

CONSTRUCTION TESTING CORPORATION

13873 N.W. 19th Avenue Miami, Florida 33054

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Report No: 04-009 FE ASTM

19 July 2004

Test Dates: 14, 26, 27 & 28 May, 2 June & 5 July 2004

Testing : Polycarbonate Hurricane Shutter Panels

Client:

Transparent Protection Systems, Inc.

6643 North 42nd Terrace
West Palm Beach, FL 33407

Phone: 888-447-8320 Fax: 561-844-2445

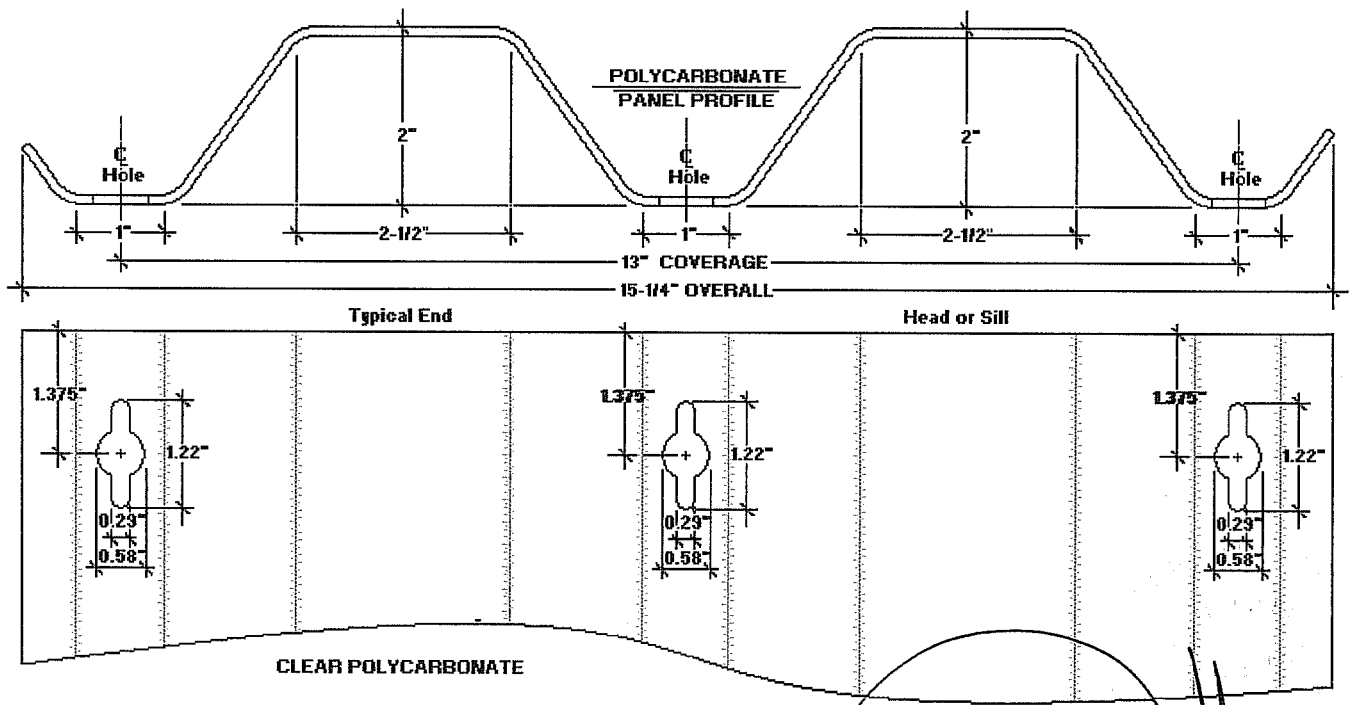
General: This test report incorporates into one document three testing activities. These are:

1. Static Wind, per ASTM E 330
2. Large Missile Impacts, per ASTM E 1886-97 & E 1996-02 @ Missile Level D
3. Cyclic Static Air Pressure Loading, per ASTM E 1886-97 & E 1996-02, Table 1 : Wind > 110 MPH

Witness to Testing:

Yamil G. Kuri, P.E. : CTC Official Witness, Raina Williams, CTC Assistant & George Dotzler, CTC Test Engineer

Description of Specimens: Specimens were nominal 1/10" polycarbonate Storm Panels (Mic'd thickness varied across section from 0.0905" to 0.1185"). These panels were extruded into a two ribbed 2" x 13" section with a nominal coverage of 13" per panel manufactured by Transparent Protection Systems, Inc. of West Palm Beach, Florida. These panels utilized the a double key hole punch pattern at each end of the panels as shown in the diagram below. Specimen were all three panels wide (41 1/4") lengths varied from 60" to 144". Specimen were mounted in a variety of fastenings these are detailed on the following page. Specimen were installed without intermediate supports to the panel overlaps. Detailed descriptions of each specimen are included immediately preceding the relevant test data together with section drawings.



