INTERNATIONAL STANDARD

**ISO 10295-2**

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# Fire tests for building elements and components — Fire testing of service installations —

## Part 2: Linear joint (gap) seals

*Essais au feu pour les éléments et composants de bâtiment — Essai au feu des installations de service —*

*Partie 2: Joints d'étanchéité pour interstices linéaires*

Reference number
ISO 10295-2:2009(E)

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# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10295-2 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*.

ISO 10295 consists of the following parts, under the general title *Fire tests for building elements and components — Fire testing of service installations*:

— *Part 1: Penetration seals*

— *Part 2: Linear joint (gap) seals*

A Part 3 dealing with guidance on the use of a test configuration to establish the direct and extended fields of application for single-component penetration seals is under development.

# Introduction

This part of ISO 10295 describes test methods used to determine the fire resistive nature of joint seals when subjected to the standard fire-exposure conditions outlined in ISO 834-1. The test data generated by this International Standard permit the classification of these various joint seals based on their intended use and fire resistance under the specified acceptance criteria of this part of ISO 10295.

Joint seals are positioned in joints, voids, gaps or other discontinuities between or bounded by two or more supporting elements. Normally such openings are denoted as “linear” because the length is greater than the width, defined by a typical ratio of at least 10:1 as in practice. Joints are present in buildings as a result of

a) design to accommodate various movements induced by thermal differentials, seismic events and wind loads and exist as a clearance separation;

b) acceptable dimensional tolerances between two or more building elements, e.g. between non-load-bearing walls and floors;

c) inadequate design, inaccurate assembly, repairs or damage to the building.

This part of ISO 10295 describes methods of test for evaluating joint seals based on their intended use. This part of ISO 10295 also allows for the application of movement prior to and/or during fire testing.

This part of ISO 10295 provides the requirements for the test specimen, the test construction, the equipment (including any special apparatus or instrumentation), the procedures and acceptance criteria as they apply to joint seals and their supporting elements.

# Fire tests for building elements and components — Fire testing of service installations —

## Part 2:
## Linear joint (gap) seals

**CAUTION — The attention of all persons concerned with managing and carrying out this fire-resistance test is drawn to the fact that fire testing can be hazardous and that there is a possibility that toxic and/or harmful smoke and gases can be evolved during the test. Mechanical and operational hazards can also arise during the construction of the test elements or structures, their testing and disposal of test residues.**

**An assessment of all potential hazards and risks to health shall be made and safety precautions shall be identified and provided. Written safety instructions shall be issued. Appropriate training shall be given to relevant personnel. Laboratory personnel shall ensure that they follow written safety instructions at all times.**

## 1 Scope

This part of ISO 10295 specifies the heating conditions, methods of test and criteria for the evaluation of the ability of a linear joint seal to maintain the fire integrity and thermal insulation of a fire-separating element at the joint being sealed. The purpose of the tests is to assess the integrity and insulation performance of the linear joint seals, including the effects of induced movement in those cases where the joint is designed to accommodate movement and has a width greater than 20 mm.

It is not the intention of this part of ISO 10295 to provide quantitative information on the rate of leakage of smoke and/or gases, or on the transmission or generation of fumes, although such phenomena can be recorded in describing the general behaviour of specimens during the test. It is not the intention of this part of ISO 10295 to evaluate joint seals where special test procedures already exist, e.g. doors, partitions, penetrations, pipes, ducts and cables.

## 2 Normative references

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

ISO 834-1, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

ISO 13943, *Fire safety — Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943 and the following apply.

**3.1**
**blockout**
recess created in the supporting construction to allow the installation of the joint seal

NOTE It is typically not required on all joint seals.

**3.2**
**fire-separating element**
floor, wall or other separating element of construction having a period of fire resistance determined in accordance with ISO 834-1

**3.3**
**joint**
linear void having a length to width ratio of at least 10:1 between or within two juxtaposed elements

NOTE Typical locations of joints include floors, the perimeter of floors, walls, ceilings and roofs.

**3.4**
**joint seal**
system designed to maintain the fire-separating function and, where required, to accommodate a specified degree of movement

**3.5**
**maximum joint width**
widest opening an installed joint seal is intended to tolerate

NOTE It is stated by the manufacturer or test sponsor.

**3.6**
**minimum joint width**
narrowest opening an installed joint seal is intended to tolerate

NOTE It is stated by the manufacturer or test sponsor.

**3.7**
**nominal joint width**
specified opening of a joint in practice

NOTE It is selected by the manufacturer or test sponsor.

**3.8**
**splice**
connection or junction within the length of a joint seal

**3.9**
**supporting construction**
fire-separating elements into which joint seals are installed

**3.10**
**termination**
special design details applied at the ends of a joint seal

**3.11**
**test construction**
complete assembly of test specimens together with their supporting construction

**3.12**
**test specimen**
joint seal of specific materials, design and dimensions

**3.13**
**transition**
change in a direction in a joint seal, e.g. from horizontal to vertical in a wall construction, or through 90° at the perimeter of a floor slab

## 4 Symbols and abbreviated terms

For the purposes of this part of ISO 10295, the symbols and abbreviated terms given in ISO 834-1, together with the following, apply.

**Table 1 — Symbol description**

| Symbol | Description |
|---|---|
| $D_{sup}$ | Supporting element thickness |
| $f$ | Deflection as function of the fire-resistance time |
| $F_{mov}$ | Movement capability factor |
| $l_1$ | Minimum furnace width |
| $l_2$ | Thickness of supporting construction |
| $l_3$ | Minimum 305 mm |
| $l_4$ | Minimum 610 mm for horizontal supporting construction and 458 mm for vertical supporting construction |
| $l_5$ | Minimum twice the thickness of supporting construction |
| $W_{MAX}$ | Maximum joint width |
| $W_{MIN}$ | Minimum joint width |
| $W_{NOM}$ | Nominal joint width |

## 5 Test equipment

**5.1 Test equipment specified in ISO 834-1**, which is applicable to all joint seals tested within the scope of this part of ISO 10295.

