 14567

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Personal protective equipment for protection against falls from a height — Single-point anchor devices

Équipements individuels de protection contre les chutes libres — Dispositifs d'ancrage en un seul point

Reference number
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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.

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.

International Standard ISO 14567 was prepard by Technical Committee ISO/TC 94, *Personal safety — Protective clothing and equipment*, Subcommittee SC 4, *Personal equipment for protection against falls*.

Personal protective equipment for protecion against falls from a height — Single-point anchor devices

1 Scope

This International Standard specifies requirements, test methods, and marking, labelling and packaging, as appropriate, of both permanent and temporary single-point anchor devices exclusively for the attachment of personal protective equipment (PPE) for protection against falls from a height for fall arrest, work positioning and travel restriction (work restraint).

It is applicable only to anchor devices for PPEs that conform to ISO 10333-1, ISO 10333-2, ISO 10333-3 and ISO 10333-5.

NOTE 1 Further standards are in preparation for other types of PPE: ISO 10333-6 and ISO 14566 (see bibliography).

Anchor devices are rated to sustain a maximum (dynamic) arresting force of 6,0 kN, and a maximum (static) loading of 1,0 kN (assuming a person of 100 kg mass) in post-fall arrest suspension, work-positioning mode, or restraint mode.

Anchor devices are intended for single person use only. A rescuer should not attach to the same anchor device as a person being rescued, unless the anchor device has been specifically designed for such purposes, and the instructions for use specifically permit this application.

NOTE 2 Vertical rigid or flexible line systems and horizontal lifelines are not within the scope of this International Standard, but are covered in ISO 10333-4 and ISO 16024.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard 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, *Ropes — Polyamide — Specification.*

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

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

ISO 10333-2, *Personal fall-arrest systems — Part 2: Lanyards and energy absorbers.*

ISO 10333-3, *Personal fall-arrest systems — Part 3: Self-retracting lifelines.*

ISO 10333-5, *Personal fall-arrest systems — Part 5: Connectors*.

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test.*

EN 10002-2*, Metallic materials — Tensile testing — Part 2: Verification of the force measuring system of the testing machine.*

EN 45001, *General criteria for the operation of testing laboratories*.

3 Terms and definitions

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

3.1
anchor device
component or assembly of components which incorporates one PPE attachment point

See Figures 1 to 5 and 8 to 13 inclusive.

3.2
anchor system
assembly of multiple anchor devices with one or more PPE attachment points

3.3
PPE attachment point
that part of an anchor device or anchor system to which the PPE of one single user may be attached

See Figures 1 to 5 and 8 to 13 inclusive.

NOTE The PPE attachment point may be mobile and/or removable.

3.4
component
part of an anchor device or anchor system at a point of sale by the manufacturers, supplied with packaging, marking and instructions for use

EXAMPLES PPE attachment points and fixings are examples of components.

3.5
fall factor
ratio of free fall distance to the length of the connecting lanyard, including any connectors, both quantities being expressed in the same units of measurement

3.6
free-fall distance
total vertical distance through which a worker could fall from the start of the fall to the onset of the arrest

3.7
free space
uninterrupted vertical distance measured from the anchor device to the ground level, the next lower substantive platform, or nearest significant obstacle

See Figure 6.

3.8
fixings
means by which an anchor device is secured or attached to the structure

See Figures 2 to 5 inclusive.

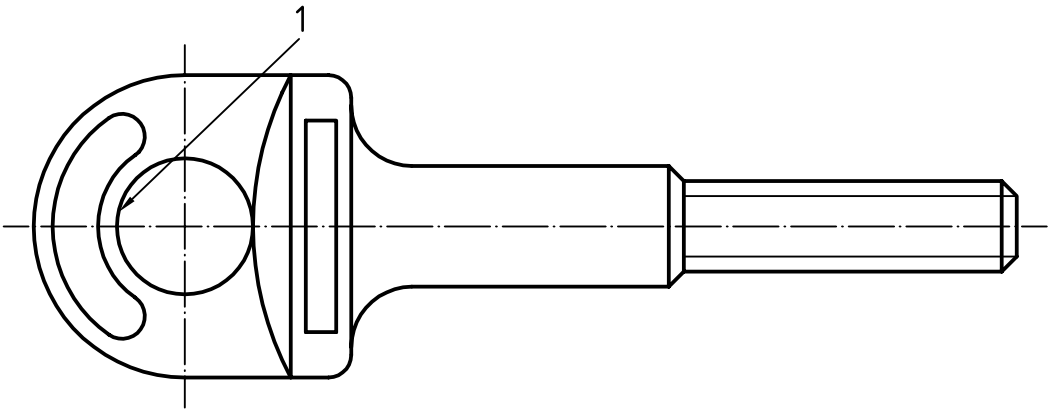
NOTE Not all anchor devices require such fixings (e.g. tripods, deadweight anchor devices). See Figures 12 and 13.

3.9
anchor
anchor device or anchor system attached to a structure, ready for the attachment of a PPE for protection against falls from a height

See Figures 2 to 5 and 8 to 13 inclusive.

3.10
structure
existing load-bearing structure such as the building, ground, roof

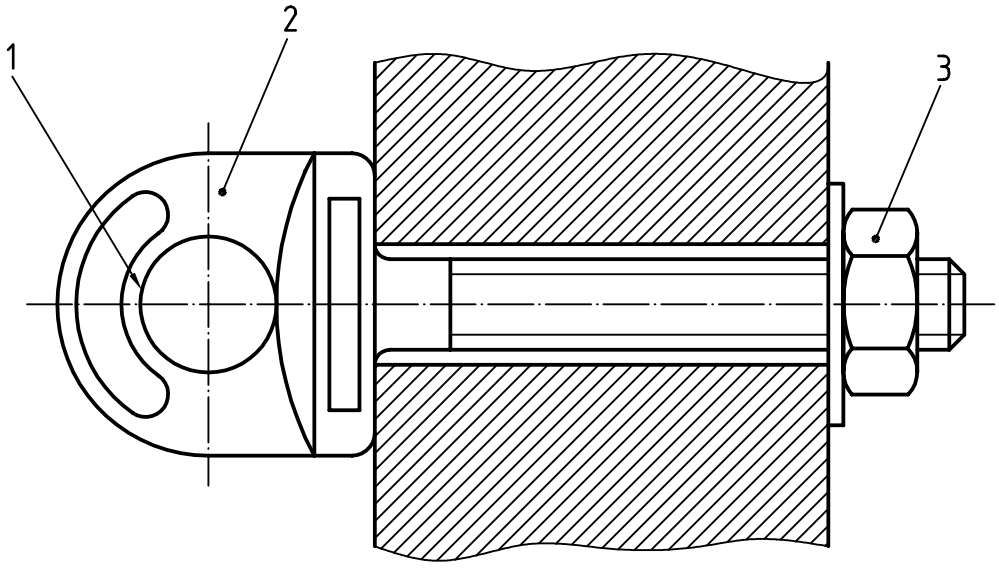
See Figures 2 to 5 inclusive.



Key

1 PPE attachment point

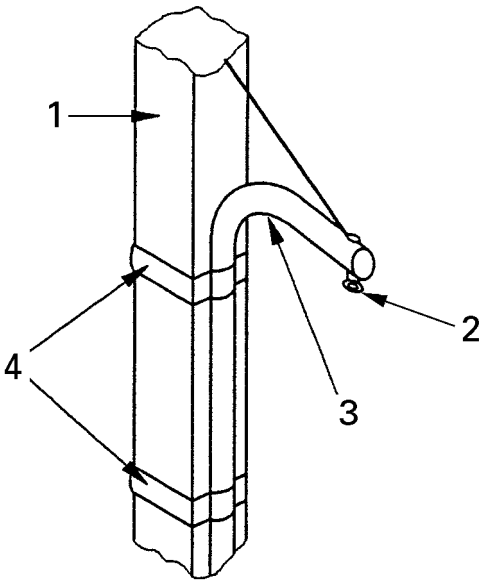
Figure 1 — Example of an anchor device (Eyebolt)



Key

1 PPE attachment point
2 Anchor device
3 Fixing

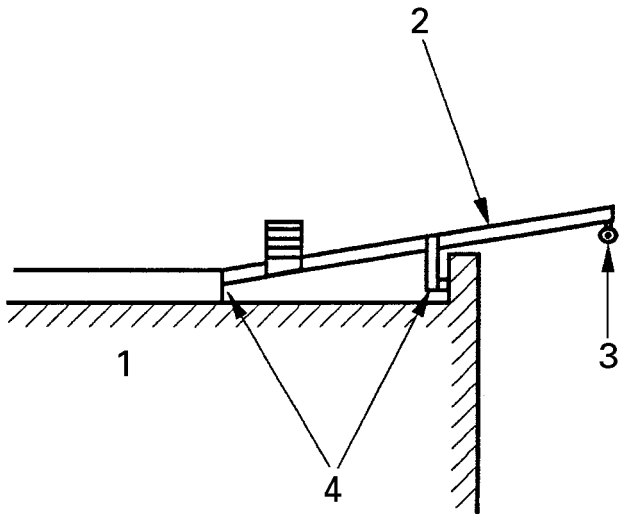
Figure 2 — Example of a PPE anchor (Eyebolt and nut)



