TEST REPORT

REPORT NUMBER: 102429832COQ-003
ORIGINAL ISSUE DATE: February 1, 2016

EVALUATION CENTER

INTERTEK TESTING SERVICES NA LTD.
1500 BRIGANTINE DRIVE
COQUITLAM, BC V3K 7C1

RENDERED TO

CENDEK RAILINGS LTD.
9685 AGUR STREET
SUMMERLAND, BC V0H 1Z2
CANADA

PRODUCT EVALUATED:
6.25 ft. Aluminum 5mm Glass Railing System

EVALUATION PROPERTY:
Load Requirements

Report of 6.25 ft. Aluminum 5mm Glass Railing System for compliance with the requirements of the following criteria:

- **2010 National Building Code of Canada**
  - **Section 4.1.5.14, *Loads on Guards***
  - **Section 9.8.8.2 *Loads on Guards***
- **2012 British Columbia Building Code**
  - **Section 4.1.5.14, *Loads on Guards***
  - **Section 9.8.8.2 *Loads on Guards***
- **2012 Ontario Building Code**
  - **Section 4.1.5.14, *Loads on Guards***
  - **Section 9.8.8.2 *Loads on Guards***

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2 Introduction

Intertek Testing Services NA Ltd. (Intertek) has conducted a test program for an Aluminum Glass Railing System submitted by Cendek Railings Ltd. The evaluation was carried out to determine whether the railings would meet the requirements of the following:

- 2010 National Building Code of Canada (NBC)
  - Section 4.1.5.14, *Loads On Guards*
  - Section 9.8.8.2 *Loads on Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Design of Guards to Not Facilitate Climbing*

- 2012 British Columbia Building Code (BCBC)
  - Section 4.1.5.14, *Loads On Guards*
  - Section 9.8.8.2 *Loads on Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Design of Guards to Not Facilitate Climbing*

- 2012 Ontario Building Code (OBC)
  - Section 4.1.5.14, *Loads On Guards*
  - Section 9.8.8.2 *Loads on Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Guards Designed Not to Facilitate Climbing*

This evaluation was conducted in the months of January to February 2016.

3 Test Samples

3.1. SAMPLE SELECTION

The client submitted one (1) aluminum railing system to the Evaluation Center on January 11, 2016 (Coquitlam ID# VAN1601111234-001). Samples were not independently selected for testing.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

The sample was identified as the following:

Table 1. Railing Configuration

Railing	Post	Post Spacing	Mounting Plate	Rails	Panel Insert
Aluminum Glass Panel – Deck Mount	2-1/2” x 2-1/2”	75”	4” x 4” x 1/4”	42” high	5mm Tempered Glass

For detailed drawings of the test sample and components, refer to Appendix B.

Note: The installation of the guardrail to the deck was not within the scope of this report, and is subject to evaluation and approval by the building official. Four 3/8 in. grade 5 bolts and washers on each post were used to install the specimen for testing.

4 Testing and Evaluation Methods

The evaluation was conducted in accordance with the testing procedures of ASTM E935-13e1, *Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.* The test specimens were loaded at a rate to achieve the specified loads between 10 seconds and 5 minutes. The specified test loads were held for one minute before the load was released. For each test, deflection measurements were taken at the point of load application. As per Section 4.1.5.14 and Section 9.8.8.2 of the 2010 NBC, 2012 BCBC, and 2012 OBC, the following tests were conducted:

4.1 2010 NBC / 2012 BCBC / 2012 OBC: SECTION 4.1.5.14 LOADS ON GUARDS

1) The minimum specified horizontal load applied inward or outward at the minimum required height of every guard shall be 0.75 kN/m or a concentrated load of 1.0 kN applied at any point.

2) Individual elements within the *guard*, including solid panels and pickets, shall be designed for a concentrated load of 0.5 kN applied over an area of 100 mm x 100 mm located at any point in the element or elements so as to produce the most critical effect.

3) The minimum specified load applied vertically at the top of every required *guard* shall be 1.5 kN/m.

4) None of the loads specified above need be considered to act simultaneously.

Notes: A safety factor of 1.67-2.5 was applied to the above loads.

4.2 2010 NBC / 2012 BCBC / 2012 OBC: SECTION 9.8.8.2 LOADS ON GUARDS

1) The minimum specified horizontal load applied inward or outward at the minimum required height of every guard shall be 0.5 kN/m or a concentrated load of 1.0 kN applied at any point.

2) Individual elements within the *guard*, including solid panels and pickets, shall be designed for a concentrated load of 0.5 kN applied over an area of 300 mm x 300 mm located at any point in the element or elements so as to engage 3 balusters.

