



SLOVENSKI STANDARD
SIST EN 1760-1:2000+A1:2009
01-maj-2009

BUXca Yý U
SIST EN 1760-1:2000

JUfbcghlfcYj !JUfcj UbYbUdfUj YZcV i hñj YbUñU_ !%XY. Gd`cýbUbu YU
bU flcj UbU]b`dfYg_i ýUbUdfYdfc[]b`dcXcj žcV i hñj Ñ `bUñU_

Safety of machinery - Pressure sensitive protective devices - Part 1: General principles for the design and testing of pressure sensitive mats and pressure sensitive floors

Sicherheit von Maschinen - Druckempfindliche Schutzeinrichtungen - Teil 1: Allgemeine Leitsätze für die Gestaltung und Prüfung von Schaltmatten und Schaltplatten

Sécurité des machines - Dispositifs de protection sensibles à la pression - Partie 1: Principes généraux de conception et d'essai des tapis et planchers sensibles à la pression

Ta slovenski standard je istoveten z: EN 1760-1:1997+A1:2009

ICS:

13.110 Varnost strojev Safety of machinery

SIST EN 1760-1:2000+A1:2009 en,fr

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 1760-1:2000+A1:2009

<https://standards.iteh.ai/catalog/standards/sist/e393b076-5f9f-49d5-8dd3-f95b4836855c/sist-en-1760-1-2000a1-2009>

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1760-1:1997+A1

April 2009

ICS 13.110

Supersedes EN 1760-1:1997

English Version

**Safety of machinery - Pressure sensitive protective devices -
Part 1: General principles for the design and testing of pressure
sensitive mats and pressure sensitive floors**

Sécurité des machines - Dispositifs de protection sensibles
à la pression - Partie 1: Principes généraux de conception
et d'essai des tapis et planchers sensibles à la pression

Sicherheit von Maschinen - Druckempfindliche
Schutzeinrichtungen - Teil 1: Allgemeine Leitsätze für die
Gestaltung und Prüfung von Schalmatten und
Schaltplatten

This European Standard was approved by CEN on 26 March 1997 and includes Amendment 1 approved by CEN on 22 February 2009.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword.....	4
Introduction	6
1 Scope	6
2 Normative references	6
3 Definitions	8
4 Requirements	10
4.1 General.....	10
4.2 Actuating force.....	10
4.3 Response time (see 7.5 for test method)	12
4.4 Static loading (see 7.6 for test method)	13
4.5 Number of operations (see 7.7 for test method).....	13
4.6 The output state of the sensor (see 7.8 for test method)	13
4.7 Response of output signal switching device(s) to the actuating force (see 7.9 for test method).....	13
4.8 Access for maintenance (see 7.10 for test method).....	14
4.9 Adjustments (see 7.11 for test method)	14
4.10 Connections (see 7.12 for test method)	14
4.11 Environmental conditions (see 7.13 for test method)	14
4.12 Power supply.....	15
4.13 Electrical equipment (see 7.15 for test method).....	16
4.14 Enclosure (see 7.16 for test method).....	16
4.15 Categories for safety-related parts of control systems according to EN 954 (see 7.17 for test method)	17
4.16 Sensor fittings (see 7.1.2 for test method).....	17
4.17 Tripping (see 7.1.2 for test method).....	17
4.18 Slipperiness and softness of the sensor top surfaces (see 7.18 for test method).....	17
4.19 Additional coverings of top surfaces of sensor(s) (see 7.19 for test method).....	17
4.20 Failure due to blocking or wedging (see 7.20 for test method)	17
5 Marking (see 7.1.2 for test method)	18
5.1 The pressure sensitive mat or pressure sensitive floor shall be marked in accordance with [A1] 6.4 of EN ISO 12100-2:2003, 6.4 b) of EN ISO 12100-2:2003/prA1:2008) [A1] and 18.1 of EN 60204-1:1992.....	18
5.2 Marking of the control unit	18
5.3 Marking of the sensor	18
5.4 All labels and markings shall be securely fixed and durable for the expected lifetime of the part of the pressure sensitive mat or pressure sensitive floor to which it is attached (see EN 61310-2).....	18
5.5 Component parts of the pressure sensitive mat or pressure sensitive floor that can be replaced in accordance with the information for use shall be identifiable.	18
6 Information for use	18
6.1 General.....	18
6.2 Instructions for use (see 7.1.2 for test method)	18
7 Testing	21
7.1 General.....	21
7.2 Sensor test sample	21
7.3 Test pieces for load tests.....	22
7.4 Test no. 1 – Actuating force (requirements see 4.2)	22
7.5 Test no. 2 – Response time (requirement see 4.3).....	26

