



PROFTECH
SPÓŁKA Z O.O.



AB 994

Research laboratory
accredited by PCA, Nr AB
994

Scopes of accreditation:

- concentration and mass measurements of flow of fine particles
- measurements of concentration and mass flow of SO₂, NO_x, CO
- concentration measurements of CO₂, O₂
- concentration and mass flow measurements of OWO
- sampling for mass concentration determination of PCDD/PDF and dioxin type PCB
- sampling for concentration determination of (As; Cd; Cr; Co; Cu; Mn; Ni; Pb; Sb; Tl; V)
- sampling for concentration determination of Hg
- sampling and determination of concentration and mass flow of HCl
- sampling and determination of concentration and mass flow of HF
- sampling for determining the concentration of individual gaseous organic compounds
- calibration of Automated Monitoring systems,
- QAL2 procedure
- annual performance test of Automated Monitoring Systems, AST procedure
- noise measurement from machinery, installations and industrial plants

Chorzów, December 07th 2021
Our ref. No.: PW/14/12/21

Report No PW/14/12/21

on concentration measurements of dioxins and furans emitted into environment from flue gas channel located at UAB KAUNO KOGENERACINĖ JĖGAINĖ, Jėgainės g. 6, Biruliškių k., LT-54469 Kauno raj., Lithuania.

Client name and address:

**UAB KAUNO KOGENERACINĖ
JĖGAINĖ,**
Jėgainės g. 6, Biruliškių k.,
LT-54469 Kauno raj.

Developed by:

mgr Grzegorz Bortel

Calculation and data transfer checked by:

inż. Dariusz Guja

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Test Report No PW/14/12/21**1. PURPOSE AND SCOPE OF THE REPORT**

Purpose of executed measurements was to determine the concentration and emission of dioxins and furans emitted to environment from flue gas channel located at *at* UAB KAUNO KOGENERACINĖ JĖGAINĖ, Jėgainės g. 6, Biruliškių k., LT-54469 Kauno raj., Lithuania.

Measurements range:

- PCDD/DF emission and concentration.

The measurements were carried out in accordance with the sampling plan and the described sampling methods.

Operating parameters of the technological installation was obtained from the customer's representative.

2. BASIS OF MEASUREMENTS EXECUTION

The measurements were taken according to the Contract No 2020-KKJ-05 dated March 31st 2020, our reference number PP/15/03/20.

3. MEASUREMENT TEAM

The measurements taken on November 05th 2021 were executed by the following team:

- Grzegorz Bortel specialist - measurement team leader,
- Grzegorz Kurzeja specialist,
- Bartłomiej Glik specialist.

4. MEASUREMENT RESULTS SUMMARY

Below are presented measurement results summary, full measurement results are presented in chapter no 6, at page 8.

Concentration of the substance in the gas in reference conditions O2 ref. 11%	PCDDF	ng/m3 ref.	0,0037
Emission limits	PCDDF	ng/m3 ref.	0,1
Transgerssion	PCDDF	ng/m3 ref.	-

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5. DESCRIPTION OF THE MEASUREMENT METHOD**Measurement of the gas volumetric flow**

The flow rate was determined according to ISO Standard PN-EN ISO 16911-1:2013 „Stationary source emissions - Manual and automatic determination of velocity and volume flow rate in ducts - Part 1: Manual reference method". Gravimetric dust monitor type Megasystem APIS X-1 and type "S" Pitot tube were used for the measurements. Measurement is accredited.

Accreditation range: differential pressure: > 5 Pa

Measurement O₂ content

The concentration of O₂ was determined using gas analyzer HORIBA PG-350E-EU equipped with testing probe 2000 mm long. The measurements were taken according to the procedure described in measurement unit as well as to Polish Standard PN-EN 14789:2017 "Stationary source emissions - Determination of volume concentration of oxygen O₂ - Reference method - Paramagnetism". Measurement is accredited.

Accreditation range: O₂ content: 3-21%

Measurement CO₂ content

The concentration of CO₂ was determined using gas analyzer HORIBA PG-350E-EU equipped with testing probe 2000 mm long. The measurements were taken according to the procedure described in measurement unit as well as to Polish Standard PN-ISO 10396:2001 "Stationary Source Emissions - Sampling For The Automated Determination Of Gas Concentrations ". Measurement is accredited.

