

# RAMTECH LABORATORIES



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## REVISED\* MASTER TEST REPORT

LABORATORY NUMBER:  
3804-16-11 (A1)

EVALUATION OF:  
FRP (IPS 7000-204HB Resin)

PREPARED FOR:  
Predl System North America  
Burnaby, BC

TEST CONDUCTED AT:  
Ramtech Laboratories  
14104 Orange Avenue  
Paramount, CA 90723

APPROVED BY:

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STEVEN BERGGREN  
LABORATORY ADMINISTRATOR  
DATE ISSUED: June 28, 2018

**Note:** This report has been revised in accordance with the client's request. Please refer to original report 3804-16-11 dated August 5, 2017 for original comments and observations

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**Introduction:**

As requested by the client, Ramtech Laboratories conducted testing on the submitted FRP (IPS 7000-204HB Resin) specimens.

The client has stated the purpose of this testing was to determine the chemical resistance as well as various mechanical and physical properties of the client's product as outlined in Section 1 of this report. Chemical resistance testing included weight change in general accordance with the Standard Specifications for Public Works (Greenbook) as well as the retaining of mechanical properties in general accordance with product approval requirements of major municipal jurisdictions

The following data and results is presented in general accordance with the reporting requirements of ISO 17025

**General Information:**

**1 The identification of the test method used:**

- 1.1 The following tests were conducted as requested by the client
  - 1.1.1.1 Chemical Resistance SSPWC 211-2 (Pickle jar Test)
  - 1.1.1.2 Weight change
  - 1.1.1.3 Tensile strength
  - 1.1.1.4 Hardness
  - 1.1.1.5 Flexural
  - 1.1.1.6 Ignition Loss of Fiberglass
  - 1.1.1.7 Abrasion
  - 1.1.1.8 Compression

**2 A description of the items tested:**

- 2.1 The samples are described (by the client) as a Custom Built Concrete Protective Liner intended for use in Municipal Sewer Systems

**3 Sampling:**

- 3.1 Ramtech Laboratories received the material tested from the client's manufacturing facility in Burnaby BC as presented below:
  - 3.1.1 Company Name: Predl Systems North America
  - 3.1.2 Address: 7520 Conrad Street
  - 3.1.3 Country: Buraby BC, V5A2H7 Canada

**4 The date of receipt of the test items:**

- 4.1 Ramtech Laboratories received the test specimens as shown below beginning in December 2016



**5 The date of performance of the test:**

- 5.1 All testing began in February 2017 and was completed in 2018:

**6 Clarification of any deviations, additions and exclusions from the test method:**

- 6.1 Ramtech Laboratories tested the submitted samples in general accordance with the prescribed test methods.

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**A Chemical Resistance (Pickle Jar—Weight Change):**

**A1 Test Results:**

The results of the Weight Loss Test are summarized below with graphical results presented in Appendix 1

Chemical Solution	Concentration	28-day	56-day	84-day	112-day
Sulphuric Acid (H <sub>2</sub> SO <sub>4</sub> )	20%	0.007%	0.013%	0.022%	0.030%
Sodium Hydroxide (NaOH)	5%	0.010%	0.019%	0.030%	0.040%
Ammonium Hydroxide (NH <sub>4</sub> OH)	5%	0.006%	0.012%	0.019%	0.026%
Nitric Acid (HNO <sub>3</sub> )	1%	0.005%	0.009%	0.015%	0.021%
Ferric Chloride (FeCl <sub>3</sub> )	1%	0.003%	0.006%	0.009%	0.014%
Sodium Hypochlorite (NaOCl)	1%	0.003%	0.006%	0.011%	0.016%
Soap	0.1%	0.002%	0.003%	0.005%	0.007%
Detergent (LAS)	0.1%	0.002%	0.003%	0.007%	0.011%
Bacteriological	BOD 700 ppm	0.007%	0.010%	0.020%	0.027%

**A2 Conditions of Acceptance:**

As provided in the 2012 Greenbook (Table 211-2B), the allowable weight change was 0.75% when testing a product having a nominal thickness of 0.375 inches or less.

