



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, June 17th 2021
Our ref. No.: PW/22/06/21

Report No PW/22/06/21

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

Client name and address:

UAB FORTUM 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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Test Report No PW/22/06/21**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 UAB FORTUM 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 2018, our reference number PP/01/05/21.

3. MEASUREMENT TEAM

The measurements taken on May 25th 2020 were executed by the following team:

- Grzegorz Bortel specialist- measurement team leader,
- Grzegorz Kurzeja 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 O ₂ ref. 11%	PCDDF	ng/m ³	0,002
Emission limits	PCDDF	ng/m ³	0,1
Transgerssion	PCDDF	ng/m ³	-

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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-350 EHR 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-350 EHR 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

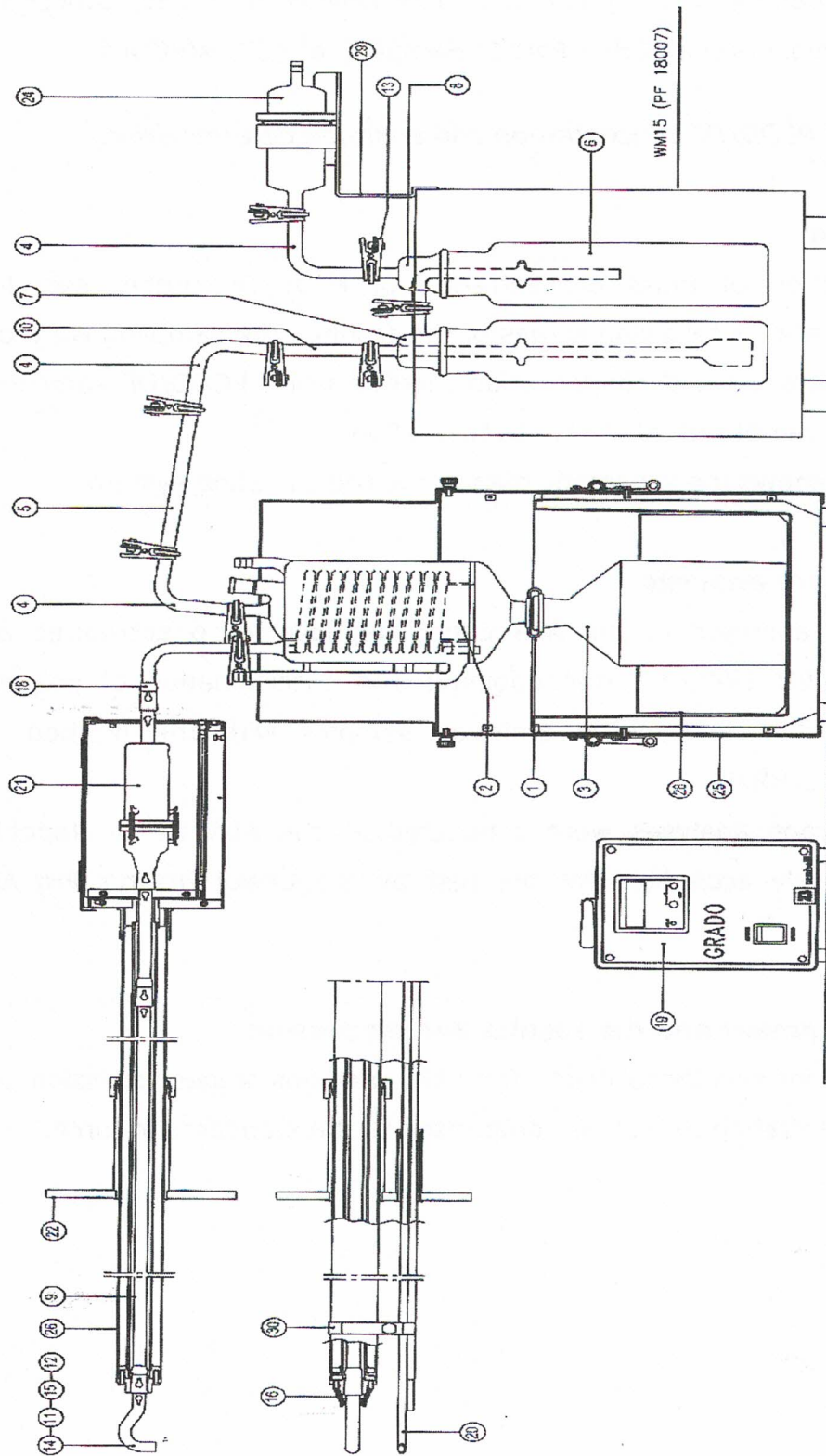
The samples were analysed at the ALS Czech Republic, s.r.o accredited laboratory following the CSN EN 1948-2,3 methodology: The determination of polychlorinated dibenzo-p-dioxine, dibenzofurans in emission samples with the method of isotop dillution using HRGC/HRMS.

