TEST REPORT ON

CENTRAL STATES MANUFACTURING, INC.'S CENTRAL-SNAP™ PANELS (24 GA., 1.75" HIGH, 16" WIDE PANEL) AT 5' 0" – 3' 9" PANEL SPANS IN ACCORDANCE WITH ASTM E1646-95(2011) & E1680-11

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

TESTING DATES: November 21, 2012
REPORTING DATE: November 27, 2012
ENCON® Project C1869-1

ACCREDITED
TL-327

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TEST SUMMARY

1.1 SUMMARY

Tests were conducted on Central States Manufacturing, Inc's Central-Snap™ (24 Ga., 1.75" high seam, 16" wide) standing seam 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 E1646-95 (Water penetration test) and E1680-11 (Air leakage test). The above-defined tests were witnessed by Bala Sockalingam, Ph.D., P.E., of ENCON Technology Inc. The panels were installed on November 16, 2012 and tested on November 21, 2012.

1.2 PANEL SYSTEM DESCRIPTION

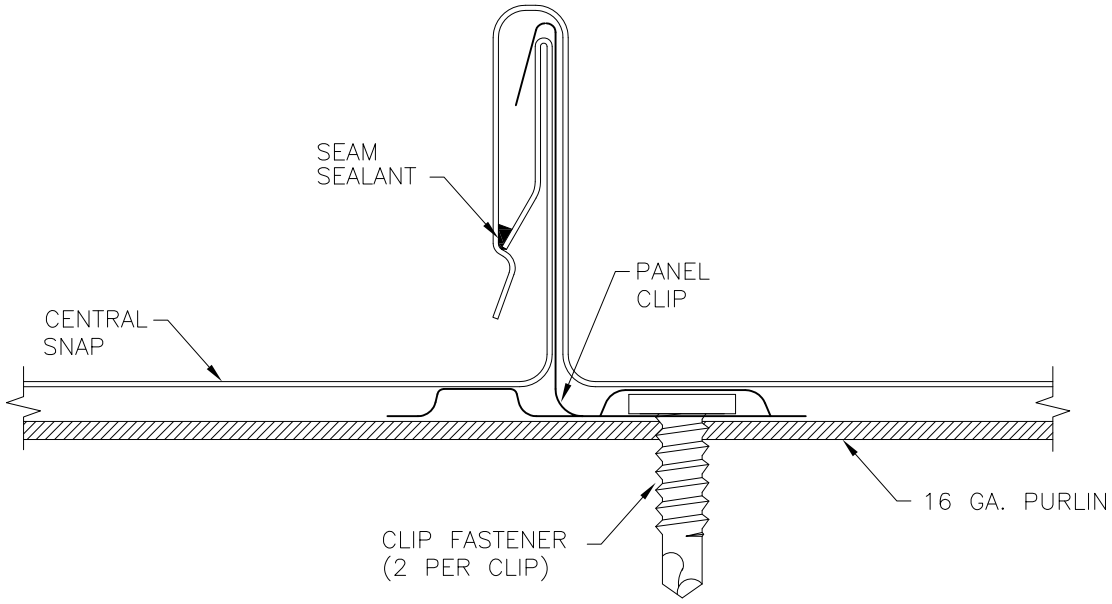
Central States Mfg.'s Central-Snap™ roof system consisted of 24 ga., 16" wide panels joined together at the sidelaps to form flat pan profile with 1.75" high seam as shown on Page 2.

Sealant used in these panels was Hot Melt Technologies' Hot Melt 8101 sealant. The nominal diameter of the sealant bead was 1/8". The Central-Snap panels were attached to nominal 16 ga., 6" deep, Cee purlin with standard panel clips and (2) #10-16 self-drilling screws per clip. Each panel spanned over unequal spans of 5' 0" and 3' 9". The panel sidelaps were manually snapped together to form the panel seam.