7.6	Test no. 3 – Static loading (requirements see 4.4).....	27
7.7	Test no. 4 – Number of operations (requirements see 4.5).....	28
7.8	Test no. 5 – Output state of the sensor (requirements see 4.6)	32
7.9	Test no. 6 – Response of output signal switching device to the actuating force (requirements see 4.7)	33
7.10	Test no. 7 – Access for maintenance (requirements see 4.8).....	33
7.11	Test no. 8 – Adjustments (requirements see 4.9)	33
7.12	Test no. 9 – Connections (requirements see 4.10)	33
7.13	Test no. 10 – Environmental conditions (requirements see 4.11).....	33
7.14	Test no. 11 – Electrical power supply (requirements see 4.12.1).....	35
7.15	Test no. 12 – Electrical equipment (requirements see 4.13).....	35
7.16	Test no. 13 – Enclosure (requirements see 4.14).....	35
7.17	Test no. 14 – Categories for safety-related parts of control systems according to EN 954 (requirements see 4.15)	35
7.18	Test no. 15 – Slipperiness and softness of the sensor top surfaces (requirements see 4.18).....	35
7.19	Test no. 16 – Additional coverings of top surfaces of sensor(s) (requirements see 4.19)	35
7.20	Test no. 17 – Failure due to blocking or wedging (requirements see 4.20)	35
Annex A (normative) Timing diagrams for devices with and without reset		36
Annex B (informative) Application notes.....		39
B.1	Mounting surface (location)	39
B.2	Size of the sensor.....	39
B.3	Selection criteria.....	39
B.4	Comparison between good and poor installation design	41
Annex C (informative) Design notes		43
C.1	General conditions	43
C.2	Pressure sensitive mats	43
C.3	Pressure sensitive floors.....	45
Annex D (informative) Installation, commissioning and test		48
D.1	General	48
D.2	Installation.....	48
D.3	Commissioning.....	48
D.4	Regular inspection and tests	49
D.5	Tests after maintenance	49
Annex E (informative) Bibliography		50
Annex ZA (informative) $\boxed{A_1}$ Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC $\boxed{A_1}$		51
Annex ZB (informative) $\boxed{A_1}$ Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC $\boxed{A_1}$		52

EN 1760-1:1997+A1:2009 (E)**Foreword**

This document (EN 1760-1:1997+A1:2009) has been prepared by Technical Committee CEN/TC 114 "Safety of machinery", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

This document includes Amendment 1, approved by CEN on 2009-02-22.

This document supersedes EN 1760-1:1997.

The start and finish of text introduced or altered by amendment is indicated in the text by tags $\boxed{A_1}$ $\boxed{A_1}$.

$\boxed{A_1}$ This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document. $\boxed{A_1}$

This is the first part of a multi-part type B standard which will cover safety devices that detect the presence of a person through the application of a pressure or force by a part of the person's body. After actuation the safety devices give a stop command which is used by the control system of the machine to provide protection for the person who caused the device to be actuated.

The other parts of the standard will cover:

Part 2: General principles for the design and testing of pressure sensitive edges and pressure sensitive bars (in preparation)

Part 3: General principles for the design and testing of pressure sensitive bumpers (in preparation)

The informative annex A presents timing diagrams for devices with and without reset. The notes in informative annex B provide guidance regarding application. It is recommended that the supplier and customer liaise to examine carefully the constraints presented by the application before placing an order for the equipment.

