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**CLIENT:** **ARTISTIC SKYLIGHT DOMES**
255 Regina Rd.
Woodbridge, ON
L4L 8M3

| Test Report No: T1248-4R2 | Revision Date: November 9, 2021 |
|---|---|

**SAMPLE ID:** Artistic Skylight Domes – Fall Protection Screen.

**SAMPLING DETAIL:** Client had submitted the samples directly to QAI for testing.

**DATE OF RECEIPT:** Three (3) skylight domes and fall protection screen assemblies were received at QAI on August 4, 2021.

**TESTING PERIOD:** September 10, 2021.

**AUTHORIZATION:** QAI Proposal Number 21MA042101 dated April 21, 2021 was accepted by signed quote and PO 21-205-nf on May 14, 2021.

**TEST(S) REQUESTED:** **Static load testing to CAL-OSHA Section 3212 (b) and Impact load testing to CAL-OSHA Section 3212 (e1) requirements.**

**TEST RESULTS:**

**STATIC LOAD – CAL-OSHA Section 3212 (b)**

| Test Location | Maximum Load (lbs) | Deflection Under Load, mm (in) | Comments |
|---|---|---|---|
| **1** | 215 | 323.9 (12.75) | Screen could not maintain higher applied load. |
| **2** | 725 | 277.8 (10.94) | No breakage of outer or inner dome. |
| **3** | 800 | 127.0 (5.00) | No breakage of outer or inner dome. |

**IMPACT LOAD – CAL-OSHA Section 3212 (e1)**

| Test Location | Drop Height, mm (in) | Impact Energy, J (lbf) | Comments |
|---|---|---|---|
| **1** | 1295 (51) | 576 (425) | Screen deformed/bent. Outer shell of dome broken. Inner shell intact & unbroken. No passage through to interior. |
| **2** | 1295 (51) | 576 (425) | Screen deformed/bent. Outer shell of dome broken. Inner shell intact & unbroken. No passage through to interior. |
| **3** | 1295 (51) | 576 (425) | Screen deformed/bent. Outer shell of dome broken. Inner shell intact & unbroken. No passage through to interior. |

**Prepared By**

Robert Giona
Operations Manager

**Signed for and on behalf of QAI Laboratories Ltd.**

Lawrence Gibson
Executive VP

## Test Assembly

The fall protection screens supplied by Artistic Skylight Domes (Artistic) for testing consisted of 2 lengths of profiled extruded aluminum running the length of the skylight, and were held in place under compression with 2 threaded rods running across the front and back of the skylight. The screen was placed into the groove on one length of profiled aluminum and was retained by aluminum clips. Once one side was secured, the screen was bent over into the other length of profiled aluminum, and again retained by the screen retaining clips.

| Component | Description | Quantity |
|---|---|---|
| Screen | Constructed from 6.3mm (0.250”) galvanized steel wire mesh. Welded at joints to create 100mm (4”) On-Center (O.C) squares. | 2 per assembly (for this size dome) |
| Profiled Aluminum Extrusion | Constructed from 6063 extruded aluminum with T6 temper. 38.5mm (1.5”) x 38.5mm (1.5”) Angle with 17.5mm (0.686”) channel on top leg (Screen channel). Wall thickness was measured as 3.2mm (0.125”). | 2 per assembly |
| Threaded Rod | 9.5mm (0.375”) diameter threaded rod, 1930mm (76”) in length. Thread count of 16 TPI. Zinc plated. | 2 per assembly |
| Lock Washers | 10mm (0.406”) Inside Diameter x 22mm (0.875”) Outside diameter x 1.2mm (0.050”) thick, zinc plated steel. | 4 per threaded rod (8 total) |
| Nuts | 9.5mm (0.375”) x 16 TPI zinc plated steel nuts | 4 per threaded rod (8 total) |
| Screen Retaining Clips | C-Channel extruded aluminum cut to 89mm (3.5”) in length. 31.75mm (1.25”) wide x 19mm (0.75”) deep, with 3.2mm (0.125”) wall thickness. | 14 per side (28 total) |
| Screen Clip Screws | #8-5/8” Tek Screw | 2 screws per clip |
| Screen Connecting Clips | Butterfly joining clips measured 19mm (0.75”) long x 25mm (1”) wide x 2mm (0.079”) thick stainless steel, connected with a #10 x 19mm (0.75”) long stainless steel screw. | 20 total (used at each intersection along seam) |

Detailed drawings of the fall screen system can be found in Appendix C of this report.