1.3 TEST RESULTS

The panel system was preloaded for positive load of 15 psf and negative load of 12 psf. The panel sidelaps were sealed to measure the extraneous leakage of the test chamber and test specimen perimeter. The panel sidelaps were unsealed and the air leakage rates were then measured for static positive pressure difference of 1.57 and 6.24 psf.

Upon completion of the air leakage test, the panel system was uniformly sprayed with water at a rate of 5.0 gal/ft^2 per hour for 15 minutes at a static positive (inward) pressure difference of 6.24 psf. There was no water leakage through the panel seams during and after the removal of the above pressure difference. The results for the two tests are summarized on Page 2.



CLIP SECTION VIEW

TEST METHOD: ASTM E 1680–11

TEST NO.	STATIC PRESSURE DIFFERENCE (PSF)	AIR INFILTRATION RATE	
		(cfm/ft^2)	(cfm/lin.ft)
1	1.57	0.0047	0.0063
2	6.24	0.0104	0.0138

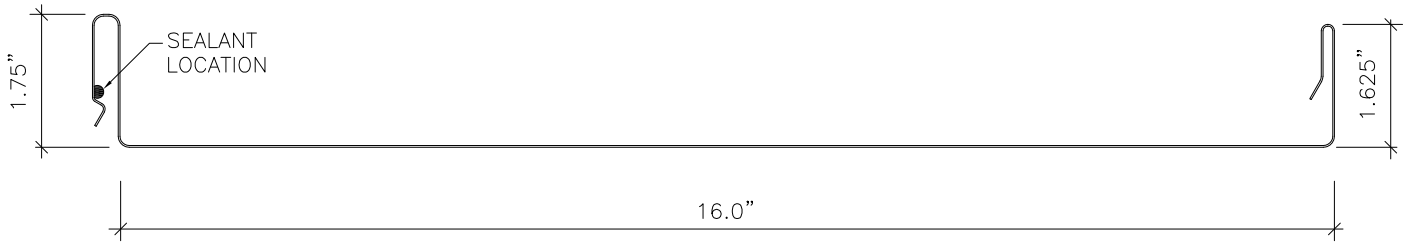
TEST METHOD: ASTM E 1646–95(2011)

TEST NO.	STATIC PRESSURE DIFFERENCE (PSF)	WATER INFILTRATION
1	6.24	NO WATER LEAKAGE

NOTES:

1. 24 GA., 16" WIDE CENTRAL–SNAP PANELS USED IN THESE TESTS.
2. CLIPS WERE ATTACHED TO PURLINS WITH (2) #10–16 SDS SCREWS.
3. PANELS SPANNED TWO UNEQUAL SPANS OF 5' 0" AND 3' 9".
4. 1/8" BEAD HOT MELT SEALANT WAS USED IN THE SIDELAPS.

ENCON TECHNOLOGY, INC.	CENTRAL STATES MFG CENTRAL–SNAP TEST PANEL	ASTM E1646 & E1680	3/17



CENTRAL–SNAP PANEL SECTION

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^2 per hour.

CALIBRATION

The water spray was calibrated on October 12, 2012 and the air-flow measuring system was calibrated on October 16, 2012.

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 six full panels and two partial panels. The panels were attached to an intermediate Cee purlin section with panel clips and (2) #10-16 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 ½" to ¾" 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

The support beams were moved to 75% of the design thermal movement of the panel clip to the support. This operation was conducted once for a total of two cycles. All supports beam connections to the test chamber were tightened.

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^2 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

Manufacturer:	Central States Manufacturing, Inc
Model Type:	Central-Snap™ Panel
Dimensions:	1.75" high seam, 16" wide flat pan profile
Panel Gauge:	24
Clip Type:	One piece fixed clip
Fasteners:	(2) #10-16 SDS
Purlin:	16 ga. (0.059" thick)
Sealant Manufacturers:	Hot Melt Technologies
Panel Sealant:	Hot Melt 8101 - Nom. 1/8" bead
Thermal Movement:	±1"