The safeguarding of machinery $\boxed{A_1}$ (see 3.20 of EN ISO 12100-1:2003) $\boxed{A_1}$ can be achieved by many different means. These means include guards which prevent access to the danger zone by means of a physical barrier (e.g. fixed guards to $\boxed{A_1}$ EN 953 $\boxed{A_1}$ and interlocking guards to EN 1088); and protective devices, (e.g. electro-sensitive protective equipment to $\boxed{A_1}$ EN 61496-1 $\boxed{A_1}$ and pressure-sensitive protective devices to this standard).

Type C standards makers and designers of machinery/installations should consider the best way to achieve the required level of safety taking into account the intended application and the results of the risk assessment (see $\boxed{A_1}$ EN ISO 14121-1 $\boxed{A_1}$).

The best solution may combine several of these different means. It is recommended that the machinery/installation supplier and the user examine together carefully the existing constraints before making their decision on the choice of safeguarding means.

The notes in informative annex C give guidance regarding the design of pressure sensitive mats and pressure sensitive floors. Informative annex D gives guidance for installation, commissioning and testing. Informative annex E contains bibliography.

This European Standard does not specify the dimensions or the configuration of the effective sensing area of pressure sensitive mat(s) or floor(s) in relation to any particular application. However, there is a requirement for the manufacturer of the safety device to provide sufficient information to enable the user (i.e. the machinery manufacturer and/or the user of the machinery) to specify an adequate arrangement.

A1 *deleted text* **A1**

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 1760-1:2000+A1:2009](https://standards.iteh.ai/catalog/standards/sist/e393b076-5f9f-49d5-8dd3-f95b4836855c/sist-en-1760-1-2000a1-2009)

<https://standards.iteh.ai/catalog/standards/sist/e393b076-5f9f-49d5-8dd3-f95b4836855c/sist-en-1760-1-2000a1-2009>

EN 1760-1:1997+A1:2009 (E)**Introduction**

Pressure sensitive protective devices are used in a wide variety of applications with different conditions of use relating, for example, to extremes of loading, electrical, physical and chemical environments. They are interfaced with the machine controls to ensure that the machine reverts to a safe condition if the pressure sensitive device is actuated.

Each type of application presents particular hazards. It is not the intention of this standard to identify those hazards nor to recommend specific methods of application to particular machines. This is normally the function of machine specific standards.

1 Scope

This Standard specifies requirements for pressure sensitive mats and floors normally actuated by the feet for use as safety devices to protect persons from dangerous machinery. The minimum safety requirements for the performance, marking and documentation are given.

The Standard covers pressure sensitive mats and floors, regardless of type of energy used, e.g. electrical, hydraulic, pneumatic or mechanical.

This standard covers mats and floors designed to detect:

- a) Persons weighing more than 35 kg;
- b) And persons (e.g. children) weighing more than 20 kg.

The detection of persons weighing less than 20 kg is not covered by this standard.

This European Standard does not specify the dimensions or the configuration of the effective sensing area of pressure sensitive mat(s) or floor(s) in relation to any particular application.

2 Normative references

[A1] The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. **[A1]**

[A1] *deleted text* **[A1]**

[A1] EN 953:1997, *Safety of machinery – Guards – General requirements for the design and construction of fixed and movable guards* **[A1]**

EN 954-1:1996, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

EN 982:1996, *Safety of machinery – Safety requirements for fluid power systems and their components - Hydraulics*

EN 983:1996, *Safety of machinery – Safety requirements for fluid power systems and their components – Pneumatics*

EN 999 A1, *Safety of machinery – The positioning of protective equipment in respect of approach speeds of parts of the human body*

A1 deleted text A1

EN 1088:1995, *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection*

A1 deleted text A1

EN 50081, *Electromagnetic compatibility – Generic emission standard*

EN 50082, *Electromagnetic compatibility – Generic immunity standard*

EN 60204-1:1992, *Safety of machinery; electrical equipment of machines; part 1: general requirements (IEC 204-1:1992, modified)*

EN 60439-1:1994, *Low-voltage switchgear and controlgear assemblies; part 1: type-tested and partially type-tested assemblies (IEC 439-1:1992 + corrigendum 1993)*

