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## Emission measurements

(3 appendices)

### Object

One sample of a paint system was delivered to RISE by the customer.

Product name: **QVFR Clear (1) + (2)**  
 Production date: (1): January 2018, batch: 180415  
 (2): November 2017, batch: 174606  
 Size of sample: 1 L, tin cans  
 Date of arrival to RISE: 2018-03-08  
 Date of analysis: week 13 – 19, 2018

### Assignment

Emission measurements according to product standard EN 16402:2013 (Paints and varnishes – Assessment of emissions of substances from coatings into indoor air – Sampling, conditioning and testing) and the horizontal standard EN 16516:2017 (Construction products: Assessment of release of dangerous substances – Determination of emissions into indoor air). The measurements are performed after 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 paint system was applied with paint roller on two glass plates of 0.40 x 0.25 m. One coat of each paint was applied, with a drying time of 4 hours between the coats. Density and spreading rate were given by the customer. The date of application was 2018-03-27.

**Table 1.**

Density (g/cm <sup>3</sup> )	Recommended spreading rate		Applied amount (g/coat and paint)
	(m <sup>2</sup> /L)	(g/m <sup>2</sup> )	
1.02 - 1.21	12	93	9.3

The product is classified as product category 4 (Table 3, EN 16402:2013).

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The specimens were placed in a separate conditioning container (with air velocity of ca 0.2 m/s) in a room with controlled climate conditions of  $23 \pm 2$  °C and  $50 \pm 5$  % RH. Air samplings after 28 days of conditioning were carried out on 2017-04-27, including 3 days of preconditioning.

Test conditions in the chamber:

Chamber volume:	0.25 m <sup>3</sup>
Temperature:	$23 \pm 0.5$ °C
Relative humidity:	$50 \pm 5$ % RH
Surface area of test specimen:	0.20 m <sup>2</sup>
Air exchange rate:	0.5 h <sup>-1</sup>
Area specific air flow rate:	0.62 m <sup>3</sup> /m <sup>2</sup> h.
Air velocity at specimen surface:	0.1 – 0.3 m/s

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 FID signals are used for compound quantification. 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 3 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<sup>3</sup> 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 30 to 50 L.

## Results

The results in Table 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<sup>-1</sup>. The wall area is 31.4 m<sup>2</sup>, floor area is 12 m<sup>2</sup>, small area, like a door, is 1.6 m<sup>2</sup> and very small area, like sealant, is 0.2 m<sup>2</sup>. 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<sup>3</sup>  
 E<sub>a</sub> = area specific emission rate, in µg/m<sup>2</sup>h  
 A = surface area of product in reference room, in m<sup>2</sup>  
 n = air exchange rate, in changes per hour, here 0.5 h<sup>-1</sup>  
 V = volume of the reference room, in m<sup>3</sup>, here 30 m<sup>3</sup>

**Table 2.**  
Emission results of **QVFR Clear (1) + (2)** after 28 days

Volatile organic compounds	CAS number	Retention time (min)	ID <sup>1</sup>	Emission rate ( $\mu\text{g}/\text{m}^2\text{h}$ )	Concentration in reference room ( $\mu\text{g}/\text{m}^3$ )	LCI <sub>i</sub> ( $\mu\text{g}/\text{m}^3$ )	R <sub>i</sub> ( $c_i/\text{LCI}_i$ )
<b>TVOC (C<sub>6</sub> – C<sub>16</sub>)</b>	--	6.5 – 38	B	350	730	--	--
<b>Volatile Carcinogens<sup>2</sup></b>		6.5 – 38					
No substances detected	--	--	B	< 1	< 1	--	--
<b>VOC with LCI<sup>3</sup></b>		6.5 – 38					
Propylene Glycol	57-55-6	9.7	A	140	290	2100	0.138
Dipropylene glycol monomethylether	34590-94-8	19.3-19.9	A	36	74	3100	0.024
2-ethyl-1-Hexanol	104-76-7	20.6	A	4	8	300	0.027
Benzenemethanol	100-51-6	21.1	A	35	72	440	0.164
2-Propenoic acid, 2-ethylhexylester	103-11-7	27.5	A	3	7	380	0.018
2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate	25265-77-4	32.1+32.7	A	410	850	600	1.417
<b>∑ VOC with LCI</b>	--	--	A	630	1300	--	--
<b>VOC without LCI<sup>4</sup></b>							
Acetic acid, 2-ethylhexyl ester	103-09-3	24.7	B	4	8	--	--
<b>∑ VOC without LCI</b>	--	--	B	4	8	--	--
<b>SVOC (C<sub>16</sub> – C<sub>22</sub>)<sup>5</sup></b>		38 - 51					
No substances detected	--	--	B	< 2	< 5	--	--
<b>∑ SVOC</b>	--	--	B	< 2	< 5	--	--
<b>VVOC (&lt; C<sub>6</sub>)<sup>6</sup></b>		4.9 – 6.5					
Formaldehyde <sup>7</sup>	50-00-0	--	A	< 2	< 5	100	--
Acetaldehyde <sup>7</sup>	75-07-0	--	A	< 2	< 5	1 200	--
<b>∑ VVOC</b>	--	--	A	< 2	< 5	--	--
<b>R = ∑ C<sub>i</sub> / LCI<sub>i</sub><sup>8</sup></b>	--	--	--	--	--	--	1.79

