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DEUTSCHE NORM

May 1990

Fire behaviour of building materials and elements

Seals for cable penetrations
Concepts, requirements and testing

DIN 4102 Part 9

Brandverhalten von Baustoffen und Bauteilen; Kabelabschottungen; Begriffe, Anforderungen und Prüfungen

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

Dimensions in mm

For tolerances, table 1, line 3 of DIN 18 202 shall apply.

Contents

1 Scope and field of application

This standard specifies requirements and methods of test for seals for cable penetrations designed to prevent the spread of fire at points where electric cables pass through horizontal or vertical separating building elements (walls or floors) subject to fire resistance requirements, and establishes relevant concepts[1]).

The testing of seals for penetrations and service shafts and ducts is covered in DIN 4102 Part 11.

Note. Testing of seals as specified in this standard does not include an assessment of the performance of electric cables (e.g. emergency power supply cables) in the event of a fire[2]).

2 Concepts

2.1 Seals for cable penetrations

Seals for cable penetrations ('seals', for short) are seals which close openings in separating building elements subject to fire resistance requirements, through which electric cables pass, in particular cables with metallic conductors, bus bars and cables with non-metallic conductors (e.g. optical fibre cables)[3]).

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1) The performance of fire-resistant seals cannot be assessed solely on the basis of this standard. Other proof of suitability must be provided (e.g. in the form of a general building inspectorate approval (agrément)).

For building materials which do not become effective until exposed to a fire and which cannot be adequately assessed on the basis of this standard, proof of suitability shall be provided (e.g. in the form of an agrément).

2) Cf. DIN 4102 Part 12.

3) The provision of service shafts and ducts (cf. DIN 4102 Part 11) shall also be regarded as serving to prevent the spread of fire along electric cables passing through walls and floors.

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2.2 Fire resistance time

For the purposes of this standard, the fire resistance time is the minimum length of time, in minutes, during which seals prevent the spread of fire and smoke through cable penetrations in fire tests carried out as specified in subclause 5.4.1, using the standard time/temperature curve. In table 1, fire resistance classes (class S) are specified as a function of the fire resistance time.

Table 1. **Fire resistance time**

Fire resistance class	Minimum fire resistance time, in min
S 30	30
S 60	60
S 90	90
S 120	120
S 180	180

3 Classifying seals

Seals shall be classified into fire resistance classes on the basis of testing in accordance with this standard, the criterion of classification being the most unfavourable result of the tests carried out as specified in subclause 5.4.1 on two specimens or more[1]).

Note. Seals tested in accordance with this standard will meet the relevant fire resistance requirements provided that the cables and their supporting constructions are installed in compliance with the relevant electrical engineering standards, in particular with DIN VDE 0100 Part 520 A 1.

4 Requirements

4.1 Separating effect of seals

4.1.1 Installed seals shall not have an opening, cavities, etc. which permit the passage of air from one side to the other (cf. Explanatory notes).

4.1.2 Seals, when tested in accordance with subclauses 5.4.1 and 5.4.2, shall, during the specified fire resistance time, meet the following requirements.

a) The spread of fire and smoke through the seal shall be prevented. This requirement is deemed to have been fulfilled if a cotton pad as specified in subclause 6.2.6 of DIN 4102 Part 2, September 1977 edition, held against the unexposed side of the seal during the test does not ignite, if there is no flame on the unexposed side and if the passage of smoke is not considered critical.

b) On the unexposed side, the surface temperature of electric cables, supporting constructions and seals shall not rise by more than 180 K above the initial ambient temperature.

4.2 Changes to cable arrangements

It shall be possible to make subsequent changes to the arrangement and number of cables passing through the seals (e.g. replacement or laying of additional cables) by simple means and without causing any damage to the electric cables present. The work involved shall be conceived and carried out so as to ensure that the fire resistance class of the seal is maintained.

5 Testing

5.1 Sampling

5.1.1 If different types of seal are to be assessed, the testing laboratory shall select the seal assumed to yield the most unfavourable result as the specimen.

5.1.2 Two specimens each per type of separating element (floor or wall) shall be subjected to testing.

5.1.3 Asymmetrical seals or those which are installed asymmetrically in walls shall be exposed to fire at least once from each side.

5.1.4 For seals for use in floors, heating of the floor underside is normally to be considered the most unfavourable case. In cases of doubt, the behaviour of the seal on exposure to heat from above shall also be tested.

If two specimens, when installed in a wall, pass the test, only one specimen is required for testing seals installed in a floor.

5.1.5 The cable arrangement used for testing shall be that shown in figure 6, this being representative of arrangements used in practice. This does not apply for purpose-made seals (cf. subclause 5.3.3) and those through which bus bars pass.

5.1.6 Where supporting constructions are used, these shall be made of sheet steel sections (cf. figure 6) and installed so as to pass through the seal.

5.2 Test furnace

The test furnace shall comply with DIN 4102 Part 2.

Note. A small-scale test furnace (e.g. one complying with DIN 4102 Part 8) may also be used for supplementary tests.

5.3 Design of test construction

5.3.1 Building elements

5.3.1.1 For seals for use in concrete or masonry walls, the specimens shall be mounted in aerated concrete walls with a minimum thickness of 100 mm.

5.3.1.2 For seals for use in floors, the specimens shall be mounted in a reinforced concrete floor, the minimum thickness of which shall be specified in accordance with the required fire resistance time.