Key

1 Structure
2 PPE attachment point
3 Anchor device
4 Fixings

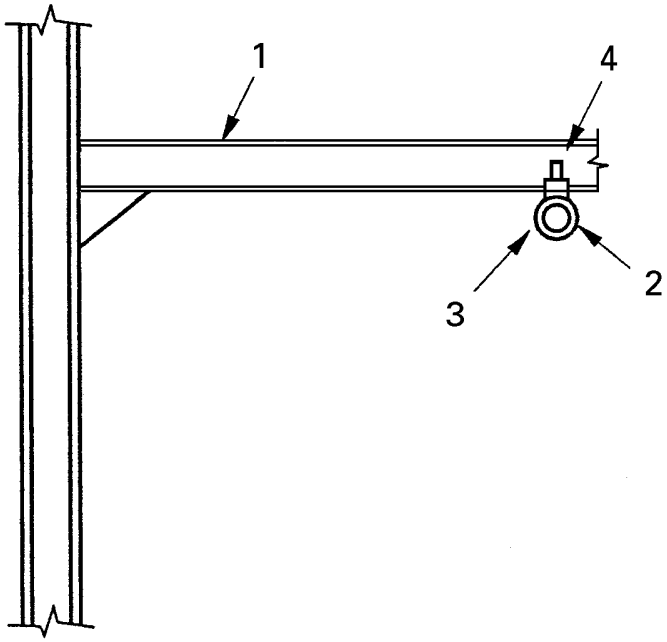
Figure 3 — Example of a PPE anchor (Column, davit and brackets)



Key

1 Structure
2 Anchor device
3 PPE attachment point
4 Fixings

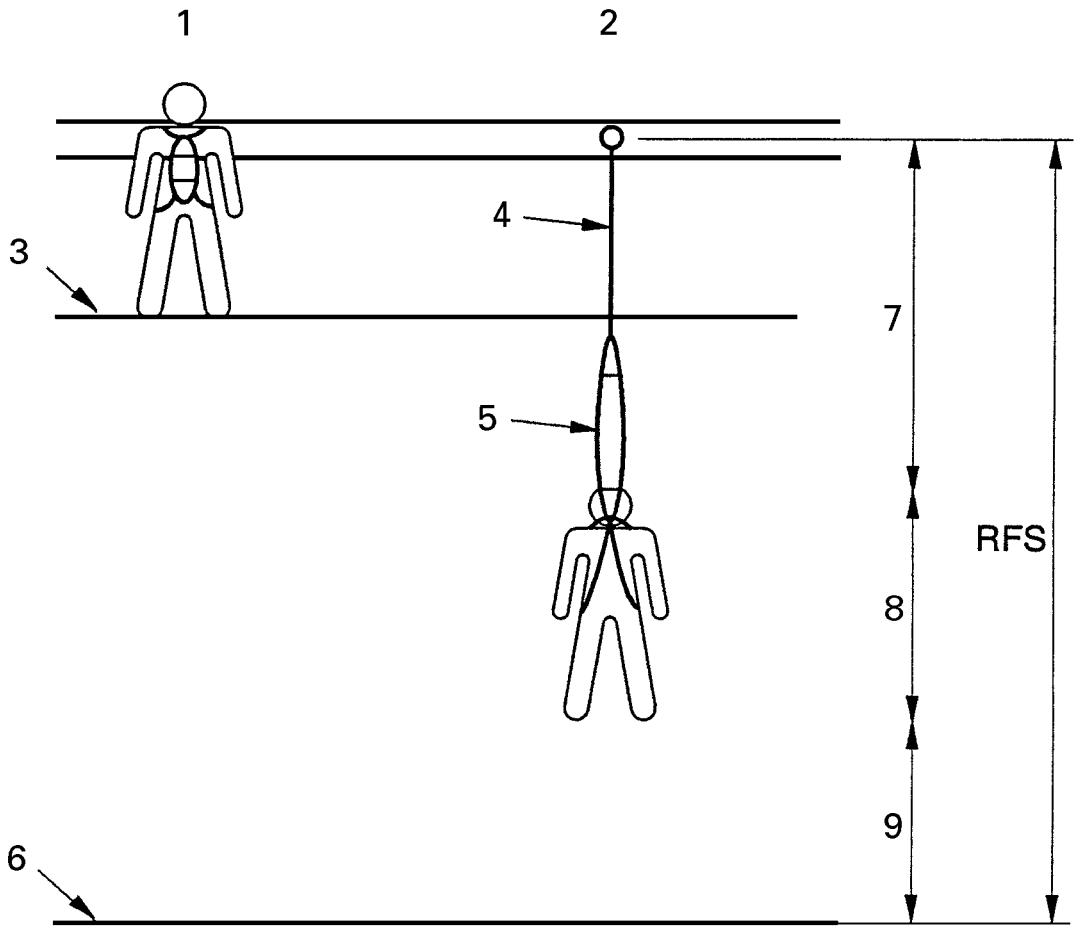
Figure 4 — Example of a PPE anchor (Deadweight cantilever or outrigger)



Key

1 Structure
2 PPE attachment point
3 Anchor device
4 Fixings

Figure 5 — Example of a PPE anchor (Beam and eyebolt)



Key

1 Position A (at the onset of the fall)
2 Position B (post-fall suspension)
3 Walkway
4 Lanyard
5 Energy absorber (extended)
6 Ground level/nearest significant obstacle
7 Lanyard length + energy absorber extension
8 Harness stretch + distance between attachment point and feet
9 Safety clearance

PPE attachment point shall be at a height greater than or equal to the RFS.

Figure 6 — Example of required free space (RFS) below position of PPE anchor

4 Classes of anchor device and anchor system

4.1 Class A

4.1.1 Class A1

Class A1 comprises anchor devices designed to be secured to vertical, horizontal and inclined surfaces, such as walls, columns and lintels. See Figure 8.

4.1.2 Class A2

Class A2 comprises anchor devices designed to be secured to inclined roofs. See Figure 11.

4.2 Class B

Class B comprises transportable temporary anchor devices. See Figure 12.

NOTE There are no classes ‘C’ or ‘D’ in this International Standard. These will be covered in ISO 16024.

4.3 Class E

Class E comprises deadweight anchor devices for use on horizontal surfaces. For the purposes of this International Standard, a horizontal surface is one which does not deviate from the horizontal by more than 5°. See Figure 13.

5 Requirements

5.1 General design requirements

5.1.1 The anchor device shall be designed to withstand a force of at least 12 kN (2 697 lb·f) in all directions in which a force could be applied during a fall arrest.

5.1.2 The PPE attachment point shall be so designed as to accept the personal protective equipment and ensure that it is not possible for correctly connected personal protective equipment to become detached unintentionally.

Particular attention shall be given to the profile of PPE attachment points, to ensure that they are compatible with those types of connector with which they are to be used.

a) The connector should be capable of free and easy engagement with the anchor point without the need for the application of force.

b) Where connectors are of the karabiner or hook variety (i.e. they possess a spring-loaded gate mechanism, with an automatic or manual locking facility), there should be sufficient clearance to allow the gate mechanism to fully close and lock after the connection between the anchor point and safety lanyard has been made.

   The closure of the gate mechanism and lock should be physically checked after the connection is made to avoid subsequent and unintentional disengagement between the connector and anchor point.

c) When the connection is fully made with a karabiner or hook-type connector, the connector should be manipulated within the anchor point to ensure that the connector’s intended bearing surface bears upon the anchor point’s intended bearing surface. The gate mechanism of the karabiner or hook should not bear upon the anchor point. (See Figure 7.)

d) When the connection is fully made, the connector should be capable of freely aligning in the directions that the safety lanyard could be pulled in as a result of a fall arrest occurrence, to avoid weakening the connector in bending.

e) Connectors utilising a lanyard retention eye or lanyard retention pin are to be preferred in making connections between anchor points and safety lanyards, to minimize the possibility of roll-out, (mechanical and/or

incompatible component disengagement between the anchor point, connector and safety lanyard), which is capable of occurring during a fall arrest.

f) Safety lanyards should not be passed through an anchor point and then connected back on themselves (i.e. forming a loop around the anchor point), to avoid weakening the lanyard and the connector in bending, unless the connector and safety lanyard is designed specifically to be attached in such a manner.

g) Knots should never be used to connect safety lanyards to anchor points;

h) Only PPEs that conform to ISO 10333-1, ISO 10333-2, ISO 10333-3 and ISO 10333-5 shall be attached.

5.1.3 Where an anchor device comprises more than one component, the design shall be such that those components cannot appear to be correctly assembled without being positively locked together.

5.1.4 Exposed edges or corners shall be relieved either with a radius or chamfer.

5.1.5 All metallic parts of anchor devices shall be capable of satisfying the corrosion test specified in 6.3.3.

5.1.6 Where relevant, anchor devices shall be so designed that, when installed, there are adequate bearing surfaces to minimize bending that would have a detrimental effect on the ability to safely arrest a falling body unless the anchor device is designed specifically to deform at bending (e.g. class A1 anchors; see Figures 2 and 8).

5.1.7 Stress-raising features shall be avoided by:

a) the provision of a suitable radius between the collar and shank of an eyebolt;

b) ensuring that the run-out of male threads which are intended to be loaded in shear or bending is a sufficient distance from the bearing surface to ensure that the shear load is borne by the unthreaded portion of the shank.

5.1.8 Where anchor devices, components or elements utilize male and female threads, there shall be adequate engagement between male and female thread. See Figures 2 and 9.

