

LAPITEC S.P.A

TEST REPORT

SCOPE OF WORK

ASTM C880 FLEXURAL PROPERTIES AND C1354 ANCHORAGE SYSTEMS OF LAPITEC SINTERED STONE PANELS

REPORT NUMBER

K1433.02-106-31 R2

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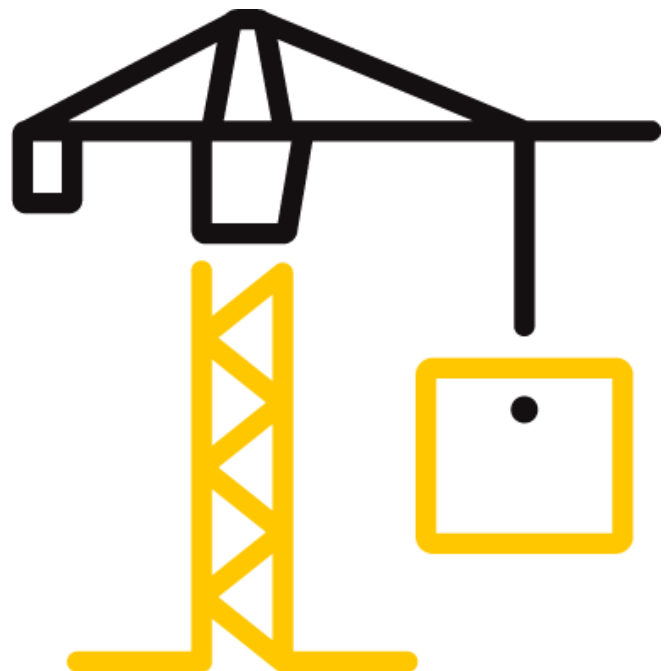
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REPORT ISSUED TO

LAPITEC S.P.A.

Via Bassanese, 6

VEDELAGO - TV, 31050

Italy

SECTION 1

SCOPE

Products: Sintered Stone Panels and Associated Anchorage Systems

Intertek Building & Construction (B&C) was contracted by Lapitec S.p.a. to evaluate the physical properties of their sintered stone panel products (designations: B. Assoluto Satin, Satin) in accordance with the test methods detailed in Section 2. Results obtained are tested values and were secured by using the designated test methods. Testing was conducted at the Intertek B&C test facility in York, Pennsylvania.

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory.

For INTERTEK B&C:

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SECTION 2

TEST METHODS

The specimens were evaluated in accordance with the following:

ASTM C880-2018, *Standard Test Method for Flexural Strength of Dimensional Stone*

ASTM C1354-2015, *Standard Test Method for Strength of Individual Stone Anchorages in Dimension Stone*

SECTION 3

MATERIAL SOURCE

The materials were provided by Lapitec S.p.a. The following was received on October 10, 2020:

- ASTM C880 - 20 Specimens - Bianco Assoluto Satin
- ASTM C1026 - 10 specimens for C880 - Bianco Assoluto Satin
- ASTM C880 - 20 Specimens - Grigio Piombo Satin

Anchorage testing materials were provided and received on January 28, 2020:

- ASTM C1354 - Lapitec K - Kerf Cut - 15 Specimens - Bianco Assoluto Satin
- ASTM C1354 - Lapitec V - Rivet System - 15 Specimens - Bianco Assoluto Satin
- ASTM C1354 - Lapitec H1 - Keil System - 15 Specimens - Bianco Assoluto Satin
- ASTM C1354 - Lapitec H2 - Fischer System - 15 Specimens - Bianco Assoluto Satin
- ASTM C1354 - Lapitec B - Bonded System - 15 Specimens - Bianco Assoluto Satin

Refer to the product description photos in Section 9. The material was tested as received. Representative materials will be retained by Intertek B&C for a minimum of four years from the test completion date.

SECTION 4

LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Cooper F. Kennedy	Intertek B&C
Scott D. Scallorn	Intertek B&C

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SECTION 5**TEST PROCEDURES**

All conditioning of test specimens and test conditions were at standard laboratory conditions unless otherwise reported. Refer to the test related photos in Section 9.

ASTM C880 - Flexural Strength Evaluation

The flexural strength evaluation was performed on a SATEC Universal Testing Machine (ICN: Y002011) equipped with a 50,000-lb load cell (ICN: 88507A) in accordance with the procedures detailed in ASTM C880. Two material types were tested in an oven-dry and wet condition, for both Bianco Assoluto Satin and Grigio Piombo Satin. Additionally, 10 specimens of Bianco Assoluto Satin were tested in wet condition after being weathered in a Freeze Thaw (ASTM C1026). Individual specimen dimensions were measured with a digital caliper (ICN: 01153). Per Section 8.1, dry condition specimens were oven-dried at 60°C for a period of 48 hours prior to cooling to room temperature and testing. Per Section 8.2, wet condition specimens were immersed in a 22 ±2°C water bath for a period of 48 hours prior to removal, wiping free of surface water and testing. Upon completion of preconditioning, the specimens were individually supported at a span of 12.5 in. on 1.25 in. diameter support blocks with compressive load applied at quarter points through two 1.25 in. diameter loading noses at a uniform stress rate of 600 psi/min until failure was observed. Ultimate failure load was recorded for calculation of flexural strength in accordance with Section 11.1. Results were averaged for each test series.

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ASTM C1354 - Shear (Gravity) Load Anchorage Evaluation

The compressive shear anchorage strength evaluation was performed on a SATEC 50 UD Universal Testing Machine (ICN: Y002011) employing a 5,000-lb load cell (ICN: 481380A) in accordance with the procedures detailed in ASTM C1354 employing restriction fixturing in general accordance with Fig. 4 and modified as required to simulate installation specific loading conditions. Specimen dimensions were verified with a 12-in. digital caliper (ICN: 01153). Anchorage mockup assemblies were evaluated in wet condition and compressive (gravity shear) load was applied parallel to the stone substrate facing, and directly to the bearing face of the bonded block portion of each anchorage mockup assembly, through a steel block loading fixture, or a steel clamping assembly, at a rate of 0.125 in/min until initial failure of the anchorage, stone or bonded fixture was observed. Load application was continued until the maximum load achieved post-initial failure of the anchorage assembly (ultimate failure) was observed. Anchorage System Load was calculated for each specimen in accordance with ASTM C1354, Section 10.2 (for both initial and post-failure peak load (ultimate system failure) conditions and averaged for each test series. Failure mode was documented for each test replicate.

