

July 16, 2024

**Subject Report of ASTM C881 (AASHTO M235) Testing**

**Product: SealBoss 4040 LV**

**Lab No.: 24-1090**

To Whom it May Concern:

SGS Testing Engineering & Consulting Services, Inc. (SGS TEC Services) is an AASHTO R18, ANS/IEC/ISO 17025:2017, and Army Corps of Engineers accredited laboratory. SGS TEC Services is pleased to present this report of testing on the subject product submitted to our laboratory in June of 2024. Testing was performed in accordance with the terms and conditions of our Service Agreement. These test results pertain only to the sample tested. The purpose of the testing was to evaluate the submitted product in accordance with the Standards referenced below:

The purpose of the testing was to evaluate the subject submitted product in accordance with ASTM C881-20 (AASHTO M235-13) Standard Specification for Epoxy-Resin Base Bonding Systems for Concrete. It is our understanding that the product is to be designated as Grade 1, Class C, Type IV epoxy-resin system. The epoxy was tested for compliance to the requirements listed in Table 1 of ASTM C881 (AASHTO M235). Information pertaining to the mixing procedures and product designation are reported in Table 1. Ambient conditions and curing procedures are reported in Table 2. Summary test results are reported in Table 3 & 4. Test results for each method are attached to this report. The testing was performed in accordance with the following test methods:

- ASTM C881-20 *Standard Specification for Epoxy-Resin Bonding Systems for Concrete*
- AASHTO M235-13 *Standard Specification for Epoxy-Resin Bonding Systems for Concrete*
- ASTM C882-20 *Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear*
- ASTM D570-18 *Standard Test Method for Water Absorption of Plastics*
- ASTM D638-22 *Standard Specification for Tensile Properties of Plastics*
- ASTM D648-18 *Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position*
- ASTM D695-15 *Standard Test Methods for Compressive Properties of Rigid Plastics*
- ASTM D2393-86 *Standard Test Method for Viscosity of Epoxy Resins and Related Components*
- ASTM D2566-86 *Linear Shrinkage of Cured Thermosetting Casting Resins During Cure*

Classification of epoxy-resin bonding systems consists of a Type, Grade, and Class. The Type distinguishes the applications for which the epoxy-resin system may be used.

- Type I For use in non-load bearing application for bonding hardened concrete to hardened concrete and other materials, and as a binder in epoxy mortars or epoxy concretes.
- Type II For use in non-load bearing applications for bonding freshly mixed concrete to hardened concrete.
- Type III For use in bonding skid-resistant materials to hardened concrete and as a binder in epoxy mortars or epoxy concretes used on traffic bearing surfaces (or surfaces subject to thermal or mechanical movements).
- Type IV For use in load bearing applications for bonding hardened concrete to hardened concrete and other materials and as a binder for epoxy mortars and concretes.
- Type V For use in load bearing applications for bonding freshly mixed concrete to hardened concrete.
- Type VI For bonding and sealing segmental precast elements, as in segment-by-segment erection, and for span-by-span erection when temporary post tensioning is applied.
- Type VII For use as a non-stress carrying sealer for segmental precast elements when temporary post tensioning is not applied as in span-by-span erection.

Grade systems are defined according to the flow characteristics of the epoxy-resin system.

- Grade 1 Low Viscosity
- Grade 2 Medium Viscosity
- Grade 3 Non-Sagging Consistency

Classes A, B, and C are defined for Types I through V, and Classes D, E, and F are defined for Types VI and VII, in accordance with the range of temperatures for which they are suitable.

- Class A For use below 40 °F [4 °C] the lowest allowable temperature to be defined by the manufacturer of the product.
- Class B For use between 40 and 60 °F [4 and 15 °C]
- Class C For use above 60 °F [15 °C] the highest allowable temperature to be defined by the manufacturer of the product.
- Class D For use between 40 and 65 °F [4 and 18 °C] for Type VI and VII applications.
- Class E For use between 60 and 80 °F [15 and 30 °C] for Type VI and VII applications.
- Class F For use above 75 °F [25 °C] for Type VI and VII applications, the highest allowable temperature to be defined by the manufacturer of the product.

### **ASTM C881 - Viscosity and Gel Time**

All materials were weighed to the nearest 0.1 gram. A timer was started as the components were combined. Once thoroughly mixed, 60 grams of the prepared epoxy was transferred to an unwaxed cup and probed every two minutes with a wooden tongue depressor until gelation occurred. Mixing time was added to calculate gel time. The Brookfield DV-E Viscometer was leveled prior to testing, and the subject product was transferred to a 500 mL plastic cup capable of accommodating the viscometer spindle. The spindle was submerged in the material up to the reference mark and adjusted to the highest spindle speed capable of achieving a reading between 20% and 80% of torque. Viscosity was recorded in centipoise and is reported with spindle size, and motor speed.

