

Testing the Vented, 2-Liter Induction Chamber

Report 14 October 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 Vented, 2-Liter Induction Chamber

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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. Vented, 2-Liter Induction Chamber (P/N 942102). These tests were designed to collect data so that VetEquip, Inc. personnel could evaluate the basic suitability of the 2-Liter Chamber as a containment device for anesthetic gasses; the 2-Liter Chamber 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 2-Liter Chamber on August 8th, 2004.

5.2 The basic test results follow:

5.2.1 With a vacuum of -0.23" w.c. measured at the evacuation port/collar, TSS measured an average velocity of 155 feet per minute within the 4.500"x2.375" slot. This corresponds roughly to a requirement of 11.5 cubic feet per minute.

5.2.2 At this setting, the slot competently capture still air along 5 ½" of the sliding lid, and challenge smoke within the chamber is seen to be wholly captured when the lid is opened and closed.

5.2.3 When injecting Sulfur Hexafluoride tracer gas at either ~0.4lpm or ~2lpm 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. There is no stated acceptance criterion for this tracer result, however any result <0.10ppm is typically very acceptable.

- 5.3 The scope of testing was limited to the following items:
- 5.3.1 In the manner of TSS SOP 4-6.v2, "Field Testing of Slot Hoods," TSS determined the capture velocity and the effective distance of capture from the 2-Liter Chamber' slot. This established the ventilation rate for the following tests.
 - 5.3.2 With the ventilation rate adjusted per the previous test, TSS injected tracer gas into the 2-Liter Chamber to mimic the performance of an anesthetic vapor. TSS then sampled for tracer leakage in the breathing zone of a human manikin, positioned above the 2-Liter Chamber to simulate an optimum viewing position, about 14" above the 2-Liter Chamber itself. TSS selected two injection rates, 400 ml/min and 2 l/m, and tested the ability of the 2-Liter Chamber to contain the tracer gas under steady-state conditions as well as the effect of opening and closing the lid.
- 5.4 Test results are discussed in greater detail in section 6 of this report. Cited figures, 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 Capture Velocity versus Vacuum:

6.1.1 Test Method:

In the manner of TSS SOP 4-6, TSS traversed the 2-Liter Chamber in the slot entry plane using a calibrated anemometer while simultaneously adjusting the airflow rate and probing with a neutral-density challenge smoke (titanium tetrachloride, $TiCl_4$). Once the airflows were adjusted so that the smoke was captured along the length of the lid, and smoke in the chamber was visually captured when the lid was opened & closed, TSS recorded the static pressure at the evacuation port/collar.

TSS chose the slot entry plane and the evacuation port/collar as the data sampling points because they would be easy for any competent technician to replicate.

Since the evacuation port/collar on the 2-Liter chamber does not have any filter or damper components, the essential relationship between capture efficiency and static pressure should not change. TSS performed this test under still air (cross-currents <20fpm) conditions.

6.1.2 Acceptance Criteria:

For acceptance, challenge smoke must be captured along the length of the lid, and smoke in the chamber must be visually captured when the lid is opened & closed.

6.1.3 Test Results:

6.1.3.1 The smoke was captured along the length of the lid, and smoke in the chamber was visually captured when the lid was opened & closed when the airflow velocity in the slot entry plane averages 155 feet per minute. This corresponded to a pressure of - 0.23" w.c. at the evacuation port/collar.

6.1.3.2 In the 4.500"x2.375" slot, the 155 feet per minute velocity corresponds roughly to 11.5 cubic feet per minute. TSS has not applied an A_k correction to this value.

6.1.3.3 Diagram 1-4 show the smoke capture properties of the slot, as well as a representative airflow velocity sample point.

