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Compliance Emissions Test Report

Knauf Insulation
EU-WBWALB East and
West Forming Stacks and
ML2ALB Forming/Curing Stack
Albion, Michigan
Project No. M241010
March 5 and 6, 2024

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ML2ALB Forming/Curing Stack and
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Albion, Michigan
March 5 and 6, 2024

Report Submittal Date
April 5, 2024

Project No. M241010

Corporate Headquarters
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Elmhurst, Illinois 60126
630-993-2100

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1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a compliance emissions test program for Knauf Insulation on March 5 and 6, 2024 on the EU-WBWALB East and West Forming Stacks and ML2ALB Forming/Curing Stack in Albion, Michigan. This report summarizes the results of the test program and test methods used.

The test locations, test dates, and test parameters are summarized below.

TEST INFORMATION		
Test Locations	**Test Dates**	**Test Parameters**
ML2ALB Forming/Curing Stack	3/5/2024	Total Particulate Matter (TPM), Ammonia (NH_3), and Visible Emissions (VE)
EU-WBWALB East and West Forming Stacks	3/6/2024	TPM, VE

The purpose of the test program was to demonstrate emissions during normal operating conditions. Selected results of the test program are summarized below. A complete summary of emission test results follows the narrative portion of this report.

TEST RESULTS					
Test Location	**Test Date**	**Source Condition**	**Test Parameter**	**Emission Limit**	**Emission Rate**
ML2ALB Forming/Curing Stack	3/5/2024	Normal	TPM	25.19 lb/hr	23.12 lb/hr
				5.59 lb/ton of glass pulled	See Knauf CBI letter
			NH_3	5.2 lb/ton of glass pulled	See Knauf CBI letter
			VE	20%	5.97%
EU-WBWALB Forming Stack East	3/6/2024	Normal	TPM	23.98 lb/hr *	11.37 lb/hr
				5.33 lb/ton of glass pulled *	See Knauf CBI letter
			VE	20% *	0.81%
EU-WBWALB Forming Stack West	3/6/2024	Normal	TPM	23.98 lb/hr *	4.05 lb/hr
				5.33 lb/ton of glass pulled *	See Knauf CBI letter
			VE	20% *	0.30%

*The Emission Limit for the EU-WBWALB are combined for the Forming Stack East and Forming Stack West

The identification of individuals associated with the test program is summarized below.

TEST PERSONNEL INFORMATION		
Location	**Address**	**Contact**
Test Coordinator	Knauf Insulation One Knauf Drive Shelbyville, Indiana 46176	Mr. Adam Estes (317) 421-4702 (phone) Adam.Estes@knaufinsulation.com
Test Facility	Knauf Insulation 1000 E. North Street Albion, Michigan 49224	
Testing Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Mr. Christopher S. Trezak Senior Project Manager (630) 993-2100 (phone) ctrezak@mp-mail.com

The test crew consisted of Messrs. A, Diaz, H. Hoeksema, H. Schell, J. Timms, J. Meyerhoff, S. McGough, and C. Trezak of Mostardi Platt.

2.0 TEST METHODOLOGY

Emission testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A, and 40 CFR, Part 51, Appendix M. Schematics of the test section diagrams and sampling trains used are included in Appendix A and B, respectively. Calculation examples and nomenclature are included in Appendix C and laboratory analysis data are found in Appendix D. Copies of analyzer print-outs and field data sheets for each test run are included in Appendix E and F, respectively.

The following methodologies were used during the test program:

Method 1 Traverse Point Determination

Test measurement points were selected in accordance with Method 1. The characteristics of the measurement location are summarized below.

TEST POINT INFORMATION						
Location	**Duct Diameter (Feet)**	**Area (Square Feet)**	**Upstream Diameters**	**Downstream Diameters**	**Test Parameter**	**Number of Sampling Points**
EU-WBWALB East Forming Stack	11.0	95.033	>0.5	>2.0	TPM	24
EU-WBWALB West Forming Stack	5.95	27.805	>0.5	>2.0	TPM	24
ML2ALB Forming/Curing Stack	7.41667	43.202	>0.5	>2.0	TPM, NH_3	24

Method 2 Volumetric Flowrate Determination

Gas velocity was measured following Method 2, for purposes of calculating stack gas volumetric flow rate at all test locations. S-type pitot tubes, differential pressure gauges, thermocouples and temperature readouts were used to determine gas velocity at each sample point at each test location. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G.

