

Airflow Testing the Improved DSx Vented, Warming Table

Report 15 August 2004

The final review and approval of this document before its release to the client is the responsibility of the following person at Technical Safety Services. In signing this cover-sheet, he acknowledges the accuracy of the data and activities reported herein:

Martin Burke _____ date: _____
Field Engineering Manager

Airflow Performance and Tracer Gas Containment Test Report

1 Title: Testing the Improved DSx Vented, Warming Table

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4 Purpose:

The purpose of this report is to document the results of special air flow performance tests conducted by TSS, Inc. upon a VetEquip, Inc. DSx surgical table. These tests were designed to collect data so that VetEquip, Inc. personnel could evaluate the basic suitability of the DSx table as a containment device for anesthetic gasses used in conjunction with surgical procedures for small animals; the DSx is designed to contain these gasses in a manner that protect the worker.

5 Summary:

5.1 Technicians from Technical Safety Services [TSS] performed airflow and tracer gas performance tests on the DSx on May 23rd and August 8th, 2004, respectively.

5.2 The subject DSx unit differs from the one tested by TSS in 2003, (see September 2003 report). This improved version has larger air channels so that considerably less vacuum is needed to achieve a 100 foot per minute (fpm) capture velocity above its grill.

5.3 The basic test results follow:

5.3.1 Using a TSS-supplied vacuum source, and with the VetEquip-supplied four foot (4') tube connected to the DSx, the proximal grille (the one closest to the waste gas scavenging outlet/collar) had a 100 fpm capture velocity at ~0.56" above the grille with a collar vacuum of -0.5"wc. The distal grille achieved the same velocity and capture distance with a collar vacuum of -0.7"wc.

- 5.3.2 At these flow settings, both the proximal and distal grilles competently capture still air from within a two-inch (2") radius, respectively.
- 5.3.3 When injecting ~0.4 lpm tracer gas in a manner derivative of ASHRAE 110-1995, with the (human) manikin at a simulated, optimal viewing position, there was ~0.02 ppm in the manikin breathing zone for either grille. There is no stated acceptance criterion for this tracer result, however any result <0.10ppm is typically very acceptable.
- 5.4 The scope of testing was limited to the following items:
 - 5.4.1 TSS tested the airflow volume as a function of vacuum, measuring the pressure at the 'Outlet, and along the tubing at 2' and 4'.
 - 5.4.2 In the manner of TSS SOP 4-6.v2 "Field Testing of Slot Hoods" to determine the capture velocity and the effective distance of capture from the DSx' grille.
 - 5.4.3 With the airflows adjusted to ~100 fpm at ~0.56" above the grilles, and with the DSx operating normally through the four foot (4') tubing, TSS injected tracer gas into a (mock-) surgical nose cone attached to a rat manikin. TSS then sampled for leakage in the breathing zone of a second, human manikin, positioned above the DSx to simulate an optimum viewing position.
- 5.5 Test results are discussed in greater detail in section 6 of this report. Cited tables and diagrams are in section 7 of this report. Deviations are cited in Section 8, and Section 9 contains pertinent additional documents used to support the validity of this report.

6 Test Results:

6.1 Airflow Volume versus Vacuum:

6.1.1 Test Method:

TSS erected a 4" diameter, low-resistance, laminar flow sensing element over the proximal (closest to the outlet) DSx grille. We measured the airflow in cfm at the center point of 4" duct using a calibrated anemometer, applying an A(k) factor of 0.9 to accommodate the single-point readings. While measuring the air flow, simultaneous vacuum readings were made directly at the outlet collar, two feet (2') and four feet (4') downstream from the collar using the standard, VetEquip, Inc.-supplied exhaust hose.

Once the readings were done for the proximal grille, the unit was reconfigured to allow air to flow through the distal grille and the test was repeated.

6.1.2 Acceptance Criteria:

There are no formal acceptance criteria applied to this test.

6.1.3 Test Results:

- 6.1.3.1 The airflow 'efficiency' through the proximal grille is higher than that of the distal grille.
- 6.1.3.2 The proximal and distal grille data are presented in Tables 1-2, respectively. This data is also plotted as Diagrams 1-6.
- 6.1.3.3 Diagram 6 may be of particular interest because it compares the (May 2003) data from the unmodified DSx to that for the current model. The current model moves about ten times (10x) more air for a given vacuum, especially in the lower pressure ranges.

6.2 Field Testing as a Slot Hood

6.2.1 Test Method:

In the manner of TSS SOP 4-6.v2, TSS placed an anemometer probe above the proximal grille, and adjusted the probe distance to achieve ~100 feet per minute. Finally, we probed about the grille with neutral-density smoke to visualize the airflow capture performance and measure the distance at which the capture remains effective.

As with the airflow-vs.-vacuum testing, once the readings were done for the proximal grille, the unit was reconfigured to allow air to flow through the distal grille and the test was repeated.

6.2.2 Acceptance Criteria:

There are no formal criteria applied to this test, but it is presumed that the smoke capture distance should be a large enough hemispheroid to collect stray vapors.

6.2.3 Test Results:

6.2.3.1 The distal grille had lower velocity and a smaller capture distance.

6.2.3.2 The proximal and distal grille data is restated here.

	<i>Proximal Grille</i>	<i>Distal Grille</i>	
Capture Velocity	100	100	fpm
Vacuum (at collar)	0.486	0.702	"wc
Distance at 100 fpm	0.56	0.56	inches
Smoke Capture Distance, Vertical	2	2	inches
Smoke Capture Distance, Lateral	2	2	inches

6.3 Tracer Gas Performance Tests:

6.3.1 Test Method:

With the DSx operating normally and providing the flow conditions similar to those described in the previous section, and in a manner derivative of ASHRAE 110-1995, TSS injected Sulfur Hexafluoride tracer gas into a mock-surgical nose cone attached to a rat manikin, then sampled for leakage in the breathing zone of a second, human manikin, positioned about 14" above the patient.

This level of realism is warranted because of concerns that the representative tracer gas flow rate, about 400 ml/min, might result in high velocity jets about the face of the patient. If these jets were of sufficient vigor, they could overcome the capture velocity and enter the surgeon's breathing zone. The flow rate of 400ml/min was selected as typical for rats/patients to be treated on the DSx.

With the tracer gas flowing at a nominal 400 ml/min, TSS continuously sampled air from the human manikin-breathing zone for five minutes. TSS used a calibrated Foxboro Miran 1A with an inherent sensitivity (LOD) of ≤ 0.007 ppm for the Sulfur Hexafluoride tracer gas. The form of the data from this instrument was logged, 1-second readings stored in an Excel file, available for audit at TSS. After the five minutes, the gas is shut off and the average concentration of tracer is calculated.

As with both previous test sections, once the readings were done for the proximal grille, the unit was reconfigured to allow air to flow through the distal grille and the test was repeated.

6.3.2 Acceptance Criteria:

There are no formal criteria applied to this test. As a means of comparison, an exposure of ≤ 0.10 ppm is typically tolerated in other ventilated enclosures.

6.3.3 Test Results:

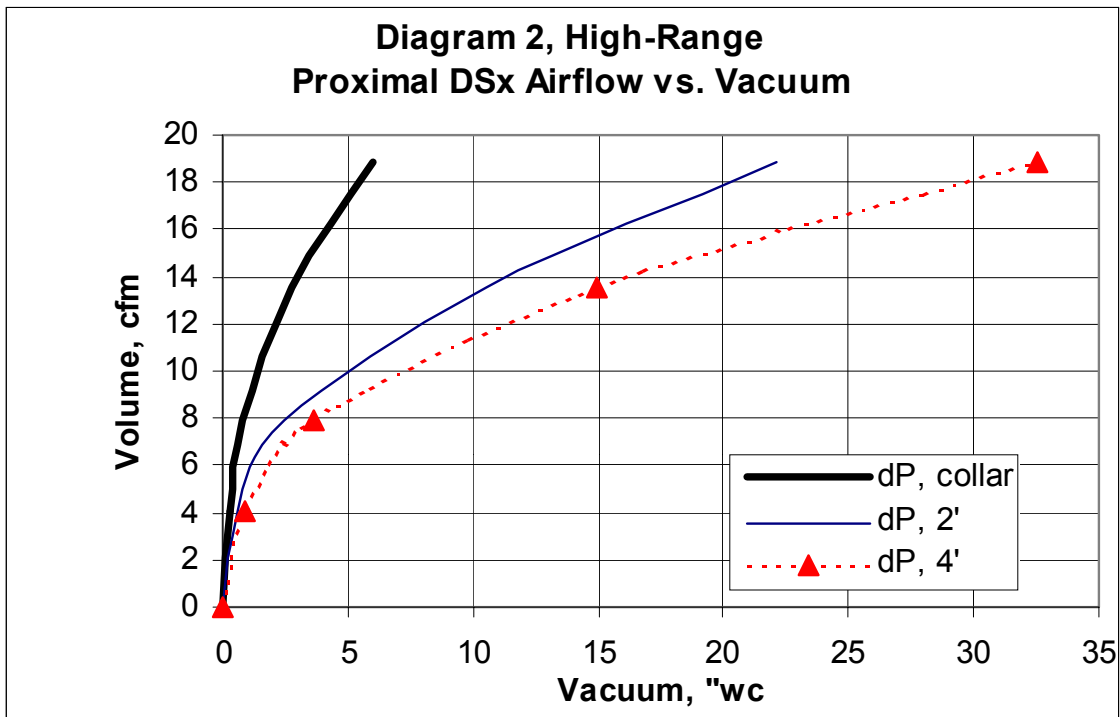
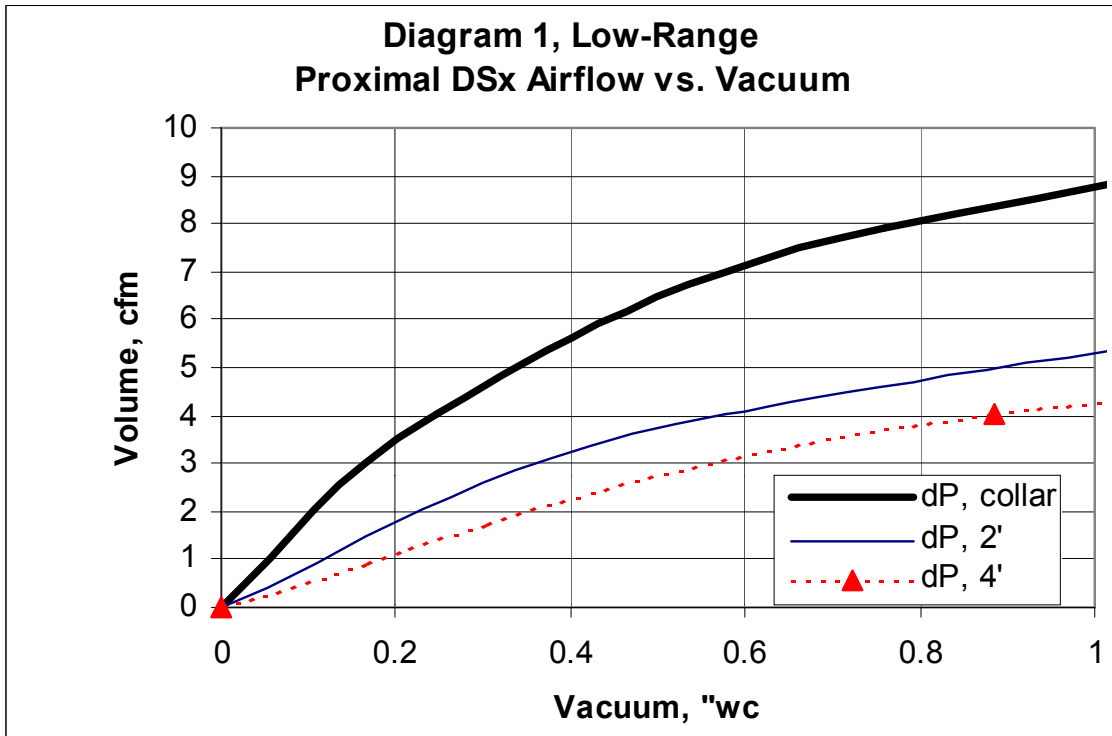
6.3.3.1 Both grilles have similar tracer gas performance results. The leakage to the operator-breathing zone is very low: ~ 0.02 ppm. These results are effectively the same as those from earlier tracer gas trials on the unmodified DSx.

