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VISTA RAILING SYSTEMS INC.
TEST REPORT

SCOPE OF WORK
STRUCTURAL PERFORMANCE TESTING ON A LED SPIGOT FRAMELESS GLASS GUARDRAIL SYSTEM

REPORT NUMBER
R3016.02-119-19 R1

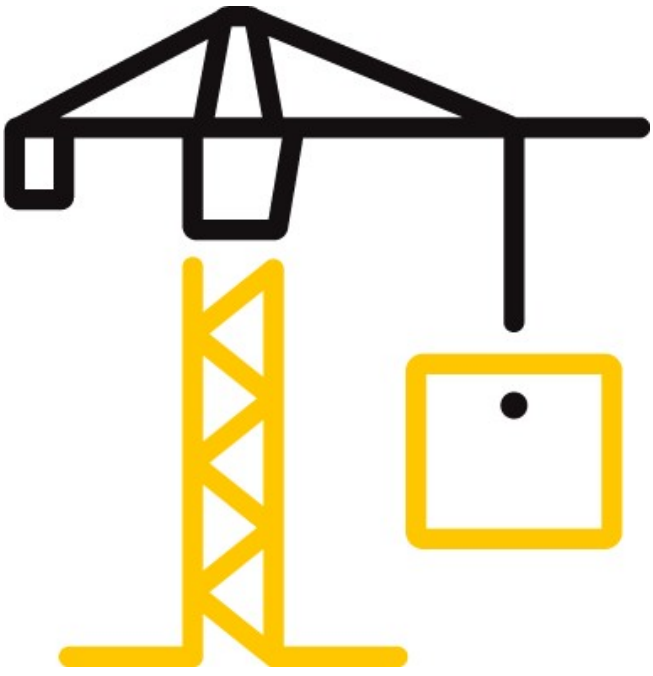
TEST DATE
05/17/24

ISSUE DATE **REVISION DATE**
06/26/24 07/11/24

RECORD RETENTION END DATE
05/17/28

PAGES
24

DOCUMENT CONTROL NUMBER
RT-R-AMER-Test-2846 (02/09/18)



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Report No.: R3016.02-119-19 R1
Date: 06/26/24 Revision Date: 07/11/24

REPORT ISSUED TO
VISTA RAILING SYSTEMS INC.
23282 River Road
Maple Ridge, British Columbia V2W 1B6 (Canada)

SECTION 1
SCOPE

Intertek Building & Construction (B&C) was contracted by Vista Railing Systems Inc. to perform structural performance testing using methods described in selected sections of ASTM E2353-21, *Standard Test Methods for Performance of Glazing in Permanent Railing Systems, Guards, and Balustrades* on their 96 in wide by 42 in high LED Spigot frameless glass guardrail system. The scope of the testing as requested by Vista Railing Systems Inc., was to assess the ability of the guard system to resist the load requirements of Section 9.8.8.2 of the 2020 NBC, 2024 OBC and 2023 NBC-AE**.** Results obtained are tested values and were secured by using the designated test methods. Testing was conducted at the Intertek test facility in York, Pennsylvania. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory.

Intertek B&C in York, Pennsylvania has demonstrated compliance with ISO/IEC International Standard 17025 and is consequently accredited as a Testing Laboratory (TL-144) by International Accreditation Service, Inc. (IAS). Intertek B&C is accredited to perform all testing reported herein.

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. Unless differently required, Intertek reports apply the "Simple Acceptance" rule, also called "Shared Risk approach," of ILAC-G8:09/2019, Guidelines on Decision Rules and Statements of Conformity. Intertek will service this report for the entire test record retention period. The test record retention period ends four years after the test date. Test records, such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation, will be retained for the entire test record retention period.

For INTERTEK B&C:

COMPLETED BY:	Adam J. Schrum	**REVIEWED BY:**	V. Thomas Mickley, Jr., P.E.
TITLE:	Project Manager	**TITLE:**	Senior Staff Engineer
SIGNATURE:	Digitally Signed by: Adam J. Schrum	**SIGNATURE:**	Digitally Signed by: Virgal Thomas Mickley, Jr.
DATE:	07/11/24	**DATE:**	07/11/24

AJS:vtm/aas/krs

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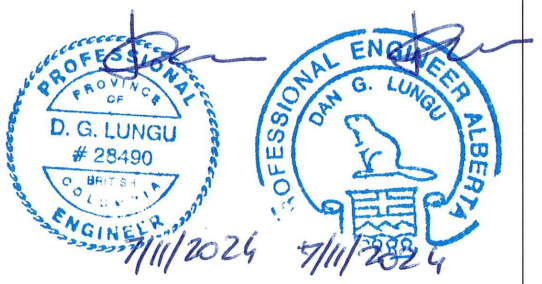
Engineer's Disclaimer: • Intertek Engineers do not assume professional responsibility of Engineer of Record. • Compliance to Building Codes must be approved by the Engineer of Record or Authority Having Jurisdiction. • Intertek Engineer's seal and signature is limited to the review of applicable code required loads, review of test setup, data, and reporting.	**Engineers Approval Stamp**  **Kal Kooner, P.Eng.** **EGBC Permit No.: 1000953** **Director, Building & Construction** **Intertek**
	 **Dan Lungu, P.Eng.** **EGBC Permit No.: 1000953** **Engineer, Building & Construction** **Intertek**

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SECTION 2
TEST METHODS

The specimens were evaluated using the static load testing procedure described within the following:

> **ASTM E2353-21**, *Standard Test Methods for Performance of Glazing in Permanent Railing Systems, Guards, and Balustrades,* Section 12.1.1 *Static Load Testing*

The required test loads were based on the specified loads per the following building code articles with the safety factors applied as indicated in this report:

2020 National Building Code of Canada (NBC)
- Section 9.8.8.2 *Loads on Guards*

2024 Ontario Building Code (OBC)
- Section 9.8.8.2 *Loads on Guards*

2023 National Building Code of Canada – Alberta Edition (NBC-AE)
- Section 9.8.8.2 *Loads on Guards*

Limitations
One specimen was tested as part of the scope of testing and not three replicate representative specimens as required by ASTM E2353. The maximum load was not sustained for 1 minute as specified by ASTM E2353.

All tests performed were to evaluate structural performance of the guardrail assembly to carry and transfer imposed loads to the supporting structure. The test specimens evaluated included the infill, rails, rail brackets, and support posts. Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

A safety factor of 1.67 - 2.5 was applied to the loads, based on an assumed failure mode and tested material. The safety factor was calculated by dividing the live load factor of 1.5 by the material resistance factors below, as defined in the CAN/CSA S157, *Strength Design in Aluminum* standard.

- ø=0.90 resistance factor for bending failure mode, resulting safety factor = 1.67
- ø=0.75 resistance factor for ductile failure mode, resulting safety factor = 2.0
- ø=0.67 resistance factor for brittle failure mode, resulting safety factor = 2.24
- ø=0.60 resistance factor for glass, wood fastener connections, resulting safety factor = 2.5

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SECTION 3
MATERIAL SOURCE/INSTALLATION

Test samples were provided by the client. Representative samples of the test specimen will be retained by Intertek B&C for a minimum of four years from the test completion date.

The 96 in wide by 42in high guardrail assembly was installed and tested as a single railing section by directly securing the posts to a concrete base. Transducers mounted to an independent reference frame were located to record movement of reference points on the guardrail system components (ends and mid-point) to determine net component deflections. See photographs in Section 10 for individual test setups.

SECTION 4
EQUIPMENT

The guardrail was tested in a self-contained structural frame designed to accommodate anchorage of the guardrail assembly and application of the required test loads. The specimens were loaded using a hydraulic ram mounted to a forklift. High strength steel cables, nylon straps, and load distribution beams were used to impose test loads on the specimens. Applied load was measured using an electronic load cell located in-line with the loading system. Electronic linear motion transducers were used to measure deflections.

SECTION 5
LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Adam J. Schrum	Intertek B&C
Shawn E. Beamer	Intertek B&C

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SECTION 6
TEST PROCEDURE

Each test specimen was inspected prior to testing to verify size and general condition of the materials, assembly, and installation. No potentially compromising defects were observed prior to testing.

An initial load, not exceeding 50% of design load, was applied and transducers were zeroed. Load was then applied at a steady uniform rate until reaching 2.0 times design load in no less than 10 seconds. After reaching 2.0 times design load, the load was released. After allowing a minimum period of one minute for stabilization, load was reapplied to the initial load level used at the start of the loading procedure, and deflections were recorded and used to analyze recovery. Load was then increased at a steady uniform rate until reaching the maximum test load (safety factor times design load) or until failure occurred. The testing time was continually recorded from the application of initial test load until the ultimate test load was reached.

Deflection and permanent set were component deflections relative to their end-points; they were not overall system displacements. All loads and displacement measurements were horizontal, unless noted otherwise.

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SECTION 7
TEST SPECIMEN DESCRIPTION

Vista Railing Systems Inc. provided the fully-assembled test specimens with the following details:

PRODUCT	LED Spigot Frameless Glass Guardrail System
RAIL LENGTH	96 in (inside of post to inside of post)
RAIL HEIGHT	42 in (top of top rail to bottom of post mount)
TOP RAIL	13/16 in high by 1 in wide inverted U-shaped 2205 stainless steel extrusion
GLASS PANEL (IN-FILL)	Two, 40 in high by 45 in wide by 1/2 in thick tempered glass panels; 2 in gap between panels and panels and posts
RAIL BRACKETS	2205 stainless steel socket brackets
POST MOUNT	2-1/2 in square by 0.070 in thick hollow 6005A-T61 aluminum extrusion with raceway channels in each corner and a 4 in by 4 in by 3/8 in thick base plate
GLASS BASE BRACKET (SPIGOT)	3-7/8 in wide by 3-7/8 in deep by 6-1/4 in high 2205 stainless steel, glass panel support; two per panel
FASTENERS	- #10-14 by 1" square-drive, pan head, self-drilling, 316 SS steel screws (one in bracket/post) - 1/4" (#14) by 3" star drive, trim head, thread cutting tip, chromoly steel, dacromet coating screw (four in base plate to post)

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SECTION 8
TEST RESULTS

Key to Test Results Tables:

Load Level: Target test load

Test Load: Actual applied load at the designated load level (target).

Elapsed Time (E.T.): The amount of time into the test with zero established at the beginning of the loading procedure.

8 ft (96 in) by 42 in Glass Guardrail System
NBC - Guards Serving not more than Two Dwelling Units

Notes:

1. *Loads were applied in the outward direction only.*
2. *Maximum guardrail height is 42 in; post mounts reported herein have not been evaluated for guardrail heights more than 42 in.*

Test No. 1 - 05/17/24
Design Load: 112.4 lb / 11.81 Square in at Edge of Glass Panel (Next to Post)

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
281 lb (2.50 x D.L.)	305	00:53	Withstood load equal to or greater than 281 lb without failure

Test No. 2 - 05/17/24
Design Load: 112.4 lb / 11.81 Square in at Bottom Center of Glass Panel

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
281 lb (2.50 x D.L.)	302	00:22	Withstood load equal to or greater than 281 lb without failure

Test No. 3 - 05/17/24
Design Load: 224.8 lb Concentrated Load at Top Corner of Glass Panel

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
506 lb (2.25 x D.L.)	542	00:50	Withstood load equal to or greater than 506 lb without failure

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Test No. 4 - 05/17/24
Design Load: 224.8 lb Concentrated Load at Bottom Corner of Glass Panel

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
506 lb (2.25 x D.L.)	635	01:17	Withstood load equal to or greater than 506 lb without failure

Test No. 5 - 05/17/24
Design Load: 34.3 plf x (96 ÷ 12 in/ft) = 274.4 lb Horizontal Uniform Load on Top Rail

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
686 lb (2.50 x D.L.)	701	02:31	Withstood load equal to or greater than 686 lb without failure

Test No. 6 - 05/17/24
Design Load: 102.8 plf x (96 ÷ 12 in/ft) = 822.4 lb Vertical Uniform Load on Top Rail

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
2056 lb (2.50 x D.L.)	2120	00:45	Withstood load equal to or greater than 2056 lb without failure

Test No. 7 - 05/17/24
Design Load: 224.8 lb Horizontal Concentrated Load at Midspan of Top Rail above Open Infill Area

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
375 lb (1.67 x D.L.)	392	00:52	Withstood load equal to or greater than 375 lb without failure

Test No. 8 - 05/17/24
Design Load: 224.8 lb Horizontal Concentrated Load at End of Rail

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
506 lb (2.25 x D.L.)	530	01:47	Withstood load equal to or greater than 506 lb without failure

Test No. 9 - 05/17/24
Design Load: 224.8 lb Horizontal Concentrated Load at Top of Post Mount

LOAD LEVEL	TEST LOAD (lb)	E.T. (min:sec)	RESULT
375 lb (1.67 x D.L.)	412	01:08	Withstood load equal to or greater than 375 lb without failure

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SECTION 9
CONCLUSION

Using performance criteria of withstanding an ultimate load of the design load multipled by the listed safety factors, the test results substantiate compliance with the design load requirements for NBC, OBC and NBC-AE-Guards Serving not more than Two Dwelling Units for the 96 in wide by 42 in high railing assembly reported herein. The Authority Having Jurisdiction (AHJ) shall determine if the noted safety factor is adequate for the product and material type.

Anchorage of support posts to the supporting structure is not included in the scope of this testing and would need to be evaluated separately.

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SECTION 10
PHOTOGRAPHS

Photo No. 1
In-Fill Load Test at Center Edge of Glass Panel

Photo No. 2
In-Fill Load Test at Bottom of Glass Panel

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Photo No. 3
Concentrated Load Test on Glass Panel

Photo No. 4
Horizontal Uniform Load Test on Top Rail

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Photo No. 5
Vertical Uniform Load Test on Top Rail

Photo No. 6
Concentrated Load Test at Top of Post

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SECTION 11
DRAWINGS

The "As-Built" drawings for the frameless glass guardrail system which follow have been reviewed by Intertek B&C and are representative of the project reported herein. Project construction was verified by Intertek B&C per the drawings included in this report. Any deviations are documented herein or on the drawings.