



PERFORMANCE EVALUATION TEST REPORT

Rendered to:

FORMTECH ENTERPRISES, INC.
126 Ben Burton Circle
Bogart, Georgia 30622

Report No.: C9598.02-106-31
Test Dates: 07/08/14
Through: 10/20/14
Report Date: 11/10/14
Test Record Retention Date: 10/20/18
Revision 1: 04/15/15

Product: Truline Hybrid Sheet Piling System

Project Summary: Architectural Testing, Inc., an Intertek company ("Intertek-ATI"), was contracted by Formtech Enterprises, Inc. to perform a simulated seawater spray conditioning and post-exposure abrasion resistance evaluation, on reinforced concrete piling specimens protected by their Truline Hybrid Sheet Piling System against a laboratory conditioned control specimen, and a fully exposed test reference specimen (both consisting of the same reinforced concrete and subjected to the same seawater exposure without the benefit of such sheathing).

Test Methods: The test specimen was evaluated in accordance with the following methods:

ASTM G 85-11, *Standard Practice for Modified Salt Spray (Fog) Testing*

ASTM C 1141-98(2013), *Standard Practice for the Preparation of Substitute Ocean Water*

ASTM C 418-12, *Standard Test Method for Abrasion Resistance of Concrete by Sandblasting*

Test Procedures: Testing was performed on materials provided to Intertek-ATI by Formtech Enterprises, Inc. A total of four fully assembled (Truline sheathed) and cured (≥ 28 days) reinforced concrete Truline piling system sections (nominal dimensions 12.0 in. by 8.0 in. by 12.0 in.) were submitted for evaluation. One specimen had the Truline PVC Sheathing joints closed with sealant while the remaining three did not. Two of the three unsealed specimens had the Truline PVC sheathing removed by Intertek-ATI personnel prior to either retention in standard laboratory conditions (as an unexposed control specimen), or initiation of simulated seawater spray exposure. This was done to provide a full-exposure test reference against which to evaluate the comparative post-exposure performance properties of the Truline sheath protected specimens. The exposed upper facing of the two sheathed specimens were topped with a sheet of Plexiglas to simulate capping representative of a typical installation condition.

Test Procedures: (Continued)

The simulated seawater spray exposure was performed in a Q-Fog chamber (ICN: Y 001671). The chamber was operated for a period of 1,000 hours in accordance with ASTM G 85, Section A3.3 with exposure maintained at 35 ±2 °C. The substitute seawater solution was prepared as specified in ASTM G 85, Section 6.2 *Synthetic Sea Salt Solution* (ASTM D 1141, Section 6). At the conclusion of the full exposure period, the Truline PVC sheaths were removed from the two protected concrete specimens and the specimens were immersed in 23 °C water for 24 hours. Upon completion of the stated pre-conditioning period, the specimens were surface dried and subjected to abrasion in accordance with the procedures detailed in ASTM C 418. The abrasion apparatus was filled with 20-30 graded sand (850-600 µm) and calibrated for an abrasive flow rate of 600 ±25 g/min. A steel abrasion shield with a 1.0 in² area circular opening was placed directly against the face of the specimen to be abraded and the abrasive spray nozzle was maintained at a distance of 3.0 in. from the specimen surface. The selected test patch was subjected to a 1.0 minute exposure to abrasion prior to relocation of the shield to another appropriate area of the specimen surface. A total of eight test patches were abraded on each concrete mock-up specimen and the volume determined by filling with clay as detailed in ASTM C 418, Section 7.1.

Test Results: The results are reported in the following table.

ASTM C 418 - Post-1,000 Hour Salt Fog Exposure Abrasion Resistance

Summary of Results						
Exposure Condition			Abrasion Coefficient (cm ³ /cm ²)	Volume Loss (cm ³ /50cm ²) ¹	Mean Thickness Loss (mm)	Increased Abrasion Resistance Retention vs. Fully Exposed Specimen (%) ²
Salt Fog	Truline Sheath	Sealed Joints				
Yes	No	N/A	0.20	10.13	2.03	N/A
No	No	N/A	0.16	7.90	1.58	22.2
Yes	Yes	No	0.16	7.99	1.60	21.2
		Yes	0.16	7.76	1.55	23.6

¹ Volume Loss as presented is converted from the Abrasion Coefficient determined per ASTM C 418, Section 8.4

² Abrasion Resistance Retention Calculated as follows: ((Exposed Value - Protected Value)/ Exposed Value)*100

Intertek-ATI will service this report for the entire test record retention period. Test records that are retained such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation will be retained by Intertek-ATI for the entire test record retention period.

