SLOVENSKI STANDARD
SIST EN 1859:2001

01-februar-2001

Dimniki - Kovinski dimniki - Preskusne metode

Chimneys - Metal chimneys - Test methods

Abgasanlagen - Metall-Abgasanlagen - Prüfverfahren

Conduits de fumée - Conduits de fumée métalliques - Méthodes d'essais

Ta slovenski standard je istoveten z: **EN 1859:2000**

ICS:

91.060.40	Dimniki, jaški, kanali	Chimneys, shafts, ducts

SIST EN 1859:2001 **en**

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1859

January 2000

ICS 91.060.40

English version

Chimneys - Metal Chimneys - Test Methods

Conduits de fumée - Conduits de fumée métalliques - Méthodes d'essais

Abgasanlagen - Metall-Abgasanlagen - Prüfverfahren

This European Standard was approved by CEN on 16 April 1999.

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

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 166 "Chimneys", the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by July 2000, and conflicting national standards shall be withdrawn at the latest by July 2000.

This European Standard should be read in conjunction with the general requirements defined in EN 1443, the products requirements defined in prEN 1856-1 and prEN 1856-2 and the general test methods defined in WI 166005 which may offer a suitable alternative to those in this document. Attention is also drawn to other material related European Standards developed by CEN/TC 166.

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

1 Scope

This European Standard describes test methods for metal chimney products.

2 Normative references

This European Standard 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 1443, Chimneys - General requirements.

EN 60529, Degrees of protection provided by enclosures (IP Code).

prEN 1856-1, Chimneys - Requirements for metal chimneys - Part 1: System chimney products.

prEN 1856-2, Chimneys - Requirements for metal chimneys - Part 2: Metal liners and connecting flue pipe products.

EN 60068-2-59, Enviromental testing. Test methods. Test Fe and guidance. Vibration. (Sine-beat method)

ISO 3966, Measurement of fluid flow in closed conduits. Velocity area method using Pitot static tubes.

3 Definitions

For the purposes of this standard, the definitions given in EN 1443 and prEN 1856-1 apply.

4 Test methods for metal chimney products

4.1 Compressive strength

4.1.1 Fitting

4.1.1.1 Test assembly

Assemble the fitting according to the manufacturer's installation instructions between two adaptors including one chimney section (see figure 1a). The adaptors shall be supplied by the chimney manufacturer and shall transfer the test load in the usual way to the load bearing wall of the test components as it is done in the installation. The test load shall be transferred to the test components by means of a pivoted plate.

4.1.1.2 Procedure and results

Increase the test load on the components without shock up to four times the design load where the flue liner is load bearing or three times the design load where the flue liner is non load bearing. The load shall be measured to an accuracy of 2 % of the design load. Record the result.

Where the design load is unknown, increase the test load uniformly and record the results to allow the point of failure to be detected. Failure is deemed to have occurred when the fitting cannot sustain a further increase in load.

Use the minimum value from three failure loads to determine the design load.

4.1.2 Chimney support

4.1.2.1 Test assembly

Install the chimney support according to the manufacturer's installation instructions. Apply the test load to the chimney support through a chimney section and an adaptor (see figure 1b). The adaptor shall be supplied by the chimney manufacturer and shall transfer the test load in the usual way to the load bearing wall of the chimney sections. The test load shall be transferred to the test component by means of a pivoted plate.

4.1.2.2 Procedure and results

Increase the test load up to the design load without shock. Record the maximum displacement of the chimney. Measure the displacement to an accuracy of 0,1 mm.

Further increase the load up to three times the design load. Record the results.

Measure the load to an accuracy of 2 % of the design load.

Where the design load is unknown, increase the load uniformly and record the results to allow the point of failure to be detected. Failure is deemed to have occurred when the support cannot sustain a further increase in load.

Record the displacement during the load increase. Use the minimum value from three failure loads to determine the design load.

4.2 Tensile strength

4.2.1 Test assembly

Install the chimney sections according to the manufacturer's installation instructions. Apply the test load through an adaptor (see figure 1c). The adaptor shall be supplied by the chimney manufacturer and shall transfer the test load in the usual way to the load bearing wall of the chimney sections.

4.2.2 Test procedure and results

Increase the test load on the components without shock up to 1,5 times the design load. The load shall be measured to an accuracy of 2 % of the design load. Record the result.

Where the design load is unknown, increase the test load uniformly and record the results to allow the point of failure to be detected. Failure is deemed to have occurred when the fitting cannot sustain a further increase in load.

Use the minimum value from three failure loads to determine the design load.