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 casing
 - 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: **48% municipal waste, 52% industrial waste: 29,25 t/h¹⁾**
- 5) Location of sampling and measurements: **in duct, after flue gases cleaning unit**

Measurement reference number		25-05-01		X	X	
Date of measurement		25.05.2021				
Measurement time range		10:12-16:16				
Scope of test		Unit	Results	Uncertainty +/-	Method	
Meteorological conditions	Atmospheric pressure	hPa	1008,9	1,7	X	
	Air temperature	oC	12			
Cross-section	Diameter	m	2,20			
	Area	m2	3,7994			
The parameters of gas in line	Temperature	oC	57	1,390		X
	Static pressure	Pa	-98	-1,050		
	Differential pressure	Pa	152	1,390		
	Gas moistness grade X	kg/kg	0,131	0,003		
	Average velocity	m/s	14,7	0,9		
	Chemical composition	O2	%	7,7		
		CO2	%	11,2	0,5	
	Wet gas density during testing	kg/m3	1,026			
	Gas density in normal conditions	kg/m3 N	1,247			
Gas density in conventional conditions	kg/m3 U	1,344				
Concentration in the gas at measurement conditions	PCDDF*	ng/m3	0,002	0,001	PN-EN 14789:2017	
Concentration in the gas at normal conditions	PCDDF*	ng/m3 N	0,003	0,001	PN-EN 14789:2017	
Concentration of the substance in the gas in the standard conditions	PCDDF*	ng/m3 U	0,003	0,001	PN-EN 14789:2017	
Concentration of the substance in the gas in the reference conditions O2 ref. 11%	PCDDF*	ng/m3 U	0,002	0,001	PN-EN 14789:2017	
Gas volume flow	measurement conditions	m3/h	201475	25285	X	
	normal conditions	m3N/h	165846	20832		
	conventional conditions	m3U/h	137564	18094		
	conventional conditions O2 ref. 11%	m3U/h	182960	27657		
The emission obtained by measuring	PCDDF*	ng/h	371,42	123,87	PN-EN 14789:2017	
Emission limits	PCDDF*	ng/m3 U	0,1		X	
Transgerssion	PCDDF*	ng/m3 U	-		X	

*- 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/108/05/21, P/109/05/21

Date of delivery to the laboratory: 28.05.2021

Date of analysis: 28.05 - 15.06.2021

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/109/05/21	PCDD/DF	0,01	0,001	+

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: 10:15 – 16:16 (364,3 min)
 nozzle diameter: 8 mm
 probe temperature: 120 °C
 scrubbers temperature: 4 °C
 aspired gas volume: 11,72 m³
 average sampling flow: 32,2 l/min
 isokinetic ratio: 97,9 %
 leak test: + / +
 gas meter temperature: 19 °C
 gas meter pressure: 0 bar
 spiking pattern: filter surface
 absorption solution: 100 ml H₂O dest. + 50 ml 2-etoksyetanol
 recovery: 84 % ¹³C₁₂-1,2,3,7,8-PECDF, />50%/
 99 % ¹³C₁₂-1,2,3,7,8,9-HxCDF, />50%/
 81 % ¹³C₁₂-1,2,3,7,8,9 HpCDF. />50%/
 TEQ sample mass: 0,03 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-02
 cartridge: moisture measurement set
 number of samplings: 1
 sampling time: 31 min
 sampling volume: 2,0 l/min
 H₂O mass: 9,05 g
 absorption efficiency: 98,1 %

Test Report No PW/22/06/21Statement of compliance with the specification/requirement:

The average value of the measurement series in the scope of dioxins and furans was assessed for compliance with the value of the emission standard for certain types of installations, fuel combustion sources and waste incineration or co-incineration devices

The laboratory has adopted the simple acceptance principle in accordance with ILAC-G8: 09/2019. The risk of incorrect acceptance / incorrect rejection for a result equal to the requirement / specification is 50%.

Decision-making bodies may adopt a different decision-making principle, which may have an impact on the outcome.

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-HR
Certificate	Calibration No	69/1/AW/21
Issued by		Laboserwis Sp. z o.o. Katowice
Date of issue the certificate of calibration		22.03.2021
Expiration date of the certificate of calibration		-

Name of measuring device		Sampler
Type of measuring device		PT-02
Certificate	Calibration No	851-2464/19 786-2246/19 R-287/16-186/16 G-373/19-227/19
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 PR2150657

Sample: P/108/05/21

Measurement results PCDD/Fs:

Sample: P/108/05/21		Final extract [µl]: 60			
		Injection volume [µl]: 4			
		Acquisition date [d.m.y h:m]: 9.6.21 2:10			
2,3,7,8-PCDD/Fs	Result [ng/sample]	Limit of Detection [ng/sample]	Limit of Quantification [ng/sample]	I-TEFs	I-TEQ Upperbound [ng/sample]
2,3,7,8-TCDD	< 0.0035	0.0035	0.007	1	0.0035
1,2,3,7,8-PeCDD	< 0.0036	0.0036	0.0072	0.5	0.0018
1,2,3,4,7,8-HxCDD	< 0.0074	0.0074	0.015	0.1	0.00074
1,2,3,6,7,8-HxCDD	< 0.0074	0.0074	0.015	0.1	0.00074
1,2,3,7,8,9-HxCDD	< 0.0074	0.0074	0.015	0.1	0.00074
1,2,3,4,6,7,8-HpCDD	0.037	0.0071	0.014	0.01	0.00037
OCDD	0.028	0.01	0.02	0.001	0.000028
2,3,7,8-TCDF	0.029	0.0025	0.0049	0.1	0.0029
1,2,3,7,8-PeCDF	0.011	0.0038	0.0076	0.05	0.00053
2,3,4,7,8-PeCDF	0.012	0.0038	0.0076	0.5	0.006
1,2,3,4,7,8-HxCDF	0.034	0.0069	0.014	0.1	0.0034
1,2,3,6,7,8-HxCDF	0.039	0.0069	0.014	0.1	0.0039
1,2,3,7,8,9-HxCDF	< 0.0069	0.0069	0.014	0.1	0.00069
2,3,4,6,7,8-HxCDF	0.036	0.0069	0.014	0.1	0.0036
1,2,3,4,6,7,8-HpCDF	0.094	0.0054	0.011	0.01	0.00094
1,2,3,4,7,8,9-HpCDF	< 0.0054	0.0054	0.011	0.01	0.000054
OCDF	< 0.0071	0.0071	0.014	0.001	0.0000071
I-TEQ from quantified 2,3,7,8-PCDD/Fs - "Lowerbound"					0.022
I-TEQ from 2,3,7,8-PCDD/Fs -, "Mediumbound"					0.026
Maximum possible I-TEQ - "Upperbound"					0.03
PCDDs	Result [ng/sample]	PCDFs	Result [ng/sample]		
Tetra-CDDs	< 0.077	Tetra-CDFs	1.4		
Penta-CDDs	< 0.05	Penta-CDFs	0.68		
Hexa-CDDs	< 0.074	Hexa-CDFs	0.57		
Hepta-CDDs	0.11	Hepta-CDFs	0.094		
OCDD	0.028	OCDF	< 0.0071		

⁴I-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/N₂≥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 PR2150657

Sample: P/108/05/21

Standards recovery:

Sample:		P/108/05/21			
		Final extract [µl]:		60	
		Injection volume [µl]:		4	
		Acquisition date [d.m.y h:m]:		9.6.21 2:10	
Extraction standard	Recovery [%]	Acceptable range [%]		Accept. rec. with respect to	
PCDDs		Basic	Extended	basic range	extended range
13C12 - 2,3,7,8-TCDD	56	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,7,8-PeCDD	88	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDD	75	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDD	51	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDD	52	40 - 130	20 - 150	YES	-
13C12 - OCDD	52	40 - 130	20 - 150	YES	-
PCDFs					
13C12 - 2,3,7,8-TCDF	81	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,7,8-PeCDF	94	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDF	69	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDF	58	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,6,7,8-HxCDF	70	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDF	66	40 - 130	20 - 150	YES	-
13C12 - OCDF	54	40 - 130	20 - 150	YES	-
Sampling standard	Recovery [%]	Acceptable range [%]		Rec. in range?	
13C12-1,2,3,7,8-PeCDF	84	> 50		YES	
13C12-1,2,3,7,8,9-HxCDF	99	> 50		YES	
13C12-1,2,3,4,7,8,9-HpCDF	81	> 50		YES	

Test Report No PW/22/06/21**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:

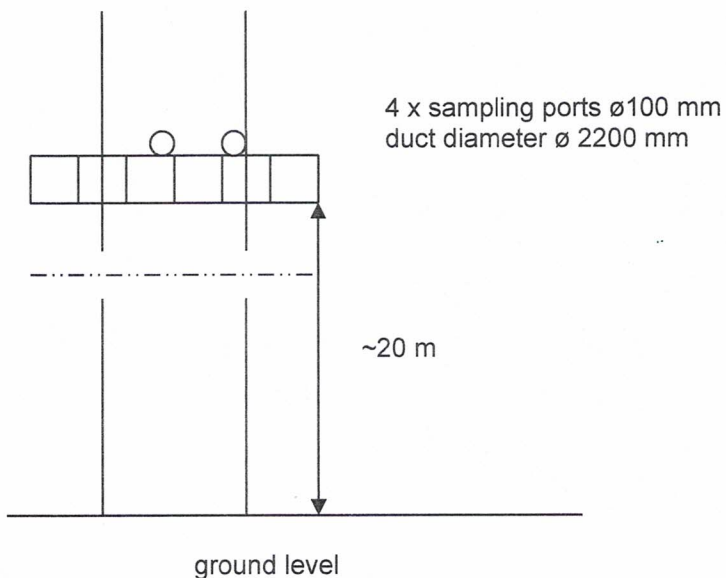
„PROFTECH” Sp. z o.o.
ul. Kurta Aldera 44, 41-506 Chorzówspełnia wymagania normy PN-EN ISO/IEC 17025:2018-02
meets requirements of the PN-EN ISO/IEC 17025:2018-02 standardAkredytowana działalność jest określona w Zakresie Akredytacji Nr AB 994
Accredited activity is defined in the Scope of Accreditation 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

DYREKTOR

inż. Dariusz Guja

.....
Name and Signature

END OF REPORT