3) The minimum specified load applied vertically at the top of every required *guard* shall be 1.5 kN/m.

4) None of the loads specified above need be considered to act simultaneously.

Notes: A safety factor of 1.67-2.5 was applied to the above loads.

4.3 2010 NBC / 2012 BCBC / 2012 OBC: SECTION 9.8.8.3 HEIGHT OF GUARDS

1) All guards shall be not less than 1070 mm high.

4.4 2010 NBC / 2012 BCBC / 2012 OBC: SECTION 9.8.8.5 OPENINGS IN GUARDS

1) Openings through any guard shall be of a size that will prevent the passage of a spherical object having a diameter of 100 mm unless it can be shown that the location and size of openings that exceed this limit do not present a hazard.

4.5 2010 NBC / 2012 BCBC / 2012 OBC: SECTION 9.8.8.6 *DESIGN OF GUARDS TO NOT FACILITATE CLIMBING / GUARDS DESIGNED NOT TO FACILITATE CLIMBING*

1) Guards except those in industrial occupancies and where it can be shown that the location and size of openings do not present a hazard, shall be designed so that no member, attachment or opening facilitates climbing.

2) Guards shall be deemed to comply with Sentence (1) where all elements protruding from the vertical and located within the area between 140 mm and 900 mm above the floor or walking surface protected by the guard conform to one of the following clauses:
a) they are located more than 450mm horizontally and vertically, or
b) they provide not more than 15 mm horizontal offset,
c) they do not provide a toe-space more than 45mm horizontally and 20 mm vertically, or
d) they present more than a 1-in-2 slope on the offset.

4.6 IN-FILL LOAD TEST

A load of 1.25 kN (281 lbs) was applied using a 100 mm x 100 mm square block on the center of the railing system normal to the in-fill. After release of the load, the system was evaluated for failure, any evidence of disengagements of any component and visible cracks in any component.

4.7 UNIFORM LOAD TEST

A uniform load of 2.5 kN/m (171 plf) was applied vertically to the top of the guardrail system. A uniform load of 1.25 kN/m (86 plf) was applied horizontally to the top of the guardrail system. The loads were applied using quarter point loads. After release of the load, the system was evaluated for failure, any evidence of disengagements of any component and visible cracks in any component.

4.8 CONCENTRATED LOAD TEST

The top of the guardrail system was subjected to three separate tests where a concentrated load of:

- 1.67 kN (375 lbs) was applied horizontally at the midspan of the top of the guard,
- 2.24 kN (503 lbs) was applied horizontally at the top of the guard adjacent to the post connection to verify the connection capacity, and
- 1.67 kN (375 lbs) was applied horizontally at the top of post.

4.9 HEIGHT OF GUARDS

All railings formed a protective barrier not less than 1070 mm (42 in.) high.

4.10 OPENINGS IN GUARDS

All railings had openings that prevented a sphere 4 in. (100 mm) in diameter to pass.

4.11 DESIGN TO PREVENT CLIMBING

No member, attachment or opening located between 140 mm and 900 mm above the floor or walking surface protected by the guards facilitated climbing.

5 Testing and Evaluation Results

5.1. RESULTS AND OBSERVATIONS

The product test results are shown in Table 2. A copy of the test data is located in Appendix A.

Table 2. Test Results

Section	Property	Result	Requirement	Pass/Fail
9.8.8.2	In-fill Load	281 lbs	281 lbs	Pass
	Vertical Uniform Load	171 plf	171 plf	Pass
	Horizontal Uniform Load	86 plf	86 plf	Pass
	Mid-span Concentrated Load	375 lbs	375lbs	Pass
	Adjacent to Post Connection Concentrated Load	503 lbs	503 lbs	Pass
	Top of Post Concentrated Load	375 lbs	375 lbs	Pass
9.8.8.3	Height of Guards	1070 mm	≥ 1070 mm	Pass
9.8.8.5	Openings in Guards	60 mm	< 100 mm	Pass
9.8.8.6	Design to Not Facilitate Climbing	No elements protruding from the vertical between 140 mm and 900 mm that facilitate climbing	No elements from the vertical between 140 mm and 900 mm that facilitate climbing	Pass

6 Conclusion

The Cendek Railings Ltd. Aluminum Glass Railing System identified in this test report has been evaluated per the requirements of the following:

- 2010 National Building Code of Canada (NBC)
  - Section 4.1.5.14, *Loads On Guards*
  - Section 9.8.8.2 *Loads on Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Design of Guards to Not Facilitate Climbing*

- 2012 British Columbia Building Code (BCBC)
  - Section 4.1.5.14, *Loads On Guards*
  - Section 9.8.8.2 *Loads on Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Design of Guards to Not Facilitate Climbing*

- 2012 Ontario Building Code (OBC)
  - Section 4.1.5.14, *Loads On Guards*
  - Section 9.8.8.2 *Loads on Guards*
  - Section 9.8.8.3, *Height of Guards*
  - Section 9.8.8.5, *Openings in Guards*
  - Section 9.8.8.6, *Guards Designed Not to Facilitate Climbing*

The product test results are presented in Section 5 of this report.