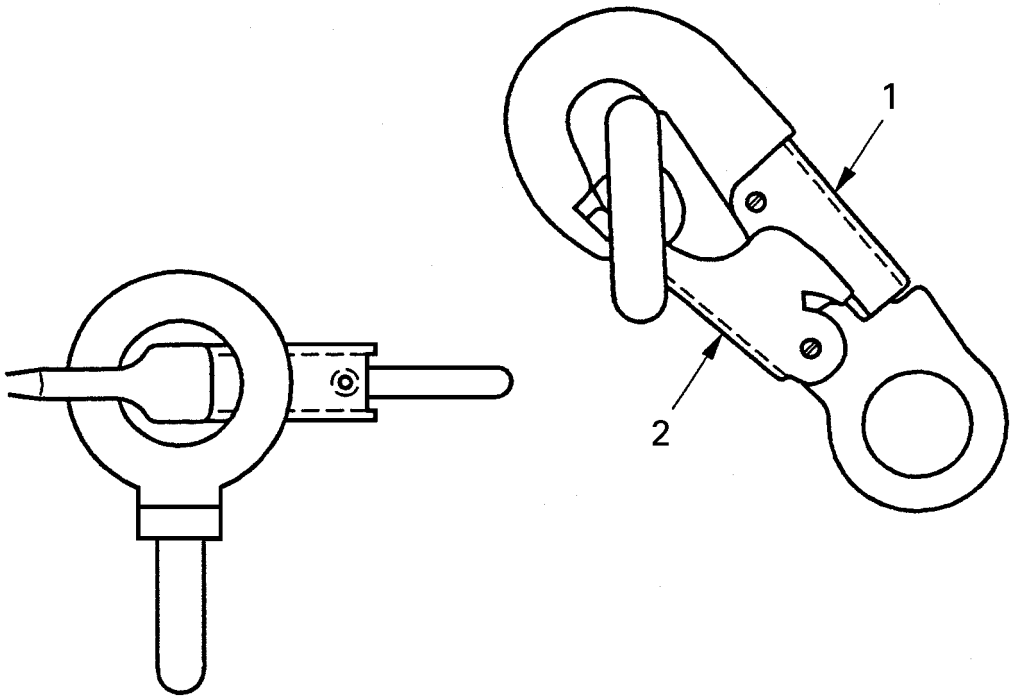
5.1.9 Through-type anchor devices shall utilize a backplate of sufficient surface area and thickness to ensure that the load is adequately distributed. See Figure 9.

5.1.10 Where anchor devices or components are to be installed using chemically bonded fixings, consideration shall be given to the future needs for inspection (e.g. for corrosion). It is recommended that female sockets should be bonded to the structure, so that male anchor devices, components or elements may be locked into them. See Figure 10.

Where anchor devices are cast-in or bonded directly to the substrate material (e.g. concrete), the anchor device shall be made of a suitable material, and the manufacturer should quote life expectancy

5.1.11 The PPE anchor shall be so designed, taking account of anticipated positions of installation and/or use, such that the distance available on site is sufficient to safely arrest the fall [see 9.1.9 d)].

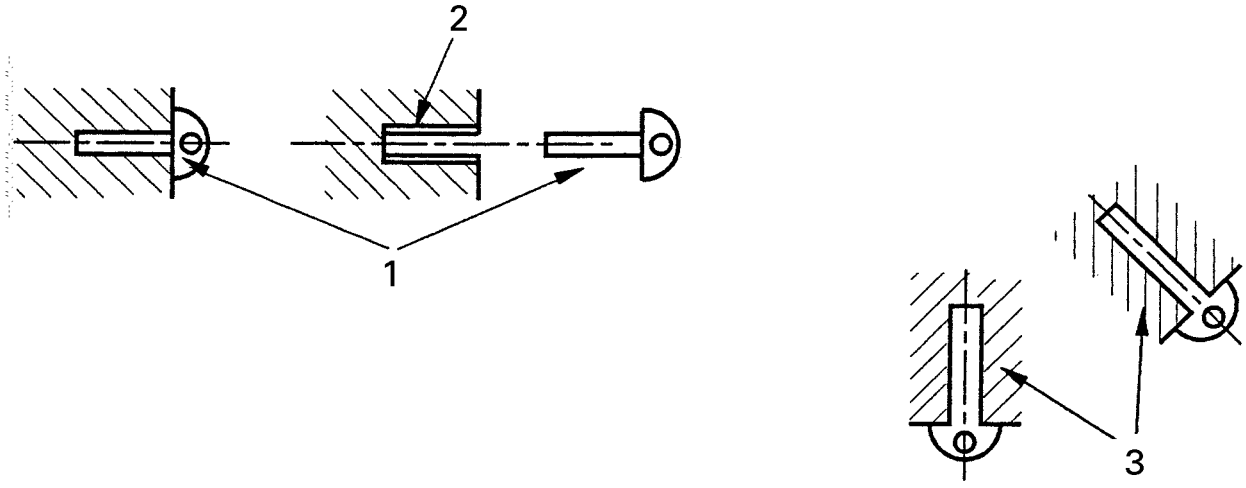
5.1.12 No anchor device or component shall be used that, without the manufacturer's approval, has been adapted or modified from the condition in which it was supplied by the manufacturer.



Key

1 Locking keeper
2 Gate keeper

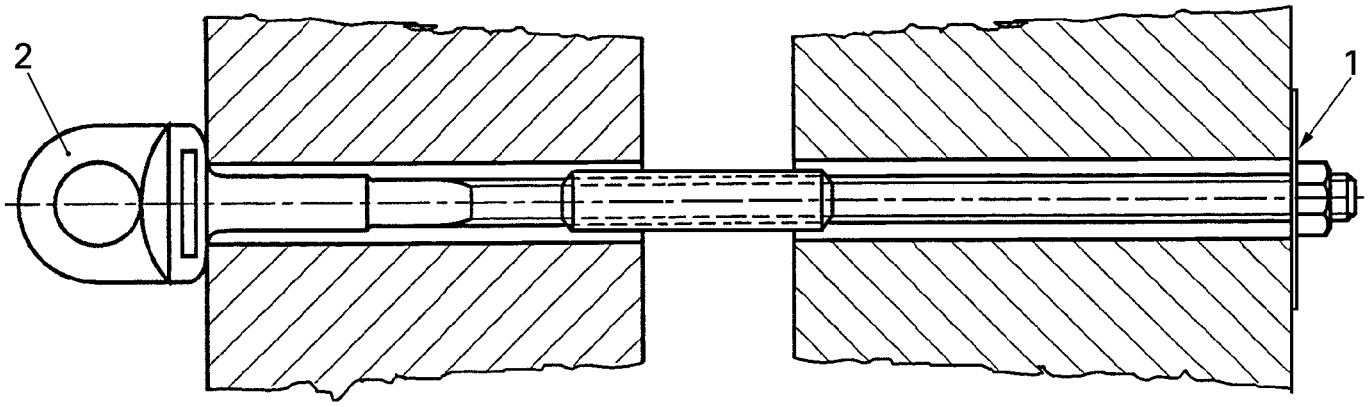
Figure 7 — Examples of incorrect bearing surfaces in hook/anchor assembly



Key

1 Anchor device
2 Fixing
3 Structure

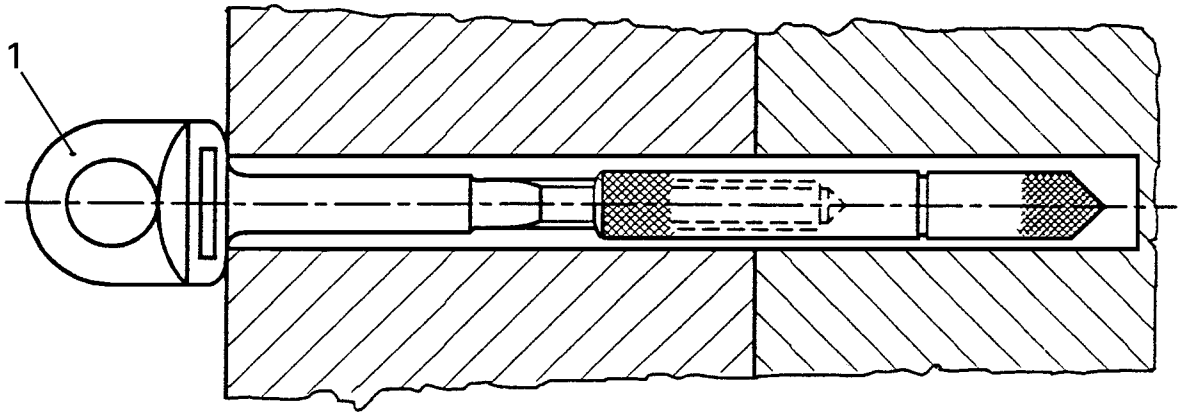
Figure 8 — Examples of Class A1 PPE anchors



