



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; Ti; 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 26th 2018
Our ref. No.: PW/34/06/18

Report No PW/34/06/18

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:

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Test Report No PW/34/06/18

List of contents:

- 1. PURPOSE AND SCOPE OF THE REPORT**
- 2. BASIS OF MEASUREMENTS EXECUTION**
- 3. MEASUREMENT TEAM**
- 4. MEASUREMENT RESULTS SUMMARY**
- 5. DESCRIPTION OF THE MEASUREMENT METHOD**
- 6. MEASUREMENT RESULTS**
- 7. MEASUREMENT DEVICES**
- 8. ANALYSIS RESULTS**
- 9. CERTIFICATE OF ACCREDITATION**
- 10. MEASUREMENT PLANE SCHEME**

Test Report No PW/34/06/18

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.

2. BASIS OF MEASUREMENTS EXECUTION

The measurements were taken according to the Purchase Order No MX19857LTKLJ18 dated May 24th 2018, our reference number PP/10/05/18.

3. MEASUREMENT TEAM

The measurements taken on May 29th 2018 were executed by the following team:

- Grzegorz Bortel specialist- measurement team leader,
- Grzegorz Kurzeja 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 conventional conditions O2 ref. 11%	PCDDF	ng/m3	0,002
Emission limits	PCDDF	ng/m3	0,1
Transgresssion	PCDDF	ng/m3	-

Test Report No PW/34/06/18

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 14789:2006 "Stationary source emissions - Determination of volume concentration of oxygen O₂ - Reference method - Paramagnetism". Measurement is accredited.

Accreditation range: O₂ content: 0,31-21%

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 14790:2006. Measurement is accredited.

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

Test Report No PW/34/06/18

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

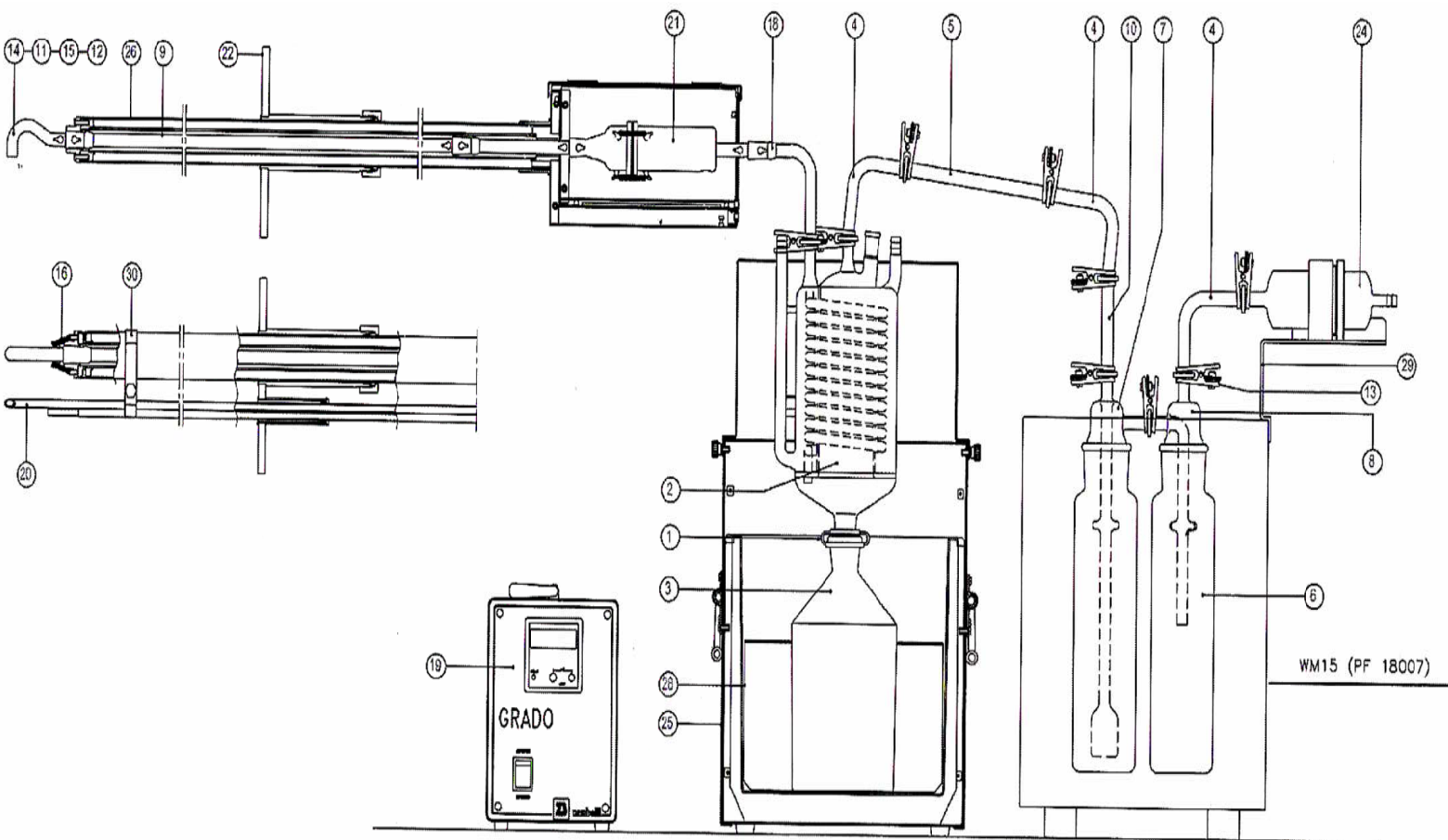
The samples were analysed at the ALS Czech Republic, s.r.o accredited laboratory following the CSN EN 1948-2,3 methodology: The determination of polychlorinated dibenzo-p-dioxine, dibenzofurans in emission samples with the method of isotop dillution using HRGC/HRMS.

