REPORT

issued by an Accredited Testing Laboratory

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Emission measurements

(2 appendices)

Object

One sample of a powder coating was delivered to RISE by the customer.

Product name:	**IGP-Dura face 5803**
Production date:	2019-10-21
Size of sample:	20 x 20 cm, thickness of powder coating 70-80 µm
Date of arrival to RISE:	2019-10-22
Date of analysis:	week 43 – 50, 2019

Assignment

Emission measurements according to the horizontal standard EN 16516:2017 (Construction products: Assessment of release of dangerous substances – Determination of emissions into indor air) and to the product standard EN 16402:2013 (Paints and varnishes – Assessment of emissions of substances from coatings into indoor air – Sampling, conditioning and testing). The measurements are performed after 3 and 28 days regarding volatile organic compounds (VOC and VVOC/SVOC), carcinogenic substances (VOC-substances, EU Regulation No 1272/2008 Annex VI, cat 1A and 1B) and aldehydes (ISO 16000-3:2011).

Method

The test was started 2019-10-25 by unwrapping the test sample. Backside was sealed with and aluminium tape. The sample was placed directly into the chamber. After 3 days of conditioning in the chamber air samplings were carried out on 19-10-28. After the specimen was placed in a separate conditioning container (with air velocity of ca 0.2 m/s) in a room with controlled climate conditions of 23 ± 2 °C and 50 ± 5 % RH. After 25 days the specimen was placed into the chamber and after 28 days air samples were carried out on 19-11-22.

Test conditions in the chamber:

Chamber volume:	0.03 m^3
Temperature:	23 ± 0.5 °C
Relative humidity:	50 ± 5 % RH
Surface area of test specimen:	0.04 m^2
Air exchange rate:	0.67 h^{-1}
Area specific air flow rate:	0.50 m^3/m^2 h.
Air velocity at specimen surface:	0.1 – 0.3 m/s

Accred. No. 1002
Testing
ISO/IEC 17025

Tenax TA was used as adsorption medium for VOC. The tubes were thermally desorbed and analysed in accordance to RISE method 0601, similar to ISO 16000-6:2011 (Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS/FID). This means an analysis in a gas chromatograph and detection with a flame ionisation detector (FID) and mass selective detector (MS). The capillary column used is coated with 5% phenyl/ 95 % methylpolysiloxane. The total volatile organic compounds (TVOC) means compounds eluting between and including n-hexane to hexadecane, having boiling points in the range of about 70-260 °C. Minimum duplicate air samples were taken and the results are mean values. Sampled volumes are 2 to 7 L.

Tenax TA was also used as adsorption medium for testing of volatile carcinogenic compounds according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B), (exclusive formaldehyde), 1 µg/m^3 and above.

The samplings of aldehydes were carried out with DNPH samplers. The samplers were analysed according to RISE method 2302, similar to ISO 16000-3:2011(Indoor air - Part 3: Determination of formaldehyde and other carbonyl compounds – Active sampling method). This means analysis on a liquid chromatograph with absorbance detector. Duplicate air samples were taken and the results are mean values. Sampled volumes were 20 L.

Results

The results relate only to the items tested.

The results in Table 1 and 2 are expressed as area specific emission rates and as concentrations in a reference room. The reference room has a base area of 3 m x 4 m and a height of 2.5 m, with an air exchange rate of 0.5 h^{-1}. The wall area is 31.4 m^2, floor area is 12 m^2, small area, like a door, is 1.6 m^2 and very small area, like sealant, is 0.2 m^2. **Wall area** is used for the calculation of the concentrations.

Calculation of the concentration from the emission rate:

$$C = \frac{E_a \times A}{n \times V}$$

C = concentration of VOC in the reference room, in µg/m^3
E_a = area specific emission rate, in µg/m^{2}h
A = surface area of product in reference room, in m^2
n = air exchange rate, in changes per hour, here 0.5 h^{-1}
V = volume of the reference room, in m^3, here 30 m^3

Table 1.
Emission results of **IGP-Dura face 5803** after 3 days

Volatile organic compounds	**CAS number**	**Retention time** (min)	**ID**[1]	**Emission rate** ($\mu g/m^2h$)	**Concentration in reference room** ($\mu g/m^3$)
TVOC ($C_6 - C_{16}$)	--	6.9 – 39	B	< 10	< 10
Volatile Carcinogens [2]		6.9 – 39			
No substances detected	--	--	B	< 1	< 1
VOC with LCI [3]		6.9 – 39			
No substances detected	--	--	A	< 2	< 5
∑ **VOC with LCI**	--	--	A	< 2	< 5
VOC without LCI [4]		6.9 – 39			
No substances detected	--	--	B	< 2	< 5
∑ **VOC without LCI**	--	--	B	< 2	< 5
SVOC ($C_{16} - C_{22}$) [5]		39 - 52			
No substances detected	--	--	B	< 2	< 5
∑ **SVOC**	--	--	B	< 2	< 5
VVOC (< C_6) [6]		5.5 – 6.9			
Formaldehyde [7]	50-00-0	--	A	< 2	< 5
Acetaldehyde [7]	75-07-0	--	A	< 2	< 5
∑ **VVOC**	--	--	A	< 2	< 5

