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MITREX.
TEST REPORT

SCOPE OF WORK
LOADS ON GUARDS TESTING, AS PRESCRIBED IN THE ONTARIO BUILDING CODE (OBC) 2012, NATIONAL BUILDING CODE OF CANADA (NBC) 2020, AND INTERNATIONAL BUILDING CODE (IBC) 2018. IMPACT AND POST-BREAKAGE RETENTION TESTING AS PRESCRIBED IN CSA A500-16 “BUILDING GUARDS”.

REPORT NUMBER
105570086TOR-001

TEST DATE(S)
10/20/23 TO 10/23/23

ISSUE DATE **REVISION DATE**
10/26/23 11/3/23

PAGES
14

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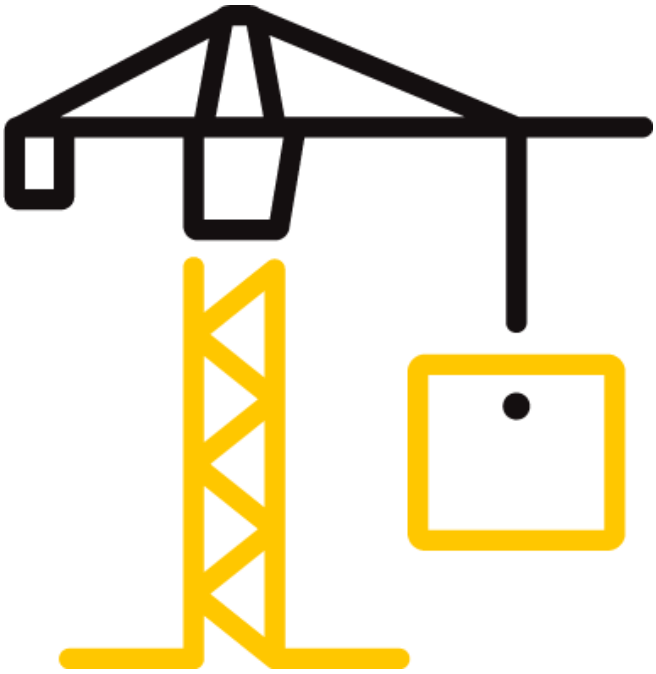

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TEST REPORT FOR MITREX.
Report No.: 105570086TOR-001
Date: 10/26/23

REPORT ISSUED TO

MITREX.
41 Racine Road,
Toronto ON M9W 2Z4
CAN

SECTION 1

SCOPE

Intertek Testing Services NA, Inc. dba Intertek Building & Construction (B&C) was contracted by Mitrex , to perform load testing on their 80 in. wide solar panel guard to assess the ability of the guard system to resist the prescribed loads in Section 4.1.5.14 “Loads on Guards” of the **Ontario Building Code (OBC) 2012**, **National Building Code of Canada (NBC) 2020** and Section 1607.8.1 *“Handrails and guards.”* of the **International Building code (IBC) 2018**. Impact and post-breakage retention testing as prescribed in Sections 5.5.2 and 5.5. 3 of **CSA A500-16 *“Building Guards”***

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 B&C 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 (where required by Certification or Accreditation bodies), or other pertinent project documentation, will be retained for the entire test record retention period.

SECTION 2

SUMMARY OF TEST RESULTS

The Mitrex 80 in. wide solar panel guardrail detailed In Section 9 of this report, has achieved the performance present in Section 10 of this report.

For INTERTEK B&C:

COMPLETED BY:	Tyrone Williams	**REVIEWED BY:**	Kal Kooner, P.Eng.
TITLE:	Technical Analyst	**TITLE:**	Director, B&C Canada
SIGNATURE:		**SIGNATURE:**	
DATE:	11/03/23	**DATE:**	11/03/23

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SECTION 3
TEST METHOD(S)

The samples were evaluated in accordance with the following:

- Section 4.1.5.14 "Loads on Guards and Handrails" Sentence 1c,3,6 of the **National Building Code of Canada (NBC) 2020.**
- Section 4.1.5.14 "Loads on Guards" Sentence 1c, 2, 4, of the **Ontario Building Code (OBC) 2012.**
- Section 1607.8.1 "Handrails and guards." of the **International Building code (IBC) 2018.**
- Sections 5.5.2 and 5.5. 3 of **CSA A500-16 "Building Guards.**
- Section 10 & 11 of **ASTM E935-21** *"Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings"*

SECTION 4
MATERIAL SOURCE/INSTALLATION

Four (4) test specimens were assembled and submitted by the client. The guards were installed and tested at the Intertek test facility in Mississauga, ON.