INTERTEK TESTING SERVICES NA LTD.

Reported by: _____
Chris Chang, P.Eng.
Engineer, Building Products

Reviewed by: _____
Dan Lungu, P. Eng.
Engineer, Manufactured Housing

Feb 02 2016
PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D. G. LUNGU
28490

Reviewed by: _____
Kal Kooner, P. Eng.
Manager, Building Products

LICENSED PROFESSIONAL ENGINEER
K. S. KOONER
100155558
02/04/16
PROVINCE OF ONTARIO

APPENDIX A: Test Data (3 pages)

Company	Cendek Railings Ltd.	Technician(s)	Chris Chang / Kevin Penner
Project No.	G102429832	Reviewer	Dan Lungu / Kal Kooner
Models	6.25 ft. Aluminum 5mm Glass Railing	Start/End Date	January 29, 2016
Product Name	Same as above	Sample ID	VAN1601111234-001
Standard	**2010 NBC/2012 OBC/2012 BCBC, Section 4.1.5.14 and 9.8.8.2**		

Test Data Package

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Test:	**Loads on Guards**			Project:	G102429832
Date:	29-Jan-16			Eng/Tech:	Kevin Penner
Client:	Cendek Railing Ltd.				Chris Chang
Product:	**Aluminum 5mm Glass Railing System**			Reviewer:	Kal Kooner
Post Spacing:	6.25 ft	1.91 m			Dan Lungu
Height of Guard:	42 in	1070 mm			
Opening in Guard:	1.38 in	35 mm			

Method: 2010 National Building Code of Canada, 4.1.5.14 Loads on Guards
2012 Ontario Building Code, 4.1.5.14 Loads on Guards
2012 British Columbia Building Code, 4.1.5.14 Loads on Guards

Safety Factor: 1.67 (based on a resistance factor Ø = 0.9 for aluminum)
2.24 (based on a resistance factor Ø = 0.67 for shear connection)
2.50 (for glass in-fill)

Equipment: Artech 5000 lbf Load Cell (Intertek ID# P60691, cal due November 2016)
Vaisala Temp/RH Indicator (Intertek ID# 9-0176, cal due December 2016)
Stopwatch (Intertek ID# P60624, cal due July 2016)
Mitutoyo Digital Caliper (Intertek ID# P60005, cal due May 2016)

Time/Temp/RH: 1:30PM / 23.0°C / 50.0%

Direction	Test	Design Load (Inward/ Outward) (lbf)	Factored Load	Calculated Moment (lbf-ft)	Equivalent Quarter-Point Load (lbf)	Required Proof Load (lbf)	Deflections (in.)	Pass/Fail
Outward	Individual Elements (over 4 in. x 4 in.)	112	281	-	-	281	2.566	**Pass**
	Vertical Uniform Load (per ft)	103	171	836	535	1070	0.860	**Pass**
	Horizontal Uniform Load (per ft)	51	86	418	268	535	2.004	**Pass**
	Midspan Horizontal Concentrated Load	225	375	-	-	375	1.596	**Pass**
	Top Rail Adjacent to Alum Connection Concentrated Load	225	503	-	-	503	3.002	**Pass**
	Top of Post Concentrated Load	225	375	-	-	375	2.051	**Pass**

Direction	Test	Design Load (Inward/ Outward) (kN)	Factored Load	Calculated Moment (kNm)	Equivalent Quarter-Point Load (kN)	Required Proof Load (kN)	Deflections (mm)	Pass/Fail
Outward	Individual Elements (over 100 mm in. x 100 mm)	0.5	1.25	-	-	1.25	65.2	**Pass**
	Vertical Uniform Load (per m)	1.5	2.5	1.13	2.38	4.76	21.8	**Pass**
	Horizontal Uniform Load (per m)	0.75	1.25	0.57	1.19	2.38	50.9	**Pass**
	Midspan Horizontal Concentrated Load	1	1.67	-	-	1.67	40.5	**Pass**
	Top Rail Adjacent to Alum Connection Concentrated Load	1	2.24	-	-	2.24	76.3	**Pass**
	Top of Post Concentrated Load	1	1.67	-	-	1.67	52.1	**Pass**

