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Zheshartsky LPK Ltd.
 Shkolnaya Str. 1
 427551 Balezinsky district
 Russia

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Braunschweig, 21 December 2021

Test report No. QA-2021-3164

Client: Zheshartsky LPK Ltd.
 Shkolnaya Str. 1
 427551 Balezinsky district (Russia)

Product name: Russian Birch Plywood

Supervision contract number: certification number 1425

Objective of the test: Evaluation of correlation in reference to the final rule of "Formaldehyde Emission Standards for Composite Wood Products" added as Title VI to the Toxic Substances Control Act (TSCA) - 'TSCA Title VI' – Final rule 40 CFR Part 770

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The test report comprises 7 pages, 5 tables and 1 figure.

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 A publication in extracts is in any case subject to the previous consent of Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut WKI, Bienroder Weg 54E in 38108 Braunschweig (Germany). The test results exclusively refer to the objects of the test. The test material was used up.



CARB notified TPC 4



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1. Task

The Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut WKI, was assigned by Messrs. Zheshartsky LPK Ltd. in 427551 Balezinsky district (Russia) to carry out the inspection and determine by measurements the formaldehyde emission potential of wood-based panels according to the requirements published by US EPA TSCA Title VI third party certifier to certify uncoated wood-based products according to the final rule 40 CFR Part 770 "Formaldehyde Emission Standards for Composite Wood Products" added as Title VI to the Toxic Substances Control Act (TSCA) - 'TSCA Title VI'.

The Fraunhofer WKI is approved as third-party certifier (TPC) by EPA.

As mentioned in 40 CFR § 770.20 (d) an equivalence or correlation has to be demonstrated between ASTM chamber and any other test method used for quarterly or quality control testing by EPA TSCA Title VI TPCs or panel producers, respectively, at least once each year for each testing apparatus or whenever there is a significant change in equipment, procedure, or the qualifications of testing personnel. Once equivalence or correlation have been established for three consecutive years, equivalence or correlation must be demonstrated every two years or whenever there is a significant change in equipment, procedure, or the qualifications of testing personnel.

The required correlation shall be established based on the test results of chamber method ASTM D 6007 "Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber" as reference test method done in the TPC laboratory and the factory production control (FPC) method used as quality control test method in the manufacturer's laboratory.

A supervision contract with certification number 1425 is in force.

2. Test methods

2.1. Reference chamber test method according to ASTM standard

In reference to the "Voluntary Consensus Standard Update" as published in Federal Register Number EPA-HQ-OPPT-2017-0245 on February 7, 2018, the correlation of an approved quality control test method is allowed to be done by using the large chamber test method ASTM E 1333 "Determining Formaldehyde Concentration in Air and Emission Rates from Wood Products Using a Large Chamber", or, upon showing equivalence, the chamber test method according to ASTM D 6007 "Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber".

Equivalence has been shown and established between the American standard ASTM E 1333 "Determining Formaldehyde Concentration in Air and Emission Rates from Wood Products Using a Large Chamber" and ASTM D 6007 "Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber" and complies with 40 CFR § 770.20 (d)(1). Therefore, the small chamber test method as specified in ASTM D 6007 can be used for quality control testing.

2.2 Quality control test method

The determination of formaldehyde release or content was carried out according to 40 CFR § 770.20 (b)(1) allowable factory production control (FPC) methods.

The manufacturer used the following method for factory production control:

<input type="checkbox"/>	ASTM D 6007-14
<input type="checkbox"/>	DMC User's Manual
<input checked="" type="checkbox"/>	EN ISO 12460-3:2015 E (Gas Analysis Method)
<input type="checkbox"/>	EN ISO 12460-5:2015 E (Perforator Method)
<input type="checkbox"/>	JIS A 1460:2015 (E) (24-hr Desiccator Method)

The determination of formaldehyde release or content was done for samples in the manufacturer's laboratory within a defined period after production as mentioned in the manufacturer's quality control manual.

The FPC test results determined were reported to Fraunhofer WKI.

3. Test material

Product:	plywood, uncoated
Product name:	Russian Birch Plywood
Plant:	Zheshartsky LPK Ltd. in 427551 Balezinsky district (Russia)
Thickness range certified [mm]:	$3 \leq 30$
Thickness range tested [mm]:	$6 \leq 30$

4. Assessment of results

4.1. ASTM chamber test results

The emission limit values of 40 CFR § 770.10 (b) of the final rule "Formaldehyde Emission Standards for Composite Wood Products" which added Title VI to the Toxic Substances Control Act (TSCA) – 'TSCA Title VI' – Final rule 40 CFR Part 770 – published by the US Environmental Protection Agency (EPA) – are listed in table 1 to this test report.

