SLOVENSKI STANDARD
SIST EN 1859:2009+A1:2013

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Nadomešča:
SIST EN 1859:2009

Dimniki - Kovinski dimniki - Preskusne metode

Chimneys - Metal chimneys - Test methods

Abgasanlagen - Metall-Abgasanlagen - Prüfverfahren

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

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Ta slovenski standard je istoveten z: EN 1859:2009+A1:2013

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ICS:

91.060.40	Dimniki, jaški, kanali	Chimneys, shafts, ducts

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2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

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Chimneys - Metal chimneys - Test methods

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

Abgasanlagen - Metall-Abgasanlagen - Prüfverfahren

This European Standard was approved by CEN on 1 May 2009 and includes Amendment 1 approved by CEN on 24 February 2013.

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SIST EN 1859:2009+A1:2013
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SIST EN 1859:2009+A1:2013

Contents

Page

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 1859:2009+A1:2013
https://standards.iteh.ai/catalog/standards/sist/6dbd0ed5-7357-4277-9c61-ccb52fda4cdb/sist-en-1859-2009a1-2013

SIST EN 1859:2009+A1:2013

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 1859:2009+A1:2013
https://standards.iteh.ai/catalog/standards/sist/bdbd0ed5-7357-4277-9c61-ccb52fda4cdb/sist-en-1859-2009a1-2013

SIST EN 1859:2009+A1:2013

Foreword

This document (EN 1859:2009+A1:2013) has been prepared by Technical Committee CEN/TC 166 “Chimneys”, the secretariat of which is held by ▌A1⟩ ASI ⟨A1▐.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2013, and conflicting national standards shall be withdrawn at the latest by October 2013.

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

This document includes Amendment 1 approved by CEN on 24 February 2013.

This document ▌A1⟩ supersedes EN 1859:2009 ⟨A1▐.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ▌A1⟩ ⟨A1▐.

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(standards.iteh.ai)
SIST EN 1859:2009+A1:2013
https://standards.iteh.ai/catalog/standards/sist/bdbd0ed5-7357-4277-9c61-ccb52fda4cdb/sist-en-1859-2009a1-2013

SIST EN 1859:2009+A1:2013

1 Scope

This European Standard describes test methods for metal chimney products.

2 Normative references

[A1] The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. [/A1]

EN 1443:2003, *Chimneys — General requirements*

EN 1856-1:2009, *Chimneys — Requirements for metal chimneys — Part 1: System chimney products*

EN 60068-2-59, *Environmental testing — Part 2: Test methods — Test Fe: Vibration, Sine beat method (IEC 60068-2-59:1990)*

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

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

3 Definitions

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For the purposes of this standard, the definitions given in EN 1443:2003 and EN 1856-1:2009 apply.

SIST EN 1859:2009+A1:2013
https://standards.iteh.ai/catalog/standards/sist/1dbd0ed5-7357-4277-9c61-ccb52fda4cdb/sist-en-1859-2009a1-2013

4 Test methods for metal chimney products

4.1 Compressive strength

4.1.1 Sections and Fittings

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 4 times the design load where the flue liner is load bearing or 3 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.

SIST EN 1859:2009+A1:2013

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 3 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.

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4.2 Tensile strength

4.2.1 Test assembly

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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.

SIST EN 1859:2009+A1:2013

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 G. 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

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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).

SIST EN 1859:2009+A1:2013
https://standards.iteh.ai/catalog/standards/sist/bdbdfded-7357-4277-9c61-ccb52fda4cdb/sist-en-1859-2009a1-2013

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 EN 1856-1:2009.

Measure the test pressure and the air flow rate, both to an accuracy of ± 5,0 %.

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

The chimney shall be tested according to Figure 5.

NOTE Figure 6 shows the arrangement for testing off-sets.