Method 3A Oxygen (O_2)/Carbon Dioxide (CO_2) Determination

Stack gas molecular weight was determined in accordance with Method 3A at all test locations. ECOM analyzers were used to determine stack gas oxygen and carbon dioxide content and, by difference, nitrogen content. All of the equipment used was calibrated in accordance with the specifications of the Method and calibration data are included in Appendix G. Copies of the gas cylinder certifications are included in Appendix H.

Method 5 Particulate Determination

Stack gas particulate concentrations and emission rates were determined in accordance with Method 5 at all test locations. An Environmental Supply Company, Inc. sampling train was used to sample stack gas at an isokinetic rate, as specified in the Method. Particulate matter in the sample probe was recovered using an acetone rinse. The probe wash and filter catch were analyzed by Mostardi Platt in accordance with the Method in the Elmhurst, Illinois laboratory. Laboratory data are found in Appendix D. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G.

Method 202 Condensable Particulate Determination

Stack gas condensable particulate matter concentrations and emission rates were determined in accordance with USEPA Method 202, in conjunction with Method 5 filterable particulate sampling at all test locations. This method applies to the determination of condensable particulate matter (CPM) emissions from stationary sources. It is intended to represent condensable matter as material that condenses after passing through a filter and as measured by this method.

The CPM was collected in the impinger portion of the Method 5 (Appendix A, 40CFR60) type sampling trains. The impinger contents were immediately purged after each run with nitrogen (N_2) to remove dissolved sulfur dioxide (SO_2) gases from the impinger contents. The impinger solution was then extracted with hexane. The organic and aqueous fractions were then taken to dryness and the residues weighed. The total of both fractions represents the CPM.

All sample recovery was performed at the test site by the test crew. Mostardi Platt personnel at the laboratory in Elmhurst, Illinois, performed all final particulate sample analyses. Laboratory data are found in Appendix D. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G.

Method 9 Visible Emission Determination

Visible emissions are determined in accordance with Method 9. The observers stood at a distance providing a clear view of the emissions with the sun oriented in the 140° sector to their back. As much as possible, the line of vision is approximately perpendicular to the plume direction.

Opacity observations are made at the point of greatest opacity in the portion of the plume where condensed water vapor is not present. Observations are made at 15-second intervals for the duration of the test run. Tests will be a minimum of 60 minutes and conducted simultaneously with the USEPA Method 5, 40CFR60, Appendix A particulate matter testing.

Visible emissions observations were conducted and recorded by Messrs. J. Meyerhoff and J. Timms who are certified visual emissions observers. Copies of the observers' certifications are presented in Appendix I.

CTM-027 Ammonia (NH_3) Determination

Ammonia concentrations were determined using USEPA Conditional Test Method (CTM) 027 at the ML2ALB Forming/Curing Stack test location. An integrated 24-point sample was extracted from the gas stream and passed through dilute (0.1 N) sulfuric acid. In the dilute acid, ammonia dissolves and forms ammonia ions. The ammonia ions were then analyzed by ion chromatography. The sample train consisted of a glass-lined probe followed by a heated filter, and four impingers. The first and second impingers contained the dilute sulfuric acid, the third impinger was empty, and the fourth impinger contained silica gel to absorb any remaining moisture. The sample train was leak checked prior to and after each test run. The samples were recovered by quantitatively transferring the contents of the first three impingers and deionized water rinses to Nalgene sample jars. The samples were labeled, and the level marked. The samples were analyzed by Mostardi Platt in the Elmhurst, Illinois laboratory. Sample analysis data are found in Appendix D. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G.