Key

1 Backplate
2 Anchor device

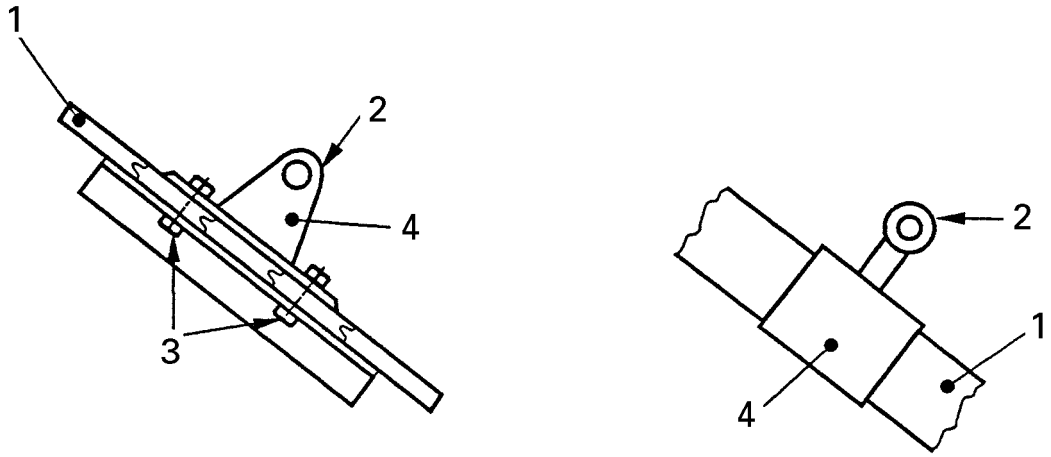
Figure 9 — Example of 'through-type' PPE anchor in load-bearing cavity wall



Key

1 Anchor device

Figure 10 — Example of chemically bonded PPE anchor



Key

1 Structure
2 PPE attachment point
3 Fixings
4 Anchor device

Figure 11 — Examples of Class A2 PPE anchors

5.2 Class A1 anchor devices (see Figure 8)

5.2.1 Static strength test

When tested in accordance with 6.3.1.1, Class A1 anchor devices shall sustain a force of 12 kN (2 697 lb·f) for a period of not less than 3 min. The anchor device may bend, but it shall not show signs of fracture.

The test is to be repeated for each direction in which an arrest force could be applied. New anchor devices may be used for each test if the manufacturer so desires.

5.2.2 Dynamic strength test

When tested in accordance with 6.3.2.2, Class A1 anchor devices shall not release the drop mass. The drop mass shall remain suspended for 3 min after the drop test. The anchor device may bend, but it shall not show signs of fracture.

The test shall be repeated for each direction in which an arrest force could be applied. New anchor devices may be used for each test if the manufacturer so desires.

5.3 Class A2 anchor devices (see Figure 11)

5.3.1 Static strength test

When tested in accordance with 6.3.1.2, Class A2 anchor devices shall sustain a force of 12 kN (2 697 lb·f) for a period of not less than 3 min. The anchor device may bend, but it shall not show signs of fracture.

The test shall be repeated for each direction in which an arrest force could be applied. New anchor devices may be used for each test if the manufacturer so desires.

5.3.2 Dynamic strength test

When tested in accordance with 6.3.2.3, Class A2 anchor devices shall not release the drop mass. The drop mass shall remain suspended for 3 min after the drop test. The anchor device may bend, but it shall not show signs of fracture.

The test shall be repeated for each direction in which an arrest force could be applied. New anchor devices may be used for each test if the manufacturer so desires.

5.4 Class B anchor devices (see Figure 12)

5.4.1 Static strength test

When tested in accordance with 6.3.1.3, Class B anchor devices shall sustain a force of 12 kN (2 697 lb·f) for a period of not less than 3 min. The anchor device may bend, but it shall not show signs of fracture.

The test shall be repeated for every orientation in which the anchor device can be installed, and for each direction in which an arrest force could be applied. This particularly applies to anchor devices as shown in Figure 12b) and 12c). New anchor devices may be used for each test if the manufacturer so desires.

5.4.2 Additional static strength test

Where the manufacturer permits self-retracting lifelines in accordance with ISO 10333-3 to be attached to side mountings on one leg of tripod products, the following additional requirements shall apply.

When tested in accordance with 6.3.1.4, anchor devices shall sustain a force of 12 kN (2 697 lb·f) for a period of not less than 3 min.

NOTE This test is intended to assess the PPE attachment points on the tripod leg and apex simultaneously. It is not intended to assess the retractable lifeline.

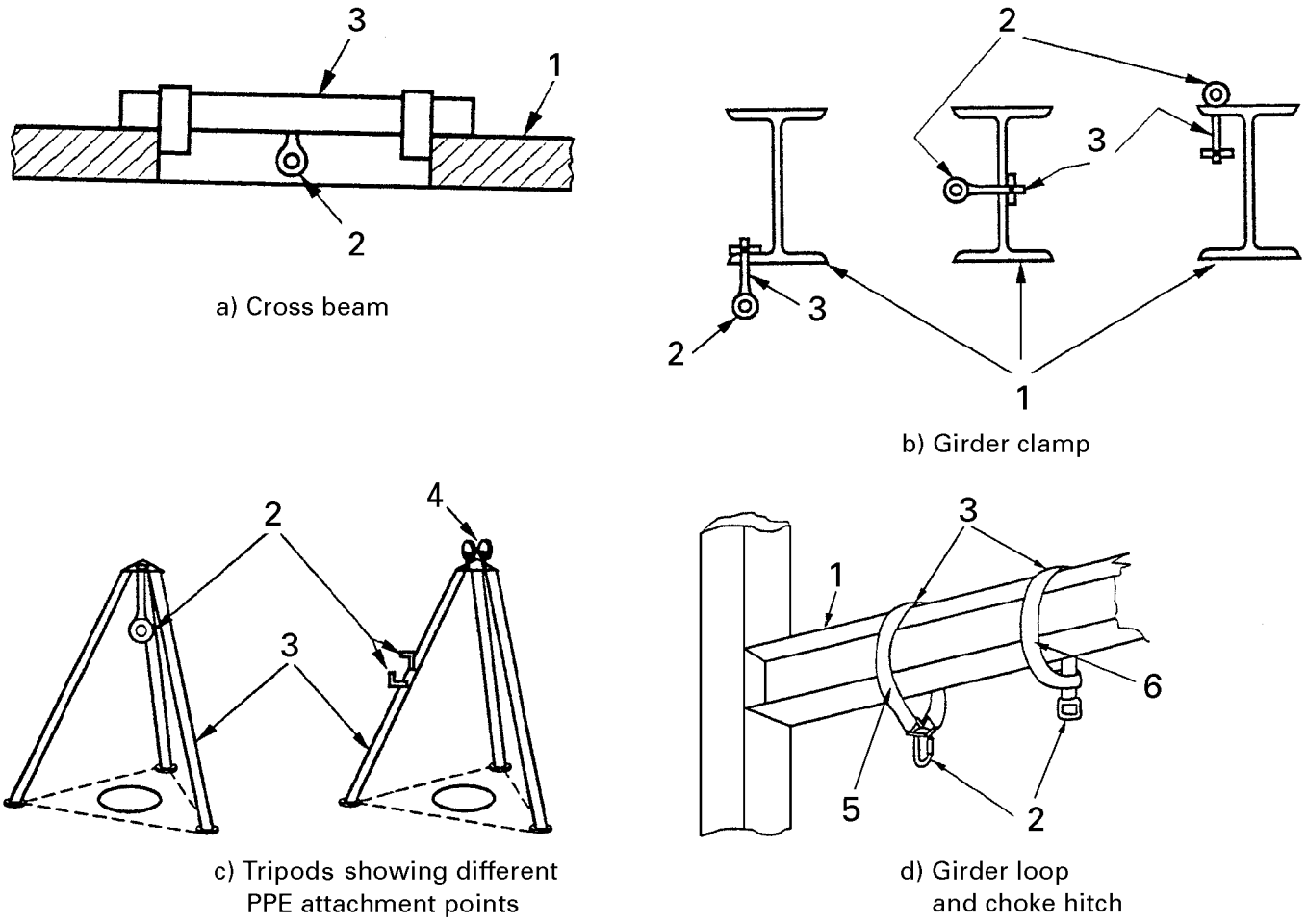
5.4.3 Dynamic strength test

When tested in accordance with 6.3.2.2, Class B anchor devices shall not release the drop mass. The drop mass shall remain suspended for 3 min after the drop test. The anchor device may bend, but it shall not show signs of fracture.

The test shall be repeated for every orientation in which the anchor device can be installed, and for each direction in which an arrest force could be applied.

NOTE This particularly applies to anchor devices as shown in Figure 12b) and 12c).

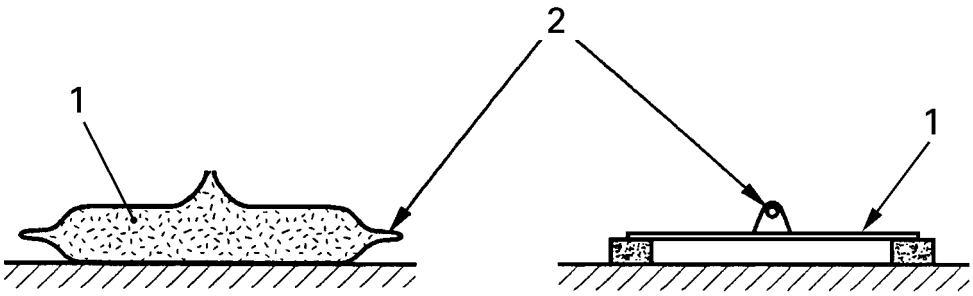
New anchor devices may be used for each test if the manufacturer so requires.



