

**TEST REPORT ON**  
**CENTRAL STATES MANUFACTURING, INC.'S**  
**R-LOC PANELS**  
**(26 GA., 80 KSI, 36" WIDE)**  
**AT 5' 0" – 3' 9" PANEL SPANS**  
**IN ACCORDANCE WITH**  
**ASTM E1646-95(2011) & E1680-11**

**TESTED FOR:**  
**Central States Manufacturing, Inc.**  
**302 Jane Place**  
**Lowell, AR 72745**  
**Telephone: (800) 356-2733**  
**Fax: (800) 356-2971**

**TESTED BY:**  
**ENCON® Technology, Inc.**  
**1216 North Lansing Avenue, Suite C**  
**Tulsa, OK 74106**  
**Telephone: (918) 492-5992**  
**FAX: (866) 366-1543**

**TEST WITNESSED BY:**  
**Bala Sockalingam, Ph.D., P.E.**

**TESTING DATES: October 22, 2015**  
**REPORTING DATE: October 30, 2015**

**ENCON® Project C2051-1**



## TABLE OF CONTENTS

	Page Number
<b>SECTION I TEST SUMMARY</b>	
1.1 Summary	1
1.2 Panel System Description	1
1.3 Test Results	1-2
1.4 Test Panel	3
<b>SECTION II DESCRIPTION OF TEST</b>	
2.1 Description of Test	4-5
<b>SECTION III TEST RESULTS</b>	
3.1 Specimen Identification	6
3.2 Test Data	7
<b>SECTION IV TEST PHOTOGRAPHS</b>	
4.1 Test Photographs	8-11
<b>SECTION V APPENDIX</b>	
5.1 Test Drawings	12-13
5.2 Flowmeter Calibration Chart	14
5.3 Test Conditions	15-16



# TEST SUMMARY

## 1.1 SUMMARY

Tests were conducted on Central States Manufacturing's R-Loc (26 ga., 1-1/4" high and 36" wide) metal roof panels at ENCON® Technology, Inc.'s Test Facility, Tulsa, Oklahoma. The purpose of the tests was to determine the resistance of exterior metal roof panel system with sealant to water penetration and air infiltration resulting from static air pressure difference between the exterior and interior surfaces. These tests meet the provisions of ASTM E1680-11 "*Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems*" and ASTM E1646-95(2011) "*Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference*".

The above-defined tests were witnessed by Bala Sockalingam, Ph.D., P.E., of ENCON Technology. The panels were installed on October 19, 2015 and tested on October 22, 2015.

## 1.2 PANEL SYSTEM DESCRIPTION

Central States's R-Loc panels were 26 ga., 1.25" high with effective coverage width of 36". Each panel consisted of four major ribs spaced at 12" o.c. as shown on Page 3.

Sealant used in the panel sidelaps was Tacky Tape® SM5227 butyl tape sealant. The nominal size of the tape sealant was 3/4" wide and 3/32" thick.

The panels were attached to nominal 16 ga. angles with #12-14 x 1.25" long Steelbinder MAXX HWH self-drilling screws. The fasteners were spaced at 7"-5"-7" o.c. at end supports and at 12" o.c. at interior support. Each panel spanned over unequal spans of 5' 0" and 3' 9". Sidelap fasteners were #14 x 7/8" long Steelbinder ZXL self-drilling screws spaced at 20" o.c.

## 1.3 TEST RESULTS

The panel sidelaps and fasteners were sealed to measure the extraneous leakage of the test chamber and test specimen perimeter for static positive pressure difference of 1.57, 6.24, 12.0 and 20.0 psf. The panel sidelaps were unsealed and the air leakage rates were then measured for the above static positive pressure difference.

Upon completion of the air leakage test, the panel system was uniformly sprayed with water at a rate of 5.0 gal/ft<sup>2</sup> per hour for 15 minutes at a static positive (inward) pressure difference of 6.24 psf. The test was then repeated for a static positive (inward) pressure difference of 12.0 and 20.0 psf. The results for the two tests are summarized on Page 2.

## TEST SUMMARY

**Table 1. Test Results for R-Loc Panels**

**Test Method: ASTM E1680-11**

Test No.	Static Pressure Difference psf	Total Air Leakage cfm	Air Infiltration Rate	
			cfm/ft <sup>2</sup>	cfm/lin.ft
1	1.57	0.054	0.0008	0.0024
2	6.24	0.075	0.0011	0.0033
3	12	0.104	0.0015	0.0046
4	20	0.154	0.0023	0.0068

