Total Particulate Matter Compliance Emissions Test Report

Knauf Insulation
SV-WBW3 Stack, and
SV-Furnace 1, 3 and 4 Stack
Albion, Michigan
Project No. M221111B
May 10-12, 2022

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Report Submittal Date
June 10, 2022

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1.0 EXECUTIVE SUMMARY

Mostardi Platt conducted a compliance emissions test program for Knauf Insulation on May 10-12, 2022 on the SV-WBW3 Stack, and SV-Furnace 1, 3 and 4 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**
SV-WBW3 Stack	May 11 & 12, 2022	Filterable Particulate Matter (FPM by Method 5 and Method 5E), Condensable Particulate Matter (CPM by Method 202), Total Particulate Matter (TPM by Method 5/202 and Method 5E), and Visible Emissions (VE)
SV-Furnace 1, 3, & 4 Stack	May 10, 2022	FPM (by Method 5), CPM (by Method 202), TPM (by Method 5/202) and VE

The purpose of the test program was to demonstrate emissions with permitted limits. 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	**Source Condition**	**Test Parameter**	**Emission Limit**	**Emission Rate**
SV-WBW3 Stack	Maximum	TPM (5/202)	2.34 lbs/tpg	See Knauf CBI
		TPM (5E)	2.34 lbs/tpg	See Knauf CBI
		VE	20%	0.0%
SV-Furnace 1, 3 and 4 Stack	Maximum	TPM	2.08 lb/hr	0.898 lb/hr
		VE	20%	0.0%

The identifications of individuals associated with the test program are summarized below.

TEST PERSONNEL INFORMATION		
Location	**Address**	**Contact**
Test Facility Test Coordinator	Knauf Insulation 1000 E. North Street Albion, Michigan 49224	Mr. Adam Estes Technical Specialist, Corporate HSE (317) 421-4702 (phone) Adam.estes@knaufinsulation.com
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 C. Buglio, J. Jimenez, M. Shreve, 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
SV-WBW3 Stack	3.42	9.168	>0.5	>2.0	FPM, CPM, TPM	24
SV-Furnace 1, 3, & 4 Stack	3.95	12.254	>0.5	>2.0	FPM, CPM, TPM	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 the 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 Filterable Particulate Matter 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 5E Particulate Determination

Stack gas particulate concentrations and emission rates were determined in accordance with Method 5E, 40 CFR, Part 60, Appendix A, at the SV-WBW3 Stack. An Environmental Supply Company, Inc. sampling train was used to sample stack gas at an isokinetic rate, as specified in the Method. The filter media were Whatman type A/E glass microfiber filters exhibiting a 99.98% efficiency on 0.3-micron DOP smoke particles in accordance with ASTM Standard Method D-2986-71. The impingers were loaded with 0.1 NaOH for the Method 5E tests. Appropriate washes were performed and all samples were labeled and placed in individual bottles for analysis. Front half particulate analysis was performed by Mostardi Platt in accordance with the Method in the Elmhurst, Illinois laboratory. Back half particulate analysis was analyzed by Element One in Wilmington, North Carolina. 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 Matter 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. A correction was made for any ammonia present due to laboratory analysis procedures. 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 were determined in accordance with Method 9. The observer stood at a distance providing a clear view of the emissions with the sun oriented in the 140° sector to his back. As much as possible, the line of vision was approximately perpendicular to the plume direction.

Opacity observations were made at the point of greatest opacity in the portion of the plume where condensed water vapor was not present. Observations were made at 15-second intervals for the duration of the test run. Tests were a minimum of 60 minutes and conducted simultaneously with the TPM particulate matter testing.

Visible emissions observations were conducted and recorded by Mr. M. Shreve, who is a certified visual emissions observer. A copy of Mr. Shreve's certification is presented in Appendix I.