All tested samples comply with the requirements of limit values.

4.2. Correlation data

Referring to 40 CFR § 770.15 (e), a product which is certified by a CARB approved TPC, were also considered as 'TSCA Title VI compliant' until the end of the transitional period dated March 22, 2019. Therefore, the test results of CARB quarterly inspection were used if necessary.

For evaluation of correlation data, following the test results of samples tested are used in reference to

<input checked="" type="checkbox"/>	initial correlation CARB/TSCA
<input type="checkbox"/>	quarterly inspection(s) CARB/TSCA
<input type="checkbox"/>	additional sample material requested by Fraunhofer WKI
<input type="checkbox"/>	samples for verification of correlation in case of production amendments or new grouping:
<input type="checkbox"/>	new glue supplier / same glue type
<input type="checkbox"/>	change of resin formulation (increase of formaldehyde to urea ratio $\geq 10\%$)
<input type="checkbox"/>	decrease of designated press time $> 20\%$
<input type="checkbox"/>	other:

The samples for initial correlation, additional test material or verification tests were selected by the customer corresponding to Fraunhofer WKI's guidelines, samples of quarterly inspection were chosen on random by a Fraunhofer WKI inspector.

All samples were marked, sent to the Fraunhofer WKI for examination. The samples arrived packed separately in polyethylene plastic foil and stored under room conditions. The corresponding test reports are mentioned in table 2. The test results determined for chamber tests according to ASTM D 6007 done in Fraunhofer WKI's laboratory and FPC test results reported by the manufacturer are listed in table 3.

4.3. Evaluation of correlation

Referring to 40 CFR § 770.20 (d)(2)(i) and (ii) the correlation must be established between the quality control test method and the ASTM chamber method. The correlation must be based on a minimum sample size of five data pairs and a simple linear regression where the dependent variable (Y-axis) is the quality control test value and the independent variable (X-axis) is the ASTM chamber test method test value and comply with an acceptable correlation coefficient ("r value").

Data mentioned in para 4.2. are used for calculation and summarized in table 3. In order to keep the correlation up to date with the current state of production, a maximum of not more than 12 data pairs (last 3 years for data of initial and/or quarterly inspections) are used for the calculation of correlation.

For calculation of correlation 40 CFR § 770.20 (d)(2)(i) three different approaches can be considered:

- correlation calculated using linear regression
- cluster approach
- threshold approach

Based on these approaches, the correlation was calculated considering the variation of ASTM chamber results and the normal distribution of data for different levels:

Level 1: data pairs with sufficient variation of chamber results

Level 2: data pairs with variation or clustering of chamber results and additional data pair

Level 3: data pairs with variation or clustering of chamber results by using an "anchor point"

The QCL was calculated by considering the correlation with best validated r-value of selectable data pairs.

4.3.1. Correlation calculated using linear regression

In general, all data available were checked concerning their normal distribution. For this statistical hypothesis testing, the Shapiro-Wilk test was used.

In case of a normal distribution of data, the calculation of correlation was done according to Pearson, for non-normal distributed data Spearman was used. The graphic analysis by MS Excel was not considered, in lieu thereof the mathematically exact derivatives of the individual steps for the respective statistics models are calculated.

The correlation coefficient (R^2) of a linear regression expresses how much the straight line considers the measuring points and was calculated as "r value" to show compliance with 40 CFR § 770.20 (d)(2)(ii).

4.3.2. Cluster approach

The correlation was calculated by using a point near to the origin considering values for untreated wood/wood particles and a chamber value lower than the blank value (zero; origin). For data pairs showing this grouping (cluster) of data, an additional data pair was used by assumed as either an additional data pair or as anchor point for the calculation of the correlation the value of untreated wood / wood particles ¹⁾.

Accordingly, a value less than the blank value was assumed for the chamber method and the following equivalent values for the derived test methods:

- ASTM chamber / DMC: 0.0 ppm
- gas analysis method: 0.0 mg/h.m²
- perforator method: 0.3 mg/100 g oven-dry material
- desiccator method: 0.0 mg/L

Due to the regression is artificially steered through the "anchor point", the correlation coefficient has to be corrected by a penalty term for this theoretical data point. The correlation coefficient R^2_{adj} (adjusted) is also described as an "uncentered" coefficient of determination and calculated as follows:

$$R^2_{adj} = 1 - (1 - R^2) \cdot \frac{n - 1}{n - p - 1}$$

Where is:

R^2_{adj} : correlation coefficient calculated with penalty term

R^2 : calculated correlation coefficient of linear regression

n : number of data pairs

p : smallest level of significance at which the null hypothesis would be rejected (here: 5%; 0.05)

The quality of the regression with anchor point is verified by using the F-statistic at $\alpha = 0.05$ significance level.