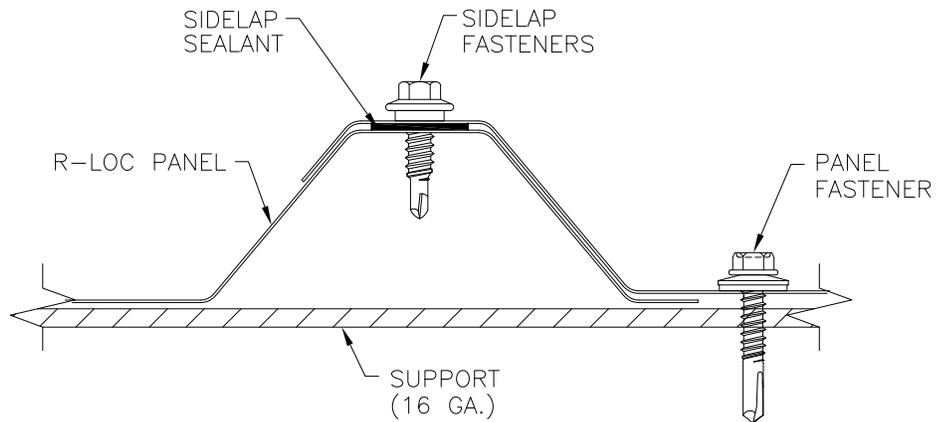
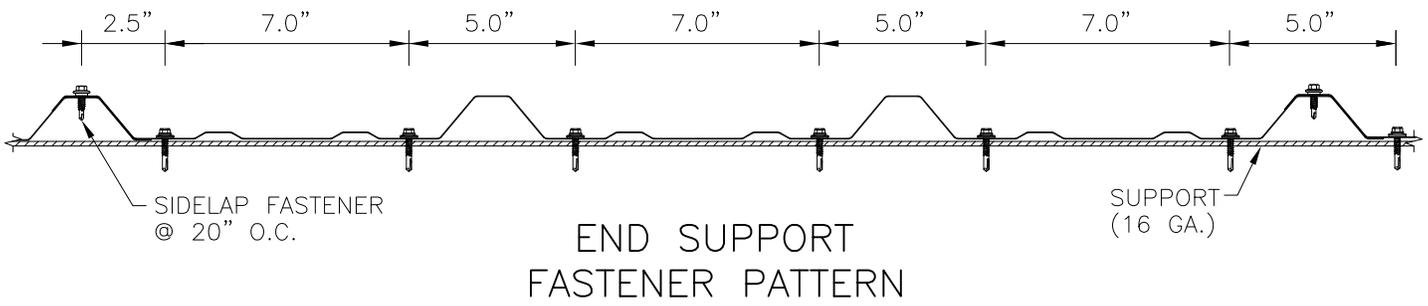
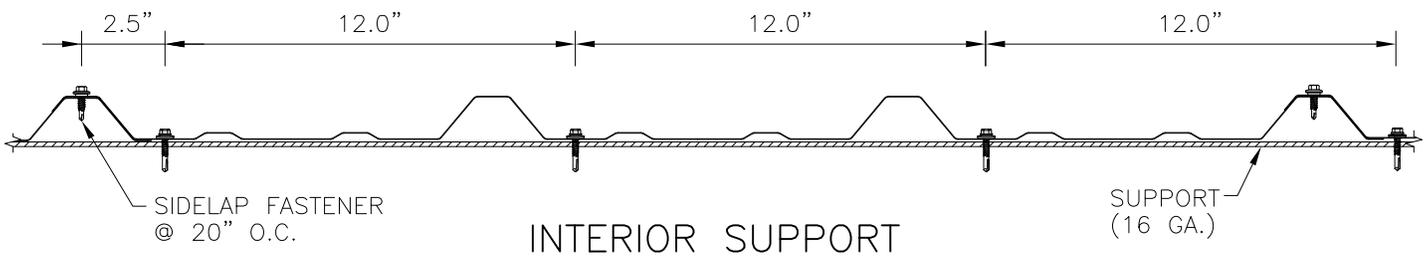
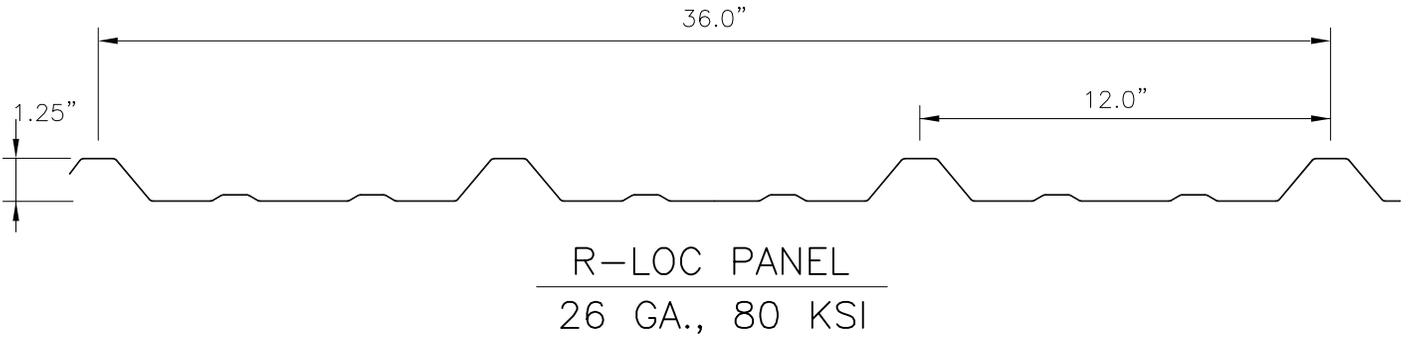
**Test Method: ASTM E1646-95 (2011)**

