

## SOURCE TESTING AUDIT REPORT: CERTIFICATION FORM

**Facility:** Hollingsworth & Vose    **Permit #:** 02-2173-ST-01    **Test Date:** March 3, 2023

**Emission Unit:** Raw Materials Handling Building    **Sampling Location:** Building NDOs

### SECTION 1: TESTING PROGRAM CERTIFICATION INFORMATION

ITEM OF INQUIRY	Yes	No	EXPLANATION
A. Is the purpose(s) for the testing clearly defined within the test report?	X		
B. Did testing include all pollutants specified within the Source Test Plan (STP)?	X		
C. Were all issues within the Department's response to the STP fully addressed?	X		
D. Was the source operating within $\pm 10\%$ of normal maximum capacity?	X		
E. Are all appropriate operating conditions documented?	X		
F. Were there any test interruptions?	X		
G. Were there any variances or modifications to the STP? (if Yes; reply to i & ii)		X	
i. Were the variances or modifications approved by the Department?			
ii. Does the report include an evaluation of the impact the variances or modifications had on the test data?			

### SECTION 2: SOURCE SAMPLING REPORT AUDITOR CERTIFICATION:

I hereby certify that to the best of my knowledge, the information provided within this source sampling audit report is complete and factual.

Name: Jacob Rankin    Title: Helena Source Team Lead

Signature:     Date: April 3, 2023

### SECTION 3: PERMITTEE REPRESENTATIVE CERTIFICATION:

I hereby certify that to the best of my knowledge, the information provided within this source sampling audit report is complete and factual.

Name: Anita Ragan    Title: EHS Manager

Signature:     Date: April 3, 2023

### SECTION 4: DEPARTMENT REPRESENTATIVE:

The Oregon Department of Environmental Quality has evaluated the Source Sampling Audit Report and has determined that the information provided is sufficient for accepting the results originating from the testing program. Although no deficiencies were exposed by the Source Sampling Audit Report, additional errors and/or inconsistencies may be detected through additional Departmental review at a later date, which may lead to a retest or an enforcement action against the permittee.

Name: \_\_\_\_\_ Title: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

# EMISSIONS TEST REPORT

## HOLLINGSWORTH & VOSE FIBER COMPANY

### PERMANENT TOTAL ENCLOSURE VERIFICATION ON RAW MATERIALS HANDLING AREA

Oregon Department of Environmental Quality  
Air Contaminant Discharge Permit: 02-2173-ST-01

Prepared for:

**Hollingsworth & Vose Fiber Company**  
1115 SE Crystal Lake Drive  
Corvallis, OR 97333

Prepared by:

**Bison Engineering, Inc.**  
3143 E. Lyndale Avenue  
Helena, MT 59601  
(406) 442-5768  
[www.bison-eng.com](http://www.bison-eng.com)

Project Number: HAV223140  
Test Date: March 3, 2023  
Report Issued: April 3, 2023



## EXECUTIVE SUMMARY

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Hollingsworth & Vose Fiber Company contracted Bison Engineering, Inc. to conduct a permanent total enclosure (PTE) verification on the Raw Materials Handling building at the Hollingsworth & Vose facility in Corvallis, Oregon. PTE verification was performed on the Raw Materials Handling building to demonstrate that all suspended particulate in the raw material handling area is captured and conveyed to the raw material handling baghouse. This report presents test data, describes the methods employed and details the quality assurance measures taken to ensure accurate data. Table 1 summarizes the test results.

**Table 1** PTE Verification Results Summary

Parameter	Units	Test Result	Criteria	Criteria Status
NEAR	N/A	0.0003	$\leq 0.05$	Pass
Facial Velocity via differential pressure measurement approach	inH <sub>2</sub> O	All measurements were $< -0.007$	$\leq -0.007$	Pass
Distance to any NDO from each emission point	Equivalent opening diameters	$\geq 4$ EDs from each emission point to any NDO	$\geq 4$	Pass
Inward direction of air flow	N/A	Visual confirmation of inward direction of flow at each NDO*	Continuous inward direction	Pass

NEAR – natural draft opening to enclosure area ratio

NDO – natural draft opening

N/A – not applicable

inH<sub>2</sub>O – inches of water

ED – equivalent opening diameter

\* Documented photographically

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**CERTIFICATION FROM RESPONSIBLE OFFICIAL**

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I have reviewed the information being submitted in its entirety. Based on information and belief formed after reasonable inquiry, I certify that the statements and information contained in this submittal are true, accurate, and complete.



\_\_\_\_\_  
Signature

04/03/2023  
\_\_\_\_\_  
Date

Anita Ragan  
\_\_\_\_\_  
Name (printed)

EHS Manager  
\_\_\_\_\_  
Title

Hollingsworth & Vose  
\_\_\_\_\_  
Company

## REVIEW AND CERTIFICATION

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All work, calculations, other activities, and tasks performed and documented in this report were carried out under my direction and supervision. This test project conforms to the requirements of Bison Engineering, Inc.'s quality manual and American Society for Testing and Materials (ASTM) D7036-04.

Project Manager: Jacob Rankin, QSTI

Title: Helena Source Team Lead

Signature: *Jacob Rankin*

Date: 04/3/2023

I have reviewed all testing details, calculations, results, conclusions and other appropriate written material contained herein, and hereby certify that the presented material is authentic and accurate.

Reviewer: Lynn Dunnington

Title: Environmental Scientist/Reporting Lead

Signature: *Lynn Dunnington*

Date: 4/3/2023

## 1.0 INTRODUCTION

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### 1.1 Project Summary and Objectives

Hollingsworth & Vose Fiber Company (H&V) contracted Bison Engineering, Inc. (Bison) to perform permanent total enclosure (PTE) verification on the Raw Materials Handling building at the H&V facility in Corvallis, Oregon. Bison performed the PTE verification in accordance with the pre-test protocol dated November 13, 2022, that was submitted to the Oregon Department of Environmental Quality (ODEQ). Testing was performed pursuant to ODEQ Air Contaminant Discharge Permit #02-2173-ST-01. Bison employed U.S. Environmental Protection Agency (EPA) test methods as described in Title 40 Code of Federal Regulations, Part 60 (40 CFR 60), Appendix A. Bison followed EPA Method 204 for PTE verification to determine if the Raw Materials Handling building could be assumed to have 100 percent capture efficiency.

### 1.2 Project Contacts

**Facility:** **Hollingsworth & Vose Fiber Company**  
**Address:** 1115 SE Crystal Lake Drive  
Corvallis, OR 97333  
**Contact:** Anita Ragan  
**Phone:** (541) 738-5382  
**Email:** anita.ragan@hovo.com

**Consultant:** **Bison Engineering, Inc.**  
**Address:** 3143 E. Lyndale Avenue  
Helena, MT 59601  
**Contact:** Jacob Rankin  
**Phone:** (406) 442-5768  
**Email:** jrankin@bison-eng.com

**State Authority:** **Oregon Department of Environmental Quality**  
**Address:** 4026 Fairview Industrial Dr. SE  
Salem, OR 97302  
**Contact:** Julia DeGagné  
**Phone:** (503) 866-9643  
**Email:** julia.degagne@deq.oregon.gov

### **1.3 Testing Personnel**

The Bison on-site testing team was led by Jacob Rankin, Qualified Source Test Individual (QSTI), Helena Source Team Lead. Mr. Rankin was assisted during field testing by Adam Bender, Qualified Individual (QI), Environmental Scientist. Mr. Rankin served as project manager. Jennifer Kessler, QI, Environmental Scientist/Quality Manager, audited the test data and authored this report. Lynn Dunnington, Environmental Scientist/Reporting Lead, performed a final quality assurance review of the data and test report.

Anita Ragan, Environmental Health & Safety Manager, was the primary contact for H&V. Ms. Ragan was on-site during testing.



## **2.0 SOURCE DESCRIPTION**

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### **2.1 Facility Description**

H&V operates a glass fiber manufacturing facility in Corvallis, Oregon, consisting of two glass plants. The glass plants generally operate 24 hours per day throughout the year. H&V melts raw materials to produce molten glass in two electrically heated furnaces. The molten glass is used to produce glass fiber in four different size/manufacturing classifications: rotary fine, rotary coarse, ultra-rotary coarse, and flameblown. The emissions from all fiberizers and the glass furnaces are controlled by ceramic filtration units (CFUs).

### **2.2 Emission Source Description**

The Raw Materials Handling building is the point where raw materials enter the H&V glass plant. The raw materials are brought in by forklift to a hopper system with varying pipe arrays to mix different amounts and compositions of raw materials. The raw material blends that are mixed in the hopper system are then fed into the glass furnaces where the raw materials are melted.

The Raw Materials Handling building has five NDO locations: the north man door, northeast loading door, southeast loading door, second floor man door, and second floor loading door. The doorways generally remain closed during normal operation, but the loading doors will open for forklifts to bring in more raw material. The time that the loading doors are open is minimal and episodic. The man doors remained closed more than the loading doors and are only opened when the one or two operators of the Raw Materials Handling building take breaks throughout the day. Under these conditions the Raw Materials Handling building is considered a PTE and all particulate matter emissions are captured and controlled by the Raw Materials Handling baghouse.

A schematic of the Raw Materials Handling building is provided in an appendix to this report.