SIST EN 1859:2009+A1:2013

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. The floor opening and wall position shall enable 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. The area below the first floor referenced 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 113 mm ± 1 mm, insulated in the voids with mineral fibre insulant having a thermal conductivity of 0,035 W/m K ± 0,002 W/m K at 20 °C with a minimum density of 70 kg/m^3. The walls shall extend at least 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 comply with the manufacturer's declared minimum distance to combustible material from the chimney fittings (see Figure 5) and 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 ± 0,002 W/m K at 20 °C, with a minimum density of 70 kg/m^3.

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SIST EN 1859:2009+A1:2013
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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, at least 7 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.

Construct the test chimney according to Figure 5 for all sections, T pieces and inspection openings.

Where a manufacturer’s product range includes bends, the test chimney shall include one offset (see Figure 6), with an offset angle of maximum 45° and an offset distance of 0.75 m ± 0.25 m.

Any inspection opening shall be in Zone C.

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.

SIST EN 1859:2009+A1:2013

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.

A method is described in informative Annex C.

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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.

SIST EN 1859:2009+A1:2013
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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 $3\text{mm}\ ^{+1mm}_{0mm}$ inserted through 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 I gives acceptable techniques.

SIST EN 1859:2009+A1:2013

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). This requirement is deemed fulfilled in a closed test room.

Ambient temperature within the test building shall be maintained within the limit of 15 °C to 30 °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.

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4.5.2.3 Drying/conditioning phase

SIST EN 1859:2009+A1:2013
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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 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 referenced by the dimension xx (see Figures 5 and 6). 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 7).

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 8). Install the floor penetration assembly supplied by the manufacturer.

Maintain the test environment.

SIST EN 1859:2009+A1:2013

Generate hot gas with the velocity flow and test temperature specified in Table 1 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

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

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 at $-{}_{0}^{+10}$ % of the value and the test temperature at ${}_{0}^{+5}$ % of the values specified in Table 1 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 x 60/50) s ± 30 s.

Maintain the flue gas temperature at the specified test temperature at ${}_{0}^{+5}$ % 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.

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In addition, for positive pressure chimney systems and negative pressure chimneys which incorporate a seal or sealant as part of the joint, introduce hot gas to achieve the hot gas velocity and test temperature specified in Table 1 for the product designation and diameter. Maintain this condition for 10 min, then shut off the hot gas generator and allow to cool for 10 min. Repeat this cycle 11 times. Measure, at ambient temperature, with an accuracy of 0.001 m, the change in vertical position of the chimney wall(s) at the top of the test sample before and after subjecting the product to the cycles.

SIST EN 1859:2009+A1:2013
https://standards.iteh.ai/catalog/standards/sist/bdbd0ed5-7357-4277-9c61-ccb521da4cdb/sist-en-1859-2009a1-2013

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 appropriate to the diameter. Regulate the rate of rise of the hot gas temperature to achieve 1 000 °C in 10 min ± 1 min.

Maintain the hot gas temperature at 1000_{-20}^{+50} °C for a period of 30 min ± 1 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.

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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 velocity as a function of test temperature T and diameter of the test chimney

		Hot gas velocity in m/s at test temperature											
		Temperature class											
		T 080	T 100	T 120	T 140	T 160	T 200	T 250	T 300	T 400	T 450	T 600	Soot-fire
		Test temperature in °C											
Pressure class	D in mm	100	120	150	170	190	250	300	350	500	550	700	1000
Negative pressure	100	1,67	1,76	1,90	2,00	2,08	2,36	2,60	2,84	3,56	3,81	4,55	5,09
	120	1,68	1,77	1,91	2,00	2,10	2,38	2,62	2,86	3,59	3,83	4,58	5,58
	160	1,71	1,80	1,94	2,04	2,13	2,42	2,66	2,91	3,65	3,90	4,66	5,56
	200	1,74	1,84	1,99	2,08	2,18	2,48	2,72	2,97	3,73	3,98	4,76	5,41
Positive pressure	100	2,35	2,47	2,65	2,77	2,90	3,26	3,56	3,85	4,73	5,01	5,86	5,09
	120	2,39	2,52	2,71	2,83	2,95	3,32	3,62	3,93	4,82	5,11	5,98	5,58
	160	2,51	2,64	2,84	2,97	3,10	3,48	3,80	4,12	5,06	5,36	6,27	5,56
	200	2,66	2,80	3,01	3,15	3,29	3,70	4,03	4,37	5,36	5,69	6,65	5,41
High positive pressure	100	5,15	5,36	5,68	5,88	6,08	6,63	7,05	7,44	8,36	8,59	9,07	5,09
	120	5,28	5,50	5,83	6,04	6,24	6,81	7,24	7,63	8,58	8,82	9,31	5,58
	160	5,62	5,86	6,20	6,42	6,64	7,24	7,70	8,12	9,13	9,39	9,91	5,56
	200	6,06	6,32	6,69	6,92	7,16	7,81	8,30	8,75	9,84	10,12	10,68	5,41