Test No.	Static Pressure Difference (psf)	Rate (gal/hr/ft <sup>2</sup> )	Test Duration (min)	Water Infiltration
1	6.24	5.0	15	No leaks
2	12	5.0	15	No leaks
3	20	5.0	15	No leaks

**Notes:**

1. Panel thickness and coverage width were 26 ga. and 36", respectively.
2. Panels were fastened to support with #12-14 x 1.25" long HWH self-drilling screws spaced at 7"-5"-7" o.c. at end supports and at 12" o.c. at interior support.
3. Sidelap fasteners were #14 x 7/8" long self-drilling screws spaced at 20" o.c.
4. Panels spanned over unequal spans of 5' 0" and 3' 9".
5. Sealant used in the panel sidelaps was Tacky Tape® SM5227 butyl tape sealant (3/4" wide and 3/32" thick).

© ENCON 2015



## **DESCRIPTION OF TEST**

### **2.1 DESCRIPTION OF TEST**

#### **OBJECTIVES**

The purpose of the tests was to determine the resistance of metal roof panel systems to water penetration and air infiltration resulting from static air pressure difference between the exterior and interior surfaces. The test method consisted of the following:

1. assembling the test panel in the test chamber to form a typical roof construction;
2. measuring the air leakage through the panel sidelaps and extraneous leakage of the test chambers;
3. spraying the exterior roof surface with water to determine any water penetration through panel sidelaps

#### **TEST CHAMBER**

The test chamber consisted of a box as shown in the applicable drawings in Section V. It contains one open surface against which the test specimen was installed. One static pressure tap is located at a corner to measure the chamber pressure in such a manner that the reading was not affected by the velocity of the air supply to or from the chamber or other air movement. The air supply opening into the chamber was arranged so that the air does not impinge directly on the test specimen with significant velocity.

#### **AIR SYSTEM**

The compressed air supply consists of a compressor unit capable of maintaining a constant positive or negative air pressure difference for the required test period. A digital manometer was used to measure the test pressure difference with accuracy of 1/100".

#### **AIR FLOW METERING SYSTEM**

A laminar flow element capable of measuring airflow of 40 SCFM was used to measure the air leakage through the panel sidelaps and extraneous leakage of the test chambers. The flow was measured as a differential pressure using a digital manometer and converted to actual flow using regression equation shown on the flowmeter calibration chart.

#### **WATER SPRAY SYSTEM**

The water spray system consists of equally spaced nozzles located at a uniform distance from the test specimen. The system was calibrated to deliver a minimum rate of 5.0 gal/ft<sup>2</sup> per hour.

#### **CALIBRATION**

The water spray was calibrated on October 21, 2015 and the air-flow measuring system was calibrated on October 19, 2015.

## DESCRIPTION OF TEST

### TEST SPECIMEN

The overall dimension of the test construction was in excess of 7' 9" x 8' 9". The panels covered unequal spans of 5' 0" and 3' 9". The construction width contained two full panels and two partial panels. The panels were attached to an intermediate Cee purlin section with self-drilling screws per clip. The panels were attached to 16 ga. eave, rake and ridge sections with self-drilling screws. An overflow device that provided a 1/2" to 3/4" deep water pond was installed on one end of the test specimen. The perimeter of the test construction was sealed to the test chamber wall. The perimeter seals between the panels and the test chamber did not duplicate the actual building perimeter details. The details of the methods of construction are depicted in the enclosed test drawings in Section V.

### TEST PROCEDURE

Since the panels were through fastened, no thermal movement of the panel to the support was conducted.

The test specimen was preloaded to a positive load greater than or equal to 15 psf or 75% of the building live load or 50 % of the design positive wind pressure difference. The test specimen was also preloaded to a negative load greater than or equal to 50 % of the building design wind uplift pressure difference.

The panel sidelap was temporarily sealed to measure the extraneous air leakage,  $Q_L$ , of the test chamber for the specified test pressure difference across the test specimen. The temporary sidelap seal was removed and the airflow through the sidelaps was measured after the test conditions were stabilized for the specified test pressure difference across the test specimen. This measured airflow was designated the total metered airflow,  $Q_M$ . The air leakage,  $Q$ , through the test specimen was equal to  $Q_M - Q_L$ . The ambient room temperature at the test specimen was also measured.

Upon the completion of the air leakage test, the water spray system was installed over the test specimen. The test specimen was subjected to the specified positive (inward) test pressure difference for 15 minutes while the spray system delivered water on the test specimen at a rate of 5.0 gal/ft<sup>2</sup> per hour. The depth and the temperature of the ponded water on the test surface were measured. The test specimen was observed for possible water leakage.

