Glass Balustrade Rail Testing
FBC 2017- HVHZ (Interior)
Interior and Exterior FBC 2017 (Large Missile & above 30 ft. Elevation)
Interior and Exterior International Building Code 2015

February 4, 2019

REPORT NUMBER:	**HETI-19-7007**
MANUFACTURER:	Arteferro Miami LLC 2955 N 75th St., Miami, Florida 33147-5943
TEST LOCATION:	Hurricane Engineering & Testing Inc. 6120 NW 97th Avenue, Doral, Florida, 33178
NOTIFICATION NUMBER:	HETI19002 (MIAMI-DADE COUNTY, FLORIDA
LAB. CERTIFICATION No.:	15-1216.04 (MIAMI-DADE COUNTY, FLORIDA)
IAS. CERTIFICATION No.:	TL-296 (ISO 17025-05)
FBC ORGANIZATION No:	TST1691
FBPE Certificate of Authorization Number: 6905	
PRODUCT:	Top Mount Railing.
PRODUCT SIZE:	145 ½" wide x 44" high
TEST SUBSTRATUM:	Concrete Compressive strength 4230 PSI, HETI-19-C100
DRAWING NO.:	AD19-12 by MCY Engineering, Inc consisting of 4 pages dated 03-13-2019.
DESIGN LOADS (psf):	**+65, -65**
TEST WITNESSED BY:	Syed Waqar Ali, Ph. D. (HETI) Dr. Nasreen K Ali, E. I. (HETI) Mr. Matthew Laskowski (HETI) Mr. Joe Martinez (Manufacturer) Mr. Luca Serman (Manufacturer) Mr. Rafael E. Droz-Seda, P.E. (HETI)

TESTING STANDARDS AND TESTING SEQUENCE:

Testing Standards:

1. Interior Florida Building Code (FBC) 2017, High Velocity Hurricane Zone (HVHZ).
2. Interior and Exterior Florida Building Code 2017, including Wind Borne Debris Regions.
3. International Building Code (IBC) 2015.

Testing Sequence (**All tests performed on a single specimen):**

1. Infill concentrated load test on 4"x4" and 12" x 12" squares.
2. Uniform Static Air Pressure Test as per TAS 202 & ASTM E 330 as Section 1609 of FBC 2017 and
3. Horizontal and Vertical Loading per IBC/FBC section 2407.1.2 and IBC 2015 section 1609.
4. ANSI Z97.1-1984 (R1994) Sec 5 for Class A 1618.4.6 & CPSC 16 CFR Part 1201 for Class II as per Section 1618.4.6 & 2407.1.4.1 of FBC 2010.
5. Large Missile Impact Test as per ASTM 1886/1996 and FBC/IBC section 1609.1.2.

CONSTRUCTION DETAILS

SPECIMEN SELECTION AND IDENTIFICATION

Number of Specimens	1
Method of Choosing	Provided by Manufacturer
Size of Specimen	145 ½" wide x 44" high
Configuration	Fixed
Distance between Glass Lites	⅜"
Hand Rail	Hand rail was installed and remained unattached.

COMPONENTS AND HARDWARE

Drawing No.	Description	Overall Dimension (in)	Maximum Thickness (in)	Material	Quantity
E1800135	Floor Anchorage Base Shoe	1.88 x 4.92	0.550	6063-T6	1
E1000424	Cap Rail	1.68 x 1.46	0.060	304 SS	1
E1806600	Glass Gasket	0.93 x 5.85 x 3.42	0.150	PVC Plastic	23
	Glass Wedge	3.95 x 2.54	0.195	PVC Plastic	23
---	Glass Wedge Shim	1.94 x 2.20	0.057	PVC Plastic	23
E1999370	Cap Gasket	0.85 x 0.98	0.049	EDPM	1
E1806620	Glazing Base Gasket	0.35 x 0.54	0.136	EDPM	1

Glazing Material

Laminated Glass (NOA) 17-0808.02 by Kuraray America, Inc.:

- ⅜" Nominal (0.365" actual) Tempered Glass
- 0.060" Interlayer SentryGlas® by Kuraray America, Inc.
- ⅜" Nominal (0.365" actual) Tempered Glass
- ¾" Nominal (0.790" actual) Total Thickness

Glass Size and Quantity (3) 48" wide x 42" high

DLO: (3) 48" wide x 37 ½" high

Glazing Method

(23) Glass gasket inlays were laid into the top mount extrusion at 3" from the ends and 6" o.c.. The glass was then installed, leveled, and set into place by installing (23) glass wedges, which were installed in the center of the inlay, on the opposite side of the glass, and included a glass wedge shim inserted between each glass wedge and the inner wall of the base shoe. The safety wedges were secured by hammering them down to a depth specified by the manufacturer using a manufacturer provided tool. Next the glazing gaskets, with a Shore A Hardness of 70, were installed on the interior and exterior of the glass. Lastly, the cap rail gasket, with a Shore A Hardness of 70, was installed on top of the glass followed by the cap rail.