EN 60529, *Degrees of protection provided by enclosures (IP code) (IEC 529:1989)*

EN 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test – Basic EMC publication (IEC 1000-4-2:1995)*

EN 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 3: Radiated, radio-frequency, electromagnetic field immunity test (IEC 1000-4-3:1995, modified)*

EN 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test – Basic EMV publication (IEC 1000-4-4:1995)*

EN 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 5: Surge immunity test (IEC 1000-4-5:1995)*

EN 61310-2, *Safety of machinery – Indication, marking and actuation – Part 2: Requirements for marking (IEC 1310-2:1995)*

A1 EN ISO 12100-1:2003, *Safety of machinery – Basic concepts, general principles for design – Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

EN ISO 12100-2:2003, *Safety of machinery – Basic concepts, general principles for design – Part 2: Technical principles (ISO 12100-2:2003) A1*

A1 EN ISO 14121-1, *Safety of machinery – Risk assessment – Part 1: Principles (ISO 14121-1:2007) A1*

A1 EN ISO 14122-2, *Safety of machinery – Permanent means of access to machinery – Part 2: Working platforms and walkways (ISO 14122-2:2001) A1*

IEC 68-2-3:1969, *Basic environmental testing procedures – Part 2: Tests. Test Ca: Damp heat, steady state*

IEC 68-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 68-2-14:1984, *Basic environmental testing procedures – Part 2: Tests. Test N: Change of temperature*

ISO 6431:1992, *Pneumatic fluid power; single rod cylinders, 1000 kPa (10 bar) series, with detachable mountings, bores from 32 mm to 320 mm; mounting dimensions*

EN 1760-1:1997+A1:2009 (E)

3 Definitions

A1) For the purposes of this document, the terms and definitions given in EN ISO 12100-1:2003 and the following apply. **A1**

3.1
pressure sensitive mat
 a safety device **A1**) (see 3.26.5 of EN ISO 12100-1:2003) **A1**) which detects a person standing on it or who steps onto it. It comprises a sensor(s) which responds to the application of pressure and a control unit, and one or more output signal switching device(s) (see figure 1).

In a pressure sensitive mat the effective sensing area is deformed locally when the sensor(s) is actuated.

3.2
pressure sensitive floor
 a safety device **A1**) (see 3.26.5 of EN ISO 12100-1:2003) **A1**) which detects a person standing on it or who steps onto it. It comprises a sensor(s) which responds to the application of pressure and a control unit, and one or more output signal switching device(s).

In a pressure sensitive floor the effective sensing area is moved as a whole when the sensor(s) is actuated.

3.3
sensor
 that part of the pressure sensitive mat or pressure sensitive floor which contains an effective sensing area on which the application of an actuating force causes the signal from the sensor to the control unit to change state

3.4
effective sensing area
 that part of the top surface area of the sensor or a combination of sensors of the pressure sensitive mat or pressure sensitive floor within which a response to an actuating force (see 4.2) will take place

3.5
control unit
 The device that responds to the condition of the sensor(s) and controls the state of the output signal switching device. It may also monitor the integrity of the pressure sensitive mat or pressure sensitive floor (see reference to categories EN 954-1) and it may contain facilities to process a reset signal. The control unit may be integrated with the machine control system.

3.6
output signal switching device
 That part of the pressure sensitive mat or pressure sensitive floor which when the sensor or monitoring function means is actuated responds by producing an OFF state. The output signal switching device may be integrated with the machine control system.