5.3.1.3 For seals for use in other types of wall (e.g. lightweight partitions) or floor, the specimens shall be installed in building elements of the type used in practice.

5.3.1.4 For seals for use in partitions, the specimen shall be mounted in gypsum plasterboard (cf. figure 5) complying with table 45 of DIN 4102 Part 4, March 1981 edition. The results obtained are also applicable where such seals are used in concrete or masonry walls.

5.3.2 Specimen size and installation

5.3.2.1 For seals in walls and floors, the minimum specimen size shall be 700 mm × 400 mm. For purpose-made seals, specimens shall be sized in accordance with subclause 5.3.3.

5.3.2.2 The seals shall be mounted with cables and supporting construction passing through them, the results obtained also applying where such an arrangement is not used in practice (i.e. where only cables pass through the seal).

For [1]), see page 1.

Supporting constructions shall be incorporated in the test arrangement as shown in figures 1 to 5.

5.3.2.3 Cables shall be arranged in the test construction as shown in figure 6.

5.3.2.4 Where seals for use in walls exceed 700 mm × 400 mm in size, the cable arrangement shown in figure 6 shall be located in the upper part of the seal, as shown in figure 2, with supporting constructions being placed in the lower part and loaded (e.g. using masonry units) as shown in figure 2.

5.3.2.5 Where seals for use in floors exceed 700 mm × 400 mm in size, the test arrangement shall be as shown in figure 4.

5.3.2.6 The length of the electric cables extending into the furnace shall be 500 mm.

For seals for use in walls, a weight equal to the mass of the 500 mm long cable sections shown in figure 6 shall be attached to the ends of the cables. Where the cables are provided with a fire-resistant coating, the uncoated lengths of cable shall be 100 mm long or more.

The cut ends of the cables on the exposed side of the specimen shall remain unsealed while those on the unexposed side shall be sealed with plaster of Paris or in some other way. The temperature of the cut ends and any gases which may be released shall be disregarded in the assessment.

5.3.2.7 The specimens shall be manufactured so as to be representative of seals used in practice.

5.3.2.8 Where provisions for subsequent changes to the arrangement and number of cables have been made, such shall be covered by the fire tests.

5.3.2.9 Where bunched telecommunication cables pass through seals and proper sealing of the spaces between the cables is not ensured, such seals shall be tested using an arrangement as shown in figure 7.

5.3.2.10 When testing seals designed to receive metal or plastic tubing with an external diameter of 15 mm or less, not less than three conduits/pipes of each type shall pass through the specimen (cf. figure 7).

5.3.3 Purpose-made seals

For purpose-made seals for use in both walls and floors, i.e. seals which differ in size and cable arrangement from those described in subclause 5.3.2, two specimens each shall be used to test the following:

a) the largest seal;
b) the smallest thickness of the building element to be sealed;
c) the seal with the highest concentration of cables (i.e. where seals accommodate a number of cables, the one which contains the highest total cross-sectional area of cables, and the one which contains the cable of largest diameter);
d) where used in the construction, blank seals;
e) supporting construction, if relevant.

The same procedure shall be followed for seals through which bus bars pass, the specimens being representative of the seal as used in practice (i.e. including any electrical insulation, etc.).

Figures 1 to 7 shall apply by analogy.

5.4 Procedure

5.4.1 Fire test based on standard time/temperature curve

Testing shall be carried out as specified in subclauses 6.2.1 and 6.2.3 to 6.2.8 of DIN 4102 Part 2 on the basis of the standard time/temperature curve. Specimens of seals for use in walls shall be positioned in the test furnace so that there is a pressure of (10 ± 2) Pa at the level of the uppermost cable tray.

The thermocouples used to measure the rise in temperature at the specimen surface shall be positioned as shown in figure 6 or figure 7. Additional thermocouples shall be used to determine any thermal bridge across the seal or supporting construction.

5.4.2 Fire test with exposure to smouldering fire

If there is any doubt that the seals will become fully effective on exposure to smouldering fire, seals which are made of materials that become effective only when exposed to heat for a specified period shall also be subjected to a fire test based on the standard time/temperature curve shown in figure 4 of DIN 4102 Part 11. The specifications of subclause 5.4.1 shall apply for all other details of the test procedure.

5.4.3 Loading

Walls and floors shall not be subjected to loading during testing.

5.4.4 Subsequent changes to cable arrangement

It shall be checked whether any provisions for subsequent changes to the cable arrangement permit such to be carried out on representative specimens.

6 Test certificate

A test certificate based on clause 8 of DIN 4102 Part 2 (disregarding table 2 and the required classification) shall be issued which gives details of the test and its results. The test certificate shall be entitled: *Prüfzeugnis zur Beantragung einer allgemeinen bauaufsichtlichen Zulassung* (Test certificate required for applications for an agrément).

The test certificate shall include a description of the test construction and, in particular, provide the following information:

a) type, thickness and fire resistance class of the wall or floor in which the seal was installed;
b) structure and thickness of the seal, cable arrangement and materials used; where the thickness of the seal exceeds that of the wall or floor, details of the protruding section;
c) type, cross-sectional area and number of electric cables and of any bunched cables and ducts passing through the specimen;
d) type of supporting construction and accompanying brackets;
e) dimensions of free spaces in the test arrangement;
f) any measures taken to provide for subsequent changes to the cable arrangement;
g) type and application of any materials which foam under heat (e.g. intumescent coatings);
h) mechanical behaviour of seals and any secondary effects of the fire (e.g. development of smoke).