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

3.2 TEST DATA

Date:	11.21.2012
Panel Manufacturer	Central States Mfg.
Panel Type	Central-Snap™ Panel
Panel Gauge	24
Panel Width (in)	16
Panel Attachment	Galvanized Steel Clip with (2) #10-16
Sealant Manufacturer	Hot Melt Technologies
Panel Sealant	Hot Melt 8101 - Nom. 1/8" bead
Panel Span (ft)	5' 0" - 3' 9"
Test Area (ft^2)	67.8
Preload Positive Pressure (psf)	15
Preload Negative Pressure (psf)	12
Ambient Temperature (F)	64.4
Panel Temperature (F)	64
Barometric Pressure (in. Hg)	29.44
Water Depth (in)	0.625

Test Method: ASTM E1680-11

Test No.	Static Pressure Difference psf	Initial Reading DP (in)	Initial Reading [1] cfm	Final Reading DP (in)	Final Reading [1] cfm	Total Air Leakage [2] cfm	Air Infiltration Rate	
							cfm/ft^2	cfm/lin.ft
1	1.57	0.782	4.008	0.845	4.331	0.3218	0.0047	0.0063
2	6.24	2.082	10.665	2.220	11.372	0.7044	0.0104	0.0138

[1] The actual flow is calculated using the regression equation shown on the flowmeter calibration chart.

[2] 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 ($gal/hr/ft^2$)	Test Duration (min)	Water Infiltration
1	6.24	5	15	No Water Leakage

PHOTOGRAPHS

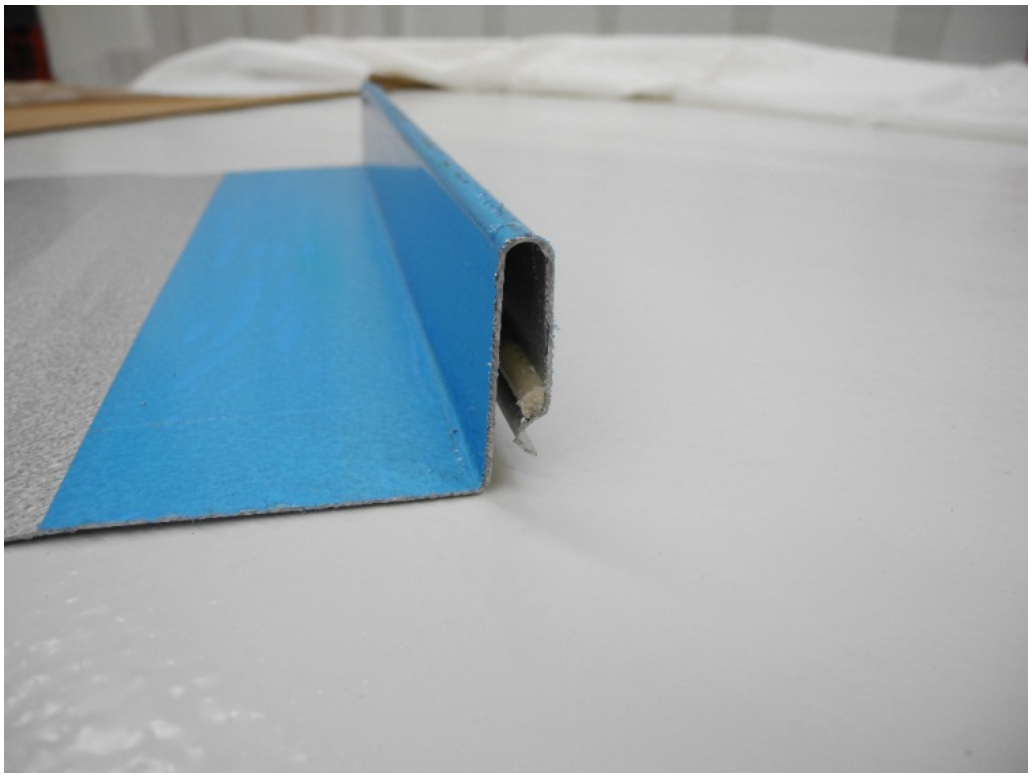


PHOTO 1 View of sealant in the panel sidelap.
(DSCN0903)