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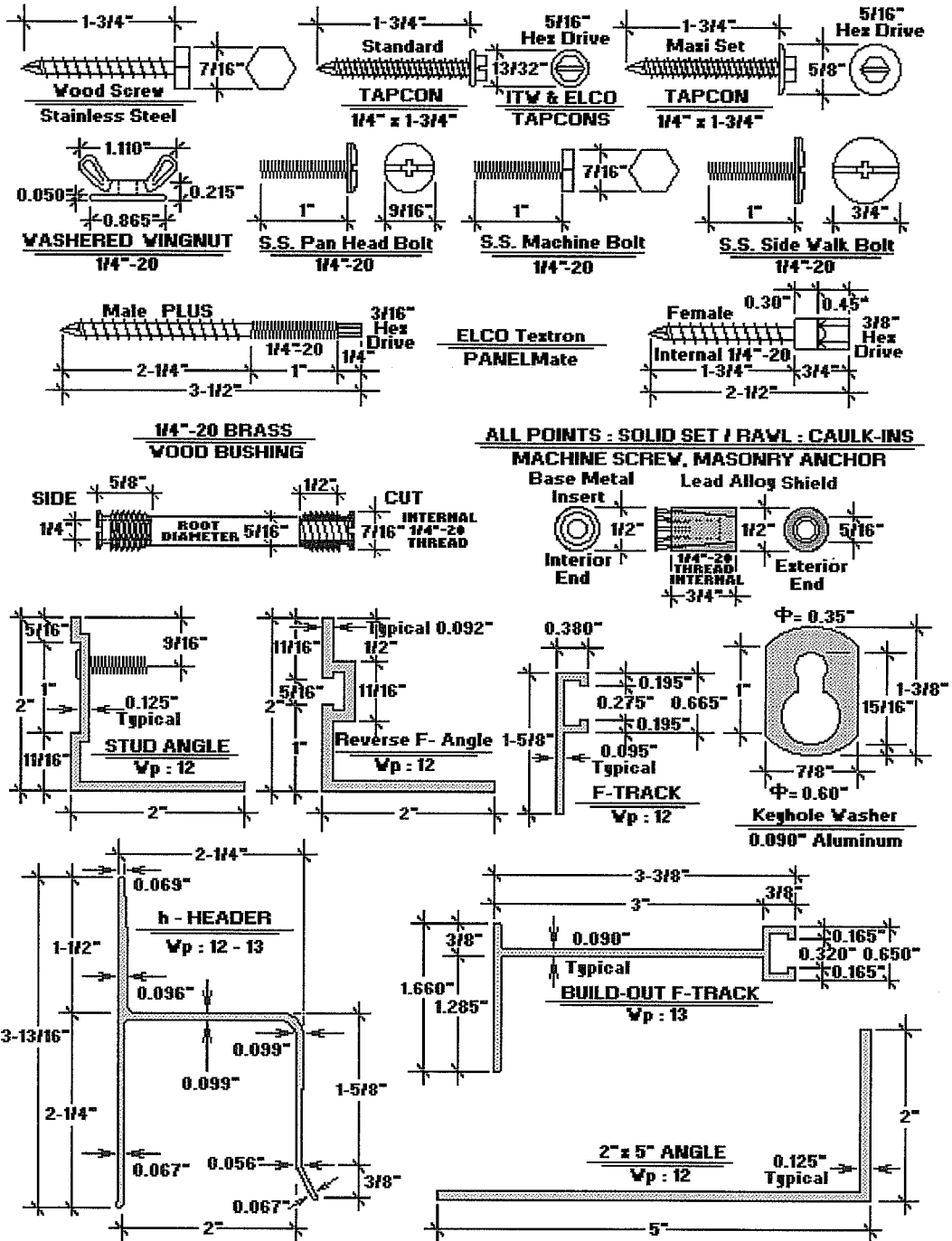
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DETAILS: Test specimens were installed with the following fasteners and aluminum extrusion:



A "Webster" gauge was utilized to determine the material hardness of aluminum components. These readings are indicated (w: 13) for example where the gauge registered a 13 hardness taken off of a mill finish extrusion. Where gauge readings are taken off of a painted aluminum component, readings are indicated (w_p: 11.5) for example. Where a number of similar aluminum components were sampled and a range of readings were found these are shown as (w: 11.5-13) or as (w_p: 10-12) for example.

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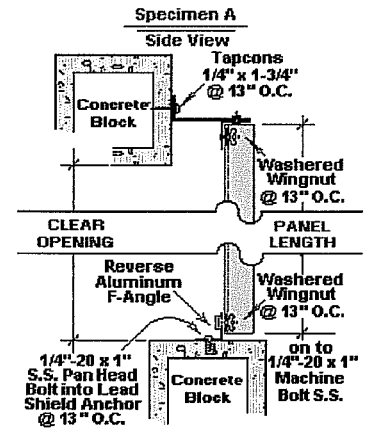
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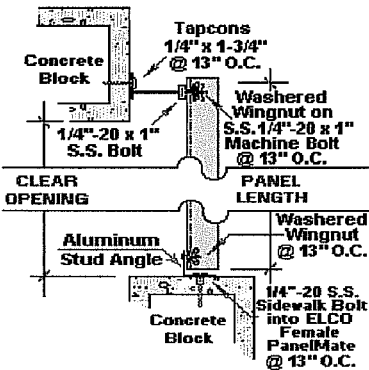
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Specimen A : Build Out / Floor, Mount : 144" Panels : 140" C.O. Impacts & Cyclic Wind Loading

Head: Panels were mounted at 13" on center (O.C.) with washered wing nuts onto a studded aluminum angle. This angle was secured with #14 x 3/4" stainless steel (S.S.), self drilling self tapping (SDST) screws at 13" O.C. to the 5" leg of a 2" x 5" aluminum angle, forming a 3" build out. This 2" x 5" angle was in turn secured to a concrete block beam with standard 1/4" x 1-3/4" **ELCO Tapcon** masonry screws at 13" O.C. by it's 2" leg which was turned away from the opening. **Sill:** Panels were mounted at 13" O.C. with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into an aluminum reverse f-track. This reverse f-angle was secured to a concrete block beam at 13" on center with S.S. 1/4"-20 x 1" pan head bolts (9/16" head and combination slot & phillips drive) into **RAWL, Caulk-In**, machine bolt, masonry anchors.



