



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, May 31st 2022
Our ref. No.: PW/53/05/22

Report No PW/53/05/22

on concentration measurements of dioxins and furans emitted into environment from flue gas channel located at UAB GREN KLAIPEDA, Kretainio g. 3 LT-94103, Klaipeda, Lithuania.

Client name and address:

UAB "GREN KLAIPEDA"

Kretainio g. 3,
LT-94103 Klaipeda

Developed by:

mgr Grzegorz Bortel

Calculation and data transfer checked by:

inż. Dariusz Guja

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Copy number: ...1/3...

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Test Report No PW/53/05/22**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 UAB GREN KLAIPEDA, Kretainio g. 3 LT-94103, Klaipeda, 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 Purchase Order No MX27936LTKLJ21 dated May 07th 2021, our reference number PP/01/05/21.

3. MEASUREMENT TEAM

The measurements taken on May 09th 2022 were executed by the following team:

- Grzegorz Bortel specialist- measurement team leader,
- Bartłomiej Glik specialist,
- Karol Sodo technician.

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 the reference conditions O2 ref. 11%	PCDDF	ng/m3	0,0028
Emission limits	PCDDF	ng/m3	0,1
Transgerssion	PCDDF	ng/m3	-

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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 1750 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 1750 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

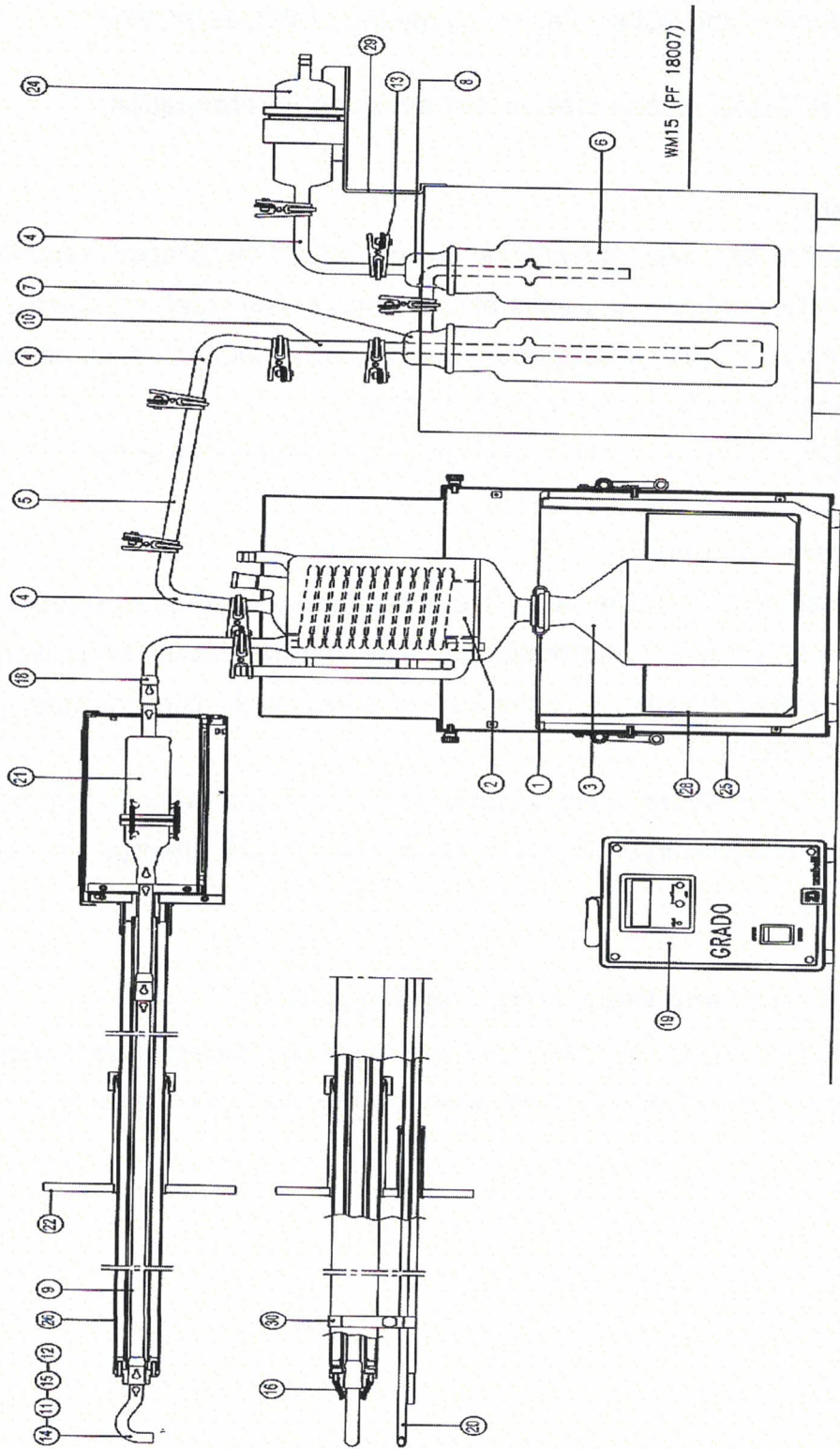
The samples were analysed at the ALS Czech Republic, s.r.o accredited laboratory following the CSN EN 1948-2,3 methodology: The determination of polychlorinated dibenzo-p-dioxine, dibenzofurans in emission samples with the method of isotop dillution using HRGC/HRMS.

