INTERNATIONAL STANDARD

ISO 10333-2

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Personal fall-arrest systems —

Part 2: Lanyards and energy absorbers

Systèmes individuels d'arrêt de chute —

Partie 2: Longes et absorbeurs d'énergie

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.

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.

International Standard ISO 10333-2 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 which incorporate a sliding-type fall arrester*

— *Part 5: Connectors*

The systems performance tests will be the subject of a future part 6 to 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 (all parts), *Quality management and quality assurance standards*.

Personal fall-arrest systems

Part 2: Lanyards and energy absorbers

1 Scope

This part of ISO 10333 specifies requirements, test methods, instructions for use and maintenance, marking, labelling and packaging, as appropriate, for lanyards and energy absorbers.

Lanyards and energy absorbers are used together as a connecting subsystem in personal fall-arrest systems (PFAS) which will be specified in a future International Standard (see ISO 10333-6 in the Bibliography).

Two classes of energy absorbers are specified for the purposes of this part of ISO 10333:

a) Type 1: used in PFAS where, due to installation, the potential free-fall distance can be limited to a maximum of 1,8 m and, if a fall takes place, the arresting force is limited to a maximum of 4,0 kN;

b) Type 2: used in PFAS where, due to installation, the potential free-fall distance can be limited to a maximum of 4,0 m and, if a fall takes place, the arresting force is limited to a maximum of 6,0 kN.

This part of ISO 10333 is applicable only to lanyards and energy absorbers limited to single-person use of a total mass not exceeding 100 kg.

NOTE Users of fall-protection equipment whose total mass (including tools and equipment) exceeds 100 kg are advised to seek advice from the equipment manufacturer regarding the suitability of this equipment, which may need additional testing.

For the purposes of this part of ISO 10333, energy absorbers may be supplied integral to a lanyard, integral to a full body harness (FBH), or may be supplied separately.

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

a) PFAS that incorporate lanyards without energy absorbers or without a means of energy dissipation;

b) special lanyards and energy absorbers which are integral (i.e. can only be separated by mutilation or by special tool) to the PFAS components as specified in ISO 10333-4.

This part of ISO 10333 does not specify those additional requirements that would apply when lanyards and energy absorbers 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 and other specifications dealing with relevant physical characteristics and/or the safety of users. In particular, when it is considered necessary to test the corrosion resistance of metallic parts of the equipment, reference should be made to ISO 9227.

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 1834:1999, *Short link chain for lifting purposes — General conditions of acceptance*.

ISO 1835:1980, *Short link chain for lifting purposes — Grade M (4), non-calibrated,for chain slings etc*.

ISO 2307:1990, *Ropes — Determination of certain physical and mechanical properties.*

ISO 3108:1974, *Steel wire ropes for general purposes — Determination of actual breaking load.*

ISO 4878:1981, *Textiles — Flat woven webbing slings made of man-made fibre*.

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

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

ISO 10333-4, *Personal fall-arrest systems — Part 4: Vertical rails and vertical lifelines which incorporate a sliding-type fall arrester.*

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

ISO 14567, *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 Lanyards and energy absorbers

3.1.1
lanyard
finished length of flexible material, which in conjunction with an energy absorber is used as a connecting subsystem in PFAS

3.1.2
adjustable lanyard
lanyard which incorporates a mechanism which allows its length to be shortened or lengthened

1) To be published.

3.1.3
energy absorber
component designed to dissipate the kinetic energy generated during a fall, and which limits the arresting forces applied to the PFAS, anchor device and user

3.1.4
energy-absorbing lanyard
lanyard with an integral energy absorber

3.1.5
FBH with energy absorber
FBH with an integral energy absorber

3.1.6
permanent extension
difference in the pin centre lengths of an energy absorber before and after deployment

3.1.7
pin centre length (PCL)
straight line distance measured between the bearing point of one energy absorber termination to the other, with the absorber under tension

See Figure 1.