## TEST RESULTS

### 3.1 SPECIMEN IDENTIFICATION

Panel Manufacturer:	Central States Manufacturing
Model Type:	R-Loc Roof Panel
Dimensions:	1-1/4" high, 36" wide coverage
Panel Gauge:	26 Ga. (0.0185" coated thickness)
Panel Fastener:	#12-14 x 1.25" long Steelbinder MAXX HWH self-drilling screws at 7"-5"-7" o.c. at end supports and at 12" o.c. at interior support.
Sidelap Fastener:	#14 x 7/8" long Steelbinder ZXL self-drilling screws
Sidelap Fastener Spacing:	20" o.c.
Fasteners Manufacturer:	Sealtite Building Fasteners
Support Thickness:	16 ga.
Sealant Manufacturer:	ITW Polymer Sealants
Panel Sealant:	Tacky Tape® SM5227 butyl tape sealant (Nom. 3/4" wide x 3/32" thick)

**Note: All the test materials were supplied by Central States Manufacturing and were not sampled by ENCON.**

## TEST RESULTS

### 3.2 TEST DATA

Date:	10.22.2015
Panel Manufacturer	Central States Manufacturing
Panel Type	R Loc Roof Panel
Panel Gauge	26 ga.
Panel Width (in)	36
Panel Attachment	#12-14 x 1-1/4" long Steelbinder MAXX SDS
Sidelap Fasteners	#14 x 7/8" long Steelbinder ZXL SDS at 20" o.c
Sealant Manufacturer	ITW Polymer Sealants
Panel Sealant	Tacky Tape® SM5227 butyl sealant (3/4" x 3/32")
Panel Span (ft)	5' 0" - 3' 9"
Test Area (ft <sup>2</sup> )	67.8
Preload Positive Pressure (psf)	20
Preload Negative Pressure (psf)	20
Ambient Temperature (F)	72.5
Panel Temperature (F)	73.4
Barometric Pressure (in. Hg)	29.23
Water Depth (in)	0.625

#### Test Method: ASTM E1680-11

Test No.	Static Pressure Difference psf	Initial Reading DP (in)	Initial Reading <sup>1</sup> cfm	Final Reading DP (in)	Final Reading <sup>1</sup> cfm	Total Air Leakage <sup>2</sup> cfm	Air Infiltration Rate	
							cfm/ft <sup>2</sup>	cfm/lin.ft
1	1.57	0.462	2.551	0.472	2.606	0.054	0.0008	0.0024
2	6.24	1.370	7.505	1.384	7.581	0.075	0.0011	0.0033
3	12.0	2.324	12.626	2.344	12.732	0.104	0.0015	0.0046
4	20.0	3.592	19.298	3.622	19.454	0.154	0.0023	0.0068

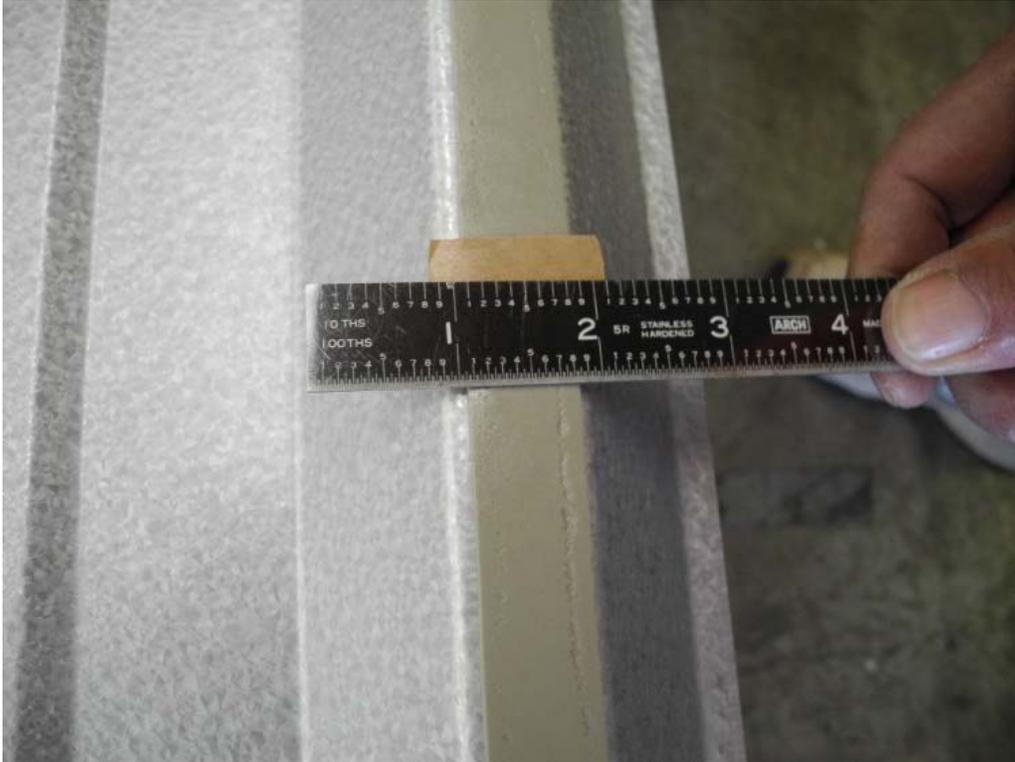
<sup>1</sup> The actual flow is calculated using the regression equation shown on the flowmeter calibration chart.