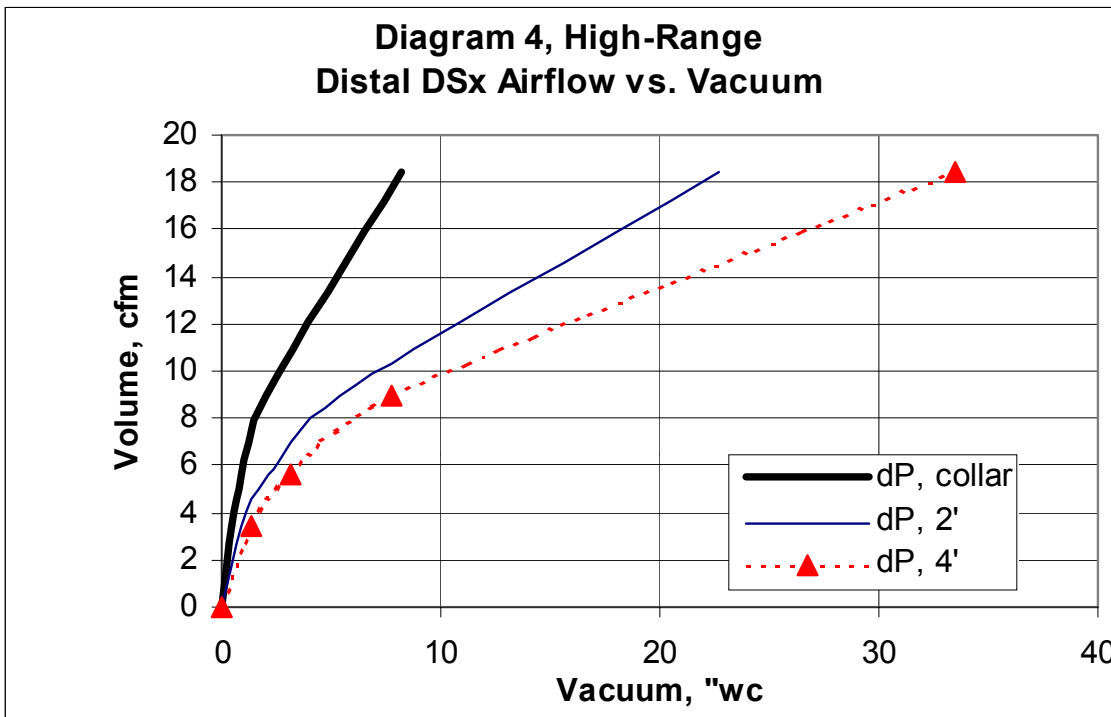
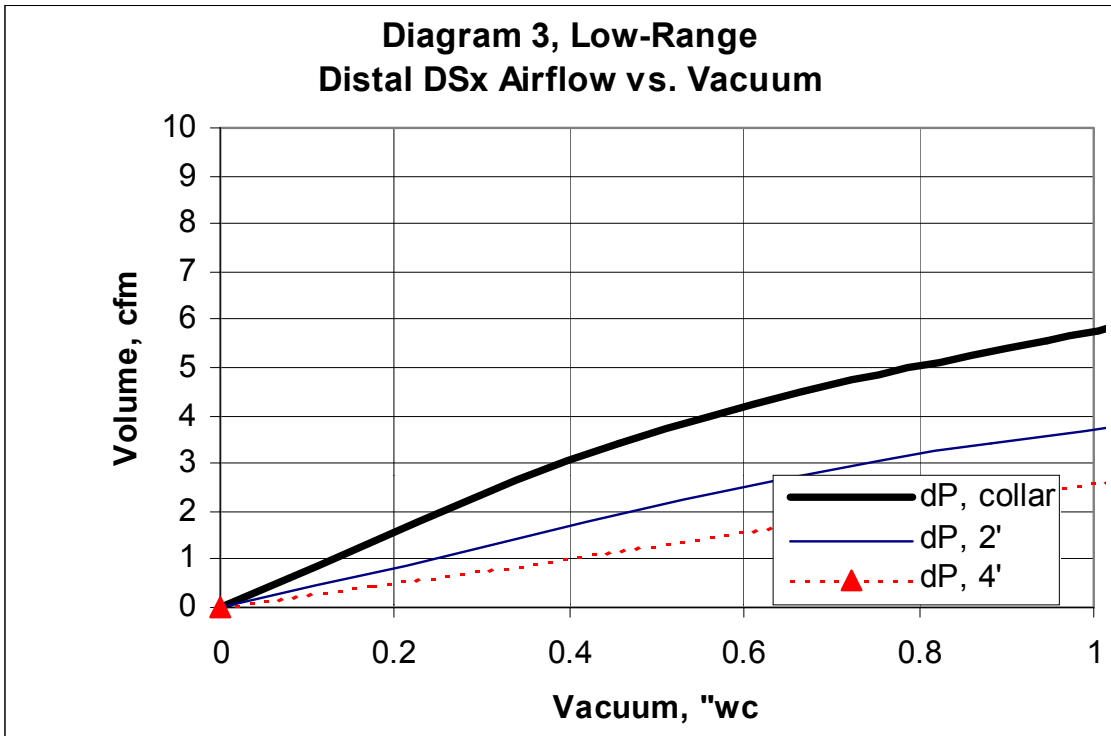
6.3.3.2 The data for both grilles is plotted as Diagram 7, and cursorily restated here:

	<i>Proximal Grille</i>	<i>Distal Grille</i>	
Tracer Gas (SF6) Flow	404	398	ml/min
Vacuum at collar	0.50	0.70	"wc
Gas in Operator Breathing Zone	0.02	0.02	ppm

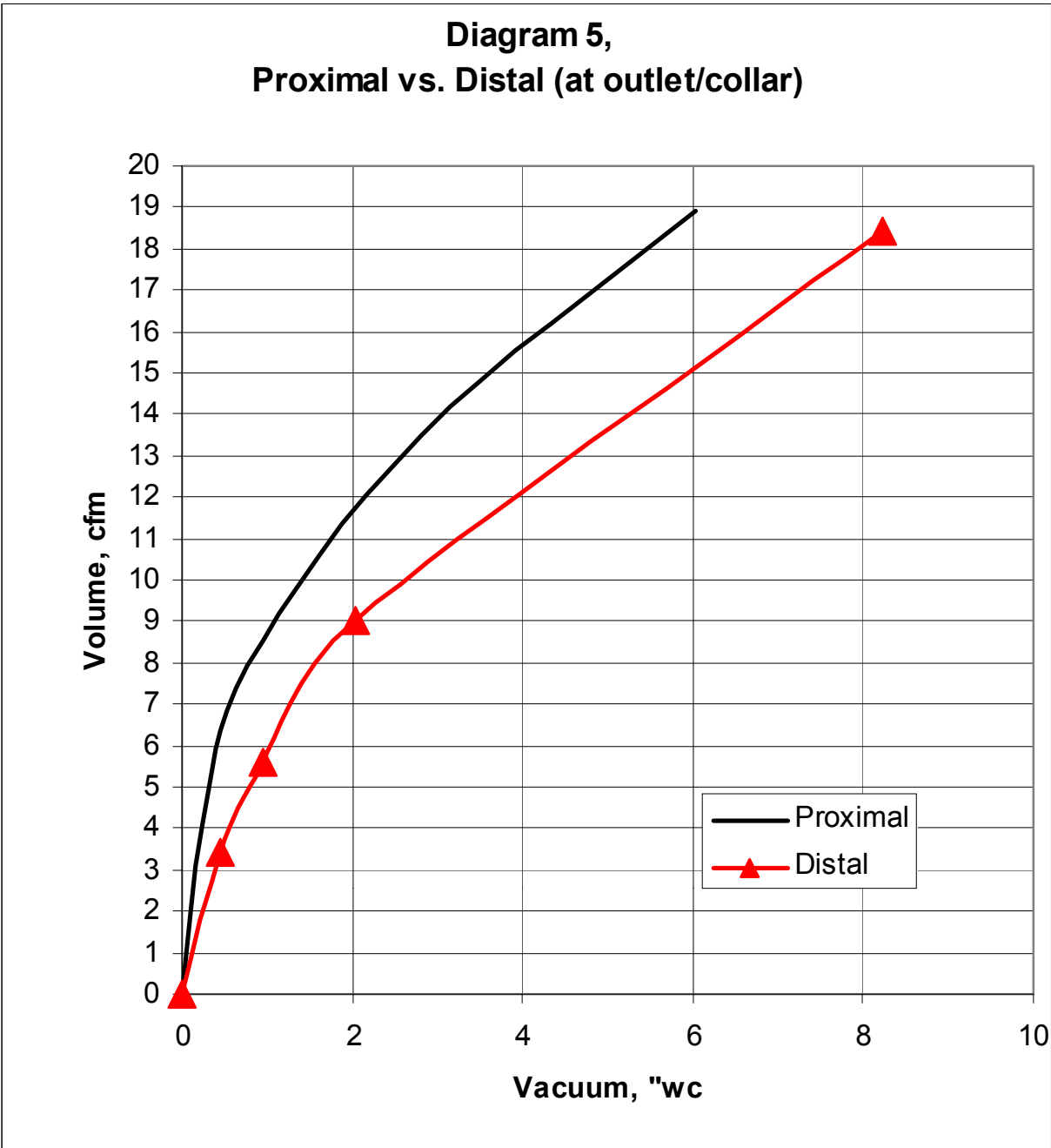
7 Diagrams and Tables:

Item	Description
Diagram 1	Proximal DSx Airflow vs. Vacuum (Low-Range)
Diagram 2	Proximal DSx Airflow vs. Vacuum (High-Range)
Diagram 3	Distal DSx Airflow vs. Vacuum (Low-Range)
Diagram 4	Distal DSx Airflow vs. Vacuum (High-Range)
Diagram 5	Proximal vs. Distal (at outlet)
Diagram 6	Modification Benefit
Diagram 7	Tracer Gas Test Plot
Table 1	Proximal DSx Airflow vs. Vacuum ("wc)
Table 2	Distal DSx Airflow vs. Vacuum ("wc)





**Diagram 5,
Proximal vs. Distal (at outlet/collar)**



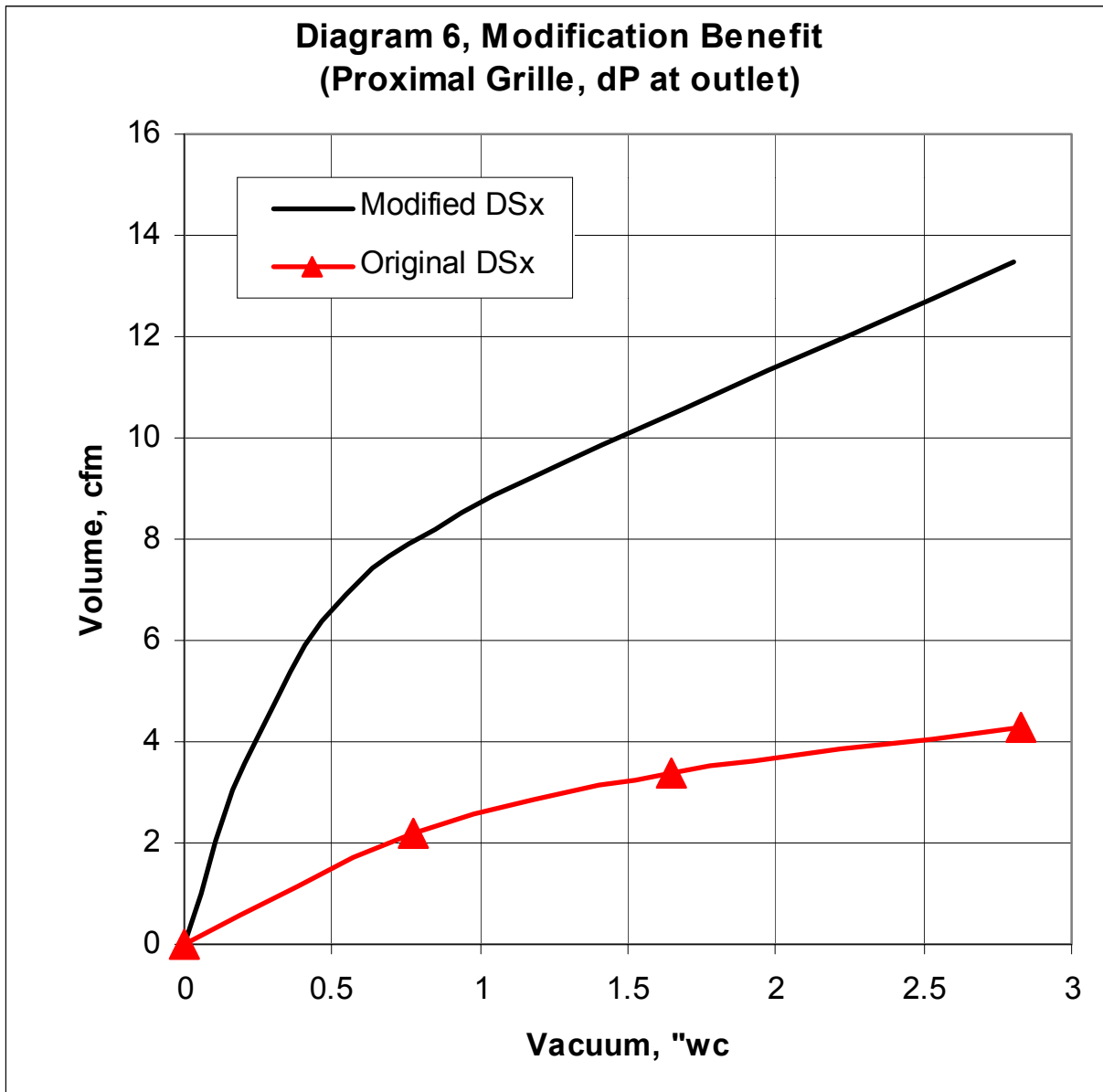


Diagram 7, Tracer Gas Test Plot

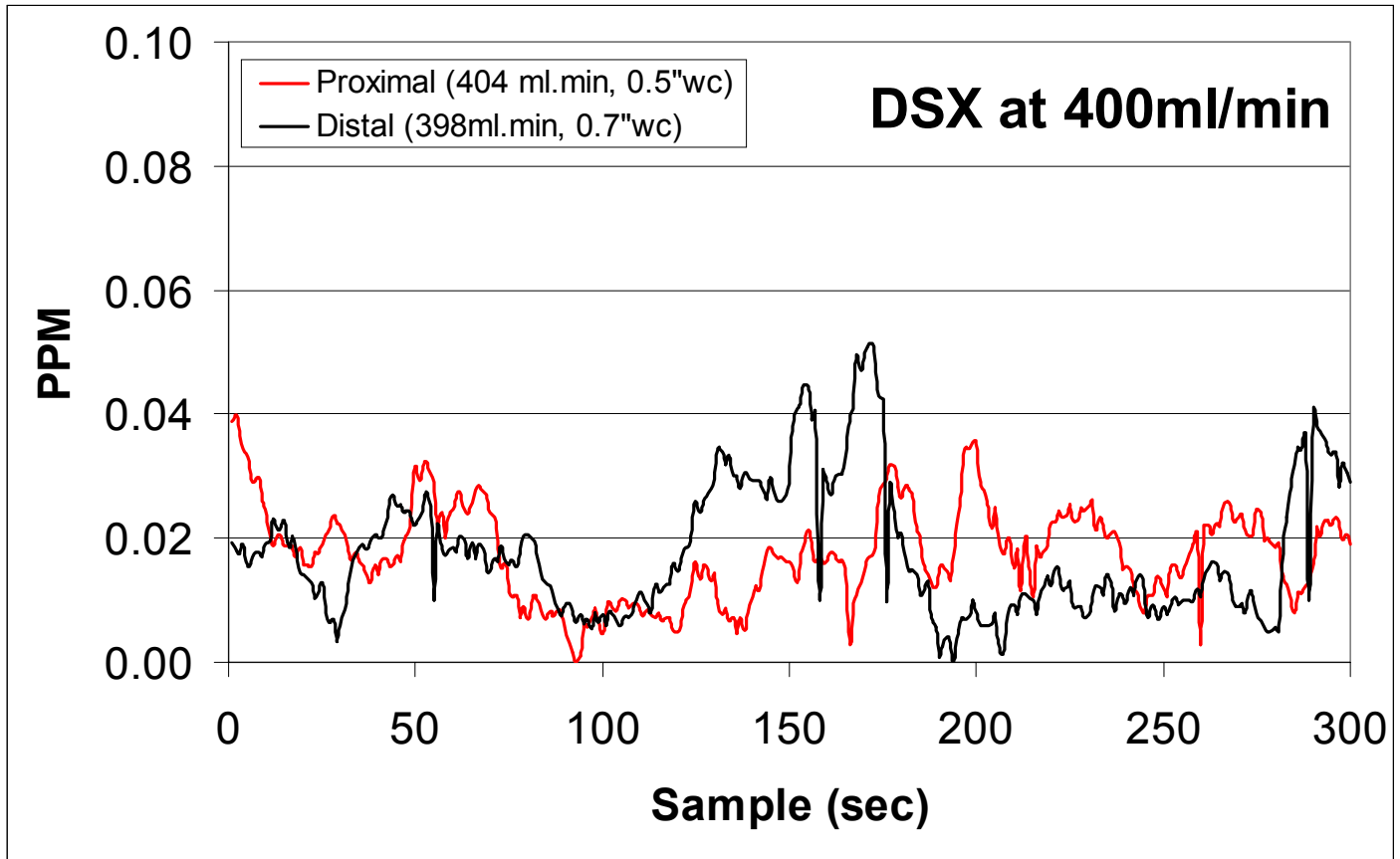


Table 1, Proximal DSx Airflow vs. Vacuum ("wc)

Corrected Values (inches of water, "WC)			
<i>0.9 correction for C/L readings in 4" round duct</i>			
Flow, cfm	dP, collar	dP, 2'	dP, 4'
0	0	0	0
4.05	0.246	0.5769	0.886
7.92	0.7584	2.433	3.653
13.5	2.801	10.49	14.99
18.9	6.031	22.08	32.57

Table 2, Distal DSx Airflow vs. Vacuum ("wc)

Corrected Values (inches of water, "WC)			
<i>0.9 correction for C/L readings in 4" round duct</i>			
Flow, cfm	dP, collar	dP, 2'	dP, 4'
0	0	0	0
3.42	0.4568	0.8812	1.401
5.58	0.9468	2.08	3.16
9	2.025	5.421	7.776
18.45	8.222	22.74	33.47

8 Discrepancies and Alterations:

The following is a list of known discrepancies and alterations made with regard to this project. The changes made after the date of testing were corrections of errors in the recorded field data.