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. , No 128/2017.

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.

Test Report No PW/34/06/18



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

Test Report No PW/34/06/18

6. MEASUREMENT RESULTS

Test Report No PW/34/06/18

- 1) Plant or unit name: **Combined Heat and Power Plant**
- 2) Flue gases cleaning unit: **ALSTOM NID flue gas cleaning solution (bag filters, activate carbon, ammonia solution, hydrated lime)**
- 3) Emission source load during measurements: **100 %**
- 4) Fuel type or material mass flow in process: **70% communal waste, 30% industrial waste**
- 5) Location of sampling and measurements: **in duct, after flue gases cleaning unit**

Measurement reference number		29-05-01		X	X
Date of measurement		29.05.2018			
Measurement time range		11:06-17:11			
Scope of test		Unit	Results	Uncertainty +/-	Method
Meteorological conditions	Atmospheric pressure		hPa	1020,5	X
	Air temperature		oC	28	
Cross-section	Diameter		m	2,20	
	Area		m ²	3,7994	
The parameters of gas in line	Temperature		oC	151	
	Static pressure		Pa	-104	
	Differential pressure		Pa	191	
	Gas moistness grade X		kg/kg	0,155	
	Average velocity		m/s	18,3	
	Chemical composition	O ₂	%	6,7	
		CO ₂	%	11,1	1,2
	Wet gas density during testing		kg/m ³	1,099	X
Gas density in normal conditions		kg/m ³ N	1,291		
Gas density in conventional conditions		kg/m ³ U	1,340		
Concentration in the gas at measurement conditions	PCDDF*	ng/m ³	0,002	0,001	PN-EN 14789:2006
Concentration in the gas at normal conditions	PCDDF*	ng/m ³	0,003	0,001	PN-EN 14789:2006
Concentration of the substance in the gas in the conventional conditions	PCDDF*	ng/m ³	0,003	0,001	PN-EN 14789:2006
Concentration of the substance in the gas in the conventional conditions O ₂ ref. 11%	PCDDF*	ng/m ³	0,002	0,001	PN-EN 14789:2006
Gas volume flow	measurement conditions	m ³ /h	250304	14044	X
	normal conditions	m ³ N/h	162301	18290	
	conventional conditions	m ³ U/h	128956	15909	
	conventional conditions O ₂ ref. 11%	m ³ U/h	184793	24996	
The emission obtained by measuring	PCDDF*	ng/h	438,45	140,02	PN-EN 14789:2006
Emission limits	PCDDF*	ng/m ³	0,1	X	X
Transgresssion	PCDDF*	ng/m ³	-		

*- the results obtained from the subcontractor (accredited)

Test Report No PW/34/06/18

Notes:

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/01/06/18, P/02/06/18

Date of delivery to the laboratory: 06.06.2018 r.