3.7
actuating force
 any force which produces a pressure on the effective sensing area to create an OFF state in the output signal switching device

3.8
reset
 the function which permits an ON state in the output signal switching devices, providing that certain conditions are met

3.9
ON state of output signal switching device(s)
 a state where the output circuit(s) is complete and the flow of current or fluid is interrupted

3.10**OFF state of output signal switching device(s)**

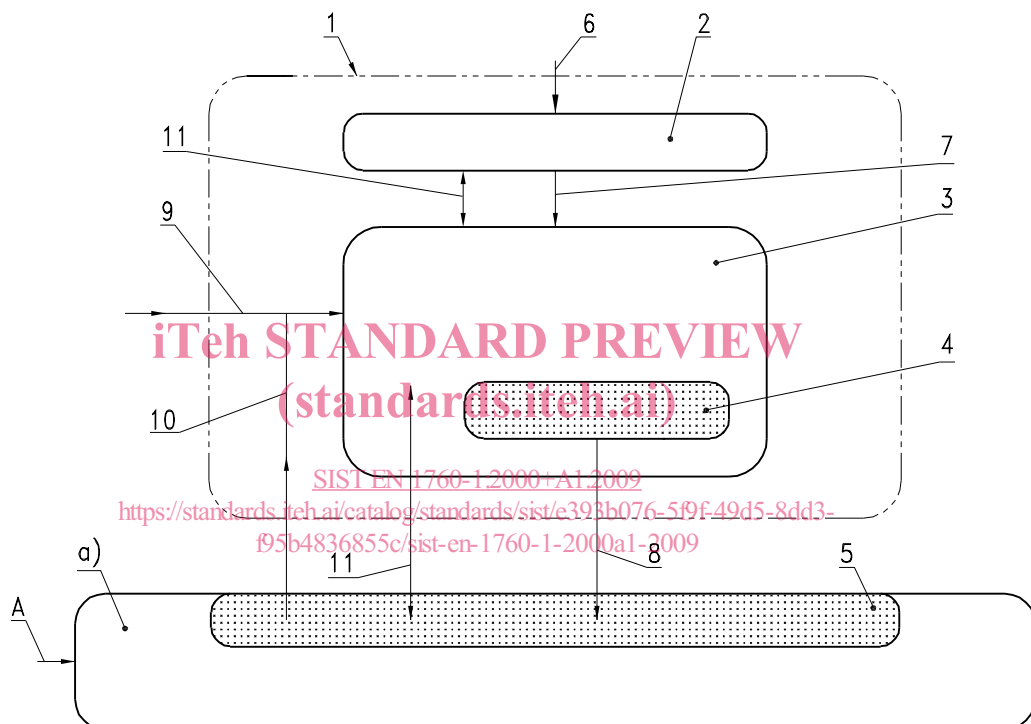
a state where the output circuit(s) is broken and the flow of current or fluid is interrupted

3.11**response time**

the time between the start of the application of a force to the effective sensing area and the start of the OFF state of the output signal switching device (see 4.3)

3.12**dead zone**

that part of the top surface area of the sensor outside the effective sensing area



- 1 Pressure sensitive mat or floor output signal processing
- 6 Actuating force
- 7 Sensor output
- 8 ON state/OFF state signal
- 9 Manual reset signal (where appropriate alternative to A)
- 10 Reset signal from machine control system (where appropriate)
- 11 Monitoring signals (optional)
- A Manual reset signal to the machine control system (where appropriate alternative to 9).
- a Machine control system(s)

Figure 1 — Pressure sensitive mat or pressure sensitive floor interfaced with a machine

EN 1760-1:1997+A1:2009 (E)**4 Requirements****4.1 General**

Pressure sensitive mats and pressure sensitive floors shall be able to detect a person who is standing on, or who steps onto the effective sensing area.

4.2 Actuating force**4.2.1 Single sensor (see 7.4.1 and 7.4.2 for test method)**

The pressure sensitive mat or pressure sensitive floor shall not respond to the actuating forces stated in table 1 when the test piece (see figure 2) is applied over the effective sensing area at a maximum speed of 2 mm/s within the operating temperature range.