Accreditation range: CO₂ content: 0,1-20%

Measurement moisture content

Moisture content was determined using condensation-absorption method. The measurements were taken according to Polish Standard PN-EN 14790:2017. Measurement is accredited.

Accreditation range: H₂O content: 29-250 g/m³

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PCDD+PCDF sampling and determination

PCDD/DF samples were taken according to the requirements of Polish Standard PN-EN 1948-1:2006 „ Stationary source emissions - Determination of mass concentration of PCDDs/PCDFs and dioxin-type PCBs - Part 1: Sampling of PCDDs/PCDFs”.

The three stages of PCDD/DF concentration and emission determination:

Stage I - sampling

For the determination of mass concentration of PCDD/DF proper sampling plays important role that affects following stages of the testing. The sampling were performed by means of the filtration and condensation method using PCDD/DF sampling system conformed to European Standard PN-EN 1948-1:2006.

The following page shows the schematic diagram of the sampling system.

Stage II - laboratory analysis

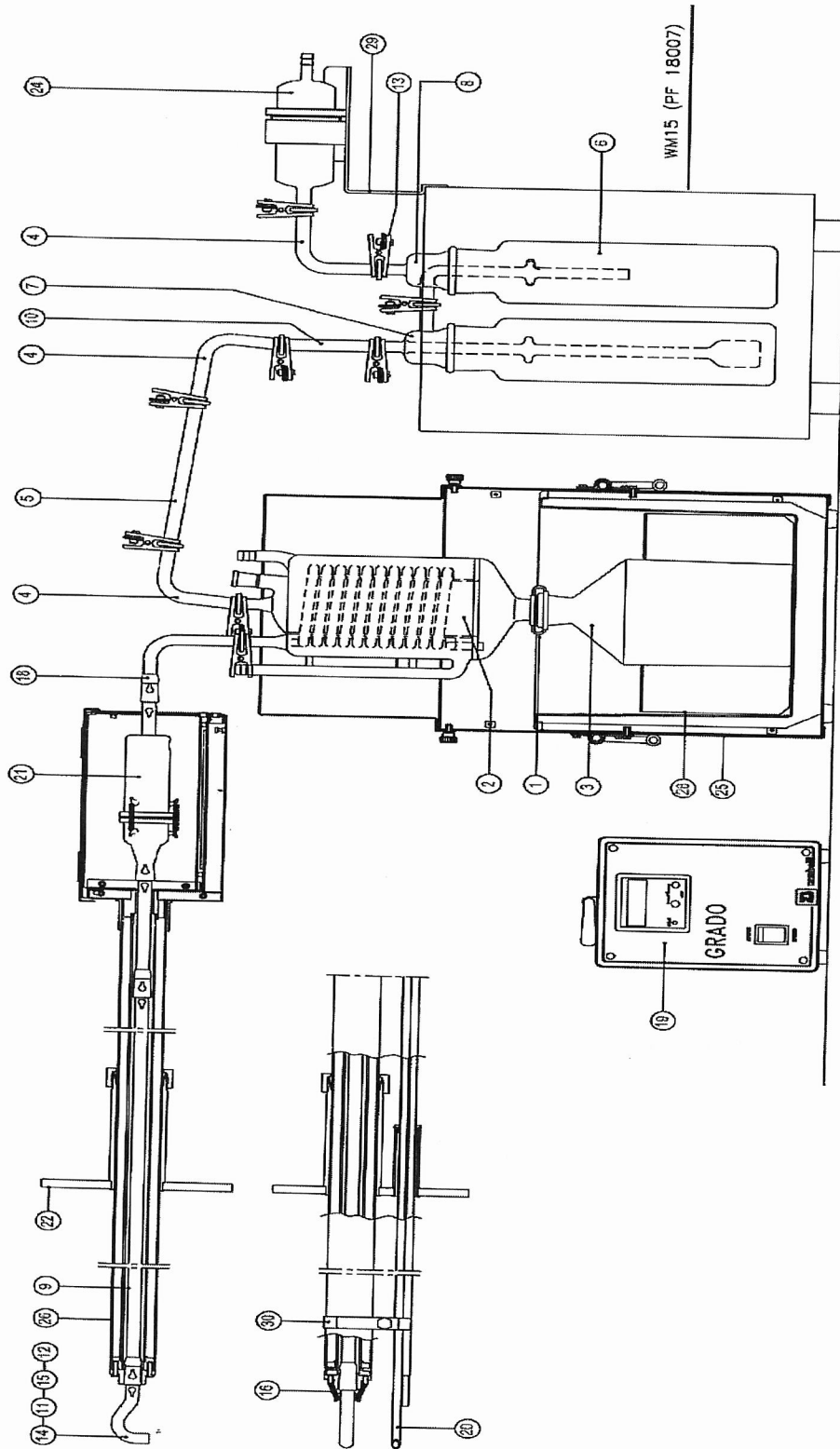
The samples were analysed at the ALS Czech Republic, s.r.o accredited laboratory following the CSN EN 1948-2,3 methodology: The determination of polychlorinated dibenzo-p-dioxine, dibenzofurans in emission samples with the method of isotop dillution using HRGC/HRMS.