Substrate 4230 PSI Concrete

Installation The floor/top mount extrusion was installed onto the concrete substrate using (36) ⅜" x 5" Hilti KH-EZ Screw Anchors and Hilti HIT-HY 100 (Epoxy), located at 4" from the ends and 3 13/16" o.c., with a minimum edge distance of 5".

INSTRUMENTATION

1. Digital Deflection Gauge System: HETI-0311 and HETI-1060
2. Manual Hydraulic Pump and Cylinder: HETI-0282, HETI-1140.
3. Force Measurement System: HETI-0182 and HETI-0850
4. Test Wall System B, Pressure Transducer HETI-0357
5. Test Wall System B, Deflection Gage HETI-0172

TEST RESULTS

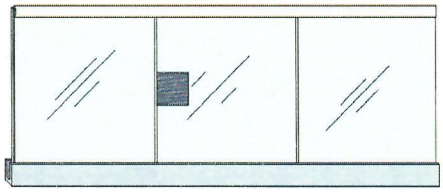
Loading Procedure:

1. Apply 50% of the maximum load.
2. Apply Maximum load in increments of 15%.
   a. Each increment held for 300 seconds.
   b. Record the deflection at start and end of 300 seconds period.
   c. Rate of loading shall be 5.0 mm per minutes to the desired load if possible.

4" Infill Test (Lateral Load)

Test Date: January 17, 2019

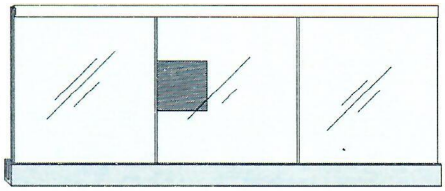
Description of Location	Duration (sec)	Force Applied (lbs)
Center of Edge of Middle Lite	300	112.4
Center of Edge of Middle Lite	300	284



12" Infill Test (Lateral Load)

Test Date: January 17, 2019

Description of Location	Duration (sec)	Force Applied (lbs)
Center of Edge of Middle Lite	300	50
Center of Edge of Middle Lite	300	200

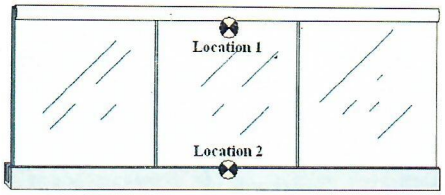


Uniform Static Air Pressure Test as per TAS 202 & ASTM E 330

Test Date: January 17, 2019

	Pressure (psf)	Def. Loc #1 (In)	Def. Loc #2 (In)	Set Loc #1/ Loc #2 (In)	Recovery Loc #1 (%)	Duration (sec)
Positive Pressure						
Design Load	+65	1.77	0.34	0.04/0.09	98	30
Test Load	+130	3.98	0.64	0.04/0.05	99	30
Negative Pressure						
Design Load	-65	1.80	0.19	0.04/0.02	98	30
Test Load	-130	3.61	0.38	0.25/0.05	93	30

Uniform Load Test was performed with ASTM E330-14 test method. See Figure for Loc #1 & Loc #2.



Horizontal and Vertical Loading per IBC/FBC

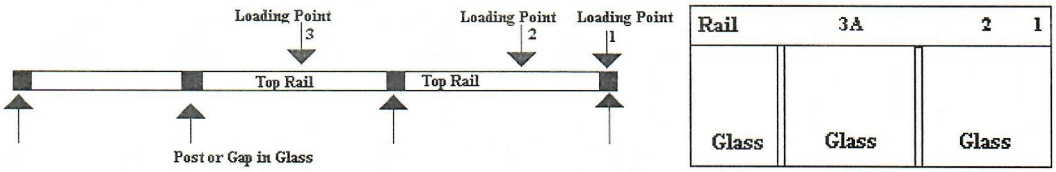
Loading Procedure:

1. Apply Maximum load in increments of 15%.
   a. Record the deflection at start and end of hold time.
   b. Rate of loading shall be 5.0 mm per minutes to the desired load if possible.