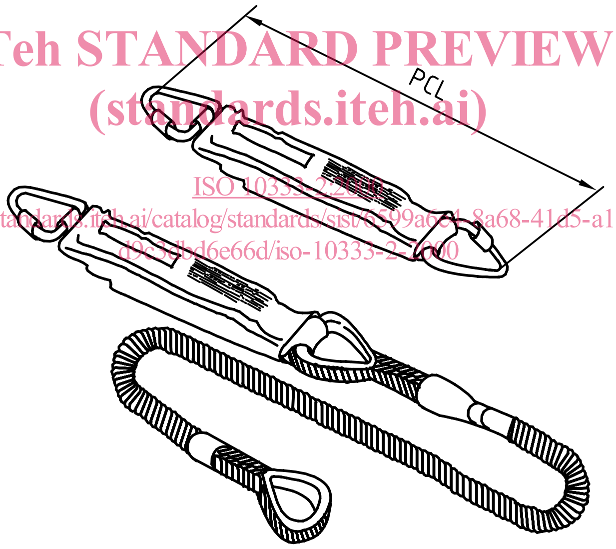

Figure 1 — Example of an energy absorber (upper view) and an energy-absorbing lanyard (lower view)

3.1.8
deployment
when the energy absorber begins and continues to permanently extend in order to dissipate the energy applied to it, it is said to have deployed

NOTE In the case of the tear-web/tear-stitch types, tearing produces a permanent extension; in the case of the friction types, dragging of the rope or webbing through the friction device produces a permanent extension.

3.1.9
free-fall distance
total vertical distance through which a worker falls under the forces of gravit¸· and air resistance only, from the start of the fall to the onset of the arresting force

3.1.10
total mass
total sum of the worker's mass plus all attached clothing and equipment

3.2 General definitions

3.2.1
component
constituent part of a PFAS (3.2.3) or subsystem (3.2.2) that has completed the manufacturer's production cycle and is available for purchase

3.2.2
subsystem
constituent part of a PFAS (3.2.3) which may consist of one or more components, and is used to connect the user from the fall-arrest attachment element of the FBH to the anchor device

NOTE A subsystem performs the two essential functions in PFAS of a) connecting, and b) arresting and energy absorbing.

3.2.3
personal fall-arrest system
PFAS
assembly of interconnected components and subsystems, including a FBH worn by the user, that 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 so as to prevent collision with the ground or other relevant obstruction, and maintains the user in a suitable post-fall arrest attitude for rescue purposes.

4 Requirements

4.1 General

To ensure that components assembled into a personal fall-arrest system perform correctly, it is recommended that they be tested in accordance with ISO 10333-6 [1].

4.2 Lanyard

4.2.1 Fibre ropes and webbing

4.2.1.1 Fibre ropes, webbing and sewing threads for lanyards shall be made from virgin high-tenacity filament or multifilament synthetic fibre or fibres suitable for the intended use.

4.2.1.2 The number of strands of a laid rope shall be at least three. Three-strand polyamide ropes shall comply with ISO 1140, three-strand polyester ropes with ISO 1141.

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

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

4.2.2 Chains

Chains shall comply with the requirements for 6,0 mm chains given in ISO 1835. Egg-shaped or similar end links and all connecting links shall be compatible with the chain in all respects. After manufacture, chain lanyards shall be proof tested to the levels given in ISO 1834.

4.2.3 Terminations

4.2.3.1 One end of a lanyard may be permanently spliced or fixed to a FBH in accordance with ISO 10333-1, or to an energy absorber according to this part of ISO 10333, or to a connector which meets the requirements of ISO 10333-5. The free end(s) of the lanyard shall be terminated in such a manner that they can be connected into a PFAS by an appropriate connector which meets the requirements of ISO 10333-5.

4.2.3.2 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.

4.2.3.3 Stitched eye terminations on webbing lanyards 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.

4.2.3.4 Eye terminations of wire rope lanyards shall be manufactured either with:

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

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

4.2.3.5 Selection of swage fitting, size, material type, compression die size/pressure, position of swage(s) on rope, and thimble size, shall be carried out 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.

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

4.2.3.7 Knots shall not be used to form lanyard terminations.

4.2.4 Fittings

4.2.4.1 All buckles, adjustment mechanisms, thimbles, and integral connections shall be smoothly finished and free from defects due to faulty material and manufacture. They shall not have sharp or rough edges that may cut, abrade or otherwise damage the lanyard material or cause injury to the user.

4.2.4.2 Adjustment mechanisms shall self-lock securely onto the lanyard material but shall not present roughened surfaces or sharp edges that may abrade or otherwise damage the material.

4.2.4.3 When tested in accordance with 5.2.4, all metallic fittings shall be free from red rust, as visible to the unaided eye, or other evidence of corrosion of the base metal. The presence of white scale after the test is acceptable.

4.2.5 Adjustment slippage

When tested in accordance with 5.2.1, the adjustment mechanism on adjustable lanyards shall not allow a lanyard slippage of more than 25 mm.

4.2.6 Static strength

When tested in accordance with 5.2.2, the lanyard, including its terminations and if applicable its adjustment device, shall sustain a force as specified in Table 1 without tearing or rupture of any element.