**5.2 Test furnace**, with internal dimensions such that a distance of at least 200 mm exists between the side or long edge of a linear joint and the furnace boundary, subject to a minimum internal size of 1 m × 1 m × 1 m for horizontal (floor) furnaces.

For vertical (wall) furnaces, the minimum internal size of the furnace shall be 1 m × 1 m and of sufficient depth to ensure that the temperature conditions specified in ISO 834-1 can be achieved, that the pressure conditions described in 6.2 can be achieved and that the test specimen is not subject to direct flame impingement at any time during the conduct of a test.

**5.3 Apparatus used for cycling of the test specimens prior to the fire test**, capable of continuous and repetitive movement between two specified points that cycles the test specimen between the minimum and maximum joint widths, and be equipped with an automatic counter capable of displaying the number of completed cycles.

# 6 Test conditions

## 6.1 Heating conditions

The heating conditions shall conform to ISO 834-1.

## 6.2 Pressure

**6.2.1** For vertical test constructions, the furnace shall be operated such that a minimum pressure of 20 Pa exists at the bottom of any test specimen.

**6.2.2** In vertical elements, all splices shall be located within the positive pressure zone so that the pressure at the bottom of the splice is a minimum of 20 Pa for the lowest splice in the test construction.

**6.2.3** For horizontal test constructions, the furnace shall be operated such that a minimum pressure of 20 Pa is established at a position (100 ± 10) mm below the lowest point of the test construction.

## 6.3 Load

Where applicable, a load shall be applied in accordance with the principles of ISO 834-1.

## 6.4 Movement

Where the seal is greater than 20 mm wide and is designed to accommodate movement, the joint shall be cycled prior to the test in accordance with Annex A using the information required in 7.8.4.

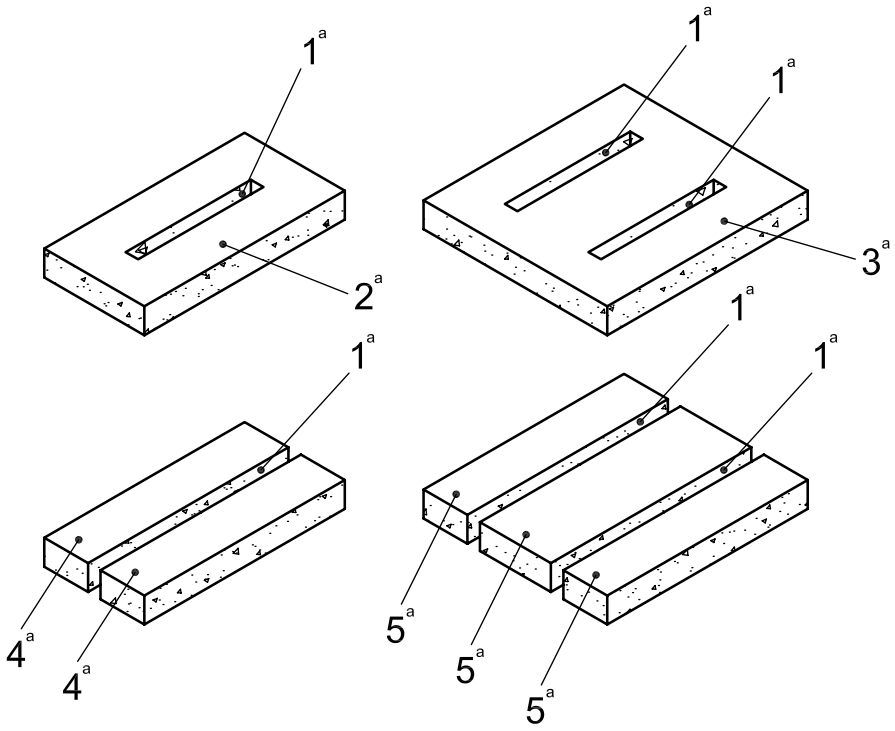
# 7 Specimen preparation

## 7.1 Supporting construction

The supporting construction shall be of known fire resistance and representative of that used in practice.

## 7.2 Test construction

**7.2.1** For the purposes of tests, joints can be formed in slabs or by adjacent discrete members; see Figure 1.



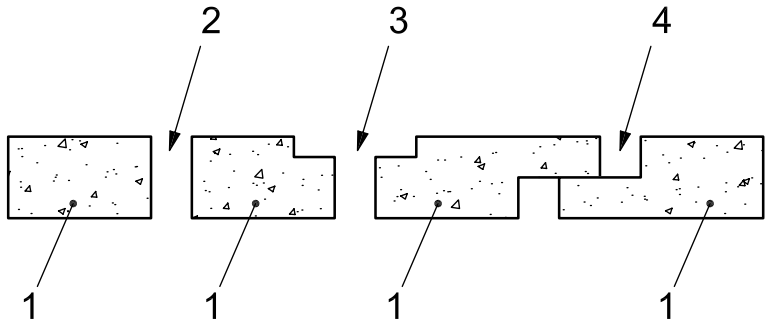

**Key**

1 linear joints
2 monolithic slab, single joint adjacent
3 monolithic slab, multiple joints adjacent
4 discrete members, single joint
5 discrete members, multiple joints

[a] Supporting constructions made of monolithic slabs may be used only for testing static joints.