Key

1 Structure
2 PPE attachment point
3 Anchor device
4 Pulley wheels for guiding self-retracting lifeline
5 Girder loop
6 Choke hitch

Figure 12 — Examples of Class B PPE anchors



Key

1 PPE anchor
2 PPE attachment point

Figure 13 — Example of Class E anchor devices

Dimensions in millimetres

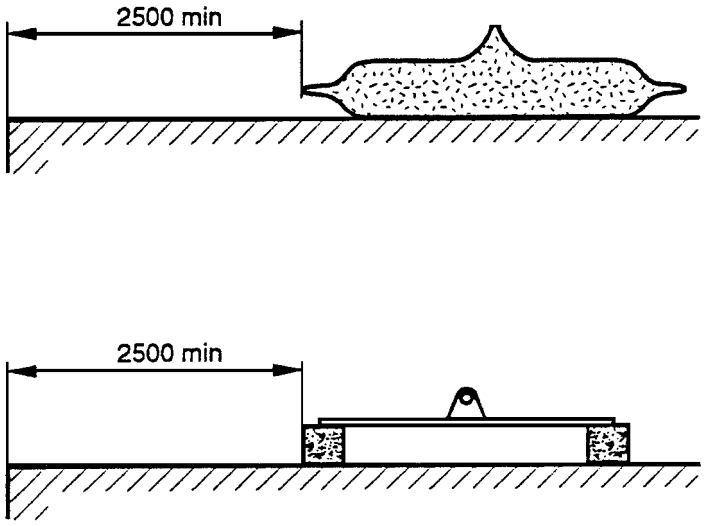


Figure 14 — Minimum distance to roof edge for Class E anchor devices

5.5 Class E — Deadweight anchor devices (see Figure 13)

5.5.1 Deadweight anchor devices shall not be used where the distance D to the edge of the roof is less than 2,5 m (98,4 in) (see Figure 14).

5.5.2 Deadweight anchor devices shall only be used under those conditions for which the manufacturer claims suitability (e.g. not suitable when there is a risk of frost, freezing, contaminated surfaces).

5.5.3 Dynamic strength test

When tested in accordance with 6.3.2.5, Class E anchor devices shall not release the drop mass. The test shall be repeated for each critical direction in which an arrest force could be applied. New anchor devices may be used for each test if the manufacturer so desires.

The displacement L of the centre of mass of the deadweight anchor device shall not exceed 1 000 mm (39,4 in). Displacement H shall be measured 3 min after drop test and shall not exceed 1 000 mm (39,4 in). (See Figure 20). The test shall be carried out under each condition, and on each type of roof surface, for which the manufacturer claims suitability.

6 Product testing (type tests)

6.1 General

The sample anchor device or anchor system shall be tested with forces applied in line with expected service. The configuration for a test shall be in accordance with the manufacturer's instructions for use and installation, including pre-tension, where applicable, to represent the worst case for each type of anchor device. For example, with Class B, tests should be conducted with the legs at maximum adjusted length.

6.2 Requirements for the test apparatus

6.2.1 Static testing machines

6.2.1.1 Force measuring

Force-measuring apparatus for static testing of components and systems shall conform to EN 10002-2.

The calibration of 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 EN 45001).

6.2.1.2 Rate of stressing

The rate of stressing shall conform to EN 10002-1.

6.2.2 Dynamic testing apparatus

The rigid anchor 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 1,0 mm (0,04 in).

The rigid anchor point shall be a ring of 20 mm ± 1 mm (0,8 in ± 0,04 in) bore and 15 mm ± 1 mm (0,6 in ± 0,04 in) diameter cross section, or a rod of the same diameter cross section.

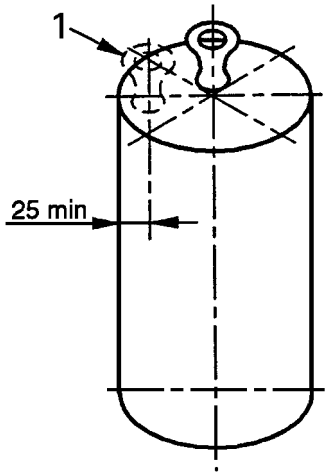
The height of the rigid anchor point shall be such as to ensure that no part of the component or system under test, or of the rigid steel mass, shall strike the floor during the test.

6.2.3 Rigid steel masses (see Figure 15)

The mass shall be 100 kg ± 1 kg (220 lb ± 2,2 lb). It shall incorporate a rigid connection point which shall be central at one end, but an offset additional connection point is also permissible to accommodate horizontal dimensional constraints of relevant testing procedures and equipment.

An additional connection point is optional.

Dimension in millimetres



Key

1 Optional, additional connection point

Figure 15 — Rigid steel mass for dynamic tests

6.2.4 Quick-release device

The quick-release device shall be compatible with the connection point of the steel masses (6.2.3). It shall ensure the release of a rigid steel mass with no initial velocity.

6.2.5 Corrosion test apparatus

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

6.3 Test methods

6.3.1 Static strength test procedures

6.3.1.1 Class A1 anchor devices

Install the anchor device according to the manufacturer's instructions in typical samples of the types of construction in which it is intended for use (e.g. concrete, brickwork, steel) (see Figure 16). This test is to confirm the performance of the anchor device and not the performance of the PPE anchor.

Install the static strength apparatus in accordance with 6.2.1 and apply the test forces to the PPE attachment point. Observe that the anchor device holds the force.

The test shall be repeated for each direction in which an arrest force could be applied. New anchor devices may be used for each test if the manufacturer so desires.

Dimensions in millimetres

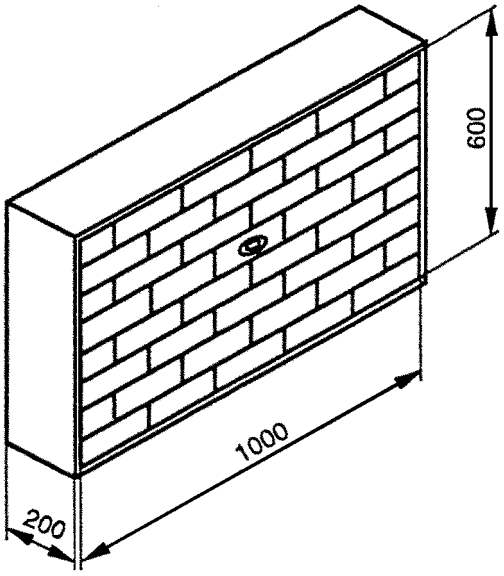


Figure 16 — Minimum dimensions of brickwork for static strength test — Class A1 anchor devices

6.3.1.2 Class A2 anchor devices

Install the anchor device according to the manufacturer's instructions in typical samples of the types of construction which it is intended for use (e.g. concrete, brickwork, steel). This test is to confirm the performance of the anchor device and not the performance of the PPE anchor.

Install the static strength apparatus in accordance with 6.2.1 and apply the test forces to the PPE attachment point. Observe that the anchor device holds the force.

The test shall be repeated for each direction in which an arrest force could be applied. New anchor devices may be used for each test if the manufacturer so desires.

6.3.1.3 Class B anchor devices

Install the device in accordance with the manufacturer's instructions. The tripod legs shall be extended to the maximum length permissible in order to obtain the most unstable condition. If the manufacturer permits differential adjustment for uneven surfaces, this also shall be assessed.

Install the static strength apparatus in accordance with 6.2.1 and apply the test force to the PPE attachment point. Observe that the anchor device holds the force, and that they remain stable.

Repeat the test for each PPE attachment point. New anchor devices may be used for each test if the manufacturer so desires.

6.3.1.4 Additional static strength test for Class B devices

Where the manufacturer permits self-retracting lifelines conforming to ISO 10333-3 to be attached to side mountings on one leg (see 5.4.2), proceed as follows.

Install a retractable lifeline to the tripod in accordance with the manufacturer's instructions. The lifeline may be shortened for the purposes of the test. Pass the lifeline around the apex pulley and connect to the static strength apparatus in accordance with 6.2.1. Apply the test force to the lifeline (Figure 17). Observe that the anchor device holds the force, and that the tripod remains stable.

The tripod legs shall be extended to the maximum length permissible in order to obtain the most unstable condition.

If the manufacturer permits differential adjustment for uneven surfaces, this tripod shall be tested in that condition.

6.3.2 Dynamic testing procedures

6.3.2.1 General

The fibre rope lanyard required for tests on Class A and B anchor devices shall be made from three-strand, 12 mm (0,472 in) diameter hawser laid polyamide (nylon) rope complying with ISO 1140. An eye 75 mm ± 10 mm (2,95 in ± 0,4 in) long shall be spliced into each end of the lanyard with a splice of five full tucks. The effective length of the lanyard measured under 40 N ± 5 N (9 lb ± 1,1 lb) shall be 2 000 mm ± 50 mm (78,7 in ± 2,0 in).

6.3.2.2 Class A1 and Class B anchor devices

Secure one end of the test lanyard by means of a connector to the anchor device under test and the other, also by means of a connector, to the 100 kg (220 lb) mass.

At a maximum of 300 mm (11,8 in) horizontally from the attachment point and by means of the quick-release device, support the solid mass so that when released it will fall freely through 2 500 mm ± 50 mm (98,4 in ± 2,0 in) before the lanyard starts to arrest the fall. For Class B anchor devices, the mass shall be positioned directly under the apex.

If the manufacturer permits differential adjustment for uneven surfaces, this tripod shall be tested in that condition.

Release the mass and observe whether the mass is arrested. For Class B anchor devices, observe also that the device is stable.

