	STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA	Page: 1/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

## TYPE TESTING REPORT

**No. 2016/17/K/Rz**

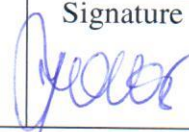
### REPORT ON TYPE TESTING OF THREE-WALL CHIMNEY SYSTEM “SKDTŻ-3L”


Kraków,  
April 2016

Copy. 2./3

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

Signature





	<b>STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA</b>	Page: 2/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

1. Tests performed by: Ośrodek Szkolenia i Rzeczoznawstwa,  
Stowarzyszenie Naukowo – Techniczne  
Inżynierów i Techników  
Przemysłu Naftowego i Gazowniczego (Training and  
Expertise Centre, Scientific-Technical Association of  
Oil and Gas Industry Engineers and Technicians)  
31-510 Kraków  
ul. Rakowicka 21/4
2. Name of products tested: Three-wall chimney systems of “SKDTŻ-3L”  
type by DARCO Sp. z o.o.
3. Type Marking of Systems Produced: Three-wall chimney systems type “SKDTŻ-3L”
4. Chimney Systems Manufacturer: DARCO Sp. z o.o.  
39-200 Dębica,  
ul. Metalowców 43
5. Team performing the test:

	<b>Full name</b>	<b>Position</b>	<b>Signature</b>
Tests performed by	M.Sc. Eng. Bolesław Gawor	Expert of SITP NiG	
	M.Sc. Eng. Krzysztof Drożdżol	Specialist	
Supervision over the tests	M.Sc. Eng. Zbigniew A. Tańch	Expert- verifier SITP NiG	
Report prepared by	PhD. Eng. Iwona Stachurek	Senior Specialist	
Tests approved by	M.Sc. Katarzyna Matuszewska	Director of the Training Centre and Expert of SITP NiG	

The report contains 29 numbered and signed pages.

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--

	<b>STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA</b>	Page: 3/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

Product name: **Three-wall chimney systems Type “SKDTŻ-3L” by DARCO Sp. z o.o.**

Technical data of three-wall chimney systems Type “SKDTŻ-3L” by DARCO Sp. z o.o. for VENTIA OY have been presented in Table 1 of this report.

**Manufacturer:**

DARCO Sp. z o.o.  
39-200 Dębica  
ul. Metalowców 43

**Timing of the tests:**

Commencement date: 22.02.2016  
Completion date: 25.03.2016

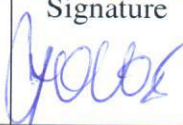
**1. SCOPE OF THE TESTS**


The type testing of three-wall chimney systems type “SKDTŻ-3L” is the type testing according to the requirements of PN-EN 1856-1:2009 “Chimneys. Requirements for metal chimneys. Part 1: System chimney products” and PN-EN 1859:2009 “Chimneys. Metal chimneys. Test methods”.

Type testing was performed in reference to basic requirements of Regulation No. 305/2011 of the European Parliament and of the European Council in conformity assessment system 2+.

**2. DOCUMENTS FORMING THE BASIS FOR THE TESTS**

1. Regulation No. 305/2011 of the European Parliament and of the European Council of 9 March 2011.
2. Act of 16 April 2004 on construction products (OJ 2004 No 92.881, as amended, OJ 2014.883, 2015.1165).
3. PN-EN 1443:2005 “Chimneys – General requirements.”
4. PN-EN 1856-1:2009 “Chimneys. Requirements for metal chimneys. Part 1: System chimney products.”
5. PN-EN 1856-2:2009 “Chimneys. Requirements for metal chimneys. Part 2: Metal flue liners and connecting flue pipes.”
6. PN-EN 1859:2009 “Chimneys. Metal chimneys. Test methods.”
7. PN EN 13384-1 + A2:2008 “Chimneys. Thermal and fluid dynamic calculation methods. Part 1. Chimneys serving one appliance.”
8. PN-EN 15821:2010 “Multi-firing sauna stoves fired by natural wood logs. Requirements and test methods.”

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--

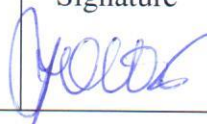
	<b>STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA</b>	Page: 4/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz


9. Technical documentation of DARCO Sp. z o.o. for Three-wall Chimney Systems – SKDTŻ.
10. Assembly instructions for three-wall chimney systems Type “SKDTŻ-3L” developed by DARCO Sp. z o.o..
11. Material attestations.
  - a. Acid-resistant steel sheet grade 1.4301, thickness 0.6 mm – Certificate Number 15K0021083-01 V01 Revele de Controle of 29 April 2015 issued by APERAM SS&S POLAND SP. Z.O.O. ul. H. Krupanka 97 41-103 Siemianowice Śląskie Pologne.
  - b. Acid-resistant steel sheet grade 1.4301, thickness 0.6 mm – Certificate Number 15G0364561-01 V01 Revele de Controle of 24 August 2015 issued by APERAM SS&S POLAND SP. Z.O.O. ul. H. Krupanka 97 41-103 Siemianowice Śląskie Pologne.
  - c. Heat-resistant steel sheet grade 1.4828, thickness 0.8 mm – Certificate Number 15K0060001-01 V01 Revele de Controle of 16 December 2015 issued by APERAM SS&S POLAND SP. Z.O.O. ul. H. Krupanka 97 41-103 Siemianowice Śląskie Pologne.
  - d. HACERAM ®refractory ceramic fibres - refractory products of aluminium-silicate fibre, Material Safety Data Sheet SDS: CSSS-TCO-010-100387, update of 26 February 2013 issued by NORGPOL Czerwiński Spółka Jawna, ul. Baletowa 104, 02-867 Warszawa.
12. Manufacturer’s declaration conformant with the requirements of PN-EN 1856-1:2009 “Chimneys. Requirements for metal chimneys. Part 1: System chimney products.”

### 3. IDENTIFICATION OF TYPE TESTING OBJECT

The object of the tests involves three-wall chimney systems type “SKDTŻ-3L” by DARCO Sp. z o.o. for VENTIA OY, comprising a flue made of acid-resistant steel sheet grade 1.4828 and 0.8 mm thick, insulator air space within a duct of acid-resistant steel grade 1.4301 of 0.5 mm thickness, high-temperature insulation made of refractory ceramic fibre of 25 mm thickness, and outer wall made of acid-resistant steel sheet of 0.6 mm thickness grade 1.4301. At the bottom part of the system, there is a draught regulator and air flow regulator, which also serves as a support element. Three-wall chimney systems type “SKDTŻ-3L” serve for flue gas release from appliances fired with natural wood logs, according to standard PN-EN 15821:2010 “Multi-firing sauna stoves fired by natural wood logs. Requirements and test methods.”

Table 1 specifies technical parameters of three-wall chimney systems type “SKDTŻ-3L” by DARCO Sp. z o.o., as declared by the manufacturer. Fig. 1. illustrates the structure of the three-wall chimney system type “SKDTŻ-3L”.