**Figure 1 — Supporting construction**

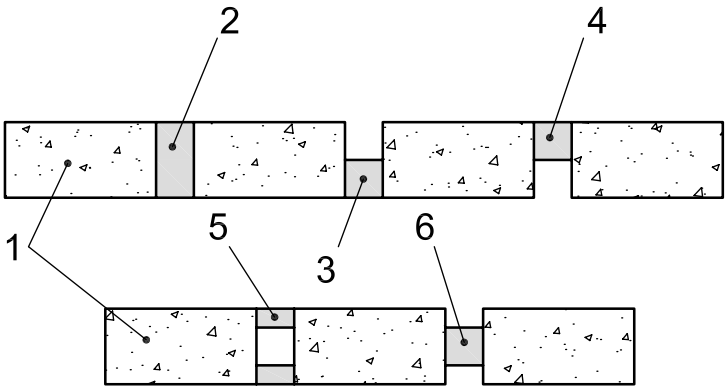
**7.2.2** A test construction may consist of multiple variations in test-specimen widths, joint configurations, test-specimen configurations, joint-face positions and supporting elements of varying thickness, see Figures 2 and 3.




**Key**

1 supporting construction
2 linear joint (single-stage joint)
3 linear joint with blockouts
4 linear offset joint (multi-stage joint)

**Figure 2 — Joint configuration**



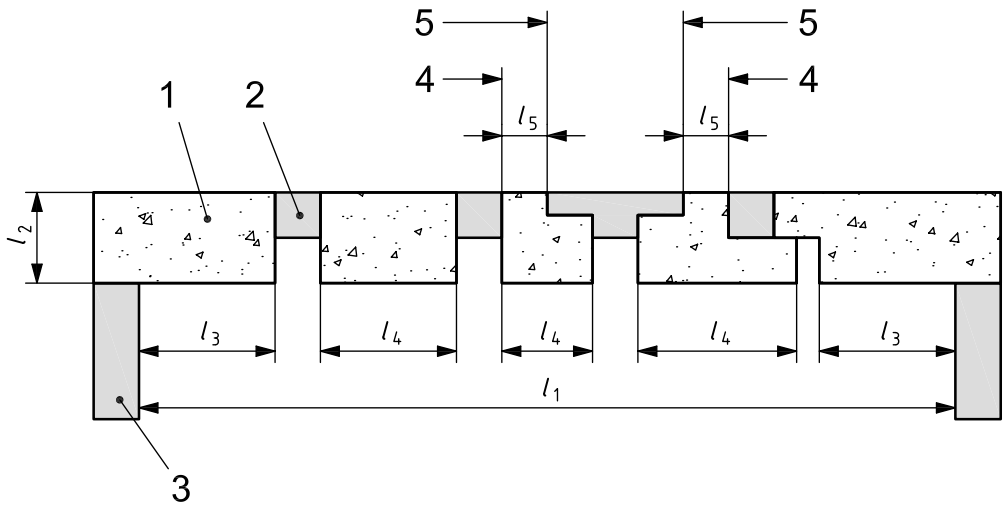

**Key**

1 supporting construction
2 test specimen fills joint
3 test specimen at bottom of joint
4 test specimen at top of joint
5 test specimen forms one or more air cavities
6 test specimen centred in joint

**Figure 3 — Test-specimen orientation in joint**

**7.2.3** The minimum width of the supporting elements between joint edges shall be 200 mm or $2T$, whichever is greater.

**7.2.4** The minimum distance between a joint edge and an adjacent blockout edge shall be 200 mm or $2T$, whichever is greater.




**Key**

1 supporting construction test specimen
2 test specimen
3 interior furnace face
4 joint edge
5 blockout edge

$l_1$ minimum furnace width
$l_2$ thickness of supporting construction
$l_3$ minimum 305 mm
$l_4$ minimum 610 mm for horizontal supporting construction and 458 mm for vertical supporting construction
$l_5$ minimum twice the thickness of supporting construction

**Figure 4 — Cross-sectional view of test construction with minimum separation distances**

## 7.3 Joint seal

**7.3.1** All materials used in the construction, fabrication and installation of the test specimen shall be representative of the intended application, design, materials and workmanship of those used in practice.

**7.3.2** Where voids exist within a joint seal, the ends shall be sealed to prevent air flow through the test specimen.

## 7.4 Splice location

**7.4.1** Splices shall be located within the positive-pressure zone so that the pressure conditions are as specified in 6.2.

**7.4.2** The splices shall be located no closer than 200 mm to any interior furnace face nor closer than 200 mm to any other splice in that test specimen.

## 7.5 Test specimen size

**7.5.1** The test specimen length shall be at least 1 m for joint seals less than or equal to 100 mm in width; for joint seals wider than 100 mm, the 10:1 length-to-width ratio shall be maintained; and joint seals wider than 300 mm shall have a minimum length of 3 m for vertical elements and 4 m for horizontal elements.

**7.5.2** Joint seals shall be installed at the nominal joint widths as in practice.

## 7.6 Number of test specimens

**7.6.1** Normally only one test specimen is tested.

**7.6.2** Joint seals intended for use in both vertical and horizontal fire-separating elements shall be tested in both orientations.

**7.6.3** For vertical fire-separating elements, asymmetrical joint seals and or building constructions required to resist fire from either side shall be subjected to fire exposure from each side unless it can be established that the fire exposure of a particular face would be more onerous.

**7.6.4** For horizontal fire-separating elements, the test specimen shall be exposed to heating from the underside.

## 7.7 Conditioning

**7.7.1** Conditioning shall be in accordance with ISO 834-1.

**7.7.2** At the time of the fire test, the supporting construction shall be in an air-dry condition and in equilibrium with the laboratory atmosphere.

**7.7.3** The curing regime of the joint seal required by the manufacturer's installation instructions shall be followed and clearly reported.

## 7.8 Information and test specimen verification

**7.8.1** For each test specimen, the following information shall be provided by the test sponsor prior to the test.

a) All fabrication details including drawings.

b) An adequate description of materials and their manufacture/supplier.

c) An installation procedure.

