



**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 SO<sub>2</sub>, NO<sub>x</sub>, CO
- concentration measurements of CO<sub>2</sub>, O<sub>2</sub>
- 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, September 23<sup>rd</sup> 2021  
Our ref. No.: PW/46/09/21

### **Report No PW/46/09/21**

**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

Verified by:

inż. Dariusz Guja

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**Test Report No PW/46/09/21****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 31<sup>st</sup> 2020, our reference number PP/15/03/20.

**3. MEASUREMENT TEAM**

The measurements taken on August 31<sup>st</sup> 2021 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 reference conditions O2 ref. 11%	PCDDF	ng/m3	<b>0,003</b>
Emission limits	PCDDF	ng/m3	<b>0,1</b>
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 O<sub>2</sub> content**

The concentration of O<sub>2</sub> 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 O<sub>2</sub> - Reference method - Paramagnetism". Measurement is accredited.

Accreditation range: O<sub>2</sub> content: 3-21%

**Measurement CO<sub>2</sub> content**

The concentration of CO<sub>2</sub> 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: CO<sub>2</sub> 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: H<sub>2</sub>O content: 29-250 g/m<sup>3</sup>

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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**

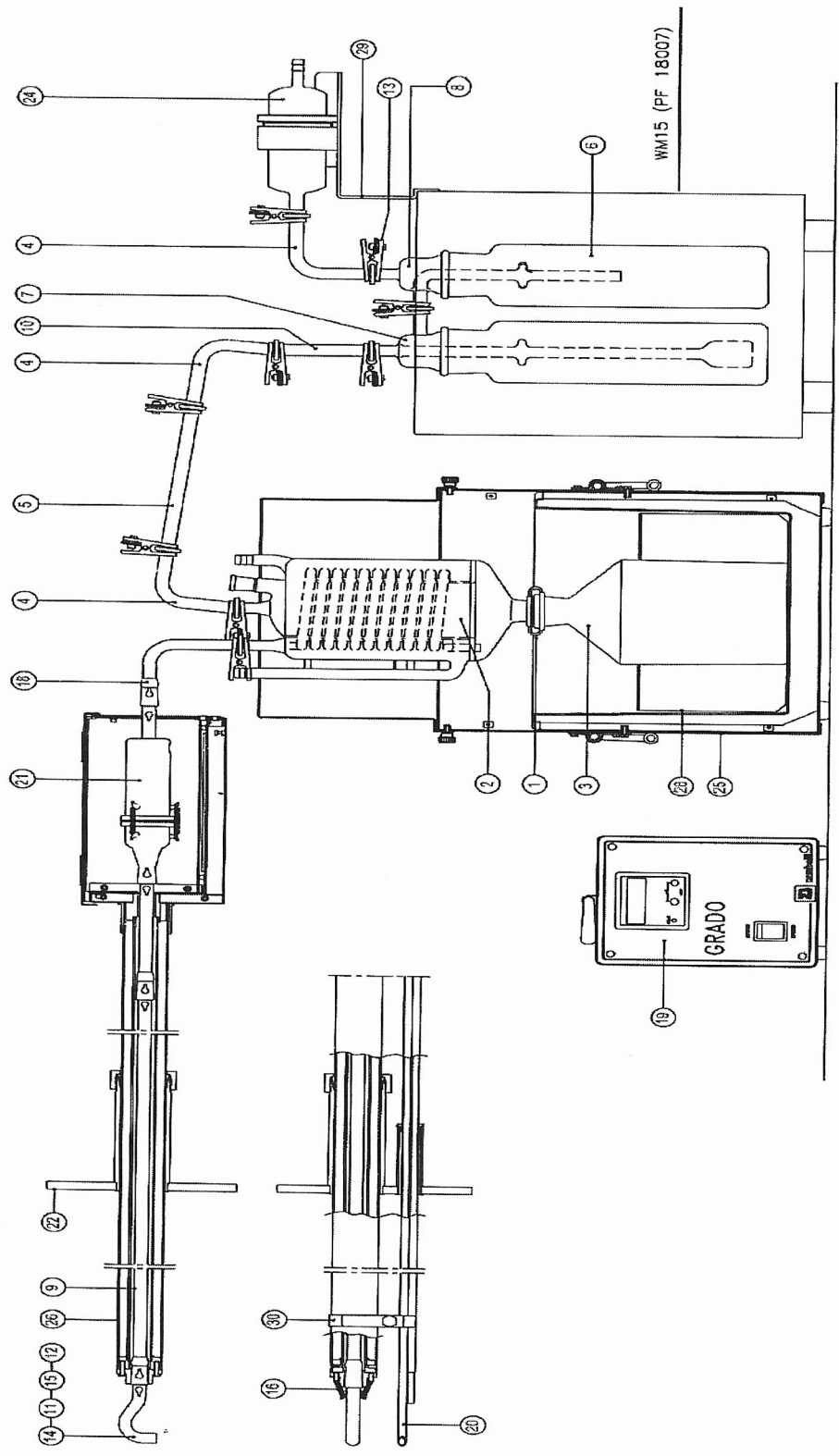
The samples were analysed at the ALS Czech Republic, s.r.o accredited laboratory following the CSN EN 1948-2,3 methodology: The determination of polychlorinated dibenzo-p-dioxine, dibenzofurans in emission samples with the method of isotop dillution using HRGC/HRMS.