4.3 Lateral strength

4.3.1 Fittings in non-vertical orientation

4.3.1.1 Test assembly

Install the chimney fittings and supports at the maximum angle from vertical according to the manufacturer's installation instructions using additional vertical supports to install the sections without deflection (see figure 2).

4.3.1.2 Procedure and results

Remove the additional vertical supports. Record the maximum deflection to an accuracy of 0,1 mm.

4.3.2 Wind load

4.3.2.1 Test assembly

Install the chimney components according to the manufacturer's installation instructions. Use the test assembly consisting of the manufacturer's declared freestanding components and further chimney sections up to the manufacturer's maximum declared lateral support separation distance between the supports, and once again the same distance up to an anchor point (see figure 3).

4.3.2.2 Procedure and results

Apply an evenly distributed test load increased uniformly up to 1,5 kN/m^2 ± 2,5 %.

> NOTE: A method for applying an evenly distributed load is described in informative annex H. Other methods using a vertical assembly may also be used.

Apply the test load to those components declared by the manufacturer for external use, except 50 % of the last laterally supported section of the test assembly.

Apply the test load by a number of individual evenly distributed loads equally spaced from the freestanding end at not more than (0,2 ± 0,01) m intervals. The individual loads shall not vary by more than 1 %. Record the results.

4.4 Gas tightness

4.4.1 Test assembly

Construct the test assembly as described in 4.5. Seal the test assembly chimney flue outlet with an air tight seal. Use adaptors supplied by the manufacturer in order to ensure that the chimney inlet and outlet are closed in a typical manner. Connect a positive pressure air supply and flow meter to the test chimney flue inlet with appropriate air tight seals. Connect a manometer to the flue of the test assembly (see figure 4).

4.4.2 Procedure and results

The test shall be carried out at ambient temperature.

Deliver air from the air supply to the flue at a rate necessary to achieve and maintain the required test pressure given in table 1 of prEN 1856-1.

Measure the test pressure and the air flow rate, both to an accuracy of ± 2,0 %.

Record the air flow rate.

4.5 Thermal performance test

4.5.1 Apparatus

The test assembly shall comprise a test structure (see 4.5.1.2), a test chimney (see 4.5.1.3), a hot gas connecting pipe (see 4.5.1.4), and measuring equipment (see 4.5.1.5).

4.5.1.1 Test assembly

Construct either:

- an open room outlet test assembly consisting of the test chimney in the test structure,

> NOTE: Figure 5 illustrates an arrangement for testing chimney sections in a combustible enclosure and figure 6 illustrates an arrangement with an off-set.

or:

- a recirculating hot gas test assembly (see figure 7) containing the test chimney in the test structure in one arm of the assembly and having interconnecting tubes so that heated air can pass around the test assembly.

4.5.1.2 Test structure

4.5.1.2.1 General

Construct a test structure consisting of two walls at right angles and two floors through which the test chimney passes, of construction as described in 4.5.1.2.2 and 4.5.1.2.3 or of equivalent thermal characteristics and dimensions, with the area below the first floor designated as Zone A, the area between the first floor and second floor as Zone B, and the area above the second floor as Zone C, as shown in figure 5. The wall/floor interface shall be

fitted with nominally 20 mm x 100 mm skirting board. The vertical distance between the floor and ceiling in Zone B shall be (2 400 ± 25) mm. The height of the chimney protruding into Zone C shall not be less than 900 mm. Timbers shall have a dimensional tolerance of ± 1 mm.

4.5.1.2.2 Walls

Construct walls consisting of nominal dimension 38 mm x 89 mm thick timbers in a framework (see figure 5) faced on each side with one layer of nominally 12 mm thick plywood to give a total thickness of 114 mm insulated in the voids with mineral fibre insulant having a thermal conductivity of 0,035 W/m K at 20 °C, with a density of 100 kg/m^3. The walls shall extend 1 200 mm.

4.5.1.2.3 Floors

Construct flooring framework of nominal dimension 50 mm x 200 mm timbers at the first floor level and nominal dimension 50 mm x 100 mm timbers at the second floor level forming an opening that enables the test chimney to be erected so that all parts of the test structure are at the manufacturer's specified clearance X mm from the chimney fittings (see figure 5) covered with one thickness of nominal dimension 20 mm boarding for the floors and one thickness of nominal dimension 12 mm plywood for the ceilings, except for the second floor ceiling (exposed top), and the spaces between the timbers filled with 100 mm thick mineral wool slab with a thermal conductivity of 0,035 W/m K at 20 °C, with a density of 100 kg/m^3.