3.0 TEST RESULT SUMMARIES

Client: Knauf Insulation
Facility: Albion, Michigan
Test Location: SV-Furnace 1, 3 and 4 Stack
Test Method: 5/202

Source Condition	Normal	Normal	Normal	
Date	5/10/22	5/10/22	5/10/22	
Start Time	9:20	12:10	14:01	
End Time	10:35	13:18	15:07	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	152.3	153.0	153.8	153.0
Flue Gas Moisture, percent by volume	3.5%	2.6%	2.8%	3.0%
Average Flue Pressure, in. Hg	29.21	29.21	29.21	29.21
Gas Sample Volume, dscf	53.757	55.911	55.767	55.145
Average Gas Velocity, ft/sec	43.954	44.944	44.955	44.618
Gas Volumetric Flow Rate, acfm	32,317	33,045	33,053	32,805
Gas Volumetric Flow Rate, dscfm	26,248	27,056	26,979	26,761
Gas Volumetric Flow Rate, scfm	27,207	27,788	27,760	27,585
Average $\%CO_2$ by volume, dry basis	0.3	0.3	0.3	0.3
Average $\%O_2$ by volume, dry basis	20.8	21.0	20.8	20.9
Isokinetic Variance	100.7	101.6	101.7	101.3
Filterable Particulate Matter (Method 5)				
grams collected	0.01116	0.00613	0.00970	0.00900
grains/acf	0.0026	0.0014	0.0022	0.0021
grains/dscf	0.0032	0.0017	0.0027	0.0025
lb/hr	0.721	0.392	0.621	0.578
Condensable Particulate Matter (Method 202)				
grams collected	0.00275	0.00347	0.00873	0.00498
grains/acf	0.0006	0.0008	0.0020	0.0011
grains/dscf	0.0008	0.0010	0.0024	0.0014
lb/hr	0.178	0.222	0.559	0.320
Total Particulate Matter (5/202)				
grams collected	0.01391	0.00960	0.01843	0.01398
grains/acf	0.0032	0.0022	0.0042	0.0032
grains/dscf	0.0040	0.0027	0.0051	0.0039
lb/hr	0.899	0.614	1.180	0.898

Client: Knauf Insulation
Facility: Albion, Michigan
Test Location: WBW3 Stack
Test Method: 5/202

	Source Condition	Normal	Normal	Normal	
	Date	5/11/22	5/11/22	5/11/22	
	Start Time	9:20	11:00	12:42	
	End Time	10:25	12:06	13:49	
		Run 1	Run 2	Run 3	Average
Stack Conditions					
Average Gas Temperature, °F		110.2	111.1	112.5	111.3
Flue Gas Moisture, percent by volume		8.9%	9.2%	9.3%	9.1%
Average Flue Pressure, in. Hg		29.20	29.20	29.20	29.20
Gas Sample Volume, dscf		55.985	53.553	51.574	53.704
Average Gas Velocity, ft/sec		20.536	20.070	19.532	20.046
Gas Volumetric Flow Rate, acfm		54,435	53,199	51,774	53,136
Gas Volumetric Flow Rate, dscfm		44,821	43,585	42,265	43,557
Gas Volumetric Flow Rate, scfm		49,199	48,001	46,604	47,935
Average $\%CO_2$ by volume, dry basis		0.5	0.5	0.5	0.5
Average $\%O_2$ by volume, dry basis		20.0	20.4	20.7	20.4
Isokinetic Variance		103.4	101.7	101.0	102.0
Filterable Particulate Matter (Method 5)					
grams collected		0.01349	0.01342	0.01161	0.01284
grains/acf		0.0031	0.0032	0.0028	0.0030
grains/dscf		0.0037	0.0039	0.0035	0.0037
lb/hr		1.428	1.445	1.258	1.377
Condensable Particulate Matter (Method 202)					
grams collected		0.00138	0.00123	0.00124	0.00128
grains/acf		0.0003	0.0003	0.0003	0.0003
grains/dscf		0.0004	0.0004	0.0004	0.0004
lb/hr		0.146	0.132	0.134	0.137
Total Particulate Matter (5/202)					
grams collected		0.01487	0.01465	0.01285	0.01412
grains/acf		0.0034	0.0035	0.0031	0.0033
grains/dscf		0.0041	0.0043	0.0039	0.0041
lb/hr		1.574	1.577	1.392	1.514

Client: Knauf Insulation
Facility: Albion, Michigan
Test Location: WBW3 Stack
Test Method: 5E