## Test Procedure – Static Load

As there is little detail or requirements noted within CAL-OSHA Section 3212 (b), the test procedure and equipment used were determined via best practices. Static loading was performed at 3 locations deemed worst case (Refer to Photo 1). Load application was made via hydraulic ram/pump with a load cell in line. Load application was distributed over a 305mm x 305mm x 19mm (12" x 12" x 0.75") wooden platen. The screen displacement was measured prior to loading, during loading and post loading application. Each load increment was held for a period of 1 minute, displacement measured, the load was released and after a period of 1 minute the residual displacement was again measured.

This procedure was repeated until maximum displacement of the ram was achieved, or when the client was satisfied with the screen performance.

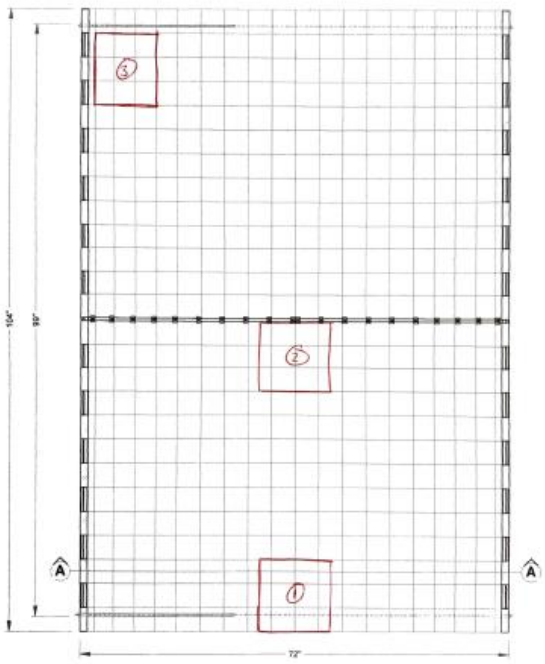
## Test Requirements

As per CAL-OSHA Section 3212 (b) – Roof opening covers shall be capable of safely supporting the greater of 400 lbs or twice the weight of the employees, equipment and materials that may be imposed on any one square foot area of the cover at any time.

## Test Locations

After review of the screen profile and the relationship to the skylight dome, three (3) locations were picked to be used as test sites, and are shown in the diagram below:

Location 1 – Center of front edge of fall protection screen.
Location 2 – Center of screen connection seam, offset to side (only 1 screen loaded).
Location 3 – Edge of fall protection screen.



## Test Results

| Load VS. Deflection Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | Load | Initial Displacement | | Under Load | | Deflection | | After Release Displacement | | Comments |
| | lbs | mm | in | mm | in | mm | in | mm | in | |
| 1 | 0 | 446.0875 | 17 9/16 | -- | -- | -- | -- | 446.0875 | 17 9/16 | No signs of deformation. |
| | 175 | 446.0875 | 17 9/16 | 331.7875 | 13 1/16 | 114.30 | 4 1/2 | 441.325 | 17 3/8 | Signs of deformation (bending) of screen. |
| | 200 | 441.325 | 17 3/8 | 276.225 | 10 7/8 | 165.10 | 6 1/2 | 436.5625 | 17 3/16 | Signs of deformation (bending) of screen. |
| | 215 | 436.5625 | 17 3/16 | 112.7125 | 4 7/16 | 323.85 | 12 3/4 | 400.05 | 15 3/4 | Yield of screen achieved. Cannot sustain further loading. |