3.0 TEST RESULT SUMMARIES

Client: Knauf Insulation
Facility: Albion, Michigan
Test Location: ML2ALB Forming and Curing Stack
Test Method: 5/202

Source Condition	Normal	Normal	Normal	
Date	3/5/24	3/5/24	3/5/24	
Start Time	10:18	14:05	15:50	
End Time	12:48	15:20	17:03	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	130.9	128.9	129.5	129.8
Flue Gas Moisture, percent by volume	5.8%	5.5%	5.4%	5.6%
Average Flue Pressure, in. Hg	28.84	28.84	28.84	28.84
Gas Sample Volume, dscf	34.286	31.561	33.605	33.151
Average Gas Velocity, ft/sec	46.601	43.013	45.527	45.047
Gas Volumetric Flow Rate, acfm	120,796	111,497	118,011	116,768
Gas Volumetric Flow Rate, dscfm	98,038	91,081	96,424	95,181
Gas Volumetric Flow Rate, scfm	104,045	96,369	101,884	100,766
Average $\%CO_2$ by volume, dry basis	0.1	0.2	0.2	0.2
Average $\%O_2$ by volume, dry basis	20.8	21.0	21.1	21.0
Isokinetic Variance	100.9	100.0	100.5	100.5
Filterable Particulate Matter (Method 5)				
grams collected	0.02058	0.02130	0.02401	0.02196
grains/acf	0.008	0.009	0.009	0.008
grains/dscf	0.009	0.010	0.011	0.010
lb/hr	7.78	8.13	9.11	8.34
Condensable Particulate Matter (Method 202)				
grams collected	0.04759	0.03367	0.03556	0.03894
grains/acf	0.017	0.013	0.013	0.015
grains/dscf	0.021	0.017	0.016	0.018
lb/hr	18.00	12.85	13.50	14.78
Total Particulate Matter (5/202)				
grams collected	0.06817	0.05497	0.05957	0.06090
grains/acf	0.025	0.022	0.022	0.023
grains/dscf	0.031	0.027	0.027	0.028
lb/hr	25.78	20.98	22.61	23.12

Client: Knauf Insulation
Facility: Albion, Michigan
Test Location: ML2ALB Forming and Curing Stack
Test Method: CTM027

Source Condition	Normal	Normal	Normal	
Date	3/5/24	3/5/24	3/5/24	
Start Time	10:18	14:05	15:50	
End Time	12:48	15:20	17:03	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	131.5	129.8	129.8	130.4
Flue Gas Moisture, percent by volume	5.2%	5.0%	4.8%	5.0%
Average Flue Pressure, in. Hg	28.84	28.84	28.84	28.84
Gas Sample Volume, dscf	39.530	39.955	39.861	39.782
Average Gas Velocity, ft/sec	44.822	45.082	44.986	44.963
Gas Volumetric Flow Rate, acfm	116,185	116,859	116,610	116,551
Gas Volumetric Flow Rate, dscfm	94,795	95,837	95,759	95,464
Gas Volumetric Flow Rate, scfm	99,968	100,854	100,625	100,482
Average %CO_2 by volume, dry basis	0.1	0.2	0.2	0.2
Average %O_2 by volume, dry basis	20.8	21.0	21.1	21.0
Isokinetic Variance	100.6	100.6	100.4	100.5
Ammonia (NH3) Emissions				
ug of sample collected	38232	42090	44921	41748
ppm	48.20	52.50	56.17	52.29
mg/dscm	34.15	37.20	39.80	37.05
lb/hr	12.13	13.35	14.27	13.25

Client:	**Knauf Insulation**
Facility:	**Albion, Michigan**
Test Location:	**WBWALB Forming East**
Test Method:	**5/202**

