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**TEST REPORT
for
MODIFIED ASTM D4541**

Rendered to:

Seves Glass Block Inc.

PRODUCT:

Glass Block with TGIC Free Polyurethane Powder Coat

Report No.: SGBI010820-22(R0)
Test Date(s): 03/31/2020 , 04/17/2020
Report Date: 04/29/2020
14 pages

Test Report

SGBI010820-22(R0)

04/29/2020

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TEST REPORT

Rendered to:

Seves Glass Block Inc.
10576 Broadview Road
Broadview Heights, OH 44147

Report No.: SGBI010820-22(R0)
Test Date: 03/31/2020 , 04/17/2020
Report Date: 04/29/2020

1.0 General Information

1.1 Product

Glass Block with TGIC Free Polyurethane Powder Coat

1.2 Project Summary

ICC NTA, LLC was contracted by Seves Glass Block Inc. to evaluate their *Glass Block with TGIC Free Polyurethane Powder Coat* in accordance with modified procedures in ASTM D4541. Results obtained are tested values and were secured by using the designated test method. Testing was conducted at ICC NTA's facility in Nappanee, IN.

1.3 Product Description

The product tested was a TGIC Free Polyurethane Powder Coat adhered to a glass block face. The product is described as a decorative glass for indoor and outdoor use. The sample material was received in good condition on February 24, 2020 and can be seen in Photo No. 1.

1.4 Qualifications

ICC NTA in Nappanee, IN has demonstrated compliance with ISO/IEC 17025 and is consequently accredited as a Testing Laboratory.

1.5 Product Sampling

No evidence was provided that a third-party agency sampled materials for the testing reported herein. All test specimens were supplied by Seves Glass Block Inc.

1.6 Witnessing

No representatives of Seves Glass Block Inc. were present for testing reported herein.

1.7 Conditions of Testing

Unless otherwise indicated, all testing reported herein was conducted in a laboratory set to maintain temperature in the range of $73.4 \pm 3.6^{\circ}\text{F}$ and humidity in the range of $50 \pm 5\% \text{RH}$. All test specimen materials were stored in the laboratory environment for no less than 40 hours prior to testing.

2.0 Referenced Standards

ASTM D4541-09, Standard Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM C297/C297M-16, Standard Test Methods for Flatwise Tensile Strength of Sandwich Constructions

ASTM D3359-09, Standard Test Methods for Measuring Adhesion by Tape Test

3.0 ASTM D4541 Modified for Laboratory Testing

3.1 General

ASTM D4541 evaluates the pull-off strength of a coating system commonly applied to metal substrates. The test determines the greatest perpendicular force that a surface can bear before failure of the substrate, coating, or adhesive. This test method applies force in tension to the surface of the substrate as compared to the shear stress applied by other methods such as scratch or knife adhesion.

3.2 Test Specimens

Seven of the twelve specimens received were selected by the client to be tested. Each specimen was cleaned with acetone to remove any impurities on the surface of the powder coat. Method A and Method B were used when prepping the surface for the steel mounting blocks. Method A consisted of leaving the surface intact as manufactured and adhering the steel mounting block to the surface. These specimens are seen in Photo No. 2 with a white dot. Method B used a cutter blade with 6 teeth, per ASTM D3359, to carefully score the surface of the powder coating in a lattice pattern as shown in Photo No. 3. To adhere the mounting blocks to the surface of the specimens, EPII HT Grey epoxy (used in field testing) was applied. The epoxy was allowed to cure for at least 24 hours, per the manufacturer's recommendation, before testing.

3.3 Test Setup and Procedure

Each test was conducted in accordance with modified procedures in ASTM D4541, as outlined herein. Steel mounting blocks were applied to the surface in the two methods outlined above. The test setup consisted of a universal testing machine (UTM) with a self-aligning fixture, specified in ASTM C297, to apply a tensile stress to the specimen's surface through steel mounting blocks. A force rate was applied to the specimen not to exceed 150psi/s to promote failure in less than 100s. The test setup can be seen in photo No. 5. The test area was then evaluated for cohesion and adhesion properties of the powder coat.

Deviations from the standard include: UTM used for testing instead of a field apparatus. Due to convex curvature of the glass, one test was conducted per specimen on the flattest spot. A multi tooth cutter per ASTM D3359 was used to promote failure in the powder coated layer.

3.4 Test Results

Results for each of the specimens are listed below. Pull-off strength was calculated by dividing the ultimate load by the bond area. More detailed data from testing can be seen in Appendix B. An example of a specimen after failure can be seen in Photos No. 8 and 9.