Source Condition	Normal	Normal	Normal	
Date	5/12/22	5/12/22	5/12/22	
Start Time	8:05	10:52	13:25	
End Time	10:17	12:58	15:31	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	107.8	109.9	110.8	109.5
Flue Gas Moisture, percent by volume	8.3%	8.6%	8.9%	8.6%
Average Flue Pressure, in. Hg	29.29	29.29	29.29	29.29
Gas Sample Volume, dscf	108.361	106.116	106.245	106.907
Average Gas Velocity, ft/sec	19.723	19.628	19.690	19.680
Gas Volumetric Flow Rate, acfm	52,281	52,028	52,193	52,167
Gas Volumetric Flow Rate, dscfm	43,650	43,136	43,060	43,282
Gas Volumetric Flow Rate, scfm	47,600	47,193	47,263	47,352
Average $\%CO_2$ by volume, dry basis	0.5	0.5	0.5	0.5
Average $\%O_2$ by volume, dry basis	19.8	19.8	19.9	19.8
Isokinetic Variance	102.7	101.8	102.1	102.2
Filterable Particulate Matter (Method 5E)				
grams collected	0.01864	0.01969	0.01981	0.01938
grains/acf	0.0022	0.0024	0.0024	0.0023
grains/dscf	0.0027	0.0029	0.0029	0.0028
lb/hr	0.993	1.059	1.062	1.038
Total Organic Carbon (Method 5E)				
grams collected	0.00171	0.00194	0.00212	0.00192
grains/acf	0.0002	0.0002	0.0003	0.0002
grains/dscf	0.0002	0.0003	0.0003	0.0003
lb/hr	0.091	0.104	0.114	0.103
Total Particulate Matter (Method 5E)				
grams collected	0.02035	0.02163	0.02193	0.02130
grains/acf	0.0024	0.0026	0.0027	0.0026
grains/dscf	0.0029	0.0032	0.0032	0.0031
lb/hr	1.084	1.163	1.176	1.141

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.