Source Condition	Normal	Normal	Normal	
Date	3/6/24	3/6/24	3/6/24	
Start Time	10:36	12:23	14:27	
End Time	11:47	13:35	15:36	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	104.4	104.1	103.6	104.0
Flue Gas Moisture, percent by volume	6.2%	7.3%	6.7%	6.7%
Average Flue Pressure, in. Hg	28.90	28.90	28.90	28.90
Gas Sample Volume, dscf	39.01	37.404	38.689	38.368
Average Gas Velocity, ft/sec	12.549	12.045	12.441	12.345
Gas Volumetric Flow Rate, acfm	71,552	68,678	70,941	70,390
Gas Volumetric Flow Rate, dscfm	60,678	57,554	59,894	59,375
Gas Volumetric Flow Rate, scfm	64,663	62,098	64,196	63,652
Average $\%CO_2$ by volume, dry basis	0.4	0.3	0.4	0.4
Average $\%O_2$ by volume, dry basis	20.9	20.9	20.9	20.9
Isokinetic Variance	99.6	100.7	100.1	100.1
Filterable Particulate Matter (Method 5)				
grams collected	0.05869	0.05025	0.05057	0.05317
grains/acf	0.020	0.017	0.017	0.018
grains/dscf	0.023	0.021	0.020	0.021
lb/hr	12.07	10.23	10.35	10.88
Condensable Particulate Matter (Method 202)				
grams collected	0.00228	0.00183	0.00296	0.00236
grains/acf	0.001	0.001	0.001	0.001
grains/dscf	0.001	0.001	0.001	0.001
lb/hr	0.47	0.37	0.61	0.48
Total Particulate Matter (5/202)				
grams collected	0.06097	0.05208	0.05353	0.05553
grains/acf	0.021	0.018	0.018	0.019
grains/dscf	0.024	0.022	0.021	0.022
lb/hr	12.54	10.60	10.96	11.37

Client:	**Knauf Insulation**
Facility:	**Albion, Michigan**
Test Location:	**WBWALB Forming West**
Test Method:	**5/202**

Source Condition	Normal	Normal	Normal	
Date	3/6/24	3/6/24	3/6/24	
Start Time	10:36	12:23	14:27	
End Time	11:41	13:28	15:31	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	114.3	114.7	115.0	114.7
Flue Gas Moisture, percent by volume	8.4%	8.2%	7.6%	8.1%
Average Flue Pressure, in. Hg	28.89	28.89	28.89	28.89
Gas Sample Volume, dscf	47.191	46.153	44.471	45.938
Average Gas Velocity, ft/sec	21.073	20.611	20.125	20.603
Gas Volumetric Flow Rate, acfm	35,157	34,385	33,575	34,372
Gas Volumetric Flow Rate, dscfm	28,606	28,010	27,519	28,045
Gas Volumetric Flow Rate, scfm	31,213	30,508	29,771	30,497
Average $\%CO_2$ by volume, dry basis	0.4	0.5	0.4	0.4
Average $\%O_2$ by volume, dry basis	20.8	20.9	20.9	20.9
Isokinetic Variance	103.6	103.4	101.5	102.8
Filterable Particulate Matter (Method 5)				
grams collected	0.05287	0.04734	0.04263	0.04761
grains/acf	0.014	0.013	0.012	0.013
grains/dscf	0.017	0.016	0.015	0.016
lb/hr	4.24	3.80	3.49	3.84
Condensable Particulate Matter (Method 202)				
grams collected	0.00267	0.00246	0.00245	0.00253
grains/acf	0.001	0.001	0.001	0.001
grains/dscf	0.001	0.001	0.001	0.001
lb/hr	0.21	0.20	0.20	0.20
Total Particulate Matter (5/202)				
grams collected	0.05554	0.04980	0.04508	0.05014
grains/acf	0.015	0.014	0.013	0.014
grains/dscf	0.018	0.017	0.016	0.017
lb/hr	4.45	4.00	3.69	4.05

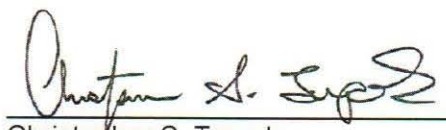
4.0 CERTIFICATION

MOSTARDI PLATT is pleased to have been of service to Knauf Insulation. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

CERTIFICATION

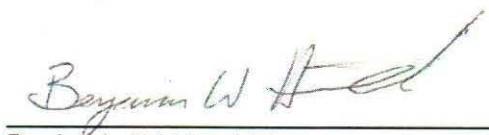
As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