- 8.1 The only attestable deviation from TSS' normal, field documentation practices was the automatic recording of data to an Excel spreadsheet. TSS anticipates no diminution in the data integrity as a consequence of this change.

9 Pertinent Additional Documentation:

The following pages contain photocopies of documents pertinent to this report. Calibration certificates are archived at the main office of Technical Safety Services.

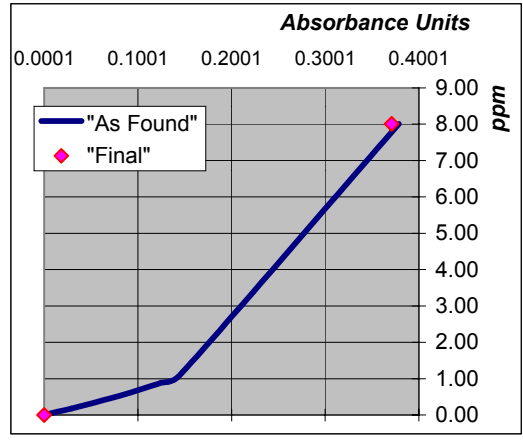
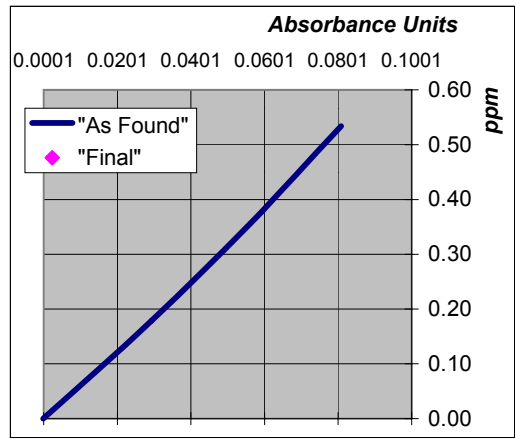
<u>Description</u>	<u>Pages</u>
Calibration Certificates	13-25

TSS/VetEquip, Inc. Project NCO040NPNA-03:
 Testing the Improved DSx Vented, Warming Table
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Instrument ID Number	1316	Fit-Factor, F = 6.7 (<<F x ABS = PPM)	
Instrument Serial Number	1A-2807		
Mirror Setting	13.04	Pre-Calibrated By	MJB PM
Scale Multiplier (1x, 10x)	10	Pre-Cal. Date/Time	8/8/04 1100H
Wavelength	10.65	um	
Slit	1	mm	Post-Calibrated By
Loop volume	5.62	liters	MJB
			Post-Cal. Date/Time
			8/8/04 1700H

Pre Test Calibration Data				
ul. inj	ul. tot.	ABS	SF6. ppm	PPM/ABS
0	0	0.0000	0.00	NA
1	1	0.0293	0.18	6.107029
1	2	0.0562	0.36	6.350034
1	3	0.0809	0.53	6.610727
1	4	0.1035	0.71	6.886413
1	5	0.1252	0.89	7.114055
1	6	0.1440	1.07	7.420942
39	45	0.3787	8.01	21.14634

Post Test Calibration Data					d%
ul. inj	ul. tot.	ABS	SF6. ppm	PPM/ABS	
0	0	0.0000	0.00	NA	
0	0		0.00		
0	0		0.00		
0	0		0.00		
0	0		0.00		
0	0		0.00		
0	0		0.00		
0	0		0.00		
45	45	0.3710	8.01	21.58522	98%



Comments
 None

TSS EQ 1308

Event # NCO40409

TSI CERTIFICATE OF CALIBRATION AND TESTING

TSI Model 8345 Serial No. 01030084
 Description VELOCICALC PORTABLE AIR VELOCITY METER
 Calibration Standard WIND TUNNEL CALIBRATION SYSTEM, SERIAL NO. 110

CALIBRATION VERIFICATION RESULTS			
Calibration Standard	Instrument Output	Difference	Error Compared to Tolerance
			Tolerance Limit- 0 Tolerance Limit+
0.0 ft/min	0.0 ft/min		PASS
34.7 ft/min	34.8 ft/min	0.3%	PASS
64.8 ft/min	64.5 ft/min	-0.5%	PASS
99.5 ft/min	98.2 ft/min	-1.3%	PASS
158.3 ft/min	156.7 ft/min	-1.0%	PASS
330.7 ft/min	328.1 ft/min	-0.8%	PASS
650.7 ft/min	649.8 ft/min	-0.1%	PASS
996.9 ft/min	992.8 ft/min	-0.4%	PASS
1463.8 ft/min	1470.2 ft/min	0.4%	PASS
2493.4 ft/min	2494.6 ft/min	0.0%	PASS
4494.5 ft/min	4488.7 ft/min	-0.1%	PASS
5874.7 ft/min	5850.2 ft/min	-0.4%	PASS
32.0 °F	31.9 °F	-0.1 °F	PASS
140.0 °F	140.0 °F	0.0 °F	PASS

Tolerance Limits:
 Velocity: ±3% of reading or 3 ft/min
 whichever is greater
 Temperature: ±0.5 °F

Velocity Calibration Conditions: Ambient Temp: 23.9°C Barometric Pressure: 740.8 mmHg
 Velocity Corrected to Std Conditions of: Ambient Temp: 21.1°C Barometric Pressure: 760.0 mmHg

TSI does hereby certify that all materials, components, and workmanship used in the manufacture of this equipment are in strict accordance with the applicable specifications agreed upon by TSI and the customer and with all published specifications. All performance and acceptance tests required under this contract were successfully conducted according to required specifications. Furthermore, all test and calibration data supplied by TSI has been obtained using standards whose accuracies are traceable to the National Institute of Standards and Technology (NIST) or has been verified with respect to instrumentation whose accuracy is traceable to NIST, or is derived from accepted values of physical constants. Our Quality Management System complies with ISO 9001 requirements and calibration procedures for this instrument adhere to ISO 10012. The accuracy of the velocity calibration facilities is at least a ratio of 1:1 with respect to the accuracy specifications of the instrument being calibrated. The accuracy of the humidity calibration facilities is at least a ratio of 2:1 with respect to the accuracy specifications of the instrument being calibrated. The accuracy of the pressure calibration facilities is at least a ratio of 2.5:1 with respect to the accuracy specifications of the instrument being calibrated. The accuracy of the temperature calibration facilities is at least a ratio of 6:1 with respect to the accuracy specifications of the instrument being calibrated.

Applicable Test Report	Report Number	Date Last Verified	Date Due
DC voltage	E000048	07-22-03	07-30-04
Barometric Pressure	E001329	05-13-03	05-31-04
Temperature (0°C)	E000822	08-04-03	08-30-04
Temperature (19-35°C)	E001807	08-04-03	08-30-04
Temperature (60°C)	E001806	08-04-03	08-30-04
Pressure	E001517	02-16-04	02-16-05
Pressure	E000808	03-16-04	02-16-05
Velocity	E002002	02-24-04	02-24-07
Dewpoint	E001319	10-28-03	10-28-04

APPROVED FOR CLIENT USE
 APR 02 2004
 FOR TSS, INC.
 www.techsafety.com

Calibrated by [Signature] Final Function Check Mar 26, 2004 Calibration Date
 TSI Incorporated Mailing Address: P.O. Box 64394 St. Paul, MN 55164 USA
 Environmental Measurements Shipping Address: 500 Cardigan Road Shoreview, MN 55126 USA
 and Controls Division Phone: (800) 777-8356 or (651) 490-2711 Fax: (651) 490-2874

TSS EQ 1225

AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION

Event # NCO40155

Customer ID: 012460 S/N: M881030
 Customer: TECHNICAL SAFETY SERVICES, INC. City: BERKELEY State: CA Order #: R040046
 As-Received Model #: ADM-870 Converted to Model #:
 PO #: _____ Customer Eqpt ID#: _____ Calibration Due Date: 01/2005 QA Code: 95 10CFR21: _____

This instrument has been calibrated using Calibration Standards which are traceable to NIST (National Institute of Standards and Technology). Quality Assurance Program and calibration procedures meet the requirements for 10CFR50 Appendix B; ANSI/N45.2; ANSI/NCSL Z540-1-1994; MIL-STD 45662A and manufacturer's specifications. Calibration accuracy is certified when meters are used with properly functioning accessories only. All Uncertainties are expressed in expanded terms (twice the calculated uncertainty). This report shall not be reproduced, except in full, without the written approval of Shortridge Instruments, Inc. Results relate only to the item calibrated. For limitations on use, see Shortridge Instruments, Inc. Instruction Manual for the use of AirData Multimeters. Procedure used: Procedure for Differential Pressure, Absolute Pressure and Temperature Recalibration of AirData Multimeters SIP-CP02 Revision: 24 Dated: 10/06/03

Calibration Technician(s): L. Handley L. Laubmaier Calibration Date: 01/27/2004
 Calibration Approved by: Ray Boalen Title: Cal mgr Date: 01/28/2004