<sup>1)</sup> ID: A = quantified compound specific, B = quantified as toluene-equivalent

<sup>2)</sup> Volatile carcinogens = VOCs according to EU Regulation No 1272/2008 Annex VI, cat 1A and 1B

<sup>3)</sup> VOC with LCI = identified VOC-compound with LCI-value according to EU-LCI, Dec 2016

<sup>4)</sup> VOC without LCI = VOC-compound without LCI-value or not identified.

<sup>5)</sup> SVOC = semi-volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)

<sup>6)</sup> VVOC = very volatile organic compounds, as defined in ISO 16000-6 (not part of accreditation)

<sup>7)</sup> VVOC-aldehydes measured with DNPH samplers (ISO 16000-3)

<sup>8)</sup> All VVOC, VOC, SVOC and carcinogens with LCI

n.d. = not detected (detection limit is approx  $1 \mu\text{g}/\text{m}^2\text{h}$ ).

Only VOC-compounds with an emission rate higher than  $2 \mu\text{g}/\text{m}^2\text{h}$  are listed in Table 2, carcinogenic compounds  $\geq 1 \mu\text{g}/\text{m}^2\text{h}$ . Only the compounds with a concentration in the reference room  $> 5 \mu\text{g}/\text{m}^3$  are evaluated based on LCI (= lowest concentration of interest). TVOC expressed in  $\mu\text{g}/\text{m}^3$  is the sum of all individual substances with concentrations  $\geq 5 \mu\text{g}/\text{m}^3$  (in toluene equivalents).

Quantification limit for TVOC is  $10 \mu\text{g}/\text{m}^2\text{h}$ . Measurement uncertainty for VOC is 15 % (rel) and for formaldehyde 30 % (rel). Background of TVOC in the empty chamber was below  $20 \mu\text{g}/\text{m}^3$  and is subtracted.

Individual substances can have response factors varying widely from the toluene response factor. The emission for example of propylene glycol was  $140 \mu\text{g}/\text{m}^2\text{h}$ . This emission expressed in toluene equivalent, like TVOC, is  $50 \mu\text{g}/\text{m}^2\text{h}$ .

See Appendix 1 for a gas chromatogram (FID spectra) and Appendix 2 for a photo of the test specimens. Appendix 3 is the sampling report received from the customer.

## Summary of the test results

The test results are summarized in Table 3.

**Table 3.**

Summary of the emission results after 28 days of **QVFR Clear (1) + (2)**

Compounds	Emission rate ( $\mu\text{g}/\text{m}^2\text{h}$ )	Concentration in reference room (wall scenario) ( $\mu\text{g}/\text{m}^3$ )
TVOC	350	730
$\Sigma$ Carcinogenic VOCs	< 1	< 1
$\Sigma$ VOC with LCI	630	1300
$\Sigma$ VOC without LCI	4	8
$\Sigma$ VVOC	< 2	< 5
Formaldehyde	< 2	< 5
$\Sigma$ SVOC	< 2	< 5
$R = \Sigma C_i / \text{LCI}_i$	1.8	

### RISE Research Institutes of Sweden AB Chemistry and Materials - Chemistry

Performed by

Examined by

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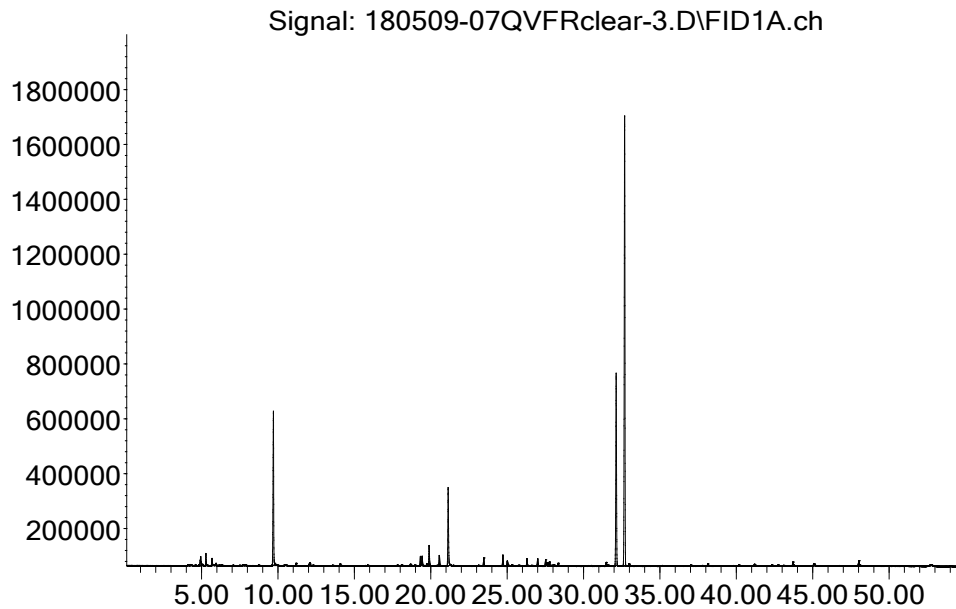
**Appendices**