Test pieces 1, 2 and 3 apply to pressure sensitive mats and pressure sensitive floors designed to detect persons weighing more than 35 kg. Test piece 4 shall additionally be applied to pressure sensitive mats and pressure sensitive floors designed to detect persons (e.g. children) weighing more than 20 kg.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 1760-1:2000+A1:2009](https://standards.iteh.ai/catalog/standards/sist/e393b076-5f9f-49d5-8dd3-f95b4836855c/sist-en-1760-1-2000a1-2009)

<https://standards.iteh.ai/catalog/standards/sist/e393b076-5f9f-49d5-8dd3-f95b4836855c/sist-en-1760-1-2000a1-2009>

Table 1 — Actuating force

Application	Test piece		Actuating force N
	Number	d mm	
For pressure sensitive mats and pressure sensitive floors designed to detect persons weighing more than 35 kg	1	11	300
	2	80	300
	3	200	600
Additional test for pressure sensitive mats and pressure sensitive floors designed to detect persons (e.g. children) weighing more than 20 kg	4	40	150

4.2.2 Combinations of sensors (see 7.4.3 and 7.4.4 for test methods)

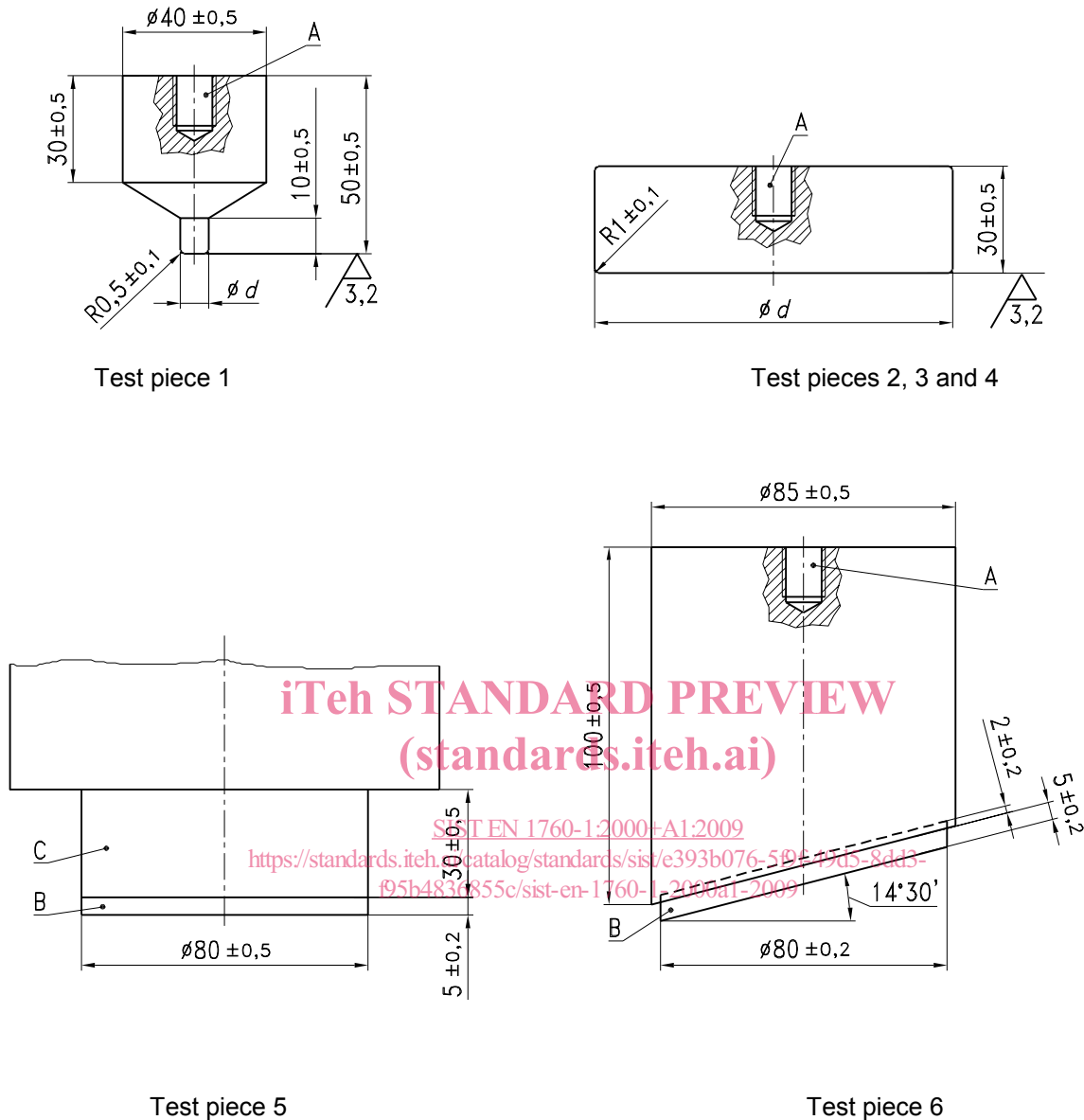
Where an effective sensing area is built up of more than one sensor, joints and junctions shall fulfil the requirements of 4.2.1 except that only test piece 2 in table 1 applies to pressure sensitive mats and pressure sensitive floors designed to detect persons weighing more than 35 kg.