AS-Received By SO Test By DL Test By _____
 Date 01/27/04 Rh 30 % Date 01/27/04 Rh _____ %
 Ambient Temperature 72 °F Ambient Temperature 77 °F
 Barometric Pressure 28.69 in Hg Barometric Pressure 28.62 in Hg
 Within spec YES NO (NA) Within spec (YES) NO Within spec YES NO

ABSOLUTE PRESSURE TEST (in Hg)

TEST METER TOLERANCE = ± 2.0 % ± .1 in Hg AS-RECEIVED TEST WITHIN SPEC YES NO (NA)

Pressure Standard	S/N	Calibration Date	Calibration Due Date	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #02-R	S/N: 41741/42451	Calibration Date: 04/21/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #04-R	S/N: 41743/42453	Calibration Date: 05/05/03	Calibration Due Date: 05/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #06-R	S/N: 41742/42452	Calibration Date: 10/23/03	Calibration Due Date: 11/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #08-R	S/N: 42186/43328	Calibration Date: 09/05/03	Calibration Due Date: 03/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #10-R	S/N: 42203/43352	Calibration Date: 09/25/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #12-R	S/N: 43166/44731	Calibration Date: 05/28/03	Calibration Due Date: 12/2003	As-Rcvd	Test 2	Test 3
Heise Model PPM-2	Mfgd by Dresser Industries	Rated Accuracy: 0.05% fs (0.0305 in Hg)	Range: 0-61 in Hg	Uncertainty: < 0.0358		

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
14.0				13.81	13.8	-0.7			
28.4		NA		28.62	28.7	.28		NA	
40.0				42.46	42.5	.09			

DIFFERENTIAL PRESSURE TEST (in wc)

TEST METER TOLERANCE = ± 2.0 % ± 0.001 in wc AS-RECEIVED TEST WITHIN SPEC YES NO (NA)

Pressure Standard	S/N	Calibration Date	Calibration Due Date	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #01-L	S/N: 41739/42449	Calibration Date: 04/22/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #01-R	S/N: 41739/42446	Calibration Date: 04/22/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #02-L	S/N: 41741/42454	Calibration Date: 04/22/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #03-L	S/N: 41738/42448	Calibration Date: 05/09/03	Calibration Due Date: 05/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #03-R	S/N: 41738/42445	Calibration Date: 05/09/03	Calibration Due Date: 05/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #04-L	S/N: 41743/42456	Calibration Date: 05/13/03	Calibration Due Date: 05/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #05-L	S/N: 41740/42450	Calibration Date: 11/24/03	Calibration Due Date: 11/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #05-R	S/N: 41740/42447	Calibration Date: 11/24/03	Calibration Due Date: 11/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #06-L	S/N: 41742/42455	Calibration Date: 11/07/03	Calibration Due Date: 11/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #07-L	S/N: 42185/42186	Calibration Date: 09/10/03	Calibration Due Date: 03/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #07-R	S/N: 42185/43326	Calibration Date: 09/10/03	Calibration Due Date: 03/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #08-L	S/N: 42186/43329	Calibration Date: 09/10/03	Calibration Due Date: 03/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #09-L	S/N: 42202/43351	Calibration Date: 10/13/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #09-R	S/N: 42202/43350	Calibration Date: 10/13/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #10-L	S/N: 42203/43353	Calibration Date: 09/29/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #11-L	S/N: 43165/44551	Calibration Date: 06/03/03	Calibration Due Date: 12/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #11-R	S/N: 43165/44730	Calibration Date: 06/03/03	Calibration Due Date: 12/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #12-L	S/N: 43166/44732	Calibration Date: 06/03/02	Calibration Due Date: 12/2003	As-Rcvd	Test 2	Test 3

Differential Pressure Standards: Heise Model PPM1 Manufactured by Dresser Industries
 #01-L, 03-L, 05-L, 07-L, 09-L, 11-L, 13-L, 15-L Rated Accuracy: > 0.07% fs (0.000175 in wc) Range: 0.0-0.25 in wc Uncertainty: < 0.00035
 #01-R, 03-R, 05-R, 07-R, 09-R, 11-R, 13-R, 15-R Rated Accuracy: > 0.06% fs (0.003 in wc) Range: 0.0-5.0 in wc Uncertainty: < 0.00348
 #02-L, 04-L, 06-L, 08-L, 10-L, 12-L, 14-L, 16-L Rated Accuracy: > 0.06% fs (0.03 in wc) Range: 0.0-50.0 in wc Uncertainty: < 0.0346

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
.0500				0.518	0.518	0			
.1250				1.258	1.256	-0.16			
.2250				2.294	2.280	-0.18			
.2700				2.728	2.725	-0.11			
2.000				2.002	1.994	-0.40		NA	
3.600				3.605	3.589	-0.44			
4.400				4.391	4.381	-0.23			
27.00				27.05	27.04	-0.04			
50.00				49.40	49.16	-0.49			
Overrange									

Shortridge Instruments, Inc.
 7855 East Redfield Road Scottsdale, Arizona 85260
 (480) 991-6744 • Fax (480) 443-1267 • www.shortridge.com • info@shortridge.com

AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION

S/N: M881030
 Order #: PO40096

LOW VELOCITY CONFIRMATION
 TEST METER TOLERANCE = ± 3.0% ± 7 FPM AS-RECEIVED TEST WITHIN SPEC YES NO (N/A)

Velocity Standard: AirData Multimeter	S/N: M96455	Calibration Date: 10/28/03	Calibration Due Date: 10/2004	As-Rcvd	Test 2	Test 3
Velocity Standard: AirData Multimeter	S/N: M96099	Calibration Date: 09/19/03	Calibration Due Date: 09/2004	As-Rcvd	<u>Test 2</u>	Test 3
Velocity Standard: AirData Multimeter	S/N: M98326	Calibration Date: 10/28/03	Calibration Due Date: 10/2004	As-Rcvd	Test 2	Test 3
Velocity Standard: AirData Multimeter	S/N: M99420	Calibration Date: 09/19/03	Calibration Due Date: 09/2004	As-Rcvd	Test 2	Test 3
Velocity Standard: AirData Multimeter	S/N: M97577	Calibration Date: 10/28/03	Calibration Due Date: 10/2004	As-Rcvd	Test 2	Test 3

Rated Accuracy: Velocity ± 2.0 % ± 3 fpm Uncertainty: <2.25 fpm at 100 fpm; <2.5 fpm at 500 fpm

Approx Set Point	Standard	Test Meter	Diff	Standard	Test Meter	Diff	Standard	Test Meter	Diff
100		110		110.8	112	1.2		110	
500		493		493.7	492	-1.7		493	

ADM-870/870C and ADM-860/860C AirData Multimeters are read in AirFoil Mode. ADM-850 Multimeters are read in Pitot Tube Mode. Uncertainties shown for Low Velocity Confirmation represent Uncertainty of the Transfer Standard Meter exposed to the pressure source only.

TEMPERATURE TEST - AIRDATA MULTIMETER (° F)
 TEST METER TOLERANCE = ± 0.2° F AS-RECEIVED TEST WITHIN SPEC YES NO (N/A)

RTD Simulator: S/N 249	Calibration Date: 01/24/02	Calibration Due Date: 01/2004	As-Rcvd	Test 2	Test 3	Set Point: 35.6° F	95° F	154.4° F
RTD Simulator: S/N 250	Calibration Date: 01/24/02	Calibration Due Date: 01/2004	As-Rcvd	Test 2	Test 3	Set Point: 35.6° F	95° F	154.4° F
RTD Simulator: S/N 253	Calibration Date: 01/24/02	Calibration Due Date: 01/2004	As-Rcvd	Test 2	Test 3	Set Point: 35.6° F	95° F	154.4° F
RTD Simulator: S/N 254	Calibration Date: 03/28/02	Calibration Due Date: 03/2004	As-Rcvd	<u>Test 2</u>	Test 3	Set Point: <u>35.6</u> ° F	95° F	154.4° F
RTD Simulator: S/N 256	Calibration Date: 03/28/02	Calibration Due Date: 03/2004	As-Rcvd	<u>Test 2</u>	Test 3	Set Point: 35.6° F	<u>95</u> ° F	154.4° F
RTD Simulator: S/N 257	Calibration Date: 03/28/02	Calibration Due Date: 03/2004	As-Rcvd	<u>Test 2</u>	Test 3	Set Point: 35.6° F	95° F	<u>154.4</u> ° F

RTD Simulators Model RTD-1000/500 Rated Accuracy: 0.005% of setting Range: 100 Ω to 11111.10 Ω Uncertainty: < 32 ppm

RTD Simulator Temperature Equivalent Set Point	Test Meter	Difference	Test Meter	Difference	Test Meter	Difference
35.60			35.7	.1		
95.00			95.0	0		
154.40			154.4	0		

TEMPERATURE TEST OF CUSTOMER'S TEMPROBE
 TEMPROBE TOLERANCE = ± 0.3° F AS-RECEIVED TEST WITHIN SPEC YES NO (N/A)

Thermometer #4	S/N 92143/Thermistor	S/N A310887	Calibration Date: 08/11/03	Cal Due Date: 08/2005	Set Point: 35° F	95° F	155° F
Thermometer #1	S/N 8A089/Thermistor	S/N 881708	Calibration Date: 05/27/03	Cal Due Date: 05/2005	Set Point: 35° F	95° F	155° F
Thermometer #3	S/N 92142/Thermistor	S/N 850104	Calibration Date: 07/02/03	Cal Due Date: 07/2005	Set Point: 35° F	95° F	155° F
Thermometer #2	S/N 8B104/Thermistor	S/N 871507	Calibration Date: 11/05/02	Cal Due Date: 11/2004	Set Point: 35° F	95° F	155° F

Above Temperature Standards: Rated Accuracy: 0.023° F/0.018° F Combined Uncertainty: < 0.025° F
 Temperature Standard AirData Multimeter S/N M00136 Calibration Date: 03/31/03 Cal Due Date: 03/2004 Set Point: 35° F 95° F 155° F
 Temperature Standard AirData Multimeter S/N M96100 Calibration Date: 05/14/03 Cal Due Date: 05/2004 Set Point: 35° F 95° F 155° F
 Above Temperature Standards: Rated Accuracy: 0.03° F Uncertainty: < 0.023° F
 Total combined Uncertainty for TempProbe testing: < 0.039° F