<sup>2</sup> Total Air Leakage  $Q_{st} : Q \times (1.326 \times B / (0.075 \times (T + 460)))^{0.5}$

#### Test Method: ASTM E1646-95 (2011)

Test No.	Static Pressure Difference (psf)	Rate (gal/hr/ft <sup>2</sup> )	Test Duration (min)	Water Infiltration
1	6.24	5	15	No leaks
2	12.0	5	15	No leaks
3	20.0	5	15	No leaks

## PHOTOGRAPHS



**PHOTO 1** View of sealant in the panel sidelap.  
(DSCN3883)



**PHOTO 2** View of panel and sidelap fasteners.  
(DSCN3967)

## PHOTOGRAPHS



**PHOTO 3** View of test setup. The panel sidelaps and fasteners were temporarily sealed for extraneous leakage measurement of the test chamber. (DSCN3924)



**PHOTO 4** View of the air flow measuring instruments. (DSCN3930)

## PHOTOGRAPHS



**PHOTO 5** View of flow measurements at differential pressure of 12.0 psf (equivalent to 2.306" of water). (DSCN3927)

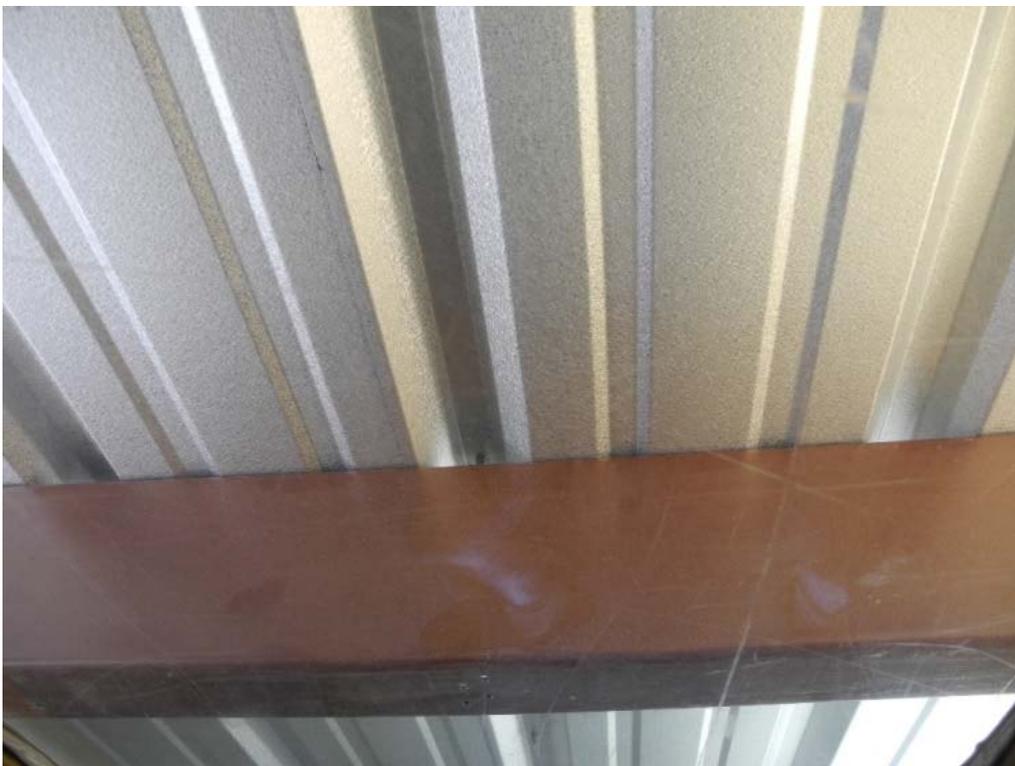


**PHOTO 6** View of flow measurements at differential pressure of 20.0 psf (equivalent to 3.843" of water). (DSCN3925)

## PHOTOGRAPHS

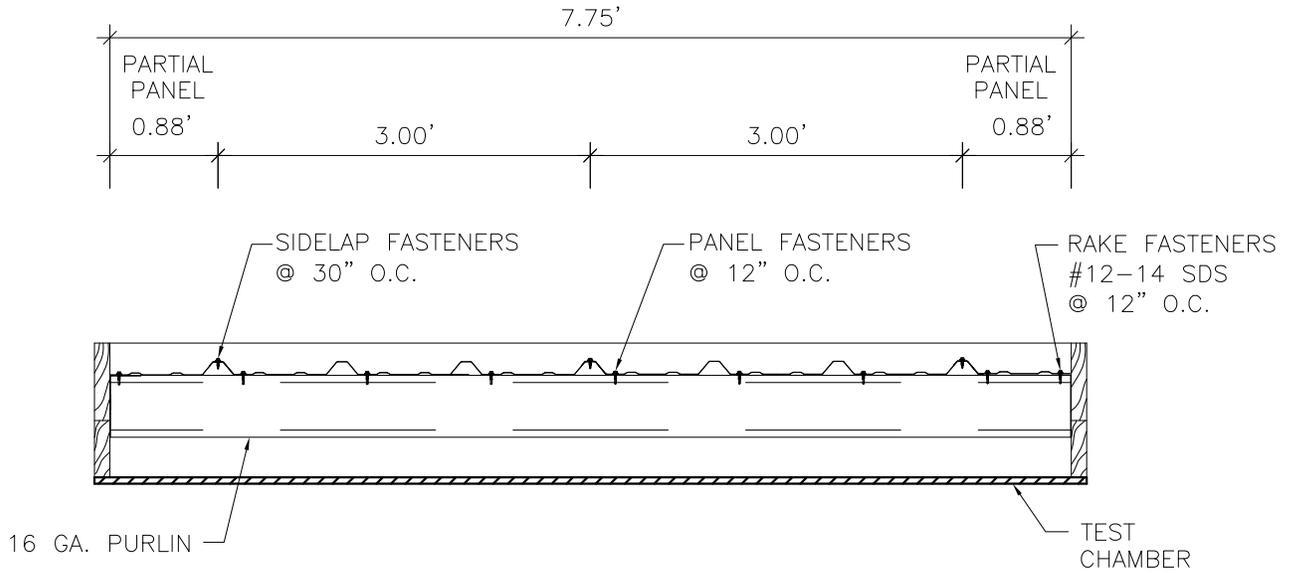


**PHOTO 7** View of water spray test.  
(DSCN3932)

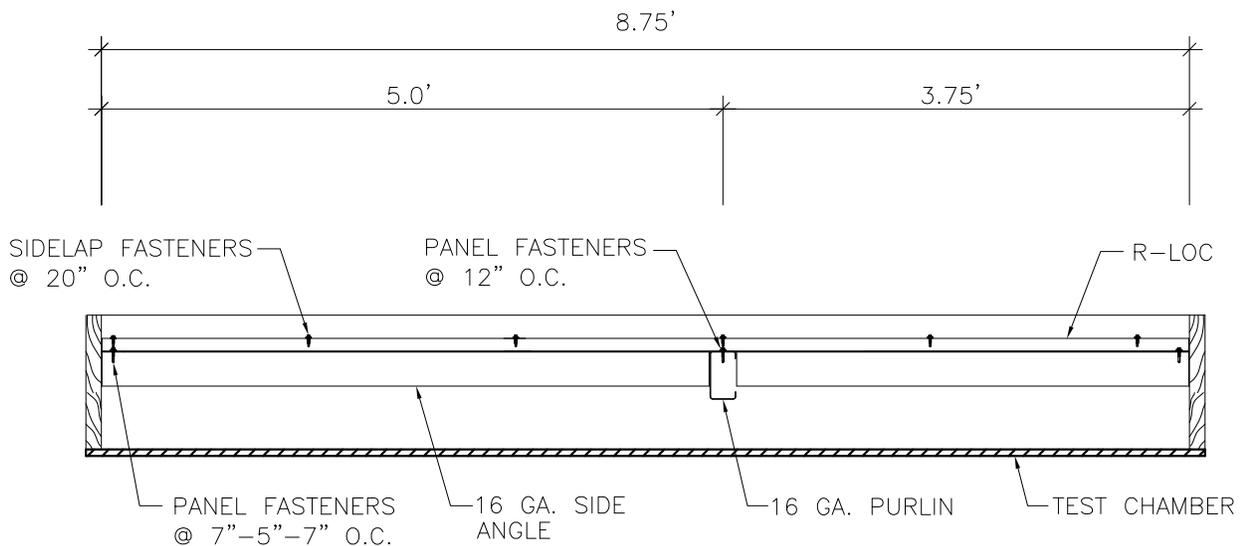


**PHOTO 8** View of panel sidelap inside the test chamber during water spray test.  
(DSCN3935)

© ENCON 2015

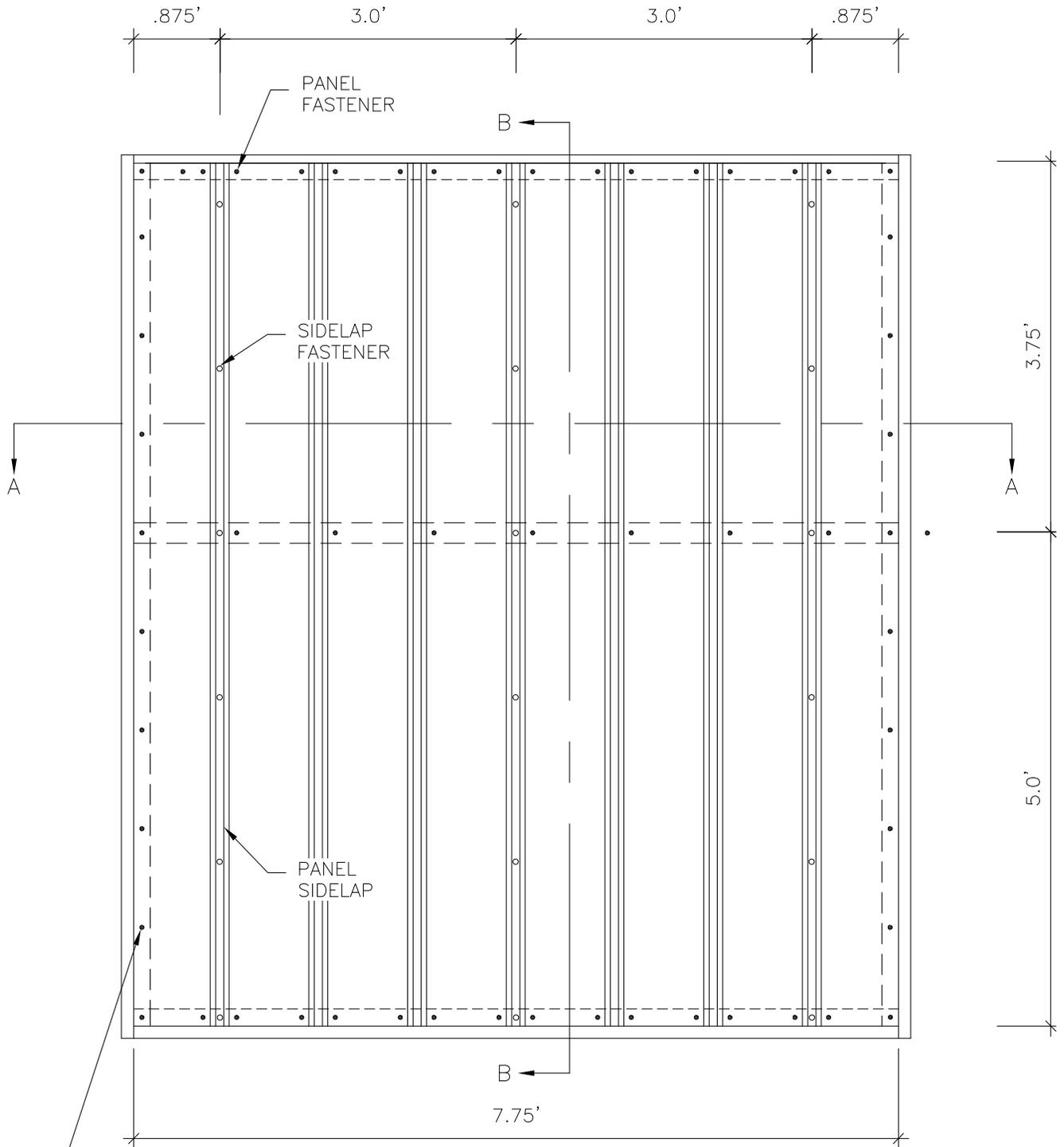