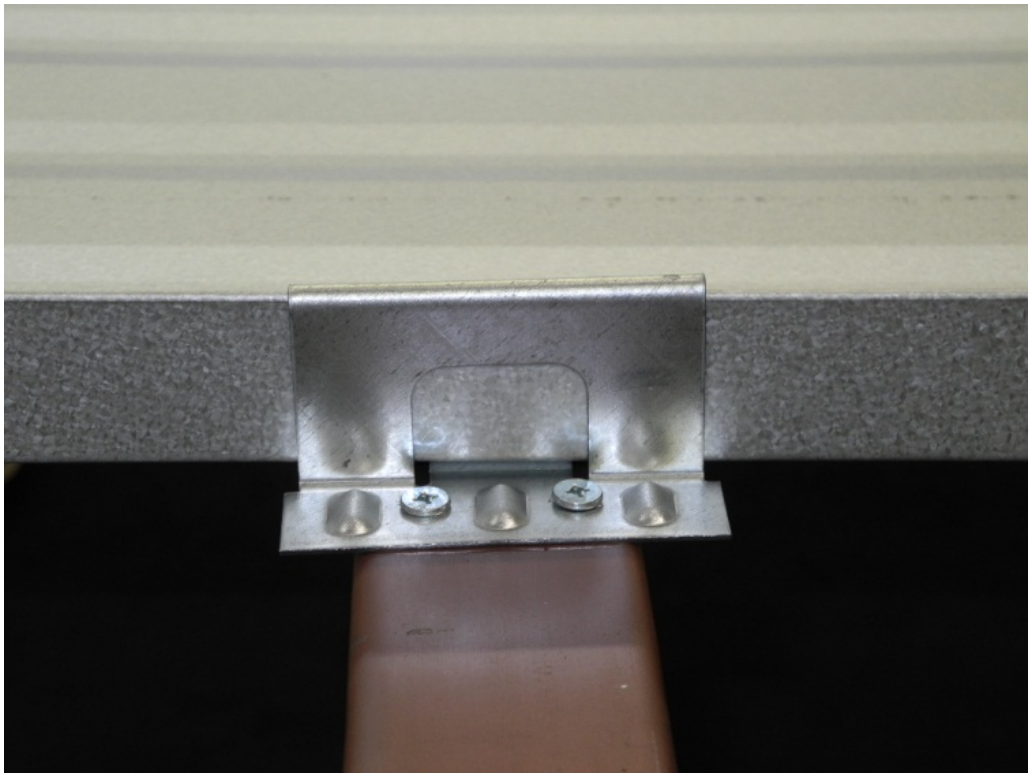


PHOTO 2 View of clip installation.
(DSCN0866)

PHOTOGRAPHS

PHOTO 3 View of test setup.
(DSCN0869)

PHOTO 4 View of support movement to simulate thermal movement of panel.
(DSCN0868)

PHOTOGRAPHS

PHOTO 5 View of the extraneous leakage measurement of the test chamber. Note the sidelap was temporarily sealed for this measurement. (DSCN0888)

PHOTO 6 View of flow measurements at differential pressure of 1.57 psf (equivalent to 0.302" of water). (DSCN0893)

PHOTOGRAPHS

PHOTO 7 View of flow measurements at differential pressure of 6.24 psf (equivalent to 1.2" of water). (DSCN0892)