Approx Set Point	Standard	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff
35.0													
95.0													
155.0													

APPROVED FOR CLIENT USE

NOTES: No "As Recv'd" readings - meter locks up on all 8's

FEB 02 2004

BY: [Signature] FOR TSS, INC.
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TSS EQ 1239

AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION Event # NCO30859

Customer ID: 012460 S/N: M97783
 Customer: TECHNICAL SAFETY SERVICES, INC. City: BERKELEY State: CA Order #: R031396
 As-Received Model #: ADM-860 Converted to Model #:
 PO #: _____ Customer Eqpt ID#: _____ Calibration Due Date: 06/2004 QA Code: 95 10CFR21: _____

This instrument has been calibrated using Calibration Standards which are traceable to NIST (National Institute of Standards and Technology). Quality Assurance Program and calibration procedures meet the requirements for 10CFR50 Appendix B; ANSI/N45.2; ANSI/NCSL Z540-1-1994; MIL-STD 45662A and manufacturer's specifications. Calibration accuracy is certified when meters are used with properly functioning accessories only. All Uncertainties are expressed in expanded terms (twice the calculated uncertainty). This report shall not be reproduced, except in full, without the written approval of Shortridge Instruments, Inc. Results relate only to the item calibrated. For limitations on use, see Shortridge Instruments, Inc. Instruction Manual for the use of AirData Multimeters. Procedure used: Recalibration Procedure for AirData Multimeters SIP-CP02 Revision: 23 Dated: 12/09/02

Calibration Technician(s): J. Glendon J. Saubman Calibration Date: 06/05/2003
 Calibration Approved by: [Signature] Title: Gen. Mgr Date: 6-5-2003

AS-Received By: JU Test By: 44 Test By: _____
 Date: 05/29/03 Rh: 51 % Date: 06/05/03 Rh: 48 % Date: _____ Rh: _____ %
 Ambient Temperature: 72 *F Ambient Temperature: 73 *F Ambient Temperature: _____ *F
 Barometric Pressure: 28.43 in Hg Barometric Pressure: 28.28 in Hg Barometric Pressure: _____ in Hg
 Within spec: YES NO NA Within spec: YES NO Within spec: YES NO

ABSOLUTE PRESSURE TEST (in Hg)

TEST METER TOLERANCE = ± 2.0 % ± .1 in Hg AS-RECEIVED TEST WITHIN SPEC YES NO N/A

Pressure Standard: Heise #02-R	S/N: 41741/42451	Calibration Date: 04/21/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #04-R	S/N: 41743/42453	Calibration Date: 05/05/03	Calibration Due Date: 05/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #06-R	S/N: 41742/42452	Calibration Date: 12/04/02	Calibration Due Date: 06/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #08-R	S/N: 42186/43328	Calibration Date: 03/14/03	Calibration Due Date: 09/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #10-R	S/N: 42203/43352	Calibration Date: 04/07/03	Calibration Due Date: 10/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #12-R	S/N: 43166/44731	Calibration Date: 11/01/02	Calibration Due Date: 05/2003	As-Rcvd	Test 2	Test 3
Heise Model PPM-2	Mfgd by Dresser Industries	Rated Accuracy: 0.05% fs (0.0305 in Hg)	Range: 0-61 in Hg	Uncertainty: < 0.0358		

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
14.0	14.39	14.3	-0.63	14.08	14.1	.14			
28.4	28.43	28.3	-0.46	28.28	28.3	.07			
40.0	40.63	40.5	-0.32	41.37	42.4	.07			

DIFFERENTIAL PRESSURE TEST (in wc)

TEST METER TOLERANCE = ± 2.0 % ± 0.001 in wc AS-RECEIVED TEST WITHIN SPEC YES NO N/A

Pressure Standard: Heise #01-L	S/N: 41739/42449	Calibration Date: 04/22/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #01-R	S/N: 41739/42446	Calibration Date: 04/22/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #02-L	S/N: 41741/42454	Calibration Date: 04/22/03	Calibration Due Date: 04/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #03-L	S/N: 41738/42448	Calibration Date: 05/09/03	Calibration Due Date: 05/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #03-R	S/N: 41738/42445	Calibration Date: 05/09/03	Calibration Due Date: 05/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #04-L	S/N: 41743/42456	Calibration Date: 05/13/03	Calibration Due Date: 05/2004	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #05-L	S/N: 41740/42450	Calibration Date: 12/06/02	Calibration Due Date: 06/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #05-R	S/N: 41740/42447	Calibration Date: 12/08/02	Calibration Due Date: 06/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #06-L	S/N: 41742/42455	Calibration Date: 12/06/02	Calibration Due Date: 06/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #07-L	S/N: 42185/42186	Calibration Date: 03/18/03	Calibration Due Date: 09/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #07-R	S/N: 42185/43326	Calibration Date: 03/18/03	Calibration Due Date: 09/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #08-L	S/N: 42186/43329	Calibration Date: 03/18/03	Calibration Due Date: 09/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #09-L	S/N: 42202/43351	Calibration Date: 04/09/03	Calibration Due Date: 10/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #09-R	S/N: 42202/43350	Calibration Date: 04/09/03	Calibration Due Date: 10/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #10-L	S/N: 42203/43353	Calibration Date: 04/09/03	Calibration Due Date: 10/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #11-L	S/N: 43165/44551	Calibration Date: 11/06/02	Calibration Due Date: 05/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #11-R	S/N: 43165/44730	Calibration Date: 11/06/02	Calibration Due Date: 05/2003	As-Rcvd	Test 2	Test 3
Pressure Standard: Heise #12-L	S/N: 43166/44732	Calibration Date: 11/06/02	Calibration Due Date: 05/2003	As-Rcvd	Test 2	Test 3

Differential Pressure Standards: Heise Model PPM1 Manufactured by Dresser Industries
 #01-L, 03-L, 05-L, 07-L, 09-L, 11-L Rated Accuracy: > 0.07% fs (0.000175 in wc) Range: 0.0-0.25 in wc Uncertainty: < 0.00035
 #01-R, 03-R, 05-R, 07-R, 09-R, 11-R Rated Accuracy: > 0.06% fs (0.003 in wc) Range: 0.0-5.0 in wc Uncertainty: < 0.00348
 #02-L, 04-L, 06-L, 08-L, 10-L, 12-L Rated Accuracy: > 0.06% fs (0.03 in wc) Range: 0.0-50.0 in wc Uncertainty: < 0.0346

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
.0500	.0537	.0536	-0.19	.0528	.0527	-0.19			
.1250	.1254	.1251	-0.24	.1261	.1259	-0.16			
.2250	.2252	.2248	-0.04	.2298	.2296	-0.09			
.2700	.2712	.2724	.44	.2710	.2718	.30			
2.000	2.032	2.041	.44	2.003	2.010	.35			
3.600	3.619	3.638	.53	3.622	3.631	.25			
4.400	4.448	4.479	.70	4.408	4.423	.34			
27.00	27.35	27.50	.55	27.14	27.29	.55			
50.00	50.25	50.41	.32	49.10	49.11	.02			
Overage	✓	✓		✓	✓				

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AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION

S/N: M97783
 Order #: 2031396

LOW VELOCITY CONFIRMATION
 TEST METER TOLERANCE = ± 3.0% ± 7 FPM AS-RECEIVED TEST WITHIN SPEC YES NO N/A

Velocity Standard: AirData Multimeter S/N: M96455 Calibration Date: 11/08/02 Calibration Due Date: 11/2003 As-Rcvd Test 2 Test 3
 Velocity Standard: AirData Multimeter S/N: M96099 Calibration Date: 09/26/02 Calibration Due Date: 09/2003 As-Rcvd Test 2 Test 3
 Velocity Standard: AirData Multimeter S/N: M98326 Calibration Date: 10/29/02 Calibration Due Date: 10/2003 As-Rcvd Test 2 Test 3
 Velocity Standard: AirData Multimeter S/N: M99420 Calibration Date: 09/26/02 Calibration Due Date: 09/2003 As-Rcvd Test 2 Test 3
 Rated Accuracy: Velocity ± 2.0 % ± 3 fpm Uncertainty: <2.25 fpm at 100 fpm; <2.5 fpm at 500 fpm

Approx Set Point	Standard	Test Meter	Diff	Standard	Test Meter	Diff	Standard	Test Meter	Diff
100	123.7	122	-1.7	115.4	116	.6			
500	515.7	514	-1.7	534.8	534	-0.8			

ADM-870/870C and ADM-860/860C AirData Multimeters are read in AirFoil Mode. ADM-850 Multimeters are read in Pitot Tube Mode. Uncertainties shown for Low Velocity Confirmation represent Uncertainty of the Transfer Standard Meter exposed to the pressure source only.