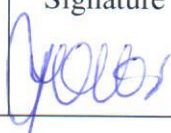
Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--

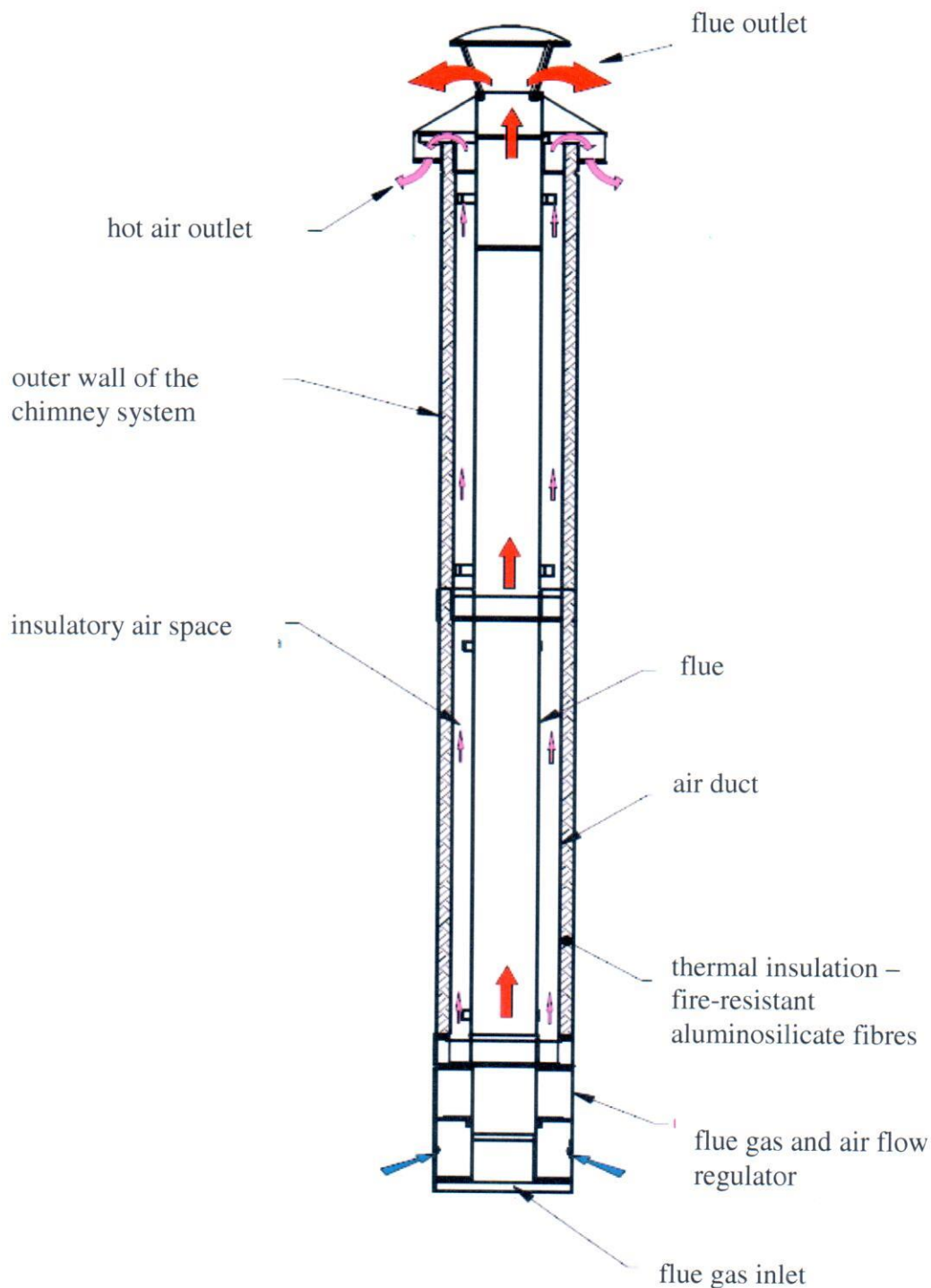
	<b>STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA</b>	Page: 5/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

**Table 1. Manufacturer's declared technical parameters of three-wall chimney systems type "SKDTŻ-3L" by DARCO Sp. z o.o.**

**Table 1.**

No	Parameters of connection pipes system	Technical data				
1	2	3				
1	Dimensions of pipes and accessories tested	DN 120				
2	Gauge DN [mm]	120	130	150	180	200
3	Chimney external diameter [mm]	250	260	280	310	330
4	Flue material, acc. to Manufacturer's Declaration	1.4828; thickness 0.8 mm				
5	Inner wall material acc. to EN-1856-1	1.4301; thickness 0.5 mm				
6	Outer wall material acc. to EN-1856-1	1.4301-cut; thickness 0.6 mm				
7	Type and thickness of insulation applied	Refractory ceramic fibre (RCF) /aluminium-silicate fibres (ASW) resistant to temperature of 1260°C; thickness 25 mm, additionally ventilated with air space of 25 mm				
8	Fuel type	wood				
9	Flue corrosion resistance acc. to Manufacturer's Declaration	resistant				
10	Flue operating method	Negative pressure; class N1				
11	Max. operating temperature of the chimney system	600°C; class T600				
12	Dry operating method	class D				
13	Soot-fire resistance	Resistant to fire; class G				
14	U-value	Air space insulation: $\lambda$ 0,025				W/mxK
		Aluminium-silicate insulation: for 600° $\lambda$ 0.14				
15	Flow-resistance coefficient	$\zeta = 0.1084$ per 1 m of flue duct				
16	Distance from flammable materials	50 mm (T600-G50)				
17	Max. chimney height	5 m				
18	Product labelling acc. to requirements of the standard	EN 1856-1 T600-N1-D-Vm-L99080 G50				


Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--



**Fig. 1. Structural diagram of the three-wall chimney system type "SKDTŻ-3L".**

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

Signature

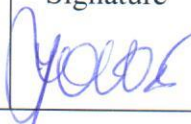
	<b>STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA</b>	Page: 7/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz


#### 4. SAMPLING METHOD

Samples for the tests were taken from the finished products warehouse of DARCO Sp. z o.o., 39-200 Dębica, ul. Metalowców 43. Sampling involved three-wall chimney system type "SKDTŻ-3L" DN/DW/DZ 120/200/250 flue diameter DN 120.

#### 5. TESTING CONDITIONS

The tests were performed by Experts and Specialists from Scientific-Technical Association of Oil and Gas Industry Engineers and Technicians (SITP NiG), Training and Expertise Centre (OSiR) in environmental conditions of the tests according to the requirements of standard PN-EN 1859-1:2009, on special test benches, with separate specialist Company Laboratory in Dębica, ul. Metalowców 43. Type testing was performed on the three-wall chimney system type "SKDTŻ-3L" DN/DW/DZ 120/200/250 with flue diameter DN 120.

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--

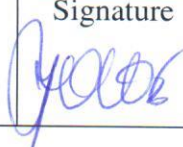
	<b>STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA</b>	Page: 8/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

## 6. TESTING PROGRAMME AND RESULTS OBTAINED


**Table 2. Testing programme, characteristics, requirements, testing method and determination of conformity of the results with type testing requirements – Annex ZA - 1 of PN-EN 1859:2009.**