SECTION 5
EQUIPMENT

Equipment Calibration		
Instrument/Equipment	**Asset #**	**Calibration Due Date**
Load Cell w/Display	280-01-0773	Nov-29-2023
Measuring Tape	278-01-0730	Nov-10-2023
Digital Caliper	280-01-0909	Nov-10-2023
Stopwatch	280-01-1254	Aug-18-2024
Digital Deflection gauge	280-01-0585	Nov-10-2023
Handheld Force Gauge	273-02-0107	Aug-18-2024
45.4 kg Impact shot Bag	n/a	n/a
150 Kg Scale	280 01 1228	March-27-2024

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SECTION 6
LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Kyle Nova	Mitrex
Travis Yeow	Mitrex

SECTION 7
TEST PROCEDURE

IN-FILL LOAD TEST

Test Loads were applied over a 100 x 100 mm square platen normal to the geometric center of the solar panel infill between supports. Specified and factored loads were applied and held for one (1) minute, whereupon deflection of the infill at the point of maximum deflection was recorded.

UNIFORM LOAD TEST

The top rail was subjected to vertical and horizontal quarter point loading (deemed to be equivalent to uniform loading) applied by means of a load distributing bar. Specified and factored loads were applied and held for one (1) minute, whereupon deflection of the top rail at mid-span was recorded.

CONCENTRATED LOAD TEST

Concentrated test loads were applied separately and sequentially at the following critical locations: horizontally on the top rail at mid-span between posts, on the top rail adjacent to a post, on top of a single post and vertically mid-span between posts. Specified and factored loads were applied over a 100 mm x 100 mm square platen and held for one (1) minute, whereupon deflection was recorded at the point of application of the load. The load applied on the rail adjacent to the post was applied to the opposite post from which the top-of-post-test was performed on.

After release of the load, the system was evaluated for failure, evidence of disengagement and visible cracks in any component.

Failure as defined in **ASTM E935-21**: *"failure—the loss of load carrying capacity or the inability to meet the required load carrying capacity specified in the applicable performance standard, depending on the purpose of the test."*

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SHOT BAG IMPACT AND POST-BREAKAGE RETENTION TESTING

A test apparatus supporting a 45.4 kg (100 lbs) shot bag and allowing unimpeded swinging was set up. The shot bag was suspended from the overhead support via a 1.83 m (6 ft.) cable and positioned to impact the inside face of the infill at the geometric center in an outward direction. The shot bag was pulled back and upwards through an arc shaped trajectory to a drop height of 1220 mm and then released, impacting the ACM infill panel. The test was performed to deliver energy of 542 N-m. The test specimen was inspected and evaluated after impact according to the following conditions from CSA A500-16 Section 5.5.3.1:

1. The panel or infill remains intact after impact; or
2. The panel or infill integrity is compromised by the impact and all of the following conditions are met:
    (i) The compromised panel or infill, including all parts and components, remains in place.
    (ii) The impact does not create an opening in the panel or infill through which a 150 mm sphere is able to pass under an 18 N load; and
    (iii) The compromised panel, infill, or system is able to withstand a load in the direction of the impact that is equivalent to 25% of the service wind load or 225 N, whichever is greater. This load may be applied in the form of a point load acting in the center of the panel or infill.

SECTION 8
TEST CALCULATIONS

A safety factor of 1.67-2.24 was applied to OBC/NBC code specified loads, based on an assumed failure mode, and tested material. The safety factor was calculated by dividing the specified live load factor of 1.5 by the material resistance factors below.

CAN/CSA S157, *Strength Design in Aluminum S*tandard.

- ø=0.90 resistance factor for bending failure mode, safety factor = 1.67
- ø=0.75 resistance factor for ductile failure mode, safety factor = 2.0
- ø=0.67 resistance factor for brittle failure mode, safety factor = 2.24

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SECTION 9
TEST SPECIMEN DESCRIPTION

The test assembly was a two-bay guardrail consisting of three (3) surface mounted extruded aluminum posts and a framed (aluminum) solar panel spanning the three (3) posts.

Posts were spaced 1020 mm and 995 mm O.C and had an aluminum shoe (base) screwed to the post from the underside using four (4)- #10 x 1-1/4 in. flat head screws and one (1) 3/8-16 x 3.5 in. flat head through bolt with nuts and lock washer through the face of the shoe and post.

The solar panel consisted of solar cells sandwiched between a tempered glass facing layer and a white back sheet held together in an aluminum frame. The interior or occupancy face of the frame consisted of an aluminum/plastic composite panel (ACM) glazed to the frame.

The solar panel was secured to the post using four (4) mounting brackets on the inline post and two (2) mounting brackets on the end post. The mounting bracket was screwed to the side of the post using two (2) #10 x 1 in. self-drilling pan head screws and to the frame of the solar panel using two (2) #10 x 3/4 in. self-drilling pan head screws.