TEMPERATURE TEST - AIRDATA MULTIMETER (° F)
 TEST METER TOLERANCE = ± 0.2° F AS-RECEIVED TEST WITHIN SPEC YES NO N/A

RTD Simulator: S/N 249 Calibration Date: 01/24/2002 Calibration Due Date: 01/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 250 Calibration Date: 01/24/2002 Calibration Due Date: 01/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 253 Calibration Date: 01/24/2002 Calibration Due Date: 01/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 254 Calibration Date: 03/28/2002 Calibration Due Date: 03/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 256 Calibration Date: 03/28/2002 Calibration Due Date: 03/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 257 Calibration Date: 03/28/2002 Calibration Due Date: 03/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulators Model RTD-1000/500 Rated Accuracy: 0.005% of setting Range: 100 Ω to 11111.10 Ω Uncertainty: < 32 ppm

RTD Simulator Temperature Equivalent Set Point	Test Meter	Difference	Test Meter	Difference	Test Meter	Difference
35.60	35.7	-1	35.8	-2		
95.00	95.0	0	95.2	-2		
154.40	154.3	-1	154.5	-1		

TEMPERATURE TEST OF CUSTOMER'S TEMPROBE
 TEMPROBE TOLERANCE = ± 0.3° F AS-RECEIVED TEST WITHIN SPEC YES NO N/A

Thermometer S/N 92143/Thermistor S/N 871513 Calibration Date: 04/04/01 Cal Due Date: 06/2003 Set Point: 35° F 95° F 155° F
 Thermometer S/N 8A089/Thermistor S/N 881708 Calibration Date: 10/05/02 Cal Due Date: 10/2004 Set Point: 35° F 95° F 155° F
 Thermometer S/N 92142/Thermistor S/N 850104 Calibration Date: 02/09/01 Cal Due Date: 05/2003 Set Point: 35° F 95° F 155° F
 Thermometer S/N 8B104/Thermistor S/N 871507 Calibration Date: 11/05/02 Cal Due Date: 11/2004 Set Point: 35° F 95° F 155° F
 Above Temperature Standards: Rated Accuracy: 0.023° F/0.018° F Combined Uncertainty: < 0.025° F
 Temperature Standard AirData Multimeter S/N: M00136 Calibration Date: 03/31/03 Cal Due Date: 03/2004 Set Point: 35° F 95° F 155° F
 Temperature Standard AirData Multimeter S/N: M96100 Calibration Date: 05/14/03 Cal Due Date: 05/2004 Set Point: 35° F 95° F 155° F
 Above Temperature Standards: Rated Accuracy: 0.03° F Uncertainty: < 0.023° F
 Total combined Uncertainty for TempProbe testing: < 0.0285

Approx Set Point	Standard	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff
35.0	35.0	34.8	-0.2										
95.0	95.0	94.9	-0.1										
155.0	155.0	155.0	0										

APPROVED FOR CLIENT USE

NOTES:

JUN 09 2003

BY: [Signature] FOR TSS, INC.
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TSS ER 1254

AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION

Event # NCO31381

Customer ID: 012460 SN: M91219
 Customer: TECHNICAL SAFETY SERVICES, INC. City: BERKELEY State: CA Order #: 8032227
 As-Received Model #: ADM-860 Converted to Model #:
 PO #: _____ Customer Eqpt ID#: _____ Calibration Due Date: 08/2004 QA Code: 95 10CFR21: _____

This instrument has been calibrated using Calibration Standards which are traceable to NIST (National Institute of Standards and Technology). Quality Assurance Program and calibration procedures meet the requirements for 10CFR50 Appendix B; ANSI/N45.2; ANSI/NC SL 2540-1-1994; MIL-STD 45662A and manufacturer's specifications. Calibration accuracy is certified when meters are used with properly functioning accessories only. All Uncertainties are expressed in expanded terms (twice the calculated uncertainty). This report shall not be reproduced, except in full, without the written approval of Shortridge Instruments, Inc. Results relate only to the item calibrated. For limitations on use, see Shortridge Instruments, Inc. Instruction Manual for the use of AirData Multimeters. Procedure used: Recalibration Procedure for AirData Multimeters SIP-CP02 Revision: 23 Dated: 12/09/02

Calibration Technician(s): J. Clendenen J. Laubmeier Calibration Date: 08/29/2003
 Calibration Approved by: Ray Baraka Title: Cal Mgr. Date: 09/02/2003

AS-Received By SO Test By JK Test By JK
 Date 08/22/03 Rh 53 % Date 08/29/03 Rh 61 % Date 09/29/03 Rh 52 %
 Ambient Temperature 77 °F Ambient Temperature 76 °F Ambient Temperature 80 °F
 Barometric Pressure 29.40 in Hg Barometric Pressure 28.44 in Hg Barometric Pressure 28.34 in Hg
 Within spec (YES) NO NA Within spec (YES) NO Within spec (YES) NO

ABSOLUTE PRESSURE TEST (in Hg)

TEST METER TOLERANCE = ± 2.0 % ± .1 in Hg AS-RECEIVED TEST WITHIN SPEC (YES) NO N/A

Pressure Standard	Heise #	S/N	Calibration Date	Calibration Due Date	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #02-R	S/N: 41741/42451	Calibration Date: 04/21/03	Calibration Due Date: 04/2004	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #04-R	S/N: 41743/42453	Calibration Date: 05/05/03	Calibration Due Date: 05/2004	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #06-R	S/N: 41742/42452	Calibration Date: 12/04/02	Calibration Due Date: 11/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #08-R	S/N: 42186/43328	Calibration Date: 03/14/03	Calibration Due Date: 09/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #10-R	S/N: 42203/43352	Calibration Date: 04/07/03	Calibration Due Date: 10/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #14-R	S/N: 43412/45043	Calibration Date: 06/18/03	Calibration Due Date: 12/2003	AS-Rcvd	Test 2	Test 3
Heise Model PPM-2 Mfgd by Dresser Industries			Rated Accuracy: 0.05% fs (0.0305 in Hg) Range: 0-61 in Hg		Uncertainty: < 0.0358		

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
14.0	14.88	15.0	.81	14.32	14.4	.56	14.38	14.4	.14
28.4	28.37	28.5	-.37	28.44	28.6	.56	28.34	28.4	.21
40.0	40.60	40.6	0	42.48	42.6	.28	42.25	42.2	-.12

DIFFERENTIAL PRESSURE TEST (in wc)

TEST METER TOLERANCE = ± 2.0 % ± 0.001 in wc AS-RECEIVED TEST WITHIN SPEC (YES) NO N/A

Pressure Standard	Heise #	S/N	Calibration Date	Calibration Due Date	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #01-L	S/N: 41739/42449	Calibration Date: 04/22/03	Calibration Due Date: 04/2004	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #01-R	S/N: 41739/42446	Calibration Date: 04/22/03	Calibration Due Date: 04/2004	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #02-L	S/N: 41741/42454	Calibration Date: 04/22/03	Calibration Due Date: 04/2004	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #03-L	S/N: 41738/42448	Calibration Date: 05/09/03	Calibration Due Date: 05/2004	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #03-R	S/N: 41738/42445	Calibration Date: 05/09/03	Calibration Due Date: 05/2004	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #04-L	S/N: 41743/42456	Calibration Date: 05/13/03	Calibration Due Date: 05/2004	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #05-L	S/N: 41740/42450	Calibration Date: 12/08/02	Calibration Due Date: 11/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #05-R	S/N: 41740/42447	Calibration Date: 12/08/02	Calibration Due Date: 11/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #06-L	S/N: 41742/42455	Calibration Date: 12/08/02	Calibration Due Date: 11/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #07-L	S/N: 42185/42186	Calibration Date: 03/18/03	Calibration Due Date: 09/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #07-R	S/N: 42185/43326	Calibration Date: 03/18/03	Calibration Due Date: 09/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #08-L	S/N: 42186/43329	Calibration Date: 03/18/03	Calibration Due Date: 09/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #09-L	S/N: 42202/43351	Calibration Date: 04/09/03	Calibration Due Date: 10/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #09-R	S/N: 42202/43350	Calibration Date: 04/09/03	Calibration Due Date: 10/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #10-L	S/N: 42203/43353	Calibration Date: 04/09/03	Calibration Due Date: 10/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #13-L	S/N: 43415/45041	Calibration Date: 06/18/03	Calibration Due Date: 12/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #13-R	S/N: 43415/45039	Calibration Date: 06/18/03	Calibration Due Date: 12/2003	AS-Rcvd	Test 2	Test 3
Pressure Standard	Heise #14-L	S/N: 43412/45045	Calibration Date: 06/18/03	Calibration Due Date: 12/2003	AS-Rcvd	Test 2	Test 3

Differential Pressure Standards: Heise Model PPM1 Manufactured by Dresser Industries
 #01-L, 03-L, 05-L, 07-L, 09-L, 11-L Rated Accuracy: > 0.07% fs (0.000175 in wc) Range: 0.0-0.25 in wc Uncertainty: < 0.00035
 #01-R, 03-R, 05-R, 07-R, 09-R, 11-R Rated Accuracy: > 0.06% fs (0.003 in wc) Range: 0.0-5.0 in wc Uncertainty: < 0.00348
 #02-L, 04-L, 06-L, 08-L, 10-L, 12-L Rated Accuracy: > 0.06% fs (0.03 in wc) Range: 0.0-50.0 in wc Uncertainty: < 0.0346

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
.0500	.0563	.0560	-.53	.0528	.0524	-.76	.0536	.0536	0
.1250	.1266	.1260	-.47	.1237	.1228	-.73	.1251	.1254	.24
.2250	.2265	.2254	-.49	.2247	.2229	-.80	.2274	.2277	.13
.2700	.2712	.2702	-.37	.2746	.2736	-.36	.2728	.2728	0
2.000	2.028	2.020	-.39	2.030	2.018	-.59	2.024	2.022	-.10
3.600	3.620	3.595	-.69	3.656	3.633	-.63	3.666	3.667	.03
4.400	4.414	4.427	.29	4.430	4.419	-.25	4.461	4.470	.20
27.00	27.33	27.25	-.29	27.74	27.68	-.22	27.37	27.37	0
50.00	50.11	49.82	-.58	49.71	49.43	-.56	49.62	49.46	-.32
Overage	✓	✓		✓	✓		✓	✓	

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AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION

S/N: M91219
 Order #: R032227

LOW VELOCITY CONFIRMATION
 TEST METER TOLERANCE = ± 3.0% ± 7 FPM AS-RECEIVED TEST WITHIN SPEC YES NO N/A

Velocity Standard: AirData Multimeter S/N: M96455 Calibration Date: 11/08/02 Calibration Due Date: 11/2003 As-Rcvd Test 2 Test 3
 Velocity Standard: AirData Multimeter S/N: M96099 Calibration Date: 09/26/02 Calibration Due Date: 09/2003 As-Rcvd Test 2 Test 3
 Velocity Standard: AirData Multimeter S/N: M98326 Calibration Date: 10/29/02 Calibration Due Date: 10/2003 As-Rcvd Test 2 Test 3
 Velocity Standard: AirData Multimeter S/N: M99420 Calibration Date: 09/26/02 Calibration Due Date: 09/2003 As-Rcvd Test 2 Test 3
 Rated Accuracy: Velocity ± 2.0 % ± 3 fpm Uncertainty: <2.25 fpm at 100 fpm; <2.5 fpm at 500 fpm

Approx Set Point	Standard	Test Meter	Diff	Standard	Test Meter	Diff	Standard	Test Meter	Diff
100	124.7	121	-3.7	106.4	104	-2.4	123.2	119	-4.2
500	525.5	522	-3.5	498.6	494	-4.6	550.4	550	-0.4

ADM-870/870C and ADM-860/860C AirData Multimeters are read in AirFoil Mode. ADM-850 Multimeters are read in Pilot Tube Mode. Uncertainties shown for Low Velocity Confirmation represent Uncertainty of the Transfer Standard Meter exposed to the pressure source only.