MOSTARDI PLATT



Program Manager

Christopher S. Trezak



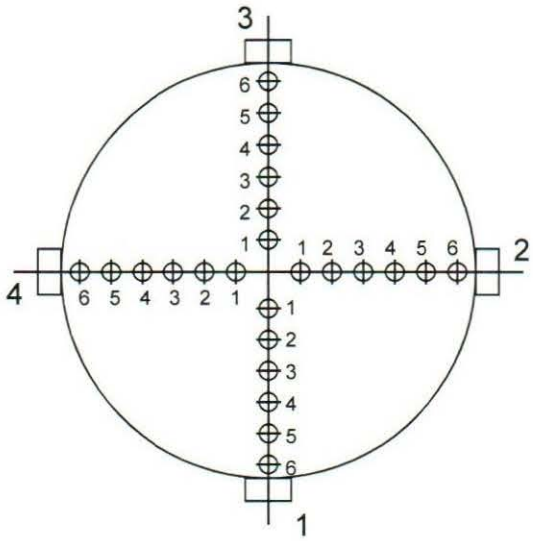
Quality Assurance

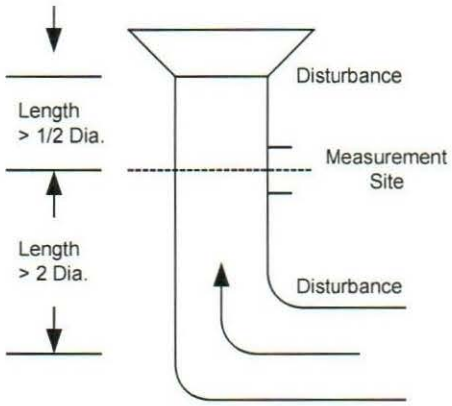
Benjamin W. Hendricks

APPENDICES

Appendix A - Test Section Diagrams

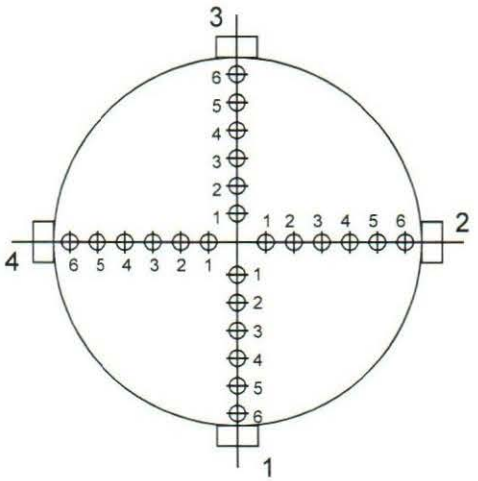
EQUAL AREA TRAVERSE FOR ROUND DUCTS

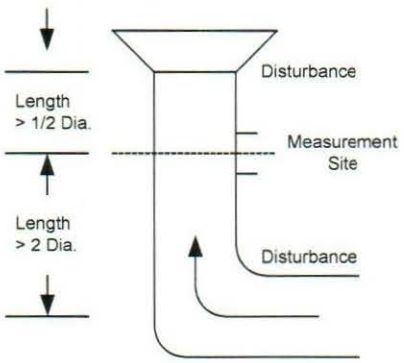




Job:	Knauf Insulation Albion, Michigan
Date:	March 5, 2024
Test Location:	ML2ALB Forming/Curing Stack
Stack Diameter:	7.41666 Feet
Stack Area:	43.202 Square Feet
No. Points Across Diameter:	12
No. of Ports:	4
Port Length:	6 Inches