The dioxin and furans analyses were conducted at the ALS Czech Republic, s.r.o. Laboratory, specifically accredited for the test by the Český Institut Pro Akreditaci, o.p.s. , Nr L 1163.

Stage III - development and the results and discussion

The last stage includes results collection from the previous stages, emission calculation and PCDD/DF concentration as well as comparison to the standards in force.

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- Opis:
- 1. ferrule
 - 2. cooler
 - 5,10. aspiration path - tubes
 - 13. clamp
 - 20. Pitot tube „S” - type
 - 25. cooler casina
 - 3. condensation pot
 - 6-8. scrubbers
 - 16. holding springs
 - 21. filter casing
 - 26. heated probe
 - 4,18. aspiration path - elbows
 - 9. aspiration path - probe tube
 - 17. aspiration controller
 - 22. yoke
 - 28. cooler coil
 - 11,12,14,15. - aspiration endings
 - 19. temperature controller
 - 24. gas dryer
 - 29,30. support

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6. MEASUREMENT RESULTS

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- 1) Plant or unit name¹⁾: **Combined Heat and Power Plant**
- 2) Flue gases cleaning unit¹⁾: **bag filters, activate carbon, hydrated lime, scrubber**
- 3) Emission source load during measurements¹⁾: **~108,4% (92,1 MW)**
- 4) Fuel type or material mass flow in process¹⁾: **53% municipal waste, 47% non – hazardous industrial waste**
- 5) Location of sampling and measurements: **in duct, after flue gases cleaning unit**

Measurement reference number		05-11-21		X	X		
Date of measurement		05.11.2021					
Measurement time range		10:31-16:32					
Scope of test		Unit	Results	Uncertainty +/-	Method		
Meteorological conditions	Atmospheric pressure		hPa	995,7	0,9	X	
	Ambient temperature		oC	7			
Cross-section	Diameter		m	2,00			
	Area		m ²	3,14			
The parameters of gas in line	Temperature		oC	40	0,690	X	
	Static pressure		Pa	145	5,030		PN-EN ISO 16911-1:2013
	Differential pressure		Pa	84	0,690		PN-EN ISO 16911-1:2013
	Gas moistness grade X		kg/kg	0,056	0,001	PN-EN 14790:2017	
	Average velocity		m/s	9,9	0,6	PN-EN ISO 16911-1:2013	
	Chemical composition	O ₂	%	8,9	0,2	PN-EN 14789:2017	
		CO ₂	%	9,4	0,4	PN-ISO 10396:2001	
	Wet gas density during testing		kg/m ³	1,106		PN-EN 14790:2006	
	Gas density in normal conditions		kg/m ³ N	1,288		PN-EN 14790:2006	
	Gas density in conventional conditions		kg/m ³ U	1,333		PN-EN 14790:2006	
Concentration in the gas at measurement conditions	PCDDF*	ng/m ³	0,0037	0,0011	PN-EN 1948:2006		
Concentration in the gas at normal conditions	PCDDF*	ng/m ³ N	0,0041	0,0013	PN-EN 1948:2006		
Concentration of the substance in the gas in standard conditions	PCDDF*	ng/m ³ U	0,0045	0,0014	PN-EN 1948:2006		
Concentration of the substance in the gas in reference conditions O ₂ ref. 11%	PCDDF*	ng/m ³ ref.	0,0037	0,0011	PN-EN 1948:2006		
Gas volume flow	measurement conditions		m ³ /h	111344	13963	X	
	normal conditions		m ³ N/h	95595	11997		
	standard conditions		m ³ U/h	87446	11492		
	reference conditions O ₂ ref. 11%		m ³ ref./h	105809	14126		
The emission obtained by measuring	PCDDF*	ng/h	393,51	130,93	PN-EN 1948:2006		
Emission limits	PCDDF*	ng/m ³	0,1		X		
Transgerssion	PCDDF*	ng/m ³	-		X		