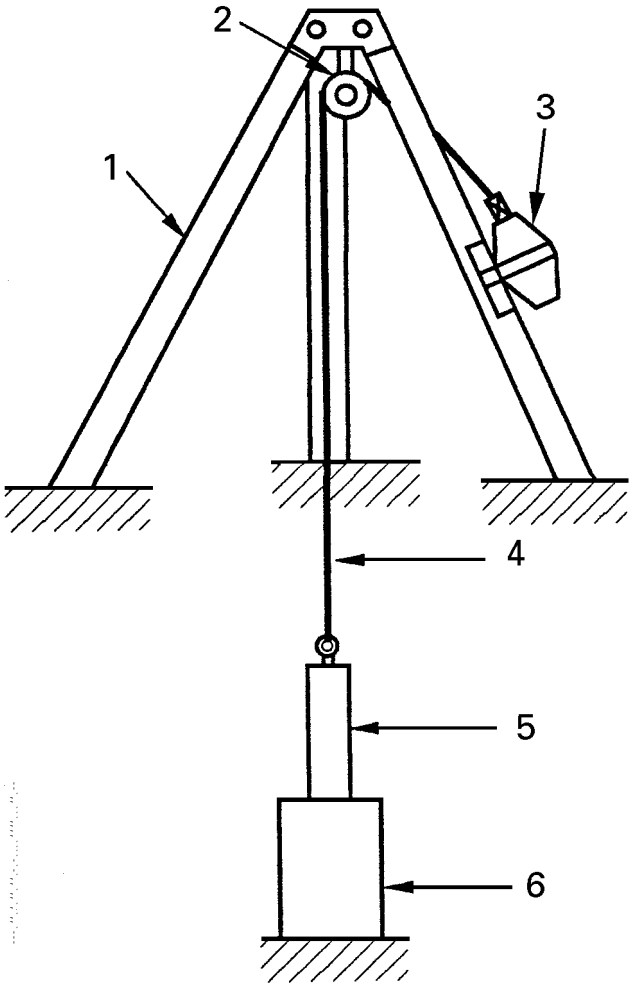
6.3.2.3 Class A2 anchor devices

Attach the anchor device according to its installation instructions, at an angle no greater than 20° from vertical, to a sample of the construction material for which it is specified (see Figure 18). Secure one end of the test lanyard by means of a connector to the anchor device under test and the other, also by means of a connector, to the 100 kg (220 lb) mass.

At a maximum of 300 mm (11,8 in) horizontally from the attachment point and by means of the quick-release device, support the solid mass so that when released it will fall freely through 2 500 mm ± 50 mm (98,4 in ± 2,0 in) before the lanyard starts to arrest the fall.

Release the mass and observe whether the mass is arrested.

Dimensions in millimetres



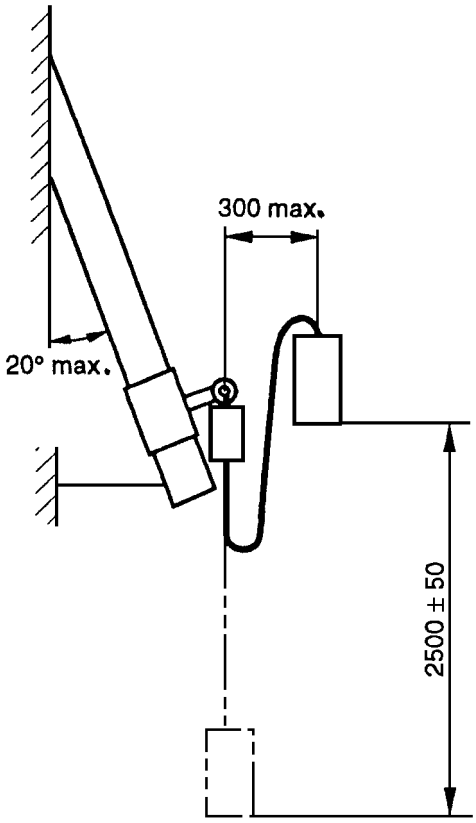


Figure 18 — Dynamic performance test for Class A2 anchor devices

Key

1 Tripod leg
2 Apex pulley
3 Retractable lifeline mounted on leg
4 Lifeline
5 Load cell
6 Tensile test machine

Figure 17 — Static test for tripod (Class B) with retractable lifeline

6.3.2.4 Additional dynamic strength test for Class B devices

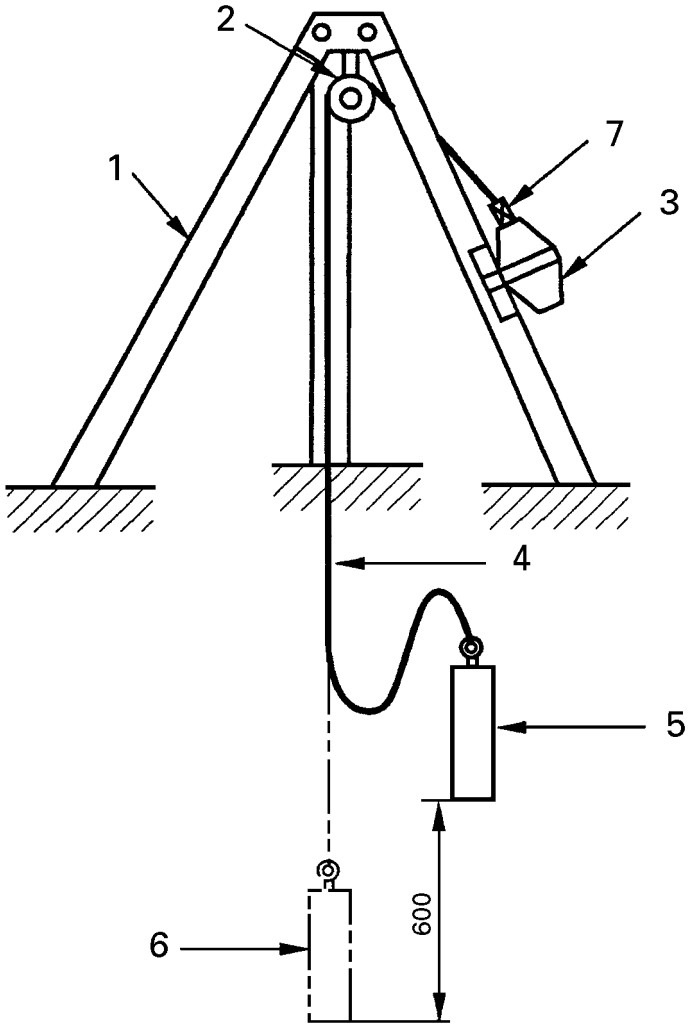
Where the manufacturer permits self-retracting lifelines conforming to ISO 10333-3 to be attached to side mountings on one leg of Class B anchor devices, proceed as follows.

Install the self-retracting lifeline to tripod in accordance with manufacturer's instructions. Pass the lifeline around the apex pulley and connect to the drop mass. With a suitable amount of lifeline paid out, prevent the retraction of the lifeline by attaching a rope clip at the exit point. Raise the mass to allow a free fall of 0,6 m (see Figure 19) with a position directly under the apex. Release the mass and observe whether the mass is arrested, and that the tripod remains stable.

If the manufacturer permits differential adjustment for uneven surfaces, this shall also be assessed.

NOTE This test is intended to assess the PPE attachment points on the tripod leg and apex simultaneously. It is not intended to assess the retractable lifeline.

Dimensions in millimetres



Key

1 Leg
2 Apex pulley
3 Retractable lifeline mounted on leg
4 Lifeline
5 Mass before release
6 Mass after freefall
7 Rope clip

Figure 19 — Dynamic test for tripod (Class B) with retractable lifeline

6.3.2.5 Class E deadweight anchors

A wire rope of 8 mm (0,315 in) diameter is required for the dynamic test.

Install the anchor device according to its installation instructions on typical samples to demonstrate the "worst case" combination of types of construction material and conditions for which the manufacturer claims suitability. For those surfaces where the manufacturer permits use when wet, the simulated roof surface used for testing shall be wet.

Where the test is to be carried out in wet conditions, apply water to the test surface, at the rate of 0,5 l/m^2, before the anchor device is assembled.

Attach the wire rope to the 100 kg (220 lb) mass and route the wire rope over the pulleys as shown in Figure 20. The pulleys shall have a minimum diameter of 100 mm (3,94 in). Secure the wire rope to the deadweight anchor device.

Raise the mass 2 500 mm ± 50 mm (98,4 in ± 2,0 in) and, at a maximum of 300 mm (11,8 in) horizontally from the radius of the pulley P, hold the mass by the quick-release device.

If the surface is to be wet, additional water should now be applied at the rate of 0,5 l/m^2.

Release the mass within 2 min of the second application of water and measure displacements L and H.

