



SLOVENSKI STANDARD
SIST ENV 1363-3:1999
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Fire resistance tests - Part 3: Verification of furnace performance

Feuerwiderstandsprüfungen - Teil 3: Nachweis der Ofenleistung

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Ta slovenski standard je istoveten z: ENV 1363-3:1998

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ICS:

13.220.50	Požarna odpornost gradbenih materialov in elementov	Fire-resistance of building materials and elements
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en

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PRÉNORME EUROPÉENNE
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**Fire resistance tests - Part 3: Verification of furnace
performance**

This European Prestandard (ENV) was approved by CEN on 5 December 1998 as a prospective standard for provisional application.

The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Prestandard has been prepared by Technical Committee CEN/TC 127 "Fire safety in buildings", the secretariat of which is held by BSI.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Prestandard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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Introduction

The general requirements for fire resistance testing including the specifications of the apparatus to be used are given in EN1363-1. However, the specification for the thermal exposure provided by fire resistance furnaces only requires that they are able to follow a defined temperature-time relationship when controlled with thermocouples of a prescribed type. In order to have a reproducible test method, it is important that the thermal exposures produced by fire resistance furnaces of different design are within defined limits. The purpose of this document is to verify the thermal exposure performance of furnaces used for the fire resistance testing of separating elements.

In addition to verifying the thermal exposure in furnaces, the procedure also verifies that the static pressure distribution in the furnace is within defined limits and the oxygen concentration are within the limits given in EN 1363-1. Variations in pressure and oxygen content will affect the integrity measurements when using the cotton pad and variations in oxygen content will also affect the rate of combustion of combustible test specimens.

The verification procedure is performed using an arrangement of measuring elements mounted within a supporting construction. The measuring elements consist of two steel plates separated by insulation. The test construction is exposed to the standard heating and pressure conditions given in EN 1363-1 for 60 minutes and measurements are made of the exposed face temperature of the steel plate of the measuring elements. In addition measurements are also made in the furnace of the static pressure distribution at several positions and of the oxygen concentration.

The thermal exposure performance of the furnace is deemed acceptable if the measurements obtained from the measuring elements and the static pressure distribution are within defined limits and the oxygen concentration is within the limits given in EN 1363-1.

Caution

The attention of all persons concerned with managing and carrying out fire resistance tests is drawn to the fact that fire testing may be hazardous and that there is a possibility that toxic and/or harmful smoke and gases may be evolved during the test. Mechanical and operational hazards may 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 European Prestandard describes a procedure for the verification of the thermal and pressure characteristics of fire resistance furnaces for the testing of separating elements.

The procedure is to be carried out on new furnaces, when the furnace is relined (replacement of > 30% of the lining), when the furnace is overhauled or every two years, whichever occurs first.

Information on additional measurements is given in annex A.

2 Normative references

This European Prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1363 Fire resistance tests Part 1 General requirements

EN 10088 Stainless steels Part 2 Technical delivery condition for sheet/plate and strip.

EN 10095 Heat resisting steels and nickel alloys

ISO 13943 Glossary of fire terms and definitions

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3 Definitions

[SIST ENV 1363-3:1999](#)

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For the purposes of this Part of EN 1363, the definitions given in EN 1363-1 and ISO 13943 together with the following apply:

3.1 time constant: The time representative of the response of a system to a step change in the input variable: the time after which a characteristic property for the process has reached 63 % of the final change due to the step change.

Note: This definition is derived from the response of a so-called first-order system to a step change. It can be shown that this response is of the form: $\Delta Y(t) = (1 - e^{-t/\tau}) \cdot \Delta Y_{\infty}$. In this expression, t is time, Y_{∞} is the final change of Y . τ is the time constant.

3.2 measuring element: A device provided for the purpose of measuring the thermal exposure in a fire resistance furnace.

3.3 test construction: The complete assembly of the measuring element together with their supporting construction.

4 Test equipment

The test equipment shall be as specified in EN 1363-1.

5 Test conditions

The heating and pressure conditions and the furnace atmosphere shall conform to those given in EN 1363-1.

6 Measuring elements

6.1 General

Each element shall consist of layers of calcium silicate insulation board, sandwiched between two steel plates of 5mm and 2mm thickness. The thicker steel plate shall be exposed to the fire. The assembly is nominally 290mm x 290mm and is shown in figures 1 to 4.

6.2 Constructional details

6.2.1 Fibre washers (pads)

The insulating fibre pads used in the construction of the measuring element shall have a density of (90 \pm 100) kg/m³.

6.2.2 Spring-loaded bolt assembly

The steel plates shall be assembled using four spring-loaded bolt assemblies which are intended to accommodate the distribution of the assembly when it is heated. The bolt holes in the plate shall be made with sufficient clearance to avoid contact when assembled. This, together with the insulating fibre washers is intended to avoid heat conduction during test.

6.2.3 Steel plate-unexposed surface

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The steel plate comprising the unexposed surface of the measuring element shall be constructed from steel number 1.4436 to EN10088-2 or equal in accordance with figure 3.

6.2.4 Thermocouples

Two thermocouples shall be peened to each steel plate at the positions specified in the figure 1. The wires shall follow the isotherm through the hot junction along a distance of 20mm from this junction.

6.2.5 Insulation boards

The insulation boards shall consist of inorganic insulation material with a density of (28 \pm 30) kg/m³ and a thickness of (10 \pm 1)mm.