**A3 Conclusions:**

To the extent tested, the FRP (IPS 7000-204HB Resin) specimens (as described in this test report) meet the conditions of acceptance as described in the Standard Specifications for Public Works Construction (Greenbook 2012) Section 211-2 having a weight change after 112 days of exposure not exceeding the limits of 0.75%

**A4 Observations and Comments:**

The submitted test specimens were prepared as “Composite-Materials” as defined in Section 211-2 having 2 adjacent edges sealed and protected

**B Chemical Resistance (Pickle Jar—Tensile Strength):**

**B1 Test Results:**

Tensile Strength is summarized below with detailed results presented in Appendix 2

Chemical Solution	Concentration Level	Tensile Strength (psi)	Retained Strength (%)
Control--Initial	N/A	7229	N/A
Sulphuric Acid (H <sub>2</sub> SO <sub>4</sub> )	20%	6805	94%
Sodium Hydroxide (NaOH)	5%	6588	91%
Ammonium Hydroxide (NH <sub>4</sub> OH)	5%	6953	96%
Nitric Acid (HNO <sub>3</sub> )	1%	7022	97%
Ferric Chloride (FeCl <sub>3</sub> )	1%	6871	95%
Sodium Hypochlorite (NaOCl)	1%	7158	99%
Soap	0.1%	7169	99%
Detergent (LAS)	0.1%	7157	99%
Bacteriological	BOD 700 ppm	6909	96%

**B2 Conditions of Acceptance:**

The Greenbook has not established the allowable change in Tensile Strength

**B3 Conclusions:**

The results of this test are presented for “Client Information Only”

**B4 Observations and Comments:**

The observations comments can be found in Appendix 2.

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**C Chemical Resistance (Pickle Jar—Hardness):**

**C1 Test Results:**

Hardness (Shore “A”) is summarized below with detailed results presented below

Chemical Solution	Concentration Level	Hardness Start	Hardness End	Retained (%)
Control--Initial	N/A	96	N/A	N/A
Sulphuric Acid (H2SO4)	20%	95	90	95%
Sodium Hydroxide (NaOH)	5%	97	89	92%
Ammonium Hydroxide (NH4OH)	5%	96	93	97%
Nitric Acid (HNO3)	1%	96	92	96%
Ferric Chloride (FeCL3)	1%	95	90	95%
Sodium Hypochlorite (NaOCl)	1%	96	94	98%
Soap	0.1%	97	97	100%
Detergent (LAS)	0.1%	96	96	100%
Bacteriological	BOD 700 ppm	96	90	94%

**C2 Conditions of Acceptance:**

The Greenbook has not established the allowable change in Hardness

**C3 Conclusions:**

The results of this test are presented for “Client Information Only”

**D Flexural Strength (ASTM D790):**

**D1 Test Results:**

SAMPLE	DIMENSION		Loading	Indicated	Modulus of	Modulus of
	Base	Depth	Span	LOAD	Rupture (MOR)	Elasticity (MOR)
ID	(b)	(d)	(in)	(lbf)	( lbf / in <sup>2</sup> )	( lbf / in <sup>2</sup> )
1	0.508	0.310	2.50	106	<b>8142</b>	<b>234649</b>
2	0.508	0.310	2.50	123	<b>9448</b>	<b>249788</b>
3	0.508	0.310	2.50	133	<b>10216</b>	<b>267014</b>
4	0.508	0.310	2.50	105	<b>8066</b>	<b>262489</b>
5	0.508	0.310	2.50	152	<b>11676</b>	<b>262489</b>
<b>Average</b>	<b>0.508</b>	<b>0.310</b>	<b>2.5</b>	<b>124</b>	<b>9510</b>	<b>255286</b>
Max	0.508	0.310	2.5	152	11676	267014
Min	0.508	0.310	2.5	105	8066	234649
STDEV	0.000	0.000	0.0	20	1512	13204