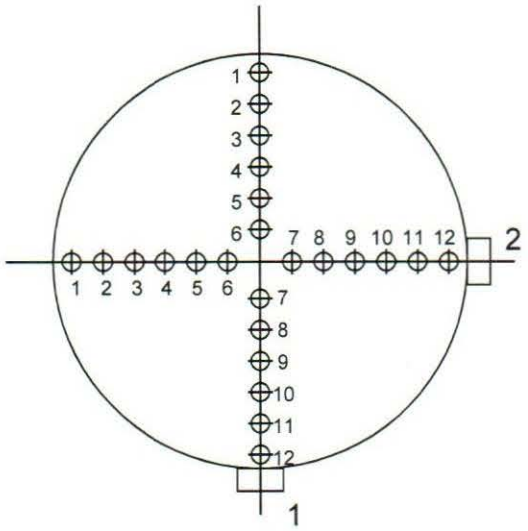
EQUAL AREA TRAVERSE FOR ROUND DUCTS

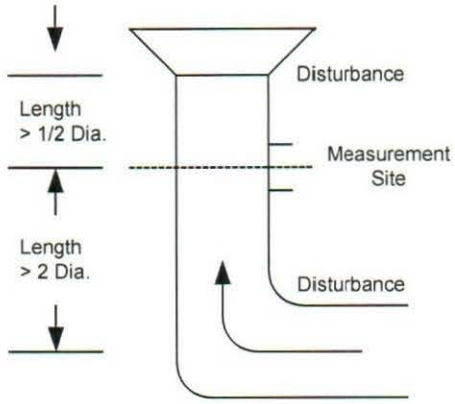




Job:	Knauf Insulation Albion Facility
Date:	March 6, 2024
Test Location:	EU-WBWALB Forming Stack East
Stack Diameter:	11.0 Feet
Stack Area:	95.033 Square Feet
No. Points Across Diameter:	12
No. of Ports:	4
Port Length:	6 inches