6.2.6 Steel plate - fire exposed surface

The steel plate comprising the fire-exposed surface of the measuring element shall be constructed from steel number 2.4816 to EN10095 equal in accordance with figure 4.

6.3 Measuring element thermocouples

The sensors and data-acquisition apparatus shall comply with the requirements given in EN 1363-1 and the following :

Sensors	:	1.0 mm or less bare-wire thermocouples
Measurement error	:	$< \pm 5$ °C
Range	:	0 °C to 1200 °C

7 Installation of measuring element

The measuring elements shall be mounted in a supporting construction as illustrated in figure 5. The supporting shall be either:

- made from concrete with a minimum nominal thickness of 100mm, or,
- if a wall, one of the high density rigid or low density rigid supporting constructions given in EN 1363-1.

The aperture into which the measuring elements are mounted shall be sloped, as shown in figure 6, to allow free flow of air over the exposed face of the measuring elements.

The exposed face of the supporting construction shall be lined with non combustible insulation board having a density of (310 ± 30) kg/m³ and a thickness of (10 ± 1) mm.

The dimensions of the test construction and the distribution of the measuring elements shall be appropriate to the furnace being evaluated. For furnaces which have an opening not greater than 4m² (e.g. 2m high x 2m wide) only one measuring element is required positioned in the centre of the supporting construction. The test construction shall be mounted in such a way that the whole of its exposed face shall be exposed to the heating conditions

8 Conditioning

The test construction shall be conditioned as described in EN 1363-1.

9 Application of instrumentation

9.1 Furnace thermocouples (plate thermometers)

Plate thermometers shall be provided in accordance with EN 1363-1. There shall be at least one for every 1.5m² of the exposed surface area of the test construction. The plate thermometers shall be oriented so that side A faces the back wall of the furnace, if it is a wall furnace, or the floor of the furnace if it is a horizontal furnace.

9.2 Pressure

The furnace shall be provided with a probe for controlling the static pressure in the furnace. Its position in the furnace shall be as specified in EN 1363-1. The furnace shall also be provided with probes for the measurement of the distribution of static pressure over the test assembly. They shall be positioned as shown in figure 7. Probes for controlling static pressure in the furnace and for determining the distribution over the test construction shall comply with EN 1363-1 and the following:

Measurement error	:	< 2 Pa
Time constant	:	< 10 s
Range	:	0 to 50 Pa

9.3 Oxygen content

The furnace shall be provided with a gas sampling probe inserted at a location where the gas composition is representative for the furnace environment. For vertical furnaces the probe shall be located at mid-height (100 ± 50)mm from the exposed face of the test construction. For horizontal furnaces the probe shall be located near the centre of the furnace (100 ± 50)mm from the exposed face of the test construction. For all furnaces, taking measurements directly within the combustion zone of the burners, near secondary air inlets, adjacent to the measuring elements or close to the flue outlet shall be avoided.

The sensor and data-acquisition apparatus shall comply with the following:

Measurement error	:	< 0.5 %O ₂
Time constant	:	< 30 s
Applicability range	:	1 to 10 %O ₂

10 Test procedure

10.1 General

The test shall be carried out using the equipment and procedures in accordance with EN 1363-1. The test duration shall be 60 min. In addition to those procedures given in EN 1363-1 the following measurements shall also be carried out:

10.2 Measuring element temperature

The exposed steel plate temperatures of each measuring element shall be measured at intervals not exceeding 1 min. For each measuring element, the average of the two exposed steel plate temperatures shall be registered.

The average $T_{s,av}$ of the exposed steel plate temperatures of all measuring elements shall be calculated and recorded.

10.3 Oxygen content

The oxygen concentration in the furnace shall be measured at intervals not exceeding 1 min. After each 5 min period, from the start of the test, the average oxygen concentration measured over the preceding 5 min shall be measured and recorded.

11 Verification criteria

11.1 Thermal characteristics

The reference temperature/time curve is given in table 1. The thermal characteristics are acceptable if $T_{s,av}$ is within $\pm 50^{\circ}\text{C}$ of the reference temperature after the first 10 min of test.

Table 1 Reference temperature/time curve

Time (min)	Temperature (°C)	Time (min)	Temperature (°C)	Time (min)	Temperature (°C)
0	20	35	848		
1	44	36	853	70	958
2	83	37	857	71	960
3	134	38	861	72	962
4	193	39	866	73	964
5	257	40	870	74	966
6	324	41	874	75	969
7	390	42	878	76	971
8	453	43	882	77	973
9	506	44	885	78	975
10	540	45	889	79	977
11	587	46	892	80	978
12	617	47	896	81	980
13	642	48	899	82	982
14	664	49	902	83	984
15	682	50	906	84	986
16	699	51	909	85	988
17	714	52	912	86	990
18	726	53	915	87	991
19	738	54	918	88	993
20	748	55	921	89	995
21	758	56	923	90	997
22	767	57	926	91	998
23	775	58	929	92	1000
24	783	59	931	93	1002
25	790	60	934	94	1004
26	797	61	937	95	1005
27	804	62	939		
28	810	63	942		
29	816	64	944		
30	822	65	946		
31	828	66	949		
32	833	67	951		
33	838	68	953		
34	843	69	956		

11.2 Pressure characteristics

The deviation from the measured pressure to the reference distribution, given by the following formula, shall not exceed 2Pa for any location.

$$\Delta p = \frac{353}{T} g \Delta y$$