*- the results obtained from the subcontractor (accredited)
¹⁾-information obtained from the client

Test Report No PW/14/12/21Notes:

Normal conditions designate the temperature of 273 K and pressure of 101,3kPa, defining normal cubic meter m³N. The standard conditions designate the temperature of 273K, pressure of 101,3 kPa and dry gases (steam contents less than 5 g/kg of flue gas), defining standard cubic meter, m³U

The specified expanded uncertainty comes from standard uncertainty multiplied by expansion coefficient k = 2, which provides 95% level of confidence for normal distribution. Uncertainty takes into account the sampling and analysis.

Registry of samples delivered to the laboratory: P/39/11/21, P/40/11/21

Date of delivery to the laboratory: 06.11.2021

Date of analysis: 08.11 - 24.11.2021

Field blanks:

ID/ number of sample	Type of substance	The criterion of the blank [ng/m ³] 11%O ₂	The value of the blank [ng/m ³] 11% O ₂	Result [+/-]
P/40/11/21	PCDD/DF	0,01	0,0021	+

Work parameters of measurement system:**PCDD/DF (PN-EN 1948:2006):**

sampling method: condensation - adsorption method
 filter parameters: 19 x 90 mm, filter efficiency: 99,998 %
 sampling train: 2 measurement axis
 oxygen reference : 11 %
 time of dioxins and furans measurement: 10:31 – 16:32 (360,2 min)
 nozzle diameter: 6 mm
 probe temperature: 119 °C
 scrubbers temperature 4 °C
 aspired gas volume 4,99 m³
 average sampling flow 13,9 l/min
 isokinetic ratio: 98,2 %
 leak test: + / +
 gas meter temperature 13,6 °C
 gas meter pressure 0 bar
 spiking pattern: filter surface
 absorption solution: 100 ml H₂O dest. + 50 ml 2-etoksyetanol
 recovery: 53 % ¹³C₁₂-1,2,3,7,8-PECDF, />50%/
 53 % ¹³C₁₂-1,2,3,7,8,9-HxCDF, />50%/
 51 % ¹³C₁₂-1,2,3,4,7,8,9 HpCDF. />50%/
 TEQ sample mass: 0,021 ng

H₂O (PN-EN 14790:2017)

sampling train: 2 measurement axis
 sampling equipment: titanium sampling train
 heated probe 2,0 m long
 sampling pump: PT-01
 cartridge: moisture measurement set
 number of samplings: 1
 sampling time: 30 min
 sampling volume: ~2,0 l/min
 H₂O mass: 3,97 g
 absorption efficiency: 98,1 %

Test Report No PW/14/12/21**O₂ paramagnetic (PN-EN 14789:2017):**

Range : 0 – 25 % [X]
 Calibration gas: O₂ – 20,018% [X] R/12/W
 N₂ – 99,99% [X] R/17/
 Sampling train: 2 measurement axis
 Sampling time/ average time: 360 min / 1 min

O ₂ concentration measurement (paramagnetic):		HORIBA PG-350E-EU			
check operation		unit	result	criterion	result +/-
„0” after adjustment, without sampling train		%	0,05	± 0,1 [%]*	+
„0” after adjustment, with sampling train	before measurement	%	0,03	± 0,5 [%]**	+
	after measurement	%	0,4	± 0,5 [%]**	+
„Span” after adjustment with sampling train /standard 20,018 % R/12/W analyzer range 25%/	before measurement	%	20,05	± 0,5 [%]**	+
	after measurement	%	20,02	± 0,5 [%]**	+
	before measurement time T90	%	18,1	> 18,02 [%]	-----
		sec.	40	< 200 sec.	+

