INSTITUT FÜR KORROSIONSSCHUTZ DRESDEN GMBH

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Test Report

PB200/091/18

Client:	VCI active pack Europe Plç Diputació 3 43550 ULLDECONA-TARRAGONA SPAIN
Date of order:	2017-11-16
Receipt of samples:	2017-11-20 and 2018-07-27
Processing time:	2017-11-29 to 2018-10-11
Order:	Testing of "Control Pack Systems Spain ControlOX VCI film" 80 µm as per VW requirements according to VW50614
Laboratory job No.:	LA2/276/17/172127, LA4/466/17/172127, LA2/93/18/172127, LA2/140/18/172127, LA2/222/18/172127
Pages:	6
Responsible examiner:	Dr. Frank Hoffmann
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Dresden, 2018-10-12

created: Dr. F. Hoffmann	checked: Dr. S. Friedrich	released: Dr. S. Friedrich
Sign:	Sign:	Sign:
Date: 2018-10-12	Date: 2018-10-12	Date: 2018-10-12

1 Task

The corrosion protective effect of the corrosion protection material “Control Pack Systems Spain ControlOX VCI film” 80 µm on steel and iron materials has to be determined according to the Volkswagen AG Standard VW50164, issue 2013-06, “Procedures for review and approval of VCI packaging materials” for the purpose of certification.

2 Supplied Materials

2.1 Corrosion protection material “Control Pack Systems Spain ControlOX VCI film” 80 µm (date of delivery: 2017-11-20)

2.2 VCI-free „Control Pack Systems Spain ControlOX reference film“ 80 µm (date of delivery: 2018-07-27)

3 Test execution

The following tests were performed with the corrosion protection material mentioned under 2.1:

- K test (distance check, flask test)
- KDW test (corrosion protection effect in direct contact, in crevices and over distance, jar test)
- DISU test (part of the protective effect which is solely associated with the emission of VCI components)
- KON test (corrosion protection effect in direct contact)
- DIS test (corrosion protection effect over distance)

The material mentioned under point 2.2 was used as reference.
The cylindrical specimen for the K-test were made of unalloyed, rimmed construction steel S235JRN2, DIN EN 10025, material number 1.0038, date of delivery: 2003-05-30, ∅ = 16 mm, h = 10 mm. For the other tests sheets (Q-Panels of Q-Lab Deutschland GmbH) made of mild steel DC 03 material-no. 1.0347, charge no. 010913258 were used.

Utilized accredited testing instruments (TI):
K test was done in the universal oven UFE500 of Memmert GmbH + Co. KG (TI-card-No. PMK 200-11).
For the determination of the refractive index of the glycerine-water-mixture during the K-Tests the ABBE-Refractometers ABBE REF 1 (TI-card-No. PMK 200-21) of PCE Deutschland GmbH was used.
KDW test was done in the universal oven UF110plus of Memmert GmbH + Co. KG (TI-card-No. PMK 200-17).
DIS, KON and DISU tests were performed in the climate chambers VC³4034 (KK6,
TI-card-No. PMK 200-3.6) and VC³7034 (KK5, TI-card-No. PMK 200-3.5) of Voetsch Industrietechnik GmbH.

4 Standards and regulations

Table 1: used accredited standards and regulations

Standard / regulation	Issue
VW50164	2013-06

5 Requirements

According to VW50164 the VCI packaging materials must pass the K, KDW, KON, DIS, and DISU tests at least with Level 2 (that means moderate or good rating), see Table 2 and Table 3.

Table 2: K test evaluation

Level	Rating
0	No corrosion protection effect
1	Slight corrosion protection effect
2	Moderate corrosion protection effect
3	Good corrosion protection effect

Table 3: Levels for evaluation the VCI corrosion protection effect (KDW, KON, DIS, DISU test)

Level	Protection factor SF for VCI film	Protection factor SF for VCI paper	Rating
0	≤3,0	≤3,0	negligible
1	≤3,5	≤4,0	weak
2	≤4,5	≤5,0	moderate
3	>4,5	>5,0	good, packaging material is suitable for overseas transport

6 Test results Corrosion protection effect ControlOX VCI film 80 µm

6.1 K test

Test duration: 2017-11-30 to 2017-12-01
Evaluation: VCI-film grades: 2;3;2;2 Reference grades: 0;0
Rating: **moderate anticorrosive effect (Level 2)**

6.2 KDW test

Test duration: 2018-08-30 to 2018-09-19

KDW Contact:

Number of cycles until the reference samples failed:
Ref: 3 RN[C3]: (1;1)

Number of cycles without failure of VCI samples:
VCI: 18 at least RN[C18]: (0;0;0;0)

Protection factor: SF ≥ 18:3
SF ≥ 6
Rating: **good (Level 3)**

C = Cycle, RN = Rust Grade (Metal sheet front side; Metal sheet back side), SF = Protection Factor

KDW Distance:

Number of cycles until the reference samples failed:
Ref: 2 RN[C2]: (2;2;0;1)

Number of cycles without failure of VCI samples:
VCI: 17 at least RN[C17]: (0;1;1;1;0;0;0;1)

Protection factor: SF ≥ 17:2
SF ≥ 8.5
Rating: **good (Level 3)**

KDW Crevice:

Number of cycles until the reference samples failed:
Ref: 2 RN[C2]: (2;2;0;2)

Number of cycles without failure of VCI samples:
VCI: 16 at least RN[C16]: (1;1;0;1;0;0;0;1)

Protection factor: SF ≥ 16:2
SF ≥ 8
Rating: **good (Level 3)**

6.3 KON test

Test duration: 2018-09-12 to 2018-10-01

Number of cycles until the reference samples failed:
Ref: 1 RN[C1]: (2;2)

Number of cycles without failure of VCI samples:
VCI: 17 at least RN[C17]: (0;2), (2;0), (2;1)

Protection factor: SF ≥ 17:1
SF ≥ 17
Rating: **good (Level 3)**

6.4 DIS test

Test duration: 2018-09-12 to 2018-10-01

Number of cycles until the reference samples failed:
Ref: 1 RN[C1]: (2;2)

Number of cycles without failure of VCI samples:
VCI: 17 RN[C17]: (1;1), (1;1), (1;0)

Protection factor: SF ≥ 17:1
SF ≥ 17
Rating: **good (Level 3)**

6.5 DISU test

Test duration: 2018-09-12 to 2018-10-01

Number of cycles until the reference samples failed:
Ref: 3 RN[C3]: (0;2); RN[C2] (2;2)

Number of cycles without failure of VCI samples:
VCI: 17 RN[C17]: (1;0), (2;2), (0;0)

Protection factor: SF ≥ 17:3
SF ≥ 5.67
Rating: **good (Level 3)**

7 Conclusion

Test	**K test**	**KON test**	**DIS test**	**DISU test**	**KDW test**	**Overall score***
Rating	moderate	good	good	good	Contact: good Distance: good Crevice: good	2.1

* Average of all test scores, 2 = good, 3 = moderate, 4 = weak, 5 = negligible

The corrosion protection effect of the corrosion protection VCI film “Control Pack Systems Spain ControlOX VCI film” 80 µm (date of delivery 2017-11-20) on steel and iron materials is “moderate to good” (overall score 2.1) according to the tests K, KDW, KON, DIS and DISU in compliance with the Volkswagen AG Standard VW50164, issue 2013-06, “Procedures for review and approval of VCI packaging materials”. A certificate can be issued.