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 Plant**  
 2) Flue gases cleaning unit: **bag filters, activate carbon, hydrated lime, scrubber**  
 3) Emission source load during measurements: **~107,5%**  
 4) Fuel type or material mass flow in process: **65% municipal waste, 35% non – hazardous industrial waste**  
 5) Location of sampling and measurements: **in duct, after flue gases cleaning unit**

Measurement reference number		31-08-21		X	X	
Date of measurement		31.08.2021				
Measurement time range		10:32-16:36				
Scope of test		Unit	Results	Uncertainty +/-	Method	
Meteorological conditions	Atmospheric pressure	hPa	<b>999,4</b>	0,9	X	
	Ambient temperature	oC	<b>15</b>			
Cross-section	Diameter	m	<b>2,00</b>			
	Area	m <sup>2</sup>	<b>3,14</b>			
The parameters of gas in line	Temperature	oC	<b>56</b>	0,970		
	Static pressure	Pa	<b>151</b>	5,240	PN-EN ISO 16911-1:2013	
	Differential pressure	Pa	<b>118</b>	0,970	PN-EN ISO 16911-1:2013	
	Gas moistness grade X	kg/kg	<b>0,123</b>	0,004	PN-EN 14790:2017	
	Average velocity	m/s	<b>11,5</b>	0,1	PN-EN ISO 16911-1:2013	
	Chemical composition	O <sub>2</sub>	%	<b>9,3</b>	0,2	PN-EN 14789:2017
		CO <sub>2</sub>	%	<b>10,1</b>	0,4	PN-ISO 10396:2001
	Wet gas density during testing	kg/m <sup>3</sup>	<b>1,023</b>		PN-EN 14790:2006	
	Gas density in normal conditions	kg/m <sup>3</sup> N	<b>1,248</b>		PN-EN 14790:2006	
Gas density in conventional conditions	kg/m <sup>3</sup> U	<b>1,339</b>		PN-EN 14790:2006		
Concentration in the gas at measurement conditions	PCDDF*	ng/m <sup>3</sup>	<b>0,003</b>	0,001	PN-EN 1948:2006	
Concentration in the gas at normal conditions	PCDDF*	ng/m <sup>3</sup>	<b>0,003</b>	0,001	PN-EN 1948:2006	
Concentration of the substance in the gas in standard conditions	PCDDF*	ng/m <sup>3</sup>	<b>0,003</b>	0,001	PN-EN 1948:2006	
Concentration of the substance in the gas in reference conditions O <sub>2</sub> ref. 11%	PCDDF*	ng/m <sup>3</sup>	<b>0,003</b>	0,001	PN-EN 1948:2006	
Gas volume flow	measurement conditions	m <sup>3</sup> /h	<b>130335</b>	2164	X	
	normal conditions	m <sup>3</sup> N/h	<b>106858</b>	1843		
	standard conditions	m <sup>3</sup> U/h	<b>89572</b>	6249		
	reference conditions O <sub>2</sub> ref. 11%	m <sup>3</sup> U/h	<b>104799</b>	7705		
The emission obtained by measuring	PCDDF*	ng/h	<b>295,59</b>	94,10	PN-EN 1948:2006	
Emission limits	PCDDF*	ng/m <sup>3</sup>	<b>0,1</b>		X	
Transgerssion	PCDDF*	ng/m <sup>3</sup>	<b>-</b>		X	

\*- the results obtained from the subcontractor ( accredited )