Date of analysis: 06.06 - 18.06.2017 r.

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/02/06/18	PCDD/DF	0,01	0,002	+

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: 4 measurement axis
 oxygen reference : 11 %
 time of dioxins and furans measurement: 11:06 – 17:11 (364,6 min)
 nozzle diameter: 6 mm
 probe temperature: 120 °C
 scrubbers temperature 4 °C
 aspired gas volume 6,713 m³
 average sampling flow 18,4 l/min
 izokinetic ratio: 1,01
 leak test: + / +
 gas meter temperature 35 °C
 gas meter pressure 0 bar
 spiking pattern: filter surface
 absorption solution: 100 ml H₂O dest. + 50 ml 2-etoksyetanol
 recovery: 61 % ¹³C₁₂-1,2,3,7,8-PECDF, />50%/
 57 % ¹³C₁₂-1,2,3,7,8-HxCDF, />50%/
 55 % ¹³C₁₂-1,2,3,7,8 HpCDF. />50%/
 TEQ sample mass: 0,02 ng

H₂O (PN-EN 14790:2006)

sampling train: 4 measurement axis
 sampling equipment: titanium sampling train
 heated probe 2,0 m long
 sampling pump: PT-01
 cartridge: K/07/05/18
 number of samplings: 1
 sampling time: 50 min
 sampling volume: 1,0 l/min
 H₂O mass: 8,75 g
 absorption efficiency: 95,9 %

Test Report No PW/34/06/18

7. MEASUREMENT DEVICES

Name of measuring device		X1- Apis
Type of measuring device		Isokinetic sampler
Certificate	Calibration No	1018-2911/17 1018-2912/17 1018-2913/17 1361/PWT/2017 G-265/17-185/17
Issued by		Laboratorium pomiarowe Introl CZAH-POMIAR Sp. z o.o. Zakład Aparatury Pomiarowej Henryk Iszczek
Date of issue the certificate of calibration		26.09.2017 27.09.2017 14.09.2017
Expiration date of the certificate of calibration		-

Name of measuring device		HORIBA
Type of measuring device		PG-350E-HR
Certificate	Calibration No	63/1/AW/18
Issued by		Laboserwis Sp. z o.o. Katowice
Date of issue the certificate of calibration		13.03.2018
Expiration date of the certificate of calibration		-

Name of measuring device		Sampler
Type of measuring device		PT-01
Certificate	Calibration No	T230/PMT/2016 982-2832/16 G-284/16-186/16 R-286/16-186/16
Issued by		Laboratorium pomiarowe Introl CZAH-POMIAR Sp. z o.o. Zakład Aparatury Pomiarowej Henryk Iszczek
Date of issue the certificate of calibration		05.09.2016 27.06.2016 24.08.2016
Expiration date of the certificate of calibration		-

Test Report No PW/34/06/18

8. ANALYSIS RESULTS



Attachment no. 1 to the Certificate of Analysis for work order PR1853523

Sample: P/01/06/18

Measurement results PCDD/Fs:

Sample: P/01/06/18		Final extract [µl]: 60			
		Injection volume [µl]: 4			
		Acquisition date [d.m.y h:m]: 12.6.18 6:51			
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	< 0.0035	0.0035	0.0069	1	0.0035
1,2,3,7,8-PeCDD	< 0.0046	0.0046	0.0092	0.5	0.0023
1,2,3,4,7,8-HxCDD	< 0.0059	0.0059	0.012	0.1	0.00059
1,2,3,6,7,8-HxCDD	< 0.0059	0.0059	0.012	0.1	0.00059
1,2,3,7,8,9-HxCDD	< 0.0059	0.0059	0.012	0.1	0.00059
1,2,3,4,6,7,8-HpCDD	< 0.081	0.041	0.081	0.01	0.00081
OCDD	< 0.079	0.039	0.079	0.001	0.000079
2,3,7,8-TCDF	< 0.0026	0.0026	0.0053	0.1	0.00026
1,2,3,7,8-PeCDF	< 0.0046	0.0046	0.0092	0.05	0.00023
2,3,4,7,8-PeCDF	< 0.0092	0.0046	0.0092	0.5	0.0046
1,2,3,4,7,8-HxCDF	< 0.017	0.0083	0.017	0.1	0.0017
1,2,3,6,7,8-HxCDF	< 0.017	0.0083	0.017	0.1	0.0017
1,2,3,7,8,9-HxCDF	< 0.0083	0.0083	0.017	0.1	0.00083
2,3,4,6,7,8-HxCDF	< 0.017	0.0083	0.017	0.1	0.0017
1,2,3,4,6,7,8-HpCDF	< 0.042	0.021	0.042	0.01	0.00042
1,2,3,4,7,8,9-HpCDF	< 0.021	0.021	0.042	0.01	0.00021
OCDF	< 0.017	0.017	0.033	0.001	0.000017
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	< 0.076	Tetra-CDFs	0.19		
Penta-CDDs	< 0.064	Penta-CDFs	0.17		
Hexa-CDDs	< 0.059	Hexa-CDFs	0.16		
Hepta-CDDs	< 0.13	Hepta-CDFs	< 0.084		
OCDD	< 0.079	OCDF	< 0.017		