[1)] ID: A = quantified compound specific, B = quantified as toluene-equivalent
[2)] Volatile carcinogens = VOCs according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B
[3)] VOC with LCI = identified VOC-compound with LCI-value according to EU-LCI, July 2018
[4)] VOC without LCI = VOC-compound without LCI-value or not identified.
[5)] SVOC = semi-volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)
[6)] VVOC = very volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)
[7)] VVOC-aldehydes measured with DNPH samplers (ISO 16000-3)

Table 2.
Emission results of **IGP-Dura face 5803** after 28 days

Volatile organic compounds	CAS number	Retention time (min)	ID[1]	Emission rate (µg/m²h)	Concentration in reference room (µg/m³)	LCI_i (µg/m³)	R_i (c_i/LCI_i)
TVOC (C_6 – C_{16})	--	6.9 – 39	B	< 10	< 10	--	--
Volatile Carcinogens [2]		6.9 – 39					
No substances detected	--	--	B	< 1	< 1	--	--
VOC with LCI [3]		6.9 – 39					
No substances detected	--	--	A	< 2	< 5	--	--
∑ **VOC with LCI**	--	--	A	< 2	< 5	--	--
VOC without LCI [4]		6.9 – 39					
No substances detected	--	--	B	< 2	< 5	--	--
∑ **VOC without LCI**	--	--	B	< 2	< 5	--	--
SVOC (C_{16} – C_{22}) [5]		39 - 52					
No substances detected	--	--	B	< 2	< 5	--	--
∑ **SVOC**	--	--	B	< 2	< 5	--	--
VVOC (< C_6) [6]		5.5 – 6.9					
Formaldehyde [7]	50-00-0	--	A	< 2	< 5	100	--
Acetaldehyde [7]	75-07-0	--	A	< 2	< 5	1200	--
∑ **VVOC**	--	--	A	< 2	< 5	--	--
R = ∑ C_i / LCI_i [8]	--	--	--	--	--	--	< 0.01

[8)] All VVOC, VOC, SVOC and carcinogens with LCI

Only VOC-compounds with an emission rate higher than 2 µg/m²h are listed in Table 2 and 3, carcinogenic compounds ≥ 1 µg/m²h. Only the compounds with a concentration in the reference room > 5 µg/m³ after 28 days are evaluated based on LCI (= lowest concentration of interest). TVOC expressed in µg/m³ is the sum of all individual substances with concentrations ≥ 5 µg/m³ (in toluene equivalents).

Quantification limit for TVOC is 10 µg/m²h. Measurement uncertainty for VOC is 15 % (rel) and for formaldehyde 30 % (rel). Background of TVOC in the empty chamber was below 10 µg/m³ and is subtracted.

See Appendix 1 for a gas chromatogram (FID spectra) and Appendix 2 for a photo of the test specimen.

Summary of the test results

The test results are summarized in Table 3 and 4.

Table 3.
Summary of the emission results after 3 days of **IGP-Dura face 5803**

Compounds	**Emission rate** ($\mu g/m^2h$)	**Concentration in reference room** ($\mu g/m^3$)
TVOC	< 10	< 10
∑ Carcinogenic VOCs	< 1	< 1
∑ VOC with LCI	< 2	< 5
∑ VOC without LCI	< 2	< 5
∑ VVOC	< 2	< 5
Formaldehyde	< 2	< 5
∑ SVOC	< 2	< 5
$R = \sum C_i / LCI_i$	< 0.01	

Table 4.
Summary of the emission results after 28 days of **IGP-Dura face 5803**

Compounds	**Emission rate** ($\mu g/m^2h$)	**Concentration in reference room** ($\mu g/m^3$)
TVOC	< 10	< 10
∑ Carcinogenic VOCs	< 1	< 1
∑ VOC with LCI	< 2	< 5
∑ VOC without LCI	< 2	< 5
∑ VVOC	< 2	< 5
Formaldehyde	< 2	< 5
∑ SVOC	< 2	< 5
$R = \sum C_i / LCI_i$	< 0.01	

Evaluation of the test results

Byggvarubedömningen has criteria regarding Emissions to indoor environment. The emissions are to be measured according to a standard method such as ISO 16000-9 after 28 days regarding VOC and formaldehyde. The requirements for the *Recommended class* is that the requirements to one of the following systems are being met: Emicode EC1, Emicode EC1^{PLUS}, Blue Angel, M1 (RTS) or GUT.

The results of the tested sample are compared to M1 and AgBB.

Decision rule: When comparing the measured results and requirement level, the average value of the measured results has been compared with the requirement level. No account is taken to the measurement uncertainty.