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 name: **Combined Heat and Power Plant¹⁾**
- 2) Flue gases cleaning unit: **ALSTOM NID flue gas cleaning solution (bag filters, activate carbon, ammonia solution, hydrated lime)¹⁾**
- 3) **Emission source load during measurements: ~85,0 MW¹⁾**
- 4) **Fuel type or material mass flow in process: 45% municipal waste, 55% industrial waste: 28,6 t/h¹⁾**
- 5) Location of sampling and measurements: **in duct, after flue gases cleaning unit**

Measurement reference number		09-05-01		X	X	
Date of measurement		09.05.2022				
Measurement time range		09:49–15:53				
Scope of test		Unit	Results	Uncertainty +/-	Method	
Meteorological conditions	Atmospheric pressure	hPa	1029,7	X	PN-Z-04030-7:1994	
	Air temperature	oC	10			
Measurement plane	Diameter	m	2,20			
	Area	m ²	3,7994			
Stack gas parameters	Temperature	oC	136			
	Static pressure	Pa	-166			
	Differential pressure	Pa	192			
	Gas moistness grade X	kg/kg	0,115			
	Average velocity	m/s	16,1			1,0
	Chemical composition	O ₂	%			8,3
		CO ₂	%	10,2	0,4	PN-ISO 10396:2001
	Wet gas density during testing	kg/m ³	0,848	X	PN-EN 14790:2017	
Gas density in normal conditions	kg/m ³ N	1,252	PN-EN 14790:2017			
Gas density in conventional conditions	kg/m ³ U	1,338	PN-EN 14790:2017			
Concentration in the gas at measurement conditions	PCDDF*	ng/m ³	0,0023	0,0007	PN-EN 1948:2006	
Concentration in the gas at normal conditions	PCDDF*	ng/m ³ N	0,0035	0,0011	PN-EN 1948:2006	
Concentration of the substance in the gas in the standard conditions	PCDDF*	ng/m ³ U	0,0036	0,0011	PN-EN 1948:2006	
Concentration of the substance in the gas in the reference conditions O ₂ ref. 11%	PCDDF*	ng/m ³ U	0,0028	0,0009	PN-EN 1948:2006	
Gas volume flow	measurement conditions	m ³ /h	220760	27700	PN-EN ISO 16911-1:2013	
	normal conditions	m ³ N/h	149542	18776		
	conventional conditions	m ³ U/h	125593	16513		
	conventional conditions O ₂ ref. 11%	m ³ U/h	159503	21304		
The emission obtained by measuring	PCDDF*	ng/h	452,13	150,45	PN-EN 1948:2006	
Emission limits	PCDDF*	ng/m ³ U	0,1	X	X	
Transgresssion	PCDDF*	ng/m ³ U	-			

*- the results obtained from the subcontractor (accredited)