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.

Test Report No PW/34/06/18



Attachment no. 1 to the Certificate of Analysis for work order PR1853523

Sample: P/01/06/18

Standards recovery:

Sample:		P/01/06/18			
		Final extract [µl]:		60	
		Injection volume [µl]:		4	
		Acquisition date [d.m.y h:m]:		12.6.18 6:51	
Extraction standard	Recovery [%]	Acceptable range [%]		Accept. rec. with respect to	
		Basic	Extended	basic range	extended range
PCDDs					
13C12 - 2,3,7,8-TCDD	71	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,7,8-PeCDD	59	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDD	85	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDD	100	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDD	78	40 - 130	20 - 150	YES	-
13C12 - OCDD	81	40 - 130	20 - 150	YES	-
PCDFs					
13C12 - 2,3,7,8-TCDF	72	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,7,8-PeCDF	64	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDF	88	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	92	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDF	73	40 - 130	20 - 150	YES	-
13C12 - OCDF	89	40 - 130	20 - 150	YES	-
Sampling standard	Recovery [%]	Acceptable range [%]		Rec. in range?	
13C12-1,2,3,7,8-PeCDF	61	> 50		YES	
13C12-1,2,3,7,8,9-HxCDF	57	> 50		YES	
13C12-1,2,3,4,7,8,9-HpCDF	55	> 50		YES	

Test Report No PW/34/06/18



Attachment no. 2 to the Certificate of Analysis for work order PR1853523

Sample:

P/02/06/18

Measurement results PCDD/Fs:

Sample:		P/02/06/18		Final extract [µl]:		60	
				Injection volume [µl]:		4	
				Acquisition date [d.m.y h:m]:		12.6.18 5:58	
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	< 0.0044	0.0044	0.0088	1	0.0044		
1,2,3,7,8-PeCDD	< 0.005	0.005	0.01	0.5	0.0025		
1,2,3,4,7,8-HxCDD	< 0.0081	0.0081	0.016	0.1	0.00081		
1,2,3,6,7,8-HxCDD	< 0.0081	0.0081	0.016	0.1	0.00081		
1,2,3,7,8,9-HxCDD	< 0.0081	0.0081	0.016	0.1	0.00081		
1,2,3,4,6,7,8-HpCDD	< 0.013	0.013	0.026	0.01	0.00013		
OCDD	< 0.015	0.015	0.03	0.001	0.000015		
2,3,7,8-TCDF	< 0.0029	0.0029	0.0059	0.1	0.00029		
1,2,3,7,8-PeCDF	< 0.0032	0.0032	0.0065	0.05	0.00016		
2,3,4,7,8-PeCDF	< 0.0032	0.0032	0.0065	0.5	0.0016		
1,2,3,4,7,8-HxCDF	< 0.0089	0.0089	0.018	0.1	0.00089		
1,2,3,6,7,8-HxCDF	< 0.0089	0.0089	0.018	0.1	0.00089		
1,2,3,7,8,9-HxCDF	< 0.0089	0.0089	0.018	0.1	0.00089		
2,3,4,6,7,8-HxCDF	< 0.0089	0.0089	0.018	0.1	0.00089		
1,2,3,4,6,7,8-HpCDF	< 0.012	0.012	0.024	0.01	0.00012		
1,2,3,4,7,8,9-HpCDF	< 0.012	0.012	0.024	0.01	0.00012		
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"					0.0077		
Maximum possible I-TEQ - "Upperbound"					0.015		
PCDDs	Result [ng/sample]	PCDFs	Result [ng/sample]				
Tetra-CDDs	< 0.097	Tetra-CDFs	< 0.11				
Penta-CDDs	< 0.07	Penta-CDFs	< 0.09				
Hexa-CDDs	< 0.081	Hexa-CDFs	< 0.14				
Hepta-CDDs	< 0.026	Hepta-CDFs	< 0.048				
OCDD	< 0.015	OCDF	< 0.012				