**Test Report No PW/46/09/21**Notes:

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

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/02/09/21, P/03/09/21

Date of delivery to the laboratory: 02.09.2021

Date of analysis: 02.09 - 20.09.2021

**Field blanks:**

ID/ number of sample	Type of substance	The criterion of the blank [ng/m <sup>3</sup> ] 11%O <sub>2</sub>	The value of the blank [ng/m <sup>3</sup> ] 11% O <sub>2</sub>	Result [+/-]
P/03/09/21	PCDD/DF	0,01	0,0026	+

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: 10:32 – 16:36 (364,2 min)  
 nozzle diameter: 6 mm  
 probe temperature: 120 °C  
 scrubbers temperature 4 °C  
 aspired gas volume 5,96 m<sup>3</sup>  
 average sampling flow 16,4 l/min  
 izokinetic ratio: 110,3 %  
 leak test: + / +  
 gas meter temperature 23,5 °C  
 gas meter pressure 0 bar  
 spiking pattern: filter surface  
 absorption solution: 100 ml H<sub>2</sub>O dest. + 50 ml 2-etoksyetanol  
 recovery: 69 % <sup>13</sup>C<sub>12</sub>-1,2,3,7,8-PECDF, />50%/  
 70 % <sup>13</sup>C<sub>12</sub>-1,2,3,7,8,9-HxCDF, />50%/  
 58 % <sup>13</sup>C<sub>12</sub>-1,2,3,4,7,8,9 HpCDF. />50%/  
 TEQ sample mass: 0,018 ng

**H<sub>2</sub>O (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: 39 min  
 sampling volume: 3,4 l/min  
 H<sub>2</sub>O mass: 17,83 g  
 absorption efficiency: 98,5 %

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**O<sub>2</sub> paramagnetic (PN-EN 14789:2017):**

Range : 0 – 25 % [X]  
 Calibration gas: O<sub>2</sub> – 20,018% [X] R/12/W  
 N<sub>2</sub> – 99,99% [X] R/17/  
 Sampling train: 2 measurement axis  
 Sampling time/ average time: 39 min / 1 min

O <sub>2</sub> 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	%	0,2	± 0,5 [%]**	+
	after measurement	%	0,1	± 0,5 [%]**	+
„Span” after adjustment with sampling train /standard 20,018 % R/12/W analyzer range 25%/	before measurement	%	20,0	± 0,5 [%]**	+
	after measurement	%	20,1	± 0,5 [%]**	+
	before measurement time T90	%	18,09	> 18,02 [%]	-----
sec.		40	< 200 sec.	+	

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

Statement 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.

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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-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 PR2184910*

Sample: P/02/09/21

**Measurement results PCDD/Fs:**

Sample: P/02/09/21		Final extract [µl]: 60			
		Injection volume [µl]: 4			
		Acquisition date [d.m.y h:m]: 11.9.21 14:44			
2,3,7,8-PCDD/Fs	Result [ng/sample]	Limit of Detection [ng/sample]	Limit of Quantification [ng/sample]	<sup>1</sup> I-TEFs	I-TEQ Upperbound [ng/sample]
2,3,7,8-TCDD	< 0.0036	0.0036	0.0071	1	0.0036
1,2,3,7,8-PeCDD	< 0.0051	0.0051	0.01	0.5	0.0026
1,2,3,4,7,8-HxCDD	< 0.0068	0.0068	0.014	0.1	0.00068
1,2,3,6,7,8-HxCDD	< 0.0068	0.0068	0.014	0.1	0.00068
1,2,3,7,8,9-HxCDD	< 0.0068	0.0068	0.014	0.1	0.00068
1,2,3,4,6,7,8-HpCDD	< 0.01	0.01	0.02	0.01	0.0001
OCDD	< 0.012	0.012	0.024	0.001	0.000012
2,3,7,8-TCDF	< 0.0051	0.0051	0.01	0.1	0.00051
1,2,3,7,8-PeCDF	< 0.0053	0.0053	0.011	0.05	0.00027
2,3,4,7,8-PeCDF	< 0.011	0.0053	0.011	0.5	0.0053
1,2,3,4,7,8-HxCDF	< 0.013	0.0066	0.013	0.1	0.0013
1,2,3,6,7,8-HxCDF	< 0.0066	0.0066	0.013	0.1	0.00066
1,2,3,7,8,9-HxCDF	< 0.0066	0.0066	0.013	0.1	0.00066
2,3,4,6,7,8-HxCDF	< 0.0066	0.0066	0.013	0.1	0.00066
1,2,3,4,6,7,8-HpCDF	< 0.0072	0.0072	0.014	0.01	0.000072
1,2,3,4,7,8,9-HpCDF	< 0.0072	0.0072	0.014	0.01	0.000072
OCDF	< 0.012	0.012	0.024	0.001	0.000012
I-TEQ from quantified 2,3,7,8-PCDD/Fs - "Lowerbound"					0
I-TEQ from 2,3,7,8-PCDD/Fs - "Mediumbound"					0.0089
Maximum possible I-TEQ - "Upperbound"					0.018
PCDDs	Result [ng/sample]	PCDFs	Result [ng/sample]		
Tetra-CDDs	< 0.078	Tetra-CDFs	0.2		
Penta-CDDs	< 0.071	Penta-CDFs	0.17		
Hexa-CDDs	< 0.068	Hexa-CDFs	< 0.1		
Hepta-CDDs	< 0.02	Hepta-CDFs	< 0.029		
OCDD	< 0.012	OCDF	< 0.012		