*2 x repeatability „0”; **2% measurement range

Test Report No PW/14/12/21**7. MEASUREMENT DEVICES**

Name of measuring device		X1- Apis
Type of measuring device		Isokinetic sampler S/N 0142
Certificate	Calibration No	824-2373/19
		824-2374/19
		824-2372/19
		824-2375/19
		G-106/20-66/20
Issued by		INTROL Sp. z o.o. KATOWICE ZAP BESTWINKA
Date of issue the certificate of calibration		27.08.2019 28.08.2019 11.03.2020
Expiration date of the certificate of calibration		-

Name of measuring device		HORIBA
Type of measuring device		PG-350E-EU
Certificate	Calibration No	130/1/AW/21
Issued by		Laboserwis Sp. z o.o. Katowice
Date of issue the certificate of calibration		28.05.2021
Expiration date of the certificate of calibration		-

Name of measuring device		Sampler
Type of measuring device		PT-01
Certificate	Calibration No	851-2463/19
		786-2245/19
		G-360/19-224/19
		R-286/16-186/16
Issued by		INTROL Sp. z o.o. KATOWICE ZAP BESTWINKA
Date of issue the certificate of calibration		29.08.2019 12.08.2019 08.08.2019
Expiration date of the certificate of calibration		-

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8. ANALYSIS RESULTS



Attachment no. 1 to the Certificate of Analysis for work order PR21A8779

Sample: P/39/11/21

Measurement results PCDD/Fs:

Sample: P/39/11/21		Final extract [µl]: 60			
		Injection volume [µl]: 4			
		Acquisition date [d.m.y h:m]: 16.11.21 16:06			
2,3,7,8-PCDD/Fs	Result [ng/sample]	Limit of Detection [ng/sample]	Limit of Quantification [ng/sample]	¹ I-TEFs	I-TEQ Upperbound [ng/sample]
2,3,7,8-TCDD	< 0.0021	0.0021	0.0042	1	0.0021
1,2,3,7,8-PeCDD	< 0.0032	0.0032	0.0064	0.5	0.0016
1,2,3,4,7,8-HxCDD	< 0.006	0.006	0.012	0.1	0.0006
1,2,3,6,7,8-HxCDD	< 0.006	0.006	0.012	0.1	0.0006
1,2,3,7,8,9-HxCDD	< 0.006	0.006	0.012	0.1	0.0006
1,2,3,4,6,7,8-HpCDD	< 0.0059	0.0059	0.012	0.01	0.000059
OCDD	< 0.011	0.011	0.021	0.001	0.000011
2,3,7,8-TCDF	0.017	0.0021	0.0041	0.1	0.0017
1,2,3,7,8-PeCDF	0.008	0.0032	0.0063	0.05	0.0004
2,3,4,7,8-PeCDF	0.021	0.0032	0.0063	0.5	0.01
1,2,3,4,7,8-HxCDF	< 0.0059	0.0059	0.012	0.1	0.00059
1,2,3,6,7,8-HxCDF	< 0.0059	0.0059	0.012	0.1	0.00059
1,2,3,7,8,9-HxCDF	< 0.0059	0.0059	0.012	0.1	0.00059
2,3,4,6,7,8-HxCDF	< 0.0059	0.0059	0.012	0.1	0.00059
1,2,3,4,6,7,8-HpCDF	< 0.012	0.0058	0.012	0.01	0.00012
1,2,3,4,7,8,9-HpCDF	< 0.0058	0.0058	0.012	0.01	0.000058
OCDF	< 0.01	0.01	0.021	0.001	0.00001
I-TEQ from quantified 2,3,7,8-PCDD/Fs - "Lowerbound"					0.013
I-TEQ from 2,3,7,8-PCDD/Fs - "Mediumbound"					0.017
Maximum possible I-TEQ - "Upperbound"					0.021
PCDDs	Result [ng/sample]	PCDFs	Result [ng/sample]		
Tetra-CDDs	< 0.046	Tetra-CDFs	0.43		
Penta-CDDs	< 0.045	Penta-CDFs	0.029		
Hexa-CDDs	< 0.06	Hexa-CDFs	< 0.095		
Hepta-CDDs	< 0.012	Hepta-CDFs	< 0.023		
OCDD	< 0.011	OCDF	< 0.01		

¹I-TEF according to NATO.

Limits of quantification are defined as double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with S/N≥3.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% confidence interval.

Estimation of uncertainty of each 2,3,7,8-PCDD/F congener is 30% and total I-TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility.

Results marked with "<" are below limit of detection or quantification.