¹⁾ referring to thesis "The formaldehyde release of wood and changes during technical processes of wood-based panels production", Christian Boehme, published by Shaker Verlag, Aachen 2000, Register D7 (Diss. University Göttingen, Germany)

4.3.3. Threshold value

As an alternative to the linear regression and cluster approaches, in case no linear regression line can be established, the threshold approach referring to 40 CFR § 770.20 (d)(2)(i) section (B) can be used. Here, the average value of the clustered data pairs from the ASTM chamber test method and the panel producer's quality control method as the quality control limit for the product. In this approach, no linear regression line is established. The average value is assigned as the upper quality control limit for production of the subject composite wood product and must be below the applicable emission standard.

4.3.4. Correlation data

The correlation diagram and level used is shown in figure 1. The correlation data and calculated factory production control (FPC) limit value to comply with 'TSCA Title VI' 40 CFR § 770.10 (b) requirements is mentioned in table 4.

Referring to 40 CFR § 770.20 (d)(2)(ii) the minimum acceptable correlation coefficient for a correlation based on the evaluated data pairs have 3-degrees of freedom and must achieve "r" values as listed in table 5.

5. Definition and calculation of limit values

5.1. Quality Control Limit (QCL)

The quality control limit (QCL) of each product type is the correlative equivalent to the applicable emission standard based on the ASTM chamber tests referring to the requirements of 'TSCA Title VI' referring to 40 CFR § 770.7 (c)(4)(i)(B).

The samples can be taken at any time after the hot press and before shipment.

The test date resp. sampling has to be fixed by the manufacturer. Therefore, the quality control limit value (QCL) has to be calculated by taking in consideration the results of test method used for internal factory production control (FPC) as specified in the manufacturer's quality control manual and chamber data of the test results.

5.2. Shipping Quality Control Limit Value (SQCL)

Shipping quality control limit means a quality control limit that is developed in conjunction with an EPA TSCA Title VI TPC that is based on panels prior to shipment rather than immediately after manufacturing.

The SQCL is based upon the correlation between the FPC test method of a product ready for shipment and the ASTM chamber tests. Depending on the shipment data fixed by the manufacturer it can be differ or be the same as QCL.

Referring to 40 CFR § 770.7 (c)(4)(i)(C) the TPC has to establish in consultation with the panel producer the quality control limits (QCLs) for formaldehyde emissions, and, if applicable, shipping quality control limits or other formaldehyde emission limits, for each panel producer and product type.

6. Evaluation

The correlation has been calculated and evaluated as follows:

Correlation data evaluated based on requirement of	period	QCL calculated for ASTM D 6007 vs. Manufacturer FPC results	Correlation complies with minimum r value
TSCA Title VI	Q4/2021	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no

On the basis of the correlation tests, considering production variability as well as method-related variances of the derived test methods used, the manufacturer must calculate tolerances that ensure that the calculated product-specific limit value (QCL) is adhered to when the product enters the market.



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Officer in charge




Dipl.-Ing. Harald Schwab
Head of Testing, Supervision and
Certifying Body

Table 1: Formaldehyde limit values for composite wood products according to the final rule "Formaldehyde Standards for Composite Wood Products Act" which added Title VI to the Toxic Substances Control Act (TSCA) – 'TSCA Title VI' – Final rule 40 CFR Part 770 – published by the US ENVIRONMENTAL PROTECTION AGENCY (EPA)

Composite Wood Product Producers	
<u>Products must comply with emission standards ⁽¹⁾ :</u>	40 CFR § 770.10 (b)
Hardwood plywood 0.05 ppm (made with a veneer core or a composite core)	
Particleboard 0.09 ppm	
MDF 0.11 ppm	
Thin MDF 0.13 ppm	

⁽¹⁾ Based on test method ASTM E 1333 (or ASTM D 6007; showing equivalence)

Table 2: Considered test reports used for evaluation of correlation data

Product: plywood, uncoated
 Product name: Russian Birch Plywood
 Plant: Zheshartsky LPK Ltd. in
 427551 Balezinsky district (Russia)
 Thickness range certified [mm]: $3 \leq 30$
 Thickness range tested [mm]: $6 \leq 30$