| Load VS. Deflection Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | Load | Initial Displacement | | Under Load | | Deflection | | After Release Displacement | | Comments |
| | lbs | mm | in | mm | in | mm | in | mm | in | |
| 2 | 0 | 701.675 | 27 5/8 | -- | -- | -- | -- | 701.675 | 27 5/8 | No signs of deformation. |
| | 200 | 701.675 | 27 5/8 | 762 | 30 | 60.325 | 2 3/8 | 701.675 | 27 5/8 | No signs of deformation. |
| | 309 | 701.675 | 27 5/8 | 804.8625 | 31 11/16 | 103.1875 | 4 1/16 | 701.675 | 27 5/8 | Screen in contact with dome. |
| | 400 | 701.675 | 27 5/8 | 838.2 | 33 | 136.525 | 5 3/8 | 708.025 | 27 7/8 | Signs of deformation (bending) of screen. |
| | 425 | 708.025 | 27 7/8 | 849.3125 | 33 7/16 | 141.2875 | 5 9/16 | 709.6125 | 27 15/16 | Signs of deformation (bending) of screen. |
| | 440 | 709.6125 | 27 15/16 | 857.25 | 33 3/4 | 147.6375 | 5 13/16 | 708.025 | 27 7/8 | Screen touching dome. |
| | 450 | 708.025 | 27 7/8 | 858.8375 | 33 13/16 | 150.8125 | 5 15/16 | 712.7875 | 28 1/16 | Screen touching dome. |
| | 500 | 712.7875 | 28 1/16 | 871.5375 | 34 5/16 | 158.75 | 6 1/4 | 712.7875 | 28 1/16 | Outer shell of dome deforming - no breakage. |
| | 600 | 712.7875 | 28 1/16 | 900.1125 | 35 7/16 | 187.325 | 7 3/8 | 717.55 | 28 1/4 | Outer shell of dome deforming - no breakage. |
| | 700 | 717.55 | 28 1/4 | 942.975 | 37 1/8 | 225.425 | 8 7/8 | 730.25 | 28 3/4 | Outer shell of dome deforming - no breakage. |
| | 725 | 730.25 | 28 3/4 | 1008.0625 | 39 11/16 | 277.8125 | 10 15/16 | 730.25 | 28 3/4 | Outer shell of dome deforming - no breakage. |

| Load VS. Deflection Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | Load | Initial Displacement | | Under Load | | Deflection | | After Release Displacement | | Comments |
| | lbs | mm | in | mm | in | mm | in | mm | in | |
| 3 | 0 | 806.45 | 31 3/4 | | -- | | -- | 806.45 | 31 3/4 | No signs of deformation. |
| | 200 | 806.45 | 31 3/4 | 836.6125 | 32 15/16 | 30.1625 | 1 3/16 | 793.75 | 31 1/4 | No signs of deformation. |
| | 300 | 793.75 | 31 1/4 | 852.4875 | 33 9/16 | 58.7375 | 2 5/16 | 792.1625 | 31 3/16 | No signs of deformation. |
| | 400 | 792.1625 | 31 3/16 | 873.125 | 34 3/8 | 80.9625 | 3 3/16 | 793.75 | 31 1/4 | No signs of deformation. |
| | 425 | 793.75 | 31 1/4 | 876.3 | 34 1/2 | 82.55 | 3 1/4 | 792.1625 | 31 3/16 | No signs of deformation. |
| | 450 | 792.1625 | 31 3/16 | 884.2375 | 34 13/16 | 92.075 | 3 5/8 | 793.75 | 31 1/4 | No signs of deformation. |
| | 500 | 793.75 | 31 1/4 | 893.7625 | 35 3/16 | 100.0125 | 3 15/16 | 794.54375 | 31 9/32 | Screen touching dome. |
| | 600 | 794.5438 | 31 9/32 | 914.4 | 36 | 119.85625 | 4 23/32 | 801.6875 | 31 9/16 | Screen touching dome. |
| | 700 | 801.6875 | 31 9/16 | 920.75 | 36 1/4 | 119.0625 | 4 11/16 | 806.45 | 31 3/4 | Screen touching dome. |
| | 800 | 806.45 | 31 3/4 | 933.45 | 36 3/4 | 127 | 5 | 812.8 | 32 | Screen in full contact with dome. |

## Conclusion

The fall protection screen system provided by Artistic Skylight Domes, when tested with static loads, has shown it has the ability to resist breakage and prevent failure of the skylight dome when loaded to the levels and locations noted above.