EQUAL AREA TRAVERSE FOR ROUND DUCTS

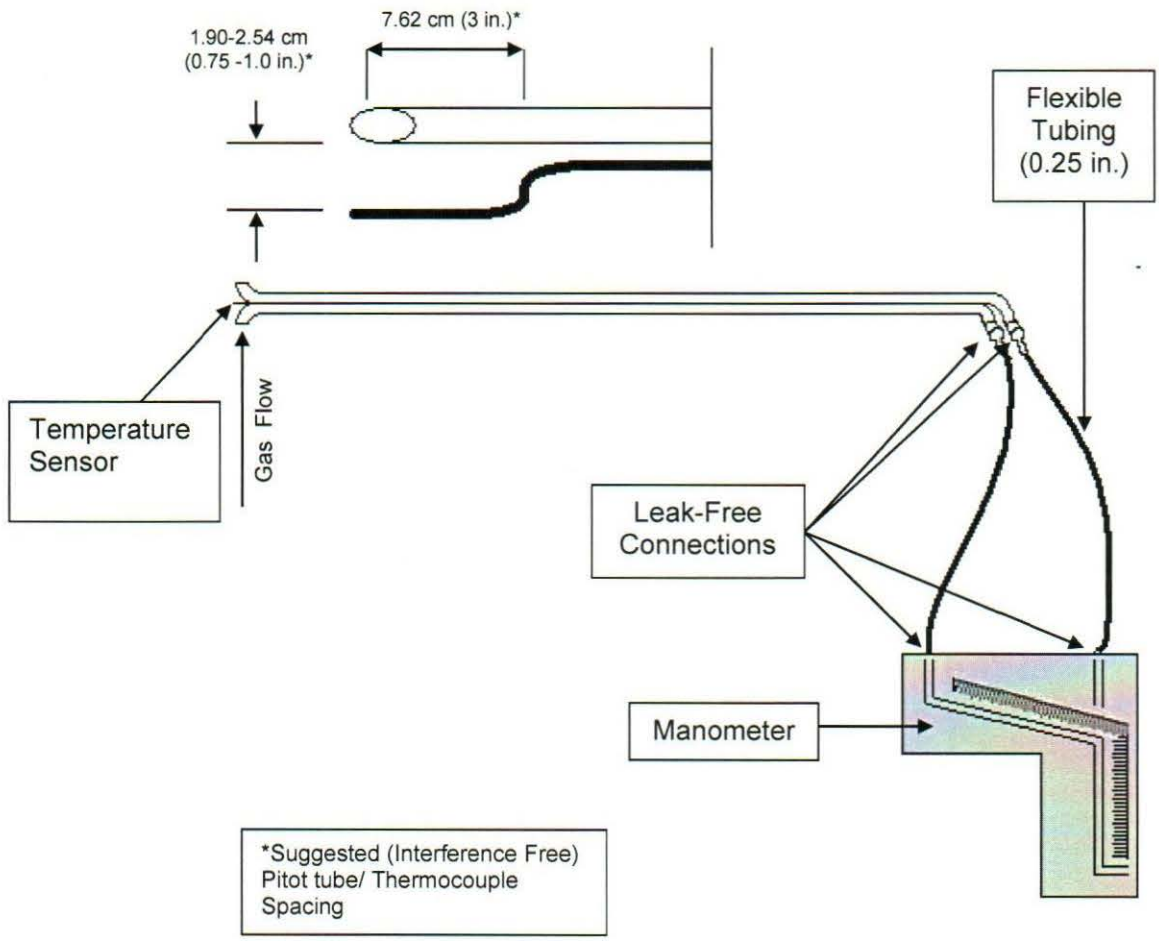




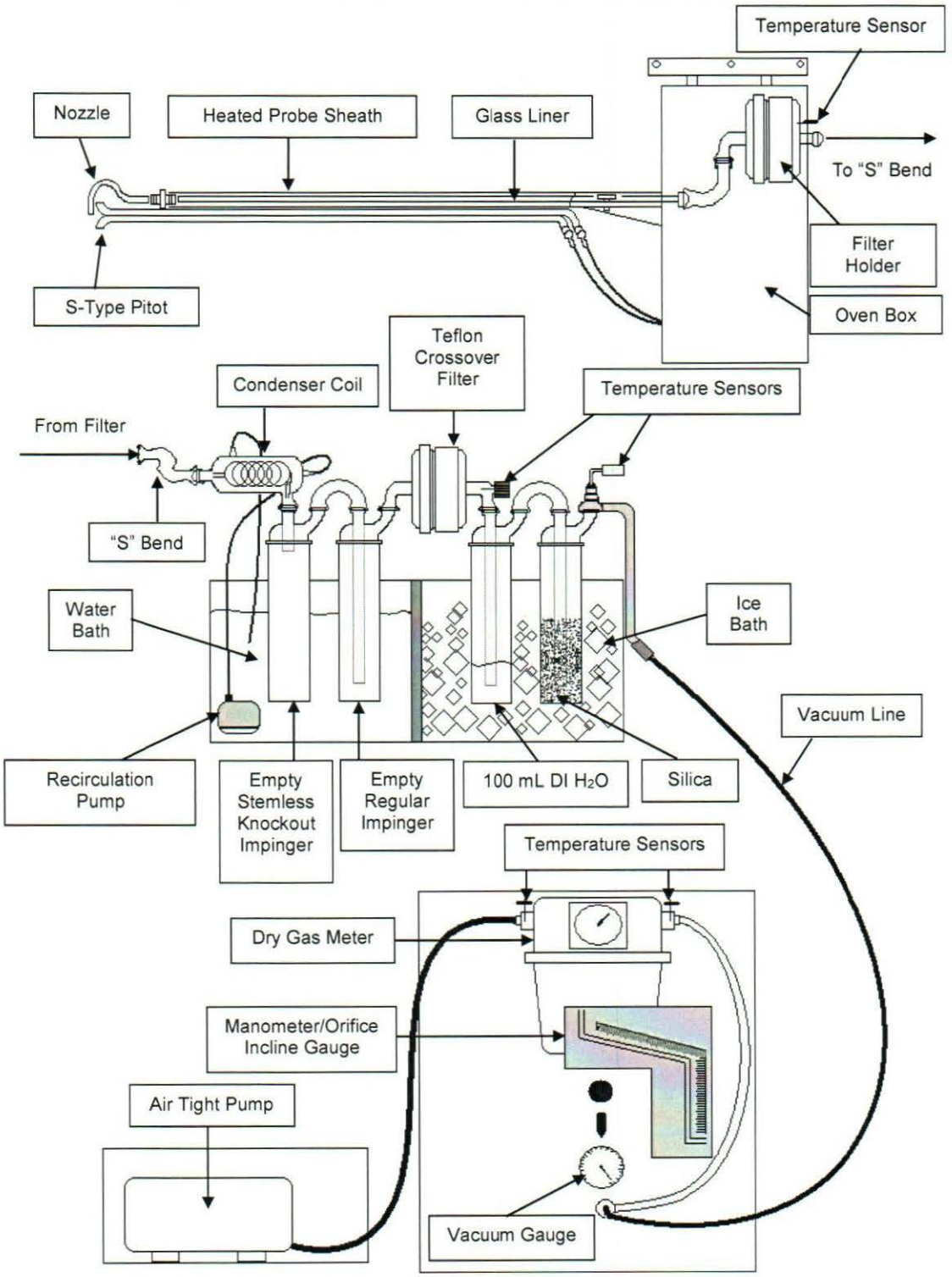
Job:	Knauf Insulation Albion, Michigan
Date:	March 6, 2024
Test Location:	EU-WBWALB Forming Stack West
Stack Diameter:	5.95 Feet
Stack Area:	27.805 Square Feet
No. Points Across Diameter:	12
No. of Ports:	2
Port Length:	6 inches