Year	Quarter	Sample-ID. No.	Sample-ID. No.	Thickness [mm]	Test report No.	related to CARB supervision	related to TSCA supervision	Date of test report [YYYY-MM-DD]
		quarterly inspection*	additional tests**					
2021	4		6286	15	QA-2021- 3153	3154	2021-12-21	
2021	4		6287	25	QA-2021- 3155	3156	2021-12-21	
2021	4		6288	30	QA-2021- 3157	3158	2021-12-21	
2021	4		5685	6	QA-2021- 3159	3160	2021-12-21	
2021	4		5686	12	QA-2021- 3161	3162	2021-12-21	

* test material was selected on random by an Fraunhofer WKI inspector during quarterly inspection

** test material was selected by the customer corresponding to Fraunhofer WKI's guidelines

Table 3: Summary - formaldehyde determination – Test methods and results

Test method TPC laboratory: ASTM D 6007

Test method manufacturer laboratory:

<input type="checkbox"/>	ASTM D 6007
<input type="checkbox"/>	DMC User's Manual
<input checked="" type="checkbox"/>	EN ISO 12460-3 (Gas Analysis Method)
<input type="checkbox"/>	EN ISO 12460-5 (Perforator Method)
<input type="checkbox"/>	JIS A 1460 (Desiccator Method)

Period of FPC test:

<input checked="" type="checkbox"/>	FPC tests at the time specified in the manufacturer's quality control manual
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Year	Quarter	Test carried out by			Fraunhofer WKI		Manufacturer	
		Sample-ID. No. quarterly inspection*	Sample-ID. No. additional tests**	Production Date [YYYY-MM-DD]	Test date [YYYY-MM-DD]	Chamber test ASTM D 6007*** [ppm]	Test date [YYYY-MM-DD]	FPC test results [mg/m ² h]
2021	4		6286	2021-11-10	2021-11-26	0.015	2021-11-15	0.4
2021	4		6287	2021-11-10	2021-11-26	0.018	2021-11-17	0.7
2021	4		6288	2021-11-10	2021-11-26	0.014	2011-11-24	0.4
2021	4		5685	2021-11-10	2021-12-14	0.035	2021-11-16	0.5
2021	4		5686	2021-11-10	2021-12-14	0.013	2021-11-17	0.3

* test material was selected on random by an Fraunhofer WKI inspector during quarterly inspection

