



**INSTITUT FÜR KORROSIONSSCHUTZ DRESDEN GMBH**  
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*Beratung - Schadensfallaufklärung - Qualitätssicherung - Forschung - Prüfung*

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## Untersuchungsbericht

### UB400/005/14

Orderer: GROFIT PLASTICS  
88825 M.P. EILLOT (ISRAEL)

Date of order: 06.05.2013

Date of delivery: 13.09.2013

Period of testing: 02.09.2013 - 30.10.2013

Order: Analysis of VCI film VCI2000 in accordance to the standard VW 50164 2013-06 of the Volkswagen AG Wolfsburg

Number of order: LA4/214/13/134095

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## 1 Conceptual Formulation

The conceptual formulation encloses the quantitative determination of the components, declared in the confidential full compositional disclosure of the orderer. Moreover the conformance of the material with the german guideline TRGS 615 had to be examined. For that purpose the total contents of nitrite and secondary amines in the material are determined quantitatively.

This procedure is performed in accordance to the standard VW 50164 2013-06 of the Volkswagen AG Wolfsburg.

The orderer delivered the following VCI film for testing:

- VCI film VCI 2000, delivery 2013-09-13
- Reference material: delivery 2013-05-06.

## 2 Methodical Information

***Quantitative determination of the components, declared in the confidential full compositional disclosure of the orderer***

The fatty acid octanoic acid (caprylic acid) in the film was determined by a coupling of gas chromatography and mass spectrometry (GC-MS) in a methanol-extract after esterification (mylester) according standard DIN EN ISO 12966-2 : 2011.

2,2',2"-nitrioltriethanol (triethanolamine) was determined quantitatively by cation chromatography (IKS procedure) after a triple ultrasonic extraction of the material with deionized water.

The compound N-lauroylsarcosine (CAS 97-78-9) was not detectable on IKS.

***Conformance of the material with the german guideline TRGS 615 (secondary amines and nitrite)***

The nitrite concentration in the VCI-film is determined quantitatively by anion chromatography (according to DIN EN ISO 10304-1:2009-07) after a triple ultrasonic extraction of the film with deionized water. An ion chromatograph Dionex ICS 5000 with gradient elution and cation-/anion suppression was used.

The concentration of secondary amines in the material is determined quantitatively by cation chromatography (IKS procedure) after a triple ultrasonic extraction of the material with deionized water and by gaschromatography / mass spectrometry.

### ***Comparability of corrosion protection VCI film and its reference material***

To verify the comparability of corrosion protection VCI film and its reference material for the corrosion protection tests the film thickness, ash content of the films and the chemical composition of the ash are determined. The amount of ash residue of the films is determined in accordance with DIN EN ISO 3451 at 600°C. The chemical composition of the ash residue is analyzed by EDS-spectroscopy.

### **3 Test results**

The following test results were determined for the sample material:

Parameter	Dimension	VCI film VCI 2000, delivery 2013-09-13
Total content of nitrite (calculated as $\text{NaNO}_2$ )	wt-% $\text{NaNO}_2$	< 0,01
<i>Total content of analyzed secondary amines:</i>		
diethanolamine	wt-%	< 0,0003
morpholine	wt-%	< 0,005
dicyclohexylamine	wt-%	< 0,01
piperazine	wt-%	< 0,01
<i>Other components:</i>		
2,2',2''-nitrioltriethanol (triethanolamine) CAS 102-71-6	wt-%	0,011
octanoic acid CAS 124-07-2	wt-%	0,049
N-lauroylsarcosine CAS 97-78-9	wt-%	not detectable

The figures < 0,005 and < 0,01 mean, that the content of the component is smaller than the minimum determination value of the analytical method.

The film thickness, the amount of ash residue and the chemical composition of the ash of the analyzed VCI film and its reference material corresponds with each other in predefined limits.

#### **4 Conclusion**

The analyzed VCI material

**Grofit VCI film VCI 2000, delivery 2013-09-13**

contains:

1. No secondary amines (TRGS 615)
2. A nitrite concentration (calculated as  $\text{NaNO}_2$ ) smaller than 1,0 Ma-% (TRGS 615)
3. The analyzed chemical composition (components) of the assayed VCI-film corresponds with the declared formulation of the confidential full compositional disclosure of the orderer.

**Therefore the sample material Grofit VCI film VCI 2000, delivery 2013-09-13, complies the requirements of the standard VW 50164 2013-06 of the Volkswagen AG Wolfsburg.**

**The assayed VCI material complies also the requirements of the German TRGS 615 (2007).**