Specimen B
Side View

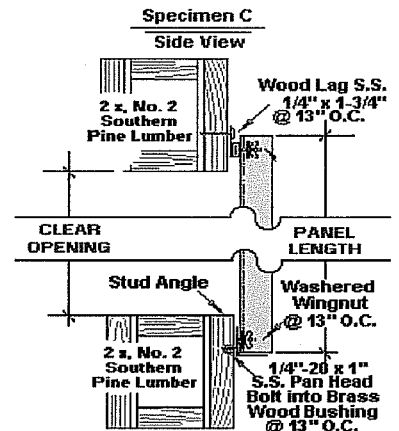


Specimen B : Build Out / Floor, Mount : 144" Panels : 140" C.O. Impacts & Cyclic Wind Loading

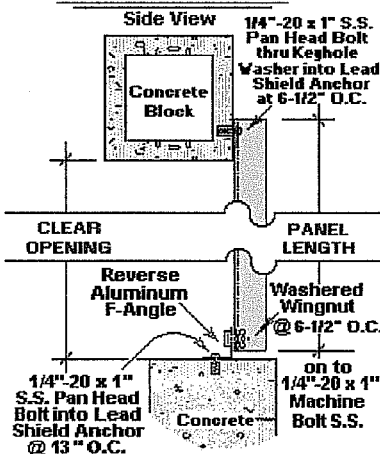
Head: Panels were mounted at 13" O.C. with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into a build out F-track extrusion. This extrusion was secured to a concrete block beam at 13" O.C. with **ELCO Maxi Set** 1/4" x 1-3/4" Tapcon masonry screws. **Sill:** Panels were mounted at 13" O.C. with washered wing nuts onto a studded aluminum angle. This angle was secured at 13" O.C. with S.S. 1/4"-20 x 1/2" side walk bolts (3/4" head and combination slot & phillips drive) into **ELCO PanelMate, Female**, wood & masonry anchors secured to a concrete block beam.

Specimen C : Wall / Wall, Mount : 144" Panels : 140" C.O. Impacts & Cyclic Wind Loading

Head: Panels were mounted at 13" O.C. with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into a F-track extrusion. This extrusion was secured to a No: 2 Southern Pine lumber beam at 13 O.C. with S.S. 1/4" x 1-3/4" wood lags. **Sill:** Panels were mounted at 13" O.C. with washered wing nuts onto a studded aluminum angle. This angle was secured at 13" O.C. with S.S. 1/4"-20 x 1" pan head bolts (9/16" head and combination slot & phillips drive) into **All Points**, brass wood bushings secured into a No: 2 Southern Pine lumber beam.



Specimen I1, I2, I3 & I4



- Specimen I1 : Wall / Floor, Mount : 120" Panels : 117" C.O. : Impacts
- Specimen I2 : Wall / Floor, Mount : 103" Panels : 100" C.O. : Impacts
- Specimen I3 : Wall / Floor, Mount : 84" Panels : 81" C.O. : Impacts
- Specimen I4 : Wall / Floor, Mount : 60" Panels : 57" C.O. : Impacts

Head: Panels were directly mounted at 6 1/2" O.C. with S.S. 1/4"-20 x 1" pan head bolts (9/16" head and combination slot & phillips drive) through an aluminum keyhole washer into **All Point, Solid Set**, machine bolt, masonry anchors set into a concrete block beam. **Sill:** Panels were mounted at 6 1/2" O.C. with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into an aluminum reverse f-track. This reverse f-angle was secured to a concrete floor slab at 13" on center with S.S. 1/4"-20 x 1" pan head bolts (9/16" head and combination slot & phillips drive) into **All Point, Solid Set**, machine bolt, masonry anchors.

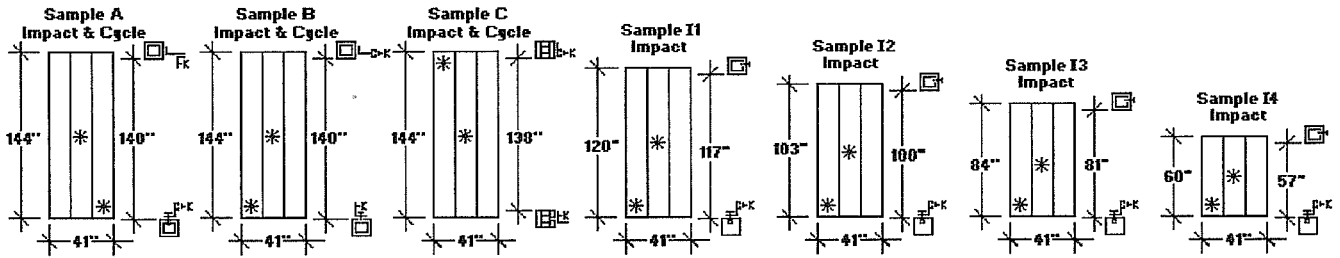
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Impact and Cyclic Wind Loading / Manner of Testing: In accordance with ASTM E 1886-97 Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials and in conformance to ASTM E 1896-02 Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes. The specimen, as described, were impacted (as shown in the diagram above) with a 9.02 lb, 96" long, S4S, 2x4, of No. 2 Southern Pine lumber, in locations as directed in the reference specification ASTM E 1896-02 and at Missile Level D. Data follows:

Impact Test Results

ID	Size	Location Rt(in), Up(in) {1}	Location Description {2}	Velocity Ft/Sec {3}	Deflection Inches {4}	Permanent Set Inches {5}
A	41" x 144"	21, 72	Center Panel 2 / 3	49.2	7.25	0.00
A	41" x 144"	33, 8	Lower Right Corner	49.6	3.50	3.50
B	41" x 144"	21, 71	Center Panel 2 / 3	49.1	7.50	0.00
B	41" x 144"	6, 12	Lower Left Corner	49.3	2.00	0.00
C	41" x 144"	21, 72	Center Panel 2 / 3	49.7	7.00	0.00
C	41" x 144"	8, 133	Upper Left Corner	49.6	3.00	0.00
I1	41" x 120"	21, 60	Center Panel 2 / 3	49.7	6.50	0.00
I1	41" x 120"	7, 11	Lower Left Corner	49.6	2.69	2.00
I2	41" x 103"	21, 52	Center Panel 2 / 3	49.6	6.00	0.00
I2	41" x 103"	6, 12	Lower Left Corner	49.5	2.88	1.75
I3	41" x 84"	21, 41	Center Panel 2 / 3	49.5	5.25	0.00
I3	41" x 84"	8, 11	Lower Left Corner	49.7	2.25	1.88
I4	41" x 60"	21, 29	Center Panel 2 / 3	49.3	4.13	0.00
I4	41" x 60"	6, 12	Lower Left Corner	49.5	2.38	2.00

(1) : Impact location given on Cartesian grid, right and up from lower left hand corner.