6.2 Tracer Gas Performance Tests:

6.2.1 Test Method:

With the 2-Liter Chamber operating normally and providing the flow conditions described in the previous section, and in a manner derivative of ASHRAE 110-1995, TSS injected undiluted, 99.97% Sulfur Hexafluoride tracer gas into 'Chamber, 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, 400-2,000 ml/min, might result in leakage from the 'Chamber itself and enter the worker's breathing zone. The flow rates of 400 ml/min and 2,000 ml/min were selected as typical for rats/patients to be treated in the 2-Liter Chamber.

With the tracer gas flowing at 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 300 consecutive, logged, 1-second readings stored in an Excel file, available for audit at TSS. Three replicates ('runs') of the five-minute test were performed.

After the five minute runs were completed, the effect of the lid was tested. While logging the leakage concentration, the lid was opened for two minutes, and then closed for two minutes. Three replicates of this test were also conducted, and the peak value is reported.

Once the testing was done for the 400 ml/min flow rate, the three, consecutive, 5-minute 'runs' were repeated for the 2,000 ml/min flow rate. The lid-effect was not tested at 2,000 ml/min.

6.2.2 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.

6.2.3 Test Results:

6.2.3.1 The 2-Liter Induction Chamber has similar tracer gas performance results at 400 ml/min and 2,000 ml/min. The average leakage to the operator-breathing zone is very low: ~ 0.02 ppm.

6.2.3.2 The lid opening & closing provided a peak concentration of 0.22 ppm with the tracer gas flowing at 400 ml/min into the chamber. While this is higher than the steady-state leakage rate, it is still low and there is no consensus standard for acceptance.

6.2.3.3 The data for both grilles is plotted as Figures 6-7.

7 Diagrams and Tables:

Item	Description
Figure 1	Elevation of 2-Liter Chamber Showing Airflow Capture
Figure 2	Plan of 2-Liter Chamber Showing Airflow Capture
Figure 3	2-Liter Chamber Full of $TiCl_4$ Smoke
Figure 4	2-Liter Chamber Cleared of 'Smoke Without Spillage After Opening
Figure 5	Tracer Gas Test Geometry
Figure 6	SF6 400 ml/min Leakage Plot
Figure 7	SF6 2,000 ml/min Leakage Plot

Figure 1



Elevation of 2-Liter Chamber Showing Airflow Capture (note anemometer in slot test-pos.)

Figure 2



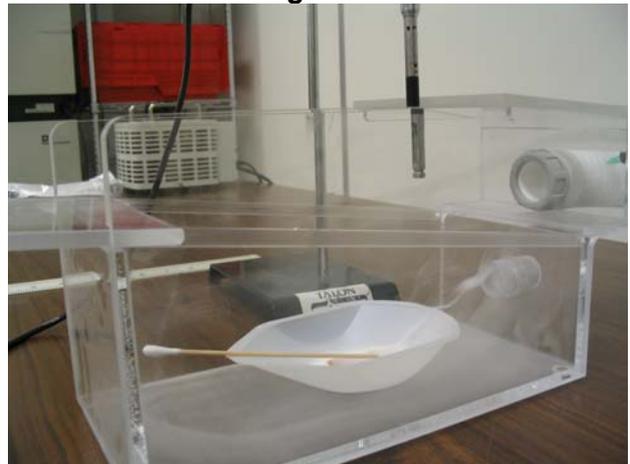
Plan of 2-Liter Chamber Showing Airflow Capture

Figure 3



2-Liter Chamber Full of TiCl_4 Smoke

Figure 4



2-Liter Chamber Cleared of 'Smoke Without Spillage After Opening (moments later)

Figure 5



Tracer Gas Test Geometry (~14" viewing distance to top of 'Chamber; Simulated Rodent)