TEMPERATURE TEST - AIRDATA MULTIMETER (°F)
 TEST METER TOLERANCE = ± 0.2° F AS-RECEIVED TEST WITHIN SPEC YES NO N/A

RTD Simulator: S/N 249 Calibration Date: 01/24/2002 Calibration Due Date: 01/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 250 Calibration Date: 01/24/2002 Calibration Due Date: 01/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 253 Calibration Date: 01/24/2002 Calibration Due Date: 01/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 254 Calibration Date: 03/28/2002 Calibration Due Date: 03/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 256 Calibration Date: 03/28/2002 Calibration Due Date: 03/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulator: S/N 257 Calibration Date: 03/28/2002 Calibration Due Date: 03/2004 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
 RTD Simulators Model RTD-1000/500 Rated Accuracy: 0.005% of setting Range: 100 Ω to 11111.10 Ω Uncertainty: < 32 ppm

RTD Simulator Temperature Equivalent Set Point	Test Meter	Difference	Test Meter	Difference	Test Meter	Difference
35.60	35.7	.1	35.7	.1	35.7	.1
95.00	95.1	.1	95.1	.1	95.0	0
154.40	154.2	-.2	154.4	0	154.4	0

TEMPERATURE TEST OF CUSTOMER'S TEMPROBE
 TEMPROBE TOLERANCE = ± 0.3° F AS-RECEIVED TEST WITHIN SPEC YES NO N/A

Thermometer S/N 92143/Thermistor S/N 871513 Calibration Date: 04/04/01 Cal Due Date: 06/2003 Set Point: 35° F 95° F 155° F
 Thermometer S/N 8A089/Thermistor S/N 881708 Calibration Date: 05/27/03 Cal Due Date: 05/2005 Set Point: 35° F 95° F 155° F
 Thermometer S/N 92142/Thermistor S/N 850104 Calibration Date: 07/02/03 Cal Due Date: 07/2005 Set Point: 35° F 95° F 155° F
 Thermometer S/N 8B104/Thermistor S/N 871507 Calibration Date: 11/05/02 Cal Due Date: 11/2004 Set Point: 35° F 95° F 155° F
 Above Temperature Standards: Rated Accuracy: 0.023° F/0.018° F Combined Uncertainty: < 0.025° F
 Temperature Standard AirData Multimeter S/N: M00136 Calibration Date: 03/31/03 Cal Due Date: 03/2004 Set Point: 35° F 95° F 155° F
 Temperature Standard AirData Multimeter S/N: M96100 Calibration Date: 05/14/03 Cal Due Date: 05/2004 Set Point: 35° F 95° F 155° F
 Above Temperature Standards: Rated Accuracy: 0.03° F Uncertainty: < 0.023° F
 Total combined Uncertainty for TempProbe testing : < 0.039° F

Approx Set Point	Standard	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff	TempProbe	Diff
35.0	35.0	34.9	-.1										
95.0	95.0	95.0	0										
155.0	155.0	155.0	0										

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NOTES: Velocity "As Rcvd" readings done in Pilot tube mode.

SEP 12 2003
 BY: DD FOR TSS, INC.
 www.techsafety.com

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Document Title INSTRUMENT CALIBRATION RECORD
 Document Number ICR-1
 Valid Date 04 September 2000
 Supersedes 06 December 1999
 Page 1 of 1

INSTRUMENT CALIBRATION RECORD

FACILITY	Technical Safety Services, Inc.	DB ID NO.	EQ 362	TSS Cal Event	NCO40374
ADDRESS	620 Hearst Avenue	MFGR.	Dickson		
CITY, STATE	Berkeley, CA	MODEL	THDx		
ZIP	94710	TYPE	Chart Recorder		
DEPARTMENT	Calibration	S/N	7157517		
CONTACT	Duy Doan	BLDG.	620 Hearst Ave		
PHONE	510.845.5591	RM.	Calibration Laboratory		

<input checked="" type="checkbox"/> AS FOUND STATUS:	<input checked="" type="checkbox"/> REASON FOR SERVICE:	<input checked="" type="checkbox"/> FINAL TEST STATUS:
<input checked="" type="checkbox"/> IN TOLERANCE	<input checked="" type="checkbox"/> SCHEDULED	<input checked="" type="checkbox"/> CALIBRATED
<input type="checkbox"/> OUT OF TOLERANCE	<input type="checkbox"/> UNSCHEDULED	<input type="checkbox"/> LIMITED CAL.
<input type="checkbox"/> INOPERATIVE	<input type="checkbox"/> NEW UNIT	<input type="checkbox"/> OUT OF TOLERANCE
		<input type="checkbox"/> INOPERATIVE

UNITS MEASURED AND TEST POINTS:	AS FOUND TEST DATA:						FINAL TEST DATA:				
	STANDARD	INSTRUMENT	DIFFERENCE	TOL. (+/-)	IN TOL?	STANDARD	INSTRUMENT	DIFFERENCE	TOL. (+/-)	IN TOL?	
Ambient °C	19.8	19	0.8	1	yes						
Low °C	2.2	3	0.8	1	yes						
Ambient %rH	50.2	50	0.2	2	yes						

STANDARDS USED	SERIAL/ID NUMBER	STD. CAL. DATE	CAL. DUE DATE
GE 1311DR/M2 Dew pointer	TSS EQ 169	10/13/03	4/13/04
Barometric Pressure (30.3 "Hg)	TSS EQ 1064	5/7/03	5/7/04

COMMENTS: 1) TUR ≥ 4:1

CALIBRATED BY (PRINT)	CALIBRATED BY (SIGN)	CALIBRATION DATE	CAL DUE DATE
Duy Doan		3/24/04	3/24/05

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MAR 26 2004

BY: FOR TSS, INC
 www.techsafety.com

TSS EQ 1282

Event# NCO 40114

Fluke Corporation

6920 Seaway Blvd
Everett, WA 98203
(425) 347-6100



Certificate of Calibration

CalNet®

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Manufacturer: Fluke
Model: FLUKE-189/CWG
Description: LOGGING MULTIMETER
Serial Number: 85090172

JAN 21 2004
BY: D.D. FOR TSS, INC.
www.techsafety.com

The Fluke Corporation, ISO Certification No. U0018, certifies that the instrument identified above was calibrated in accordance with applicable Fluke calibration procedures. Its calibration processes are ISO-9001 controlled and are designed to certify that the instrument was within its published specifications at the time of calibration.

The measurement standards and instruments used during the calibration of this instrument are traceable to the United States National Institute of Standards and Technology (NIST), natural physical constants, consensus standards, or by ratio type measurements.

Cal Date: Nov 13, 2003	Temperature: 23° C ± 5°	Report Number: 1598453-85090172
Next Cal Due: Nov 12, 2004	Humidity: < 80%	Received Condition: New Product
Cell Lead: Greg Romig		Returned Condition: In Tolerance
Calibration Procedure: 189.150		
Test Station: 187/189		

End of Report

TSS EQ 1307

Event #NCO40405

Certificate of Calibration

A.P. BUCK, INC. mini-BUCK CALIBRATOR™

Serial No. 3305B Date Calibrated: 3-25-04 Next Calibration due date: 3-25-05

Model No. M-1 M-5 M-30

Applicable Measurement Standards

Description	MFR.	Model	Serial #	Calibration Due Date	N. I. S. T.
<input type="checkbox"/> 100ml Burette	Kimble	17027F-100	1219	02/15/2008	Special 17027F
<input type="checkbox"/> 1000ml Burette	Kimble	17081	0002	10/15/2005	ASTM E542
<input checked="" type="checkbox"/> 1000ml Burette	Kimble	17081	0003	10/15/2005	ASTM E542
<input checked="" type="checkbox"/> Stopwatch	CMS	387-621	0996605	07/17/2004	EL015
<input type="checkbox"/> Stopwatch	Fisher	14-649-5	230268455	10/21/2004	FREQ. STD. 104

This instrument as received on 3-19-04 at A.P. Buck, Inc.'s facility was found to be:

- Unable to calibrate as received due to condition of unit.
 Within specifications of $\pm 0.5\%$ of the display reading.
 Not in specification by _____ % High _____ % Low of the display.

The instrument listed above has been adjusted to nominal, utilizing a 1,000ml burette, and an electronic digital stop watch, which are traceable to the National Institute of Standards & Technology (NIST). The accuracy of the instruments used to perform calibration is greater than 4 to 1. The A.P. Buck, Inc. Calibration system is in compliance with ANSI Z540-1 and IEC guide 25.

Calibration was conducted with A.P. Buck, Inc. Calibration Procedure APB-1 Rev. 6.1 with a constant flow pump using the Bubble-meter method. A.P. Buck, Inc. guarantees the accuracy and repeatability of $\pm 0.5\%$ for any display reading as described under the instruction manual "Principles of Operation". Responsibilities shall in no event, nor for any cause whatsoever, exceed the price charged for the calibration represented by this certification.

QA APPROVAL BY: Chandrika Panchal

APPROVED FOR CLIENT USE

A.P. BUCK, INC.
 7101 Presidents Drive, Suite 110
 Orlando, FL 32809
 Phone: 407-851-8602
 Fax: 407-851-8910

APR 02 2004
 BY: [Signature] FOR TSS, INC.
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