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.

Test Report No PW/34/06/18



Attachment no. 2 to the Certificate of Analysis for work order PR1853523

Sample: P/02/06/18

Standards recovery:

Sample:		P/02/06/18			
		Final extract [µl]:		60	
		Injection volume [µl]:		4	
		Acquisition date [d.m.y h:m]:		12.6.18 5:58	
Extraction standard	Recovery [%]	Acceptable range [%]		Accept. rec. with respect to	
PCDDs		Basic	Extended	basic range	extended range
13C12 - 2,3,7,8-TCDD	59	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,7,8-PeCDD	57	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDD	87	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDD	96	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDD	77	40 - 130	20 - 150	YES	-
13C12 - OCDD	78	40 - 130	20 - 150	YES	-
PCDFs					
13C12 - 2,3,7,8-TCDF	68	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,7,8-PeCDF	62	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDF	88	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	96	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDF	76	40 - 130	20 - 150	YES	-
13C12 - OCDF	84	40 - 130	20 - 150	YES	-

Test Report No PW/34/06/18

9. CERTIFICATE OF ACCREDITATION

POLSKIE CENTRUM AKREDYTACJI
POLISH CENTRE FOR ACCREDITATION

 **PCA**
POLSKIE CENTRUM
AKREDYTACJI

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” Spółka Jawna
D. Guja, D. Nowiński
ul. Józefa Maronia 44, 41-506 Chorzów

spełnia wymagania normy PN-EN ISO/IEC 17025:2005
meets requirements of the PN-EN ISO/IEC 17025:2005 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

Certyfikat akredytacji ważny do dnia 29.01.2021 r.
The certificate of accreditation is valid until 29.01.2021

Akredytacji udzielono dnia 30.01.2009 r.
Accreditation was granted on 30.01.2009

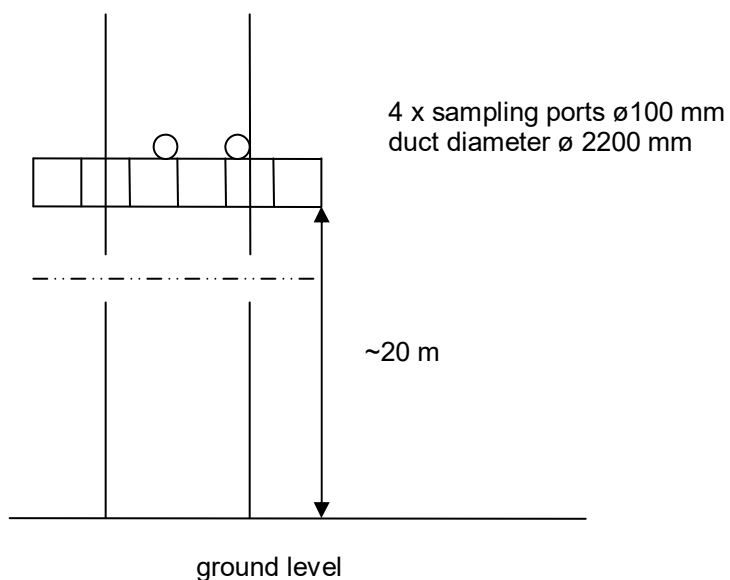
  **DYREKTOR**
POLSKIEGO CENTRUM AKREDYTACJI

LUCYNA OLBORSKA

Warszawa, dnia 11 stycznia 2017 roku

Test Report No PW/34/06/18

10. MEASUREMENT PLANE SCHEME



Approved by

.....
Name and Signature

END OF REPORT