RICE ENGINEERING

ASTM E985 TEST REPORT

GR2457 HCB-10 Base Shoe and PG2475 Pad and Isolator

Rendered to:
R&B Wagner, Inc.
10600 W Brown Deer Rd
Milwaukee, WI 53224

Report Number:	R15-06-210.2
Set-up Date:	07/23/2015
Test Date:	07/23/2015
Report Date:	07/28/2015

Project Identification: GR2457HCB-10 base shoe with PG2475 pad and isolator ASTM E985 Testing

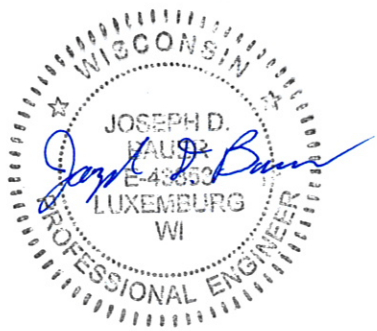
Project Scope: Rice Engineering was contacted by R&B Wagner, Inc. to witness testing of their GR2457 base shoe guardrail system, specifically the amount of deflection that would occur in 13/16" thick tempered PVB laminated glass (3/8" / 0.060" PVB / 3/8"), 5/8" thick tempered PVB laminated glass (1/4" / 0.060" PVB / 3/8"), and 5/8" thick tempered SGP laminated glass (1/4" / 0.060" SGP / 3/8") when pulled to design loads as described in ASTM E985 "Standard Specification for Permanent Metal Railing Systems and Rails for Buildings". On July 23rd, 2015, Joseph Bauer of Rice Engineering witnessed testing for the three different configurations. The testing was performed on-site at the R&B Wagner facility and was conducted by Justin Wesser.

Conclusions: The 13/16" PVB laminated glass lite was tested to a maximum deflection of 1.938" at ultimate test load (365 lbf). The allowable deflection was 2.25". The residual deflection (measured at 90 lbf) was 0.155". The allowable residual deflection was 0.45". There were no signs of deformation on the base shoe or any problems with the pad and isolators, therefore 13/16" PVB laminated glass passed the ASTM E985 test.

The 5/8" PVB laminated glass lite was tested to a maximum deflection of 2.653" at ultimate test load (365 lbf). The allowable deflection was 2.25". The residual deflection (measured at 90 lbf) was 0.171". The allowable residual deflection was 0.45". There were no signs of deformation on the base shoe or any problems with the pad and isolators, therefore 5/8" PVB laminated glass passed the ASTM E985 test for residual deflection, but did not pass for maximum deflection.

The 5/8" SGP laminated glass lite was tested to a maximum deflection of 1.394" at ultimate test load (365 lbf). The allowable deflection was 2.25". The residual deflection (measured at 90 lbf) was 0.067". The allowable residual deflection was 0.45". There were no signs of deformation on the base shoe or any problems with the pad and isolators, therefore the 5/8" SGP laminated glass passed the ASTM E985 test.

Prepared & Witnessed By:



Joseph D. Bauer, Wisconsin P.E.

Master Table

Key

Front

All Inputs should be unadjusted read outs from test	Mid	Left #1 (*If Applicable*)	Left #2 *(If Applicable)*
Deflection Reading @ 0 lbs	3.81	4.158	4.096
Deflection Reading @ Pre-Load (180 lbsf)	2.695	2.592	2.543
Deflection Reading @ Released Test Load (1/2 Pre-load)	3.158	3.169	3.121
Deflection Reading @150 lbsf	2.86	2.784	2.728
Deflection Reading @ 200 lbsf	2.577	2.445	2.392
Deflection Reading @ 250 lbsf	2.266	2.074	2.039
Deflection Reading @ 300 lbsf	1.91	1.714	1.697
Deflection Reading @ Ultimate Test Load (365 lbsf)	1.448	1.231	1.207
Deflection Reading @ Released Test Load (1/2 Pre-load)	3.006	3.014	2.971
Height of Rail (h)	42		
Length of Rail (l)	48		
Max Deflection [(h/24)+(l/96)]	2.25		
Max Residual Deflection (20% of Max)	0.45		

Zero Point for Calculations

Back

All Inputs should be unadjusted read outs from test	Mid	Left #1 *(If Applicable)*	Left #2 *(If Applicable)*
Deflection Reading @ 0 lbs	4.505	4.855	4.611
Deflection Reading @ Pre-Load	3.507	3.387	3.332
Deflection Reading @ Released Test Load (1/2 Pre-load)	3.960	3.984	3.923
Deflection Reading @150 lbsf	3.667	3.597	3.535
Deflection Reading @ 200 lbsf	3.377	3.210	3.155
Deflection Reading @ 250 lbsf	3.038	2.826	2.784
Deflection Reading @ 300 lbsf	2.761	2.444	2.427
Deflection Reading @ Ultimate Test Load	2.330	1.967	1.932
Deflection Reading @ Released Test Load (1/2 Pre-load)	3.932	3.852	3.887

R & B WAGNER, INC.
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10600 W BROWN DEER ROAD | MILWAUKEE, WI | 53224
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Railing System Load/Deflection Testing

Test Type:	Horizontal Load to 365 lbs per ASTM E985 per section 7.1.5	Submitted By:	KES	Date	07/23/15
Test Focus (Part #s):	50" Long GR2457HCB-10, 3/4" laminated with PVB interlayer (0.060"), PG2475, PGISO75				
Railing Type:	Shoe molding, 4 panel grips, with glass and unsupported sides				
Railing Specifications:	42" (TOR) No caprail. 12" C-C hole locations				
Test Method:	365 lbf load per ASTM standards Tested using ID#0328 readout, load cell and string pot (calibration due 6/19/2016)				

Test Specifications per ASTM E985:		**Results:**				
	System Calculations:	**Load (lbf)**	**Displacement (in.)**			**Test AVG**
			Midrail	**Left**	**Left 2**	
Pre Load	**180 (lbf)**	Preload	0.463	0.577	0.578	0.5393
Released Test Load	**90 (lbf)**	RTL	0	0	0	0.0000
		150	0.298	0.385	0.393	0.35866667
Ultimate Test Load	**365 (lbf)**	200	0.581	1	0.729	0.6780
		250	0.892	1.095	1.082	1.0230
Deflection Specifications Per ASTM E985		300	1.248	1.455	1.424	1.3757
Max Deflection	**(h/24)+(l/96) = 2.25 in**	UTL	1.71	1.938	1.914	1.8540
		RD	0.152	0.155	0.15	0.152
Residual Deflection (At RTL)	**20% of MD = 0.45 in**					

NOTES:

Midrail at 0 lbf =3.81

Potentiometer cannot be zeroed, so calculations are done manually

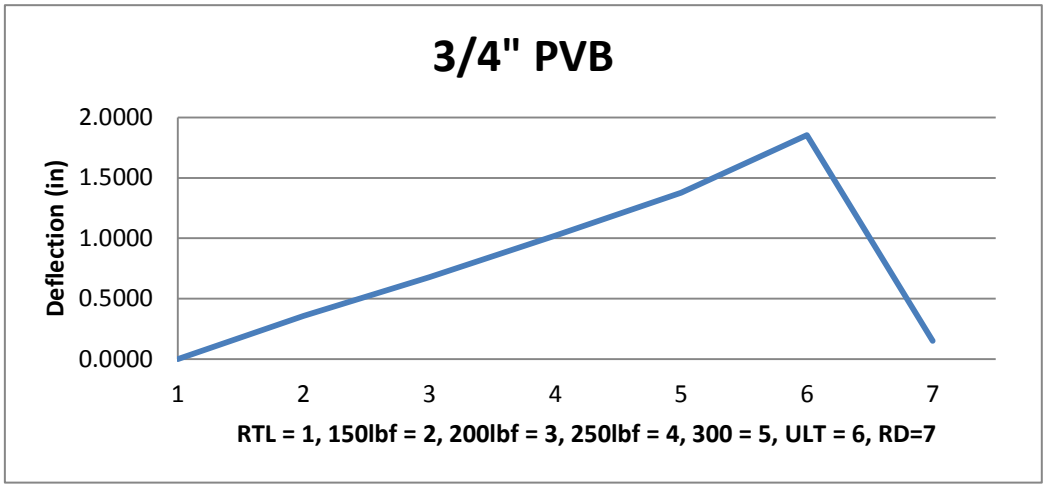
Mounted to steel plate. Panel grips torqued to 120 in-lbs

75.4 degrees F, 55% humidity

CONCLUSIONS:

Rail meets ASTM Standard for Max Deflection

Rail meets ASTM Standard for Residual Deflection



Initial Setup

Preload of 180 lbf
Actual Deflection of
0.463 in

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
Actual Deflection of 1.71 in

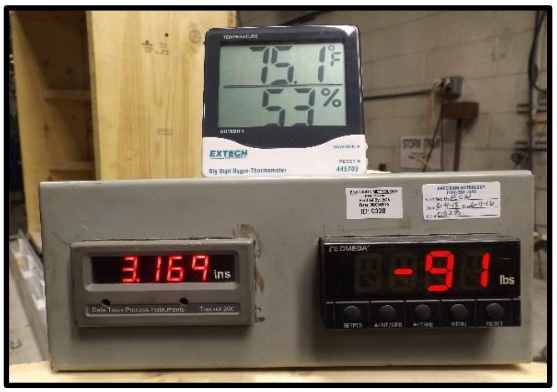
Deflection at ULT

Residual Deflection at 90 lbf
Actual Deflection of 0.152 in

Initial Setup
(Left)

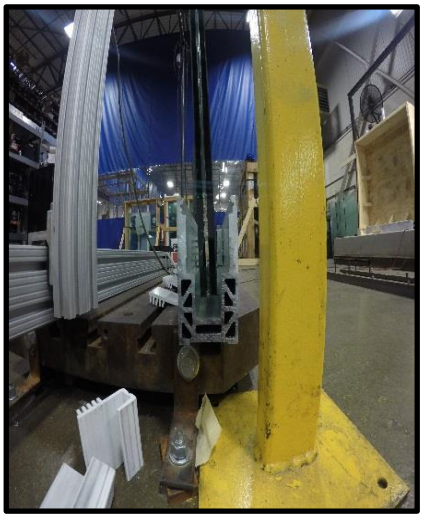
Preload of 180 lbf
Actual Deflection of
0.577 in
Deflection number will
automatically update

Release Test Load of 90 lbf



Ultimate Test Load of 365 lbf
Actual Deflection of
1.455 in
Deflection number will automatically update

Deflection at ULT



Residual Deflection at 90 lbf
Actual Deflection of
1.938 in
Deflection number will automatically update

Initial Setup
(Left 2)

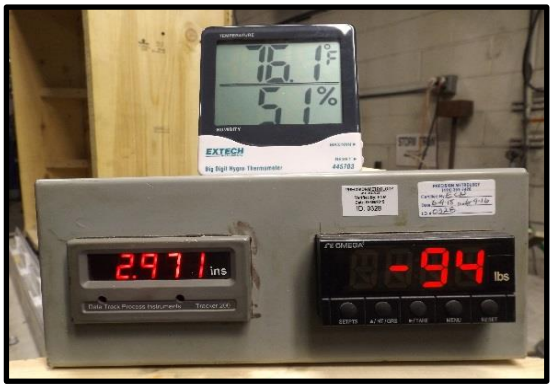
Preload of 180 lbf
Actual Deflection of 0.578 in
Deflection number will automatically update

Release Test Load of 90 lbf

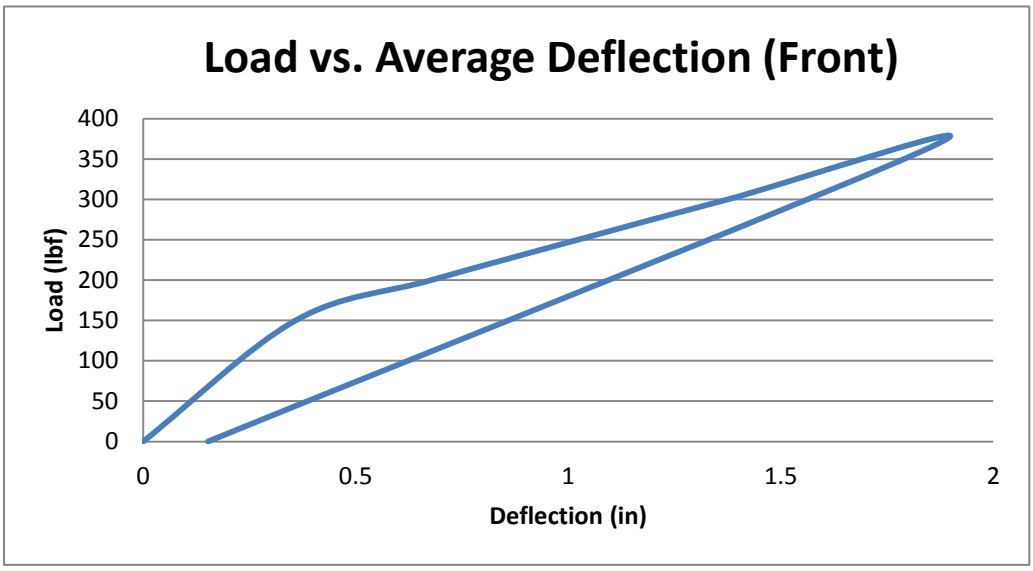
Ultimate Test Load of 365 lbf
Actual Deflection of
1.424 in
Deflection number will automatically update

Deflection at ULT

Residual Deflection at 90 lbf
Actual Deflection of
1.914 in
Deflection number will automatically update



Load	Average Deflection
0	0
150	0.3586667
200	0.678
250	1.023
300	1.3756667
365	1.854
0	0.1523333



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Test Specifications per ASTM E985:		**Results:**				
	System Calculations:	**Load (lbf)**	**Displacement (in.)**			**Test AVG**
			Midrail	**Left**	**Right**	
Pre Load	**180 (lbf)**	Preload	0.453	0.597	0.591	0.5470
Released Test Load	**90 (lbf)**	RTL	0	0	0	0.0000
		150	0.293	0.387	0.388	0.356
Ultimate Test Load	**365 (lbf)**	200	0.583	1	0.768	0.7083
		250	0.922	1.158	1.139	1.0730
Deflection Specifications Per ASTM E985		300	1.199	1.54	1.496	1.4117
Max Deflection	**(h/24)+(l/96) = 2.25 in**	UTL	1.63	2.017	1.991	1.8793
		RD	0.028	0.132	0.036	0.0653
Residual Deflection (At RTL)	**20% of MD = 0.45 in**					

NOTES:

Midrail at 0 lbf = 4.505 in

Potentiometer cannot be zeroed, so calculations are done manually

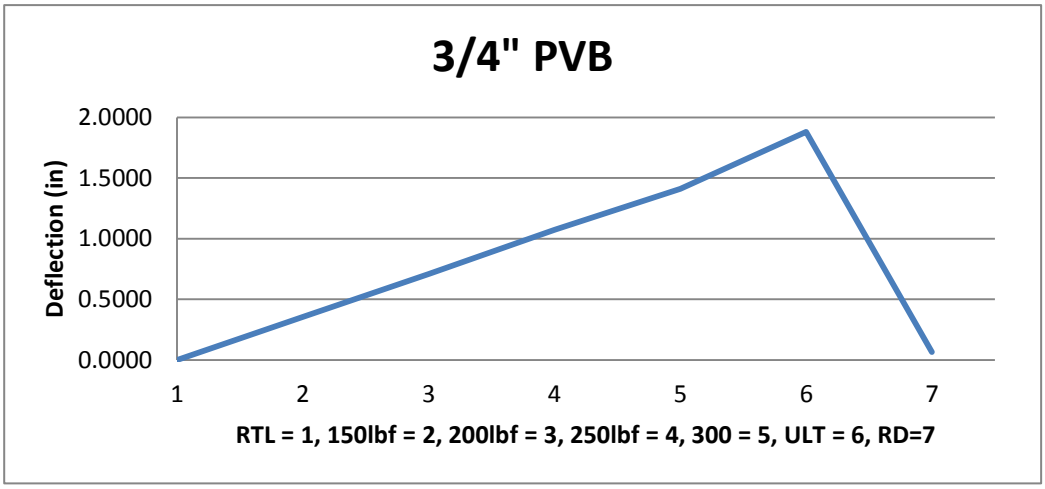
Mounted to steel plate. Panel grips torqued to 120 in-lbs

Piston bottomed out before 365 could be reached, block added and test finished

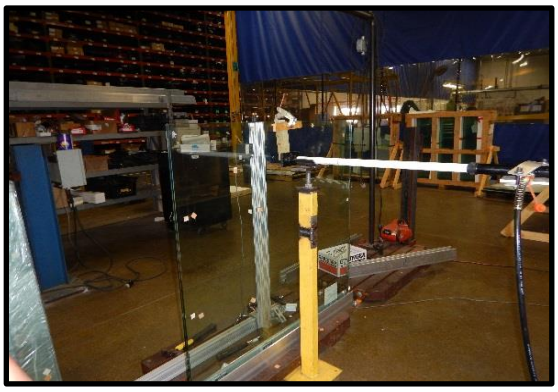
CONCLUSIONS:

Rail meets ASTM Standard for Max. Allowed Deflection

Rail meets ASTM Standard for Residual Deflection



Initial Setup (Middle)



Preload of 180 lbf
Actual Deflection of 0.453 in

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
Actual Deflection of 1.63
in

Deflection at ULT

Residual Deflection at 90 lbf
Actual Deflection of
0.028 in

Initial Setup
(Left)

Preload of 180 lbf
Actual Deflection of
0.597 in
Deflection number will
automatically update

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
Actual Deflection of
2.017 in
Deflection number will automatically update

Deflection at ULT

Residual Deflection at 90 lbf
Actual Deflection of
0.132 in
Deflection number will automatically update

Initial Setup
(Right)

Preload of 180 lbf
Actual Deflection of
0.591 in
Deflection number will automatically update

Release Test Load of 90 lbf

Ultimate Test Load of 365 lbf
Actual Deflection of
1.991 in
Deflection number will automatically update

Deflection at ULT

Residual Deflection at 90 lbf
Actual Deflection of
0.036 in
Deflection number will
automatically update

Load	Average Deflection
0	0
150	0.356
200	0.7083333
250	1.073
300	1.4116667
365	1.8793333
0	0.0653333