**Table 2.**

No	Characteristics tested	Requirements acc. to PN-EN 1856-1:2009	Testing methods acc. to PN-EN 1859:2009 PN-EN 1856-1:2009	Conformity with the requirements
1	2	3	4	5
1.	Dimensions check	5.1 5.2	acc. to PN-EN 1856-1 p. 4	Conformant
2.	Gas tightness before compressive strength tests	6.5	acc. to PN-EN 1859 p.4.4.	Conformant
3.	Mechanical resistance	Wind load strength 6.2.3.2	acc. to PN-EN 1859 p.4.3.2, Fig. G.1	Conformant
		Compressive strength 6.2.1.1	acc. to PN-EN 1859 p.4.1, Rys. 1a	Conformant
4.	Gas tightness after compressive strength tests	6.5	acc. to PN-EN 1859:2009 p.4.4.	Conformant
5.	Flow resistance	6.6.7.1 6.6.7.2	acc. to PN-EN 1859 p.4.12 PN-EN 13384 Table B.8	Conformant
6.	Thermal tests – thermal resistance	6.6.3	acc. to PN-EN 1859 p.4.5.3, Fig. 7	Conformant
7.	Resistance to fire	6.3	acc. to PN-EN 1859 p.4.5.3, Fig. 7	Conformant
8.	Gas tightness before and after thermal tests	6.5	acc. to PN-EN 1859 p.4.4	Conformant
9.	Resistance against rain water	6.6.6	acc. to PN-EN 1859 p.4.9	Conformant
10.	Corrosion-resistance	6.7.1	acc. to PN-EN 1856-1 p.6.7 Table 4	Conformant
11.	Freeze thaw resistance	6.7.3	acc. to PN-EN 1856-1 p.6.7.3	Conformant
12.	Check of labelling	ZA3	acc. to PN-EN 1856-1 p. 9	Conformant
13.	Test of packaging	p. 8.4	acc. to PN-EN 1856-1 p. 8.4	Conformant

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--



	STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA	Page: 9/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

## 7. LISTING OF TEST RESULTS

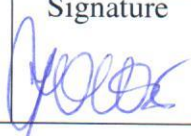
### 7.1. DIMENSIONS CHECK

Dimensions check was performed on the supplied elements by comparing them with the manufacturer's construction documentation and the declared deviations using typical measurement tools (with the appropriate measurement accuracy) according to the requirements of PN-EN 1856-1 p. 5.1 and p. 5.2. Samples for the tests were taken from the finished products warehouse of DARCO Sp. z o.o.; testing involved three-wall chimney system type "SKDTŻ-3L" DN/DW/DZ 120/200/250 with flue diameter DN 120.

Results of tests have been presented in Table 3.

**Table 3. Results of tests involving the nominal diameter dimensions check of the three-wall chimney system type "SKDTŻ-3L".**

No.	Type of duct controlled	Nominal value	Measured value	Average DN value	Permissible tolerance acc. to PN-EN 1856	Final result
		[mm]	[mm]	[mm]	[mm]	
1	2	3	4	5	6	7
1.	Flue	120	123.0	123.2	± 5	positive
2.			123.5			positive
3.			123.2			positive
4.			123.4			positive
5.			123.1			positive
6.	Inner air duct	200	201.5	201.6		positive
7.			201.4			positive
8.			201.8			positive
9.			201.6			positive
10.		201.5		positive		
11.	Outer wall of the chimney system	250	253.3	253.4		positive
12.			253.1			positive
13.			253.6			positive
14.			253.5			positive
15.			253.4			positive

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--



## 7.2. GAS TIGHTNESS TEST BEFORE COMPRESSIVE STRENGTH TESTS

Gas tightness test of the three-wall chimney system type “SKDTŻ-3L” was performed according to the requirements of PN-EN 1856-2:2009 at the manufacturer’s declared test pressure of 40 Pa class N1 with the method according to standard PN-EN 1859:2009.

Gas tightness test was performed at special test bench – Photo 1. The test bench for gas tightness test was furnished with compressed air source with flow regulation and measurement using a Wöhler unit. The inlet of the duct was blinded using special balloon – Photo 2, and connected to a pressure source; the outlet of the duct tested was tightly blinded with another balloon of the Wöhler unit.



Photo 1. Test bench for gas tightness test before compressive strength tests.



Photo 2. Sealing of the chimney system during gas tightness test.

Photo 3. presents Wöhler unit. Photo 4. presents the course of the gas tightness test. The results of the tests have been presented in Table 4.



Photo 3. Course of gas tightness test of SKDTŻ-3L chimney using a Wöhler unit



Photo 4. Course of gas tightness test of three-wall chimney systems type “SKDTŻ-3L”.

Table 4. Gas tightness test results before compressive strength tests of three-wall chimney systems type "SKDTŻ-3L".

Table 4.

No.	Type of duct controlled	Pressure class N1 test	Nominal duct length	Result obtained	Average measurement result	Permissible leakage	Final result
		[Pa]	[mm]			[m <sup>3</sup> /h]	
1	2	3	4	5	6	7	8
1.	Ø 120	40	5500	0.8	0.72	< 4.5	positive
2.				0.7			positive
3.				0.6			positive
4.				0.8			positive
5.				0.7			positive

### 7.3. MECHANICAL STRENGTH TEST

#### 7.3.1. WIND LOAD TENSILE STRENGTH TEST

The test was performed on the three-wall chimney system type "SKDTŻ-3L" DN/DW/DZ 150/200/250 according to the diagram according to standard PN-EN 1859:2009. The chimneys tested were subjected to the load of 1.5 kN/m<sup>2</sup>. The tests were performed on the special test bench meeting the requirements of standard PN EN 1859, manufactured by DARCO Sp. z o.o. according to the ideological diagram - Fig. 2. The course of the test has been presented in Photos 5 and 6.

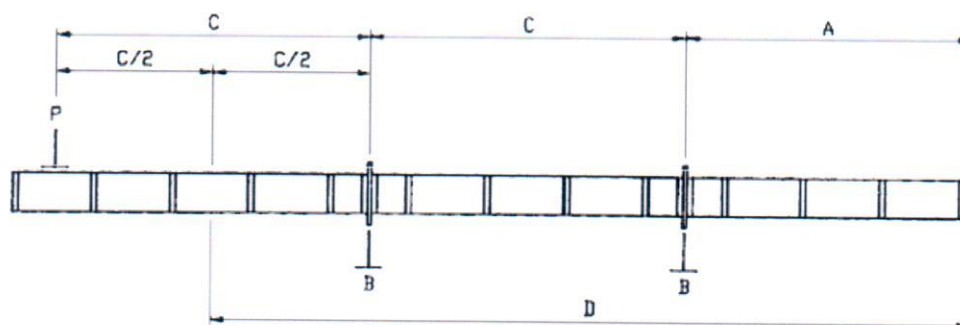


Fig. 2. Ideological diagram for wind load resistance tests, conformant to standard PN EN 1859.



Photo 5. The course of the wind load mechanical properties test.

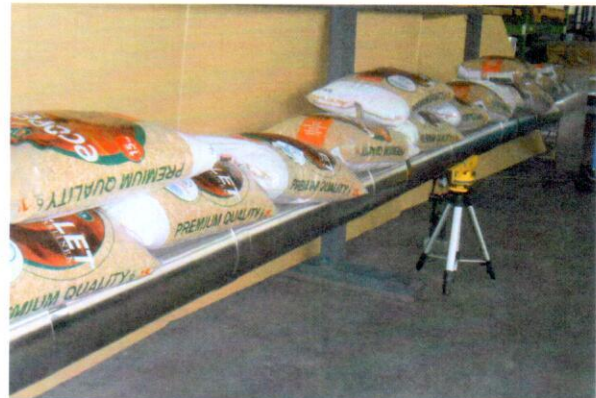
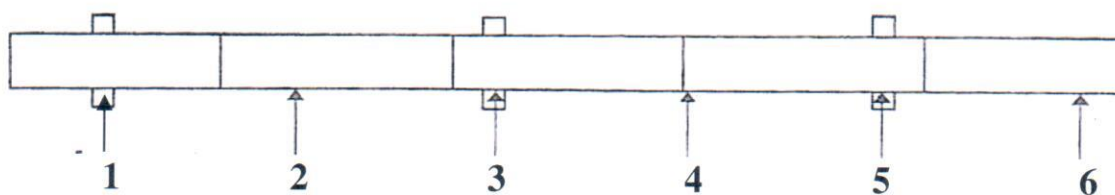


Photo 6. The course of the wind load mechanical properties test – deflection value measurement.