### **ASTM C882 – Shear Bond Strength**

The mixed material was applied to the surface of two hardened mortar sections cut at a 30-degree angle. The hardened sections were pressed together and allowed to cure at the designated temperature until the time of testing. The specimens were capped with sulfur in accordance with ASTM C617 and loaded at a rate of  $35 \pm 7$  psi/sec. in accordance with ASTM C39 until failure. The peak load and failure type were

### **ASTM D570 – Water Absorption**

2.00" x 0.25" cylindrical specimens were cast and cured at respective temperature until the time of testing. The initial weight and dimensions of the specimens was determined prior to immersion in the solutions. The specimens were immersed in water for 24 hours at standard laboratory temperature. The specimens were removed from the water, dried, and final weight and volume determinations recorded.

### **ASTM D638 - Tensile Properties**

Type I specimens were cast by client and shipped to SGS TEC for final curing at respective temperature until the time of testing. The rate of testing was 0.2 in./min of crosshead displacement. Elongation was determined using an extensometer with a 2.00" gage length.

### **ASTM D648 – Deflection Temperature under Load**

5.00" x 0.50" x 0.50" specimens were cast and cured at respective temperature until the time of testing. Prior to testing, the width and depth of each specimen was measured three times using a digital micrometer. The average width and depth were used to calculate a total applied load equal to a fiber stress of 264 psi. Specimens were loaded edgewise into the testing apparatus, and center point loaded using a span length of 4". The testing apparatus was immersed in a bath of Precision B+ paraffin oil at room temperature and the calculated load was applied. The deflection measurement gage was adjusted to zero five minutes after the load was applied, and the bath was heated at a rate of  $2.0 \pm 0.2^\circ\text{C}/\text{min}$ . Temperature was recorded when each specimen deflected 0.01".

### **ASTM D695 - Compressive Properties**

1.00" x 2.00" cylindrical specimens were cast and cured at respective temperature until the time of testing. The rate of testing was 0.05 in./min of crosshead displacement.

**Table 1 – Product Information & Mix Proportions**

<b>Product Name</b>	<b>SealBoss 4040 LV</b>
<b>Lot # A   Exp Date</b>	<b>8826   NA</b>
<b>Lot # B   Exp Date</b>	<b>8728   NA</b>
<b>Grade Designation</b>	<b>1</b>
<b>Class Designation</b>	<b>C</b>
<b>Type Designation</b>	<b>IV</b>
<b>Components</b>	<b>2 Component</b>
<b>Part A (g)</b>	<b>100</b>
<b>Part B (g)</b>	<b>43</b>
<b>Mixing Time</b>	<b>3 minutes</b>
<b>Mixer Type</b>	<b>Hand</b>

**Table 2 – Mixing & Cure Conditions**

<b>Test Method</b>	<b>Conditioning and Mixing Temperature of Epoxy (± 2°F)</b>	<b>Curing Temperature of Epoxy (± 2°F)</b>
Gel Time	73°F	NA
Viscosity (Grade 1 & 2 only)	73°F	NA
Heat Deflection	73°F	73°F
Lineage Shrinkage	73°F	73°F
Water Absorption	73°F	73°F
Tensile Strength & Elongation*	73°F	60°F
Compressive Properties	73°F	60°F
Shear Bond – H   H	73°F	60°F

\*Note – Optional for Grade 3 bonding agents

**Table 3 – Plastic Properties**

<b>ASTM</b>	<b>Test Property</b>	<b>Age</b>	<b>73°F</b>	<b>ASTM C881</b>			
				<b>Type I</b>	<b>Type II</b>	<b>Type IV</b>	<b>Type V</b>
D2393	viscosity (Poise) - Grade 1	Plastic	<b>3.2</b>	20 (max)	20 (max)	20 (max)	20 (max)
C881	Gel Time <sup>1</sup> (min.)	Plastic	<b>11</b>	30 (min)	30 (min)	30 (min)	30 (min)

<sup>1</sup> The purchaser may specify a minimum gel time of 5 minutes for Types I and IV when automatic proportioning, mixing, and dispensing equipment are used.

**Table 4 – Hardened Properties**

ASTM	Test Property	Age	60°F	ASTM C881			
				Type I	Type II	Type IV	Type V
C882	Shear Bond Hardened to Hardened ( <i>psi</i> )	2 days	<b>1,540</b>	1,000 (min)	NA	1,000 (min)	NA
		14 days	<b>2,370</b>	1,500 (min)	NA	1,500 (min)	NA
D695	Compressive Yield Strength ( <i>psi</i> )	7 days	<b>12,500</b>	8,000 (min)	5,000 (min)	10,000 (min)	8,000 (min)
	Compressive Modulus ( <i>psi</i> )	7 days	<b>416,000</b>	150,000 (min)	90,000 (min)	200,000 (min)	150,000 (min)
D638	Tensile Strength ( <i>psi</i> )	7 days	<b>9,480</b>	5,000 (min)	2,000 (min)	7,000 (min)	6,000 (min)
	% Elongation	7 days	<b>2.1</b>	1.0 (min)	1.0 (min)	1.0 (min)	1.0 (min)
<b>Tests Conditioned and Cured at 75°F</b>							
D2566	Linear Shrinkage (%)	48 hrs	<b>0.0000</b>	0.005 (max)	0.005 (max)	0.005 (max)	0.005 (max)
D570	Water Absorption (%)	14 days	<b>0.2</b>	1% (max)	1% (max)	1% (max)	1% (max)
D648	Heat Deflection ( <i>°F</i> )	7 days	<b>147</b>	NA	NA	120° (min)	120° (min)

Summary

Based on the results of our testing to date the submitted product meets the following designations per ASTM C881/AASHTO M235:

Grade 1 | Class C | Type I, IV

We appreciate the opportunity to provide our services to you on this project. Please do not hesitate to contact us at your convenience if you have any questions about this report or if we may be of further assistance.

