TEST REPORT ON

METAL ROOFING SYSTEMS INC.
SYSTEM 2500 ROOF PANELS
(24 GA., 2" HIGH, 16" WIDE FLAT PAN PANEL)
AT 5' 0" – 3' 9" PANEL SPANS
IN ACCORDANCE WITH
ASTM E1646-95 (2003) & E1680-95 (2003)

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

TESTING DATE: May 30, 2008
REPORTING DATE: May 31, 2008
ENCON® Project C1589-1

ACCREDITED
TL-327

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TEST SUMMARY

1.1 SUMMARY

Tests were conducted on Metal Roofing Systems' System 2500 (2" high seam, 16" wide, 24 Ga., 50 ksi) 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 E1680-95 (2003) "*Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems*" and ASTM E1646-95 (2003) "*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 Inc. The panels were installed on May 28, 2008 and tested on May 30, 2008.

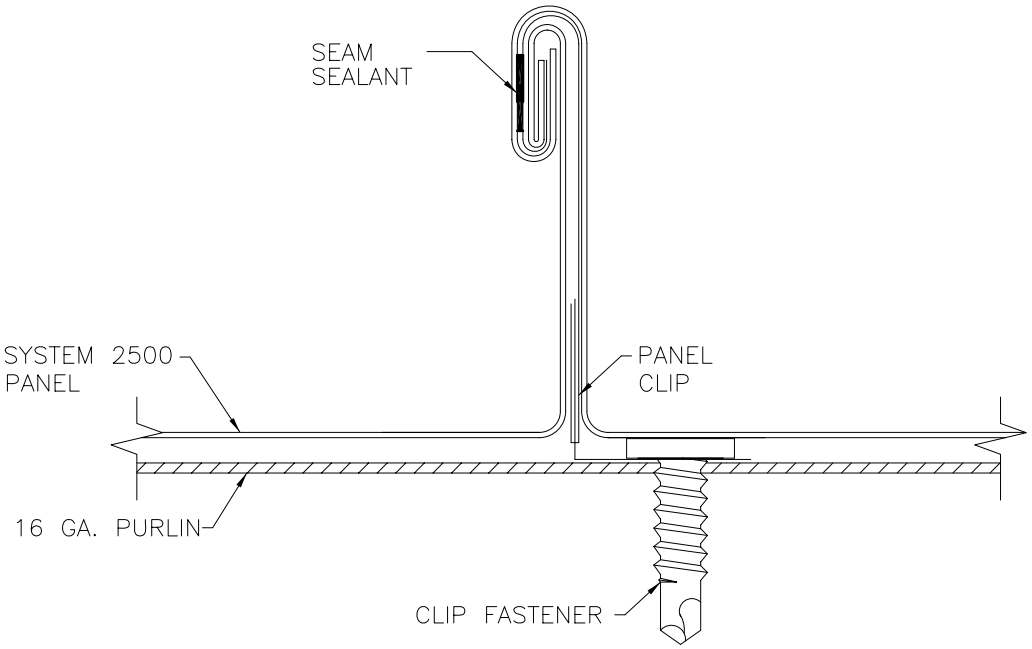
1.2 PANEL SYSTEM DESCRIPTION

Metal Roofing's System 2500 roof system consisted of 16" wide, 24 ga., 50 ksi (nom.) yield panels joined together at the sidelaps to form a flat pan profile with a 2" high seam as shown on Page 2.

The sidelap sealant used in these panels was Q'So Inc.'s Q-54 Mastomeric Butyl Sealant. The nominal diameter of the sealant bead was 3/16". The System 2500 panels were attached to nominal 16 ga., 6" deep, Cee purlin with two piece sliding 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 mechanically seamed to form a 180º panel seam.

1.3 TEST RESULTS

The panel system was preloaded for positive and negative load of 15 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, 6.24 & 12.0 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 12.0 psf. The results for the two tests are summarized on Page 2.



CLIP SECTION VIEW

TEST METHOD: ASTM E 1680–95 (2003)

TEST NO.	STATIC PRESSURE DIFFERENCE (PSF)	AIR INFILTRATION RATE	
		(cfm/ft^2)	(cfm/lin.ft)
1	1.57	0.0004	0.0006
2	6.24	0.0007	0.0010
3	12.00	0.0012	0.0016

TEST METHOD: ASTM E 1646–95 (2003)

TEST NO.	STATIC PRESSURE DIFFERENCE (PSF)	WATER INFILTRATION
1	12.0	NONE

NOTES:

1. 24 GA. SYSTEM 2500 PANELS WITH 180° SEAM 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. 3/16" BEAD SEALANT WAS FACTORY APPLIED IN THE PANEL SEAM.