## 3.0 PTE VERIFICATION RESULTS

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### 3.1 Summary of Results

Bison followed EPA Method 204 to assess whether the Raw Materials Handling building meets the criteria for a PTE. The Raw Materials Handling building has five access points that are potential NDOs. All access points are typically closed during normal operations. Area measurements were taken for each potential NDO with the opening cracked approximately one inch wide to ensure the building would meet Method 204 criteria. The doors are typically closed during normal operations. Supporting data and photographic evidence of inward flow are included in the appendices to this report.

#### 3.1.1 NEAR

Bison field personnel calculated the total interior area of the Raw Materials Handling building to be 9,245 square feet (ft<sup>2</sup>). Using Method 204, Eq. 204-2 the NEAR was calculated for NDOs that were each open approximately one inch:

$$\begin{aligned}\text{Eq. 204-2} \quad \text{NEAR} &= \text{total area of all NDOs}/\text{total enclosure area} \\ \text{NEAR} &= 2.8 \text{ ft}^2/9,245 \text{ ft}^2 = 0.0003\end{aligned}$$

NEAR was calculated to be 0.0003, which is less than the limit of 0.05 for permanent total enclosures as stipulated by Method 204, Section 8.2. Table 2 presents the NDO dimensions with an opening of approximately one inch.

**Table 2** NDO Dimensions

<b>NDO #</b>	<b>NDO Description</b>	<b>Length (in)</b>	<b>Width (in)</b>	<b>Area (in<sup>2</sup>)</b>
1	North Man Door	84	1	84
2	NE Load In/Out Door	1	64	64
3	SE Load In/Out Door	1	107	107
4	Second Floor Man Door	79.5	1	79.5
5	Second Floor Load In/Out Door	1	68	68
<b>Total area of all NDOs (ft<sup>2</sup>)</b>				<b>2.8</b>

in – inches

in<sup>2</sup> – square inches**3.1.2 Equivalent Opening Diameters**

Method 204, Section 5.1 requires that any NDO be at least four equivalent opening diameters (ED) from each emitting point. Using the area measurements from Table 2, Bison calculated the ED from each NDO to the emitting point (hopper system). Table 3 presents the results of the measurements.

**Table 3** Equivalent Opening Diameters

<b>NDO #</b>	<b>NDO Description</b>	<b>ED</b>	<b>Distance to emitting point (in)</b>	<b># of Diameters</b>
1	North Man Door	1.98	245	124
2	NE Load In/Out Door	1.97	352	179
3	SE Load In/Out Door	1.98	453	229
4	Second Floor Man Door	1.98	205	104
5	Second Floor Load In/Out Door	1.97	284	144

Note: ED calculations assume each NDO is open approximately one inch.

**3.1.3 Facial Velocity and Inward Flow**

A Shortridge Instruments electronic micromanometer (serial number M22572) was used to measure differential pressure in lieu of calculating facial velocity. Each NDO was opened approximately one inch during pressure measurements. Bison conducted three rounds of

five measurements on each NDO. The five measurements were taken approximately one minute apart. After recording the five pressure measurements, the door was returned to the closed position, field personnel moved to the next location, opened the next NDO approximately one inch and performed five measurements on that NDO. This procedure was repeated until three rounds of five measurements were complete.

**Table 4** Differential Pressure Measurements

<b>NDO #</b>	<b>NDO Description</b>	<b>Units</b>	<b>Round 1 Average</b>	<b>Round 2 Average</b>	<b>Round 3 Average</b>	<b>Overall Average</b>
1	North Man Door	inH <sub>2</sub> O	-0.0093	-0.0103	-0.0146	-0.0114
2	NE Load In/Out Door	inH <sub>2</sub> O	-0.0120	-0.0127	-0.0100	-0.0116
3	SE Load In/Out Door	inH <sub>2</sub> O	-0.0164	-0.0163	-0.0108	-0.0145
4	Second Floor Man Door	inH <sub>2</sub> O	-0.0107	-0.0197	-0.0182	-0.0162
5	Second Floor Load In/Out Door	inH <sub>2</sub> O	-0.0116	-0.0109	-0.0131	-0.0119

Photographs of the inward flow direction are presented in an appendix to this report.

### **3.2 Operating Conditions**

H&V personnel ensured that the Raw Materials Handling building was operating under normal conditions during the PTE verification.

### **3.3 Field Observations**

Testing was performed as outlined in the test protocol. No adverse or unusual environmental conditions were noted that are known to have influenced the outcome of these tests.

## **4.0 EMISSION TEST METHODS AND PROCEDURES**

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### **4.1 Testing Methods and Procedures**

Bison testing personnel performed the following EPA methods as described in 40 CFR 60, Appendix A.

**EPA Reference Method 204, “Criteria for and Verification of a Permanent or Temporary Total Enclosure.”** The objective of Method 204 is to determine whether a permanent or temporary enclosure meets the criteria for being considered a total enclosure. If all the criteria are met, then the capture efficiency is assumed to be 100 percent.

### **4.2 Sample Handling and Analytical Procedures**

Sampling procedures are cited in the appropriate methods and there was no deviation from those methods. No physical samples requiring off-site processing were generated during this test campaign.

### **4.3 Audit Samples**

The stationary source audit program (SSAP) is effectively suspended as of March 2022 because there are currently no independent accredited audit sample providers (AASP).