Sincerely,

SGS TESTING, ENGINEERING & CONSULTING SERVICES, INC.



Tom Dang  
 Project Manager



James G. McCants III  
 Laboratory Manager, Chemist

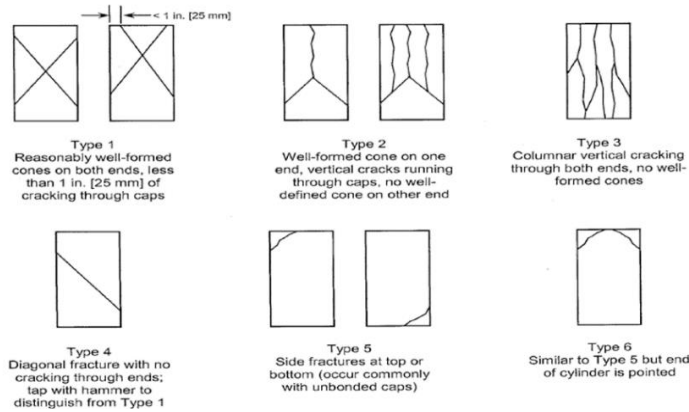
**Table 5 – ASTM D570 – Water Absorption**

Specimen ID	Diameter (in.)	Thickness (in.)	Initial Weight (g)	Weight After 24hr Soak (g)	Difference (g)	% Absorption
1	2.000	0.122	7.3774	7.3924	0.0150	0.20
2	2.000	0.129	7.1637	7.1785	0.0148	0.21
3	2.000	0.130	7.5953	7.6108	0.0155	0.20
<b>Average</b>						<b>0.20</b>

**Table 6 – ASTM D648 – Heat Deflection**

Specimen ID	Avg. Width (in.)	Avg. Depth (in.)	Total Load Applied (g) 264 psi	Heat Deflection Temperature (°F)
1	0.497	0.498	2458.4	147.0
2	0.498	0.500	2479.8	146.8
<b>Average</b>				<b>146.9</b>

**Figure 1 – Fracture Types per ASTM C39**



**Table 8 – ASTM C882 – Hardened to Hardened – Shear Bond Strength**

Curing Temp.	Age	Specimen ID	Dummy Diameter (in.)	Slant Height (in.)	Bond Area (in <sup>2</sup> )	Peak Load (lbf)	Bond Strength (psi)	Total Area of Voids	Fracture Type	Average (psi)
60°F	2 day	1	3.00	6.00	14.14	23,792	1,680	NA	3	1,540
		2	3.00	6.00	14.14	20,879	1,480	NA	3	
		3	3.00	6.00	14.14	20,816	1,470	NA	3	
	14 day	1	3.00	6.00	14.14	35,538	2,510	NA	3	2,370
		2	3.00	6.00	14.14	32,995	2,330	NA	3	
		3	3.00	6.00	14.14	32,081	2,270	NA	3	

**Table 9 – ASTM D695 – Compressive Strength**

Curing Temp.	Specimen ID	Diameter (in.)	Height (in)	Area (in <sup>2</sup> )	Yield Load (lbf.)	Peak Load (lbf.)	Compressive Yield Strength (psi)	Peak Stress (psi)	Compressive Modulus (psi)
60°F	1	1.00	2.00	0.7854	9,457	9,457	12,040	12,040	401,800
	2	1.00	2.00	0.7854	9,975	9,975	12,700	12,700	401,700
	3	1.00	2.00	0.7854	9,786	9,786	12,460	12,460	427,100
	4	1.00	2.00	0.7854	10,415	10,415	13,260	13,260	431,500
	5	1.00	2.00	0.7854	9,474	9,474	12,060	12,060	418,100
	<b>Average</b>							<b>12,500</b>	<b>12,500</b>

**Table 10 – ASTM D638 – Tensile Strength**

Curing Temp.	Specimen ID	Width (in.)	Thickness (in)	Area (in <sup>2</sup> )	Peak Load (lbf.)	Peak Stress (psi)	% Elongation
60°F	1	0.505	0.132	0.0667	593	8,890	2.0
	2	0.503	0.129	0.0646	617	9,540	1.9
	3	0.503	0.129	0.0646	622	9,640	1.8
	4	0.503	0.125	0.0628	602	9,580	2.3
	5	0.502	0.130	0.0654	636	9,730	2.7
	<b>Average</b>						<b>9,480</b>