Figure 6

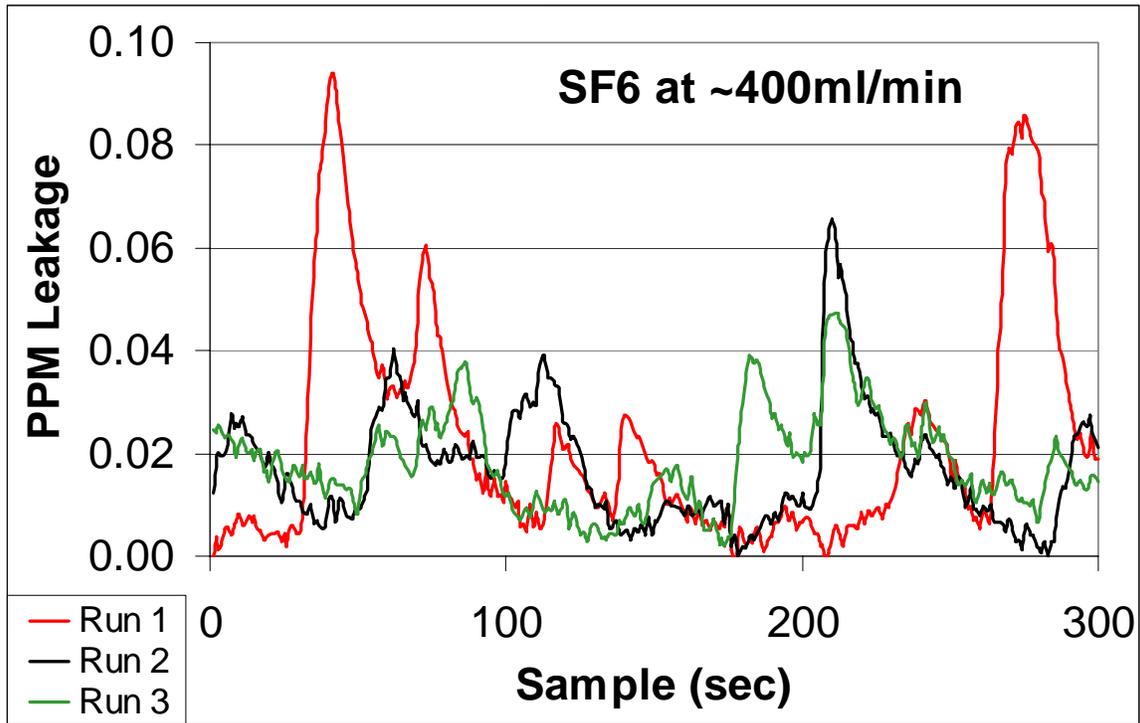
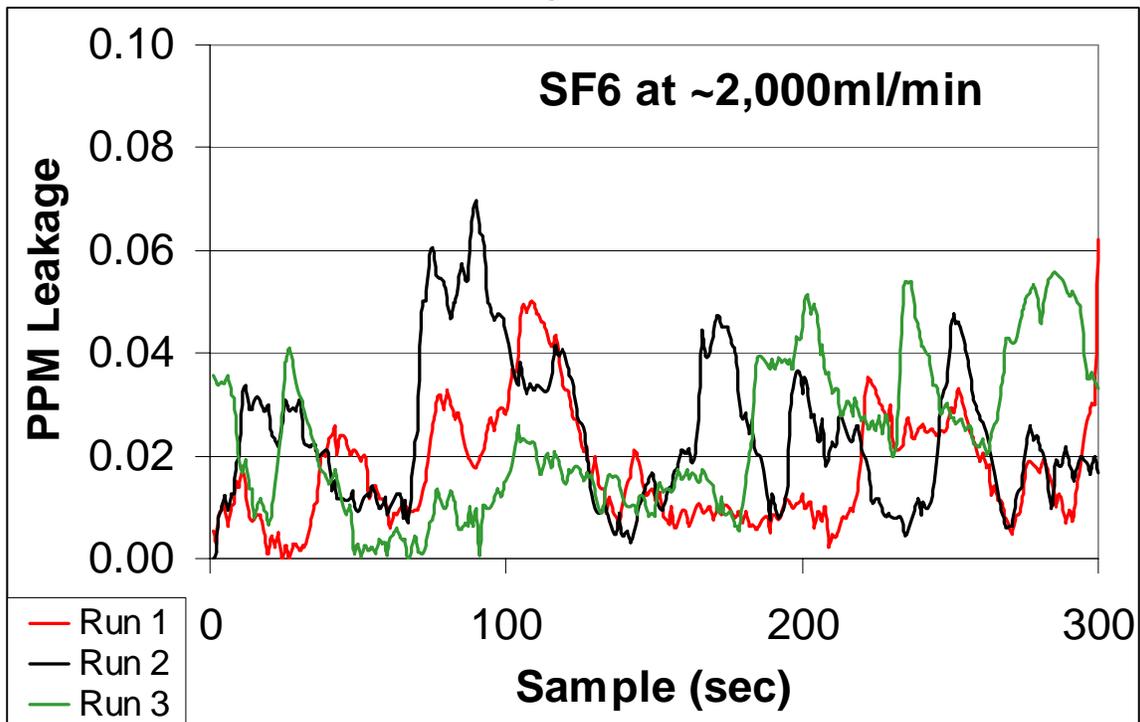