**7.8.2** The laboratory shall verify, as far as possible, the conformity of the test specimen with the information provided. Any area of discrepancy shall be resolved and any details that are not verified shall be documented prior to commencement of the test.

**7.8.3** On occasions, it might not be possible to verify the conformity of all aspects of the test specimen construction prior to the test and adequate evidence might not be available after the test. When it is necessary to rely on information provided by the sponsor then it shall be clearly stated in the test report. The laboratory shall, nevertheless, ensure that it fully appreciates the design of the test specimen and shall be confident that it is able to accurately record the constructional details in the test report.

### 7.8.4 Nominal joint width, $W_{NOM}$

Where the joint is designed to accommodate significant movement, the sponsor shall provide values for

a) minimum joint width, $W_{MIN}$;

b) maximum joint width, $W_{MAX}$.

The laboratory shall use the above values when cycling of the test specimen is required.

## 7.9 Tested joint width

Joint seals shall be installed and tested at nominal joint widths, $W_{NOM}$. Where cycling is required, the test shall be carried out at the maximum joint width.

# 8 Instrumentation

## 8.1 Temperature

### 8.1.1 Furnace thermocouples (Plate thermometers)

Unless otherwise noted herein, shall be distributed in accordance with ISO 834-1. At least one plate thermometer shall be provided for every 1,5 $m^2$ of the heated test construction area, subject to a minimum of four plate thermometers for each test construction. These plate thermometers shall be symmetrically distributed with respect to the heated area of the test construction.

### 8.1.2 Unexposed-surface thermocouples

**8.1.2.1** Specimen thermocouples shall conform to specification and installation requirements of ISO 834-1, except as described specified in 8.1.2.2 to 8.1.2.4.

**8.1.2.2** All unexposed-surface thermocouples provided for thermal measurements shall be in conformity with ISO 834-1. When necessary, the disc and thermocouple pad may be deformed to follow a non-planar surface profile of a test specimen. In the event of small sections, it is permissible to reduce the size of the pad subject to a minimum dimension of 12 mm in either width or length. If the modified unexposed-surface thermocouple and pad cannot be placed on the contour of the surface, use the roving thermocouple in 8.1.3.

**8.1.2.3** No unexposed-surface thermocouples shall be placed inside the 200 mm boundary around the furnace walls.

**8.1.2.4** Unexposed-surface thermocouples shall be located on the test construction as given in 8.1.2.4.1 to 8.1.2.4.5.

**8.1.2.4.1** One unexposed-surface thermocouple shall be positioned on every splice. Centre the unexposed-surface thermocouple on the splice.

**8.1.2.4.2** Provide at least two unexposed-surface thermocouples and place a minimum of one thermocouple per linear metre on the test specimen.

**8.1.2.4.3** Two unexposed-surface thermocouples shall be placed at the junction between the supporting construction and test specimen.

**8.1.2.4.4** Place a minimum of one unexposed-surface thermocouple per linear metre on each supporting element at a maximum distance from the blockout or joint edge of $D_{sup}$, equal to the thickness of the supporting element. See Figure 4.

**8.1.2.4.5** If, in the opinion of the laboratory, potential weak spots can be identified, additional unexposed-surface thermocouples shall be attached to these locations.

### 8.1.3 Roving thermocouples

**8.1.3.1** Roving thermocouples shall conform to specification and installation requirements of ISO 834-1.

**8.1.3.2** Where it is impractical to attach unexposed-surface thermocouples as outlined above because of the nature of the test specimen or to identify any local “hot spots”, careful use shall be made of a roving thermocouple in accordance with the procedures given in ISO 834-1.

### 8.2 Pressure

**8.2.1** The pressure sensors shall be in accordance with ISO 834-1.

**8.2.2** The pressure sensors shall be positioned, and the pressure monitored and controlled, using the principles given in ISO 834-1.

### 8.3 Deformation

**8.3.1** Deformations of the test construction shall be measured and recorded.

**8.3.2** Instrumentation for the measurement of deflection of the supporting construction shall be located so as to provide data in terms of the amount and rate of deflection during and, where appropriate, after the fire test.

### 8.4 Integrity

**8.4.1** The integrity of the test construction shall be measured in accordance with the procedures given in ISO 834-1.

**8.4.2** When difficulties arise in attempting to use the normal cotton pad for the assessment of loss of integrity in accordance with ISO 834-1, the size of the cotton pad shall be reduced to 30 mm × 30 mm × 20 mm. The cotton pads shall be prepared and conditioned in accordance with ISO 834-1. The wire supporting frame shall also be adapted to suit the smaller cotton pad size.

### 8.5 Multiple test specimens

**8.5.1** When testing multiple test specimens, only the unexposed-surface thermocouples designated for a specific test specimen shall be used in assessing the performance of that test specimen.

## 9 Test procedure

### 9.1 Selection of procedures

Refer to Annex A for movement procedures.

### 9.2 Load application

**9.2.1** Joint seals designed to withstand a direct load shall be loaded appropriately. This is not intended to include loads induced by relative movements of the supporting elements.

**9.2.1.1** The superimposed load shall be applied to the test specimen at least 15 min before the commencement of the fire test.

**9.2.1.2** The superimposed load shall be applied in such a manner so as to minimize the effects on the thermal and physical properties of the test specimen.

**9.2.1.3** The test sponsor shall specify a service load for each test specimen. The specified service load shall be documented.

**9.2.2** Joint seals intended to be non-load-bearing do not require superimposed loads during fire testing.

**9.2.3** All joint seals shall be described as load bearing or non-load-bearing in the test report.

### 9.3 General test procedure

**9.3.1** The procedures given in ISO 834-1 shall govern the commencement of the fire test.

**9.3.2** The procedures given in ISO 834-1 shall govern the measuring and recording of the following:

a) temperatures;

b) furnace pressure;

c) deformation;

d) integrity of the test construction.