Dimensions in millimetres

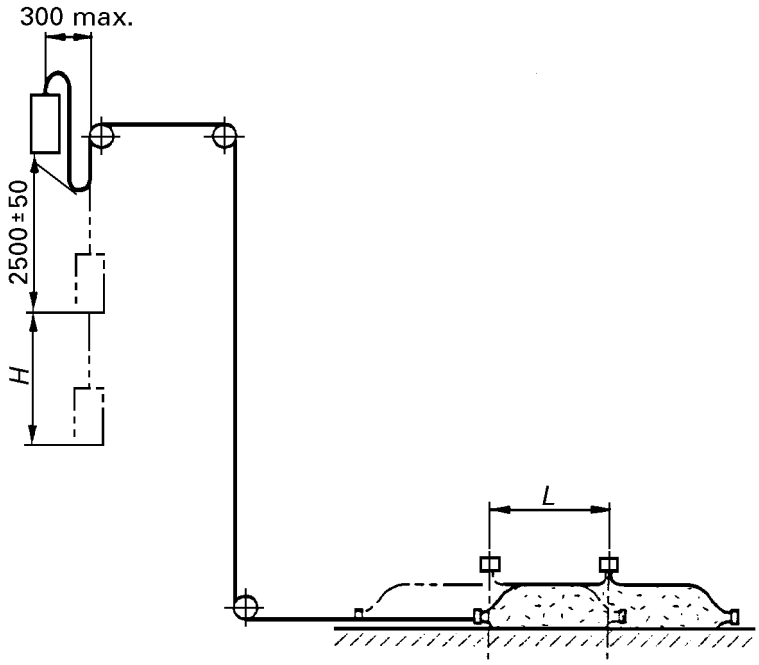


Figure 20 — Dynamic performance test on Class E anchor devices

6.3.3 Testing for corrosion resistance of metallic components

6.3.3.1 The apparatus shall comply with 6.2.5.

6.3.3.2 The specimen shall be exposed to the neutral salt spray test in accordance with ISO 9227 for a period of 24 h, and dried for 1 h.

6.3.3.3 Examine the specimen. Metal parts shall show no evidence of corrosion that would affect their function (white scaling or tarnishing is acceptable if function is not impaired).

Where necessary to gain visual access to internal components, dismantle the device and examine as described.

7 Instructions for use, and for marking

7.1 Instructions for general use

Clear instructions in the appropriate national language, for installation and general use, shall be supplied with each commercially indivisible consignment of anchor devices or anchor systems, and should include at least the following:

a) instructions containing appropriate detail, supplemented by sketches if necessary, to enable the purchaser to install and use the device or system correctly;

b) a statement of any limitations of the product (for examples, see 5.1.2 and Figure 7);

c) a warning against making any alterations or additions to the product without the prior, written consent of the manufacturer;

d) advice that documentation such as a record card be issued with and kept for each system or component, containing at least the following particulars:

   — whether the anchor device is suitable for fall-arrest, work-positioning and/or restraint use,

   — identification mark(s),

   — manufacturer's or supplier's name and address,

   — the manufacturer's serial number, if any,

   — suitability for use with other components within personal fall arresting systems,

   — date of purchase,

   — date first put into service,

   — date the next examination/service is due,

   — a space for comments;

e) instructions that where practical the anchor device or system shall be above the position of the user;

f) instructions that immediately before use, the user shall:

   — make a visual inspection of the anchor device or system to ensure that it is in a serviceable condition, and

   — ensure that the recommendations for use with other components within a system, as advised on the record card for the system or component, are complied with;

g) a warning to remove the device or system from service immediately if the system or device has been used to arrest a fall, or should any doubt arise as to its safe condition, until such time that it has been inspected and, if appropriate, tested by a competent person, authorized by the manufacturer;

h) an instruction that the system or device be examined or, where deemed necessary by the manufacturer, serviced (at least once every 12 months) by a competent person authorized by the manufacturer;

i) a recommendation that where an anchor device or system is intended to be used exclusively for the attachment of PPE, it shall be clearly marked with a statement to that effect;

j) a warning that compatibility between the anchor and any connector used with it is critical (e.g. see 5.1.2 and Figure 7).

7.2 Instructions for use specific to Class E deadweight anchors

The instruction for use should warn of the potential incompatibility between deadweight anchor devices and self-retracting lifelines (see ISO 10333-3) in situations where the lifeline has to extend and retract in the horizontal plane, and lanyards with energy absorbers (see ISO 10333-2) in fall-arrest situations where the lifeline or lanyard could be pulled over a sharp or abrupt 90° edge (e.g. a roof edge). The user should be advised to seek guidance from the manufacturer of the lifeline or lanyard that he intends to use.

For deadweight anchor devices (Class E), it is imperative that the instructions state on which types of roof surfaces the device may be used (i) when the surface is dry, and (ii) when the surface is wet.

7.3 Marking

Each detachable component of a system shall be clearly, indelibly and permanently marked, by any suitable method not having a harmful effect on the materials, with the following.

Identification mark comprising:

— the manufacturer or supplier's name, trade mark or other means of identification;

— the manufacturer's batch number or serial number of the component.

The characters in the identification mark shall be readable and discernible.

8 Installation requirements

8.1 Where anchor devices are to be installed in an existing building, the types of wall shall be checked to ascertain the nature and thickness of the structural materials, and appropriate fixings shall be selected (see clause 10). The installer shall follow the manufacturer's instructions.

8.2 For fixings in steelwork or timber, the design and method of installation shall be verified by a suitably qualified engineer that it is capable of sustaining the relevant static test force.

8.3 For fixings in substrate other than those specified in the manufacturer's instructions for use, the installer shall verify the suitability by carrying out a test in a sample of the material. The sample shall meet the requirements of the relevant test specified in clause 5.

8.4 Care shall be taken to assess the suitability of a transportable temporary anchor device and any associated fixings for the application in which it is to be used. The viability of any installation shall be verifiable by a suitable qualified engineer.

8.5 After installation, Class A1 anchor devices in materials other than steelwork or timber, unless of the through-bolt type, shall be submitted to a pull-out test to confirm the soundness of the fixing. The test force shall be 5 kN (1124 lb·f). The fixing shall sustain the force for a minimum of 15 s.

8.6 The installer shall also ensure that the minimum clearance required or necessary to arrest the fall of a falling worker does not exceed the distance available on site (see Figure 6).

8.7 Class E deadweight anchor devices of the water-weight type shall be withdrawn from service if any leakage occurs. Repairs should only be undertaken by the manufacturer.

9 Position of anchors

9.1 General

9.1.1 Fall-arrest systems are designed to limit the extent of an accidental fall. This is achieved by gradually decelerating the faller over a distance. In order to prevent the possibility of a collision, there shall be sufficient free space directly under the faller for the fall to be arrested in; i.e. the free space shall be greater than the distance of the fall, and the path of the fall shall be obstacle free.

9.1.2 The required free space (RFS) on site shall be determined by considering factors such as what fall protection devices(s) are to be attached to the anchor device (obtaining arrest distance from manufacturer’s information), free-fall distances, faller’s mass, height of faller, harness stretch, and safety clearance required between faller’s feet and ground in post-fall suspension.

9.1.3 The PPE anchor shall be installed so that its vertical height above ground or other relevant level shall be at least equal to the RFS. For an example, refer to Figure 6.

9.1.4 Wherever anchor devices are to be used, particularly in brickwork or combined brickwork/blockwork walls, it shall be ensured that there is sufficient stability of the wall to provide adequate safety against its collapse if the arrest force from a falling person is applied.

9.1.5 Anchor devices shall be fixed in load-bearing structural members where the effects of fixing to such structures is fully understood. They shall not be fixed in non-load-bearing infill panels without specialist advice first being sought.

9.1.6 The position for the installation of anchor devices shall be determined by a competent person, nominated by the installer, who shall consider the manufacturer's instructions for use and the need to consult with a suitably qualified engineer.

9.1.7 In specifying the position of the anchor device, the installer should ensure that the fall factor (FF) associated with the attached or incorporated fall protection system is kept to a minimum.

Fall factors of 1 and less are to be preferred. Fall factors greater than 1 are only acceptable when the installer is restricted in the choice of installation position.

Free fall distances shall be limited to 4 m.

9.1.8 Anchor devices shall not be installed in brickwork less than 225 mm (8,86 in) thick.

9.1.9 The principles governing the selection of positions for anchor devices are so to arrange them that:

a) the lanyard or connector can be attached before the user moves into a position where he/she would be at risk from a fall;

b) the anchor device is in a material strong enough to take the shock load of the arrest of a falling person;

c) due regard is paid to possible deterioration of anchor devices, for example that caused by atmospheric conditions;

d) the installer shall ensure that the minimum clearance required or necessary to arrest the fall of a falling worker does not exceed the distance available on site (see also 5.1.11);

e) the opening of any window does not reduce the effectiveness of any anchor device or lanyard or reduce the available fall distance to less than required;

f) the direction of load applied in service is in accordance with the manufacturer's instructions;

g) anchor devices are not installed at a distance from the edge of base materials or at spacings that are less than recommended by the manufacturer;

h) anchor devices are installed at depths in accordance with the manufacturer's instructions;

i) the lanyard and connector do not trail over sharp or abrupt edges in normal use or when pulled taught during a fall-arrest occurrence

9.2 Class A1 anchor devices

Additional positioning requirements are specific to Class A1 anchors, fixings designed to be secured to vertical, horizontal and inclined surfaces (e.g. walls, columns, lintels).

The following are the positions for anchor devices in the vicinity of window openings.

a) Inner reveals: in the reveal and, except in the case of double-hung sash windows, at waist level, provided that there is a minimum of 150 mm (5,9 in) thickness of masonry or concrete from either edge of the reveal to the centre of the anchor. See Figure 21.

b) Inside face of buildings: at a height within the 'typical safe reach' illustrated in Figure 22 and at least 150 mm (5,9 in) from any edge of the reveal, and for double-frame sash windows, not more than 150 mm (5,9 in) above bottom rail level. In some instances it may be necessary to fix into the floor slab or structural soffit;

c) Outer reveals: at a height within the 'typical safe reach' illustrated in Figure 22. The reveal width shall be sufficient to allow a minimum of 150 mm (5,9 in) from both structural edges. Due regard shall be given to 9.1.9 d).

d) Large window openings: due regard shall be paid to 9.1.9 d). In some instances it may be necessary to install more than one anchor device in the vertical height and/or on both reveals of the windows, or it may be necessary to fix into the floor slab or structural soffit.

e) In steel-framed buildings anchor devices may have to be secured to the structural steel framework.

f) Where a window sill is less than 1 m above the floor, the anchor shall be installed to allow the connection to be made before the window is opened.