As installed on a concrete substrate using three (3)-1/2 x 6 in. wedge anchors with a minimum embedment depth of 100 mm, the height of the guard measured 1090 mm from the surface of the substrate to the top of the metal frame.

Part Name	QTY	Part Dimensions (mm)				Reported Material
		Length	Width	Height	Nominal Thickness	
Shoe (Base)	3	115	127	63.7	13	Aluminium
Post	3	1095	38	50	2.6 & 6.3	Aluminium
Solar Panel						
• Glass layer	1	2015	-	975	3	Tempered Glass
• Channel frame	1	2035	39.8	995	10	Aluminium
• ACM layer	1	2026	-	992	3	Aluminium/Plastic- composite material (ACM)
Mounting bracket	8	100	13	24	4.6 & 12.5	Aluminium

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SECTION 10
TEST RESULTS

National Building Code of Canada (NBC) 2020. & Ontario Building Code (OBC) 2012.							
Direction of Load	**Test**		**Specified loads kN**	**Deflection at Specified load (mm)**	**Safety Factor**	**Factored Load Applied (kN)**	**Results**
OUTWARD	**Horizontal infill load** applied normal to the panel over a 100 mm x 100 mm platen		0.5	8.36	2.50	1.25	Load Resisted
	Evenly Distributed Vertical Load Applied at the Top of the Guard (mid Span)/Quarter Point Equivalent load		1.5kN/m	-	1.67	2.51kN/m	Load Resisted
	Horizontal load applied at the minimum required height of the guard.	Top Rail (mid Span)	1.0	39.64	2.00	2.00	Load Resisted
		Adjacent to Post	1.0	23.24	2.24	2.24	Load Resisted
		Top of Post	1.0	42.32	2.24	2.24	Load Resisted
After release of the load, there was no evidence of disengagement and/or visible cracks in any component.							

Sample	CSA-A500 Section 5.5.3 Criteria for successful impact and post-breakage retention testing	Results
1	The panel or infill remains intact after impact	Pass

Sample	CSA-A500 Section 5.5.3 Criteria for successful impact and post-breakage retention testing	Results
2	The panel or infill remains intact after impact	Infill integrity is compromised by the impact.
	The panel or infill integrity is compromised by the impact and all the following conditions are met:	
	(i) The compromised panel or infill, including all parts and components, remains in place;	Pass
	(ii) the impact does not create an opening in the panel or infill through which a 150 mm sphere is able to pass under an 18 N load; and	Pass
	(iii) The compromised panel, infill, or system is able to withstand a load in the direction of the impact that is equivalent to 25% of the service wind load or 225 N, whichever is greater. This load may be applied in the form of a point load acting in the center of the panel or infill.	Max load of 4965N was applied.

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Sample	CSA-A500 Section 5.5.3 Criteria for successful impact and post-breakage retention testing	Results
3	The panel or infill remains intact after impact	Pass

International Building code (IBC) 2018							
Direction of Load	**Test**	**Specified loads (kN)**		**Deflection at Specified load (mm)**	**Safety Factor**	**Factored Load Applied (kN)**	**Results**
OUTWARD	Horizontal infill load applied normal to the panel over a 100 mm x 100 mm platen	0.22		4.79	4	0.88	Load Resisted
	Evenly Distributed Vertical Load Applied at the Top of the Guard (mid Span)/Quarter Point Equivalent load.	0.73 kN/m		-	4	2.92kN/m	Load Resisted
	Evenly Distributed Horizontal Load Applied at the Top of the Guard (mid Span)/Quarter Point Equivalent load.	0.73 kN/m		23.85	4	2.92kN/m	Load Resisted
	Concentrated Vertical Load-Applied at the top of the Guard (mid span)	0.89		1	4	3.56	Load Resisted
	Horizontal load applied at the minimum required height of the guard	Top Rail (mid Span)	0.89	33.36	2.5	2.23	Load Resisted *Crack to ACM the panel occurred at 2.35kN*
		Adjacent to Post	0.89	37.23	4	3.56	Load Resisted *Crack to the ACM panel occurred at 3.63kN*
		Top of Post	0.89	41.21	2.5	2.23	Load Resisted

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SECTION 11
CONCLUSION

Intertek Testing Services NA Ltd. (Intertek) has conducted testing for Mitrex on their 80 in. wide solar panel guard to assess the ability of the guard system to satisfy the requirements in the following:

- Section 4.1.5.14 “Loads on Guards and Handrails” Sentence 1c,3,6 of the **National Building Code of Canada (NBC) 2020.**
- Section 4.1.5.14 “Loads on Guards” Sentence 1c, 2, 4, of the **Ontario Building Code (OBC) 2012.**
- Section 1607.8.1 “Handrails and guards.” of the **International Building code (IBC) 2018.**
- Sections 5.5.2 and 5.5. 3 of **CSA A500-16 “Building Guards.**

The Mitrex 80 in. wide solar panel guardrail detailed In Section 9 of this report, has achieved the performance present in Section 10 of this report.