## Test Procedure – Impact Load

As there is little detail or requirements noted within CAL-OSHA Section 3212 (e1), the test procedure and equipment used were determined via best practices. Impact loading was conducted using an impact bag constructed from a polyethylene bag filled with pea gravel. The bag was then wrapped in 2 layers of high strength duct tape, and then wrapped in 2 layers of canvas. The finished bag was measured to have a weight of 45.3 kg (100 lbs) which was attached to a quick release mechanism. The bag was raised to a height of 1295mm (51 inches) before release, which would provide impact energy of 192.8 kg (425 lbs).

## Test Requirements

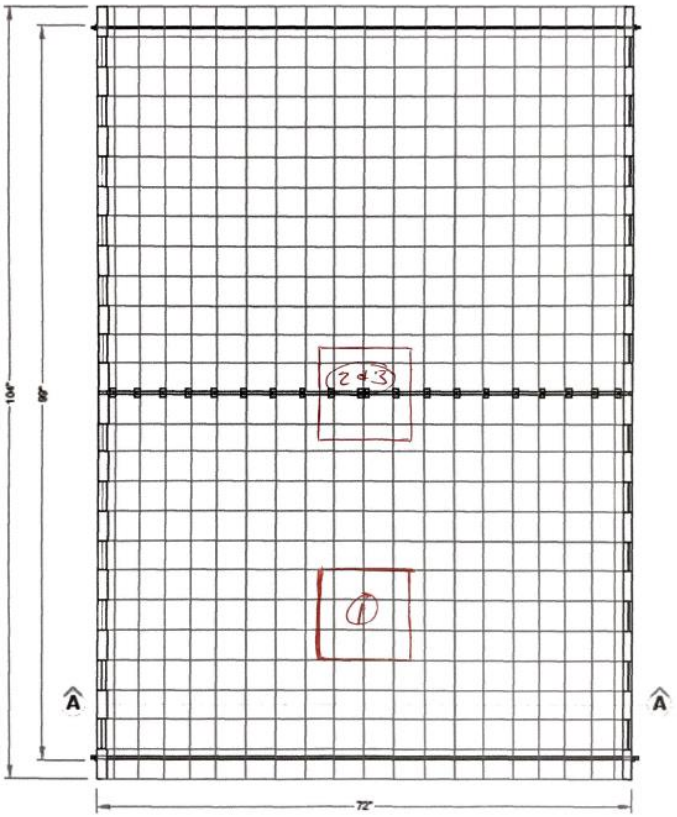
As per CAL-OSHA Section 3212 (e1) – The design, construction, and installation of skylight screens shall meet the strength requirements equivalent to that of covers specified in subsection (b). They shall also be of such design, construction and mounting that under design loads or impacts, they will not deflect downward sufficiently to break the glass below them. The construction shall be of grillwork, with openings not more than 4 inches by 4 inches or of slatwork with openings not more than 2 inches wide with length unrestricted, or of other material of equal strength and similar configuration.

## Test Locations

After review of the screen profile and the relationship to the skylight dome, three (3) locations were picked to be used as test sites, and are shown in the diagram below. For each test, a new screen assembly was used.

Location 1 – Center of one section of fall protection screen.
Locations 2 & 3 – Center of screen connection seam, both screens loaded.

*** Diagram can be found on next page***




## Test Results

| Test Location | Impact Bag Mass, kg (lbs) | Drop Height, mm (in) | Impact Energy, J (lbf) | Comments |
|---|---|---|---|---|
| 1 | 45.3 (100) | 1295 (51) | 576 (425) | Screen deformed/bent. Outer shell of dome broken. Inner shell intact & unbroken. No passage through to interior. |
| 2 | 45.3 (100) | 1295 (51) | 576 (425) | Screen deformed/bent. Outer shell of dome broken. Inner shell intact & unbroken. No passage through to interior. |
| 3 | 45.3 (100) | 1295 (51) | 576 (425) | Screen deformed/bent. Outer shell of dome broken. Inner shell intact & unbroken. No passage through to interior. |

## Conclusion

The fall protection screen system provided by Artistic Skylight Domes, when tested with impact loads of 576 J (425 lbf), has shown it has the ability to resist breakage of both layers of the skylight and prevent passage through to the interior when impacted at the levels and locations noted above.