1 SECTION VIEW A-A  
2

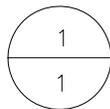


1 SECTION VIEW B-B  
3

© ENCON 2015

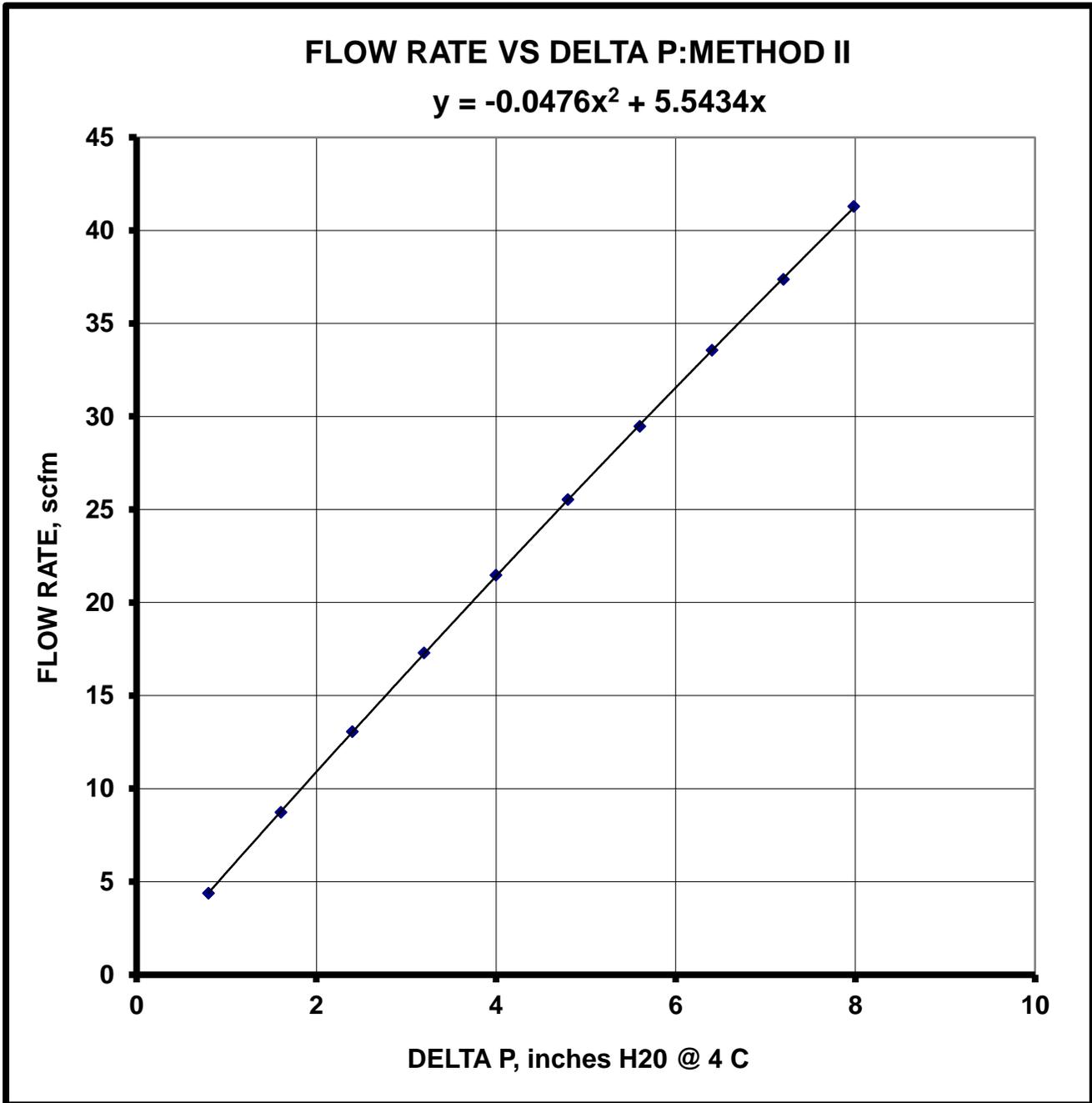


RAKE FASTENERS  
#12-14 SDS  
@ 12" O.C.



PLAN VIEW

ATTACHMENT TO CALIBRATION CERTIFICATE 51630  
AS FOUND/AS LEFT CALIBRATION DATA ( Gas = Air )  
Page 3 of 3



Flow - Humidity - Temperature - Pressure - Design - Consulting - Engineering

NIST Traceable Calibration Data Sheet

Graftel, LLC. 870 Cambridge Drive, Elk Grove Village, IL. 60007  
P. 847-364-2600 F. 847-364-2899

www.graftel.com

## APPENDIX

### 5.3 TEST CONDITIONS

#### A. OWNERSHIP OF ENCON WORK PRODUCT

All test results developed as a part of this work shall be CUSTOMER's property. All samples submitted to ENCON for testing shall become the property of ENCON. CUSTOMER understands that any test program including procedures and test machines incorporated as a part of this work is a result of continuing long-term research and development by ENCON and because of this all ENCON test procedures, test drawings and other intellectual property relating to this work is and shall remain the property of ENCON. Test samples were disposed of shortly after completion of the tests unless other arrangements were agreed to in writing prior to the test.