The results of the wind load [mm] strength test of the three-wall chimney systems type “SKDTŻ-3L have been presented in Fig. 3. and in Table 5.



MEASUREMENT POINTS



Fig. 3. Diagram of deflections of three-wall chimney systems type “SKDTŻ-3L” upon wind load strength test, where:



- maximum deflection in flexible conditions,  
- deflection after wind load strength test.

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

Signature



Table 5. Results of wind load strength test of three-wall chimney systems type “SKDTŻ-3L”.

Table 5.

No.	Chimney tested	External diameter	Surface under load	Test load	Maximum buckling	Final result
		[m]	[m <sup>2</sup> ]	[kN]	[mm]	
1	2	3	4	5	6	7
1.	DN 120/200/250	0.25	1.375	2.06	~ 7.8	positive

The performed wind load strength test of the three-wall chimney systems type “SKDTŻ-3L” yielded positive results; after the test, the chimney system did not feature durable deformation, as presented in Fig. 3.

### 7.3.2. COMPRESSIVE STRENGTH TEST

Compressive strength test was performed on a special hydraulic test bench: Fig. 4. and Photo 7. The test was performed on a three-wall chimney system type “SKDTŻ-3L” DN/DW/DZ 150/200/250. Photos 8 and 9 present the impact of compressive forces on the support element of the three-wall chimney system type “SKDTŻ-3L”. The results of the compressive strength test have been presented in Table 6.

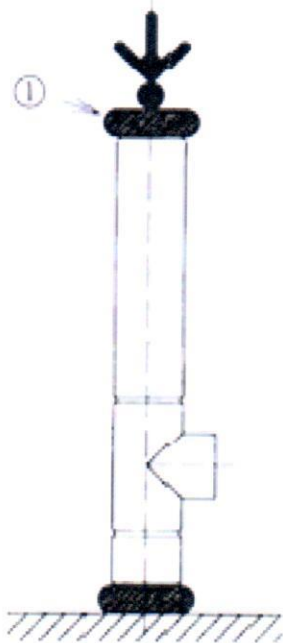



Fig.4. Ideological diagram of compressive strength test according to PN-EN 1859.



Photo 7. The course of the compressive strength test of the three-wall chimney system type “SKDTŻ-3L”.

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

Signature

	STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA	Page: 14/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

**Table 6. Results of the compressive strength tests of the three-wall chimney systems type “SKDTŻ-3L”.**

**Table 6.**

No.	Chimney tested	Declared test load	Nominal sample length	Test load acc. to PN-EN 1856	Final result
		[kN]	[mm]	[kN]	
1	2	3	4	5	6
1	DN 120/200/250	~0.5	~700	2.0	positive

During the test load on the hydraulic press onto the support element of the three-wall chimney system type “SKDTŻ-3L, no cracking, delamination, or deformations were detected; air flow and flue gas exhaust regulatory elements functioned in the correct manner.


#### **7.4. GAS TIGHTNESS TEST AFTER COMPRESSIVE STRENGTH TESTS**


After wind load strength test of the three-wall chimney system type “SKDTŻ-3L” DN/DW/DZ 120/200/250, the gas tightness test of flue ducts was repeated. The course of the gas tightness test was described in point 7.2, and illustrated in Photos 3. and 4. The results of the gas tightness tests after mechanical tests have been presented in Table 7.

**Table 7. Results of the gas tightness test after compressive strength tests of the three-wall chimney system type “SKDTŻ-3L”.**

**Table 7.**

No.	Type of duct tested	Test pressure class N1	Nominal length of the duct	Result obtained	Average measurement result	Permissible leakage	Final result
		[Pa]	[mm]			[m <sup>3</sup> /h]	
1	2	3	4	5	6	7	8
1.	Ø 120	40	5500	0.8	0.8	< 4.5	positive
2.				0.8			positive
3.				0.9			positive
4.				0.7			positive
5.				0.8			positive

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--

	STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA	Page: 15/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

### 7.5. HYDRAULIC FLOW RESISTANCE TEST

Hydraulic flow resistance values determined with the coefficient of flow resistance for three-wall chimney systems type “SKDTŻ-3L” DN/DW/DZ 120/200/250 have been adopted according to Table B8 of the normative annex of standard PN EN 13384-1 + A2:2008 – Table 8.

**Table 8. Values of coefficients of flow resistance for particular elements of the three-wall chimney system type “SKDTŻ-3L”.**


No.	Internal diameter of the chimney tested	Element tested	Value of coefficient $\zeta$
1	2	3	4
1.	Ø 120	Straight pipe	0.11
2.		T-pipe 90°	1.20
3.		Terminal	1.6

### 7.6. THERMAL TESTS – THERMAL RESISTANCE

Thermal resistance tests have been performed on a specially constructed test bench according to the requirements of standard PN-EN 1859 p.4.5.3 – Fig. 5. Fig. 6 presents the structure of the thermal test bench; Fig. 7 illustrates the flue gas inlet method in thermal tests of the three-wall chimney systems type “SKDTŻ-3L”. The course of the test has been presented in Photos 10 and 11. The tests involved the three-wall chimney system type “SKDTŻ-3L” DN/DW/DZ 120/200/250. During the thermal tests, temperature distribution has been determined for the manufacturer’s declared distance from flammable materials “XX” (50 mm) in two zones:

- A – lower temperature measurement zone,
- B – medium temperature measurement zone.

The results for the thermally stabilised operating conditions have been presented in Table 9. and in the diagram – Fig. 9.