iTeh STANDARD PREVIEW
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SIST EN 1859:2009+A1:2013
https://standards.iteh.ai/catalog/standards/sist/bdbd0ed5-7357-4277-9c61-cc6...-en-1859-2009-a1-2013

NOTE The table refers to a maximum diameter of 200 mm. Hot gas velocities for other sizes are possible by calculating according to EN 13384-1.

SIST EN 1859:2009+A1:2013

4.6 Thermal resistance

4.6.1 Test assembly

Use a test assembly consisting of two fans, two electric heaters, and interconnecting tubes so that heated air can pass around the test assembly. Install in each arm of the test assembly approximately two meters of the already thermally tested chimney sections including at least two joints (see Figure 9).

4.6.2 Test procedure

Maintain the test environment specified in 4.5.2.1.

Circulate hot gas around the test assembly. The velocity of the hot air shall be of 4 m/s minimum and the hot gas temperature at the ends of the test sections shall not differ by more than 10 K. For negative pressure chimneys maintain the pressure in the test chimney between 0 Pa and -10 Pa.

Measure the internal and external surface temperature of the chimney sections as specified in 4.5.1.5.5.

For chimneys designated suitable for dry operation, the hot gas shall have a heat content and temperature so that the inner surface of the chimney sections under test reaches a temperature 20 % below the designated temperature (nominal working temperature), but not more than 200 °C.

For chimneys designated suitable for wet applications, the hot gas shall be water vapour saturated and shall have a heat content and temperature such that the inner surface reaches a temperature of 70 °C. The gas is considered saturated if humidity is equal to or greater than 95 % measured at entry to the test sample.

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Adjust the temperature, heat content and humidity of the hot air until equilibrium conditions exist. Equilibrium is reached when the difference between the outer surface temperature of the chimney sections and the ambient temperature does not change by more than 1 % in 60 min. Record the heat input (Q1), in Watts, the flue gas temperature t_g and the internal (t_j) and external (t_0) surface temperatures.

SIST EN 1859:2009+A1:2013
https://standards.iteh.ai/catalog/standards/sist/bdbd0ed5-7357-4277-9c61-
ccb52fda4cdb/sist-en-1859-2009a1-2013

Reassemble the test assembly without the test chimney sections or replace by the calibrated section. Repeat the test as described before until the hot gas temperature is the same as during the tests with the chimney sections in place, and until equilibrium condition exists. Equilibrium is reached when the difference between the hot gas temperature and the ambient temperature does not change by more than 1 % in 3 h.

Record the heat input (Q_2).

4.6.3 Results

Calculate the thermal resistance (1/Λ) from:

$$1/\Lambda = A_i(t_i - t_0)/(Q_1 - Q_2) \quad (2)$$

where

- Q_1 is the total heat input in watts with the chimney section;
- Q_2 is the total heat input in watts without the chimney sections;
- t_j is the inner surface temperature;
- t_0 is the outer surface temperature;
- A_j is the total inner surface area of the test chimney.