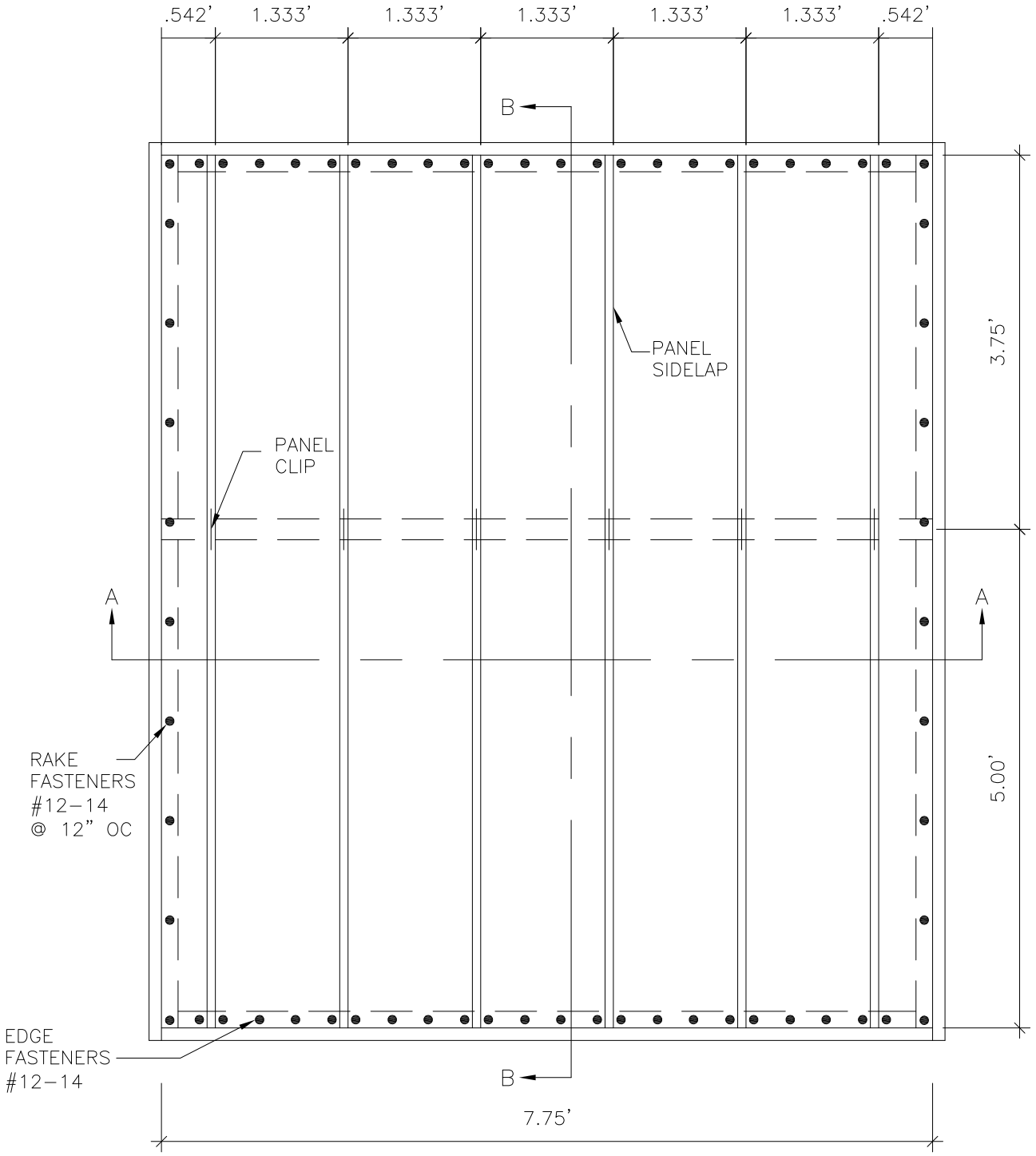
PHOTO 8 View of water spray test. (DSCN0899)