Test:	**Dimensional Checks**			Project:	G102429832
Date:	29-Jan-16			Eng/Tech:	Chris Chang
Client:	Cendek Railing Ltd.			Reviewer:	Kal Kooner
Product:	**Aluminum 5mm Glass Railing System**				Dan Lungu
Post Spacing:	6.25	ft	1.91		m
Height of Guard:	42	in	1070		mm
Opening in Guard:	1.375	in	35		mm

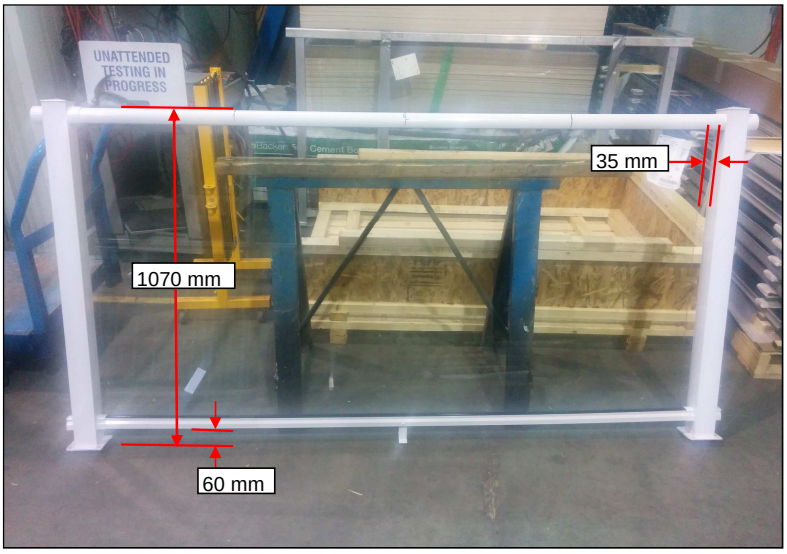
Method:
2010 National Building Code of Canada
2012 Ontario Building Code
2012 British Columbia Building Code
9.8.8.3 Height of Guards
9.8.8.5 Openings in Guards
9.8.8.6 Design of Guards to Not Facilitate Climbing / Guards Designed Not to Facilitate Climbing / *Design to Prevent Climbing*

Time/Temp./RH: 1:30PM / 23.0°C / 50.0%

Equipment:
Mitutoyo Digital Caliper (Intertek ID# P60005, cal due May 2016)
Stanley FatMax Tape Measure (Intertek ID# P60494, cal due August 2016)

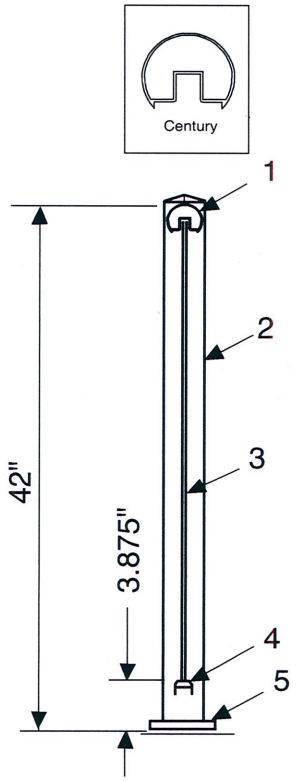
Description		Measured Dimension (mm)	Requirement (mm)	Pass/Fail
9.8.8.3 Height of Guards		1070	≥ 1070	**Pass**
9.8.8.5 Openings in Guards	Between Glass Panel/Post	35	< 100	**Pass**
	Under Bottom Rail	60	< 100	**Pass**

Description	Result	Requirement	Pass/Fail
9.8.8.6 Design of Guards to Not Facilitate Climbing / Guards Designed Not to Facilitate Climbing	No elements protruding from the vertical between 140 mm and 900 mm that facilitate climbing	No elements protruding from the vertical between 140 mm and 900 mm that facilitate climbing	**Pass**