Figure 7



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:

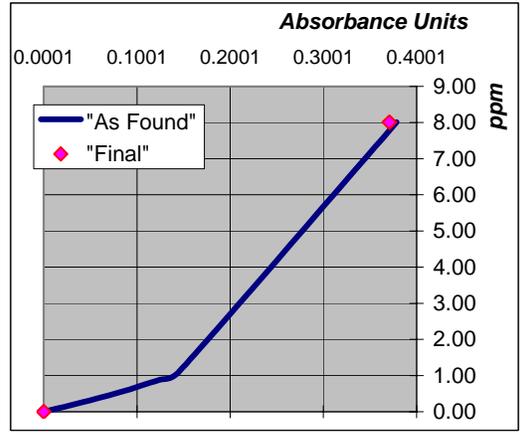
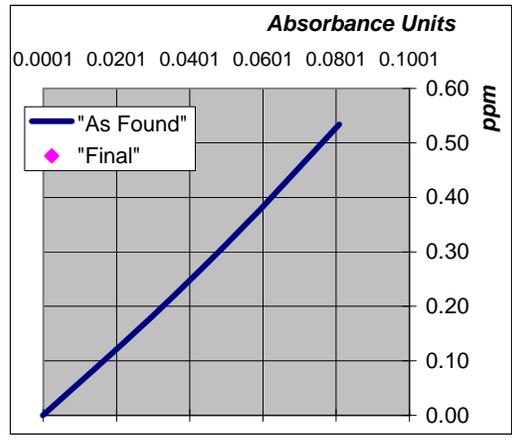
The following pages contain photocopies of documents pertinent to this report. Calibration certificates are archived at the main office of Technical Safety Services.

<u>Description</u>	<u>Pages</u>
Calibration Certificates	11-17

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	MJB
Loop volume	5.62 liters	Post-Cal. Date/Time	8/8/04 1700H

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

ul. inj	ul. tot.	ABS	SF6. ppm	PPM/ABS	d%
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-	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

Calibrated by  Final Function Check
 Calibration Date Mar 26, 2004

TSI Incorporated
 Environmental Measurements and Controls Division
 Mailing Address: P.O. Box 64394 St. Paul, MN 55164 USA
 Shipping Address: 500 Cardigan Road Shoreview, MN 55126 USA
 Phone: (800) 777-8356 or (651) 490-2711 Fax: (651) 490-2874

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

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	41.4	.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	✓	✓		✓	✓				

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: 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										
35.0	35.0	34.8	-.2										
95.0	95.0	94.9	-.1										
155.0	155.0	155.0	0										

APPROVED FOR CLIENT USE

NOTES:

JUN 09 2003

BY: J.P. FOR TSS, INC.
www.techsafety.com

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



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

APPROVED FOR CLIENT USE

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®

APPROVED FOR CLIENT USE

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.
www.techsafety.com