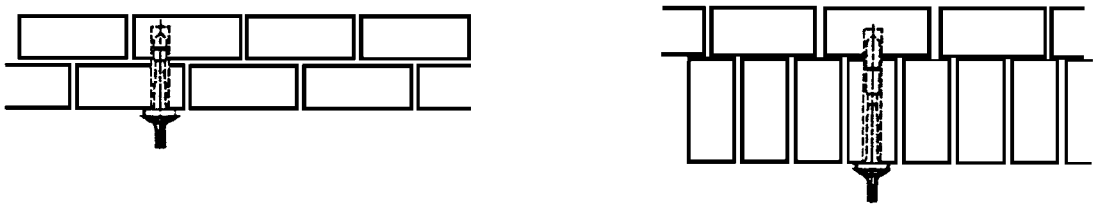
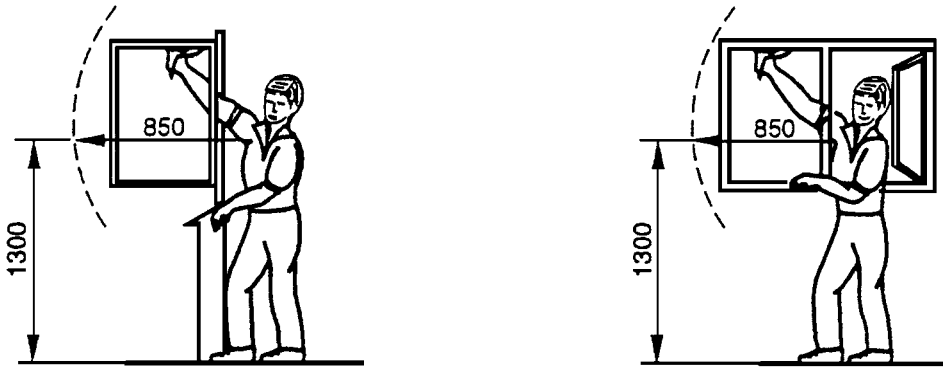


Figure 21 — Position of anchor device when installed in brickwork

Dimensions in millimetres



NOTE For people who are smaller than average, it may be necessary for them to use some form of cleaning aid to increase their reach. Cleaning from stepladders is considered unsafe.

Figure 22 — Typical safe reach for cleaning windows

9.3 Class A2 anchor devices

9.3.1 The following additional positioning advice is specific to Class A2 anchor devices, fixings designed to be secured to roofs.

Particular attention shall be paid to the strength of the structural member to which the anchor device is to be attached, together with the distance between supports and integrity of its fixings.

9.3.2 Users shall be able to gain free movement over all relevant areas of the roof while attached to an anchor, if necessary transferring safely between appropriately placed anchors.

9.3.3 Unless specifically designed for such situations, anchor devices shall not be positioned so that a fall over the gable end is possible.

9.4 Class B anchor devices

9.4.1 The following additional positioning requirements are specific to Class B anchor devices (transportable temporary anchors).

It is essential that the suitability of the positions in which transportable temporary anchors are to be used shall be assessed by a competent person, if necessary in consultation with a suitably qualified engineer. All users shall be made aware of those positions which are considered suitable, and shall be instructed not to use them in any other position.

9.4.2 The user shall ensure that transportable temporary anchors are installed in such a way that they cannot accidentally become dislodged during use, with due regard to the stability of both the anchor device and the structure. Tripods shall only be erected on stable surfaces.

9.4.3 Users of cross beams [Figure 12a)] shall be aware of possible hazards due to trailing anchor lines (e.g. tripping).

9.4.4 Users of girder attachment type devices [Figure 12b)] shall check manually to ensure that the locking device is correctly engaged before each occasion of use.

9.5 Class E — Deadweight anchor devices

9.5.1 The following additional positioning requirements are specific to class E anchor devices (deadweight anchors for use on horizontal surfaces).

The position for installation of deadweight anchors shall be determined by a competent person, if necessary in consultation with a suitably qualified engineer, and shall take into account the structural capacity of the surface being used.

9.5.2 Deadweight anchor devices shall only be used in conjunction with the types of material and under the operating conditions indicated in the manufacturer's instructions marked on the device. If no such marking is present, the anchor device shall not be used.

10 Selection of type of fixing

10.1 Selection will depend upon the nature of the types of construction to the building. All fixings shall be designed to withstand the maximum anticipated force applied in the direction of load in service.

10.2 Suggested types of fixing for commonly encountered types of construction are as follows:

a) load-bearing brickwork not less than 225 mm (8,86 in) thick: through type (Figure 9) expanding or chemically bonded (Figure 10)

b) load-bearing cavity construction: through type (Figure 9)

c) structural concrete: cast in expanding, chemically bonded (Figure 10) or other sockets.

d) structural steel: through type (Figure 2) clamping type

For other materials and fixing conditions, it is important that specialist advice be sought.

11 Method of fixing

11.1 Holes for expanding socket or chemically bonded fixings shall be drilled in strict accordance with the manufacturer's recommendations. Attention shall be paid to cleaning out the holes to ensure that resultant dust particles are removed to leave clean-sided holes to the full depth required.

11.2 Holes for expanding sockets or chemically bonded anchors shall be drilled with a rotary percussion drill, and the debris removed. If rotary or diamond boring equipment is used, the pull-out strength of resin-bonded anchors may have been reduced and therefore advice shall be sought from the fixings manufacturers.

11.3 When correctly fixed, inserts used for chemically bonded fixings shall be sufficiently embedded in resin.

11.4 Cast-in sockets in reinforced concrete shall be fixed in position before pouring the concrete. The bond mechanism shall be located behind, and at 90° to, the main reinforcement.

11.5 When male-threaded anchor devices, components or elements are inserted into holes drilled in the structure, the following points shall be observed.

a) The depth of hole shall be sufficient so that the correct length of shank as recommended by the manufacturer is enclosed when tightened (for example, see Figures 9 and 10).

b) If a bearing surface (e.g. eyebolt collar) is provided, that surface shall seal against the face of the structure when the threads are tightened, in conjunction with a weatherproof seal if necessary (see Figures 2, 9 and 10).

c) When fixings are installed into brickwork, they shall be installed such that they do not rely on the bond of one single brick to those adjacent to it (see Figure 19).

11.6 Where anchor devices, components or elements utilize male and female threads, ensure adequate engagement between the male and female thread. See Figures 2, 5, 8, 9 and 10.

11.7 When assembling threaded elements, components or anchor devices, the manufacturer’s recommended torque loadings shall be applied.

11.8 When holes have been drilled in a structure where it may be exposed to external weather conditions, a suitable weatherproof seal (e.g. polyethylene washer) shall be applied to prevent ingress of water. See Figures 9 and 10.

12 Inspection and testing

12.1 Recommended tests after installation using expanding socket or chemically bonded fixings

12.1.1 Each anchor/fixing, after installation, shall be submitted to an axial pull-out force of 5 kN (1124 lb·f) to confirm the soundness of the fixing. The fixing shall sustain the force for a minimum of 15 s. Fixings failing this test shall be rejected.

12.1.2 After testing, the structural fabric shall be carefully examined for cracking or other signs of failure, and appropriate action taken where necessary.

12.2 Recommended tests after installation for clamping or through-type fixings

12.2.1 Clamping and through-type anchors shall be tested by tightening the nut with a torque spanner set to the manufacturer's recommendation.

12.2.2 After testing, the structural fabric shall be carefully examined for cracking or other signs of failure, and appropriate action taken where necessary.

12.3 Certificate of test after installation

The installer shall provide a certificate stating that the anchor devices have been installed and tested in accordance with this International Standard. The certificate shall include a warning against misuse of the anchor device and shall draw attention to the need to inspect the anchor device before each occasion of use.

13 Maintenance

13.1 Before each occasion of use, anchor devices and anchor systems shall be visually inspected and shall be checked manually, in accordance with the manufacturer's instructions for use.

13.2 At least once every year, each anchor device and anchor system shall be fully examined, in accordance with the manufacturer's instructions, by a competent person authorized by the manufacturer.

Where necessary, anchor devices/anchor systems may require testing in accordance with the manufacturer's instructions.

13.3 The following additional inspection and examination is specific to Class A1 anchor devices.

The examination should include a visual inspection for wear to the eyebolt and damage to the surrounding structure. Demountable components should be removed, thoroughly examined for wear, defects and corrosion, re-installed if satisfactory, and retested as specified in 12.1. A new certificate, in accordance with 12.3, should be issued.

Bibliography

[1] ISO 10333-4, *Personal fall-arrest systems — Part 4: Fall arresters and vertical systems.*

[2] ISO 10333-6, *Personal fall-arrest systems — Part 6: Systems performance tests.*

[3] ISO 14566, *Personal equipment for protection against falls — Work positioning systems.*

[4] ISO 16024, *Personal equipment for protection against falls — Horizontal lifelines.*

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