The furnace pressure shall be monitored, controlled and recorded so that the conditions specified in 6.2 are met.

**9.3.3** In multiple tests, test specimens that fail, due to loss of integrity, shall be closed so as to continue with the testing of remaining test specimens.

### 9.4 Termination of test

The test shall be terminated in accordance with any of the provisions of ISO 834-1.

## 10 General performance criteria

### 10.1 Insulation

**10.1.1** For each test specimen, all unexposed-surface thermocouples as described in 8.1.2, except those specified in 8.1.2.4.5, shall be used in the average temperature calculations.

NOTE The initial temperature is defined as the average unexposed-surface temperature of the relevant test specimen at the commencement of the test.

**10.1.2** Transmission of heat through the joint seal during the classification period shall not raise the average temperature on its unexposed-surface more than 140 K above the initial average temperature.

**10.1.3** Transmission of heat through the test construction during the classification period shall not raise any one of the thermocouple temperatures of the unexposed-surface more than 180 K above its initial temperature.

### 10.2 Integrity

**10.2.1** Failure to maintain integrity shall be determined in accordance with ISO 834-1.

**10.2.2** Failure to maintain integrity of each supporting construction within $D_{sup}/2$, where $D_{sup}$ is the thickness of the separating element, of the longitudinal edge of the test specimen constitutes a failure of only that test specimen. See Figure 4.

**10.2.3** Failure to maintain integrity of a supporting construction between two test specimens outside $D_{sup}/2$ of the longitudinal edge of either test specimen shall not be deemed a failure of either test specimen.

**10.2.4** Failure to maintain integrity of a test specimen constitutes a failure of only that test specimen.

## 11 Expression of test results

The fire resistance of the test specimen shall be given as the time, measured in completed elapsed minutes, for which the insulation and integrity performance criteria have been satisfied.

## 12 Test report

**12.1** For each joint seal tested, the test report shall include all important information relevant to the test specimen, supporting elements and fire test as stated in ISO 834-1. The report shall also include the following:

a) sponsor's intended field of application for the joint seal;

b) joint-seal length or height used in the fire test;

c) description of the supporting construction (including the density and type of material, moisture content, special fabrication details) and the orientation;

d) relevant drawings of the supporting construction, detailing materials and composition;

e) shape and dimensions of recesses, which shall be documented if the blockouts are formed in the test construction to secure any part of the joint seal;

f) all installation procedures provided by the sponsor;

g) details of equipment used;

h) photographs of the installation procedure;

i) description of the rate of leakage of smoke and/or gases, or on the transmission or generation of fumes, if appropriate.

**12.2** The test report shall include the following information if the specific test options listed below are selected.

**Table 2 — Report content**

| If | | then | |
|---|---|---|---|
| | the superimposed load is applied to the test specimen, | | photographically document its placement and measure any test assembly deflection. |
| | the type of transition is tested, | | include the test sponsor's installation and/or fabrication instructions, photographs and documentation of the procedure and installation. |
| | the type of termination detail of the joint seal, | | include the test sponsor's installation and or fabrication instructions, photographic documentation of the procedure and installation. |
| | the splicing method were used, | | include the sponsor's instructions and photographic documentation of the procedure. |
| | cycled according to 6.4 and Annex A, | | include details of all cyclic movement information and photographs of the test specimen. |

**12.3** The test report shall contain specific information about the joint seal, including

a) a full description of the joint seal;

b) details of all primers, adhesives, tools or backing materials used during installation;

c) the curing procedure for any components of the joint seal;

d) the tested joint seal shall be identified by a unique name or model;

e) details of the width and depth at which the joint seal was fire tested.

**12.4** The test report shall include test results in the form described in Clause 11.

**12.5** The test report shall carry the following statement in a prominent position:

“This report provides the constructional details, the test conditions and the results obtained when a specific form of joint seal was tested following the procedure in this part of ISO 10296. Any significant deviation with respect to size, constructional details, loads, stresses, edge or end conditions can invalidate the application of the test result”.

### 12.6 Joint-seal classifications

**12.6.1** The performance of joint seals and the conditions of the test shall be expressed by filling in Table 3 for each attribute and each test specimen tested. Where information is not available or applicable to the test, an “X” shall be entered in the table.

**12.6.2** The classification of a given joint seal can be derived from the table according to relevant and appropriate requirements. Where an “X” appears after the attribute, no conclusion can be drawn on the performance of the seal with respect to that parameter.

**Table 3 — Joint seal attributes**

| Attributes | Designation |
|---|---|
| | |
| Maximum joint width, $W_{MAX}$ | 0000 (mm) |
| Minimum joint width, $W_{MIN}$ | 0000 (mm) |
| Nominal joint width, $W_{NOM}$ | 0000 (mm) |
| | |
| Joint in horizontal supporting construction | H |
| Vertical joint in vertical supporting construction | V |
| Horizontal joint in vertical supporting construction | L |
| | |
| Cycling rate (c/min) $\geqslant$ 20 (seismic) | S |
| Cycling rate (c/min) $<$ 20 (wind sway) | W |
| Cycling rate (c/min) $<$ 1 (thermal) | L |
| | |
| Manufactured splices | M |
| Field splices | F |
| Both manufacturer and field splices | B |
| | |
| Joint forming tee intersection | L |
| Joint changing direction in same plane | H |
| Joint forming a cross intersection | C |
| Joint changing direction in different planes | V |
| Joint forming a termination | E |
| | |
| Load applied to joint during test | L000 (kg/m$^2$) |
| | |
| Fire resistance – insulation | I000 (min) |
| Fire resistance – integrity | E000 (min) |