Spec. No.	Ultimate Load (lbf)	Elapsed Time (sec)	Failure Mode	Bond Area (in ²)	% Epoxy Failure	% Powder Coat Failure	Pull-Off Strength (psi)	Notes
120292	268	3.24	AFF	0.98	75%	25%	272	25% powder coating removed
120293	318	4.14	AFF	0.96	65%	35%	332	35% powder coating removed
120294	314	3.92	AFF	1.00	100%	0%	315	100% adhesive failure
120295	231	2.12	AFF	0.99	70%	30%	233	30% powder coating removed
120296	298	3.04	AFF	0.99	75%	25%	300	25% powder coating removed
120348*	392	3.82	AFF	0.96	100%	0%	408	100% adhesive failure
120349*	424	8.04	AFF	0.98	100%	0%	433	100% adhesive failure

*Specimens surface was left intact with no scoring of powder coat

3.5 Summary and Conclusions

ICC NTA, LLC was contracted by Seves Glass Block Inc. to evaluate their Glass Block with TGIC Free Polyurethane Powder Coating in accordance with modified procedures in ASTM D4541. There was no failure of the powder coat for the specimens that were tested without altering the surface of the substrate. When the surface of the specimen was scored, some failure could be seen in the powder coated layer. A summary of the results can be found below.

Standard, Section	Variable	Avg Pull-off Strength (psi)
D4541-09 Pull-Off Strength of Coatings	Unscored Surface	421*
	Scored Surface	291

*Failure mode was 100% adhesive failure of epoxy with no failure occurring in powder coat

4.0 Closing Statement

This report contains only findings and results arrived at after employing the specific test procedures listed herein. It does not constitute a recommendation for, endorsement of, or certification of the product or material tested. ICC NTA, LLC makes no warranty, expressed or implied, except that the test has been performed, and a report prepared, based upon the specimen specified by the client. Extrapolation of data, from the test data provided herein, to the batch or lot from which the specimens were obtained may not correlate and should be interpreted with extreme caution. ICC NTA assumes no responsibility for variations in quality, composition, appearance, performance, or other features of similar materials produced by the client, other persons, or under conditions over which ICC NTA has no control. ICC NTA has issued this report for the exclusive use of the client to whom it is addressed. Any use or duplication of this report shall not be made without their consent. This report shall only be reproduced in its entirety.

For ICC NTA, LLC:

Cody Meyer
Test Engineer

04/29/2020

Brad Wear
Senior Test Engineer

04/29/2020

Appendix A – Photographs



**Photo No. 1
Materials Received**



**Photo No. 2
Materials Selected for Testing: Black Dot-Scored Surface, White Dot-Unscored Surface, No Dot: Not Tested**



Photo No. 3
Method A: Un-Scored Surface After Cleaning



Photo No. 4
Method B: Scored Surface After Cleaning

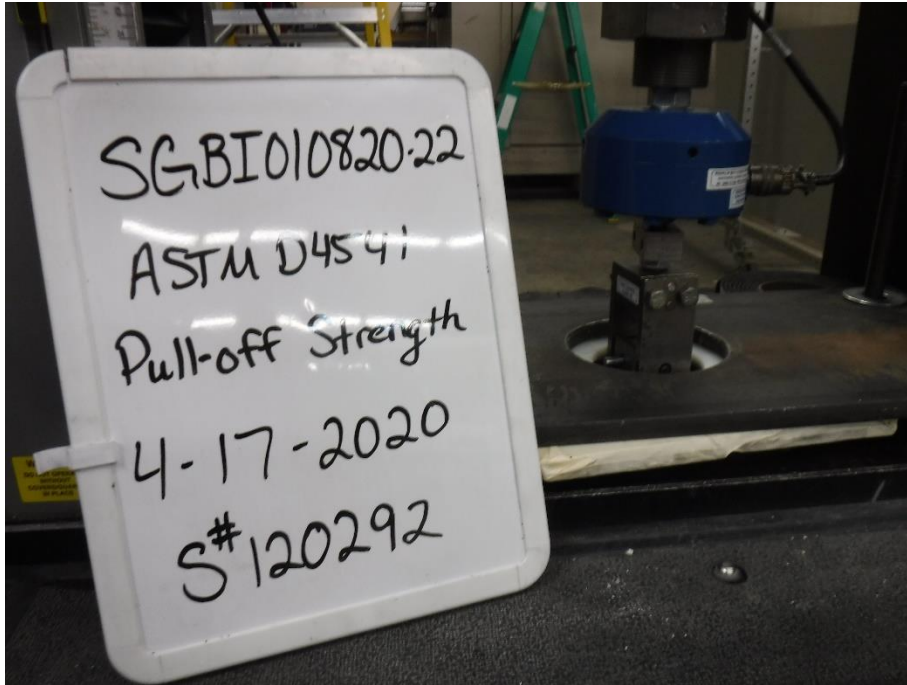


Photo No. 5
Test Setup: Specimen Number 120292



Photo No. 6
Close-Up of Test Setup Loading Fixture



Photo No. 7
Steel Mounting Block Adhered to Surface

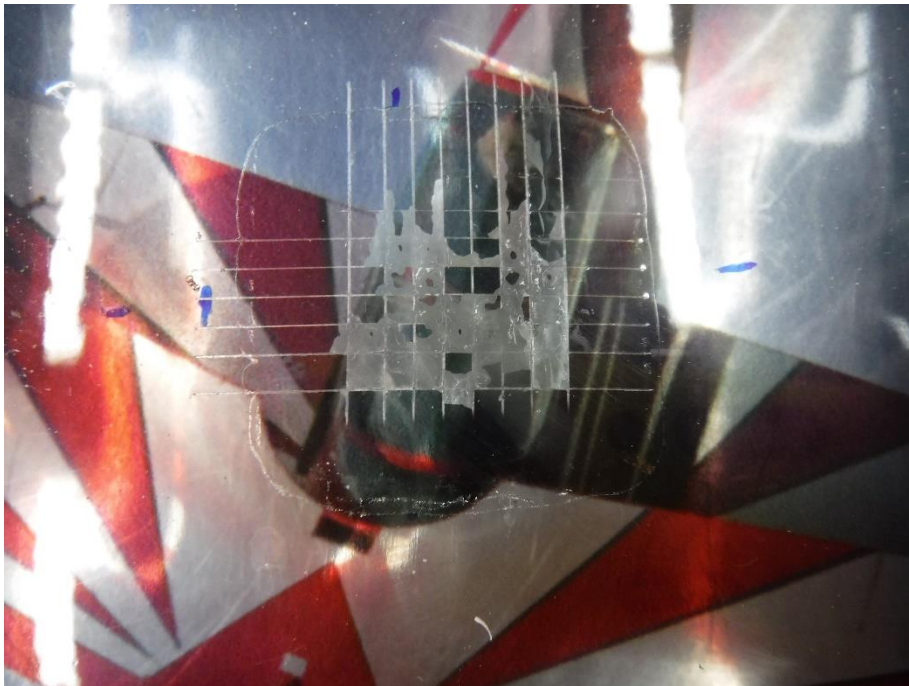


Photo No. 8
Coating Removed from Surface



Photo No. 9
Mounting Block and Specimen After Pull Test

Appendix B - Data

SGBI010820-22, ASTM D4541 Pull-Off Strength of Coatings Modified for Glass
Out 1

ICC NTA

SUMMARY DATA ASTM D4541-09 Pull-Off Strength of Coatings: Modified for Glass Substrates

General:

Client: Seves Glass Block Inc.
Job Number: SGBI010820-22
Test Location: ICC NTA
Nappanee, Indiana

Date Received: 2/24/2020
Construction Date: 4/16/2020
Constructed By: Stephanie Truex

Procedure Modifications: For this test a Universal Testing Machine (UTM) was used with a self-aligning fixture specified in ASTM C297 to apply the load instead of a portable pull-off adhesion tester.
Due to the convex curvature of the glass face one test will be conducted on the flattest spot for each of the 5 specimens tested.
A multi-tooth cutter blade was used to score the test area in accordance with ASTM D3359.

Product Description:

Manufacturer: Seves Glass Block
Trade Name: Glass Block
Material Description: Glass Block with Powder Coating
Coating Description: TGIC Free Polyurethane Powder Coating
Nominal Dimensions: 6-in. wide x 6-in. long x 0.5-in. thick
Construction Description: Blocks were cleaned and scored with a multi-tooth cutter blade in accordance with ASTM D3359.

Ambient Conditions:

Ambient Temp.: 72.6° F
Ambient R.H.: 49.7% R.H.
Sensor Asset No.: 00577

Apparatus:

Asset No.
Load Frame: 00140
Load Cell: 02091
Load Fixture: 00666
Support Fixture: 00847

Test Data:

Performed By: Stephanie Truex
Witnessed By: Cody Meyer
Test Date: 4/17/2020
Load Rate: 75 psi/s
Adhesive: EPII HT Grey From Resin Lab PKG Date: 12/27/19, Exp. Date: 12/27/20

Test Details and Results:

Spec. No.	Ultimate Load (lbf)	Elapsed Time (sec)	Failure Mode	Bond Area (in ²)	% Epoxy Failure	% Powder Coat Failure	Pull-Off Strength (psi)	Notes
120292	268.45	3.24	AFF	0.98	75%	25%	272.80	25% powder coating removed
120293	318.79	4.14	AFF	0.96	65%	35%	332.88	35% powder coating removed
120294	314.05	3.92	AFF	1.00	100%	0%	315.63	100% adhesive failure
120295	231.47	2.12	AFF	0.99	70%	30%	233.22	30% powder coating removed
120296	298.66	3.04	AFF	0.99	75%	25%	300.16	25% powder coating removed
Maximum	319	4	--	1.00	100%	35%	333	
Minimum	231	2	--	0.96	65%	0%	233	
Average	286	3	--	0.98	77%	23%	291	
Std. Dev.	36	1	--	0	--	--	39	
COV (%)	12.72	24.24	--	1.61	--	--	13.44	

*Pull-Off Strength is calculated by dividing the ultimate Load by the bond area.