4.5.1.3 Test chimney

Construct the test chimney using the components materials and construction representing the manufacturer's product range, including a termination, and, if incorporated, joints. Assemble the chimney in accordance with the manufacturer's installation instructions, including firestops or firestops and spacers to a height of not less than 4,5 m, including base support components, if used.

Include any finishing (e.g. non-combustible enclosures or claddings) specified in the manufacturer's instructions.

4.5.1.4 Hot gas connecting pipe

Construct a purpose-made insulated straight flue pipe having an internal diameter equal to that of the flue of the test chimney of a length of approximately seven diameters (7D) measured from the centre line of the flue gas generator to the entry to the test chimney, insulated to provide a thermal resistance value of not less than that equivalent to 50 mm thickness of material having a thermal conductivity of 0,125 W/m K ± 0,005 W/m K at 750°C.

NOTE: This item should be supplied by the chimney manufacturer.

4.5.1.5 Measuring equipment and its location

4.5.1.5.1 Ambient temperature

Measure ambient air temperature with an accuracy of ± 1,5°C, in Zone A at a position 300 mm ± 5 mm below the ceiling and in all other zones 300 mm ± 5 mm above the floor.

When testing a non-enclosed chimney, place additional ambient measuring points at levels corresponding to the outer surface temperature measurements.

The method is described in normative annex A.

4.5.1.5.2 Hot gas temperature

Measure the hot gas temperature with an accuracy of ± 3 °C for hot gas temperatures less than or equal to 600 °C and ± 0,75 % for hot gas temperatures greater than 600 °C at a position 50 mm ± 2 mm before the inlet to the test chimney and at a point in the cross section coincident with the highest temperature position.

The method is described in normative annex B.

4.5.1.5.3 Metal surface temperature

Measure the surface temperature of metal components with an accuracy of ± 1,5 °C.

The method is described in normative annex C.

4.5.1.5.4 Combustible/wood surface temperature

Measure the surface temperature of the adjacent wood/combustible parts of the test structure with an accuracy of ± 1,5 °C.

The method is described in normative annex D.

4.5.1.5.5 Locations for surface temperature measurements

Establish the maximum temperature of the surfaces of the test structure and the test chimney during the thermal cycle appropriate to the designation.

Locations for thermocouples are described in normative annex E.

4.5.1.5.6 Chimney draught measurement

Measure the draught in the chimney with an accuracy of ± 2 %, through a 150 mm ± 2 mm length of stainless steel tubing, internal diameter 3 mm $^{+1mm}_{-0mm}$ inserted trough the flue pipe and flush with the flue surface and sealed by brazing, at a distance of 100 mm ± 2 mm from the entry to the test chimney.

4.5.1.5.7 . Hot gas volume flow

Measure the flue gas volume to an accuracy of + 10 %, - 5 %.

Informative annex J gives acceptable techniques.

4.5.2 Test environment and conditioning

4.5.2.1 Test room

The test room shall consist of a ventilated space not subject to draughts greater than 0,5 m/s measured at the ambient thermocouple positions (see 4.5.1.5).

Ambient temperature within the test building shall be maintained within the limit of 20 °C ± 15 °C, measured at the designated ambient temperature positions (see 4.5.1.5).

The humidity shall be controlled between 30 % - 70 % RH.

Ambient air shall be able to circulate freely between all parts of the test room.

The distance between the test assembly and other structures (e.g. test room walls) shall be at least 1,0 m.

4.5.2.2 Vibration conditioning

Vibration conditioning shall be undertaken using vibration equipment and measuring techniques complying with EN 60068-2-59.

4.5.2.2.1 Procedure

Place each fitting intended for inclusion in the thermal test onto the vibrating table in its vertical orientation. Subject each fitting to a sinusoidal excitation at an acceleration equal to 9,81 m/sec^2, with a frequency of 10 Hz and an amplitude of 2,5 mm for 45 min.

4.5.2.3 Drying/conditioning phase

Incorporate a drying phase into the thermal cycle if required by the manufacturer's instructions.

Blow hot gases into the chimney in such a way that the hot gas temperature (see 4.5.1.5.2) rises to the nominated test temperature in 60 min ± 5 min, unless otherwise required.

4.5.3 Test procedure

Install the chimney components which have been subjected to the vibration conditioning criteria of 4.5.2.2 in the test assembly which is appropriate to the manufacturer's declared product location designation.

Encase a chimney designated for internal use and with combustible enclosure in Zone B on the remaining two sides with 12 mm nominal dimension plywood and positioned on the basis of the manufacturer's specified clearance to the enclosure and walls, measured between the outer surface of the chimney sections and the interior surface of the enclosing materials. Such clearance is designated by the dimension X (see figure 5). Close the floor penetrations

at each ceiling and floor level with a firestop or firestop and spacer arrangement supplied by the manufacturer.