**12.6.3** Classification is based on the information in Table 3.

EXAMPLE A joint seal tested at a maximum (M) 300 mm width under a 1 000 kg/m$^2$ load in a full-scale floor assembly successfully completing a 2 h fire-resistance test after being cycled at a rate of 1 c/min using both splicing techniques but without transitions or terminations would be expressed as follows:

| Width | Orientation | Cyclic rate | Splice | Transition | Loading | Fire resistance |
|---|---|---|---|---|---|---|
| M300 | H | L | B | X | L1000 | I120E120 |

# Annex A
(normative)

# Movement, deflection and other configurations

## A.1 Mechanically induced movement

**A.1.1** Where a joint seal is designed to accommodate movement and is greater than 20 mm in width, a movement capability factor, $F_{mov}$, is defined as given in Equation (A.1):

$$F_{mov} = \frac{W_{MAX} - W_{MIN}}{W_{NOM}} \times 100 \quad \text{(A.1)}$$

This annex only applies to joint seals where the value of $F_{mov}$ is greater than 10.

**A.1.2** Prior to fire testing, the test construction shall be pre-conditioned by cycling a minimum of 500 times between the minimum and maximum joint widths. Cycling shall start and finish at the nominal joint width. Machines can be used to cycle the joint seal that is then placed into the supporting construction. Cycling rates of 20 c/min shall be designated as seismic, cycling rates of 5 c/min shall be designated wind sway, and those rates below 1 c/min shall be designated thermal. The sponsor shall designate a cycling rate that shall be recorded in the test report.

**A.1.3** The test specimen shall be cycled in accordance with 7.8.4 using the values specified by the sponsor.

**A.1.4** After cycling, the test construction shall be allowed to stabilize for 12 h to 73 h, without alteration before fire testing; if this is not done, the reasons shall be stated in the report.

## A.2 Movement of joint seals during the fire test

**A.2.1** The test apparatus should be capable of inducing the required types of movement during the fire test. These are special cases depending on the requirements of the sponsor or on particular applications in practice.

**A.2.2** For the test procedure, the supporting construction shall be equipped for controlling vertical and horizontal displacement as well as rotational deformation as a function of the test time.

## A.3 Vertical deflection during the fire test

### A.3.1 Vertical deflection in horizontal supporting construction — Option 1

One of the adjacent supporting elements bounding each test specimen shall be stabilized so as to prevent or minimize deflection. The other supporting construction shall be unsupported to allow deflection that shall be limited to 100 mm by some mechanical means.

### A.3.2 Vertical deflection in horizontal supporting construction — Option 2

The joint seals shall be subject to vertical displacement between joint faces. The procedure adopted shall be fully described in the test report.

## A.4 Other configurations

**A.4.1** A termination and/or transition can be tested under these criteria, provided that the sponsor and authority requiring the test agree that the modifications to the test construction required to perform the test are acceptable.

**A.4.2** The following types can be tested in accordance with this part of ISO 10295:

a) horizontal changes in direction of the joint, such as corners;

b) horizontal to vertical changes in direction of the joint, such as a floor intersecting a wall or following the contour of stairs;

c) joint intersections, such as “tees” or “crosses”.

# Annex B
(normative)

# Field of application

## B.1 Field of application of the test results

Depending on materials and location of the joint in the test construction, certain conclusions can be drawn. Table B.1 summarizes the test orientations that shall apply for potential applications.

**Table B.1 — Test orientations and corresponding potential field of application**

| Test orientation [a] | Field of application |
|---|---|
| H | Horizontal joint between two horizontal supporting constructions<br>and<br>Horizontal joint in a horizontal supporting construction and abutting a vertical supporting construction |
| V | Vertical joint between two vertical supporting constructions |
| L | Horizontal joint at top of a vertical supporting construction abutting the bottom of a horizontal supporting construction<br>and<br>Horizontal joint between two vertical supporting constructions [b] |
| [a] See Table 3 for description of designations H, V and L.<br>[b] Typical application is for use in base isolated buildings equipped with seismic devices. | |

## B.2 Supporting construction

**B.2.1** A result obtained with a specific supporting construction may be applied only to that particular type of supporting construction.

**B.2.2** Results obtained with concrete and masonry supporting construction may be applied only to concrete and masonry elements of a thickness and density equal to or greater than those tested.

## B.3 Number of specimens

At least one test specimen shall be tested for each specific supporting construction and classification desired, unless it can be demonstrated that, by using interpolation and extrapolation techniques, the number of test specimens can be reduced.

## B.4 Cycling of joint seals

**B.4.1** Cycling is not intended to simulate all the performance attributes of a joint seal. Cycling is designated to induce compression and tension, which can fatigue the joint seal in practice and affect the fire resistance.