¹⁾-information obtained from the client

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Normal conditions designate the temperature of 273 K and pressure of 101,3kPa, defining normal cubic meter m³N. The conventional 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 conventional 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/86/05/22, P/87/05/22
Date of delivery to the laboratory: 11.05.2022
Date of analysis: 11.05 - 30.05.2022

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/87/05/22	PCDD/DF	0,01	< 0,01	+

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: 09:49 – 15:53 (364,3 min)
nozzle diameter: 6 mm
probe temperature: 120 °C
scrubbers temperature 4 °C
aspired gas volume 5,77 m³
average sampling flow 15,9 l/min
izokinetic ratio: 97,2 %
leak test: + / +
gas meter temperature 16 °C
gas meter pressure 0 bar
spiking pattern: filter surface
absorption solution: 100 ml H₂O dest. + 50 ml 2-etoksyetanol
recovery: 77 % ¹³C₁₂-1,2,3,7,8-PECDF, />50%
70 % ¹³C₁₂-1,2,3,7,8,9-HxCDF, />50%
79 % ¹³C₁₂-1,2,3,7,8,9 HpCDF. />50%
TEQ sample mass: 0,02 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
moisture measurement set
cartridge:
number of samplings: 1
sampling time: 31 min
sampling volume: 2,0 l/min
H₂O maas: 8,19 g
absorption efficiency: 97,3 %

Test Report No PW/53/05/22**O₂ paramagnetic (PN-EN 14789:2017):**

Range : 0 – 5 % []
 0 – 10 % [X]
 0 – 25 % []

Calibration gas: O₂ – 9,012% [X] R/07/W
 O₂ – 20,018% [] R/12/W
 N₂ – 99,99% [X] R/17/

Sampling train: 2 measurement axis

Sampling time/ average time: 364 min / 1 min

O ₂ concentration measurement (paramagnetic):		HORIBA PG-350E-EU (130/1/AW/21)			
check operation		unit	result	criterion	result +/-
„0” after adjustment, without sampling train		%	0,05	± 0,1 [%]*	+
„0” after adjustment, with sampling train	before measurement	%	0,05	± 0,2 [%]**	+
	after measurement	%	0,1	± 0,2 [%]**	+
„Span” after adjustment with sampling train /standard 9,012 % R/07/W analyzer range 25%/	before measurement	%	9,0	± 0,2 [%]**	+
	after measurement	%	9,1	± 0,2 [%]**	+
	before measurement time T90	%	8,2	> 8,12 [%]	-----
sec.		35	< 200 sec.	+	

Test Report No PW/53/05/22**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 PR2246532

Sample:

P/86/05/22

Measurement results PCDD/Fs:

Sample: P/86/05/22		Final extract [µl]: 60			
		Injection volume [µl]: 4			
		Acquisition date [d.m.y h:m]: 19.5.22 2:44			
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	< 0.0018	0.0018	0.0035	1	0.0018
1,2,3,7,8-PeCDD	< 0.0052	0.0052	0.01	0.5	0.0026
1,2,3,4,7,8-HxCDD	< 0.019	0.019	0.038	0.1	0.0019
1,2,3,6,7,8-HxCDD	< 0.019	0.019	0.038	0.1	0.0019
1,2,3,7,8,9-HxCDD	< 0.019	0.019	0.038	0.1	0.0019
1,2,3,4,6,7,8-HpCDD	< 0.099	0.049	0.099	0.01	0.00099
OCDD	< 0.14	0.069	0.14	0.001	0.00014
2,3,7,8-TCDF	< 0.0035	0.0035	0.007	0.1	0.00035
1,2,3,7,8-PeCDF	< 0.0059	0.0059	0.012	0.05	0.0003
2,3,4,7,8-PeCDF	< 0.0059	0.0059	0.012	0.5	0.003
1,2,3,4,7,8-HxCDF	< 0.011	0.011	0.022	0.1	0.0011
1,2,3,6,7,8-HxCDF	< 0.011	0.011	0.022	0.1	0.0011
1,2,3,7,8,9-HxCDF	< 0.011	0.011	0.022	0.1	0.0011
2,3,4,6,7,8-HxCDF	< 0.011	0.011	0.022	0.1	0.0011
1,2,3,4,6,7,8-HpCDF	< 0.04	0.04	0.079	0.01	0.0004
1,2,3,4,7,8,9-HpCDF	< 0.04	0.04	0.079	0.01	0.0004
OCDF	< 0.039	0.039	0.078	0.001	0.000039
I-TEQ from quantified 2,3,7,8-PCDD/Fs - "Lowerbound"					0
I-TEQ from 2,3,7,8-PCDD/Fs - "Mediumbound"					0.01
Maximum possible I-TEQ - "Upperbound"					0.02
PCDDs	Result [ng/sample]	PCDFs	Result [ng/sample]		
Tetra-CDDs	< 0.039	Tetra-CDFs	0.32		
Penta-CDDs	< 0.073	Penta-CDFs	< 0.17		
Hexa-CDDs	< 0.19	Hexa-CDFs	< 0.18		
Hepta-CDDs	0.19	Hepta-CDFs	< 0.16		
OCDD	< 0.14	OCDF	< 0.039		