Appendix B - Sample Train Diagrams

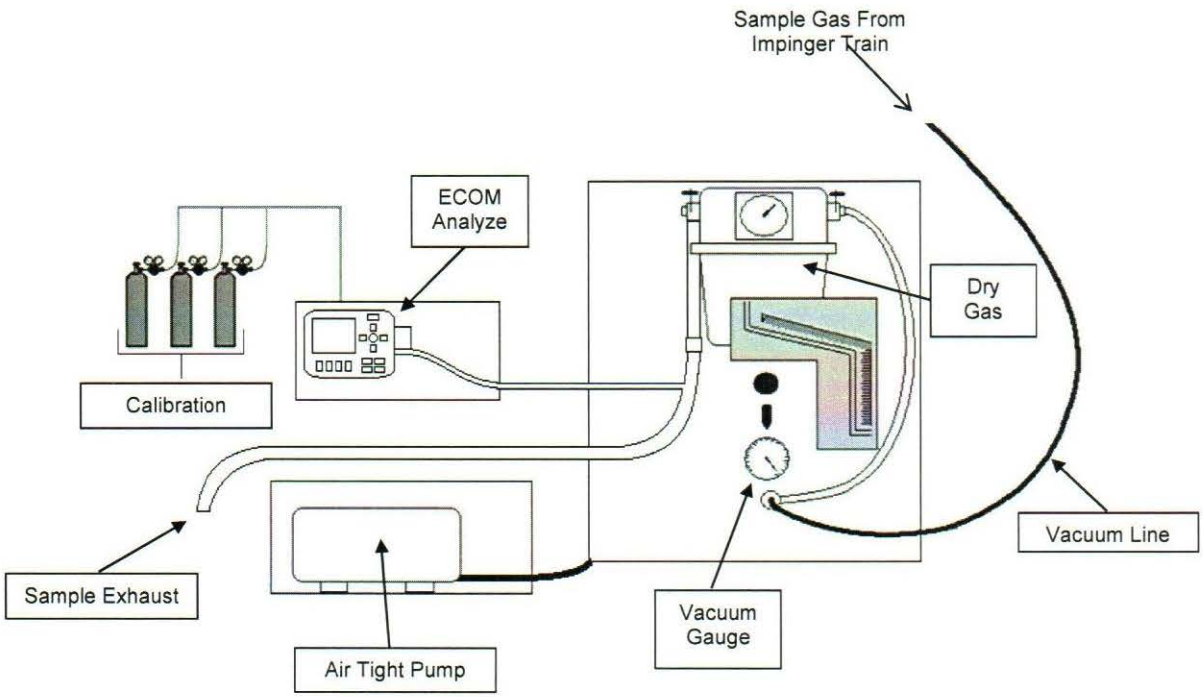
USEPA Method 2- Type S Pitot Tube Manometer Assembly



USEPA Method 5/202- Condensable Particulate Matter



USEPA Method 3A - Integrated Oxygen/Carbon Dioxide Sample Train Diagram Utilizing ECOM To Measure from Sample Exhaust



USEPA Conditional Test Method 027 - Ammonia Sample Train Diagram (Out-of-Stack Filter)