PHOTOGRAPHS

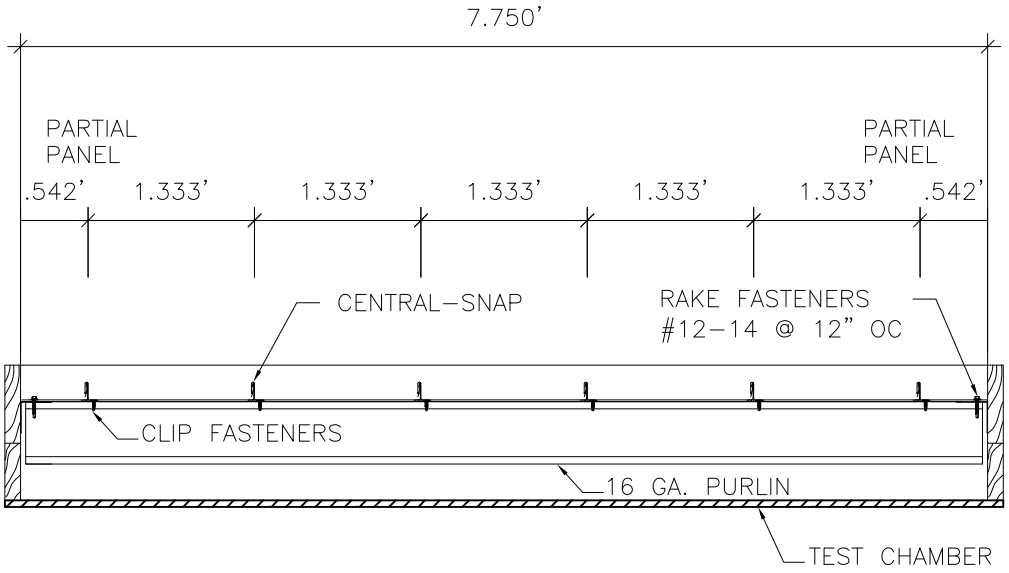
PHOTO 9 View of panel and clips during the water test
(DSCN0898)

PHOTO 10 View of panel sidelaps during the water test
(DSCN0897)

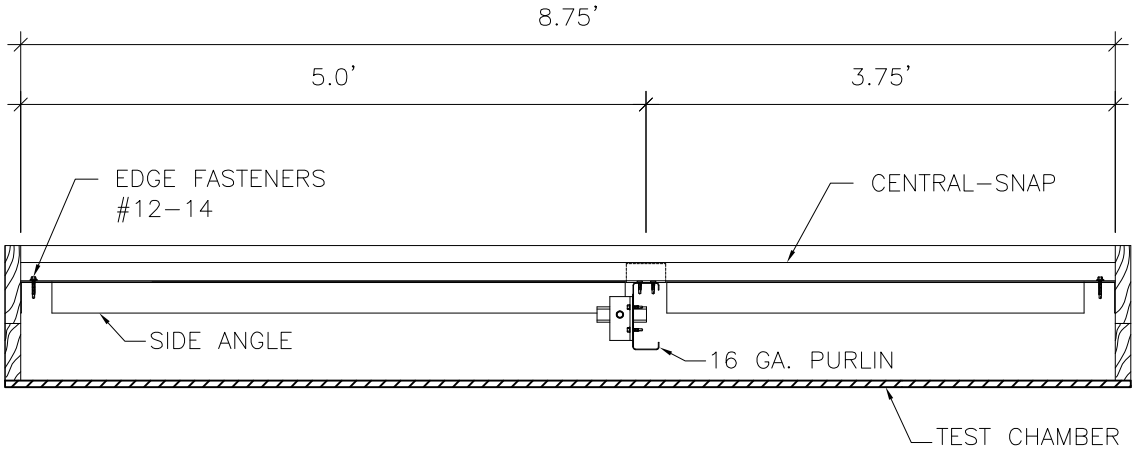
ENCON TECHNOLOGY, INC.	CENTRAL STATES MFG CENTRAL–SNAP TEST DETAILS	ASTM E1646 & E1680	13/17