24 GA. SYSTEM 2500 SSMR PANEL

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 April 24, 2008 and the air-flow measuring system was calibrated on February 13, 2008.

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 four 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:	Metal Roofing Systems
Model Type:	System 2500 Panel
Dimensions:	2" high seam, 16" wide flat pan profile with 180º seam
Panel Gauge:	24
Clip Type:	System 2500 two piece sliding clip
Fasteners:	(2) #10-16 SDS
Purlin:	16 ga. (0.059" thick)
Sealant Manufacturer:	Q'So Inc.
Panel Sealant:	Q-54 Mastomeric Butyl Sealant
Sealant Size:	Nom. 3/16" bead
Thermal Movement:	±0.625"

Note: All the test materials were supplied by Metal Roofing Systems and were not sampled by ENCON.

3.2 TEST DATA

Date:	5.30.2008
Panel Manufacturer	Metal Roofing Systems
Panel Type	System 2500
Panel Gauge	24
Panel Width (in)	16
Panel Attachment	System 2500 Clip with (2) #10-16 SDS
Sealant Manufacturer	Q'So Inc.
Panel Sealant	Q-54 Mastomeric Butyl Sealant (Nom. 3/16" Bead)
Panel Span (ft)	5' 0" - 3' 9"
Test Area (ft^2)	67.8
Preload Positive Pressure (psf)	15
Preload Negative Pressure (psf)	15
Ambient Temperature (F)	78.8
Panel Temperature (F)	78.2
Barometric Pressure (in. Hg)	29.15
Water Depth (in)	0.625

Test Method: ASTM E1680-95 (2003)

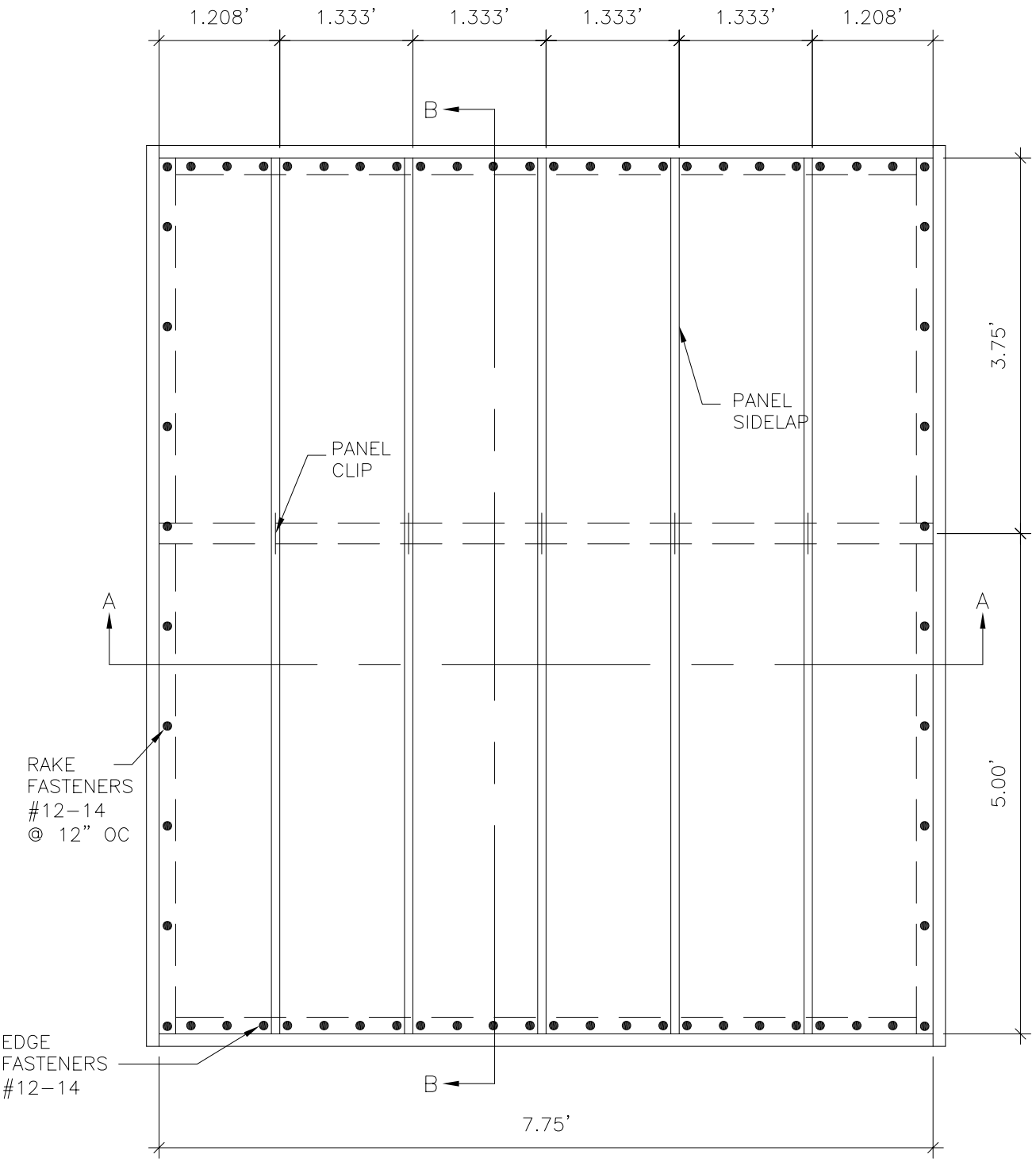
Test No.	Static Pressure Difference psf	Initial Reading DP (in)	Initial Reading [1] cfm	Final Reading DP (in)	Final Reading [1] cfm	Total Air Leakage [2] cfm	Air Infiltration Rate	
							cfm/ft^2	cfm/lin.ft
1	1.57	0.861	4.411	0.867	4.442	0.0300	0.0004	0.0006
2	6.24	2.251	11.501	2.261	11.552	0.0497	0.0007	0.0010
3	12.00	3.456	17.615	3.472	17.696	0.0792	0.0012	0.0016