Material Coating	Average Pull-off Strength (psi)
TGIC Free Polyurethane Powder Coating	291

This summary contains only data arrived at after employing the specific test procedures listed herein. This summary data might not include all reporting requirements of the test standard. The data herein does not constitute a recommendation for, endorsement of, or certification of the product or material tested. ICC NTA makes no warranty, expressed or implied, except that the test has been performed, and data prepared, based upon the specimen furnished by the client. Extrapolation of data, from the test data provided herein, to the batch or lot from which the specimens were obtained may not correlate and should be interpreted with extreme caution. ICC NTA assumes no responsibility for variations in quality, composition, appearance, performance, or other features of similar materials produced by the client, other persons, or under conditions over which ICC NTA has no control. ICC NTA has issued this data summary for the exclusive use of the client to whom it is addressed. Any use or duplication of this summary shall not be made without their consent. This summary shall only be reproduced in its entirety.

SUMMARY DATA
ASTM D4541-09 Pull-Off Strength of Coatings:
Modified for Glass Substrates

General:

Client: Seves Glass Block Inc.
Job Number: SGBI010820-22
Test Location: *ICC NTA*
Nappanee, Indiana

Date Received: 2/24/2020
Construction Date: 3/30/2020
Constructed By: Stephanie Truex

Procedure Modifications: For this test a Universal Testing Machine (UTM) was used with a self-aligning fixture specified in ASTM C297 to apply the load instead of a portable pull-off adhesion tester.
Due to the convex curvature of the glass face one test will be conducted on the flattest spot for each of the 2 specimens tested.

Product Description:

Manufacturer: Seves Glass Block
Trade Name: Glass Block
Material Description: Glass Block with Powder Coating
Coating Description: TGIC Free Polyurethane Powder Coating
Nominal Dimensions: 6-in. wide x 6-in. long x 0.5-in. thick
Construction Description: Blocks were cleaned and left unscored for testing.

Ambient Conditions:

Ambient Temp.: 73.5° F
Ambient R.H.: 48.8% R.H.
Sensor Asset No.: 00577

Apparatus:

Asset No.
Load Frame: 00140
Load Cell: 02091
Load Fixture: 00666
Support Fixture: 00847

Test Data:

Performed By: Melissa Johnson
Witnessed By: Cody Meyer
Test Date: 3/31/2020
Load Rate: 75 psi/s
Adhesive: EPII HT Grey From Resin Lab PKG Date: 12/27/19, Exp. Date: 12/27/20

Test Details and Results:

Spec. No.	Ultimate Load (lbf)	Elapsed Time (sec)	Failure Mode	Bond Area (in ²)	% Epoxy Failure	% Powder Coat Failure	Pull-Off Strength* (psi)	Notes
120348	392.62	3.82	AFF	0.96	100%	0%	408.75	100% adhesive failure
120349	424.87	8.04	AFF	0.98	100%	0%	433.74	100% adhesive failure
Maximum	425	8	--	0.98	100%	0%	434	
Minimum	393	4	--	0.96	100%	0%	409	
Average	409	6	--	0.97	100%	0%	421	
Std. Dev.	23	3	--	0	--	--	18	
COV (%)	5.58	50.28	--	1.39	--	--	4.20	

*Pull-Off Strength is calculated by dividing the ultimate Load by the bond area.

Material Coating	Average Pull-off Strength (psi)
TGIC Free Polyurethane Powder Coating	421

This summary contains only data arrived at after employing the specific test procedures listed herein. This summary data might not include all reporting requirements of the test standard. The data herein does not constitute a recommendation for, endorsement of, or certification of the product or material tested. ICC NTA makes no warranty, expressed or implied, except that the test has been performed, and data prepared, based upon the specimen furnished by the client. Extrapolation of data, from the test data provided herein, to the batch or lot from which the specimens were obtained may not correlate and should be interpreted with extreme caution. ICC NTA assumes no responsibility for variations in quality, composition, appearance, performance, or other features of similar materials produced by the client, other persons, or under conditions over which ICC NTA has no control. ICC NTA has issued this data summary for the exclusive use of the client to whom it is addressed. Any use or duplication of this summary shall not be made without their consent. This summary shall only be reproduced in its entirety.

Appendix C - Revision Log

<u>Rev. #</u>	<u>Date</u>	<u>Page(s)</u>	<u>Revision(s)</u>
0	04/29/2020	N/A	Original report issue