**D2 Conditions of Acceptance:**

The Greenbook has not established the allowable change in Flexural Strength

**D3 Conclusions:**

The results of this test are presented for “Client Information Only”

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**E Ignition Loss (ASTM D-2584)**

**E1 Purpose:**

The purpose of this test was to determine the resin content of the test specimen

**E2 Test Procedure:**

E2.1 The test specimen was placed into a crucible and weighed to the nearest 1.0 mg

E2.2 The test specimen was heated in a Bunsen flame until the specimen ignited

E2.3 The test specimen was allowed to burn at a uniform and moderate rate until only ash and carbon remained

**E3 Test Results:**

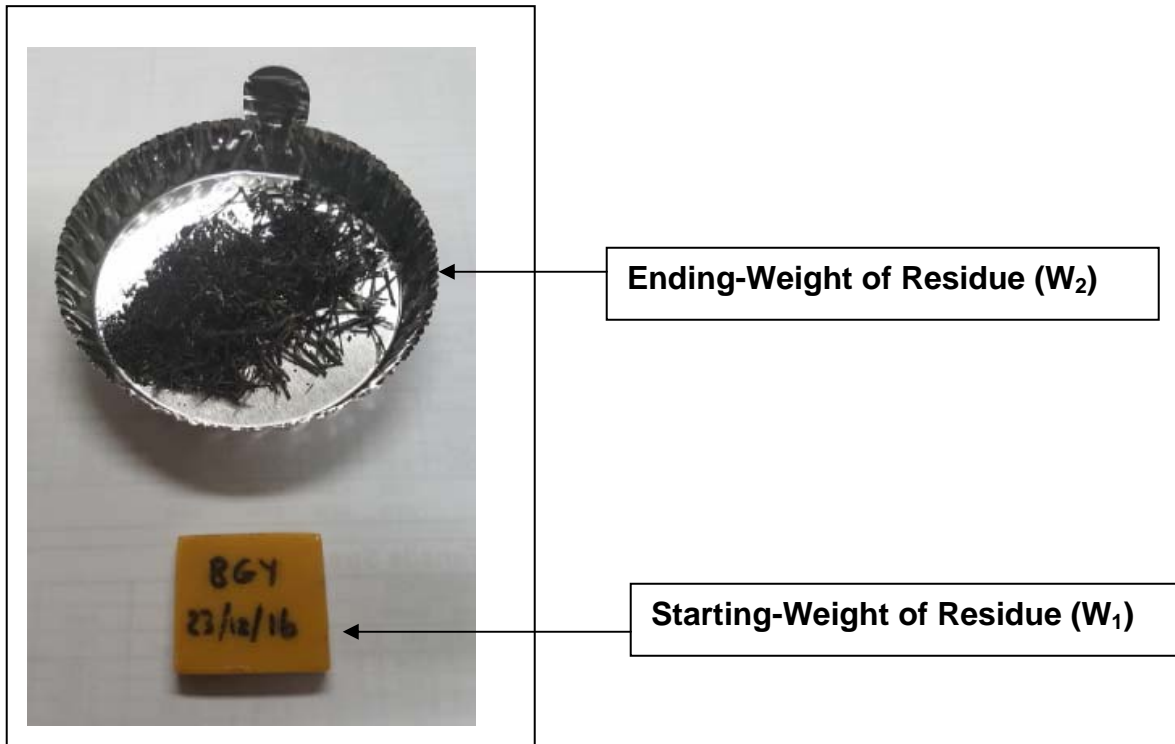
The Ignition test results are summarized below

Test No.	Starting Weight (Grams)	Ending Weight (Grams)	Weight Loss (Grams)	Ignition Loss (%)
1	4.301	2.103	2.198	51.1%
2	4.501	2.205	2.296	51.0%
3	4.184	2.005	2.179	52.1%
4	4.463	2.101	2.362	52.9%
5	4.355	2.008	2.347	53.9%