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

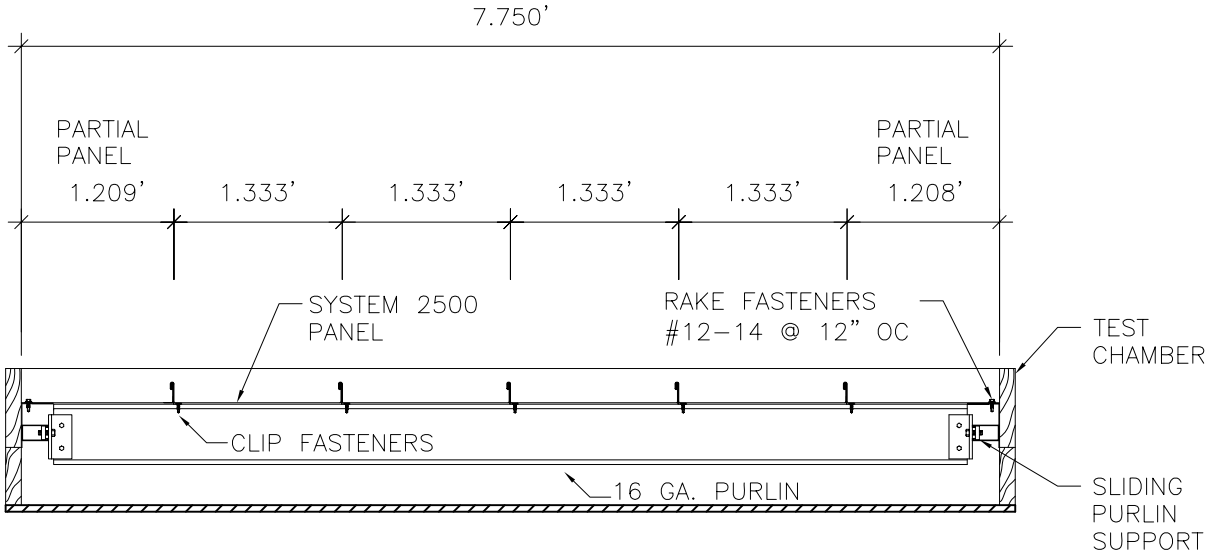
[2] Total Air Leakage $Q_{st} = Q \times (1.326 \times B / (0.075 \times (T + 460)))^{0.5}$

Test Method: ASTM E1646-95 (2003)