1. Gas Chromatogram
2. Photo of the test specimens
3. Sampling report

## Appendix 1

**Gas chromatogram****QVFR Clear (1) + (2), after 28 days:**

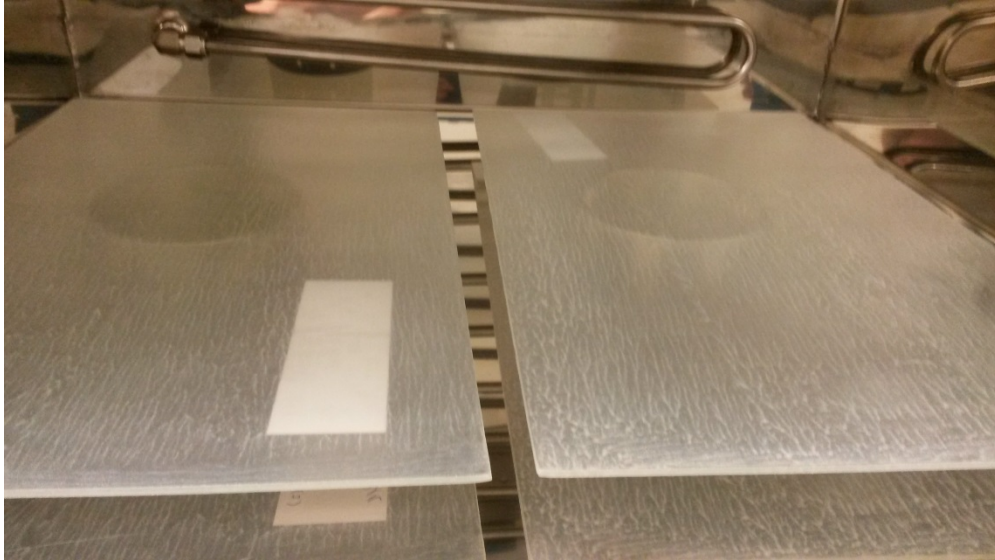
Abundance



Time--&gt;

TVOC between C<sub>6</sub> and C<sub>16</sub>, means compounds eluting between 6.5 and 38 minutes.

## Appendix 2

**Photo of the test specimens**

Appendix 3

**Sampling Report (paints etc)**

<b>Sampler (Name, Company, contact info):</b> Scandinavian Trading Ltd, unit 2, Glen court, Canada Road, Byfleet, Surrey, KT14 7JL, United Kingdom		<b>Manufacturer of the product (Company, address):</b> Intumescent Systems Ltd, Envirograf House, Barfrestone, Dover, Kent CT15 7JG, United Kingdom	
<b>Name of product:</b> QVFR Clear (1) QVFR Clear (2)		<b>Product category according to EN 16402:2013, clause 5:</b>  Type 4 Function: passive fire protection, inc top coat	
<b>Manufacturing Date:</b> QVFR Clear (1) January 2018 QVFR Clear (2): November 2017		<b>Batch No:</b> QVFR Clear (1): 180415 QVFR Clear (2): 174606	
<b>Amount of material sampled:</b> 1 lit		<b>Density (g/L):</b> 1.02 – 1.21	
<b>Solid content (vol %):</b> QVFR Clear (1): 51% QVFR Clear (2): 44%		<b>Spreading rate (m<sup>2</sup>/L):</b> QVFR clear 1: 85 μ QVFR clear 2: 85 μ Total spreading rate 12 m <sup>2</sup> /lit per coat	
<b>Sample is taken from:</b> Production line <input type="checkbox"/> Stock / Storage <input checked="" type="checkbox"/> Miscellaneous <input type="checkbox"/> -where, specify:		<b>How was the product stored before sampling?</b> Indoor environment	
<b>If a sub-sample was collected from a larger material amount, describe how the sub-sample was taken:</b>		<b>Packing material:</b> Metal tin	
<b>Remarks:</b>			
<b>Confirmation:</b> I hereby confirm that the sample was selected, taken and packed in accordance with this protocol.			
<b>Date of sampling:</b> 15.02.2018		<b>Signature:</b> <i>Agnete Loeser</i>	