(2) : The location description relative to the product assembly.

(3) : Impact velocity measured with an Oehler Chronometer model 35P, verified by the video method.

(4) : Deflections recorded by the change in height of a collapsed aluminum foil cylinder.

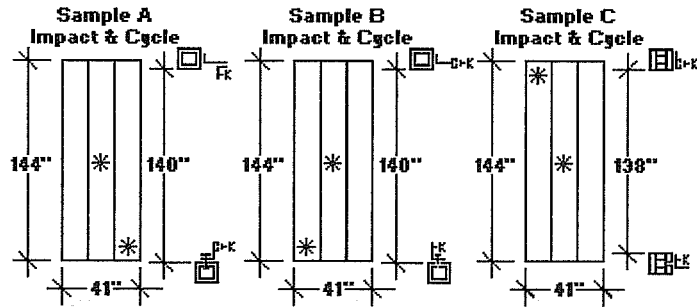
(5) : Set readings made from the deformed product to a reference plane with a steel ruler.

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Following impacts, specimens A, B & C were cyclic wind loaded as directed in the reference specification ASTM E 1996-02, Table 1 : Cyclic Static Air Pressure Loading. In general, numerous static air pressure cycles are applied to specimens at varying load levels based upon the positive and negative design load levels. A detailed account follows:

Cyclic Wind Loading Data

No. Cycles	Range	Design PSF	Low PSF	High PSF	Defl'ns A		Defl'ns B		Defl'ns C	
					Low Inches	High Inches	Low Inches	High Inches	Low Inches	High Inches
0					0.000	NA	0.000	NA	0.000	NA
3500	20% to 50% Pos. DL	39.0	7.8	19.5	2.563	4.688	2.625	4.750	2.125	4.313
300	0% to 60% Pos. DL	39.0	0.0	23.4	0.438	5.500	0.500	5.563	0.438	5.000
600	50% to 80% Pos. DL	39.0	19.5	31.2	5.188	6.625	5.250	6.688	4.688	6.125
100	30% to 100% Pos. DL	39.0	11.7	39.0	3.500	7.563	0.244	7.625	3.000	7.125
0					0.125	NA	0.125	NA	0.094	NA
0					0.000	NA	0.000	NA	0.000	NA
50	30% to 100% Neg. DL	(39.0)	(11.7)	(39.0)	3.875	7.875	4.000	7.875	3.375	7.375
1050	50% to 80% Neg. DL	(39.0)	(19.5)	(31.2)	5.625	7.000	5.750	7.031	5.000	6.500
50	0% to 60% Neg. DL	(39.0)	(0.0)	(23.4)	0.625	5.875	0.688	5.938	0.375	5.313
3350	20% to 50% Neg. DL	(39.0)	(7.8)	(19.5)	3.000	5.250	3.031	5.281	2.500	4.625
0					0.219	NA	0.250	NA	0.188	NA
9000	Total Cycles									

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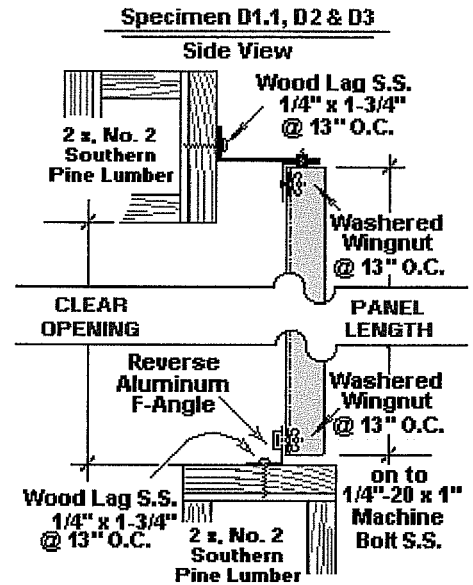
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Specimen D1.1 : Build Out / Floor, Mount : 84" Panels : 80" C.O. : +Wind

Head: Panels were mounted at 13" on center with washered wing nuts onto a studded aluminum angle. This angle was secured with #14 x 3/4" stainless steel, self drilling, self tapping, screws at 13" on center to the 5" leg of a 2" x 5" aluminum angle, forming a 3" build out. This 2" x 5" angle was in turn secured to a No: 2 Southern Pine lumber beam at 13 on center with S.S. 1/4" x 1-3/4" wood lags. **Sill:** Panels were mounted at 13" O.C. with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into an aluminum reverse f-track. This reverse f-angle was secured to a No: 2 Southern Pine lumber beam at 13 on center with S.S. 1/4" x 1-3/4" wood lags.

Static Wind Loading / Manner of Testing: In accordance with ASTM E 330-97 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference : The loads applied to the specimen in a 45 second load cycle (10 seconds from zero to the load, 30 second duration at load & 5 seconds to release load) were at levels specified by the client's Consulting Engineer. Polyethylene film (2 mil) and tape were used to seal air leakage during loads these were used in a manner that did not influence the results. Gauges were mounted along the centerline of the specimen's primary span to record deflections. The deflection readings follow:



Wind Load Data : Specimen D1.1

Load PSF	Load in H2O	Top		Center		Bottom		NET Defl'n at Load	Gross Defl'n at Load	Percent Recovery	Percent Recovery
		Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load				
0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	NA	NA
10.4	2.0	0.000	0.000	1.313	0.000	0.000	0.000	1.313	0.000	100.0%	100.0%
20.8	4.0	0.000	0.000	2.625	0.000	0.000	0.000	2.625	0.000	100.0%	100.0%
31.2	6.0	0.031	0.000	3.375	0.000	0.000	0.000	3.359	0.000	100.0%	100.0%
41.6	8.0	0.063	0.000	4.063	0.000	0.000	0.000	4.031	0.000	100.0%	100.0%
52.0	10.0	0.094	0.000	4.750	0.031	0.000	0.000	4.703	0.031	99.3%	99.3%
62.4	12.0	0.125	0.000	5.375	0.063	0.000	0.000	5.313	0.063	98.8%	98.8%
72.8	14.0	0.156	0.031	6.125	0.125	0.031	0.000	6.031	0.109	98.2%	98.0%
83.2	16.0	0.188	0.094	6.750	0.188	0.063	0.031	6.625	0.125	98.1%	97.2%
93.6	18.0	0.219	0.125	7.438	0.250	0.094	0.063	7.281	0.156	97.9%	96.6%
104.0	20.0	0.250	0.188	8.125	0.313	0.125	0.094	7.938	0.172	97.8%	96.2%
114.4	22.0	NR	NR	NR	NR	NR	NR				

Shear Failure at ~20-1/4" H2O, at head, 2nd & 3rd panel overlap torn from fastener.