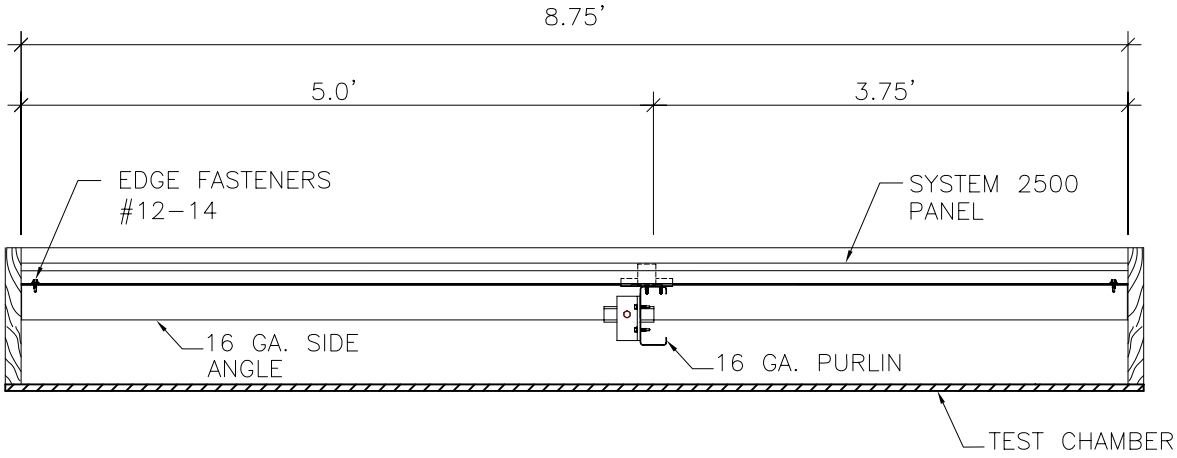
Test No.	Static Pressure Difference psf	Rate ($gal/hr/ft^2$)	Test Duration (min)	Water Infiltration
1	12	5	15	No Water Leakage



1/1 PLAN VIEW



1/2 SECTION VIEW A–A



1/3 SECTION VIEW B–B

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Calibration Report

Customer Name:	Encon Technology,Inc.	**Report #**	FCAL10825-784180-R1
Customer Address:	6717 South Yale Ave., Suite 200, Tulsa, OK 74136		
Customer PO #	CC	**Received Date:**	7/19/2006
Model #	50MW20-2	**Cal Date:**	8/3/2007
Serial #	784180-R1	**Meter Type:**	LFE
Lab Temp :	77 Deg F	**Fluid Type:**	Air
Calibration Procedure:	FDP-001	**Lab Relative Humidity:**	38%
		Calibration Tech:	P. Del Ferraro
Notes, Adjustments and Repairs :	STP: 70F & 14.7 PSIA Pressure measured at Inlet		

Calibration Results (As Found = As Left)

Test Point #	Meter Pres PSIA	Delta P In H20 @4C	Meter Temp Deg. F	Act. Flow ACFM	Std. Flow SCFM	C Factor Rho*dP/mu^2	K Factor Q*mu/dP	Viscosity mP
1	15.261	8.1828	74.7658	41.5958	42.8084	1.8633E-05	935.271	184.01
2	15.109	7.4473	75.5311	38.0853	38.7507	1.6724E-05	942.061	184.24
3	15.045	7.1836	75.6097	36.8346	37.3144	1.6057E-05	944.686	184.27
4	14.860	6.1442	75.3245	31.8309	31.8658	1.3585E-05	954.017	184.18
5	14.709	5.1714	75.3997	27.0360	26.7865	1.1314E-05	962.844	184.20
6	14.553	4.0788	75.2852	21.5180	21.0983	8.8341E-06	971.424	184.16
7	14.435	3.0788	75.4941	16.3684	15.9127	6.6072E-06	979.281	184.23
8	14.372	2.5054	75.4786	13.3806	12.9516	5.3536E-06	983.710	184.22
9	14.285	1.4896	75.4576	8.01385	7.71028	3.1641E-06	990.888	184.21
10	14.249	0.9949	75.4228	5.37050	5.15437	2.1084E-06	994.176	184.20
11	14.232	0.7306	75.3947	3.95135	3.78801	1.5466E-06	996.033	184.19
12	14.216	0.4667	75.2987	2.52765	2.42087	9.8736E-07	997.287	184.17

Standards Used in Calibration

Standard #	Description	Serial #	ReCal Date
FDI 05	5 Cu. Ft. Bell, 1 cuft volumes	N/A	1/08/2008
FDI 123	Bell Computer Cart (A/D; Volts, mA, Temp.)	N/A	2/19/2008
FDI 24	Heise Press Trans 150 PSIA	S9-21856	1/10/2008
FDI 101	Digital Pressure Gauge	531887	5/23/2008
FDI 44	Diff Press Trans 10" H2O	241130	8/5/2007

The instrument referenced above was calibrated using standards traceable to the National Institute of Standards and Technology. Calibration reports for references maintained by FDI are available upon request to the customer of this calibration report. The volumetric flowrates reported are within a best uncertainty of +/- 0.2% of reading. Flow Dynamics, Inc. calibration services comply with ANSI Z540-1-1994, ISO Guide 25 and ISO 9001:2000 and accredited to NVLAP NIST Handbook 150 and ISO/IEC 17025:2005.

I certify the accuracy of this Calibration Report: Andrew Yee (Name) — Calibration Engineer (Title) — (Signature)

End of Report

NVLAP Lab Code 200688-0

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.

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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

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