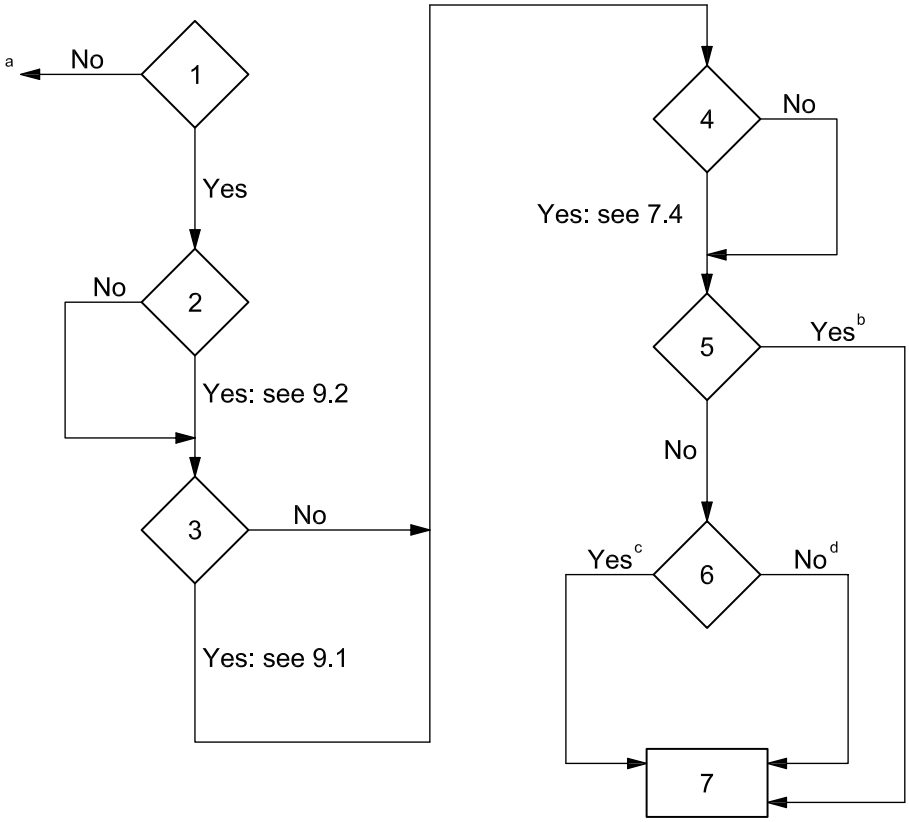
**B.4.2** The cyclic rate can affect the joint seal's material performance. Hence, three broad categories have been established. The order of decreasing priority is seismic, wind sway, and thermal. Joint seals tested at a higher priority should perform in the lower categories.

**B.4.3** This part of ISO 10295 exempts certain joint seals from cyclic testing. Compression-set data shall be provided on test specimens relying solely upon compression for placement in joints to satisfy long-term performance.

## B.5 Classification

A fire-resistive test on a joint seal shall not be used for the classification of adjacent supporting construction that forms the boundaries of the joint utilized during the fire test. Tests for walls and partitions, columns, beams, floors (with or without ceilings), roofs (with or without ceilings) are addressed by ISO 834 (all parts); tests for doors, shutters and glazing are addressed by ISO 3008; tests on glazed elements are addressed by ISO 3009.

The flow chart shown in Figure B.1 can assist in determining the applicable test specimens in evaluating joint seals.




**Key**

1 question: Is the joint length to width ratio at least 10:1 in practice?

2 question: Is the joint seal load bearing?

3 question: Is $F_{mov}$ (see A.1.1) greater than 10 and the nominal joint width greater than 20 mm?

4 question: Is the joint seal spliced in practice?

5 question: Is the maximum joint width 100 mm or less?

6 question: Is the maximum joint width at least 300 mm and greater than 100 mm?

7 result: Construct test specimen.

a Stop. Test standard is not applicable.

b Minimum specimen length shall be 1 000 mm.

c The length to width ration of the specimen shall be at least 10:1.

d The minimum length of vertical specimens shall be 3 000 mm and the minimum length of horizontal specimens shall be 4 000 mm.

**Figure B.1 — Flow chart**

# Annex C
(informative)

# Commentary and guidance

## C.1 General

This part of ISO 10295 specifies the heating conditions, method of test and acceptance criteria for evaluating joint seals. This evaluation includes the ability of a joint seal to maintain the same or greater integrity and insulation of the fire-supporting elements bounding it. Greater integrity may be ascertained by continuing to fire test the joint seal beyond the thermal resistance of the supporting construction providing the test conditions defined in the test method can be maintained.

This information has been prepared to provide the user of this part of ISO 10295 with background on the development of this document. It also provides guidance in the planning, performance and reporting of fire resistance tests carried out in conformity with this part of ISO 10295 and interpreting and applying of test result.

The fire-resistance performance of a structure is only as good as the weakest component, which can be the joint between two adjacent elements. It is, therefore, important to establish the contribution of joint seals designed to protect such joints. As the test results should be reproducible, the test specimen shall be accurately prepared and the test conditions, e.g. joint forces, clearly specified.

## C.2 The field of application

**C.2.1** The purpose of this part of ISO 10295 is to assess joint seals under two separate intended uses:

— as a filler with movements less than or equal to 10 % of its nominal joint width;

— as a joint seal with movements greater than 10 % of its nominal joint width.

Table B.1 lists the test orientations and their corresponding field of application.

**C.2.2** Test orientation “H” is not valid for field of application “horizontal joint at top of a vertical supporting construction abutting the bottom of a horizontal supporting construction” because of the following fire test restriction.

— The deflection in “H” is only downward; however, the deflection of a “horizontal joint at top of a vertical supporting construction abutting the bottom of a horizontal supporting construction” can be both downward and inward/outward.

**C.2.3** Test orientation “V” is not valid for field of application “horizontal joint at top of a vertical supporting construction abutting the bottom of a horizontal supporting construction” and “horizontal joint between two vertical supporting constructions” because of the following fire-test restrictions.

— The furnace pressure in “V” is only 20 Pa at the top of the joint seal; however, it is necessary that the furnace pressure for “horizontal joint at top of a vertical supporting construction abutting the bottom of a horizontal supporting construction” and “horizontal joint between two vertical supporting constructions” be 20 Pa along the entire length of the joint seal.

— The deflection in “V” is only inward/outward; however, the deflection of a “horizontal joint at top of a vertical supporting construction abutting the bottom of a horizontal supporting construction” and “horizontal joint between two vertical supporting constructions” can be both downward and inward/outward.

— The pressure for the splice in “V” is only at 13 Pa; however, it is necessary that the pressure for the “horizontal joint at top of a vertical supporting construction abutting the bottom of a horizontal supporting construction” and “horizontal joint between two vertical supporting constructions” be 20 Pa at its upper point.