Results obtained are tested values and were secured by using the designated tested methods. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. It is the exclusive property of the client so named herein and relates only to specimens tested. This report may not be reproduced, except in full, without the written approval of Intertek-ATI.

For INTERTEK-ATI:

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Attachments (pages) This report is complete only when all attachments listed are included.

Appendix A - Datasheets (2)

Appendix B - Photographs (4)



Revision Log

<u>Rev. #</u>	<u>Date</u>	<u>Page(s)</u>	<u>Revision(s)</u>
0	11/10/14	N/A	Original report issue.
1	04/15/15	Cover, 1, 3	Removed Cover Page, Revised first sentence in Project Summary to Read Architectural Testing, Inc., an Intertek company, ("Intertek-ATI"). Replaced all instances of Architectural Testing with Intertek-ATI.



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APPENDIX A

Datasheets

ASTM C 418 - Post-1,000 Hour Salt Fog Exposure Abrasion Resistance

Individual Test Patch Results						
Specimen Details		Test Area (cm²)	Cavity Volume (cm³)	Abrasion Coefficient (cm³/cm²)	Volume Loss (cm³/50cm²)¹	Mean Thickness Loss (mm)
Exposure Condition	Test Patch					
Fully Exposed	1	6.70	1.28	0.20	9.90	1.98
	2		1.28	0.20	9.95	1.99
	3		1.27	0.20	9.85	1.97
	4		1.49	0.23	11.51	2.30
	5		1.15	0.18	8.88	1.78
	6		1.49	0.23	11.51	2.30
	7		1.11	0.17	8.63	1.73
	8		1.39	0.22	10.78	2.16
	Mean Results		1.31	0.20	10.13	2.03

Unexposed Laboratory Control	1	6.70	1.33	0.241	10.34	2.07
	2		1.01	0.16	7.80	1.56
	3		0.72	0.11	5.55	1.11
	4		1.07	0.17	8.30	1.66
	5		0.57	0.09	4.43	0.89
	6		1.06	0.16	8.21	1.64
	7		1.16	0.18	9.00	1.80
	8		1.24	0.19	9.58	1.92
	Mean Results		1.02	0.16	7.90	1.58

¹ Volume Loss as presented is converted from the Abrasion Coefficient determined per ASTM C 418, Section 8.4

ASTM C 418 - Post-1,000 Hour Salt Fog Exposure Abrasion Resistance (Continued)

Individual Test Patch Results						
Specimen Details		Test Area (cm²)	Cavity Volume (cm³)	Abrasion Coefficient (cm³/cm²)	Volume Loss (cm³/50cm²)¹	Mean Thickness Loss (mm)
Exposure Condition	Test Patch					
Truline Sheathed (Unsealed Joints)	1	6.70	0.66	0.10	5.12	1.02
	2		1.16	0.18	8.97	1.79
	3		0.96	0.15	7.46	1.49
	4		1.28	0.20	9.95	1.99
	5		0.97	0.15	7.51	1.50
	6		0.96	0.15	7.41	1.48
	7		1.17	0.18	9.07	1.81
	8		1.09	0.17	8.44	1.69
	Mean Results		1.03	0.16	7.99	1.60

Truline Sheathed (Sealed Joints)	1	6.70	1.40	0.22	10.83	2.17
	2		0.81	0.13	6.29	1.26
	3		0.66	0.10	5.12	1.02
	4		0.93	0.14	7.22	1.44
	5		0.94	0.15	7.32	1.46
	6		1.23	0.19	9.56	1.91
	7		0.98	0.15	7.61	1.52
	8		1.05	0.16	8.14	1.63
	Mean Results		1.00	0.16	7.76	1.55

¹ Volume Loss as presented is converted from the Abrasion Coefficient determined per ASTM C 418, Section 8.4



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APPENDIX B

Photographs



Photo No. 1
Full-Exposure Specimen in Salt Fog Exposure Chamber



Photo No. 2
Sheathed Specimen in Salt Fog Exposure Chamber



Photo No. 3
Truline System Sheathed Specimen Section Joint Detail - Unsealed



Photo No. 4
Truline System Sheathed Specimen Section Joint Detail - Sealed



Photo No. 5
Full Exposure Comparative Specimen - Post Test Condition



Photo No. 6
Laboratory Conditioned (Unexposed) Control Specimen



Photo No. 7
Truline System Sheathed Specimen (Unsealed Joint) - Post Test Condition



Photo No. 8
Truline System Sheathed Specimen (Sealed Joint) - Post Test Condition