** test material was selected by the customer corresponding to WKI's guidelines

*** test results calculated to 3 decimales

N/A: not reported

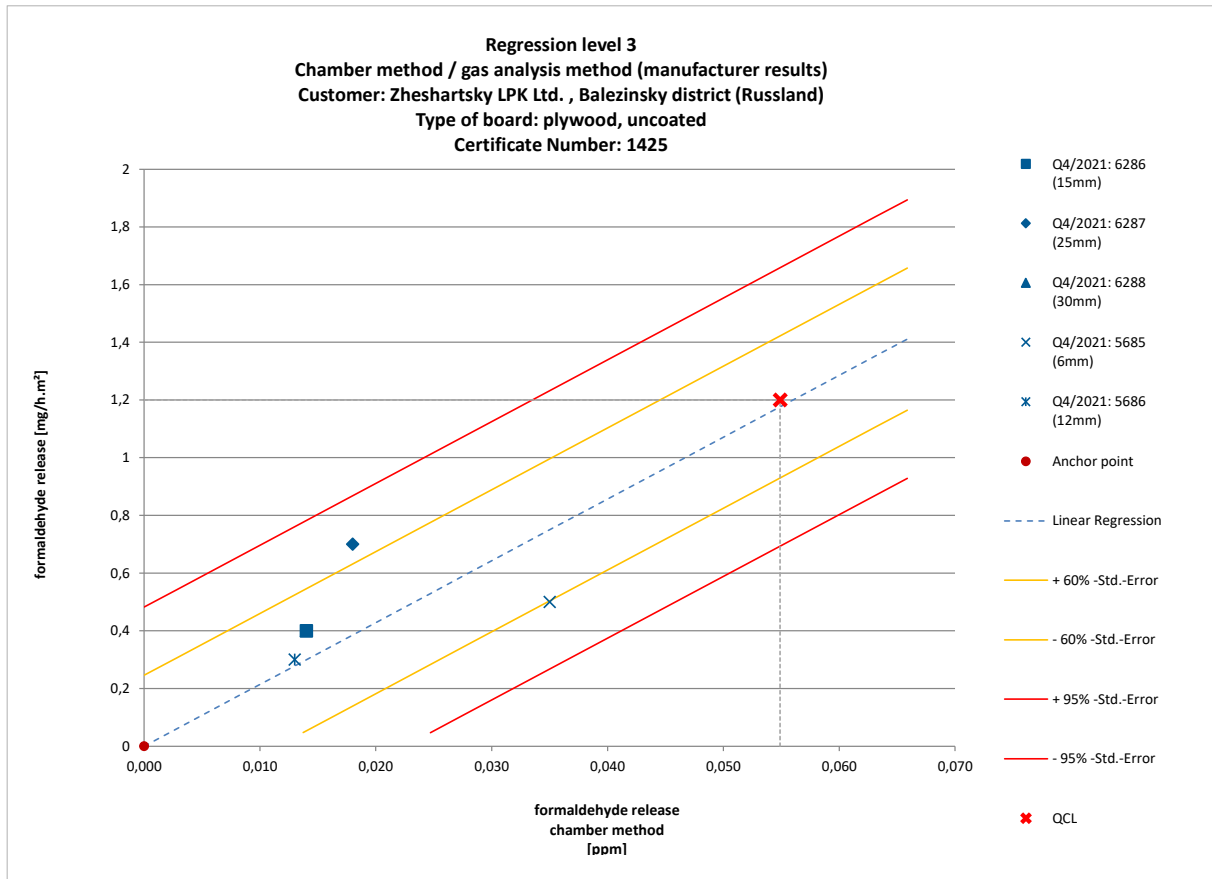


Figure 1: Correlation of chamber test results according to ASTM D 6007 (TPC laboratory) versus Factory production control (FPC) method (manufacturer's laboratory)

Test method manufacturer laboratory:	<input type="checkbox"/>	ASTM D 6007
	<input type="checkbox"/>	DMC User's Manual
	<input checked="" type="checkbox"/>	EN ISO 12460-3 (Gas Analysis Method)
	<input type="checkbox"/>	EN ISO 12460-5 (Perforator Method)
	<input type="checkbox"/>	JIS A 1460 (Desiccator Method)

based on FPC tests carried out at the time specified in the manufacturer's quality control manual

Table 4: Calculated quality control limit value (QCL) based on correlation factor determined for immediate FPC tests carried out at the time specified in the manufacturer's quality control manual

Product: plywood, uncoated
 Product name: Russian Birch Plywood
 Plant: Zheshartsky LPK Ltd. in
 427551 Balezinsky district (Russia)
 Thickness range certified [mm]: $3 \leq 30$
 Thickness range tested [mm]: $6 \leq 30$

Option used to establish the correlation and calculation of QCL or fixed threshold value without correlation (see chapter 4.2):

- correlation calculated using linear regression
 cluster approach
 threshold approach large variance of test results e.g. due to very low emitting product; additional data pairs of quarterly inspections have to be included

Quality Control Limit (QCL) was established for the certified thickness range (allowable tolerances: minimum +2 mm; maximum -2 mm)

- yes particleboard, plywood, MDF
 yes thin MDF (≤ 8 mm) by considering the technical feasibility
 no QCL is valid for 3 months (related to issue date of the report) subject to additional tests to verify the certified thickness range

Correlation based on the manufacturer's factory production control (FPC) values determined by	Correlation data*						Quality Control Limit (QCL) based on Manufacturer FPC method
	Number of Data pairs	Factor	R ² -adj. F-Statistic a=0.05 Significant	r-value	min. r-value accepted*	intercept of y-axis**	
EN ISO 12460-3 (Gas Analysis Method)	5	21.32	0.8453	0.9194	0.878	0.0	1.2 mg/m²h

* Referring to 40 CFR § 770.20 (d)(2)(ii) the minimum acceptable correlation coefficient for a correlation based on the evaluated data pairs have 3-degrees of freedom and must achieve an r-value as mentioned in table 5

** see chapter 4

Table 5: Minimum acceptable correlation coefficients ("r" values) for a correlation based on on the evaluated data pairs referring to 40 CFR § 770.20 (d)(2)(ii)

Minimum "r" values	
Degrees of freedom (n-2)	"r" value
3	0.878
4	0.811
5	0.754
6	0.707
7	0.666
8	0.632
9	0.602
10 or more	0.576

"n" is number of data pairs
"r" is the correlation coefficient
Correlations based on five data pairs have 3-degrees of freedom and must achieve an "r" value of 0.878 or greater.