**Average      52.2%**

$$\text{Ignition Loss, weight \%} = [(W_1 - W_2)/W_1] \times 100$$

Where:       $W_1$  = Starting-Weight of Specimen in grams  
               $W_2$  = Ending-Weight of Residue in grams



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**F Abrasion (ASTM D-4060)**

**F1. Introduction:**

In accordance with the client's request, a Taber Abrasion Test was performed on the following products:  
A. FRP (IPS 7000-204HB Resin)

**F2. Purpose:**

The purpose of this test was to determine the resistance of the client's submitted products to abrasion produced by the Taber Abraser

**F3. Sampling:**

Ramtech Laboratories did not independently sample the material tested and makes no comment as to the sampling procedures that may have been conducted by others

**F4. Test Procedure:**

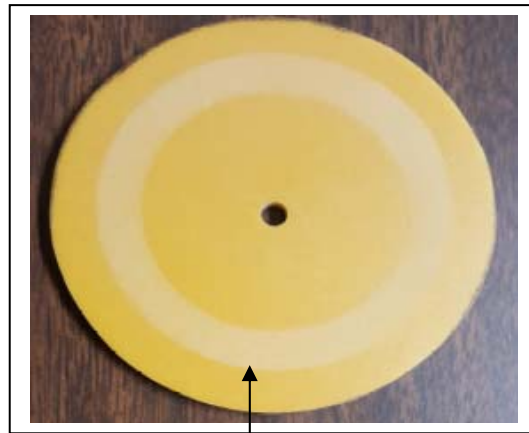
Ramtech Laboratories tested the submitted products in general accordance with ASTM D-4060 using CS-17 wheels with 1000 grams applied to each wheel and subjected to 1000 revolutions

**F5. Test Results:**

The results of this test are presented in the table below

**FRP (IPS 7000-204HB Resin)**

Sample ID	Starting Weight (Grams)	Ending Weight (Grams)	Loss (%)
1	51.850	51.809	0.044%
2	43.412	43.368	0.048%
3	54.216	54.179	0.057%
4	44.601	44.566	0.066%



Area of Wear

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**G Compression (ASTM D-695)**

**G1 Introduction:**

In accordance with the client's request, a Compressive Strength Test was performed on the FRP (IPS 7000-204HB Resin) product

**G2 Purpose:**

The purpose of this test was to determine the resistance of the client's submitted products to a compressive force produced by a universal testing machine

**G3 Sampling:**

Ramtech Laboratories did not independently sample the material tested and makes no comment as to the sampling procedures that may have been conducted by others