Where pressure sensitive mats and pressure sensitive floors are designed to detect persons (e.g. children) weighing 20 kg or more only test pieces 2 and 4 shall apply.

For other parts of the effective sensing area, 4.2.1 shall apply (see table 1).

EN 1760-1:1997+A1:2009 (E)

Dimensions in millimetres



- A Mounting proposal only
 B Rubber "shoe", 60 Shore A \pm 5 Shore A, fixed with adhesive
 C Steel
 For d see table 1

Figure 2 — Test pieces

4.3 Response time (see 7.5 for test method)

The response time shall be stated by the manufacturer and shall not exceed 200 ms over the operating temperature range. The response time is the time between (a) and (b) where:

- Is when a test piece touches vertically the effective sensing area at a velocity of 0,25 m/s; and
- Is the start of the OFF state of the output signal switching device (see figures A.1, A.2 and A.3).

NOTE The 200 ms limit is specified to prevent the safety device from being defeated by the application of short stepping impulses.

4.4 Static loading (see 7.6 for test method)

4.4.1 After the application of a static force of $2000\text{ N} \pm 50\text{ N}$ within the effective sensing area through test piece 2 (see figure 2), for a period of 8 h, the output signal switching device shall change state within 2 min after the removal of the force and the deformation shall not be more than 2 mm depth at the lowest part of the top surface after 1 h.

4.4.2 After the application of a static force of $750\text{ N} \pm 20\text{ N}$ within the effective sensing area at another location to that used in 4.4.1 through test piece 1 (see figure 2) for a period of 8 h, the deformation shall not be more than 2 mm at the lowest part of the top surface after 1 h.

4.5 Number of operations (see 7.7 for test method)

4.5.1 A pressure sensitive mat or pressure sensitive floor shall perform its function for the typical expected number of operations.

4.5.1.1 The expected number of operations for the pressure sensitive mat or pressure sensitive floor is 100 000 operations in each of five locations (500 000 operations in total). If the effective sensing area consists of a combination of sensors, this requirement shall apply to the combination of sensors.

4.5.1.2 In addition, the expected number of operations for the sensor alone is a further one million operations in one other location.

4.5.2 When the requirements of 4.4 and 4.5.1 have been met, the pressure sensitive mat or pressure sensitive floor shall still meet the requirements of 4.2 and 4.3.

4.6 The output state of the sensor (see 7.8 for test method)

The sensor output signal shall change to a value or state which causes the output signal switching device(s) to change to the OFF state when any actuating force is applied to the effective sensing area. This value or state shall maintain the output signal switching device(s) in the OFF state until the actuating force is removed (see figures A.1, A.2 and A.3).

4.7 Response of output signal switching device(s) to the actuating force (see 7.9 for test method)

4.7.1 General

When any actuating force is applied to the effective sensing area the output signal switching device(s) shall change from an "ON" state to an "OFF" state. The output signal switching device shall remain in the OFF state for at least as long as the actuating force is applied.

4.7.2 Device with reset

For a pressure sensitive mat or pressure sensitive floor with reset the reset signal shall be manually applied either directly to the control unit of the safety device or alternatively via the machine control system (see figure 1).

The reset shall perform 2 functions:

- a) Start inhibit interlock