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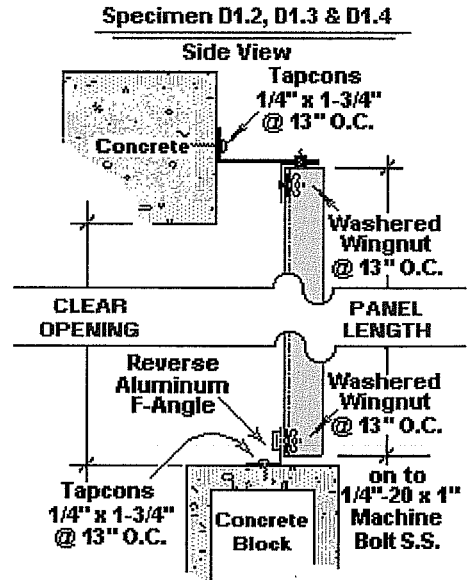
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Specimen D1.2 : Build Out / Floor, Mount : 84" Panels : 80" C.O. : -Wind

Head: Panels were mounted at 13" on center with washered wing nuts onto a studded aluminum angle. This angle was secured with #14 x 3/4" stainless steel, self drilling, self tapping, screws at 13" on center to the 5" leg of a 2" x 5" aluminum angle, forming a 3" build out. This 2" x 5" angle was in turn secured to a concrete beam at 13" on center with **Maxi Set 1/4" x 1-3/4" ITW Tapcon** masonry screws. **Sill:** Panels were mounted at 13" on center with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into an aluminum reverse f-track. This reverse f-angle was secured at 13" on center to a concrete block beam with standard 1/4" x 1-3/4" ITW Tapcon masonry screws.

Static Wind Loading / Manner of Testing: In accordance with ASTM E 330-97 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference : The loads applied to the specimen in a 45 second load cycle (10 seconds from zero to the load, 30 second duration at load & 5 seconds to release load) were at levels specified by the client's Consulting Engineer. Polyethylene film (2 mil) and tape were used to seal air leakage during loads these were used in a manner that did not influence the results. Gauges were mounted along the centerline of the specimen's primary span to record deflections. The deflection readings follow:



Wind Load Data : Specimen D1.2

Load PSF	Load in H2O	Top		Center		Bottom		NET Defl'n at Load	Gross Defl'n at Load	Percent Recovery	Percent Recovery
		Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load				
0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	NA	NA
(10.4)	2.0	0.031	0.000	1.500	0.000	0.000	0.000	1.484	0.000	100.0%	100.0%
(20.8)	4.0	0.063	0.000	2.750	0.000	0.000	0.000	2.719	0.000	100.0%	100.0%
(31.2)	6.0	0.094	0.000	3.563	0.000	0.000	0.000	3.516	0.000	100.0%	100.0%
(41.6)	8.0	0.125	0.000	4.250	0.000	0.000	0.000	4.188	0.000	100.0%	100.0%
(52.0)	10.0	0.156	0.000	4.938	0.031	0.000	0.000	4.859	0.031	99.4%	99.4%
(62.4)	12.0	0.188	0.094	5.688	0.063	0.031	0.016	5.578	0.008	99.9%	98.9%
(72.8)	14.0	0.250	0.125	6.313	0.125	0.063	0.047	6.156	0.039	99.4%	98.0%
(83.2)	16.0	0.281	0.156	7.000	0.219	0.094	0.063	6.813	0.109	98.4%	96.9%
(93.6)	18.0	0.313	0.188	7.688	0.250	0.125	0.094	7.469	0.109	98.5%	96.7%
(98.8)	19.0	0.344	0.250	8.000	0.375	0.125	0.125	7.766	0.188	97.6%	95.3%
(104.0)	20.0	NR	NR	NR	NR	NR	NR				

Shear Failure at ~19-1/2" H2O, at sill, 1st & 2nd panel overlap torn from fastener.

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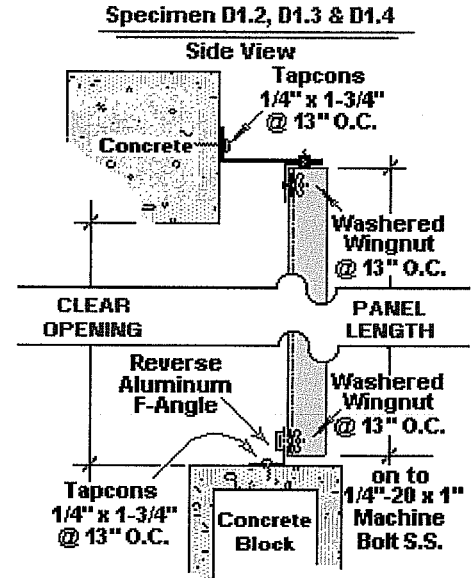
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Specimen D1.3 : Build Out / Floor, Mount : 84" Panels : 80" C.O. : -Wind

Head: Panels were mounted at 13" on center with washered wing nuts onto a studded aluminum angle. This angle was secured with #14 x 3/4" stainless steel, self drilling, self tapping, screws at 13" on center to the 5" leg of a 2" x 5" aluminum angle, forming a 3" build out. This 2" x 5" angle was in turn secured to a concrete beam at 13" on center with **Maxi Set 1/4" x 1-3/4" ITW Tapcon** masonry screws. **Sill:** Panels were mounted at 13" on center with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into an aluminum reverse f-track. This reverse f-angle was secured at 13" on center to a concrete block beam with standard 1/4" x 1-3/4" ITW Tapcon masonry screws.