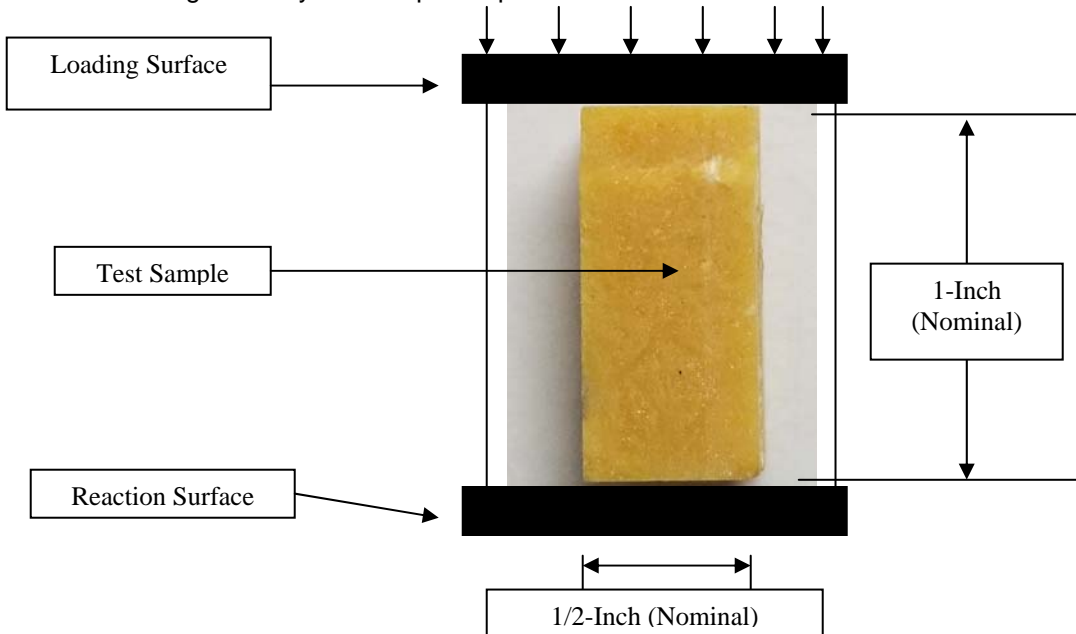
**G4 Test Procedure:**

Ramtech Laboratories tested the submitted products in general accordance with ASTM D-695

**G5 Test Results:**

The results of this test are presented in the below

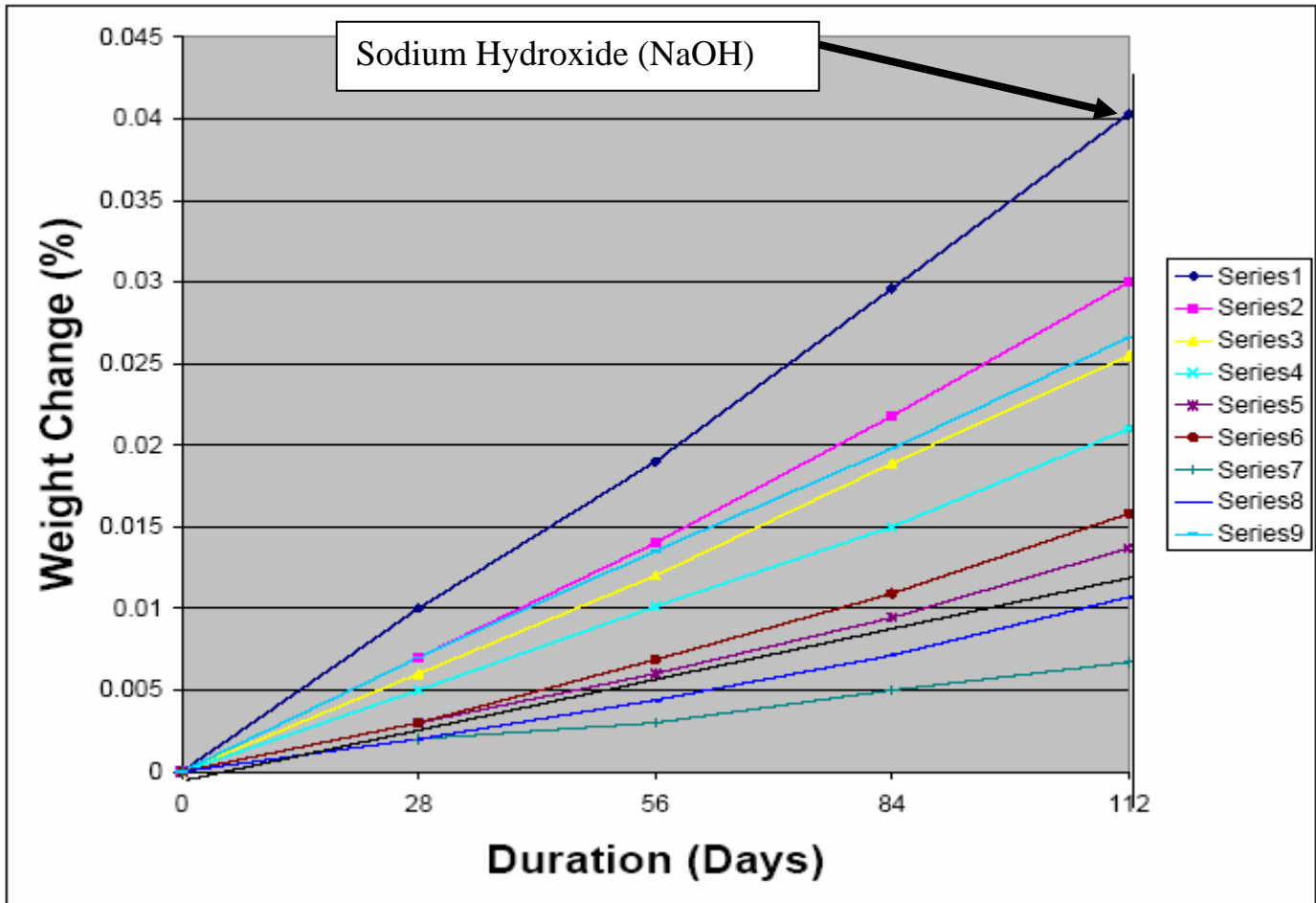
1. Average Compressive Stress = 13,313 psi (STDEV = 1518 psi)
2. Average Density = 63.96 pound per cubic foot