<sup>1</sup>I-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<sub>0</sub>≥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 PR2184910**

Sample:

P/02/09/21

**Standards recovery:**

Sample:		P/02/09/21			
		Final extract [µl]:		60	
		Injection volume [µl]:		4	
		Acquisition date [d.m.y h:m]:		11.9.21 14:44	
Extraction standard	Recovery [%]	Acceptable range [%]		Accept. rec. with respect to	
PCDDs		Basic	Extended	basic range	extended range
13C12 - 2,3,7,8-TCDD	68	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,7,8-PeCDD	74	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDD	59	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	40	40 - 130	20 - 150	YES	-
13C12 - OCDD	48	40 - 130	20 - 150	YES	-
PCDFs					
13C12 - 2,3,7,8-TCDF	56	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,7,8-PeCDF	72	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDF	59	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDF	62	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,6,7,8-HxCDF	55	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDF	93	40 - 130	20 - 150	YES	-
13C12 - OCDF	57	40 - 130	20 - 150	YES	-
Sampling standard	Recovery [%]	Acceptable range [%]		Rec. in range?	
13C12-1,2,3,7,8-PeCDF	69	> 50		YES	
13C12-1,2,3,7,8,9-HxCDF	70	> 50		YES	
13C12-1,2,3,4,7,8,9-HpCDF	58	> 50		YES	

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**9. CERTIFICATE OF ACCREDITATION**

**POLSKIE CENTRUM AKREDYTACJI**  
POLISH CENTRE FOR ACCREDITATION



Sygnatariusz 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 Chorzów**

spełnia wymagania normy PN-EN ISO/IEC 17025:2018-02  
meets requirements of the PN-EN ISO/IEC 17025:2018-02 standard

Akredytowana działalność jest określona w Zakresie Akredytacji Nr AB 994  
Accredited activity is defined in the Scope of Accreditation No AB 994

Akredytacja 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 994

Akredytacji udzielono dnia 30.01.2009 r.  
Accreditation was granted on 30.01.2009



DYREKTOR  
POLSKIEGO CENTRUM AKREDYTACJI

LUCYNA OLBORSKA

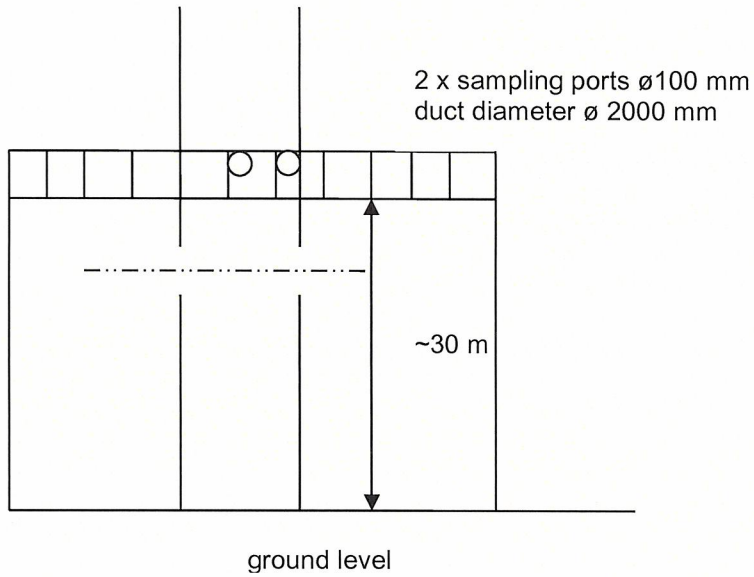
Warszawa, dnia 9 grudnia 2019 roku

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**10. MEASUREMENT PLANE SCHEME**



Approved by

.....  
Name and Signature

END OF REPORT