Seal only joints and openings between spacers or supports and the test structure and all joints in the enclosure casing.

Install a chimney designated for use without an enclosure into the test structure, without enclosing the test chimney and without closing the floor penetrations (see figure 8).

For a chimney designated for internal use and with non combustible enclosure, the sides of the enclosure shall be closed to the walls of the test assembly unless otherwise specified by the manufacturer, see figure 9. Install the floor penetration assembly supplied by the manufacturer.

Maintain the test environment.

Generate hot gas with the volume flow and test temperature specified in table 1 and table 2 appropriate to the product designation and diameter.

Adjust the hot gas flow pattern so that the overall temperature distribution factor (OTDF) for the hot gas is not greater than 1,05.

Where:

$$\text{OTDF} = \frac{\text{peak hot gas temperature}}{\text{mean hot gas temperature}} \qquad (1)$$

Ensure that the hot gas CO/CO_2 ratio does not exceed 0,01.

Maintain the ambient temperature of the test room so that it does not vary by more than 5 °C for the duration of the test.

4.5.3.1 Heat stress test

Generate hot gas with the volume flow and test temperature specified in table 1 and table 2 appropriate to the product designation and diameter. Regulate the rate of rise of the hot gas temperature to achieve the specified gas temperature (T_t) in time $T = (T_t \times 60/50)$ s ± 30 s.

Maintain the flue gas temperature at the specified test temperature until equilibrium is achieved. Equilibrium is deemed to exist when the average rate of rise of the temperature on the test chimney or structure does not exceed 2 °C per 30 min.

In addition, for positive pressure chimney systems only, introduce hot gas to achieve the volume flow and test temperature specified in table 1 and table 2 for the product designation and diameter. Maintain this condition for 5 min, then shut off the hot gas generator and allow to cool for 10 min. Repeat this cycle 50 times. Measure and record the gas tightness according to 4.4.

4.5.3.2 Thermal shock test

With the test assembly temperatures within 10 °C of the test room ambient conditions generate hot gas with the volume flow and test temperature specified in table 1 and table 2 appropriate to the diameter. Regulate the rate of rise of the hot gas temperature to achieve 1000 °C in 10 min ± 1 min.

Maintain the hot gas temperature at $1000 \begin{smallmatrix} +20 \\ -0 \end{smallmatrix}$ °C for a period of 30 min, then turn off the hot gas generator.

Continue to record the temperatures on the test assembly until the temperatures have reached their maximum and are decreasing.

Measure and record flue regularity and measure gas tightness according to 4.4.

Repeat the heat stress test.

4.5.4 Results

Record all temperature values as specified in 4.5.1.5 Record any instance where the temperature exceeds the allowed values.

For the purposes of determining temperature rises on chimney accessory parts and on enclosures and structures, such temperatures shall be related to the ambient air temperature as follows.

The temperatures of joists shall be related to the average of the ambient temperatures above and below the joist area.

The temperatures of floor and roof material shall be related to the ambient temperatures above the floor or roof.

The temperatures of ceiling material shall be related to the ambient temperature below the ceiling.

The temperatures of chimney surfaces or accessories shall be related to the ambient temperature of the zone in which the chimney surface or accessory temperature is measured.

During the heat stress test the temperature rise shall be based on the ambient temperature recorded at the end of the relevant firing period.

TABLE 1: Hot gas volume flow vs test temperature

THERMAL PERFORMANCE											
Diameter (mm)	Volume Flow (m^3/h) Temperature (°C)										
	100	120	150	170	190	250	300	350	500	550	700
80	41,80	42,21	43,51	44,61	45,88	49,82	53,29	56,71	63,73	66,83	79,98
100	65,31	65,95	67,99	69,70	71,69	77,84	83,27	88,61	99,58	104,42	124,97
125	102,05	103,05	106,23	108,90	112,01	121,63	130,10	138,45	155,60	163,16	195,27
150	146,94	148,39	152,97	156,82	161,30	175,15	187,35	199,36	224,06	234,95	281,18
175	200,01	201,97	208,21	213,44	219,54	238,40	255,00	271,36	304,97	319,80	382,72
200	261,24	263,80	271,94	278,78	286,75	311,38	333,07	354,42	398,33	417,69	499,88

TABLE 2: Hot gas volume flow vs flue diameter

THERMAL SHOCK						
Temperature (°C)	Volume flow (m^3/h) Diameter (mm)					
	80	100	125	150	175	200
1000	108,00	144,00	252,00	360,00	468,00	612,00