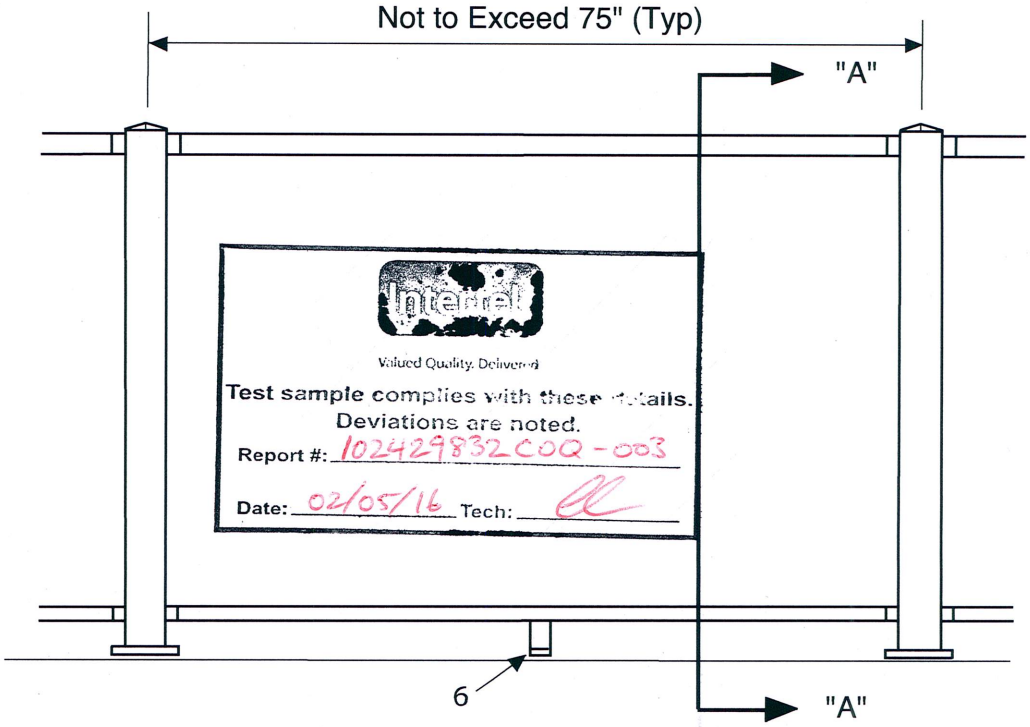
APPENDIX B: Drawings (5 pages)

Glass Railing - Surface Mount



SECTION "A-A"

NOT TO SCALE



ELEVATION OF BALCONY RAILING

NOT TO SCALE

Notes: 1. This guard system complies with the requirements of Part 4 and Part 9 of the 2010 Canadian Building Code (NBC), 2012 British Columbia Building Code (BCBC) and the 2012 Ontario Building Code (OBC).

2. Fastening detail to be determined on-site and is not within the scope of this document.

Century Aluminum Railings

9685 Agur St., Summerland ,B.C. V0H 1Z2

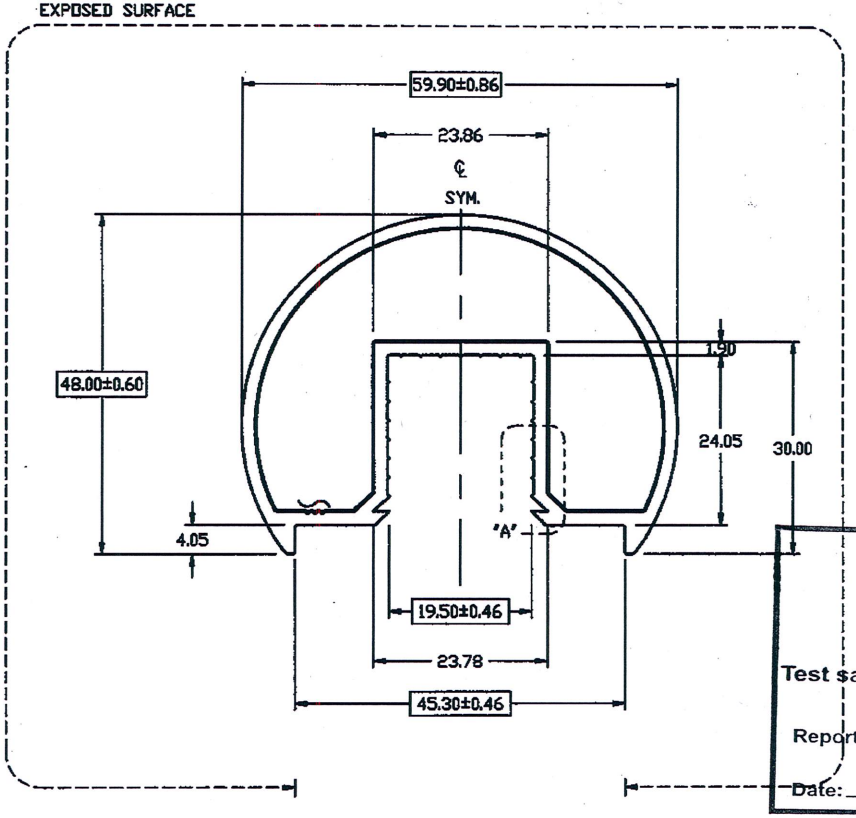
Phone: (778) 516-6000 • Fax: (778) 516-6003 • **Toll Free: 1-877-810-4841**