Compressive (gravity shear) load was also applied in a parallel shear direction to the stone substrate but tangent to the typical installation of the anchorage setup. Test fixturing and test mechanics are in the same manner as those listed in the above paragraph.

Test Procedure - In accordance to the method detailed above, 4 anchorage systems were evaluated (Refer to the test related photos in Section 9):

- 6.0-in. riveted fin channel (Lapitec V)
- 14.0-in. bonded fin channel (Lapitec B)
- 2.4-inch anchorage track using imbedded nut (Lapitec H Keil)
- 2.4-inch anchorage track using imbedded bolt (Lapitec H Fischer)

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ASTM C1354 - Tensile Load Anchorage Evaluation

The tensile anchorage strength evaluation was performed on a SATEC 50 UD Universal Testing machine (ICN: Y002011) employing a 5,000-lb load cell (ICN: 481380A) in accordance with the procedures detailed in ASTM C1354 employing restriction fixturing in general accordance with Fig. 2 and modified as required to simulate installation specific loading conditions. Specimen dimensions were verified with a 12-in. digital caliper (ICN: 01153). Anchorage mockup assemblies were evaluated in wet condition and tension load was applied perpendicular to the anchorage mockup assembly, through a steel block loading fixture, or a steel clamping assembly, at a rate of 0.125 in/min until initial failure of the anchorage, stone or bonded fixture was observed. Load application was continued until the maximum load achieved post-initial failure of the anchorage assembly (ultimate failure) was observed. Anchorage System Load was calculated for each specimen in accordance with ASTM C1354, Section 10.2 (for both initial and post-failure peak load conditions) and averaged for each test series. Failure mode was documented for each test replicate.

Test Procedure - In accordance to the method detailed above, 4 anchorage systems were evaluated (Refer to the test related photos in Section 9):

- Lapitec V, a 6.0-in. riveted fin channel
- Lapitec B, a 14.0-in. bonded fin channel
- Lapitec H Keil, a 2.4-inch anchorage track using imbedded nut
- Lapitec H Fischer, a 2.4-inch anchorage track using imbedded bolt

ASTM C1354 - Kerf Anchorage Evaluation

The kerf anchorage strength evaluation was performed on a SATEC UTM (ICN: Y002011) equipped with a 5,000-lb load cell (ICN: 481380A) employing restriction fixturing as detailed in Fig. 1 (a = 4.1 in., L = 5 in.). Specimen dimensions and fixture placement were verified with a 12 in. x 0.001 in. digital caliper (ICN: INT01153) and steel rule. The kerf anchorage mockup substrates were evaluated in wet condition against the provided steel kerf anchorage clips with load applied in both inward and outward directions so as to represent both positive and negative wind load conditions. Load was applied through a 1.25 in. diameter loading nose across the width of each specimen at a rate of 200 lb_f/min. Ultimate Failure Load was captured for each specimen mockup and Anchorage System Load was both calculated in accordance with ASTM C1354, Section 10.1 and averaged for each test series. Failure mode was documented for each test replicate.

Test Procedure - In accordance to the method detailed above, 1 anchorage system was evaluated (Refer to the test related photos in Section 9):

- Lapitec K, a Kerf style anchorage system.

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SECTION 6

TEST SPECIMEN DESCRIPTIONS

ASTM TEST PROCEDURE	QUANTITY OF SPECIMENS	NOMINAL SPECIMEN DIMENSIONS	PANEL DESIGNATION	VISUAL CHARACTERISTICS
ASTM C880 - Flexural Strength	White: 40 Black: 20	100mm by 300mm by 30mm	Bianco Assoluto Satin & Grigio Piombo Satin	White Manufactured Stone & Black Manufactured Stone
ASTM C1354 - Anchorage Strength (Shear - Gravity and Lateral)	10 per system	305mm Sq	Bianco Assoluto Satin	White Manufactured Stone
ASTM C1354 - Anchorage Strength (Tensile)	5 specimens per system	305mm Sq	Bianco Assoluto Satin	White Manufactured Stone
ASTM C1354 - Kerf Anchorage Strength	10 per system	305mm Sq	Bianco Assoluto Satin	White Manufactured Stone

SECTION 7

TEST RESULTS

ASTM C880 - Control - Grigio Piombo Satin - Black

SPECIMEN NO.	WIDTH (in)	THICKNESS (in)	FAILURE LOAD (lbf)	FLEXURAL STRENGTH (psi)
Control-Dry-1	3.93	1.22	3,726.5	6,017.2
Control-Dry-2	3.93	1.20	3,852.6	6,380.7
Control-Dry-3	3.94	1.21	3,670.9	5,982.6
Control-Dry-4	3.93	1.22	3,413.1	5,479.2
Control-Dry-5	3.94	1.20	3,169.7	5,218.8
Control-Dry-6	3.94	1.19	3,858.9	6,456.4
Control-Dry-7	3.94	1.20	3,743.6	6,139.3
Control-Dry-8	3.94	1.20	3,561.1	5,870.7
Control-Dry-9	3.93	1.21	3,789.4	6,146.7
Control-Dry-10	3.93	1.20	3,873.7	6,413.9
Dry Control Series Mean			3,666.0	6,010.6
Standard Deviation			226.4	403.2

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ASTM C880 - Control - Grigio Piombo Satin - Black