"Lowerbound" and "Upperbound" are levels defined in Regulation 2017/644 and EN 1948-4.

"Mediumbound" is levels defined in Regulation 2017/644.

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Attachment no. 1 to the Certificate of Analysis for work order PR21A8779

Sample:

P/39/11/21

Standards recovery:

Extraction standard		Recovery [%]	Acceptable range [%]		Accept. rec. with respect to	
			Basic	Extended	basic range	extended range
PCDDs						
13C12 - 2,3,7,8-TCDD		95	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,7,8-PeCDD		93	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDD		83	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDD		98	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDD		93	40 - 130	20 - 150	YES	-
13C12 - OCDD		45	40 - 130	20 - 150	YES	-
PCDFs						
13C12 - 2,3,7,8-TCDF		97	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,7,8-PeCDF		85	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDF		98	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDF		96	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,6,7,8-HxCDF		89	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDF		80	40 - 130	20 - 150	YES	-
13C12 - OCDF		41	40 - 130	20 - 150	YES	-
Sampling standard	Recovery [%]	Acceptable range [%]		Rec. in range?		
13C12-1,2,3,7,8-PeCDF	53	> 50		YES		
13C12-1,2,3,7,8,9-HxCDF	53	> 50		YES		
13C12-1,2,3,4,7,8,9-HpCDF	51	> 50		YES		

Test Report No PW/14/12/21**9. CERTIFICATE OF ACCREDITATION****POLSKIE CENTRUM AKREDYTACJI**
POLISH CENTRE FOR ACCREDITATIONSygnatariusz EA MLA
EA MLA Signatory**CERTYFIKAT AKREDYTACJI**
LABORATORIUM BADAWCZEGO
ACCREDITATION CERTIFICATE OF TESTING LABORATORY
Nr AB 994

Potwierdza się, że: / This is to confirm that:

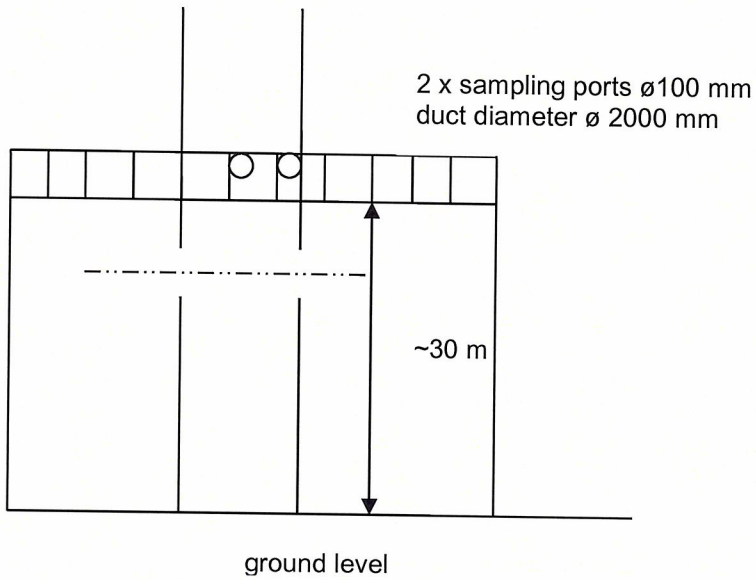
„PROFTECH” Sp. z o.o.
ul. Kurta Aldera 44, 41-506 Chorzówspełnia wymagania normy PN-EN ISO/IEC 17025:2018-02
meets requirements of the PN-EN ISO/IEC 17025:2018-02 standardAkredytowana działalność jest określona w Zakresie Akredytacji Nr AB 994
Accredited activity is defined in the Scope of Accreditation No AB 994Akredytacja pozostaje w mocy pod warunkiem przestrzegania
wymagań jednostki akredytującej określonych w kontrakcie Nr AB 994
This accreditation remains in force provided the Laboratory observes
the requirements of Accreditation Body defined in the Contract No AB 994Akredytacji udzielono dnia 30.01.2009 r.
Accreditation was granted on 30.01.2009DYREKTOR
POLSKIEGO CENTRUM AKREDYTACJI

LUCYNA OLBORSKA


Warszawa, dnia 9 grudnia 2019 roku

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10. MEASUREMENT PLANE SCHEME



Approved by


.....
Name and Signature

inż. Dariusz Guja

END OF REPORT