Static Wind Loading / Manner of Testing: In accordance with ASTM E 330-97 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference : The loads applied to the specimen in a 45 second load cycle (10 seconds from zero to the load, 30 second duration at load & 5 seconds to release load) were at levels specified by the client's Consulting Engineer. Polyethylene film (2 mil) and tape were used to seal air leakage during loads these were used in a manner that did not influence the results. Gauges were mounted along the centerline of the specimen's primary span to record deflections. The deflection readings follow:



Wind Load Data : Specimen D1.3

Load PSF	Load in H2O	Top		Center		Bottom		NET		Gross	
		Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Percent Recovery	Percent Recovery
0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	NA	NA
(10.4)	2.0	0.063	0.000	1.625	0.000	0.000	0.000	1.594	0.000	100.0%	100.0%
(20.8)	4.0	0.094	0.000	2.938	0.000	0.000	0.000	2.891	0.000	100.0%	100.0%
(31.2)	6.0	0.125	0.000	3.688	0.000	0.000	0.000	3.625	0.000	100.0%	100.0%
(41.6)	8.0	0.156	0.000	4.375	0.000	0.000	0.000	4.297	0.000	100.0%	100.0%
(52.0)	10.0	0.188	0.000	5.094	0.031	0.000	0.000	5.000	0.031	99.4%	99.4%
(62.4)	12.0	0.250	0.125	5.813	0.063	0.031	0.000	5.672	0.000	100.0%	98.9%
(72.8)	14.0	0.281	0.156	6.500	0.125	0.063	0.031	6.328	0.031	99.5%	98.1%
(83.2)	16.0	0.313	0.188	7.188	0.219	0.094	0.063	6.984	0.094	98.7%	97.0%
(93.6)	18.0	0.375	0.219	7.938	0.250	0.125	0.094	7.688	0.094	98.8%	96.9%
(98.8)	19.0	0.406	0.250	8.250	0.375	0.156	0.125	7.969	0.188	97.6%	95.5%
(104.0)	20.0	NR	NR	NR	NR	NR	NR				

Test discontinued when sample D1.2 Failed.

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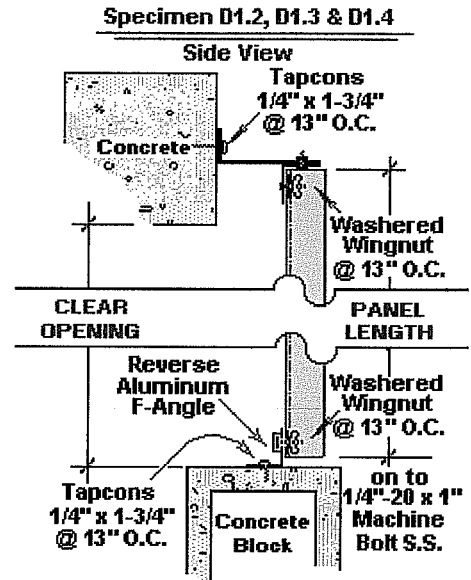
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Specimen D1.4 : Build Out / Floor, Mount : 84" Panels : 80" C.O. : -Wind

Head: Panels were mounted at 13" on center with washered wing nuts onto a studded aluminum angle. This angle was secured with #14 x 3/4" stainless steel, self drilling, self tapping, screws at 13" on center to the 5" leg of a 2" x 5" aluminum angle, forming a 3" build out. This 2" x 5" angle was in turn secured to a concrete beam at 13" on center with Maxi Set 1/4" x 1-3/4" ITW Tapcon masonry screws. **Sill:** Panels were mounted at 13" on center with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into an aluminum reverse f-track. This reverse f-angle was secured at 13" on center to a concrete block beam with standard 1/4" x 1-3/4" ITW Tapcon masonry screws.

Static Wind Loading / Manner of Testing: In accordance with ASTM E 330-97 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference : The loads applied to the specimen in a 45 second load cycle (10 seconds from zero to the load, 30 second duration at load & 5 seconds to release load) were at levels specified by the client's Consulting Engineer. Polyethylene film (2 mil) and tape were used to seal air leakage during loads these were used in a manner that did not influence the results. Gauges were mounted along the centerline of the specimen's primary span to record deflections. The deflection readings follow:



Wind Load Data : Specimen D1.4

Load PSF	Load in H2O	Top		Center		Bottom		NET		Gross	
		Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Percent Recovery	Percent Recovery
0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	NA	NA
(10.4)	2.0	0.000	0.000	1.438	0.000	0.000	0.000	1.438	0.000	100.0%	100.0%
(20.8)	4.0	0.063	0.000	2.688	0.000	0.000	0.000	2.656	0.000	100.0%	100.0%
(31.2)	6.0	0.094	0.000	3.438	0.000	0.000	0.000	3.391	0.000	100.0%	100.0%
(41.6)	8.0	0.125	0.000	4.125	0.000	0.000	0.000	4.063	0.000	100.0%	100.0%
(52.0)	10.0	0.156	0.000	4.813	0.094	0.000	0.000	4.734	0.094	98.0%	98.1%
(62.4)	12.0	0.188	0.000	5.500	0.188	0.031	0.000	5.391	0.188	96.5%	96.6%
(72.8)	14.0	0.219	0.094	6.188	0.219	0.047	0.031	6.055	0.156	97.4%	96.5%
(83.2)	16.0	0.250	0.125	6.875	0.250	0.063	0.063	6.719	0.156	97.7%	96.4%
(93.6)	18.0	0.281	0.156	7.594	0.313	0.078	0.063	7.414	0.203	97.3%	95.9%
(98.8)	19.0	0.219	0.188	7.875	0.375	0.094	0.063	7.719	0.250	96.8%	95.2%
(104.0)	20.0	NR	NR	NR	NR	NR	NR				

Test discontinued when sample D1.2 Failed.

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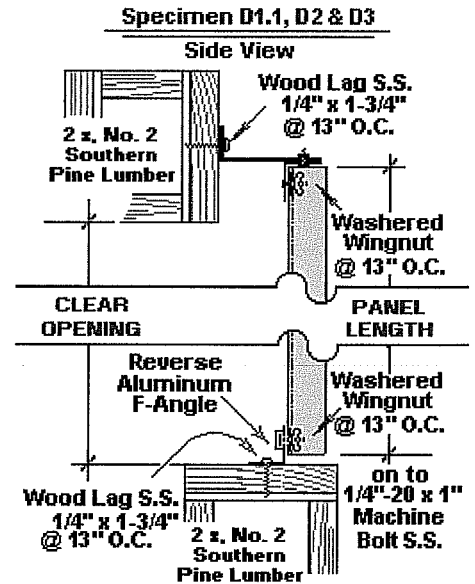
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Specimen D2 : Build Out / Floor, Mount : 144" Panels : 140" C.O. : -Wind

Head: Panels were mounted at 13" on center with washered wing nuts onto a studded aluminum angle. This angle was secured with #14 x 3/4" stainless steel, self drilling, self tapping, screws at 13" on center to the 5" leg of a 2" x 5" aluminum angle, forming a 3" build out. This 2" x 5" angle was in turn secured to a No: 2 Southern Pine lumber beam at 13 on center with S.S. 1/4" x 1-3/4" wood lags. **Sill:** Panels were mounted at 13" O.C. with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into an aluminum reverse f-track. This reverse f-angle was secured to a No: 2 Southern Pine lumber beam at 13 on center with S.S. 1/4" x 1-3/4" wood lags.

Static Wind Loading / Manner of Testing: In accordance with ASTM E 330-97 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference : The loads applied to the specimen in a 45 second load cycle (10 seconds from zero to the load, 30 second duration at load & 5 seconds to release load) were at levels specified by the client's Consulting Engineer. Polyethylene film (2 mil) and tape were used to seal air leakage during loads these were used in a manner that did not influence the results. Gauges were mounted along the centerline of the specimen's primary span to record deflections. The deflection readings follow:



Wind Load Data : Specimen D2

Load PSF	Load in H2O	Top		Center		Bottom		NET		Gross	
		Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Defl'n at Load	Percent Recovery	Percent Recovery
0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	NA	NA
(10.4)	2.0	0.063	0.000	3.250	0.000	0.000	0.000	3.219	0.000	100.0%	100.0%
(20.8)	4.0	0.156	0.000	5.500	0.063	0.000	0.000	5.422	0.063	98.8%	98.9%
(31.2)	6.0	0.188	0.000	7.000	0.125	0.000	0.000	6.906	0.125	98.2%	98.2%
(41.6)	8.0	0.313	0.000	8.188	0.188	0.031	0.000	8.016	0.125	98.4%	98.5%
(46.8)	9.0	0.344	0.031	8.688	0.313	0.063	0.016	8.484	0.164	98.1%	97.8%
(52.0)	10.0	0.375	0.063	9.250	0.438	0.094	0.031	9.016	0.266	97.1%	96.6%
(57.2)	11.0	0.438	0.125	9.813	0.563	0.125	0.094	10.531	0.328	96.9%	96.0%
(62.4)	12.0	NR	NR	NR	NR	NR	NR				

Shear Failure at ~11-1/2" H2O, at sill, 2nd panel of three torn from fasteners.

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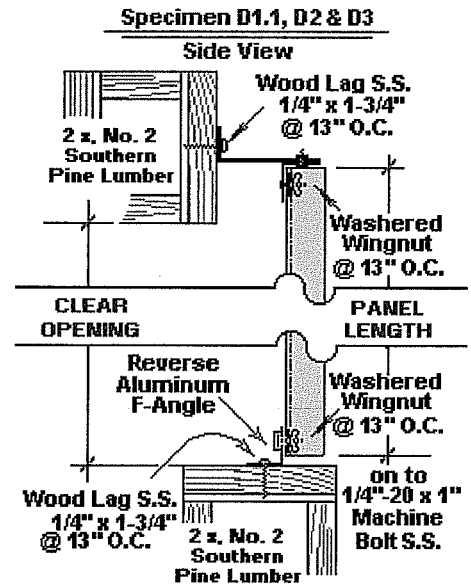
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Phone : 305-685-6657 Fax : 305-685-6659 Email : ctclab@bellsouth.net

Specimen D3 : Build Out / Floor, Mount : 60" Panels : 57" C.O. : -Wind

Head: Panels were mounted at 13" on center with washered wing nuts onto a studded aluminum angle. This angle was secured with #14 x 3/4" stainless steel, self drilling, self tapping, screws at 13" on center to the 5" leg of a 2" x 5" aluminum angle, forming a 3" build out. This 2" x 5" angle was in turn secured to a No: 2 Southern Pine lumber beam at 13 on center with S.S. 1/4" x 1-3/4" wood lags. **Sill:** Panels were mounted at 13" O.C. with washered wing nuts onto stainless steel, 1/4"-20 x 1" machine bolts trapped into an aluminum reverse f-track. This reverse f-angle was secured to a No: 2 Southern Pine lumber beam at 13 on center with S.S. 1/4" x 1-3/4" wood lags.