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 PR2246532

Sample:

P/86/05/22

Standards recovery:

Sample:		P/86/05/22			
		Final extract [µl]:		60	
		Injection volume [µl]:		4	
		Acquisition date [d.m.y h:m]:		19.5.22 2:44	
Extraction standard	Recovery	Acceptable range [%]		Accept. rec. with respect to	
PCDDs	[%]	Basic	Extended	basic range	extended range
13C12 - 2,3,7,8-TCDD	94	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,7,8-PeCDD	65	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDD	82	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDD	84	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDD	84	40 - 130	20 - 150	YES	-
13C12 - OCDD	100	40 - 130	20 - 150	YES	-
PCDFs					
13C12 - 2,3,7,8-TCDF	71	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,7,8-PeCDF	52	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDF	100	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDF	100	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,6,7,8-HxCDF	76	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDF	96	40 - 130	20 - 150	YES	-
13C12 - OCDF	100	40 - 130	20 - 150	YES	-
Sampling standard	Recovery	Acceptable range		Rec. in range?	
	[%]	[%]			
13C12-1,2,3,7,8-PeCDF	77	> 50		YES	
13C12-1,2,3,7,8,9-HxCDF	70	> 50		YES	
13C12-1,2,3,4,7,8,9-HpCDF	79	> 50		YES	

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9. CERTIFICATE OF ACCREDITATION

POLSKIE CENTRUM AKREDYTACJI
POLISH CENTRE FOR ACCREDITATIONSygnatariusz EA MLA
EA MLA SignatoryCERTYFIKAT AKREDYTACJI
LABORATORIUM BADAWCZEGO
ACCREDITATION CERTIFICATE OF TESTING LABORATORY

Nr AB 994

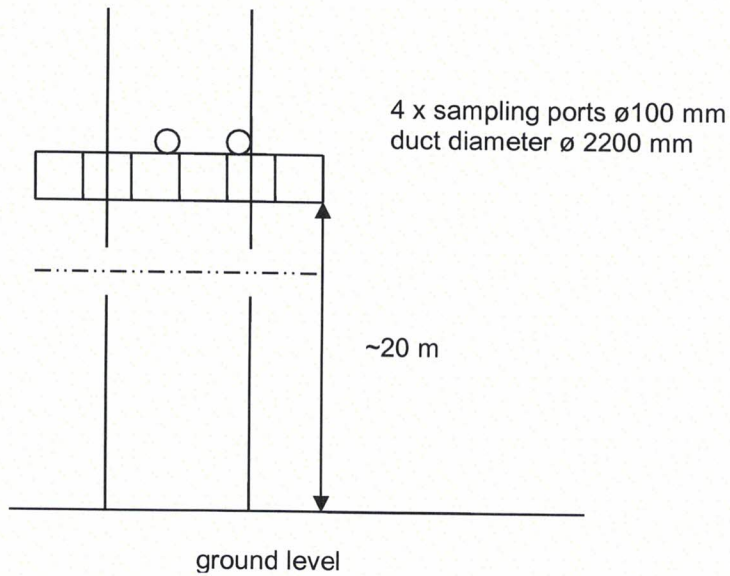
Potwierdza się, że: / This is to confirm that:

„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

DYREKTOR

.....
Name and Signature
inz. Dariusz Guja

END OF REPORT