## C.3 Joint seal attributes

This part of ISO 10295 addresses the following attributes of joint seals under fire resistance tests:

a) integrity and insulation performance of the joint seals used in connection with a specified supporting construction;

b) effect of the joint seal on the integrity and insulation performance of the supporting elements;

c) ability of joint seals to maintain their integrity and insulation performance during deflection;

d) ability of joint seals to maintain their integrity and insulation performance after cyclic movement;

e) ability of joint seals to maintain their integrity and insulation performance while conforming to changes in direction;

f) ability of a splice to maintain its integrity and insulation performance;

g) ability of the termination of a joint seal to maintain its integrity and insulation performance;

h) ability of the joint seal to withstand a designated load while maintaining its integrity and insulation performance.

## C.4 Movement

Not all joint seals are required to possess all of the attributes described in Clause C.2. Joint seals tested with movements greater than 10 % of their nominal joint width can be used in an application designed to accommodate movement of less than 10 % but the reverse is not true. Further, the test configuration and specimen orientation also influence the possible field of application of the joint seal.

## C.5 Supporting construction

Testing joint seals in gypsum stud wall constructions is generally more severe in terms of fire resistance than masonry or concrete construction of greater or equivalent thickness. The results of joint seals tested in gypsum wall construction can generally be applied to concrete and masonry elements of a thickness and density equal to or greater than those tested.

## C.6 Cycling joint seals

A joint seal can be fatigued over time by various building movements. This cycling test is not intended to replicate *in situ* performance of the joint seal; rather, it is intended to stress them. By cycling the joint seals, fatigue can become evident. Fire testing these seals increases the level of confidence that their fire resistance does not diminish after movement as in practice.

## C.7 Maximum joint width

This part of ISO 10295 requires that tests be carried out at maximum joint width. This position is usually the most severe. The maximum joint width also induces a tensile stress on the bond of chemically adhered materials, while the stress on compressive type fillers is at its design minimum at this dimension.

## C.8 Deformation and deflection

Movement of a joint seal during a fire is very possible. Many common construction practices can cause differential deflection of supporting constructions during a fire, i.e. the distance of the beam to the joint edge, differing thickness and matrix of supporting constructions, the type of construction interface (floor-to-wall).

EXAMPLE When the structural integrity of one or more supporting columns fails, then one of the supporting elements can deflect more than its counterpart.

In order to simulate differential deflection, one of the horizontal supporting elements is supported or structurally reinforced to eliminate deflection, while the other supporting construction is allowed to deflect.

## C.9 Loading

Joint seals vary greatly in width depending on application. Joint seals designed to absorb differential thermal changes of building materials have limited movement and subsequently can be narrow in width. However, joint seals designed to absorb large structural displacements caused by seismicity or wind sway can be extremely large, for instance 600 mm or more. Therefore, joint seals such as those designed for seismic or wind sway applications, intended to be load bearing, have a superimposed load applied during the full duration of the fire test.

Horizontal joint seals with narrow widths can be subject to point loads caused by high-heel shoes. The sponsor should evaluate this fact.

Only the joint seals are loaded. The supporting construction is not loaded. The fire resistance (insulation, integrity and load-bearing capacity) of the supporting construction has already been determined by ISO 834-1. The joint seal's supporting construction for this test is not intended to, nor can it, reflect the actual deflection in practice because

a) one part of the supporting construction is simply supported on three sides;

b) the same supporting construction is supported and reinforced so as not to deflect during the test;

c) the other supporting member is simply supported, allowing a limited deflection.

The deflection during this test will ascertain the joint seal's sealing capability under vertical shear rotation.

## C.10 Pressure

Furnace pressure does not affect the test results (fire-endurance rating) of all joint seals. Pressure is a factor when the hot gases of the furnace are able to be convectively forced through a joint seal. The permeability of the joint seal is a key factor for consideration when analyzing the effect of furnace pressure on the joint seal. For example, the fire endurance rating of a 25 mm thick steel plate tested at a negative furnace pressure is not affected by a 20 Pa (≈ in 0,08 $H_2O$) furnace pressure.

Typically permeable (fibrous or porous) joint seals are very susceptible to furnace pressure. For example, a low-density mineral-fibre joint seal is typically affected by a pressure differential. When tested at a negative furnace pressure, this type of joint seal allows the cooler laboratory air to be drawn through the joint seal into the furnace. When tested at a positive furnace pressure, for example 2,5 Pa (≈ in 0,01 $H_2O$), the hot gases in the furnace are forced through the joint seal. This reverse convective flow decreases a fire-endurance rating achieved using a negative furnace pressure. When tested at higher positive furnace pressures, such as 20 Pa (≈ 0,08 in $H_2O$), this joint seal's fire-endurance rating usually continues to decrease.

Hermetic joint seals can be unaffected by furnace pressure. This part of ISO 10295 addresses both static and dynamic joint seals. Elastomeric sealants are examples of hermetic joint seals that are typically dynamic by design. Steel and mortar joint seals are examples of hermetic materials that are typically static. One element for consideration is the degradation of the joint seal. A joint seal that is hermetic before fire testing might not be hermetic after fire testing. When the hermetic characteristic of a joint seal remains intact, furnace pressure is not a contributing factor to the fire-endurance rating achieved.

There are many tests to which the joint seals can be subjected that can be used as one factor in assessing its hermetic characteristics. For example, applying a hose stream to metallic joint seals can make metal fatigue apparent, indicating that the hermetic characteristic can be compromised. Another example is the use of air-leakage tests before and after fire testing the joint seal. A zero rating before and after this type of testing indicates that the hermitic property of these joint seals remains intact. Another example is the use of a small-scale test comparing the joint seal under the furnace pressure being considered.

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