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

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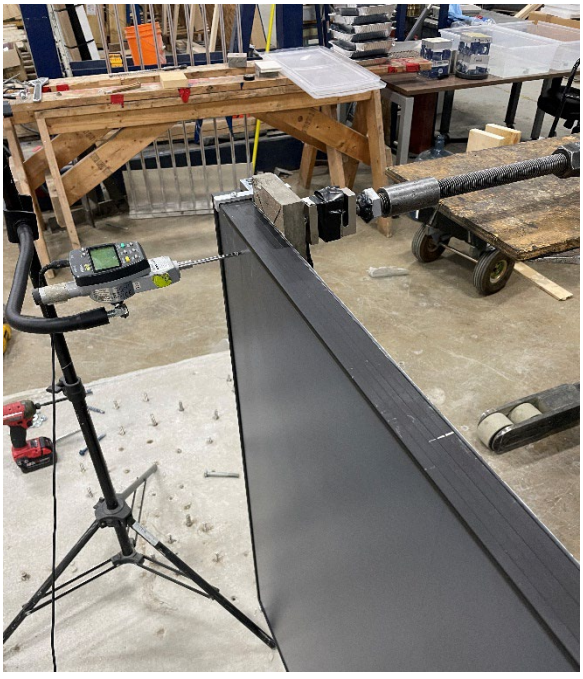
SECTION 12
PHOTOGRAPHS

Horizontal Mid Span Concentrated Load Test (2-Bay)

Vertical ¼ Point/UDL Load Test



Adjacent to Post Horizontal Concentrated Load Test

Infill Load Test

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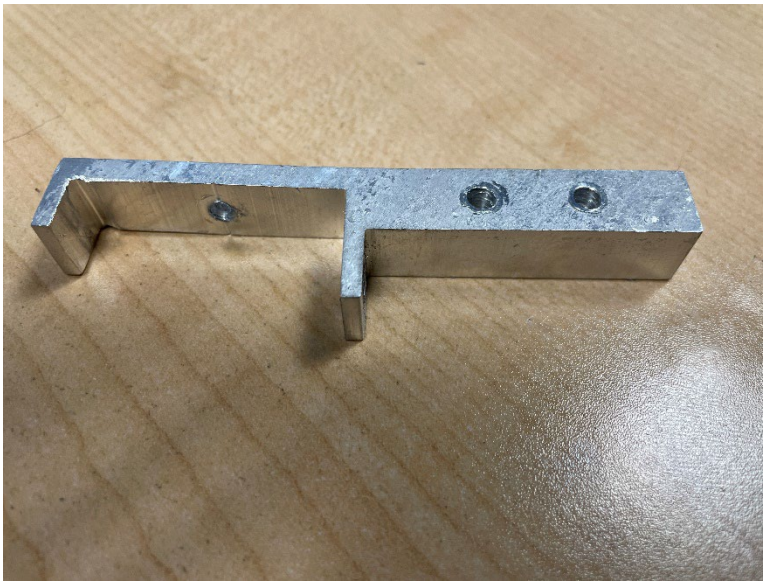
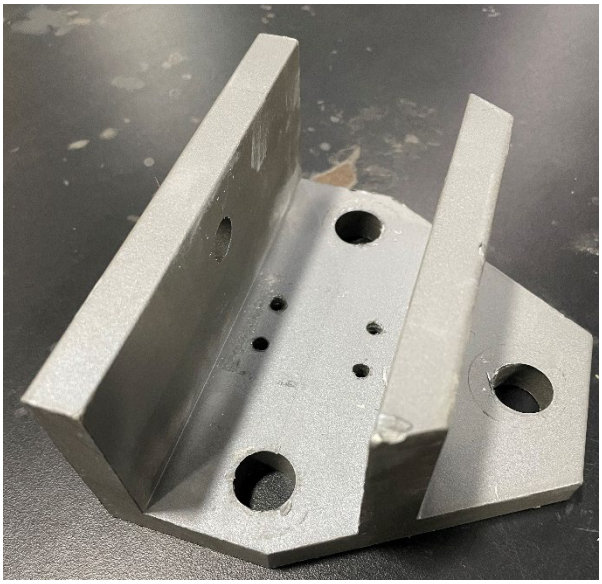
Shot Bag Impact Test



Mount Bracket



Post Shoe/Base

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SECTION 14
REVISION LOG

REVISION #	DATE	SECTION	REVISION
0	10/26/23	N/A	Original Report Issue
1	11/3/2023	N/A	Company name changed from “Gcat Group Inc” to “Mitrex”