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--

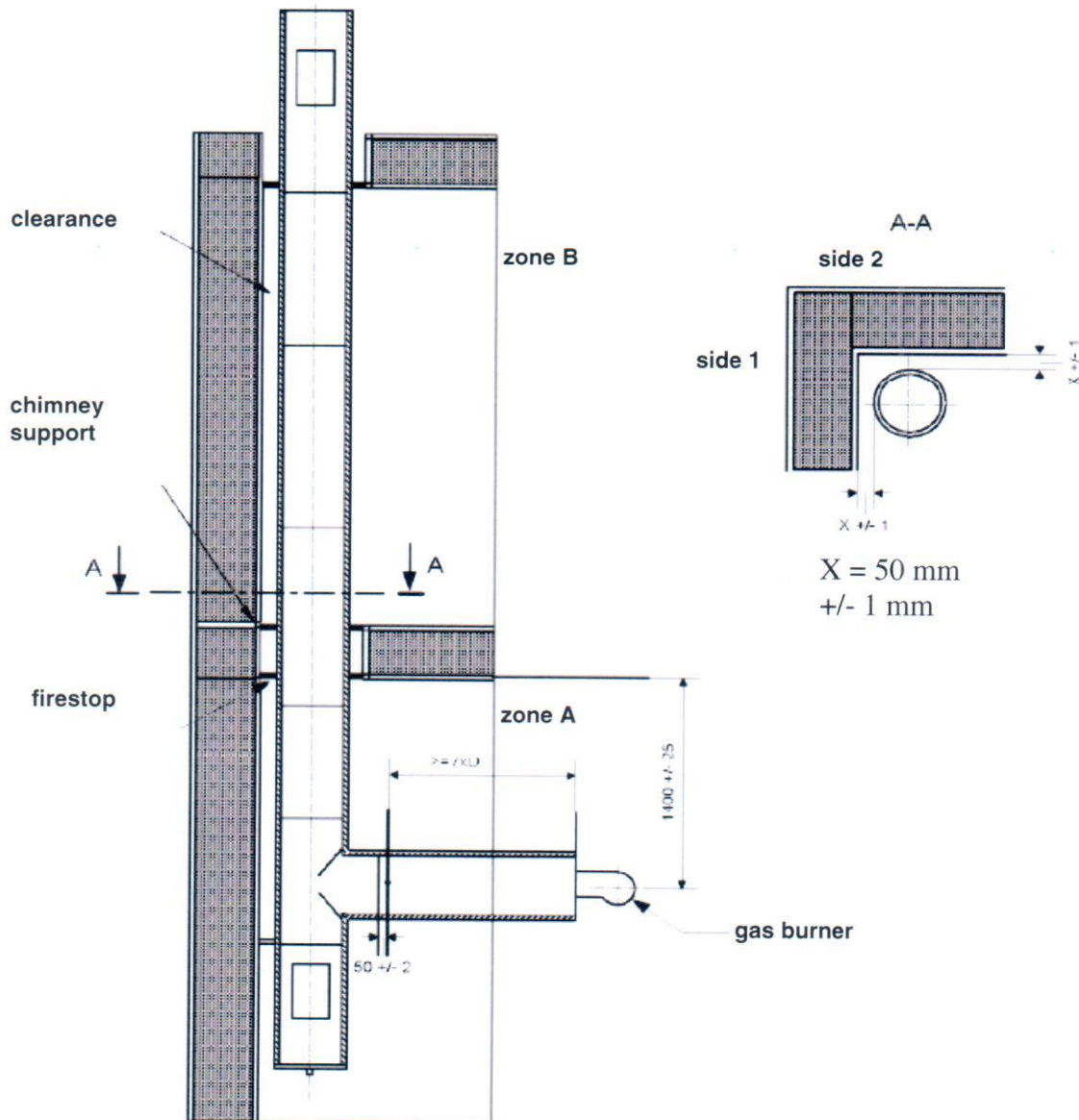


Fig. 5. Diagram of the test bench for thermal tests of chimney systems according to PN-EN 1859.

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

Signature



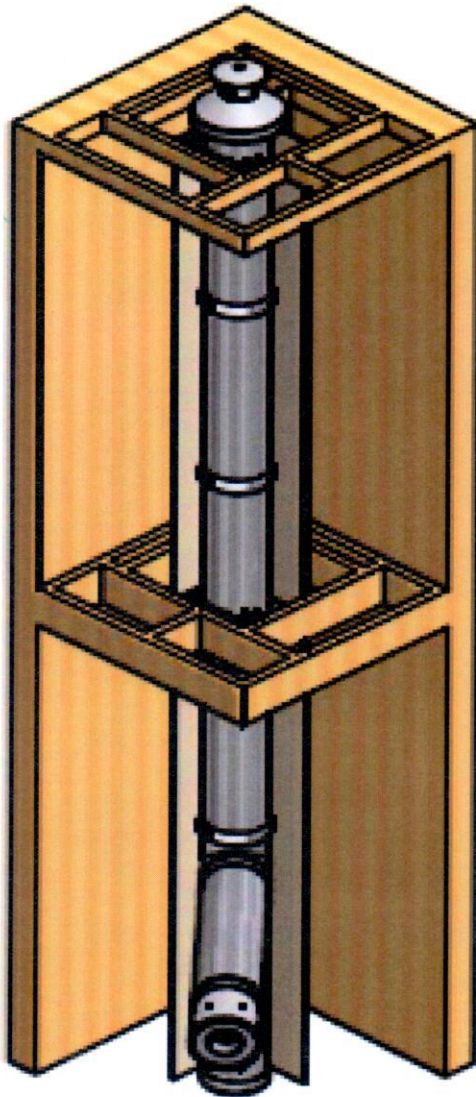
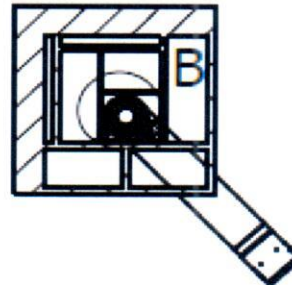
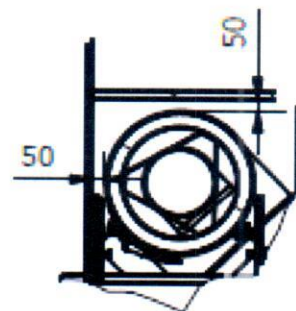



Fig. 6. Structure of the workstation for thermal tests of the three-wall chimney systems type "SKDTŻ-3L" according to the manufacturer's requirements.



**B DETAIL**  
**1 : 15**



. 7. Method of flue gas inlet for thermal tests of the three-wall chimney systems type "SKDTŻ-3L".

	STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA	Page: 18/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

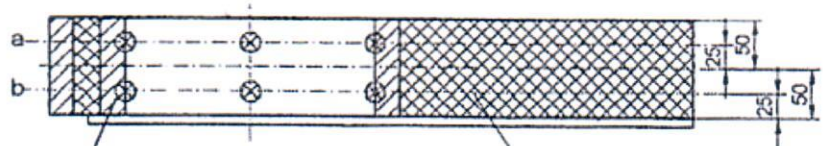


Fig. 8. Thermal elements' distribution points on particular floors of the test bench.

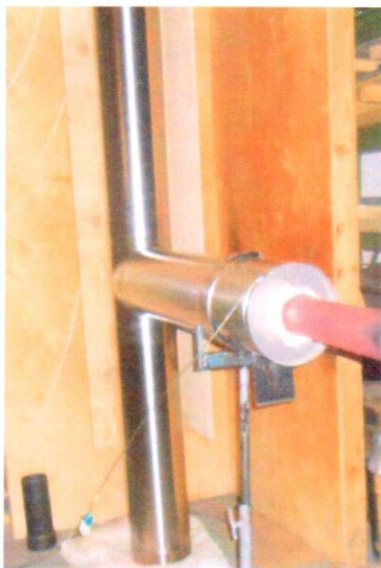
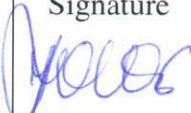


Photo 10. The course of the thermal test at the test bench according to PN-EN 1859.



Photo 11. Measurement of outer wall temperature during thermal tests of the three-wall chimney systems type "SKDTŻ-3L".

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--



TYPE TESTING REPORT

Number:  
2016/17/K/Rz

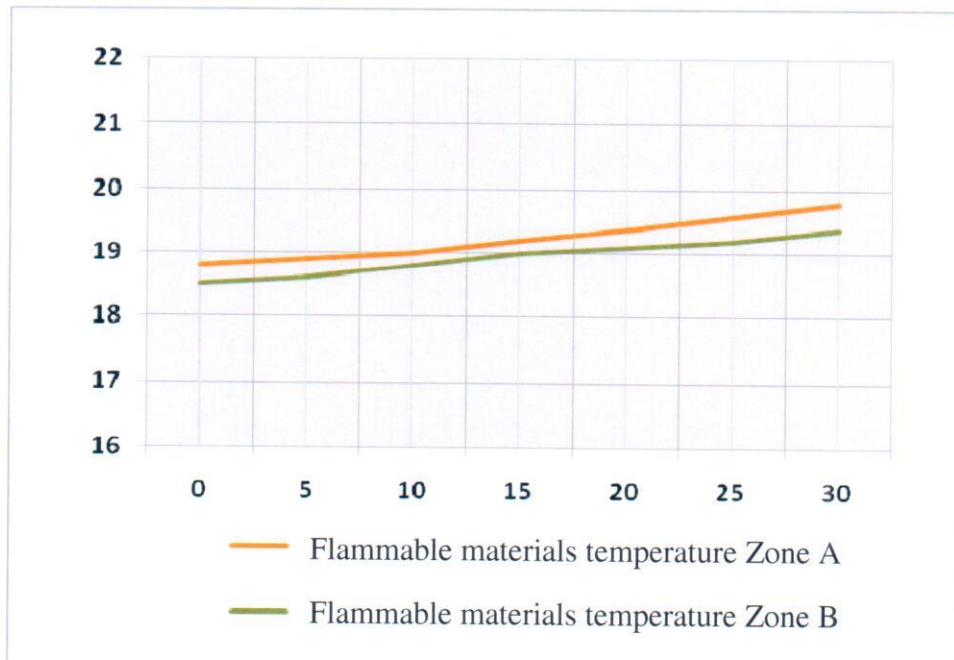
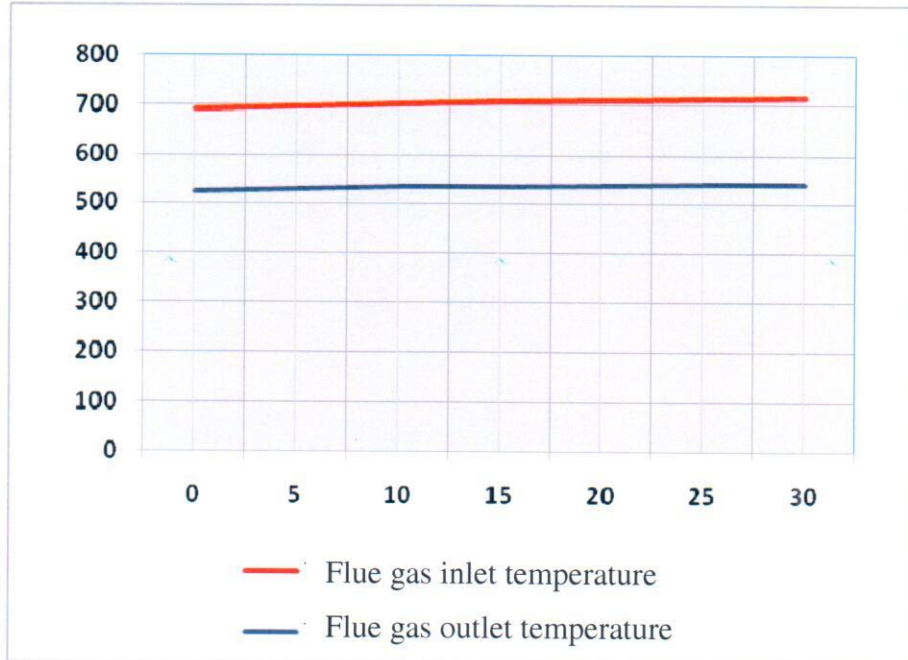



Fig. 9. Temperature distribution at the test bench during the thermal tests of the three-wall chimney systems type "SKDTŻ-3L".

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

Signature

	STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA	Page: 20/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

**Table 9. Results of the temperature distribution tests for flammable materials in stabilised thermal conditions at declared operating temperature of T 600. Flue gas temperature in T 700°C test according to PN-EN 1856.**

Table 9.

No.	Chimney tested	Equivalent diameter DN	Summary duct length	Flue gas temp. during tests	Temperature distribution in zones		Permissible leakage after the tests	Final result
		[mm]	[mm]	[°C]	[°C]		[dm <sup>3</sup> /s x m <sup>2</sup> ]	
1	2	3	4	5	6		7	8
1.	DN 120/200 /250	120	~3500	700	A	18.5±1	< 3.0	positive
					B	19.1±1		

### 7.7. RESISTANCE TO FIRE


The test of resistance to fire was performed at a specially constructed test bench according to the requirements of PN-EN 1859 p.4.5.3. The course of the test has been presented in Photos 12 and 13. The test involved the three-wall chimney system type "SKDTŻ-3L" DN/DW/DZ 120/200/250. During the test of resistance to fire, temperature distribution was determined for the manufacturer's declared distance from flammable materials "XX" (50 mm) in two zones:

A – lower temperature measurement zone,

B – medium temperature measurement zone.

At the same time, inlet flue gas temperature was recorded (1000°C), as well as exhaust flue gas temperature from the tested chimney system.

The results for the thermally stabilised operating conditions have been presented in Table 10 and in diagram – Fig. 10. Table 11 presents average results of temperature measurements at measurement points on floor 1 and 2, at the manufacturer's declared distance from flammable materials.

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--



TYPE TESTING REPORT

Number:  
2016/17/K/Rz

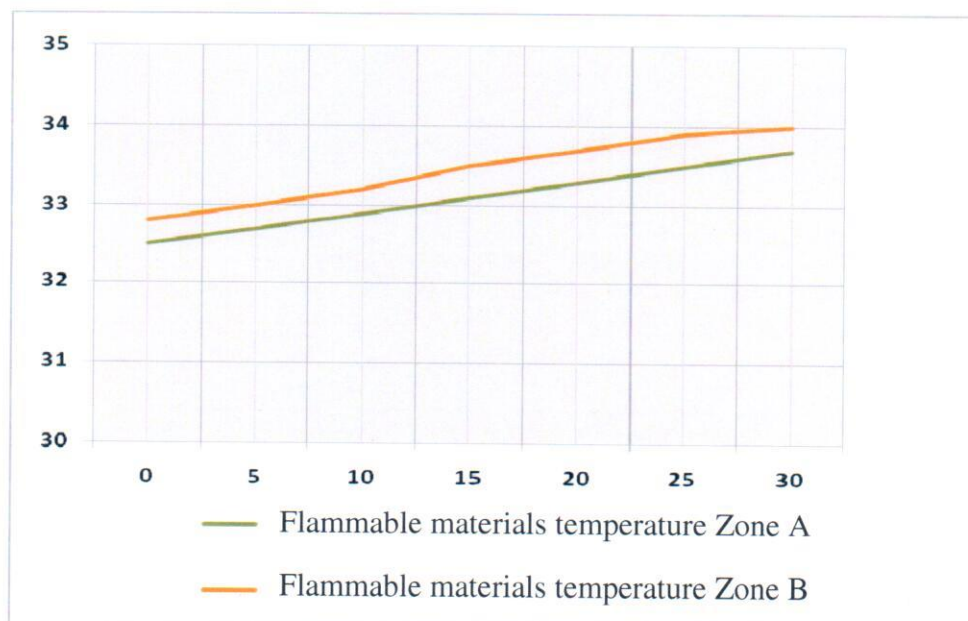
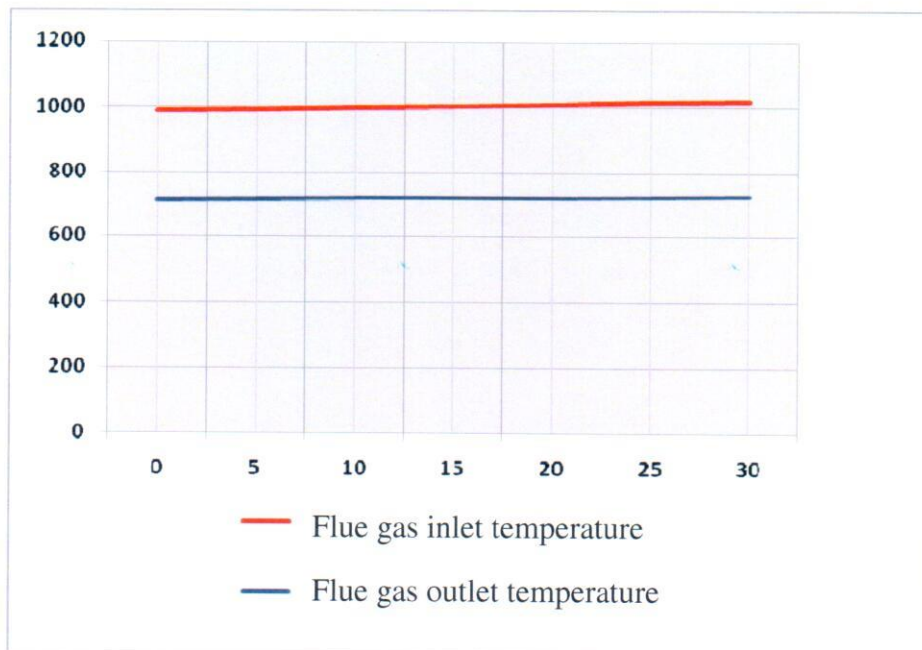