1/1 PLAN VIEW



1/2 SECTION VIEW A–A



1/3 SECTION VIEW B–B

FLOW DYNAMICS

www.flow-dynamics.com

Certificate of Calibration

COX FLOW MEASUREMENT

www.cox-instruments.com

15555 North 79th Place • Scottsdale, AZ 85260 • Phone: (480) 948-3789 • Fax: (480) 948-3610 • sales@flow-dynamics.com

Customer Name:	Encon Technology, Inc	**Report #**	CCAL33557 - 784180-R1-A
Customer Address:	Bala Sockalingam 1216 N Lansing Ave, Suite C Tulsa OK USA 74106		
Customer PO #	CC		
Model #	50MW20-2	**Cal Date:**	10/4/2012
Serial #	784180-R1		
Calibration Procedure:	FDP-001	**Lab Temp :**	74.5 Deg F
Calibration Tech:	Keith	**Lab Relative Humidity:**	40.1%
Fluid:	Air		
Notes, Adjustments & Repairs	STP: 70 Deg. F and 14.7 PSIA. Meter pressure measured Upstream		

Calibration Results (AS FOUND = AS LEFT)

Test Point #	Meter Pres	Delta P	Meter Temp	Act. Flow	Std. Flow	Viscosity	C Factor	K Factor
	PSIA	In H20 @4C	Deg. F	ACFM	SCFM	mP	Rho*dP/mu^2	Q*mu/dP
1	14.7775	8.11001	73.2150	41.4268	41.4052	183.541	1.8026E-05	937.462
2	14.6624	7.23079	72.5492	37.2939	37.0304	183.339	1.6002E-05	945.529
3	14.5295	6.37109	72.3905	33.1263	32.6039	183.290	1.3983E-05	952.945
4	14.4232	5.61214	72.3169	29.3975	28.7262	183.266	1.2232E-05	959.923
5	14.3186	4.82465	72.2822	25.4402	24.6806	183.255	1.0441E-05	966.235
6	14.2217	4.03030	72.1977	21.3855	20.6098	183.229	8.6671E-06	972.185
7	14.1326	3.23286	72.1766	17.2683	16.5384	183.222	6.9095E-06	978.618
8	14.0543	2.42478	72.1575	13.0364	12.4165	183.215	5.1542E-06	984.959
9	13.9869	1.61102	72.1842	8.71031	8.25598	183.223	3.4076E-06	990.568
10	13.9464	1.05344	72.2364	5.71825	5.40376	183.238	2.2212E-06	994.583
11	13.9119	0.49085	72.4883	2.67366	2.51917	183.314	1.0311E-06	998.441

Standards Used in Calibration

Standard #	Description	Serial #	ReCal Date
FDI-005	5 Cu. Ft. Bell, 1 cuft volumes	n/a	3/21/2016
FDI-123	Small Bell Cart - mA, VDC, Frequency	n/a	3/8/2013
FDI-101	Digital Mensor Barometer	531887	8/22/2013
FDI-132	Mensor 30 PSIA, SN: 532106	532106	11/21/2012
FDI-44	Mensor 10" H2O DP,SN 241130	n/a	9/17/2013

The instrument referenced above was calibrated using standards traceable to the National Institute of Standards and Technology. Calibration reports for references maintained by Cox Flow Measurement, Inc. are available upon request to the customer of this calibration report. The volumetric flow rates reported are within a best uncertainty of +/- 0.2% of reading (Represents an expanded uncertainty using a coverage factor, k = 2, at an approximate level of confidence of 95%) and applies to calibration equipment only and does not apply to the UUT (Unit Under Test).
Cox Flow Measurement, Inc. calibration services are accredited by NVLAP (NVLAP Lab Code 200668) to ISO/IEC 17025:2005 (NIST Handbook 150) and are compliant to ANSI/NCSLZ540-1-1994; Part 1. This certificate is not an endorsement by NVLAP, NIST or an agency of the federal government.
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I certify the accuracy of this Calibration Report: Pon Bounsone (Name) — Sr. Mfg. Technician (Title) — Digitally signed by Pon Bounsone DN: cn=Pon Bounsone, o=Cox Flow Measurement, ou=Sr. Mfg Technician, email=nbounsone@badgermeter.com, c=US Date: 2012.10.04 09:01:30 -07'00' (Signature)

NVLAP NVLAP Lab Code 200668

APPENDIX

5.3 TEST CONDITIONS

A. OWNERSHIP OF ENCON WORK PRODUCT

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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.

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APPENDIX

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