ENCON will use its normal procedures to retain copies of the information developed as a part of this test for a period of three years from the date the work was done. This material may be routinely destroyed thereafter.

#### B. ENCON GUARANTEE

ENCON guarantees it used its best effort to accomplish this test work. Work done by ENCON was carefully completed by personnel believed to be competent. ENCON tests were based on what was currently believed to be good engineering practices in use at the time of the test.

The safety factors used are generally accepted as suitable to produce safe results. However, good engineering practices and applicable codes and insurance requirements must be taken into consideration in determining if a test procedure is satisfactory for a specific end use. Applicable specifications, good engineering practices and applicable safety factors may change in the future. CUSTOMER should be alert to these changes.

The information and test results presented by ENCON in this test report are offered in good faith based on information ENCON believes to be reliable. This information is offered as a guide to assist CUSTOMER in CUSTOMER's endeavors and does not contain any warranties as to fitness by ENCON. No REPRESENTATION OF WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE are made by ENCON, and more specifically, ENCON hereby expressly disclaim such. In no event shall ENCON be liable for ANY CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES, including, without limitation, labor, transportation, loss of use, loss of profits, harm, personnel injury and damage to property.

If any doubt exists as to the proper means of interpreting or using the test results contained herein, contact ENCON for clarification. CUSTOMER should assure themselves through careful evaluations that test results are suitable for those end uses to which CUSTOMER intends to put them.

## APPENDIX

Information and material provided by CUSTOMER to ENCON was reviewed by an ENCON executive. However, ENCON does not accept the responsibility for accuracy or verification of CUSTOMER's information or the suitability of CUSTOMER materials. Materials supplied by CUSTOMER were tested as received and were not evaluated for code or insurance compliance. CUSTOMER is expected to review the ENCON drawings, tables, test results and other information provided by ENCON to CUSTOMER critically so as to assure CUSTOMER that these presentations, formulas, drawings and other information are accurate and meaningful for the purpose intended.

No other warranties or guarantees shall be issued, implied, delivered or otherwise construed to be issued, implied or delivered.

ENCON® TECHNOLOGY, INC., 2015