Fig. 10. Temperature distribution at the testing workstation during the test of resistance to fire of the three-wall chimney systems type "SKDTŻ-3L".

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

Signature



Photo 12. The course of the test of resistance to fire at the workstation according to standard PN-EN 1859.



Photo 13. Measurement of outer wall temperature during the test of resistance to fire of the three-wall chimney systems type "SKDTŻ-3L".

Table 10. Results of the temperature distribution tests for flammable materials in stabilised thermal conditions for soot fire resistance tests of the three-wall chimney systems type "SKDTŻ-3L".


Flue gas temperature at T 1000°C test according to PN-EN 1856.

No.	Chimney tested	Equivalent diameter DN	Summary duct length	Flue gas temp. during tests	Temperature distribution in zones		Permissible leakage after tests	Final result
		[mm]	[mm]	[°C]	[°C]		[m <sup>3</sup> /h]	
1	2	3	4	5	6		7	8
1.	DN 120/200 /250	120	~3500	1000	A	38.6±1	< 3.0	positive
					B	39.1±1		

Table 10.

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

Signature

	STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA	Page: 23/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

**Table 11. Average results of temperature measurements in measurement points on floors 1 and 2 at the manufacturer's declared distance from flammable materials.**

Table 11.

No.	Flue gas temperature $T_s$	Ambient temperature $T_o$	700	1000
		[°C]	[°C]	
1	2	3	4	5
1.	Average temperature at the ceiling of floor 1	16	18.5	38.6
2.	Average temperature at the ceiling of floor 2	17	19.1	39.1
3.	OTDF	≤ 1.05		
4.	CO/CO <sub>2</sub>	≤ 0.01		

**700°C – test temperature for the declared temperature class T600**

**1000° - test temperature for soot fire resistance**

**Attention:** In the event of chimney assembly directly in the sauna, where higher temperatures occur, apply thermal sleeve to protect against direct contact with the outer metal surface of the chimney.

### 7.3. GAS TIGHTNESS TEST BEFORE AND AFTER THERMAL TESTS

Before and after thermal tests of the chimney system type "SKDTŻ-3L" DN/DW/DZ 150/200/250, the gas tightness test of flue ducts was performed again. The course of the gas tightness test was described in p. 7.2, and it has been illustrated in Photos 3 and 4. The tests were performed on the assembled chimney system prepared for thermal tests; the nominal length of the sample amounted to 3500 mm. The results of the gas tightness tests after thermal tests have been presented in Tables 12. and 13.

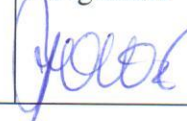
**Table 12. Results of the gas tightness tests before thermal tests of the three-wall chimney systems type "SKDTŻ-3L".**

Table 12.

No.	Type of duct tested	Test pressure class N1	Nominal duct length	Result obtained	Average measurement result	Permissible leakage	Final result
		[Pa]	[mm]			[m <sup>3</sup> /h]	
1	2	3	4	5	6	7	8
1.	∅ 120	40	3500	0.68	0.7	< 3.0	positive
2.				0.70			positive
3.				0.69			positive
4.				0.72			positive
5.				0.71			positive

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

Signature




	STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA	Page: 24/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

Table 13. Results of gas tightness tests after thermal tests of three-wall chimney systems type “SKDTŻ-3L”.

Table 13.

No.	Type of duct tested	Test pressure class N1	Nominal duct length	Result obtained	Average measurement result	Permissible leakage	Final result
		[Pa]	[mm]			[m <sup>3</sup> /h]	
1	2	3	4	5	6	7	8
1.	Ø 120	40	3500	0.52	0.5	< 3.0	positive
2.				0.48			positive
3.				0.50			positive
4.				0.49			positive
5.				0.51			positive

#### 7.4. RAIN WATER DURABILITY TEST

The rain water durability test of the three-wall chimney system type “SKDTŻ-3L” DN/DW/DZ 150/200/250 was performed according to the test method presented in standard PN-EN 1859 p. 4.9 on a test bench meeting the requirements of standard PN-EN 1859 - Fig. 11. The course of the test has been presented in Photos 14. and 15. The results of the rain water durability tests have been presented in Table 14.

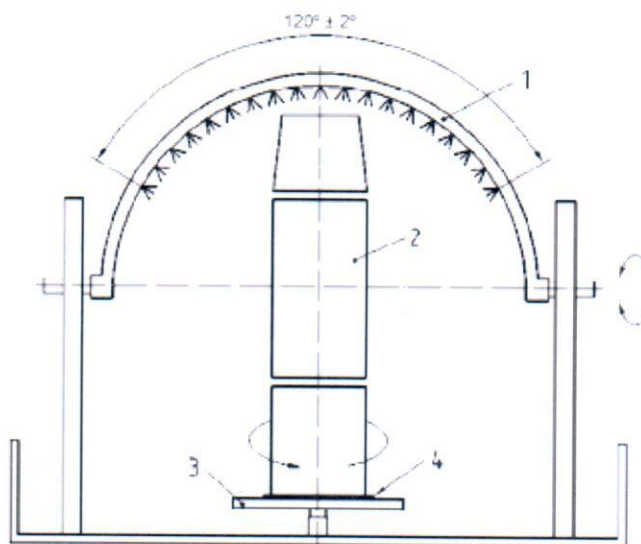


Fig. 11. Diagram of the test bench for testing rain water durability.

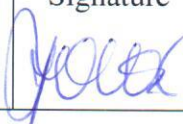
Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--






Photo 14. Element for testing rain water durability of the three-wall chimney system type "SKDTŻ-3L".



Photo 15. The course of the rain water durability test of the three-wall chimney systems "SKDTŻ-3L".

	STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA	Page: 26/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

**Table 14. Results of tests of durability against rain water of the three-wall chimney systems type “SKDTŻ-3L”.**

**Table 14.**

No.	Type of duct tested	Length of duct tested	Weight before the test	Weight after the test	Weight increase $\Delta m$	Permissible weight increase	Testing time	Final result
		[m]	[kg]			[1%]	[min]	
1	2	3	4	5	6	7	8	9
1.	DN 120/200 /250	~1000	10.62	10.70	0.08	0.10	30±1	positive
2.			10.58	10.65	0.07			positive

The determined slight weight increase after the test of durability against rain water of the three-wall chimney systems type “SKDTŻ-3L” is caused by the presence of small volumes on the chimney walls.