	Material - Aluminum	Thickness	Alloy
1	Top Rail - Century 2.35" x 1.89	.083	6063-T5
2	Post - 2.50" x 2.50"	.075	6063-T5
3	Glass - Tempered 5 mm	.196	N/A
4	Bottom Rail - 1.06" x 1.41"	.070	6063-T5
5	Baseplate - 4" x 4"	.250	6005A-T6
6	Support Leg	.125	6063-T5

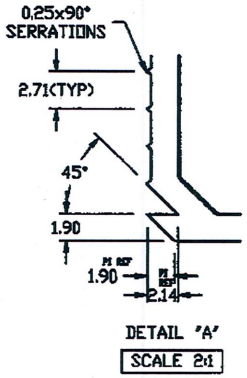
12/23/15

APEX aluminum extrusions

Customer Name:	Deksmart Railings	Quote No.: 1392-8	Apex Die Number: 2174
Part Description:	Century Component Top Rail	Part No.: 695950	
Note:	Standard Aluminum Association Tolerances to Apply Unless Otherwise Noted		Customer No.:



ACTUAL SIZE



DETAIL "A"
SCALE 2:1

Intertek
Valued Quality. Delivered.

Test sample complies with these details.
Deviations are noted.

Report #: 102429832COQ-003

Date: 02/05/16 Tech: CC

Area=sq.mm	433.845
Weight=kg/m	1.200
Perimeter=mm	454.646
Outer Perimeter=mm	244.716
C.C.D.=mm	59.900
Factor:	23
Ratio:	75
Cavities:	1
Press No.:	1
Scale:	AS NOTED
Alloy:	6063 T5
Date:	3/20/2015
Drawn by:	dc

SAL-304-1 5/10/2012

TYP WALL U.O.S. 1.90±0.25

~ Denotes Apex ID Mark .25x90° V GROOVE (3X)

All unmarked radii .95R unless otherwise noted

Break all corners .40R unless otherwise noted

[ ] - Denotes Critical Dimension

No Exposed Surfaces Except As Marked

Rev:	Description:	Date:

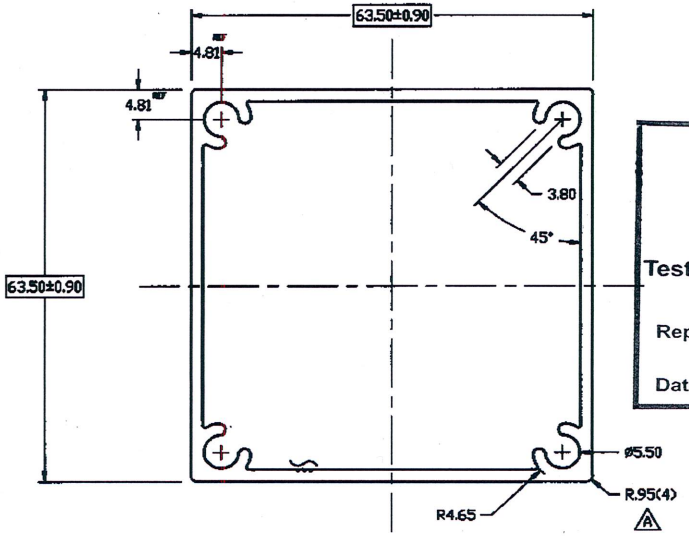
This is not an Apex Aluminum Extrusion design. Apex Aluminum Extrusion in accepts no responsibility or liability for the performance of products produced from it. Apex makes no warranty of fitness for a particular purpose with regards to the extrusions produced from this drawings.

PRINT APPROVAL: Customer signature indicates that dimensions and tolerances have been accepted as shown. Customer also assumes all legal responsibility for having this profile made and will fully protect Apex Aluminum Extrusions Ltd. in case of patent or any other claims.