SPECIMEN NO.	WIDTH (in)	THICKNESS (in)	FAILURE LOAD (lbf)	FLEXURAL STRENGTH (psi)
Control-Wet-1	3.93	1.20	2,981.1	4,901.3
Control-Wet-2	3.94	1.19	3,874.3	6,522.5
Control-Wet-3	3.94	1.19	3,634.6	6,123.7
Control-Wet-4	3.94	1.20	3,583.5	5,945.7
Control-Wet-5	3.94	1.21	3,416.0	5,566.5
Control-Wet-6	3.94	1.20	3,459.8	5,737.5
Control-Wet-7	3.93	1.22	3,756.6	6,054.3
Control-Wet-8	3.93	1.20	3,665.3	6,037.0
Control-Wet-9	3.94	1.21	3,415.3	5,546.9
Control-Wet-10	3.93	1.20	3,469.1	5,741.1
Wet Control Series Mean			3,525.6	5,817.7
Standard Deviation			244.5	434.5

ASTM C880 - Control - Bianco Assoluto Satin - White

SPECIMEN NO.	WIDTH (in)	THICKNESS (in)	FAILURE LOAD (lbf)	FLEXURAL STRENGTH (psi)
Control-Dry-1	3.93	1.21	2,446.6	3,982.3
Control-Dry-2	3.93	1.19	3,630.9	6,101.6
Control-Dry-3	3.93	1.21	3,412.3	5,556.9
Control-Dry-4	3.93	1.19	3,592.5	6,047.1
Control-Dry-5	3.94	1.21	3,497.1	5,678.3
Control-Dry-6	3.92	1.20	3,860.2	6,404.5
Control-Dry-7	3.93	1.20	3,165.8	5,229.7
Control-Dry-8	3.93	1.20	3,612.2	6,032.6
Control-Dry-9	3.92	1.20	3,040.4	5,048.3
Control-Dry-10	3.93	1.22	3,280.1	5,297.8
Dry Control Series Mean			3,353.8	5,537.9
Standard Deviation			400.4	699.6

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ASTM C880 - Control - Bianco Assoluto Satin - White

SPECIMEN NO.	WIDTH (in)	THICKNESS (in)	FAILURE LOAD (lbf)	FLEXURAL STRENGTH (psi)
Control-Wet-1	3.92	1.21	2970.0	4,879.4
Control-Wet-2	3.92	1.20	3252.4	5,387.8
Control-Wet-3	3.93	1.20	3691.6	6,071.8
Control-Wet-4	3.94	1.20	3498.7	5,733.4
Control-Wet-5	3.93	1.20	3130.7	5,233.8
Control-Wet-6	3.93	1.21	3193.2	5,242.7
Control-Wet-7	3.93	1.21	3443.0	5,580.6
Control-Wet-8	3.93	1.22	2980.0	4,813.1
Control-Wet-9	3.93	1.20	3914.7	6,449.5
Control-Wet-10	3.93	1.21	3306.5	5,418.3
Wet Control Series Mean			3338.1	5,481.0
Standard Deviation			303.7	505.4

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ASTM C880 - Freeze Thaw (ASTM C1026) - Bianco Assoluto Satin - White

SPECIMEN NO.	WIDTH (in)	THICKNESS (in)	FAILURE LOAD (lbf)	FLEXURAL STRENGTH (psi)
F/T-Wet-1	3.93	1.20	4,070.0	6,774.4
F/T-Wet-2	3.93	1.20	3,724.2	6,209.3
F/T-Wet-3	3.93	1.22	3,440.0	5,517.6
F/T-Wet-4	3.95	1.25	4,163.2	6,361.3
F/T-Wet-7	3.93	1.20	4,153.7	6,856.4
F/T-Wet-8	3.93	1.20	3,944.4	6,562.1
F/T-Wet-9	3.92	1.20	3,615.4	5,958.7
F/T-Wet-10	3.94	1.21	3,707.6	6,013.3
F/T-Wet-11	3.93	1.21	3,914.8	6,419.3
F/T-Wet-12	3.93	1.20	4,341.1	7,174.0
Freeze-Thaw (Wet) Series Mean			3,907.4	6,384.6
Standard Deviation			282.7	486.8

*** Excluded due to midspan deflectometer data capture error.

PERFORMANCE VARIATION FROM WET CONTROL SERIES MEAN	CONTROL VALUE	5,481.0
	% DIFFERENCE	+16.5%

**ASTM C1026 - Freeze-Thaw - Bianco Assoluto Satin - White
(C880 Flexural Supplemental Information)**

SPECIMEN NO.	SPECIMEN THICKNESS (in)	POST-EXPOSURE CONDITION			VISUAL EVALUATION
		CRACKING DETAILS			
		NEW CRACKS OBSERVED	PRE-EXISTING CRACKS		
			OBSERVED	PROPAGATION OBSERVED	
F/T-1	1.20	No	None	N/A	No cracking, breakage and/or mass loss observed
F/T-2	1.20	No	None	N/A	
F/T-3	1.22	No	None	N/A	
F/T-4	1.25	No	None	N/A	
F/T-5	1.20	No	None	N/A	
F/T-6	1.20	No	None	N/A	
F/T-7	1.20	No	None	N/A	
F/T-8	1.21	No	None	N/A	
F/T-9	1.21	No	None	N/A	
F/T-10	1.20	No	None	N/A	

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ASTM C1354 - Lapitec V Rivet System - Anchorage - Tensile Load Evaluation

SPECIMEN DETAILS	ULTIMATE	FAILURE MODE
SPECIMEN ID	FAILURE LOAD (lbf)	
Lapitec V Rivet - W - 1	416.2	Panel Fracture
Lapitec V Rivet - W - 2	416.8	Panel Fracture
Lapitec V Rivet - W - 3	319.2	Panel Fracture
Lapitec V Rivet - W - 4	324.0	Panel Fracture
Lapitec V Rivet - W - 5	413.5	Panel Fracture
Series Mean	377.9	
Standard Deviation	51.5	

ASTM C1354 - Lapitec V Rivet System - Gravity (Shear) Load Evaluation

SPECIMEN DETAILS	LOAD AT	ULTIMATE	FAILURE MODE
SPECIMEN ID	FIRST PEAK (lbf)	FAILURE LOAD (lbf)	
Lapitec V Rivet - W - 1	801.3	907.9	Rivet Failure
Lapitec V Rivet - W - 2	894.0	894.0	Rivet Failure
Lapitec V Rivet - W - 3	873.4	873.4	Rivet Failure
Lapitec V Rivet - W - 4	735.0	735.0	Rivet Failure
Lapitec V Rivet - W - 5	834.2	834.2	Rivet Failure
Series Mean	827.6	848.9	
Standard Deviation	62.9	69.5	

ASTM C1354 - Lapitec V Rivet System - Lateral (Shear) Load Evaluation

SPECIMEN DETAILS	LOAD AT	ULTIMATE	FAILURE MODE
SPECIMEN ID	FIRST PEAK (lbf)	FAILURE LOAD (lbf)	
Lapitec V Rivet - W - Lat - 1	878.6	878.6	Rivet Failure
Lapitec V Rivet - W - Lat - 2	794.7	794.7	Rivet Failure
Lapitec V Rivet - W - Lat - 3	756.5	756.5	Rivet Failure
Lapitec V Rivet - W - Lat - 4	778.9	778.9	Rivet Failure
Lapitec V Rivet - W - Lat - 5	878.1	878.1	Panel Fracture
Series Mean	817.4	817.4	
Standard Deviation	57.3	57.3	

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ASTM C1354 - Lapitec H1 Keil System - Tensile Load Evaluation (White)

SPECIMEN DETAILS SPECIMEN ID	ULTIMATE FAILURE LOAD (lbf)	FAILURE MODE
Lapitec H Keil - W - White - 1	401.6	Panel Fracture
Lapitec H Keil - W - White - 2	507.3	Panel Fracture
Lapitec H Keil - W - White - 3	493.2	Panel Fracture
Lapitec H Keil - W - White - 4	406.2	Panel Fracture
Lapitec H Keil - W - White - 5	443.0	Panel Fracture
Series Mean	450.3	
Standard Deviation	48.6	

ASTM C1354 - Lapitec H1 Keil System - Gravity (Shear) Load Evaluation (White)

SPECIMEN DETAILS SPECIMEN ID	LOAD AT FIRST PEAK (lbf)	ULTIMATE FAILURE LOAD (lbf)	FAILURE MODE
Lapitec H Keil - W - White - 1	1,130.8	1,130.8	Anchorage Core Failure
Lapitec H Keil - W - White - 2	1,223.4	1,223.4	Anchorage Core Failure
Lapitec H Keil - W - White - 3	1,089.6	1,089.6	Anchorage Core Failure
Lapitec H Keil - W - White - 4	968.3	968.3	Anchorage Core Failure
Lapitec H Keil - W - White - 5	1,064.3	1,064.3	Anchorage Core Failure
Series Mean	1,095.3	1,095.3	
Standard Deviation	93.3	93.3	

ASTM C1354 - Lapitec H1 Keil System - Lateral (Shear) Load Evaluation (White)

SPECIMEN DETAILS SPECIMEN ID	LOAD AT FIRST PEAK (lbf)	ULTIMATE FAILURE LOAD (lbf)	FAILURE MODE
Lapitec H Keil - W - Lat - White - 1	1,211.2	1,211.2	Anchorage Core Failure
Lapitec H Keil - W - Lat - White - 2	1,239.8	1,239.8	Anchorage Core Failure
Lapitec H Keil - W - Lat - White - 3	1,127.7	1,127.7	Anchorage Core Failure
Lapitec H Keil - W - Lat - White - 4	1,229.9	1,229.9	Anchorage Core Failure
Lapitec H Keil - W - Lat - White - 5	1,297.1	1,297.1	Anchorage Core Failure
Series Mean	1,221.1	1,221.1	
Standard Deviation	61.3	61.3	

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ASTM C1354 - Lapitec H2 Fischer System - Tensile Load Evaluation

SPECIMEN DETAILS SPECIMEN ID	ULTIMATE FAILURE LOAD (lbf)	FAILURE MODE
Lapitec H Fischer - W - 1	441.9	Panel Fracture
Lapitec H Fischer - W - 2	596.9	Panel Fracture
Lapitec H Fischer - W - 3	520.6	Panel Fracture
Lapitec H Fischer - W - 4	583.6	Panel Fracture
Lapitec H Fischer - W - 5	471.3	Panel Fracture
Series Mean	522.9	
Standard Deviation	67.8	

ASTM C1354 - Lapitec H2 Fischer System - Gravity (Shear) Load Evaluation

SPECIMEN DETAILS SPECIMEN ID	LOAD AT FIRST PEAK (lbf)	ULTIMATE FAILURE LOAD (lbf)	FAILURE MODE
Lapitec H Fischer - W - 1	1,241.5	1,241.5	Anchorage Core Failure
Lapitec H Fischer - W - 2	1,193.3	1,193.3	Anchorage Core Failure
Lapitec H Fischer - W - 3	1,312.0	1,312.0	Panel Fracture
Lapitec H Fischer - W - 4	1,257.2	1,257.2	Anchorage Core Failure
Lapitec H Fischer - W - 5	1,266.9	1,266.9	Panel Fracture
Series Mean	1,254.2	1,254.2	
Standard Deviation	43.0	43.0	

ASTM C1354 - Lapitec H2 Fischer System - Lateral (Shear) Load Evaluation

SPECIMEN DETAILS SPECIMEN ID	LOAD AT FIRST PEAK (lbf)	ULTIMATE FAILURE LOAD (lbf)	FAILURE MODE
Lapitec H Fischer - W - Lat - 1	1,372.4	1,372.4	Anchorage Core Failure
Lapitec H Fischer - W - Lat - 2	1,341.1	1,341.1	Panel Fracture
Lapitec H Fischer - W - Lat - 2	1,310.6	1,310.6	Anchorage Core Failure
Lapitec H Fischer - W - Lat - 4	1,324.3	1,324.3	Anchorage Core Failure
Lapitec H Fischer - W - Lat - 5	1,244.0	1,244.0	Anchorage Core Failure
Series Mean	1,318.5	1,318.5	
Standard Deviation	47.6	47.6	

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ASTM C1354 - Lapitec B Bonded - Tensile Load Evaluation

SPECIMEN DETAILS SPECIMEN ID	ULTIMATE FAILURE LOAD (lbf)	FAILURE MODE
Lapitec B Bonded Anchors - W - 1	583.6	Cohesive Bond Failure
Lapitec B Bonded Anchors - W - 2	748.9	Cohesive Bond Failure
Lapitec B Bonded Anchors - W - 3	721.9	Cohesive Bond Failure
Lapitec B Bonded Anchors - W - 4	500.1	Cohesive Bond Failure
Lapitec B Bonded Anchors - W - 5	776.0	Cohesive Bond Failure
Series Mean	666.1	
Standard Deviation	118.8	

ASTM C1354 - Lapitec B Bonded - Gravity (Shear) Load Evaluation

SPECIMEN DETAILS SPECIMEN ID	LOAD AT FIRST PEAK (lbf)	ULTIMATE FAILURE LOAD (lbf)	FAILURE MODE
Lapitec B Bonded Anchors - W - 1	863.5	863.5	Cohesive Bond Failure
Lapitec B Bonded Anchors - W - 2	1,016.4	1,016.4	Cohesive Bond Failure
Lapitec B Bonded Anchors - W - 3	718.8	718.8	Cohesive Bond Failure
Lapitec B Bonded Anchors - W - 4	759.1	759.1	Cohesive Bond Failure
Lapitec B Bonded Anchors - W - 5	735.8	735.8	Cohesive Bond Failure
Series Mean	818.7	818.7	
Standard Deviation	124.0	124.0	

ASTM C1354 - Lapitec B Bonded - Lateral (Shear) Load Evaluation

SPECIMEN DETAILS SPECIMEN ID	LOAD AT FIRST PEAK (lbf)	ULTIMATE FAILURE LOAD (lbf)	FAILURE MODE
Lapitec B Bonded Anchors - W - Lat - 1	536.4	536.4	Relaxation of Bond
Lapitec B Bonded Anchors - W - Lat - 2	937.3	937.3	Relaxation of Bond
Lapitec B Bonded Anchors - W - Lat - 3	115.8	115.8	Black Primer Failure
Lapitec B Bonded Anchors - W - Lat - 4	891.0	891.0	Relaxation of Bond
Lapitec B Bonded Anchors - W - Lat - 5	1,195.0	1,195.0	Relaxation of Bond
Series Mean	735.1	735.1	
Standard Deviation	418.2	418.2	

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ASTM C1354 - Lapitec K Kerf System - Negative Windload - Tensile Load Evaluation

SPECIMEN DETAILS SPECIMEN ID	ULTIMATE FAILURE LOAD (lbf)	ANCHORAGE SYSTEM LOAD (lbf) ¹	DEFLECTION AT FAILURE	FAILURE MODE
Lapitec K Kerf - Neg - 1	187.3	154.5	0.036	Fracture - Kerf Lip
Lapitec K Kerf - Neg - 2	131.6	108.6	0.116	Fracture - Kerf Lip
Lapitec K Kerf - Neg - 3	163.5	134.9	0.049	Fracture - Kerf Lip
Lapitec K Kerf - Neg - 4	126.1	104.0	0.124	Fracture - Kerf Lip
Lapitec K Kerf - Neg - 5	121.8	100.5	0.114	Fracture - Kerf Lip
Series Mean	146.1	120.5	0.088	
Standard Deviation	28.3	23.3	0.042	

¹ Calculated in accordance with ASTM C1354, Section 10.1 ((test machine load*a)/L)

ASTM C1354 - Lapitec K Kerf System - Negative Windload (Continued) - Measurements

SPECIMEN DETAILS SPECIMEN ID	REAR KERF THICKNESS	FACING KERF THICKNESS	KERF REBATE HEIGHT	KERF REBATE DEPTH
Lapitec K Kerf - Neg - 1	0.194	0.173	0.152	0.436
Lapitec K Kerf - Neg - 2	0.181	0.196	0.151	0.456
Lapitec K Kerf - Neg - 3	0.199	0.187	0.149	0.423
Lapitec K Kerf - Neg - 4	0.167	0.207	0.153	0.484
Lapitec K Kerf - Neg - 5	0.162	0.190	0.149	0.466
Series Mean	0.181	0.191	0.151	0.453
Standard Deviation	0.016	0.012	0.002	0.024

ASTM C1354 - Lapitec K Kerf System - Positive Windload - Tensile Load Evaluation

SPECIMEN DETAILS SPECIMEN ID	ULTIMATE FAILURE LOAD (lbf)	ANCHORAGE SYSTEM LOAD (lbf) ¹	DEFLECTION AT FAILURE	FAILURE MODE
Lapitec K Kerf - Pos - 1	132.6	109.4	0.112	Fracture - Kerf Lip
Lapitec K Kerf - Pos - 2	150.4	124.1	0.167	Fracture - Kerf Lip
Lapitec K Kerf - Pos - 3	142.3	117.4	0.131	Fracture - Kerf Lip
Lapitec K Kerf - Pos - 4	142.1	117.2	0.120	Fracture - Kerf Lip
Lapitec K Kerf - Pos - 5	130.8	107.9	0.151	Fracture - Kerf Lip
Series Mean	139.6	115.2	0.136	
Standard Deviation	8.0	6.6	0.023	

¹ Calculated in accordance with ASTM C1354, Section 10.1 ((test machine load*a)/L)

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ASTM C1354 - Lapitec K Kerf System - - Positive Windload (Continued) - Measurements

SPECIMEN DETAILS SPECIMEN ID	REAR KERF THICKNESS	FACING KERF THICKNESS	KERF REBATE HEIGHT	KERF REBATE DEPTH
Lapitec K Kerf - Pos - 1	0.199	0.179	0.135	0.438
Lapitec K Kerf - Pos - 2	0.177	0.193	0.153	0.479
Lapitec K Kerf - Pos - 3	0.199	0.173	0.152	0.429
Lapitec K Kerf - Pos - 4	0.164	0.185	0.152	0.478
Lapitec K Kerf - Pos - 5	0.191	0.174	0.151	0.477
Series Mean	0.186	0.181	0.149	0.460
Standard Deviation	0.015	0.008	0.008	0.025

SECTION 8

CONCLUSION

No performance requirements were specified for any other test component within the scope of this program, so results were reported as obtained.

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SECTION 9

PHOTOGRAPHS



Photo No. 1

ASTM C880 - Flexural Strength - Preconditioning (Oven Dry)



Photo No. 2

ASTM C880 - Flexural Strength - Preconditioning (Wet)

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Photo No. 3

ASTM C880 - Flexural Strength - Test Setup (Bianco Assoluto Satin)



Photo No. 4

ASTM C880 - Flexural Strength - Representative Failure (Bianco Assoluto Satin)

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Photo No. 5

ASTM C880 - Flexural Strength - Test Setup (Grigio Piombo Satin)



Photo No. 6

ASTM C880 - Flexural Strength - Representative Failure (Grigio Piombo Satin)

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**Photo No. 7****ASTM C1026 - Freeze Thaw - Representative Weathering Condition
(30 mm Supplemental C880 Flexural Specimens)****Photo No. 8****ASTM C880 - Flexural Strength - Typical, Post-Freeze Thaw Cycling, Failure Plane**

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Photo No. 9

ASTM C880 - Flexural Strength - Typical, Post-Freeze Thaw Cycling, Failure Plane Detail



Photo No. 10

Materials Testing Specimens - As Received

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Photo No. 11

Anchorage Testing Specimens - As Received



Photo No. 12

Anchorage Testing Specimens - As Received

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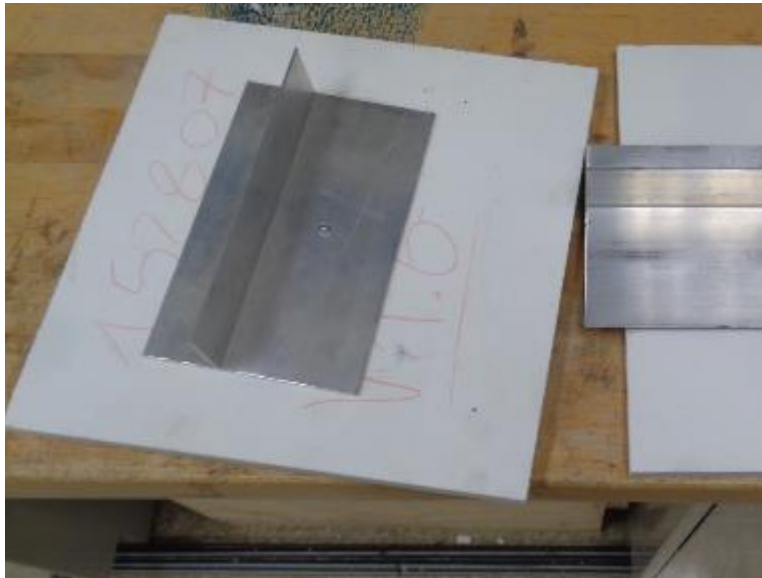


Photo No. 13

ASTM C1354 - Shear/Lateral Shear - Lapitec V - Riveted Fin - As Received



Photo No. 14

ASTM C1354 - Shear - Lapitec V - Riveted Fin - Test Setup

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Photo No. 15

ASTM C1354 - Shear - Lapitec V - Riveted Fin - Representative Failure



Photo No. 16

ASTM C1354 - Shear - Lapitec V - Riveted Fin - Representative Failure

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Photo No. 17

ASTM C1354 - Lateral Shear - Lapitec V - Riveted Fin - Test Setup



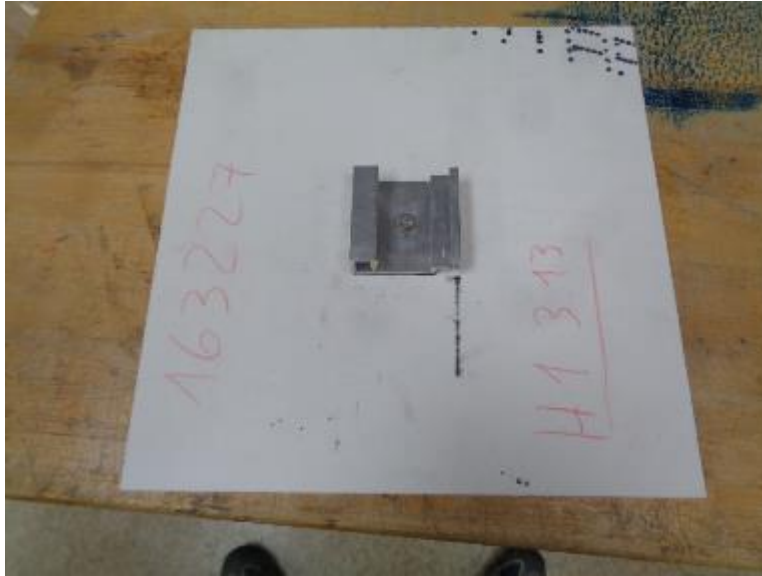
Photo No. 18

ASTM C1354 - Lateral Shear - Lapitec V - Riveted Fin - Representative Failure

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**Photo No. 19****ASTM C1354 - Shear/Lateral Shear - Lapitec H1 - Keil System (White) - As Received****Photo No. 20****ASTM C1354 - Shear - Lapitec H1 - Keil System (White) - Test Setup**

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Photo No. 21

ASTM C1354 - Shear - Lapitec H1 - Keil System (White) - Representative Failure



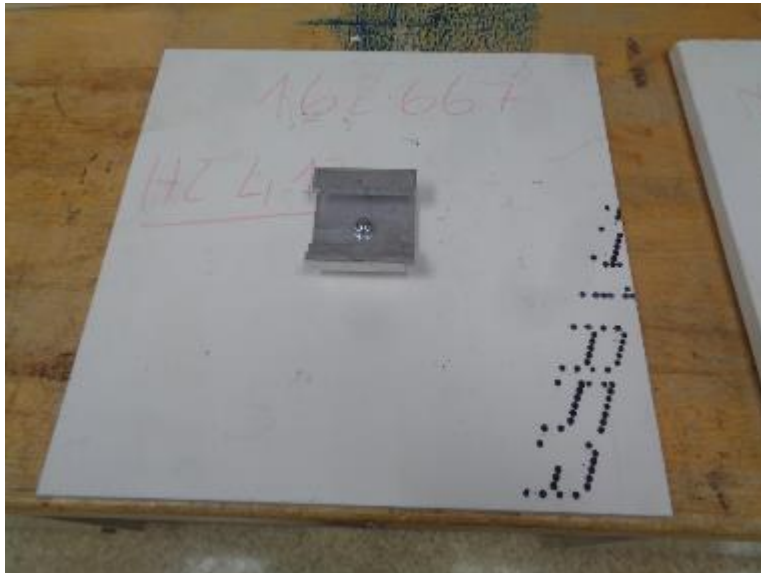
Photo No. 22

ASTM C1354 - Lateral Shear - Lapitec H1 - Keil System (White) - Test Setup

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**Photo No. 23****ASTM C1354 - Lateral Shear - Lapitec H1 - Keil System (White) - Representative Failure****Photo No. 24****ASTM C1354 - Shear/Lateral Shear - Lapitec H2 - Fischer System - As Received**

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**Photo No. 25****ASTM C1354 - Shear - Lapitec H2 - Fischer System - Test Setup****Photo No. 26****ASTM C1354 - Shear - Lapitec H2 - Fischer System - Representative Failure**

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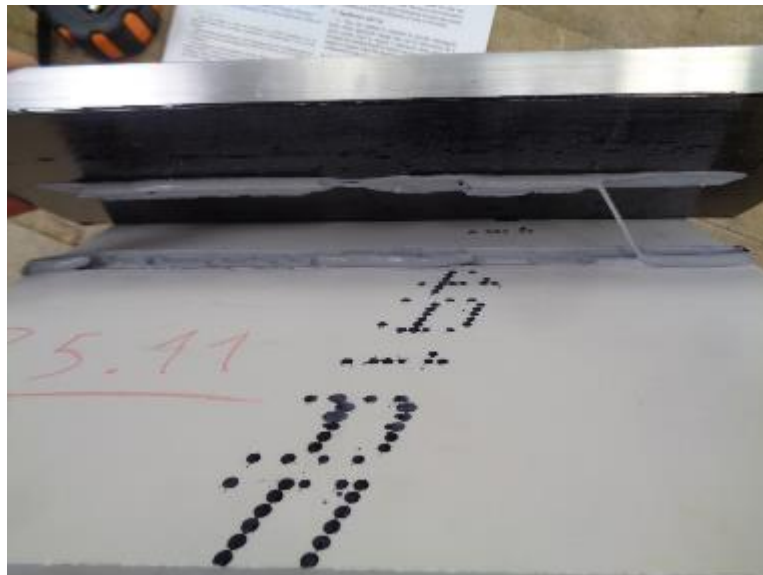
Date: 09/21/20

**Photo No. 27****ASTM C1354 - Lateral Shear - Lapitec H2 - Fischer System - Test Setup****Photo No. 28****ASTM C1354 - Shear/Lateral Shear - Lapitec B - Bonded System - As Received**

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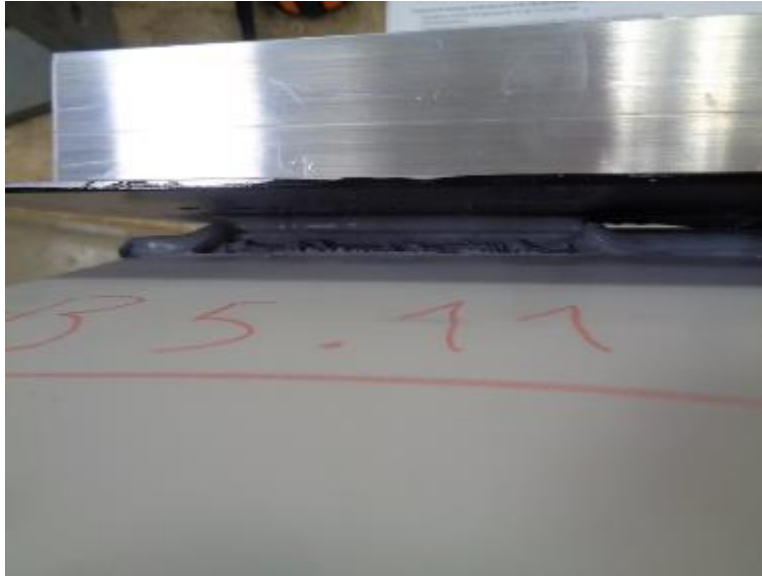
Date: 09/21/20

**Photo No. 29****ASTM C1354 - Shear - Lapitec B - Bonded System - Test Setup****Photo No. 30****ASTM C1354 - Shear - Lapitec B - Bonded System - Representative Failure**

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**Photo No. 31****ASTM C1354 - Shear - Lapitec B - Bonded System - Representative Failure in Progress****Photo No. 32****ASTM C1354 - Lateral Shear - Lapitec B - Bonded System - Test Setup**

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**Photo No. 33****ASTM C1354 - Lateral Shear - Lapitec B - Bonded System - Typical Test Failure
(Adhesive Release of Rail - Cohesive Failure)****Photo No. 34****ASTM C1354 - Lateral Shear - Lapitec B - Bonded System - Atypical Test Failure
(Adhesive Release of Rail Finish)**

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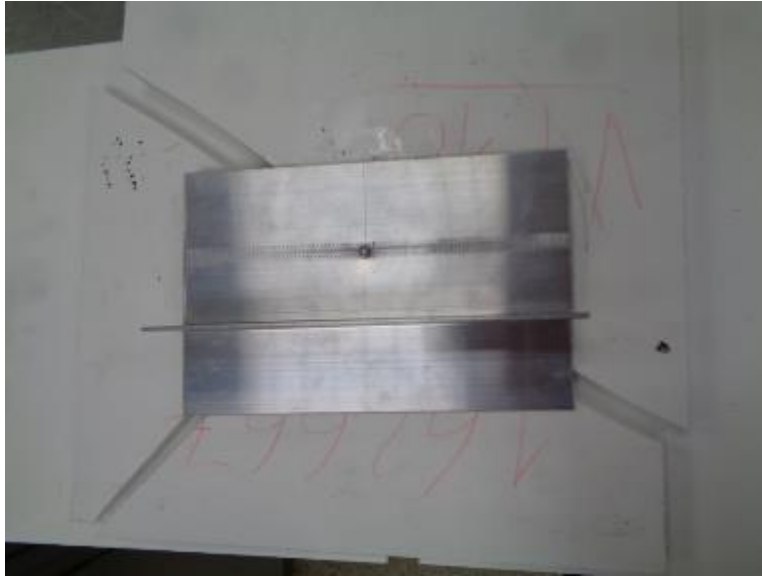
Date: 09/21/20

**Photo No. 35****ASTM C1354 - Tensile - Lapitec V - Rivet Fin - Test Setup****Photo No. 36****ASTM C1354 - Tensile - Lapitec V - Rivet Fin - Representative Failure**

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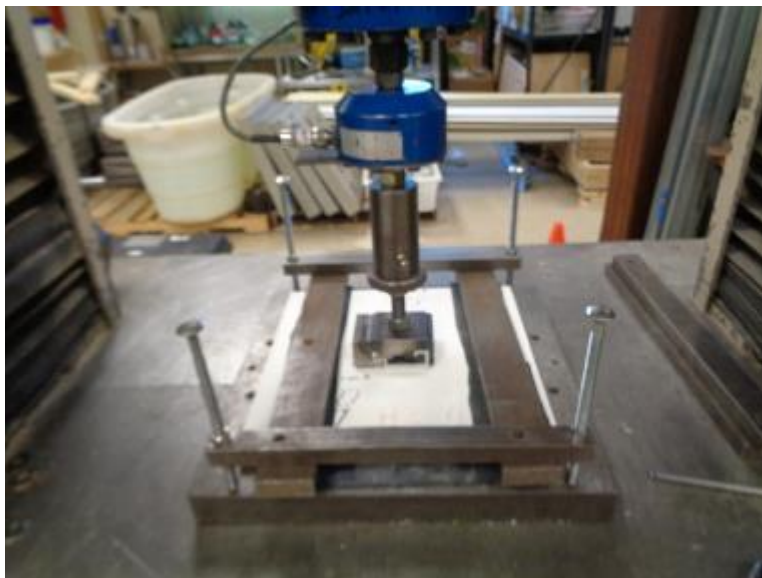
Date: 09/21/20

**Photo No. 37****ASTM C1354 - Tensile - Lapitec V - Rivet Fin - Representative Failure****Photo No. 38****ASTM C1354 - Tensile - Lapitec H1 - Keil System (White) - Test Setup**

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**Photo No. 39****ASTM C1354 - Tensile - Lapitec H1 - Keil System (White) - Representative Failure****Photo No. 40****ASTM C1354 - Tensile - Lapitec H2 - Fischer System - Test Setup**

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**Photo No. 41****ASTM C1354 - Tensile - Lapitec H2 - Fischer System - Representative Failure****Photo No. 42****ASTM C1354 - Tensile - Lapitec B - Bonded System - Test Setup**

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**Photo No. 43****ASTM C1354 - Tensile - Lapitec B - Bonded System - Representative Failure****Photo No. 44****ASTM C1354 - Lapitec K - Kerf System - Test Setup**

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Photo No. 45

ASTM C1354 - Lapitec K - Kerf System - Test Setup



Photo No. 46

ASTM C1354 - Lapitec K - Kerf System - Test Setup

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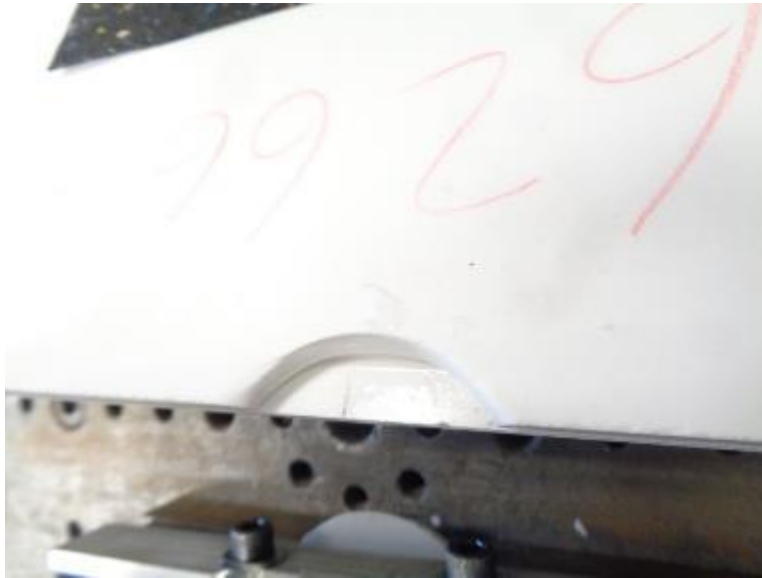


Photo No. 47

ASTM C1354 - Tensile - Lapitec K - Kerf System - Representative Failure

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SECTION 10

REVISION LOG

REVISION #	DATE	PAGES	REVISION
0	09/21/20	N/A	Original Report Issue
1	01/26/21	3, 4, 7, 8, 9, 10	Revised specimens received and removed unnecessary data columns
2	01/28/21	3, 4, 7, 8, 9, 10	Removed unnecessary data columns