Table 5.
The test results after 28 days of **IGP-Dura face 5803** are compared to the relevant requirements in M1

Compounds	**Requirement M1** (mg/m^{2}h)	**Test Results** (mg/m^{2}h)	**Pass / Fail**
TVOC	< 0.2	**< 0.010**	**PASS**
Formaldehyde	< 0.05	**< 0.002**	**PASS**
CMR 1A+1B	< 0.001	**< 0.001**	**PASS**
Single VOC (µg/m^3)	≤ EU-LCI	≤ EU-LCI	**PASS**
Ammonia	< 0.03	not measured	--
Odour	≥ 0.0	not measured	--

The test results are in compliance with the tested requirements of M1 and meet the requirements for the *Recommended class*.

Table 6.
Comparison of the criteria according to **AgBB (ver Aug 2018)** and **IGP-Dura face 5803** test results

Volatile organic compound	Criteria according to **AgBB** (mg/m^3)	**Test Results** (mg/m^3)	**Pass / Fail**
After 3 days:			
$TVOC_{spez3}$	≤ 10	**< 0.010**	**PASS**
∑ Carcinogens	≤ 0.01	**< 0.001**	**PASS**
After 28 days:			
$TVOC_{spez28}$	≤ 1	**< 0.010**	**PASS**
∑ Carcinogens	≤ 0.001	**< 0.001**	**PASS**
∑ VOC without LCI	≤ 0.1	**< 0.005**	**PASS**
∑ SVOC	≤ 0.1	**< 0.005**	**PASS**
$R = \sum C_i / LCI_i$	≤ 1	**< 0.01**	**PASS**

$TVOC_{spez}$ = ∑ VOC with LCI + ∑ VOC without LCI

The test results are in compliance with the requirements in AgBB (Feb 2018) 3 + 28 days.

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Chemistry and Materials - Chemistry

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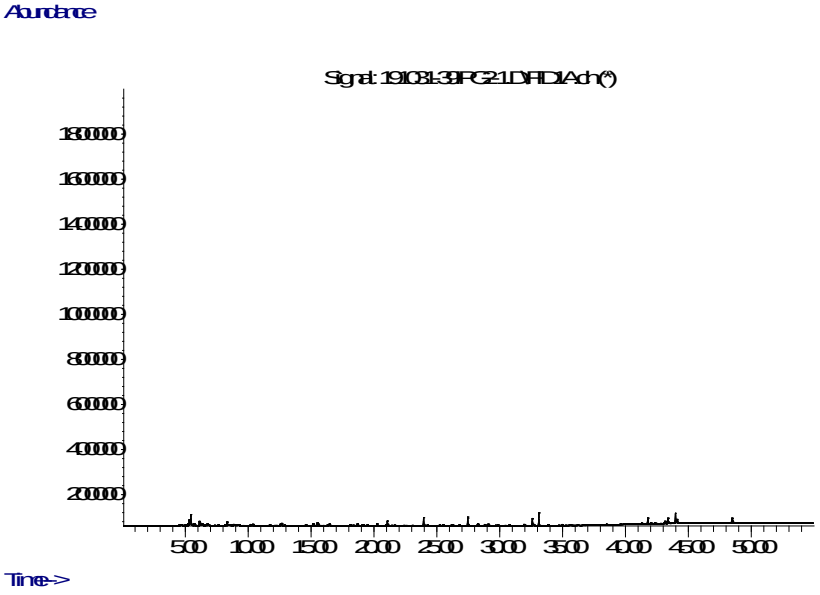
Appendices

1. Gas Chromatograms
2. Photo of the test specimen

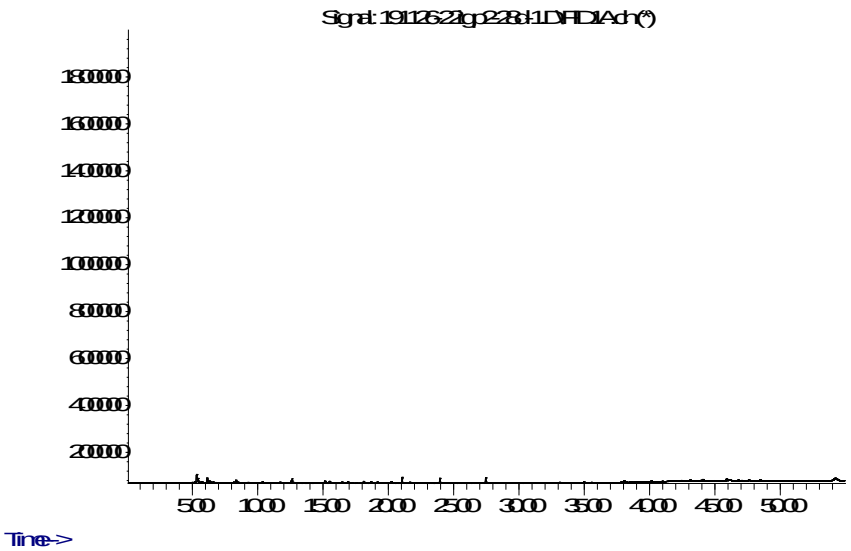
Appendix 1

Gas chromatograms

IGP-Dura face 5803, after 3 days:



IGP-Dura face 5803, after 28 days:



TVOC between C_6 and C_{16}, means compounds eluting between 6.9 and 39 minutes.

Appendix 2

Photo of the test specimen