#### 7.5. CORROSION RESISTANCE TEST

Corrosion resistance of the flue was declared by the manufacturer due to the applied type of material, marking 50 for:

- chrome-nickel-silicon alloy steel acc. to DIN 1.4828, PN-EN 10027-1, after V3 corrosion-resistance tests pursuant to PN-EN 1856 Annex A.3.

Air duct casing and outer wall of the chimney made of steel 1.4301 meet the requirements of resistance to corrosion due to weather conditions pursuant to PN-EN 1856 Table 4.

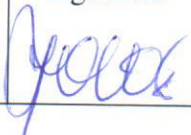
#### 7.6. TEST OF FREEZE-THAW RESISTANCE


According to the requirements of standard PN-EN 1856-2 p.6.7.3, three-wall chimney systems type “SKDTŻ-3L” by DARCO Sp. z o.o. meet the requirements regarding freeze-thaw resistance.

#### 7.7. MARKING CHECK

Check of the marking was performed on the basis of the requirements of the harmonized standard EN 1856-1:2009 “Chimneys. Requirements for metal chimneys. Part 1: System chimney products” and on the basis of the requirements of EU CPD Directive 89/106/EEC. The method of marking the three-wall chimney systems type “SKDTŻ-3L” by DARCO Sp. z o.o. has been presented below:

## EN 1856-1 T600-N1-D-Vm-L99080 G50

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--

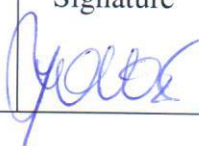
	<b>STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA</b>	Page: 27/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz


### 7.8. TEST OF PACKAGING

Packaging of three-wall chimney systems type “SKDTŻ-3L” by DARCO Sp. z o.o. must conform to the manufacturer’s instruction. The elements stored must be secured against direct impact of weather conditions and dirt. The manufactured three-wall chimney systems type “SKDTŻ-3L” are packed in individual cardboard packaging, while the parameters, dimensions and basic information for users are contained in the manual attached with the product.

### 8. LIST OF TABLES

- Table 1. Manufacturer’s declared technical parameters of three-wall chimney systems type “SKDTŻ-3L” by DARCO Sp. z o.o.
- Table 2. Testing programme, characteristics, requirements, testing method and determination of conformance of the results with type testing requirements – Annex ZA - 1 of PN-EN 1859:2009.
- Table 3. Results of tests involving the nominal diameter dimensions check of the three-wall chimney system type “SKDTŻ-3L”
- Table 4. Gas tightness test results before compressive strength tests of three-wall chimney systems type “SKDTŻ-3L”.
- Table 5. Results of wind load strength test of three-wall chimney systems type “SKDTŻ-3L”.
- Table 6. Results of the compressive strength tests of the three-wall chimney systems type “SKDTŻ-3L”.
- Table 7. Results of the gas tightness test after compressive strength tests of the three-wall chimney system type “SKDTŻ-3L”.
- Table 8. Values of coefficients of flow resistance for particular elements of the three-wall chimney system type “SKDTŻ-3L”.
- Table 9. Results of the temperature distribution tests for flammable materials in stabilized thermal conditions at declared operating temperature of T 600. Flue gas temperature in T 700°C test according to PN-EN 1856.
- Table 10. Results of the temperature distribution tests for flammable materials in stabilized thermal conditions for soot fire resistance tests of the three-wall chimney systems type “SKDTŻ-3L”.  
Flue gas temperature at T 1000°C test according to PN-EN 1856.
- Table 11. Average results of temperature measurements in measurement points on floors 1 and 2 at the manufacturer’s declared distance from flammable materials.
- Table 12. Results of the gas tightness tests before thermal tests of the three-wall chimney

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--

	<b>STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA</b>	Page: 28/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

systems type “SKDTŻ-3L”.

Table 13. Results of gas tightness tests after thermal tests of three-wall chimney systems type “SKDTŻ-3L”.

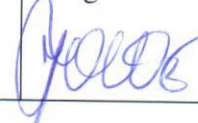
Table 14. Results of tests of durability against rain water of the three-wall chimney systems type “SKDTŻ-3L”.


## 9. LIST OF FIGURES

- Fig.1. Structural diagram of the three-wall chimney system type “SKDTŻ-3L”.
- Fig. 2. Ideological diagram for wind load resistance tests, conformant to standard PN EN 1859.
- Fig. 3. Diagram of deflections of three-wall chimney systems type “SKDTŻ-3L” upon wind load strength test.
- Fig.4. Ideological diagram of compressive strength test according to PN-EN 1859.
- Fig. 5. Diagram of the test bench for thermal tests of chimney systems according to PN-EN 1859.
- Fig. 6. Structure of the test bench for thermal tests of the three-wall chimney systems type „SKDTŻ-3L” according to the manufacturer’s requirements.
- Fig. 7. Method of flue gas inlet for thermal tests of the three-wall chimney systems type “SKDTŻ-3L”.
- Fig. 8. Thermal element distribution points on particular floors of the test bench.
- Fig. 9. Temperature distribution at the test bench during the thermal tests of the three-wall chimney systems type “SKDTŻ-3L”.
- Fig. 10. Temperature distribution at the test bench during the test of resistance to fire of the three-wall chimney systems type “SKDTŻ-3L”.
- Fig. 11. Diagram of the test bench for testing rain water durability.

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.

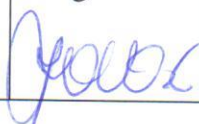
Signature



	<b>STOWARZYSZENIE NAUKOWO-TECHNICZNE INŻYNIERÓW I TECHNIKÓW PRZEMYSŁU NAFTOWEGO I GAZOWNICZEGO OŚRODEK SZKOLENIA I RZECZOZNAWSTWA</b>	Page: 29/29
	<b>TYPE TESTING REPORT</b>	Number: 2016/17/K/Rz

## 10. LIST OF PHOTOGRAPHS

- Photo 1 Test bench for gas tightness test before compressive strength tests.
- Photo 2 Sealing of the chimney system during gas tightness test.
- Photo 3 Wöhler type unit for measuring gas tightness of chimney systems.
- Photo 4 The course of gas tightness test of three-wall chimney systems type "SKDTŻ-3L".
- Photo 5 The course of the wind load mechanical properties test.
- Photo 6 The course of the wind load mechanical properties test – deflection value measurement.
- Photo 7 The course of the compressive strength test of the three-wall chimney system type "SKDTŻ-3L".
- Photo 8 The impact of compressive forces on the support element of the three-wall chimney system type "SKDTŻ-3L – frontal view.
- Photo 9 The impact of compressive forces on the support element of the three-wall chimney system type "SKDTŻ-3L – view of the regulatory element.
- Photo 10 The course of the thermal test at the test bench according to PN-EN 1859.
- Photo 11 Measurement of outer wall temperature during thermal tests of the three-wall chimney systems type "SKDTŻ-3L".
- Photo 12 The course of the test of durability against rain water of the three-wall chimney systems type .
- Photo 13 Measurement of outer wall temperature during fire resistance tests of the three-wall chimney systems type "SKDTŻ-3L".
- Photo 14 Element for testing durability against rain water of the three-wall chimney systems type "SKDTŻ-3L".
- Photo 15 The course of the test for durability against rain water of the three-wall chimney systems type "SKDTŻ-3L".

Introduction of changes, copying and distribution of this document without the consent of the Director of the Training and Expertise Centre is strictly forbidden.	Signature 
--	--