Date: Signed:

APEX aluminum extrusions

Customer Name: Deksmart Railings		Quote No.: 1392-13	Apex Die Number: 2179
Part Description: 2 1/2" Post Material		Part No.: 695987	
Note: Standard Aluminum Association Tolerances to Apply Unless Otherwise Noted			Customer No.:



ACTUAL SIZE

Intertek
Valued Quality. Delivered.
Test sample complies with these details.
Deviations are noted.
Report #: 102429832COQ-003
Date: 02/05/16 Tech:

Area=sq.mm	538.4483
Weight=kg/m	1.490
Perimeter=mm	530.119
Outer Perimeter=mm	253.313
C.C.D.=mm	89.471
Factor:	21
Ratio:	58
Cavities:	1
Press No.:	1
Scale:	AS NOTED
Alloy:	6063 T5
Date:	3/20/2015
Drawn by:	dc

SAL-304-1 5/10/2012

TYP WALL U.O.S. 1.90±0.25

Denotes Apex ID Mark .25x90° V GROOVE (3X)

All unmarked radii .95R unless otherwise noted

Break all corners .40R unless otherwise noted

[ ] - Denotes Critical Dimension

Exposed All Around

Rev:	Description:	Date:
A	RADII CHANGED FROM R0.40 to R0.95	5/25/2015

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Date: 05/25/15 Signed: Michael Gill

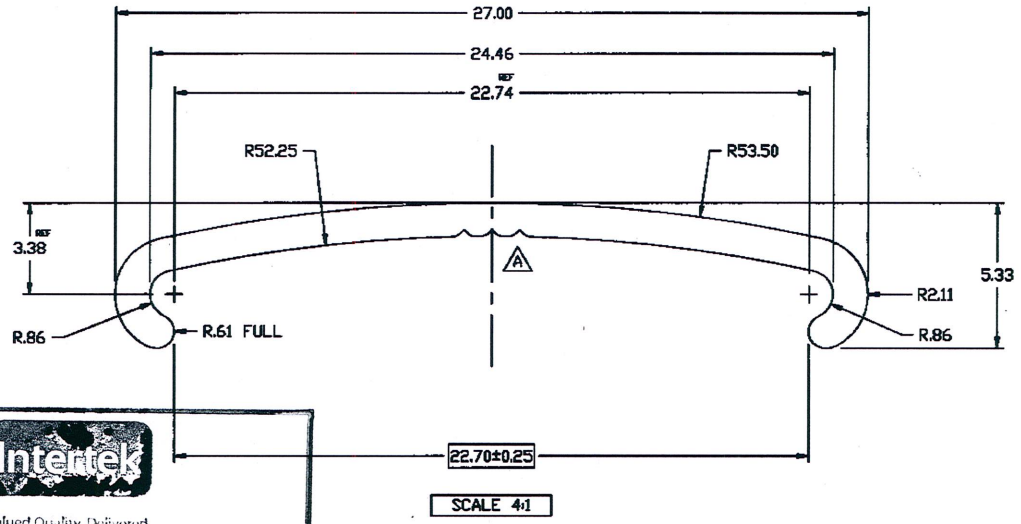
APEX aluminum extrusions

Customer Name:	Deksmart Railings	Quote No.:	1392-2
Part Description:	Bottom Rail Clip	Part No.:	615128
Note:	**Standard Aluminum Association Tolerances to Apply Unless Otherwise Noted**		

Apex Die Number: 2168

Customer No.:

Area=sq.mm	39.772
Weight=kg/m	0.110
Perimeter=mm	66.453
Outer Perimeter=mm	--
C.C.D.=mm	26.928
Factor:	35
Ratio:	98
Cavities:	8
Press No.:	1
Scale:	AS NOTED
Alloy:	6063 T5
Date:	4/21/2015
Drawn by:	dc



Intertek
Valued Quality. Delivered.
Test sample complies with these details.
Deviations are noted.
Report #: 102429832COQ-003
Date: 02/05/16 Tech: ll

EXPOSED SURFACE

ACTUAL SIZE

No Exposed Surfaces Except As Marked

SAL-304-1 5/10/2012

TYP WALL U.O.S. 1.25±0.15

~ Denotes Apex ID Mark .25x90° V GROOVE (3X)

All unmarked radii .00R unless otherwise noted

Break all corners .25R unless otherwise noted

[ ] - Denotes Critical Dimension

Rev:	Description:	Date:
A	I.D. marks changed from bumps to grooves	4/21/2015

This is not an Apex Aluminum Extrusion design. Apex Aluminum Extrusion in accepts no responsibility or liability for the performance of products produced from it. Apex makes no warranty of fitness for a particular purpose with regards to the extrusions produced from this drawings.

PRINT APPROVAL: Customer signature indicates that dimensions and tolerances have been accepted as shown. Customer also assumes all legal responsibility for having this profile made and will fully protect Apex Aluminum Extrusions Ltd. in case of patent or any other claims.