## APPENDIX A – Static Load Photographs

Photo 1. Static Load Location #1

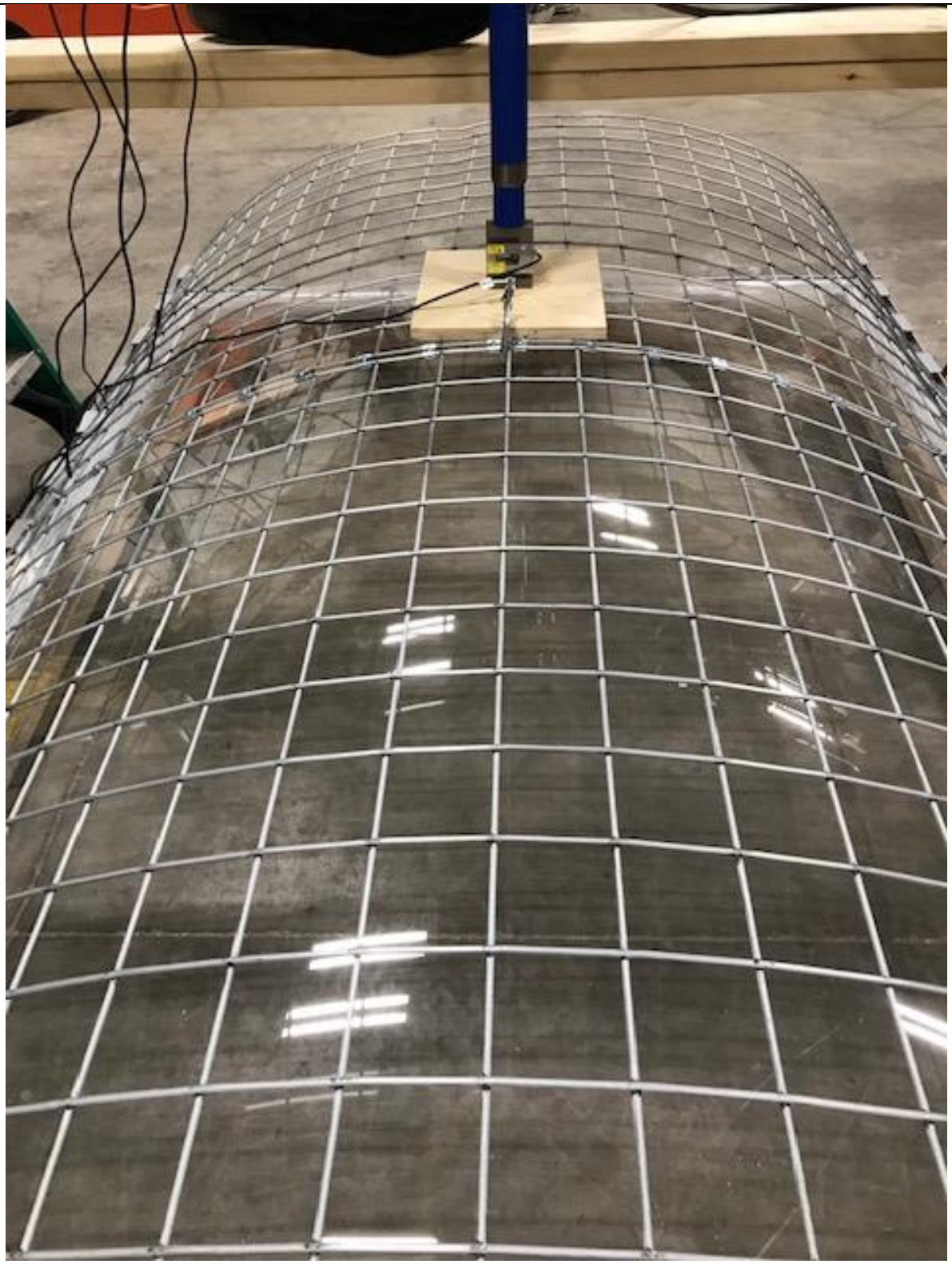


Photo 2. Static Load Location #2

Photo #3. Static Load Location #2 – Under Load

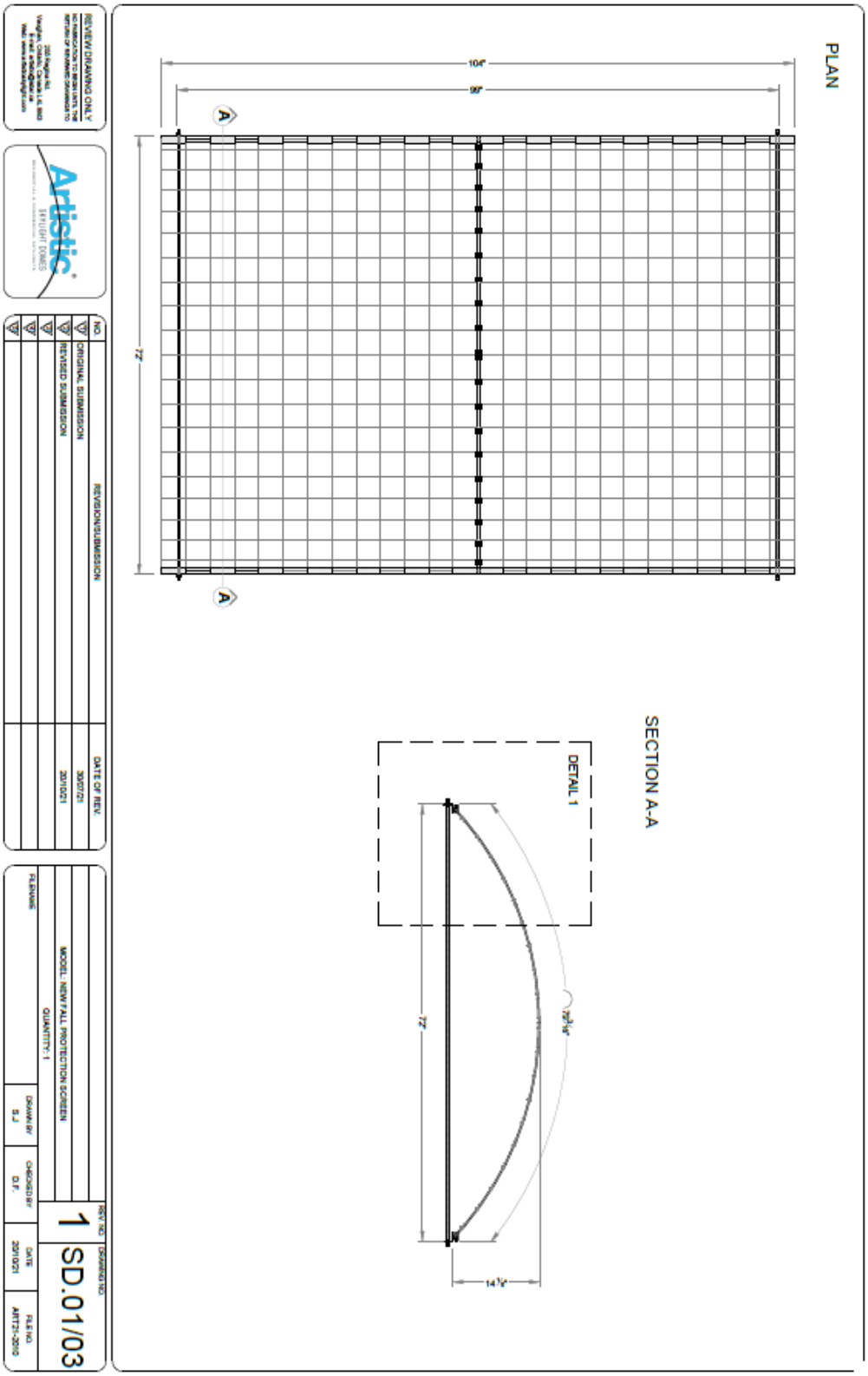
Photo #4. Static Load Location #3 – Under Load

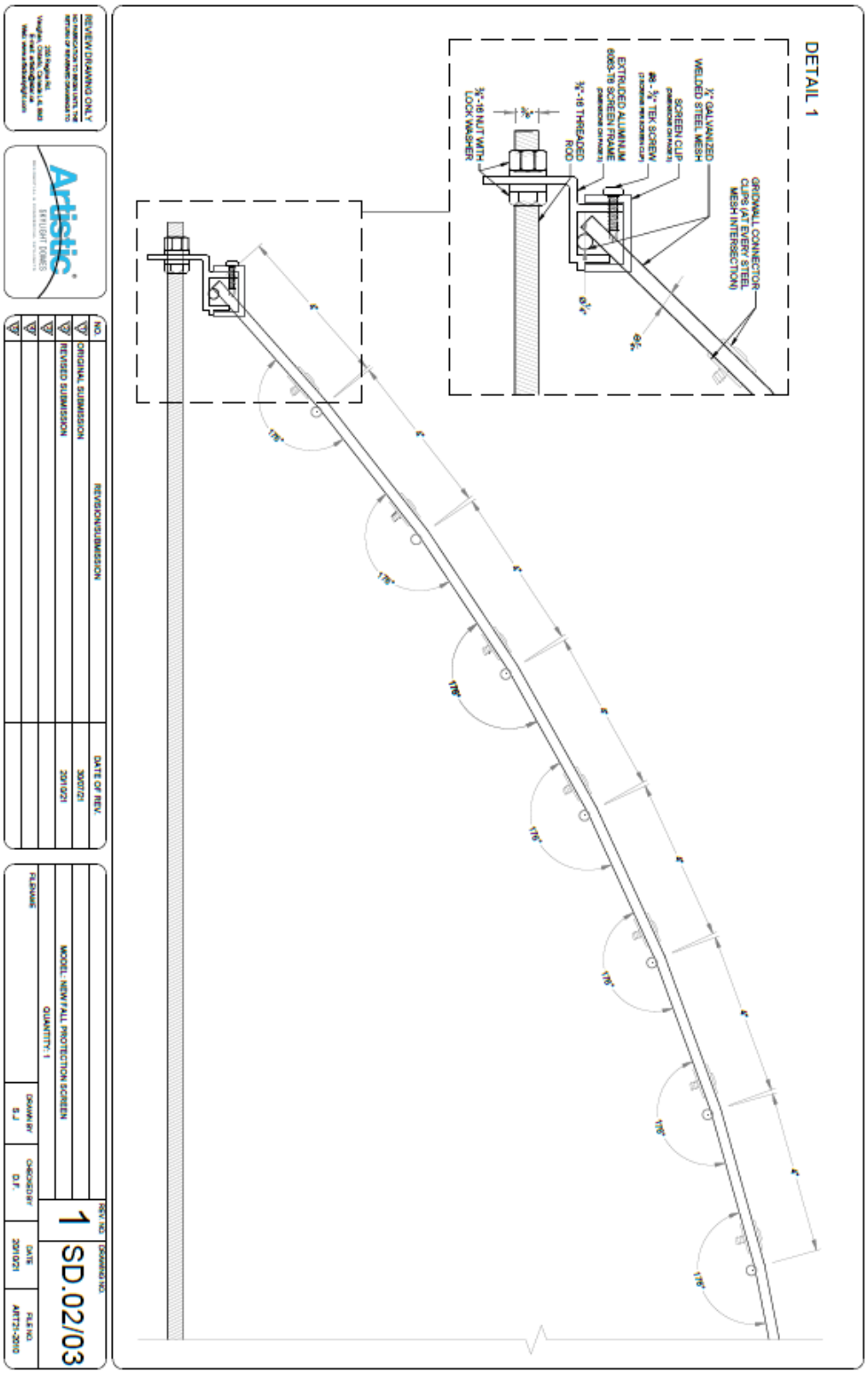
## APPENDIX B – Impact Load Photographs

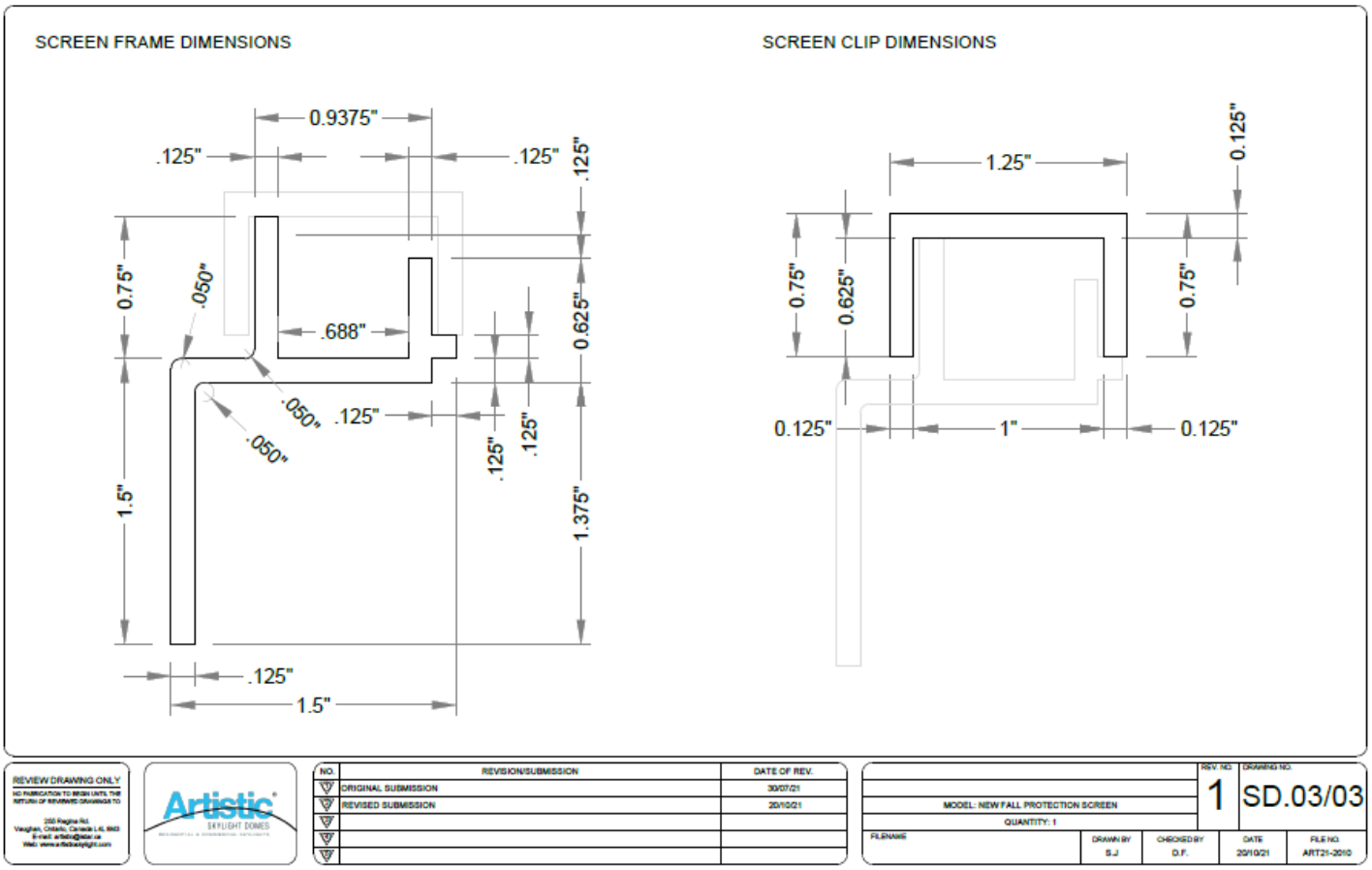
Photo #5 – Impact Location #1 – Post Impact

Photo #6 – Impact Location #2 – Post Impact

## APPENDIX C – Client Drawings








## Decision Rule

Unless specifically stated or identified otherwise, QAI has utilized a simple acceptance rule to make conformity decisions on testing results contained in this report, as applicable.

## Revision History

| Revision | Date | Comments | Eng/Tech |
|---|---|---|---|
| 0 | October 29, 2021 | Original Issue | R. Giona |
| 1 | November 4, 2021 | Added CAL-OSHA 3212 (e1) reference to Impact Load statement on cover page. Added CAL-OSHA 3212 (e1) Test requirement into Impact Load section of report. | R. Giona |
| 2 | November 9, 2021 | Added comment regarding Inner shell of dome unbroken and intact to cover page and impact test result sections. | R. Giona |

****End of Report****