Static Wind Loading / Manner of Testing: In accordance with ASTM E 330-97 Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference : The loads applied to the specimen in a 45 second load cycle (10 seconds from zero to the load, 30 second duration at load & 5 seconds to release load) were at levels specified by the client's Consulting Engineer. Polyethylene film (2 mil) and tape were used to seal air leakage during loads these were used in a manner that did not influence the results. Gauges were mounted along the centerline of the specimen's primary span to record deflections. The deflection readings follow:



Wind Load Data : Specimen D3

Load	Load	Top		Center		Bottom		NET	Gross	
		Def'n	Def'n	Def'n	Def'n	Def'n	Def'n			
PSF	in H2O	at Load	at Load	at Load	at Load	at Load	at Load	at Load	Percent Recovery	Percent Recovery
0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	NA	NA
(31.2)	6.0	0.094	0.000	1.750	0.000	0.000	0.000	1.703	100.0%	100.0%
(62.4)	12.0	0.188	0.000	2.938	0.000	0.000	0.000	2.844	100.0%	100.0%
(93.6)	18.0	0.313	0.000	3.875	0.031	0.031	0.000	3.703	99.2%	99.2%
(109.2)	21.0	0.344	0.031	4.344	0.063	0.063	0.031	4.141	99.2%	98.6%
(124.8)	24.0	0.406	0.063	4.844	0.125	0.125	0.063	4.578	98.6%	97.4%
(140.4)	27.0	0.438	0.094	5.344	0.188	0.188	0.094	5.031	98.1%	96.5%
(145.6)	28.0	0.500	0.125	5.500	0.250	0.250	0.125	5.125	97.6%	95.5%
(150.8)	29.0	NR	NR	NR	NR	NR	NR			

Shear Failure at ~27-1/2" H2O, at sill, 1st & 2nd panel overlap, torn from fastener.

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Report No: 04-009 FE ASTM

19 July 2004

Test Dates: 14, 26, 27 & 28 May, 2 June & 5 July 2004

Test Summary : Polycarbonate Hurricane Shutter Panels

Client:

Transparent Protection Systems, Inc.

6643 North 42nd Terrace

West Palm Beach, FL 33407

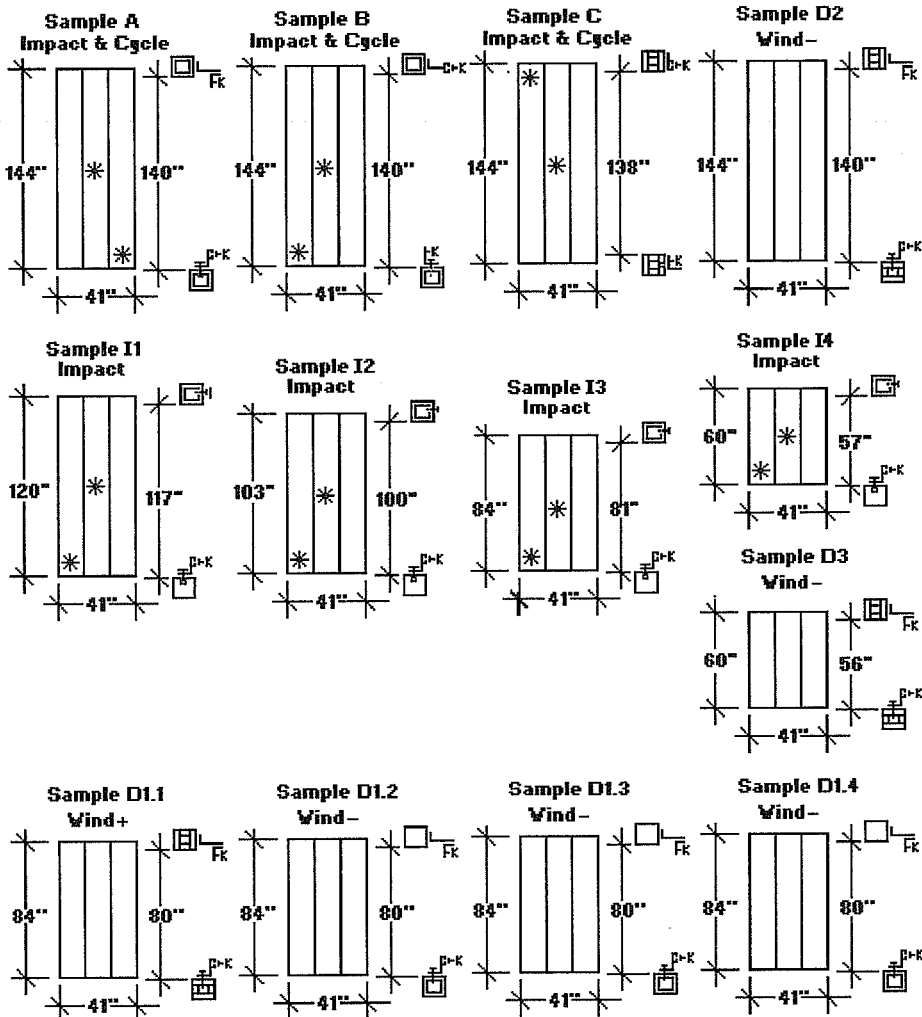
Phone: 888-447-8320 Fax: 561-844-2445

IMPACTS : Specimens A, B, C, I1, I2, I3 & I4 were impacted in accordance with ASTM E 1886-97 per specification ASTM E 1996-02 at Missile Level D. None failed as a result of impacts.

CYCLIC WIND LOADS : Specimens A, B & C were subjected to cyclic wind loads in accordance with ASTM E 1886-97 per specification ASTM E 1996-02, Table 1. All specimen successfully completed the cyclic wind loads to verified a Design Load of +/-39.0 PSF.

WIND LOADS : Specimens D1.1, D1.2, D1.3, D1.4, D2 & D3 were subjected to static wind loads in accordance with ASTM E 330-97. Specimen were tested to failure, these failures are described following the relevant data.

CONCLUSION: Following testing all specimen were disassembled. No failures were observed in the shutters, the fastenings or anchorages, except as noted in specimen deliberately tested to failure, descriptions of these follow the relevant data. The shutter product here in and in the accompanying drawings complies with **Standard Specification for Performance of... Storm Shutters Impacted by Windborne Debris in Hurricanes** for a Design Load of +/-PSF at Missile Level D. The shutter product was tested in accordance with and meets the requirements to comply with Florida Building Code 2001, Sections 1606, 1619 & 1626.



Respectfully submitted, CONSTRUCTION TESTING CORPORATION

(Miami-Dade Certification # 01-0924.04)

Report by George Dotzler: _____

Test witnessed & report reviewed _____

By Yamil G. Kuri, P.E.: _____

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