Date: 04/21/15 Signed: Michael Gill

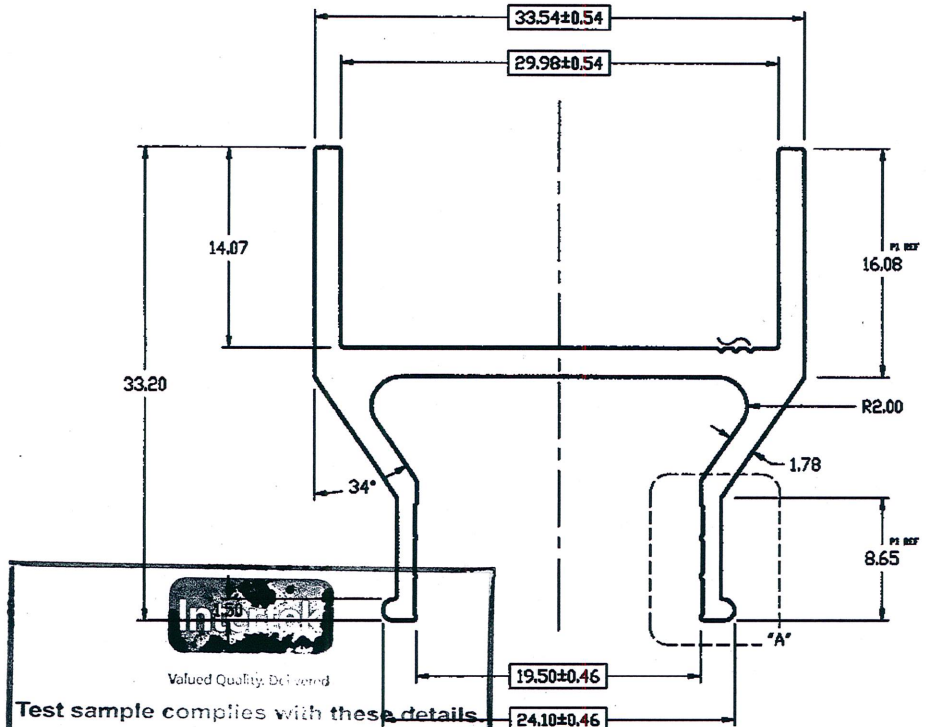
APEX aluminum extrusions

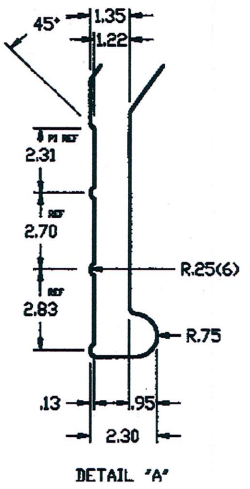
Customer Name:	Deksmart Railings	Quote No.:	1392-3
Part Description:	Bottom Rail	Part No.:	629082
Note:	Standard Aluminum Association Tolerances to Apply Unless Otherwise Noted		

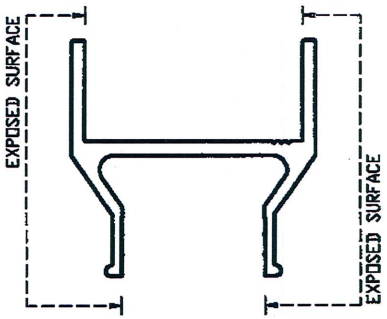
Apex Die Number: 2169

Customer No.:

Area=sq.mm	183.031
Weight=kg/m	0.506
Perimeter=mm	196.351
Outer Perimeter=mm	--
C.C.D.=mm	44.379
Factor:	23
Ratio:	57
Cavities:	3
Press No.:	1
Scale:	AS NOTED
Alloy:	6063 T5
Date:	3/20/2015
Drawn by:	dc







Valued Quality Delivered

Test sample complies with these details
Deviations are noted.
Report #: 1024298320OQ-003
Date: 02/05/16 Tech: AL

☐ - Denotes Critical Dimension

No Exposed Surfaces Except As Marked

SAL-304-1 5/10/2012

TYP WALL U.O.S. 1.78±0.15

~ Denotes Apex ID Mark .25x90° V GROOVE (3X)

All unmarked radii .80R unless otherwise noted

Break all corners .25R unless otherwise noted

Rev:	Description:	Date:

This is not an Apex Aluminum Extrusion design. Apex Aluminum Extrusion in accepts no responsibility or liability for the performance of products produced from it. Apex makes no warranty of fitness for a particular purpose with regards to the extrusions produced from this drawings.

PRINT APPROVAL: Customer signature indicates that dimensions and tolerances have been accepted as shown. Customer also assumes all legal responsibility for having this profile made and will fully protect Apex Aluminum Extrusions Ltd. in case of patent or any other claims.

Date: Signed: