ACURLITE STRUCTURAL SKYLIGHTS

STRUCTURAL & IMPACT TEST REPORT

Model "Hurricane Skylight"
Fixed Skylight

NCTL-110-10024-1

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STRUCTURAL & IMPACT PERFORMANCE TEST REPORT

Report No:	*NCTL-110-10024-1*
Test Date:	*01/19/07*
Report Date:	*01/25/07*
Expiration Date:	*01/31/11*
Revision Date:	*04/17/07*

Client: *Acurlite Structural Skylights*
1017 North Vine Street
Berwick, PA 18603

Test Specimen: *Acurlite Structural Skylights' Model "Hurricane Skylight" Fixed Skylight.*

Tests Conducted: *Florida Building Code 2004 TAS 201-94, "Impact Test Procedures"; Florida Building Code 2004 TAS 202-94, "Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components using Uniform Static Air Pressure." Florida Building Code 2004 TAS 203-94, "Criteria for Testing Products Subjected to Cyclic Pressure Loading."*

Design Pressures:

Specimen 1	*(TAS-202)*	*"Hurricane Skylight" Fixed Skylight*	*+ 75.0 psf. - 75.0 psf.*
Specimen 2	*(TAS-201/203)*	*"Hurricane Skylight" Fixed Skylight*	*+ 75.0 psf. - 75.0 psf.*
Specimen 3	*(TAS-201/203)*	*"Hurricane Skylight" Fixed Skylight*	*+ 75.0 psf. - 75.0 psf.*
Specimen 4	*(TAS-201/203)*	*"Hurricane Skylight" Fixed Skylight*	*+ 75.0 psf. - 75.0 psf.*

TEST SPECIMEN DESCRIPTION

Model Designation: *"Hurricane Skylight"*

General: *The test specimen was a fixed lite aluminum prime skylight measuring 51-15/16" wide by 108-1/2" high overall without flashing and 58-1/2" wide by 107-1/2" high overall with flashing. The fixed lite was glazed to the frame members, providing a viewing area of 46" wide by 96" high. An extruded aluminum cover was snap-fitted at the pressure plates. An extruded aluminum glazing adapter was fastened with screws on 6" center at the frame perimeter. The unit employed aluminum flashing that was fastened to the unit using #12x1" hex head tek screws on 11" centers and fastened to one another using pop rivets. The frame was of double screw butt-type corner construction. Frame members were not thermally broken.*

Glazing: *The fixed lite was exterior glazed using sealed insulating glass with a silicone back-bedding, an exterior glazing gasket at the rafters and a screwed-in-place extruded aluminum pressure plate at the rafters. The pressure plate was fastened to the rafter using 1/4" #20x2-3/4" hex head screws located on 6" centers. The overall insulating glass thickness was 1-5/16" consisting of one (1) lite of 1/4" heat strengthened glass to the exterior, one (1) lite of laminated glass to the interior and one (1) space created by a desiccant-filled aluminum spacer system. The laminated glass consisted of two (2) lites of 1/4" heat strengthened glass separated by a 0.090" thick PVB interlayer.*

Weatherseals: *No weatherseals employed.*

Weeps: *No apparent weeps employed.*

Interior & Exterior Surface Finish: *Brown anodized aluminum.*

Sealant: *The exterior glazing surface at the purlines was back-filled with backer-rod and sealed with a silicone sealant. The pressure plate was sealed in place with a silicone sealant. All exterior flashing joints were sealed with a silicone sealant.*

Installation: *The unit was installed into a steel mock opening. The unit was fastened to the opening using two (2) 3" x 3" x 1/4" extruded aluminum angles at each end of the rafters. The angles were fastened to the rafters using a 1/2" x 4-1/2" hex head cap screw with finish nut, lock washer and two (2) flat washers. The angles were fastened to the steel using a 1/2" x 2" hex head top bolt with finish nut, lock washer and two (2) flat washers. The steel opening consisted of one (1) C4 x 5.4 C-channel welded to a 3" x 3" x 1/4" steel angle.*

SEQUENCE OF TESTS PERFORMED:
TAS 202-94/ PA 202-94
Air Infiltration
Half Test Load Positive
Design Load Positive
Half Test Load Negative
Design Load Negative
Water Resistance
Test Load Positive
Test Load Negative
Forced Entry Resistance

TEST RESULTS

<u>TAS 202-94 – Uniform Static Air Pressure Testing</u> *– Done on a 14° pitch*

Air Infiltration *- ASTM E283*

	Test Pressure	***Measured***	***Allowable***
Specimen 1	*1.57 psf*	*<0.01 cfm/ft²*	*0.3 cfm/ft²*

Water Infiltration Test *- ASTM E331*

Specimen 1
Water @ 11.25 psf load for 15 minutes penetration.

Result: *Passed. No water*

TEST RESULTS *(Continued)*

Static Air Pressure Tests *- ASTM E330*

Specimen 1
Design Load + 75.0 psf, -75.0 psf.
Positive Loads

Range of Test	***Actual Load***	***Deflection***	***Perm. Set***
Half Test Load	*+ 56.25 psf*	*N/A*	*N/A"*
Sill			
Design Load	*+ 75.0 psf*	*0.097"*	*0.047"*
Test Load	*+ 112.5 psf*	*0.074"*	*0.014"*
Jamb			
Design Load	*+ 75.0 psf*	*0.176"*	*0.064"*
Test Load	*+ 112.5 psf*	*0.194"*	*0.022"*
Negative Loads			
Half Test Load	*- 52.5 psf*	*N/A*	*N/A*
Sill			
Design Load	*- 75.0 psf*	*0.092"*	*0.030"*
Test Load	*- 112.5 psf*	*0.214"*	*0.112"*
Jamb			
Design Load	*- 75.0 psf*	*0.037"*	*0.024"*
Test Load	*- 112.5 psf*	*0.278"*	*0.101"*

Forced Entry Resistance *- ASTM F588* *Meets as Stated*
(See Appendix A for test results)

TAS 201-94 – Large Missile Impact
Impact tests were conducted in accordance with TAS 201-94/ PA 201-94.

Type and weight of missile: *#2 Southern Yellow Pine 2x4, Length 102" & 9 lbs.*

Specimen 1	***Location***	***Comments***	***Speed***
Impact	*Center of Lite*	*No Penetration / Passed*	*50 fps*
Impact	*Lower Right Corner Lite*	*No Penetration / Passed*	*50 fps*
Specimen 2	***Location***	***Comments***	***Speed***
Impact	*Center of Lite*	*No Penetration / Passed*	*50 fps*
Impact	*Lower Right Corner Lite*	*No Penetration / Passed*	*50 fps*
Specimen 3	***Location***	***Comments***	***Speed***
Impact	*Center of Lite*	*No Penetration / Passed*	*50 fps*
Impact	*Lower Right Corner Lite*	*No Penetration / Passed*	*50 fps*

TAS 203-94 – Cycling Testing

Specimen #1 ***Design Pressures: + 75.0 psf - 75.0 psf***

Range of Test						
Positive Loads	*Actual*				*# of Cycles*	*Result*
+0.2 to +0.5 DP	*15.0*	*psf to*	*37.5*	*psf*	*3,500*	*Passed*
+0.0 to +0.6 DP	*0.0*	*psf to*	*45.0*	*psf*	*300*	*Passed*
+0.5 to +0.8 DP	*37.5*	*psf to*	*60.0*	*psf*	*600*	*Passed*
+0.3 to +1.0 DP	*22.5*	*psf to*	*75.0*	*psf*	*100*	*Passed*
Negative Loads	*Actual*				*# of Cycles*	*Result*
-0.3 to -1.0 DP	*22.5*	*psf to*	*75.0*	*psf*	*50*	*Passed*
-0.5 to -0.8 DP	*37.5*	*psf to*	*60.0*	*psf*	*1,050*	*Passed*
-0.0 to -0.6 DP	*0.0*	*psf to*	*45.0*	*psf*	*50*	*Passed*
-0.2 to -0.5 DP	*15.0*	*psf to*	*37.5*	*psf*	*3,350*	*Passed*

Specimen #2 ***Design Pressures: + 75.0 psf - 75.0 psf***

Range of Test						
Positive Load	*Actual*				*# of Cycles*	*Result*
+0.2 to +0.5 DP	*15.0*	*psf to*	*37.5*	*psf*	*3,500*	*Passed*
+0.0 to +0.6 DP	*0.0*	*psf to*	*45.0*	*psf*	*300*	*Passed*
+0.5 to +0.8 DP	*37.5*	*psf to*	*60.0*	*psf*	*600*	*Passed*
+0.3 to +1.0 DP	*22.5*	*psf to*	*75.0*	*psf*	*100*	*Passed*
Negative Loads	*Actual*				*# of Cycles*	*Result*
-0.3 to -1.0 DP	*22.5*	*psf to*	*75.0*	*psf*	*50*	*Passed*
-0.5 to -0.8 DP	*37.5*	*psf to*	*60.0*	*psf*	*1,050*	*Passed*
-0.0 to -0.6 DP	*0.0*	*psf to*	*45.0*	*psf*	*50*	*Passed*
-0.2 to -0.5 DP	*15.0*	*psf to*	*37.5*	*psf*	*3,350*	*Passed*

Specimen #3 ***Design Pressures: + 75.0 psf - 75.0 psf***

Range of Test						
Positive Load	*Actual*				*# of Cycles*	*Result*
+0.2 to +0.5 DP	*15.0*	*psf to*	*37.5*	*psf*	*3,500*	*Passed*
+0.0 to +0.6 DP	*0.0*	*psf to*	*45.0*	*psf*	*300*	*Passed*
+0.5 to +0.8 DP	*37.5*	*psf to*	*60.0*	*psf*	*600*	*Passed*
+0.3 to +1.0 DP	*22.5*	*psf to*	*75.0*	*psf*	*100*	*Passed*
Negative Loads	*Actual*				*# of Cycles*	*Result*
-0.3 to -1.0 DP	*22.5*	*psf to*	*75.0*	*psf*	*50*	*Passed*
-0.5 to -0.8 DP	*37.5*	*psf to*	*60.0*	*psf*	*1,050*	*Passed*
-0.0 to -0.6 DP	*0.0*	*psf to*	*45.0*	*psf*	*50*	*Passed*
-0.2 to -0.5 DP	*15.0*	*psf to*	*37.5*	*psf*	*3,350*	*Passed*

Disclaimer: *This test report was prepared by National Certified Testing Laboratory (NCTL), for the exclusive use of the above named client; it does not constitute certification of this product. The results are for that particular specimen tested and does not imply the quality of similar or identical products manufactured or installed from specifications identical to the tested product. NCTL is a testing lab and assumes that all information provided by the client is accurate and does not guarantee or warranty any product tested or installed.*

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APPENDIX A

Forced Entry Resistance Test Results

***Test Method**: ASTM F588-04, "Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact".*

TEST RESULTS

Paragraph No.	*Loads*	*Duration*	*Measured*	*Allowed*
A2.1 Disassembly Test	*N/A*	*5 Minutes*	*No Entry*	*No Entry*
A2.3 Sash Manipulation	*N/A*	*5 Minutes*	*No Entry*	*No Entry*

APPENDIX B

Estimated Uncertainty of Measurements

As required by Section 5.10.3 of ISO 17025, "General Requirements for the Competence of Testing and Calibration Laboratories", listed below is the estimated expanded uncertainties for the applicable measurements in this report:

Operating Force:	*± 0.6 lb_f (± 2.7 N)*
Test Pressures:	*± 0.2 psf (± 10 Pa)*
Air Leakage:	*± 0.12/A cfm/ft² (± 0.06/A L/ (sec • m²))* *Where A is the area of the test specimen*
Deflection Measurements:	*± 0.002 inches (± 0.05 mm)*
Deglazing Force:	*± 0.7 lb_f (± 3.1 N)*
Forced Entry Loads:	*± 0.7 lb_f (± 3.1 N)*

All of the above expanded uncertainties are determined from combined standard uncertainties and a coverage factor k = 2.00 based on a normal distribution, and define an interval estimated to have a level of confidence of 95%.

ACURLITE STRUCTURAL SKYLIGHTS

IMPACT & CYCLING TEST REPORT

Model "Hurricane Skylight"
Fixed Skylight

NCTL-110-10024-2

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IMPACT & CYCLING PERFORMANCE TEST REPORT

Report No:	*NCTL-110-10024-2*
Test Date:	*01/19/07*
Report Date:	*01/25/07*
Expiration Date:	*01/31/11*
Revision Date:	*04/17/07*

Client: *Acurlite Structural Skylights*
1017 North Vine Street
Berwick, PA 18603

Test Specimen: *Acurlite Structural Skylights' Model "Hurricane Skylight" Fixed Skylight.*

Tests Conducted: *ASTM E1996-04, "Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes"; ASTM E1886-05, "Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials".*

TEST SPECIMEN DESCRIPTION

General: *The test specimen was a fixed lite aluminum prime skylight measuring 51-15/16" wide by 108-1/2" high overall without flashing and 58-1/2" wide by 107-1/2" high overall with flashing. The fixed lite was glazed to the frame members, providing a viewing area of 46" wide by 96" high. An extruded aluminum cover was snap-fitted at the pressure plates. An extruded aluminum glazing adapter was fastened with screws on 6" center at the frame perimeter. The unit employed aluminum flashing that was fastened to the unit using #12x1" hex head tek screws on 11" centers and fastened to one another using pop rivets. The frame was of double screw butt-type corner construction. Frame members were not thermally broken.*

Glazing: *The fixed lite was exterior glazed using sealed insulating glass with a silicone back-bedding, an exterior glazing gasket at the rafters and a screwed-in-place extruded aluminum pressure plate at the rafters. The pressure plate was fastened to the rafter using 1/4" #20x2-3/4" hex head screws located on 6" centers. The overall insulating glass thickness was 1-5/16" consisting of one (1) lite of 1/4" heat strengthened glass to the exterior, one (1) lite of laminated glass to the interior and one (1) space created by a desiccant-filled aluminum spacer system. The laminated glass consisted of two (2) lites of 1/4" heat strengthened glass separated by a 0.090" thick PVB interlayer.*

Weatherseals: *No weatherseals employed.*

Weeps: *No apparent weeps employed.*

Interior & Exterior Surface Finish: *Brown anodized aluminum.*

Sealant: *The exterior glazing surface at the purlines was back-filled with backer-rod and sealed with a silicone sealant. The pressure plate was sealed in place with a silicone sealant. All exterior flashing joints were sealed with a silicone sealant.*

Installation: *The unit was installed into a steel mock opening. The unit was fastened to the opening using two (2) 3" x 3" x 1/4" extruded aluminum angles at each end of the rafters. The angles were fastened to the rafters using a 1/2" x 4-1/2" hex head cap screw with finish nut, lock washer and two (2) flat washers. The angles were fastened to the steel using a 1/2" x 2" hex head top bolt with finish nut, lock washer and two (2) flat washers. The steel opening consisted of one (1) C4 x 5.4 C-channel welded to a 3" x 3" x 1/4" steel angle.*

IMPACT TEST PARAMETERS

The appropriate missile to be used for impact tests was selected in accordance with section 6 of ASTM E1996 based on the following criteria:

Level of Protection:	*Basic Protection / Enhanced Protection*
Wind Zone:	*Wind Zone 4 – greater than 140 mph*
Assembly Height Above Ground Level:	*Less than or equal to 30 feet basic protection*
	Greater than 30 feet enhanced protection

IMPACT TEST RESULTS

Large missile impact tests were conducted using a #2 Southern Yellow Pine 2 x 4 measuring 92" in length and weighing 9 lbs (Missile D) as shown in Table 2 of ASTM E1996. Missile speeds and impact locations were in accordance with Table 2 and Section 5.3 of ASTM E1996. For pass/fail criteria, no penetration is defined as no tear longer than 5 inches in length and 1/16" wide or no opening through which a 3" diameter solid sphere can freely pass per section 7 of ASTM E 1996. All specimens were conditioned at 70° F ± 15°F prior to testing. Missile orientation at impact complies with section 11.2.2 of ASTM E1886.

Specimen 1	***Location***	***Comments***	***Speed***
Impact	*Center of Lite*	*No Penetration / Passed*	*50 fps*
Impact	*Lower Right Corner Lite*	*No Penetration / Passed*	*50 fps*
Specimen 2	***Location***	***Comments***	***Speed***
Impact	*Center of Lite*	*No Penetration / Passed*	*50 fps*
Impact	*Lower Right Corner Lite*	*No Penetration / Passed*	*50 fps*
Specimen 3	***Location***	***Comments***	***Speed***
Impact	*Center of Lite*	*No Penetration / Passed*	*50 fps*
Impact	*Lower Right Corner Lite*	*No Penetration / Passed*	*50 fps*

Results: *After impacts, there was no penetration or separation of glass from the frame. Upon completion of testing, all specimens meet the requirements of ASTM E1996, section 7.*

PRESSURE CYCLING TEST RESULTS

After completion of the impact tests, the specimens were pressure cycled in accordance with Table 1 of ASTM E1996. The duration of each air pressure cycle was between 1 and 5 seconds. Where required, two-(2) mil plastic film was used to obtain cycle loads. The film did not affect the performance of the specimen or influence the results of the test. For pass/fail criteria, passing is defined as no tear longer than 5 inches in length and 1/16" wide or no opening through which a 3" diameter solid sphere can freely pass per Section 7 of ASTM E 1996.

Specimen #1 ***Design Pressures: + 75.0 psf - 75.0 psf***

Range of Test Positive Loads	Actual	# of Cycles	Result
+0.2 to +0.5 DP	15.0 psf to 37.5 psf	3,500	Passed
+0.0 to +0.6 DP	0.0 psf to 45.0 psf	300	Passed
+0.5 to +0.8 DP	37.5 psf to 60.0 psf	600	Passed
+0.3 to +1.0 DP	22.5 psf to 75.0 psf	100	Passed
Negative Loads	**Actual**	**# of Cycles**	**Result**
-0.3 to -1.0 DP	22.5 psf to 75.0 psf	50	Passed
-0.5 to -0.8 DP	37.5 psf to 60.0 psf	1,050	Passed
-0.0 to -0.6 DP	0.0 psf to 45.0 psf	50	Passed
-0.2 to -0.5 DP	15.0 psf to 37.5 psf	3,350	Passed

Specimen #2 ***Design Pressures: + 75.0 psf - 75.0 psf***

Range of Test Positive Load	Actual	# of Cycles	Result
+0.2 to +0.5 DP	15.0 psf to 37.5 psf	3,500	Passed
+0.0 to +0.6 DP	0.0 psf to 45.0 psf	300	Passed
+0.5 to +0.8 DP	37.5 psf to 60.0 psf	600	Passed
+0.3 to +1.0 DP	22.5 psf to 75.0 psf	100	Passed
Negative Loads	**Actual**	**# of Cycles**	**Result**
-0.3 to -1.0 DP	22.5 psf to 75.0 psf	50	Passed
-0.5 to -0.8 DP	37.5 psf to 60.0 psf	1,050	Passed
-0.0 to -0.6 DP	0.0 psf to 45.0 psf	50	Passed
-0.2 to -0.5 DP	15.0 psf to 37.5 psf	3,350	Passed

Specimen #3 ***Design Pressures: + 75.0 psf - 75.0 psf***

Range of Test Positive Load	Actual	# of Cycles	Result
+0.2 to +0.5 DP	15.0 psf to 37.5 psf	3,500	Passed
+0.0 to +0.6 DP	0.0 psf to 45.0 psf	300	Passed
+0.5 to +0.8 DP	37.5 psf to 60.0 psf	600	Passed
+0.3 to +1.0 DP	22.5 psf to 75.0 psf	100	Passed
Negative Loads	**Actual**	**# of Cycles**	**Result**
-0.3 to -1.0 DP	22.5 psf to 75.0 psf	50	Passed
-0.5 to -0.8 DP	37.5 psf to 60.0 psf	1,050	Passed
-0.0 to -0.6 DP	0.0 psf to 45.0 psf	50	Passed
-0.2 to -0.5 DP	15.0 psf to 37.5 psf	3,350	Passed

Results: *Upon completion of testing, the specimens meet the requirements of ASTM E1996, Section 7.*

TEST COMPLETED 01/19/07

The listed impact test results were secured by using the ASTM E1886 test method and indicate compliance with the performance requirements of ASTM E1996 for the listed test parameters at the following design pressures:

Positive Design Pressure:	*+ 75.0 psf*
Negative Design Pressure:	*- 75.0 psf*

Detailed drawings were available for laboratory records and compared to the test specimen at the time of this report. A copy of this report along with representative sections of the test specimen will be retained by NCTL. The results obtained apply only to the specimen tested and do not imply the quality of similar products manufactured or installed identical to the tested product. This report does not constitute certification or approval of the product, which may only be granted by a certification program validator or recognized approval entity. All tests were conducted in compliance with the referenced ASTM specifications. This report may not be reproduced, except in full, without the written consent of NCTL.

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ASTM E1996 COMPLIANCE STATEMENT

On January 19, 2007, Acurlite Structural Skylights completed impact testing at National Certified Testing Laboratories in York, PA. All tests were performed in full accordance with ASTM E1886 and ASTM E1996 with no deviations (Ref: NCTL-110-10024-2).

Manufacturer:	*Acurlite Structural Skylights*
Product Series:	*Series "Hurricane Skylight"*
Product Configuration Tested:	*Fixed Lite Aluminum Prime Skylight*
Tested Size:	*51-15/16" x 108-1/2" overall*
Glazing Configuration:	*Interior: one (1) lite of laminated glass consisting of (2) lites of 1/4" heat strengthened glass separated by a 0.090" thick PVB interlayer*
	Exterior: one (1) lite of 1/4" heat strengthened glass

Level of Protection:	*Basic Protection / Enhanced Protection*
Wind Zone:	*Wind Zone 4 – greater than 140 mph*
Assembly Height Above Ground Level:	*Less than or equal to 30 feet basic protection*
	Greater than 30 feet enhanced protection

Impact Missile Used:	*Missile D*
Positive Design Pressure:	*+ 75.0 psf*
Negative Design Pressure:	*- 75.0 psf*

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APPENDIX A

Estimated Uncertainty of Measurements

As required by Section 5.10.3 of ISO 17025, "General Requirements for the Competence of Testing and Calibration Laboratories", listed below is the estimated expanded uncertainties for the applicable measurements in this report:

Operating Force:	*± 0.6 lb_f (± 2.7 N)*
Test Pressures:	*± 0.2 psf (± 10 Pa)*
Air Leakage:	*± 0.12/A cfm/ft^2 (± 0.06/A L/ (sec• m^2))* *Where A is the area of the test specimen*
Deflection Measurements:	*± 0.002 inches (± 0.05 mm)*
Deglazing Force:	*± 0.7 lb_f (± 3.1 N)*
Forced Entry Loads:	*± 0.7 lb_f (± 3.1 N)*

All of the above expanded uncertainties are determined from combined standard uncertainties and a coverage factor k = 2.00 based on a normal distribution, and define an interval estimated to have a level of confidence of 95%.