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**APPENDIX 1**  
(Pickle-Jar Weight Change)

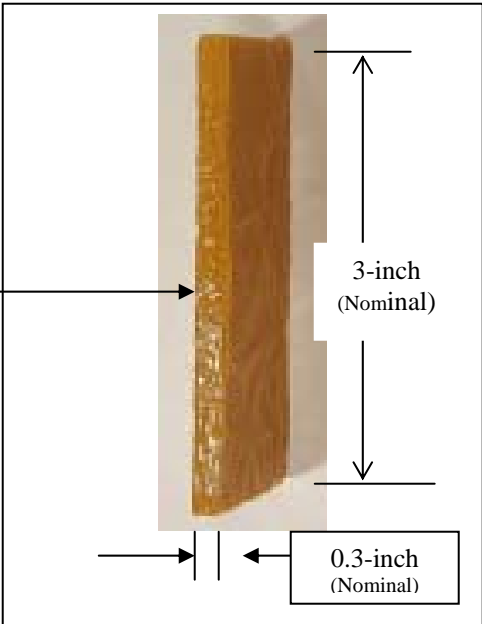
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**The results of the 112 day test are outlined below**

- Sulphuric Acid (0.030%)
- Sodium Hydroxide (0.040%)
- Ammonium Hydroxide (0.026%)
- Nitric Acid (0.021%)
- Ferric Chloride (0.014%)
- Sodium Hypochlorite (0.016%)
- Soap (0.007%)
- Detergent (0.011%)
- Bacteriological (0.027%)

Typical Weight Change  
Test Specimen Starting Weight  
(15 grams--Nominal)



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**APPENDIX 2**  
**(Pickle-Jar Tensile Strength)**

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Chemical Solution	Concentrate Level	Ave. Tensile Strength (psi)	Max Tensile Strength (psi)	Min Tensile Strength (psi)	STDEV (psi)	Retained Strength (%)
Control--Initial	N/A	7229	8511	6489	941	N/A
Sulphuric Acid	20%	6805	8016	6100	889	94%
Sodium Hydroxide	5%	6588	7745	5905	855	91%
Ammonium Hydroxide	5%	6953	8186	6242	902	96%
Nitric Acid	1%	7022	8255	6294	911	97%
Ferric Chloride	1%	6871	8085	6153	898	95%
Sodium Hypochlorite	1%	7158	8442	6399	950	99%
Soap	0.1%	7169	8475	6412	958	99%
Detergent (LAS)	0.1%	7157	8441	6411	942	99%
Bacteriological	BOD 700 ppm	6909	8117	6225	875	96%