## **APPENDIX A: AREA DRAWING AND TEST DATA**

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**BISON**

**ENGINEERING, INC.**

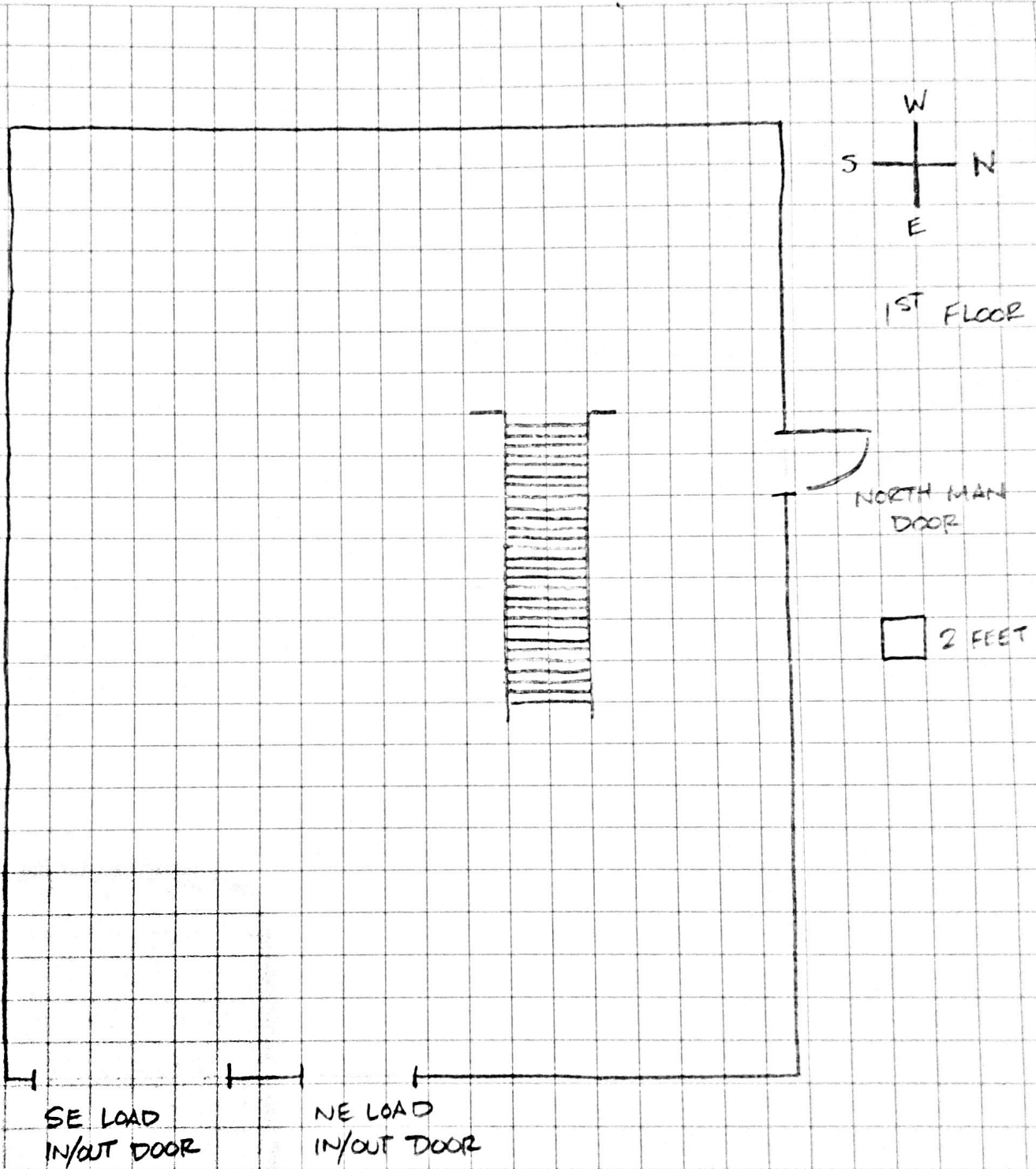
An Employee Owned Company

Prj. No.: HAV223140

Location: RAW MATERIALS AREA

By: JACOB RANKIN

Date: 3/31/23 Sheet: 1 of 2





**BISON**

**ENGINEERING, INC.**

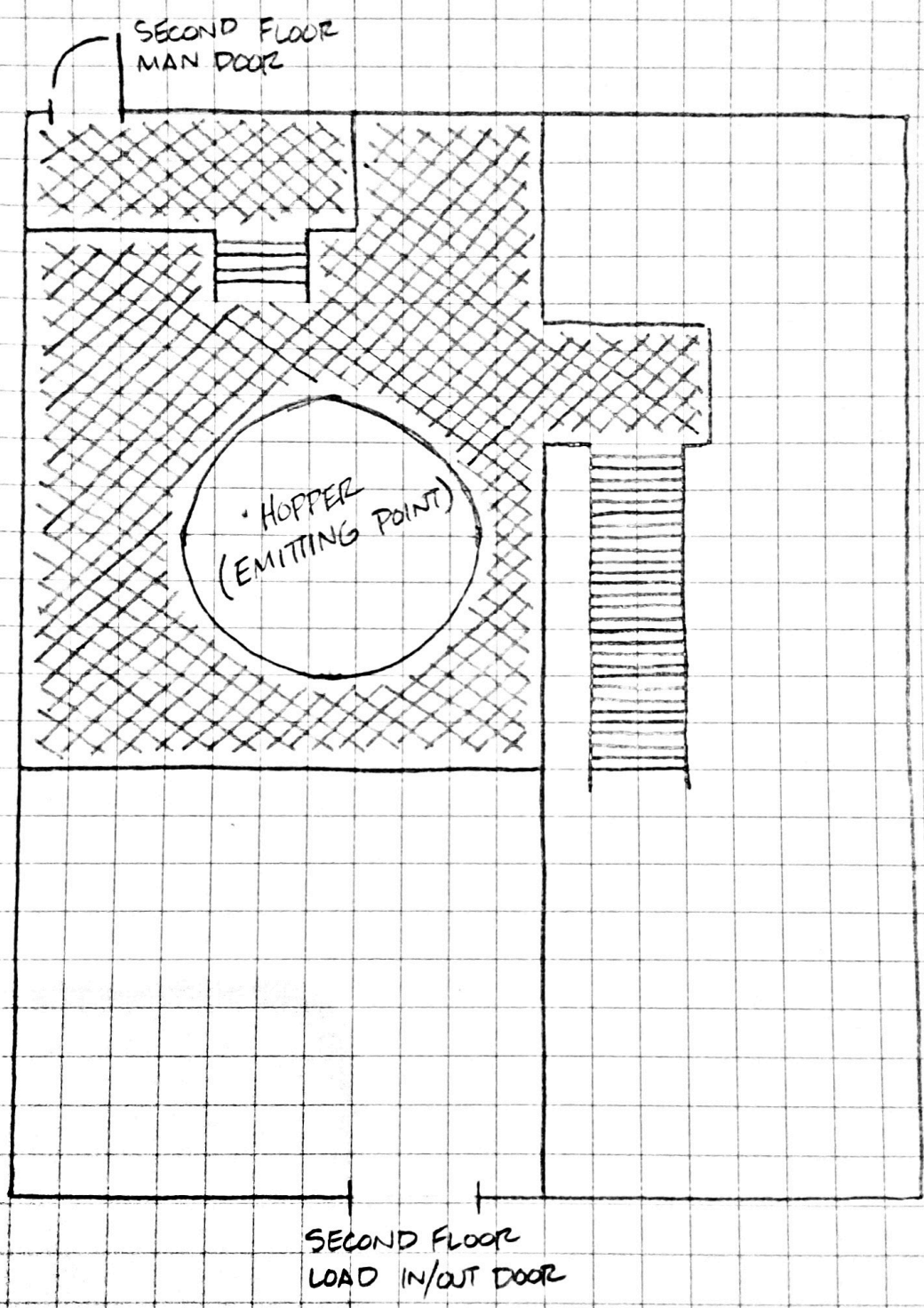
An Employee Owned Company

Prj. No.: HAV223140

Location: RAW MATERIALS AREA

By: JACOB RANKIN

Date: 3/31/23 Sheet: 2 of 2



2<sup>ND</sup> FLOOR

□ 2 FEET

▣ GRATING





<b>COMPANY</b>	Hollingsworth & Vose
<b>FACILITY</b>	Glass Plant 1
<b>LOCATION</b>	Corvallis, Oregon
<b>SOURCE</b>	Raw Materials Handling Building
<b>DATE</b>	03/03/23
<b>METHOD</b>	M204
<b>PARAMETER</b>	PTE Verification

**Bison Engineering, Inc.**  
**Method 204 Area Calculations**

**Enclosure Interior Dimensions**

Location Description		Length (ft)	Width (ft)	Area (ft <sup>2</sup> )
NE	Wall	35	37.4	1,310
SE	Wall	35	45.75	1,601
SW	Wall	35	37.4	1,310
NW	Wall	35	45.75	1,601
	Floor	37.4	45.75	1,712
	Ceiling	37.4	45.75	1,712
Total enclosure area:				9,245 ft <sup>2</sup>

Note: The ceiling is assumed to have the same surface area as the floor.

**NEAR Calculation**

$$\begin{aligned} \text{Total area of NDOs (A}_N\text{):} & \quad 2.8 \text{ ft}^2 \\ \text{Total enclosure area (A}_T\text{):} & \quad \frac{9,245 \text{ ft}^2}{0.0003} \leq 0.05 \quad \text{PASS} \end{aligned}$$

NEAR - NDO to enclosure area ratio

**NDO Dimensions**

NDO #	NDO Location Description	Length (in)	Width (in)	Area (in <sup>2</sup> )
1	North Man Door	84	1	84
2	NE Load In/Out Door	1	64	64
3	SE Load In/Out Door	1	107	107
4	Second Floor Man Door	79.5	1	79.5
5	Second Floor Load In/Out Door	1	68	68
Total area of all NDOs:				2.8 ft <sup>2</sup>

Note: If a doorway is a potential NDO, crack door open 1" and measure the opening.

Example: Door is 20" tall \* 1" wide opening = NDO area of 20 in<sup>2</sup>

Account for any gaps below or above. Example: Door has 0.25" gap between floor and is 36" wide = 0.25\*36

**Equivalent Diameter (ED)**

NDO #	NDO Location Description	ED (in)	Distance to collection point (in)	# of ED	
1	North Man Door	1.98	245	124	PASS
2	NE Load In/Out Door	1.97	352	179	PASS
3	SE Load In/Out Door	1.98	453	229	PASS
4	Second Floor Man Door	1.98	205	104	PASS
5	Second Floor Load In/Out Door	1.97	284	144	PASS

**Example Calculations:**

$$\begin{aligned} \text{NEAR} = A_N/A_T & = 0.0003 \\ \text{Where } A_N & \quad 2.8 \text{ ft}^2 \\ \text{Where } A_T & \quad 9245.2917 \text{ ft}^2 \end{aligned}$$

$$\begin{aligned} \text{ED} = (2 * \text{Length} * \text{Width}) / (\text{Length} + \text{Width}) & = 1.98 \text{ in} \\ \text{Where Length} & = 84 \text{ in} \\ \text{Where Width} & = 1 \text{ in} \\ \text{(North Man Door)} & \end{aligned}$$

**Bison Engineering, Inc.**  
**Method 204 Field Data**

**Client:** Hollingsworth & Vose  
**Source:** Raw Materials Handling Building  
**Location:** Corvallis, Oregon  
**Date:** 3/3/2023

NDO Description	North Man Door			NE Load In/Out Door			SE Load In/Out Door			Second Floor Man Door			
Time (mm:ss)	13:04	13:15	13:25	12:58	13:12	13:21	13:00	13:14	13:23	13:10	13:19	13:29	
Units	Inches of H <sub>2</sub> O			Inches of H <sub>2</sub> O			Inches of H <sub>2</sub> O			Inches of H <sub>2</sub> O			
Readings	#1	-0.0125	-0.0102	-0.0104	-0.0093	-0.0106	-0.0121	-0.0181	-0.0202	-0.0118	-0.0091	-0.0084	-0.0108
	#2	-0.0082	-0.0118	-0.0174	-0.0128	-0.0113	-0.0089	-0.0148	-0.0157	-0.0092	-0.0075	-0.0114	-0.0086
	#3	-0.0096	-0.0107	-0.0173	-0.0103	-0.0135	-0.0073	-0.0140	-0.0155	-0.0096	-0.0196	-0.0144	-0.0153
	#4	-0.0087	-0.0092	-0.0172	-0.0143	-0.0141	-0.0102	-0.0207	-0.0155	-0.0116	-0.0086	-0.0116	-0.0177
	#5	-0.0076	-0.0098	-0.0105	-0.0135	-0.0138	-0.0114	-0.0143	-0.0147	-0.0118	-0.0085	-0.0526	-0.0384
<b>Average</b>	<b>-0.0093</b>	<b>-0.0103</b>	<b>-0.0146</b>	<b>-0.0120</b>	<b>-0.0127</b>	<b>-0.0100</b>	<b>-0.0164</b>	<b>-0.0163</b>	<b>-0.0108</b>	<b>-0.0107</b>	<b>-0.0197</b>	<b>-0.0182</b>	
<b>Overall</b>		<b>-0.0114</b>			<b>-0.0116</b>			<b>-0.0145</b>			<b>-0.0162</b>		

NDO Description	Second Floor Load In/Out Door			
Time (mm:ss)	13:06	13:17	13:27	
Units	Inches of H <sub>2</sub> O			
Readings	#1	-0.0113	-0.0121	-0.0107
	#2	-0.0077	-0.0088	-0.0143
	#3	-0.0155	-0.0101	-0.0147
	#4	-0.0113	-0.0100	-0.0133
	#5	-0.0122	-0.0133	-0.0127
<b>Average</b>	<b>-0.0116</b>	<b>-0.0109</b>	<b>-0.0131</b>	
<b>Overall</b>		<b>-0.0119</b>		

Note: Yellow shading indicates values between -0.01 and -0.007 to alert testing personnel of values approaching (but not exceeding) the limit of -0.007.

## **APPENDIX B: INWARD FLOW DIRECTION PHOTOS**

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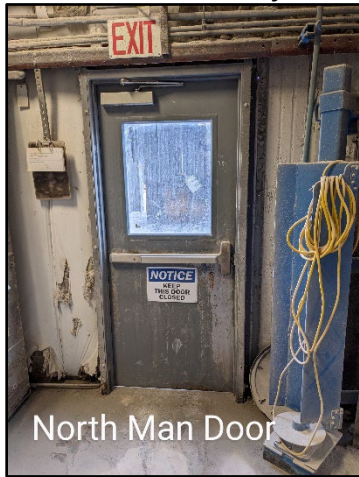
**Bison Engineering, Inc.**  
**EPA Method 204**  
**Documentation of Inward Flow Direction**

Client: Hollingsworth & Vose  
Location: Corvallis, Oregon  
Enclosure: Raw Materials Handling Building  
Date: 3/3/2023

The photographs below document inward flow direction at five NDOs

**1 - North Man Door**  
Outside Doorway

Inside Doorway

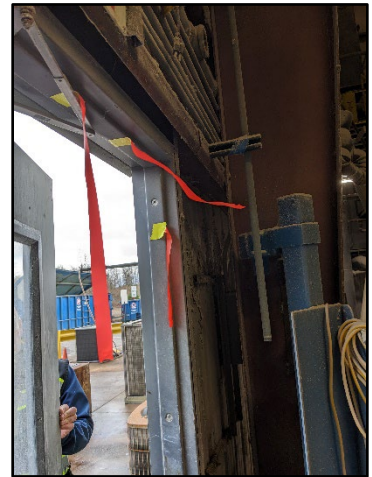


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3-3-2023 14:10

3-3-2023 13:52



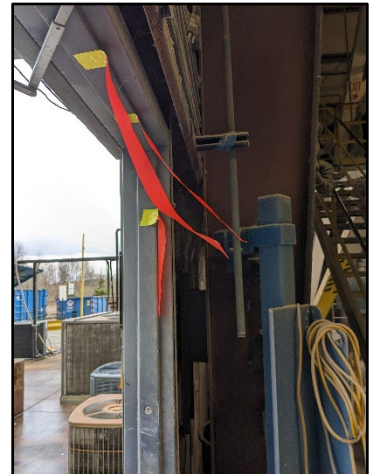
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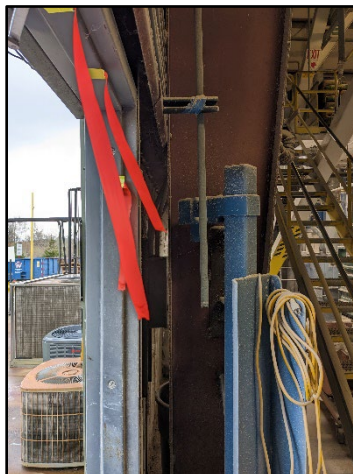
3-3-2023 14:31



3-3-2023 14:41



3-3-2023 14:50





## 2 - NE Load In/Out Door

Inside Doorway



3-3-2023 14:00

Outside Doorway

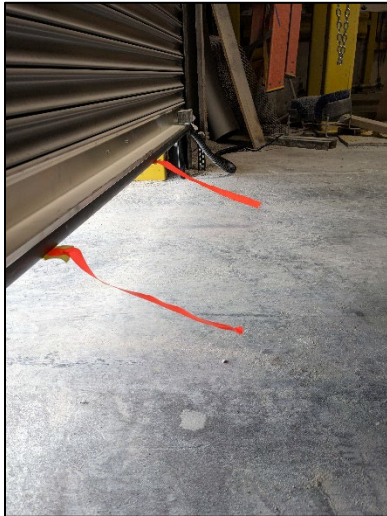


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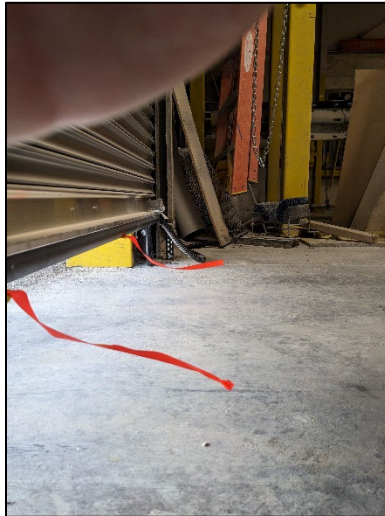
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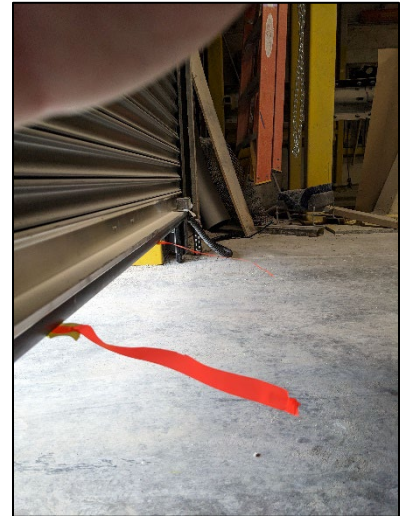
3-3-2023 14:20



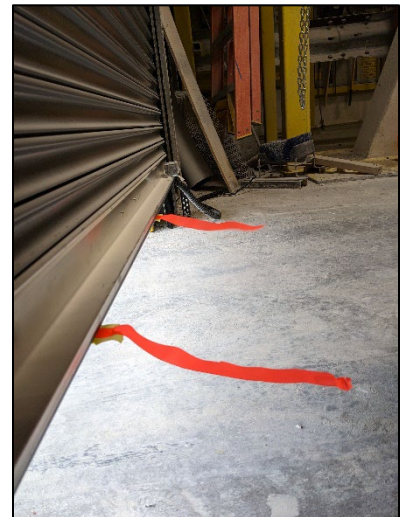
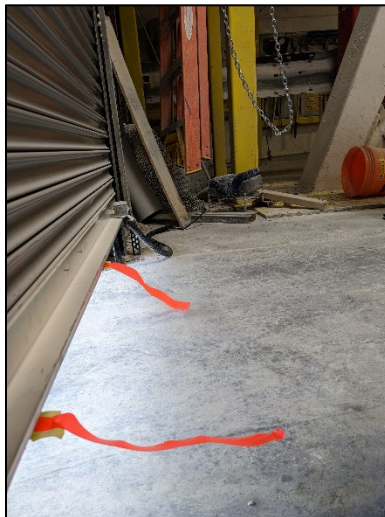
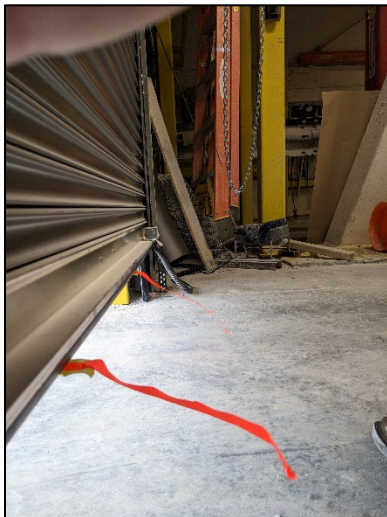
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3-3-2023 14:40



3-3-2023 14:50





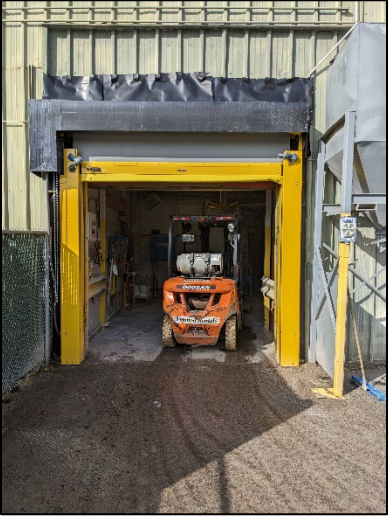
**3 - SE Load In/Out Door**

Inside Doorway



3-3-2023 14:00

Outside Doorway



3-3-2023 14:10

3-3-2023 13:50



3-3-2023 14:19



3-3-2023 14:30



3-3-2023 14:40



3-3-2023 14:50





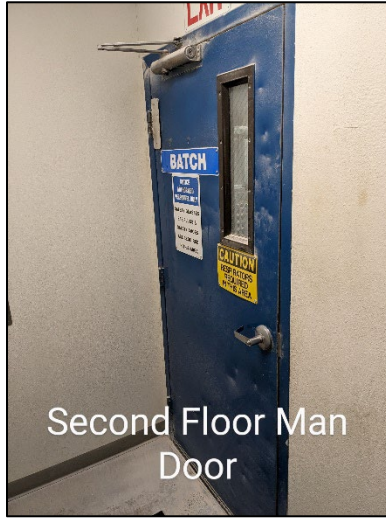
# 4 - Second Floor Man Door

Inside Doorway



3-3-2023 14:02

Outside Doorway



Second Floor Man Door

3-3-2023 14:11

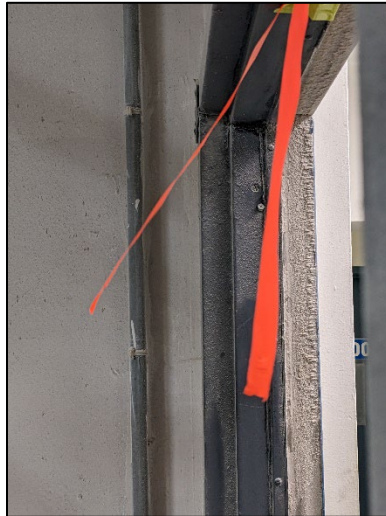
3-3-2023 13:55



3-3-2023 14:21



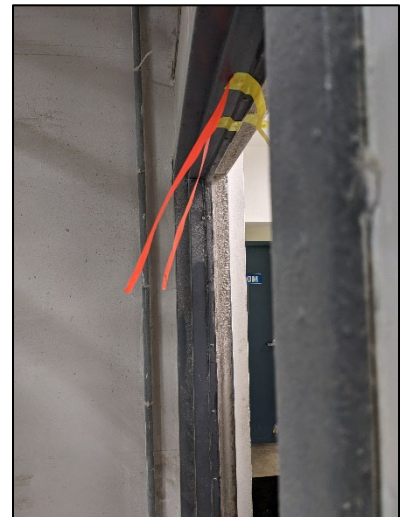
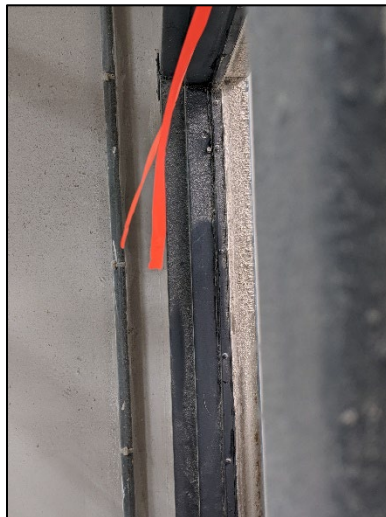
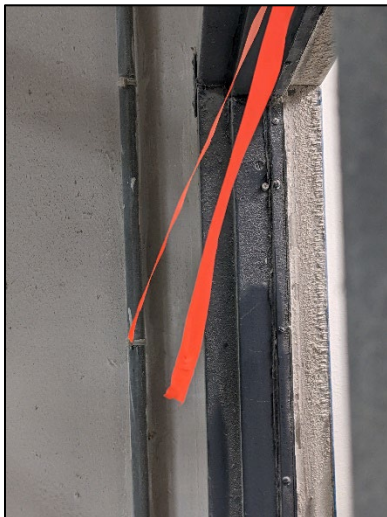
3-3-2023 14:32



3-3-2023 14:42



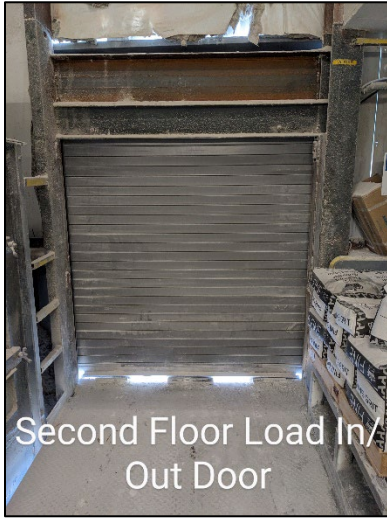
3-3-2023 14:52





## 5 - Second Floor Load In/Out Door

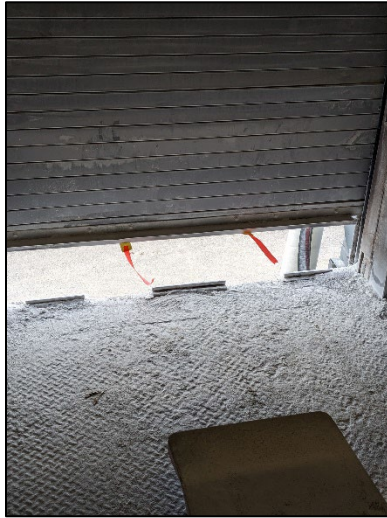
Inside Doorway



Second Floor Load In/  
Out Door

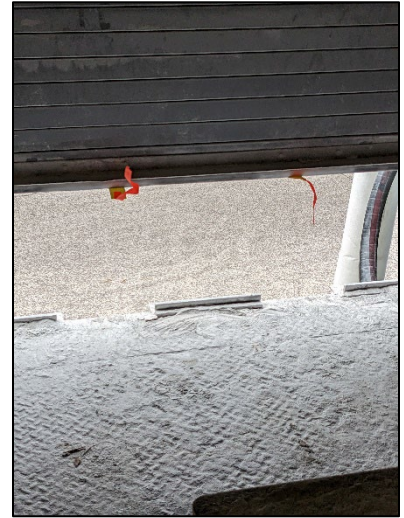
3-3-2023 14:11

3-3-2023 13:54



3-3-2023 14:21

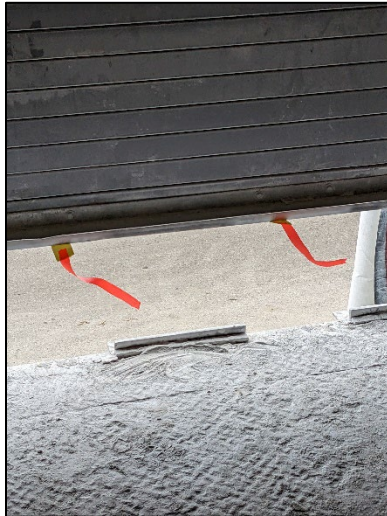
3-3-2023 14:02



3-3-2023 14:32



3-3-2023 14:41



3-3-2023 14:51



## **APPENDIX C: CALIBRATIONS AND CERTIFICATIONS**

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# *Accredited Air Emission Testing Body*

A2LA has accredited

## **BISON ENGINEERING, INC.**

In recognition of the successful completion of the joint A2LA and Stack Testing Accreditation Council (STAC) evaluation process, this laboratory is accredited to perform testing activities in compliance with ASTM D7036:2004 - Standard Practice for Competence of Air Emission Testing Bodies.

Presented this 27<sup>th</sup> day of January 2022 .



Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 4675.01  
Valid to November 30, 2023

*This accreditation program is not included under the A2LA ILAC Mutual Recognition Arrangement.*



# AIRDATA MULTIMETER CERTIFICATE OF CALIBRATION

Customer ID: 022037 S/N: M22572  
 Customer: BISON ENGINEERING, INC. City: HELENA State: MT  
 Model #: ADM-850L PO #: \_\_\_\_\_ Calibration Due Date: 02/2025 Order #: 230186

Rh 35 %

Ambient Temperature 71 °F

Barometric Pressure 28.56 in Hg

### ABSOLUTE PRESSURE TEST (in Hg) TEST METER TOLERANCE = ± 2.0 % ± .1 in Hg

Pressure Standard: Heise #02-R S/N: 41741/42451	_____	Pressure Standard: Heise #12A-R S/N: 45605/48491	_____
Pressure Standard: Heise #04-R S/N: 41743/42453	_____	Pressure Standard: Heise #14-R S/N: 43412/45043-2	_____
Pressure Standard: Heise #06-R S/N: 41742/42452-1	✓	Pressure Standard: Heise #16-R S/N: 43413/45044	_____
Pressure Standard: Heise #08-R S/N: 42186/43328	_____	Pressure Standard: Heise #18-R S/N: 44581/46845	_____
Pressure Standard: Heise #10-R S/N: 42203/43352	_____	Pressure Standard: Heise #20-R S/N: 44582/46847	_____

Approx Set Point	Standard	Test Meter	% Diff
14.0	14.00	13.9	-.71
28.4	28.56	28.7	.49
40.0	40.00	40.2	.50

### DIFFERENTIAL PRESSURE TEST (in wc) TEST METER TOLERANCE = ± 2.0 % ± 0.001 in wc

Pressure Standard: Heise #01-L S/N: 41739/42449	_____	Pressure Standard: Heise #11-L S/N: 43165/44551-1	_____
Pressure Standard: Heise #01-R S/N: 41739/42446	_____	Pressure Standard: Heise #11-R S/N: 43165/44730	_____
Pressure Standard: Heise #02-L S/N: 41741/42454	_____	Pressure Standard: Heise #12A-L S/N: 45605/48490-1	_____
Pressure Standard: Heise #03A-L S/N: 45570/48461	_____	Pressure Standard: Heise #13-L S/N: 43415/45041	_____
Pressure Standard: Heise #03A-R S/N: 45570/48460	_____	Pressure Standard: Heise #13-R S/N: 43415/45039	_____
Pressure Standard: Heise #04-L S/N: 41743/42456	_____	Pressure Standard: Heise #14-L S/N: 43412/45045	_____
Pressure Standard: Heise #05-L S/N: 41740/42450	✓	Pressure Standard: Heise #15-L S/N: 43416/45042	_____
Pressure Standard: Heise #05-R S/N: 41740/42447	✓	Pressure Standard: Heise #15-R S/N: 43416/45040-1	_____
Pressure Standard: Heise #06-L S/N: 41742/42455	✓	Pressure Standard: Heise #16-L S/N: 43413/45046	_____
Pressure Standard: Heise #07-L S/N: 42185/42186	_____	Pressure Standard: Heise #17-L S/N: 44579/46842	_____
Pressure Standard: Heise #07-R S/N: 42185/43326	_____	Pressure Standard: Heise #17-R S/N: 44579/46841	_____
Pressure Standard: Heise #08-L S/N: 42186/43329	_____	Pressure Standard: Heise #18-L S/N: 44581/46846	_____
Pressure Standard: Heise #09-L S/N: 42202/43351	_____	Pressure Standard: Heise #19-L S/N: 44580/46844	_____
Pressure Standard: Heise #09-R S/N: 42202/43350	_____	Pressure Standard: Heise #19-R S/N: 44580/46843	_____
Pressure Standard: Heise #10-L S/N: 42203/43353	_____	Pressure Standard: Heise #20-L S/N: 44582/46848	_____

Approx Set Point	Standard	Test Meter	% Diff
.0100	.0100	.0100	.00
.0500	.0515	.0514	-.19
.1250	.1254	.1254	.00
.2250	.2254	.2253	-.04
1.000	1.008	1.006	-.20
2.000	2.008	2.004	-.20
3.600	3.604	3.590	-.39
4.400	4.401	4.399	-.05
27.00	27.01	27.02	.04
50.00	50.05	49.85	-.40
Over Pressure	NA	✓	NA

## Shorridge Instruments, Inc.

7855 East Redfield Road Scottsdale, Arizona 85260  
 (480) 991-6744 • Fax (480) 443-1267 • www.shorridge.com

# AIRDATA MULTIMETER CERTIFICATE OF CALIBRATION

S/N: M22572

Order #: 230186

## LOW VELOCITY CONFIRMATION (FPM) TEST METER TOLERANCE = ± 3.0% ± 7 FPM

Vel Eqv Trans Std: S/N: M02009	Vel Eqv Trans Std: S/N: M10897
Vel Eqv Trans Std: S/N: M02903	Vel Eqv Trans Std: S/N: M10901
Vel Eqv Trans Std: S/N: M10839	Vel Eqv Trans Std: S/N: M13492
Vel Eqv Trans Std: S/N: M10840	Vel Eqv Trans Std: S/N: M19325

Approx Set Point	Standard	Test Meter	Diff
100	101	100	-1
500	514	514	0

ADM-880C, ADM-870C and ADM-860C AirData Multimeters are read in AirFoil Mode. ADM-850L AirData Multimeters are read in Pitot Tube Mode.

## TEMPERATURE TEST - AIRDATA MULTIMETER (° F) TEST METER TOLERANCE = ± 0.2° F

RTD Simulator: S/N 249	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 250	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 253	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 254	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 256	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 257	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 292	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 293	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 294	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 313	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 314	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 315	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 316	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 317	Set Point:	35.6° F	95° F	154.4° F
RTD Simulator: S/N 318	Set Point:	35.6° F	95° F	154.4° F

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

NOTES: \_\_\_\_\_

Procedure used: Procedure for Differential Pressure, Absolute Pressure and Temperature Calibration of AirData Multimeters SIP-CP01 Revision: 17  
Dated: 12/10/15. There were no additions to or deviations from the calibration procedure during this calibration process.

This instrument has been calibrated using Calibration Standards which are traceable to NIST (National Institute of Standards and Technology). Test accuracy ratio is 4:1 for pressures and temperature. Quality Assurance Program and calibration procedures meet the requirements for ANSI/NCSL Z540-1, ISO 17025, 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.

Limitations on use: See Shortridge Instruments, Inc. Instruction Manual for the use of AirData Multimeters

Any calibration due date shown is specified by the customer. The enclosed ADM Calibration Standards for Pressure and Temperature form is an integral part of this calibration and must remain with this Certificate of Calibration.

Calibration Technician(s): B. Lu Calibration Date: 02/24/2023

Calibration Approved by: m. Ramirez Title: Cal Mgr Date: 02/24/2023

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

# Shortridge Instruments, Inc. AirData Multimeter Calibration Equipment

Order Number: 230186    Serial Number: M22572    Test Type: Initial    As-Received    Final

### ABSOLUTE PRESSURE STANDARDS

Model	S/N	Heise Model	Mfgd by	Calibrated by	Calibration Date	Due Date
ADM #02-R	41741/42451	PPM-2	Dresser Industries	Ashcroft	04/28/22	06/2023
ADM #04-R	41743/42453	PPM-2	Dresser Industries	Ashcroft	11/19/21	02/2023
ADM #06-R	41742/42452-1	PPM-2	Dresser Industries	Ashcroft	09/01/22	09/2023
ADM #08-R	42186/43328	PPM-2	Dresser Industries	Ashcroft	03/26/22	05/2023
ADM #10-R	42203/43352	PPM-2	Dresser Industries	Ashcroft	03/07/22	04/2023
ADM #12A-R	45605/48491	PPM-2	Dresser Industries	Ashcroft	08/01/22	08/2023
ADM #14-R	43412/45043-2	PPM-2	Dresser Industries	Ashcroft	09/28/22	09/2023
ADM #16-R	43413/45044	PPM-2	Dresser Industries	Ashcroft	01/27/22	03/2023
ADM #18-R	44581/46845	PPM-2	Mfgd & Calibrated by Ashcroft, Inc.		10/26/21	11/2022
ADM #20-R	44582/46847	PPM-2	Mfgd & Calibrated by Ashcroft, Inc.		07/07/22	07/2023
#02-R, 04-R, 06-R, 08-R, 10-R, 12A-R, 14-R, 16-R, #18-R, 20-R			Rated Accuracy: 0.05% fs (0.0305 in Hg)	Range: 0-30 psia	Resolution: 0.01	Uncertainty: < 0.0358
			Rated Accuracy: 0.05% fs (0.0305 in Hg)	Range: 0-60 in Hg	Resolution: 0.001	Uncertainty: < 0.0358

### DIFFERENTIAL PRESSURE STANDARDS

Model	S/N	Heise Model	Mfgd by	Calibrated by	Calibration Date	Due Date
ADM #01-L	41739/42449	PPM-1	Dresser Industries	Ashcroft	04/28/22	06/2023
ADM #01-R	41739/42446	PPM-1	Dresser Industries	Ashcroft	04/29/22	06/2023
ADM #02-L	41741/42454	PPM-1	Dresser Industries	Ashcroft	04/28/22	06/2023
ADM #03A-L	45570/48461	PPM-1	Dresser Industries	Ashcroft	11/24/21	02/2023
ADM #03A-R	45570/48460	PPM-1	Dresser Industries	Ashcroft	11/24/21	02/2023
ADM #04-L	41743/42456	PPM-1	Dresser Industries	Ashcroft	11/23/21	02/2023
ADM #05-L	41740/42450	PPM-1	Dresser Industries	Ashcroft	09/01/22	09/2023
ADM #05-R	41740/42447	PPM-1	Dresser Industries	Ashcroft	09/01/22	09/2023
ADM #06-L	41742/42455	PPM-1	Dresser Industries	Ashcroft	09/01/22	09/2023
ADM #07-L	42185/42186	PPM-1	Dresser Industries	Ashcroft	03/29/22	05/2023
ADM #07-R	42185/43326	PPM-1	Dresser Industries	Ashcroft	03/29/22	05/2023
ADM #08-L	42186/43329	PPM-1	Dresser Industries	Ashcroft	03/28/22	05/2023
ADM #09-L	42202/43351	PPM-1	Dresser Industries	Ashcroft	03/07/22	04/2023
ADM #09-R	42202/43350	PPM-1	Dresser Industries	Ashcroft	03/07/22	04/2023
ADM #10-L	42203/43353	PPM-1	Dresser Industries	Ashcroft	03/07/22	04/2023
ADM #11-L	43165/44551-1	PPM-1	Dresser Industries	Ashcroft	08/04/22	08/2023
ADM #11-R	43165/44730	PPM-1	Dresser Industries	Ashcroft	08/04/22	08/2023
ADM #12A-L	45605/48490-1	PPM-1	Dresser Industries	Ashcroft	08/03/22	08/2023
ADM #13-L	43415/45041	PPM-1	Dresser Industries	Ashcroft	10/11/22	09/2023
ADM #13-R	43415/45039	PPM-1	Dresser Industries	Ashcroft	10/11/22	09/2023
ADM #14-L	43412/45045	PPM-1	Dresser Industries	Ashcroft	10/11/22	09/2023
ADM #15-L	43416/45042	PPM-1	Dresser Industries	Ashcroft	02/07/22	03/2023
ADM #15-R	43416/45040-1	PPM-1	Dresser Industries	Ashcroft	02/07/22	03/2023
ADM #16-L	43413/45046	PPM-1	Dresser Industries	Ashcroft	02/07/22	03/2023
ADM #17-L	44579/46842	PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		10/29/21	11/2022
ADM #17-R	44579/46841	PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		10/29/21	11/2022
ADM #18-L	44581/46846	PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		10/29/21	11/2022
ADM #19-L	44580/46844	PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		07/14/22	07/2023
ADM #19-R	44580/46843	PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		07/14/22	07/2023
ADM #20-L	44582/46848	PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		07/14/22	07/2023
#01-L, 03A-L, 05-L, 07-L, 09-L, 11-L, 13-L, 15-L, 17-L, 19-L			Rated Accuracy: > 0.07% fs (0.000175 in wc)	Range: 0.0-0.25 in wc	Res.: 0.00001	Uncertainty: < 0.00035
#01-R, 03A-R, 05-R, 07-R, 09-R, 11-R, 13-R, 15-R, 17-R, 19-R			Rated Accuracy: > 0.06% fs (0.003 in wc)	Range: 0.0-5.0 in wc	Res.: 0.0001	Uncertainty: < 0.00348
#02-L, 04-L, 06-L, 08-L, 10-L, 12A-L, 14-L, 16-L, 18-L, 20-L			Rated Accuracy: > 0.06% fs (0.03 in wc)	Range: 0.0-50.0 in wc	Res.: 0.001	Uncertainty: < 0.0346

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HAV223140

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# Shortridge Instruments, Inc. AirData Multimeter Calibration Equipment

Customer Order Number, Meter Serial Number, and Test Type are referenced on page 1

## LOW VELOCITY EQUIVALENT CONFIRMATION STANDARDS

Vel Eqv Transfer Standard S/N: M02009	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 08/16/22	Due Date: 08/2023
Vel Eqv Transfer Standard S/N: M02903	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/28/22	Due Date: 12/2023
Vel Eqv Transfer Standard S/N: M10839	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 10/26/22	Due Date: 10/2023
Vel Eqv Transfer Standard S/N: M10840	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 10/26/22	Due Date: 10/2023
Vel Eqv Transfer Standard S/N: M10897	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 01/25/23	Due Date: 01/2024
Vel Eqv Transfer Standard S/N: M10901	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, inc.	Calibration Date: 12/29/22	Due Date: 12/2023
Vel Eqv Transfer Standard S/N: M13492	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, inc.	Calibration Date: 08/16/22	Due Date: 08/2023
Vel Eqv Transfer Standard S/N: M19325	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 06/30/22	Due Date: 06/2023
Rated Accuracy: Velocity $\pm 1.5\% \pm 3.5$ fpm		Range: 100-5000 fpm    Resolution: 0.1	Uncertainty: <5.00 fpm at 100 fpm; <7.50 fpm at 500 fpm	

## TEMPERATURE STANDARDS

RTD Simulator S/N: 249	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/02/20	Due Date: 03/2024
RTD Simulator S/N: 250	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/02/20	Due Date: 03/2024
RTD Simulator S/N: 253	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/02/20	Due Date: 03/2024
RTD Simulator S/N: 254	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/04/20	Due Date: 04/2024
RTD Simulator S/N: 256	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/04/20	Due Date: 04/2024
RTD Simulator S/N: 257	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/04/20	Due Date: 04/2024
RTD Simulator S/N: 292	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 01/03/20	Due Date: 01/2024
RTD Simulator S/N: 293	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 01/03/20	Due Date: 01/2024
RTD Simulator S/N: 294	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 01/03/20	Due Date: 01/2024
RTD Simulator S/N: 313	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/25/22	Due Date: 03/2026
RTD Simulator S/N: 314	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/25/22	Due Date: 03/2026
RTD Simulator S/N: 315	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/25/22	Due Date: 03/2026
RTD Simulator S/N: 316	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 06/06/22	Due Date: 05/2026
RTD Simulator S/N: 317	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/23/22	Due Date: 05/2026
RTD Simulator S/N: 318	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/23/22	Due Date: 05/2026
Rated Accuracy: 0.025% of setting		Range: 100.00 $\Omega$ to 11111.10 $\Omega$	Resolution: 0.01 $\Omega$	Uncertainty: $\leq 32$ ppm	

Thermometer #1 S/N 8A089/Thermistor S/N A410660	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 02/24/22	Due Date: 02/2024
Thermometer #2 S/N 8B104/Thermistor S/N 871507	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 12/07/22	Due Date: 11/2024
Thermometer #5 S/N B11780/Thermistor S/N B10505	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 05/16/22	Due Date: 05/2024
Thermometer #6 S/N B11782/Thermistor S/N B10509	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 06/09/22	Due Date: 06/2024
Thermometer #7 S/N B49938/Thermistor S/N B482202	Model 1504/5610	Mfgd and Calibrated by Fluke		Calibration Date: 10/13/21	Due Date: 10/2023
Rated Accuracy(combined): 0.0324° F		Range: 32° F to 176° F	Resolution: 0.001° F	Combined Uncertainty with Baths: $\leq 0.040$ ° F	

Temp Transfer Standard S/N M00136	Model ADM-870	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 10/26/22	Due Date: 10/2023
Temp Transfer Standard S/N M96100	Model ADM-870	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 03/15/22	Due Date: 03/2023
Rated Accuracy: 0.03° F		Range: 33° F to 158° F	Resolution: 0.01° F	Uncertainty: < 0.023° F
Total combined Uncertainty for MultiTemp and TemProbe testing : $\leq 0.046$ ° F				

This form must remain with the Certificate of Calibration corresponding to the Customer Order Number and Meter Serial Number referenced on page 1.

**Shortridge Instruments, Inc.**

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TEMPROBES CALIBRATION TEST REPORT

Customer ID: 022037 Multimeter Serial Number: M22572  
 Customer: BISON ENGINEERING, INC. City: HELENA State: MT Order #: 230186  
 Test By: B. Lu Date: 02/15/2023 Calibration Due Date: 02/2025  
 Rh: 26 % Ambient Temperature: 71 ° F Barometric Pressure 28.44 in Hg

TEMPERATURE TEST (° F) TEMPROBE TOLERANCE = ± 0.3° F  
 TEMPROBE MODEL NUMBER: ADT442 TEMPROBE ID#: TP-M22572

Test(s) with Customer's Meter  Test(s) with In-house Temperature Calibration Standard  All Within Specification Yes  No

Temperature Standard Thermometer #1 S/N 8A089 / Thermistor S/N A410660	Set Point: <u>35° F</u> 95° F 155° F
Temperature Standard Thermometer #2 S/N 8B104 / Thermistor S/N 871507	Set Point: 35° F 95° F 155° F
Temperature Standard Thermometer #5 S/N B11780 / Thermistor S/N B10505	Set Point: 35° F 95° F <u>155° F</u>
Temperature Standard Thermometer #6 S/N B11782 / Thermistor S/N B10509	Set Point: 35° F 95° F 155° F
Temperature Standard Thermometer #7 S/N B49938 / Thermistor S/N B482202	Set Point: 35° F <u>95° F</u> 155° F
Temperature Standard AirData Multimeter S/N M00136	Set Point: 35° F 95° F 155° F
Temperature Standard AirData Multimeter S/N M96100	Set Point: <u>35° F</u> <u>95° F</u> <u>155° F</u>

Approx Set Point	Uncertainty ° F	Thermometer/Thermistor ° F	TempProbe ° F	Offset ° F
35 ° F	0.00324	<u>35.0</u>	<u>35.0</u>	<u>.0</u>
95 ° F	0.00324	<u>95.0</u>	<u>94.9</u>	<u>-.1</u>
155 ° F	0.00324	<u>155.0</u>	<u>155.1</u>	<u>.1</u>

TEMPERATURE TEST (° F) TEMPROBE TOLERANCE = ± 0.3° F  
 TEMPROBE MODEL NUMBER: ADT446 TEMPROBE ID#: TP-M22572

Test(s) with Customer's Meter  Test(s) with In-house Temperature Calibration Standard  All Within Specification Yes  No

Temperature Standard Thermometer #1 S/N 8A089 / Thermistor S/N A410660	Set Point: <u>35° F</u> 95° F 155° F
Temperature Standard Thermometer #2 S/N 8B104 / Thermistor S/N 871507	Set Point: 35° F 95° F 155° F
Temperature Standard Thermometer #5 S/N B11780 / Thermistor S/N B10505	Set Point: 35° F 95° F <u>155° F</u>
Temperature Standard Thermometer #6 S/N B11782 / Thermistor S/N B10509	Set Point: 35° F 95° F 155° F
Temperature Standard Thermometer #7 S/N B49938 / Thermistor S/N B482202	Set Point: 35° F <u>95° F</u> 155° F
Temperature Standard AirData Multimeter S/N M00136	Set Point: 35° F 95° F 155° F
Temperature Standard AirData Multimeter S/N M96100	Set Point: <u>35° F</u> <u>95° F</u> <u>155° F</u>

Approx Set Point	Uncertainty ° F	Thermometer/Thermistor ° F	TempProbe ° F	Offset ° F
35 ° F	0.00324	<u>35.0</u>	<u>35.0</u>	<u>.0</u>
95 ° F	0.00324	<u>95.0</u>	<u>95.0</u>	<u>.0</u>
155 ° F	0.00324	<u>155.0</u>	<u>155.1</u>	<u>.1</u>

Procedure used: Procedure for Calibration/Recalibration of MultiTemps and/or TempProbes SIP-CP14 Rev: 03 Dated: 07/31/14. There were no additions to or deviations from the calibration procedure during this calibration process.

Calibration standards used by Shortridge Instruments, Inc. are traceable to NIST (National Institute of Standards and Technology). Calibration is performed in accordance with ANSI/NCSL Z540-1, ISO 17025, MIL-STD 45662A and manufacturer's specifications. Calibration accuracy is certified when meters are used with properly functioning accessories only. This report shall not be reproduced, except in full, without the written approval of Shortridge Instruments, Inc. Results relate only to the item calibrated. Limitations on use: See Shortridge Instruments, Inc. Instruction Manual for the use of AirData Multimeters.

The enclosed ADM or HDM Calibration Standards form(s) is/are an integral part of this calibration and must remain with this Certificate of Calibration. Any calibration due date shown is specified by the customer.

Calibration Approved by: m. Ramirez Title: Cal Mgr. Date: 02/24/2023

Shortridge Instruments, Inc.

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# Shortridge Instruments, Inc. AirData Multimeter Calibration Equipment

Order Number: 230186    Serial Number: TP-M22572    Test Type: Initial    As-Received    Final

### ABSOLUTE PRESSURE STANDARDS

ADM #02-R	S/N: 41741/42451	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 04/28/22	Due Date: 06/2023
ADM #04-R	S/N: 41743/42453	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/19/21	Due Date: 02/2023
ADM #06-R	S/N: 41742/42452-1	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/01/22	Due Date: 09/2023
ADM #08-R	S/N: 42186/43328	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/26/22	Due Date: 05/2023
ADM #10-R	S/N: 42203/43352	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/07/22	Due Date: 04/2023
ADM #12A-R	S/N: 45605/48491	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/01/22	Due Date: 08/2023
ADM #14-R	S/N: 43412/45043-2	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/28/22	Due Date: 09/2023
ADM #16-R	S/N: 43413/45044	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 01/27/22	Due Date: 03/2023
ADM #18-R	S/N: 44581/46845	Heise Model: PPM-2	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 10/29/21	Due Date: 11/2022
ADM #20-R	S/N: 44582/46847	Heise Model: PPM-2	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 07/07/22	Due Date: 07/2023
#02-R, 04-R, 06-R, 08-R, 10-R, 12A-R, 14-R, 16-R	Rated Accuracy: 0.05% fs (0.0305 in Hg)		Range: 0-30 psia		Resolution: 0.01	Uncertainty: < 0.0358
#18-R, 20-R	Rated Accuracy: 0.05% fs (0.0305 in Hg)		Range: 0-60 in Hg		Resolution: 0.001	Uncertainty: < 0.0358

### DIFFERENTIAL PRESSURE STANDARDS

ADM #01-L	S/N: 41739/42449	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 04/28/22	Due Date: 06/2023
ADM #01-R	S/N: 41739/42446	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 04/29/22	Due Date: 06/2023
ADM #02-L	S/N: 41741/42454	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 04/28/22	Due Date: 06/2023
ADM #03A-L	S/N: 45570/48461	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/24/21	Due Date: 02/2023
ADM #03A-R	S/N: 45570/48460	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/24/21	Due Date: 02/2023
ADM #04-L	S/N: 41743/42456	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/23/21	Due Date: 02/2023
ADM #05-L	S/N: 41740/42450	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/01/22	Due Date: 09/2023
ADM #05-R	S/N: 41740/42447	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/01/22	Due Date: 09/2023
ADM #06-L	S/N: 41742/42455	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/01/22	Due Date: 09/2023
ADM #07-L	S/N: 42185/42186	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/29/22	Due Date: 05/2023
ADM #07-R	S/N: 42185/43326	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/29/22	Due Date: 05/2023
ADM #08-L	S/N: 42186/43329	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/28/22	Due Date: 05/2023
ADM #09-L	S/N: 42202/43351	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/07/22	Due Date: 04/2023
ADM #09-R	S/N: 42202/43350	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/07/22	Due Date: 04/2023
ADM #10-L	S/N: 42203/43353	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/07/22	Due Date: 04/2023
ADM #11-L	S/N: 43165/44551-1	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/04/22	Due Date: 08/2023
ADM #11-R	S/N: 43165/44730	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/04/22	Due Date: 08/2023
ADM #12A-L	S/N: 45605/48490-1	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/03/22	Due Date: 08/2023
ADM #13-L	S/N: 43415/45041	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 10/11/22	Due Date: 09/2023
ADM #13-R	S/N: 43415/45039	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 10/11/22	Due Date: 09/2023
ADM #14-L	S/N: 43412/45045	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 10/11/22	Due Date: 09/2023
ADM #15-L	S/N: 43416/45042	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 02/07/22	Due Date: 03/2023
ADM #15-R	S/N: 43416/45040-1	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 02/07/22	Due Date: 03/2023
ADM #16-L	S/N: 43413/45046	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 02/07/22	Due Date: 03/2023
ADM #17-L	S/N: 44579/46842	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 10/29/21	Due Date: 11/2022
ADM #17-R	S/N: 44579/46841	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 10/29/21	Due Date: 11/2022
ADM #18-L	S/N: 44581/46846	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 10/29/21	Due Date: 11/2022
ADM #19-L	S/N: 44580/46844	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 07/14/22	Due Date: 07/2023
ADM #19-R	S/N: 44580/46843	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 07/14/22	Due Date: 07/2023
ADM #20-L	S/N: 44582/46848	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 07/14/22	Due Date: 07/2023
#01-L, 03A-L, 05-L, 07-L, 09-L, 11-L, 13-L, 15-L, 17-L, 19-L	Rated Accuracy: > 0.07% fs (0.000175 in wc)		Range: 0.0-0.25 in wc		Res.: 0.00001	Uncertainty: < 0.00035
#01-R, 03A-R, 05-R, 07-R, 09-R, 11-R, 13-R, 15-R, 17-R, 19-R	Rated Accuracy: > 0.06% fs (0.003 in wc)		Range: 0.0-5.0 in wc		Res.: 0.0001	Uncertainty: < 0.00348
#02-L, 04-L, 06-L, 08-L, 10-L, 12A-L, 14-L, 16-L, 18-L, 20-L	Rated Accuracy: > 0.06% fs (0.03 in wc)		Range: 0.0-50.0 in wc		Res.: 0.001	Uncertainty: < 0.0346

## Shortridge Instruments, Inc.

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HAV223140

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# Shortridge Instruments, Inc. AirData Multimeter Calibration Equipment

Customer Order Number, Meter Serial Number, and Test Type are referenced on page 1

## LOW VELOCITY EQUIVALENT CONFIRMATION STANDARDS

Vel Eqv Transfer Standard S/N: M02009	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 08/16/22	Due Date: 08/2023
Vel Eqv Transfer Standard S/N: M02903	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/28/22	Due Date: 12/2023
Vel Eqv Transfer Standard S/N: M10839	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 10/26/22	Due Date: 10/2023
Vel Eqv Transfer Standard S/N: M10840	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 10/26/22	Due Date: 10/2023
Vel Eqv Transfer Standard S/N: M10897	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 01/25/23	Due Date: 01/2024
Vel Eqv Transfer Standard S/N: M10901	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/29/22	Due Date: 12/2023
Vel Eqv Transfer Standard S/N: M13492	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 08/16/22	Due Date: 08/2023
Vel Eqv Transfer Standard S/N: M19325	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 06/30/22	Due Date: 06/2023
Rated Accuracy: Velocity $\pm 1.5\% \pm 3.5$ fpm		Range: 100-5000 fpm    Resolution: 0.1	Uncertainty: <5.00 fpm at 100 fpm; <7.50 fpm at 500 fpm	

## TEMPERATURE STANDARDS

RTD Simulator S/N: 249	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/02/20	Due Date: 03/2024
RTD Simulator S/N: 250	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/02/20	Due Date: 03/2024
RTD Simulator S/N: 253	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/02/20	Due Date: 03/2024
RTD Simulator S/N: 254	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/04/20	Due Date: 04/2024
RTD Simulator S/N: 256	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/04/20	Due Date: 04/2024
RTD Simulator S/N: 257	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/04/20	Due Date: 04/2024
RTD Simulator S/N: 292	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 01/03/20	Due Date: 01/2024
RTD Simulator S/N: 293	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 01/03/20	Due Date: 01/2024
RTD Simulator S/N: 294	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 01/03/20	Due Date: 01/2024
RTD Simulator S/N: 313	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/25/22	Due Date: 03/2026
RTD Simulator S/N: 314	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/25/22	Due Date: 03/2026
RTD Simulator S/N: 315	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/25/22	Due Date: 03/2026
RTD Simulator S/N: 316	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 06/06/22	Due Date: 05/2026
RTD Simulator S/N: 317	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/23/22	Due Date: 05/2026
RTD Simulator S/N: 318	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 05/23/22	Due Date: 05/2026
Rated Accuracy: 0.025% of setting		Range: 100.00 $\Omega$ to 11111.10 $\Omega$	Resolution: 0.01 $\Omega$	Uncertainty: $\leq 32$ ppm	

Thermometer #1 S/N 8A089/Thermistor S/N A410660	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 02/24/22	Due Date: 02/2024
Thermometer #2 S/N 8B104/Thermistor S/N 871507	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 12/07/22	Due Date: 11/2024
Thermometer #5 S/N B11780/Thermistor S/N B10505	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 05/16/22	Due Date: 05/2024
Thermometer #6 S/N B11782/Thermistor S/N B10509	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 06/09/22	Due Date: 06/2024
Thermometer #7 S/N B49938/Thermistor S/N B482202	Model 1504/5610	Mfgd and Calibrated by Fluke		Calibration Date: 10/13/21	Due Date: 10/2023
Rated Accuracy(combined): 0.0324° F		Range: 32° F to 176° F	Resolution: 0.001° F	Combined Uncertainty with Baths: $\leq 0.040$ ° F	

Temp Transfer Standard S/N M00136	Model ADM-870	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 10/26/22	Due Date: 10/2023
Temp Transfer Standard S/N M96100	Model ADM-870	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 03/15/22	Due Date: 03/2023
Rated Accuracy: 0.03° F		Range: 33° F to 158° F	Resolution: 0.01° F	Uncertainty: < 0.023° F
Total combined Uncertainty for MultiTemp and TemProbe testing : $\leq 0.046$ ° F				

This form must remain with the Certificate of Calibration corresponding to the Customer Order Number and Meter Serial Number referenced on page 1.

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This is the last page of the report.