Test Date: January 18, 2019

Horizontal Load Application											
	Force (lbs)	Hold Time (Sec)	Loc. #1			Loc. #2			Loc. #3A		
			Deflection (in)		Set (in)	Deflection (in)		Set (in)	Deflection (in)		Set (in)
			Start	End		Start	End		Start	End	
Interior Side	200	300	0.00	0.97	0.06	0.00	0.78	0.00	0.00	0.75	0.07
	400	300	0.00	1.62	0.04				0.00	1.28	0.04
	800	60	0.00	2.78	0.09	0.00	2.14	0.05	0.00	2.15	0.03
Exterior Side	200	60							0.00	0.56	0.08
	800	60							0.00	2.61	0.28
	Vertical Load Application										
Top Rail	50	300	0.00	0.00	0.00				0.00	0.00	0.00
	100	300	0.00	0.00	0.00				0.00	0.01	0.00
	200	60	0.00	0.01	0.00				0.00	0.01	0.00
	1200	60	0.00	0.13	0.03				0.00	0.12	0.04

Horizontal and Vertical Loading Points:



Safety Glazing Testing as per ANSI Z97.1-1984 (R1994)

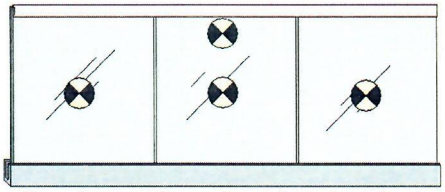
TEST PROCEDURE

The test specimen as described in construction details was tested. The sample was impacted at center of each glass with a 100-pound lead Impactor. The Impactor was constructed as specified in ANSI Z97.1-1984 (R1994). The drop height and test results are summarized in table below.

TEST RESULTS

Test Date: January 18, 2019

No.	Drop Height (in)	Results
Center of Left Glass Lite		
1	12	Glass was intact and no damaged was observed.
2	18	Glass was intact and no damaged was observed.
3	48	Glass was intact and no damaged was observed.
Center of Middle Glass Lite		
1	12	Glass was intact and no damaged was observed.
2	18	Glass was intact and no damaged was observed.
3	48	Glass was intact and no damaged was observed.
Center of Right Glass Lite		
1	12	Glass was intact and no damaged was observed.
2	18	Glass was intact and no damaged was observed.
3	48	Glass was intact and no damaged was observed.
8" (max) Below the Top of the Hand Rail		
1	12	Glass was intact and no damaged was observed.
2	18	Glass was intact and no damaged was observed.
3	48	Glass was intact and no damaged was observed.



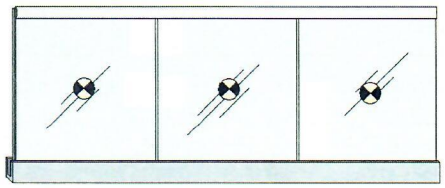
⊗ - Impact Locations (interior view)

Large Missile Impact Test Results

Test Date: January 21, 2019

Impact Location	Speed (fps)	Description of Result
Center of Left Glass Lite	50	Both Lites Broke Top rail remained in Place
Center of Middle Glass Lite	50	Both Lites Broke Top rail remained in Place
Center of Right Glass Lite	50	Both Lites Broke Top rail remained in Place

The sample was impacted with a #2 Southern Yellow Pine S4S, 2 x 4 missile, 9 lbs 96" long.



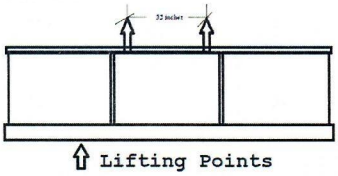
⊗ - Impact Locations (exterior view)

Vertical Uplift Load

Test Date: January 24, 2019

Description of Location	Duration (sec)	Force Applied (lbs)
Two Point Lifting on Glass Hand Rail	30	1067
Maximum force applied to achieve failure = 1450 lbf.		

Note: The upward force was applied to the top rail as two-point loading at 32 inches on center at mid span. The load required 50# x 5.33 ft. x 4 = 1067 lbf.



Conclusion

The test sample represented intended construction as indicated in the marked drawing. The sample was tested in accordance with provisions of Florida Building Code 2017, International Building Code 2015.

The Railing was intact and all parts were securely in place at the conclusion of each test except as note for the large missile impact test, where both glass lites of the laminated glass broke on impact while the top rail remained in place.

NOTE: The above results were obtained using the designated test methods that indicates compliance with the performance requirements of the referenced specifications. This report does not constitute certification of the specimens tested.

STATEMENT OF INDEPENDENCE

The Hurricane Engineering & Testing, Inc., does not have, nor does it intend to acquire or will acquire, a financial interest in any company manufacturing or distributing products tested or labeled by the Hurricane Engineering & Testing, Inc. Hurricane Engineering & Testing, Inc., is not owned, operated or controlled by any company manufacturing or distributing products it test or labels.

Dr. Nasreen K. Ali
Vice President

Mr. Rafael E. Droz-Seda, P.E.
Resident Engineer