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

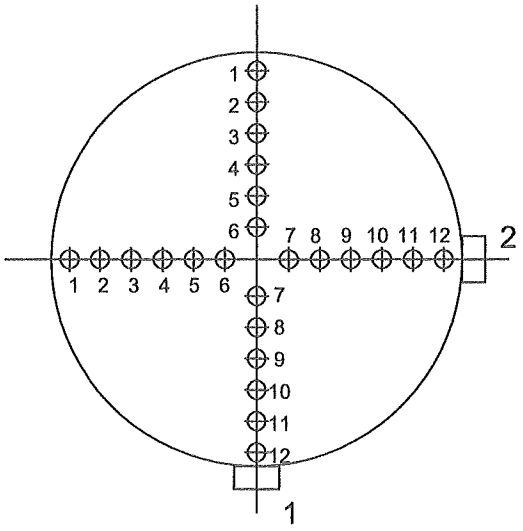
Christopher S. Trezak — Program Manager

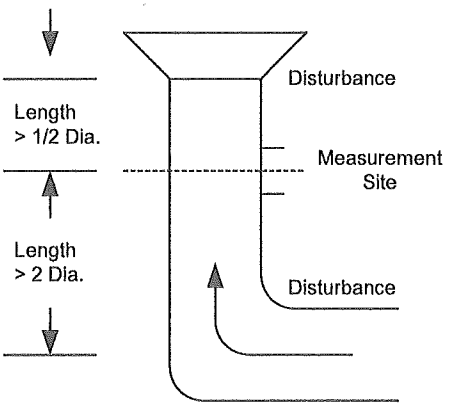
Scott W. Banach — Quality Assurance

APPENDICES

Appendix A - Test Section Diagrams

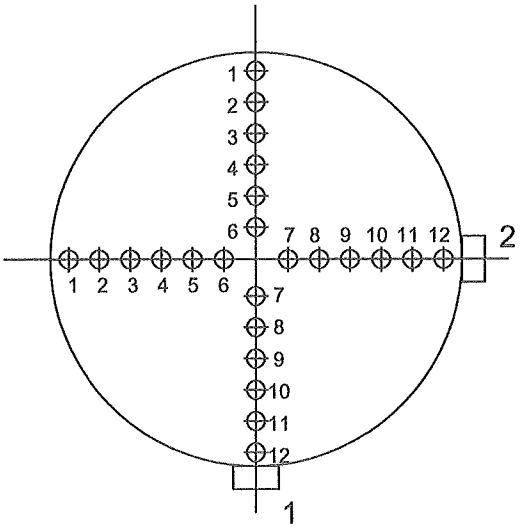
EQUAL AREA TRAVERSE FOR ROUND DUCTS

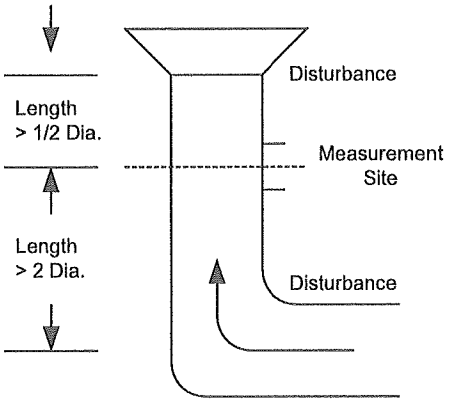




Job:	Knauf Insulation Albion Facility
Date:	May 11 & 12, 2022
Test Location:	WBW3 Stack
Duct Diameter:	7.5 Feet
Duct Area:	44.179 Square Feet
No. Points Across Diameter:	12
No. of Ports:	2
Port Length:	6 inches

EQUAL AREA TRAVERSE FOR ROUND DUCTS

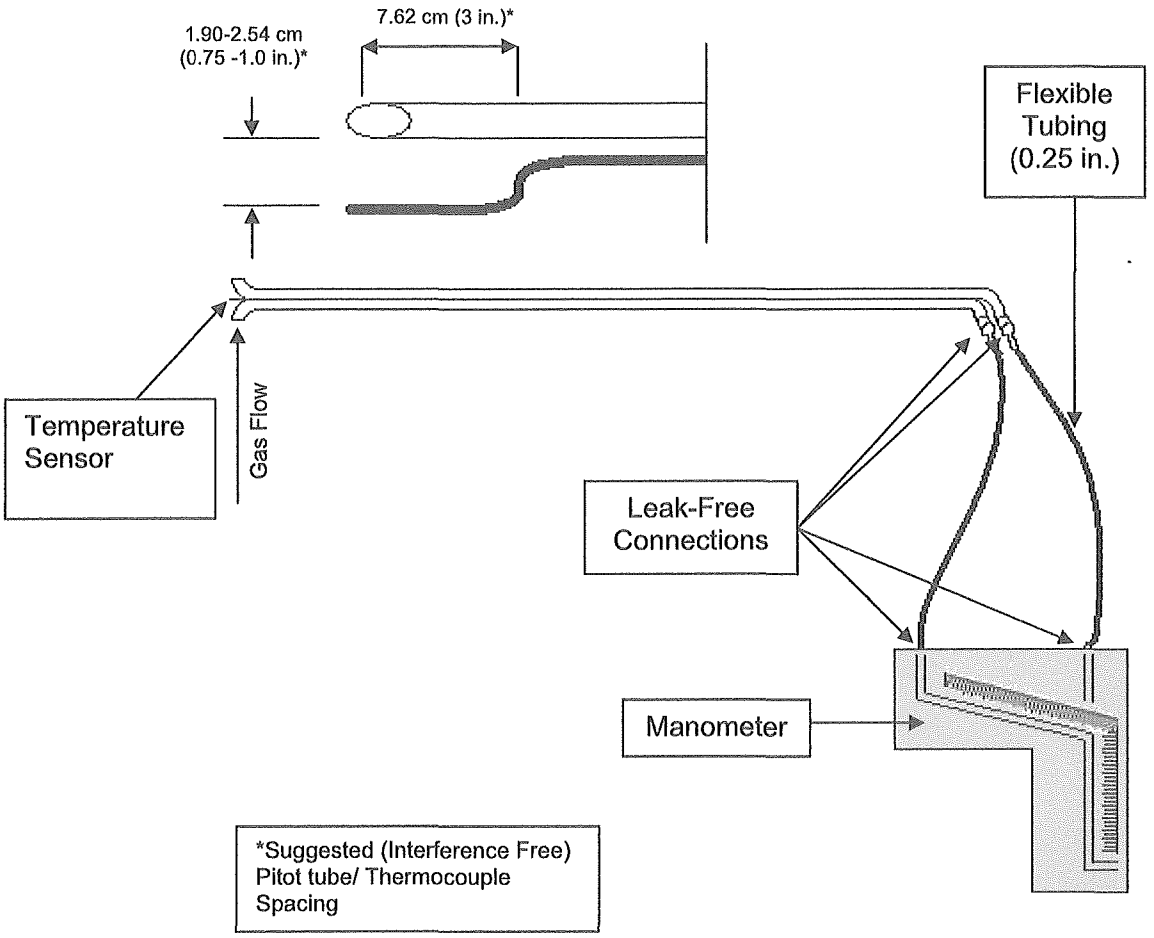




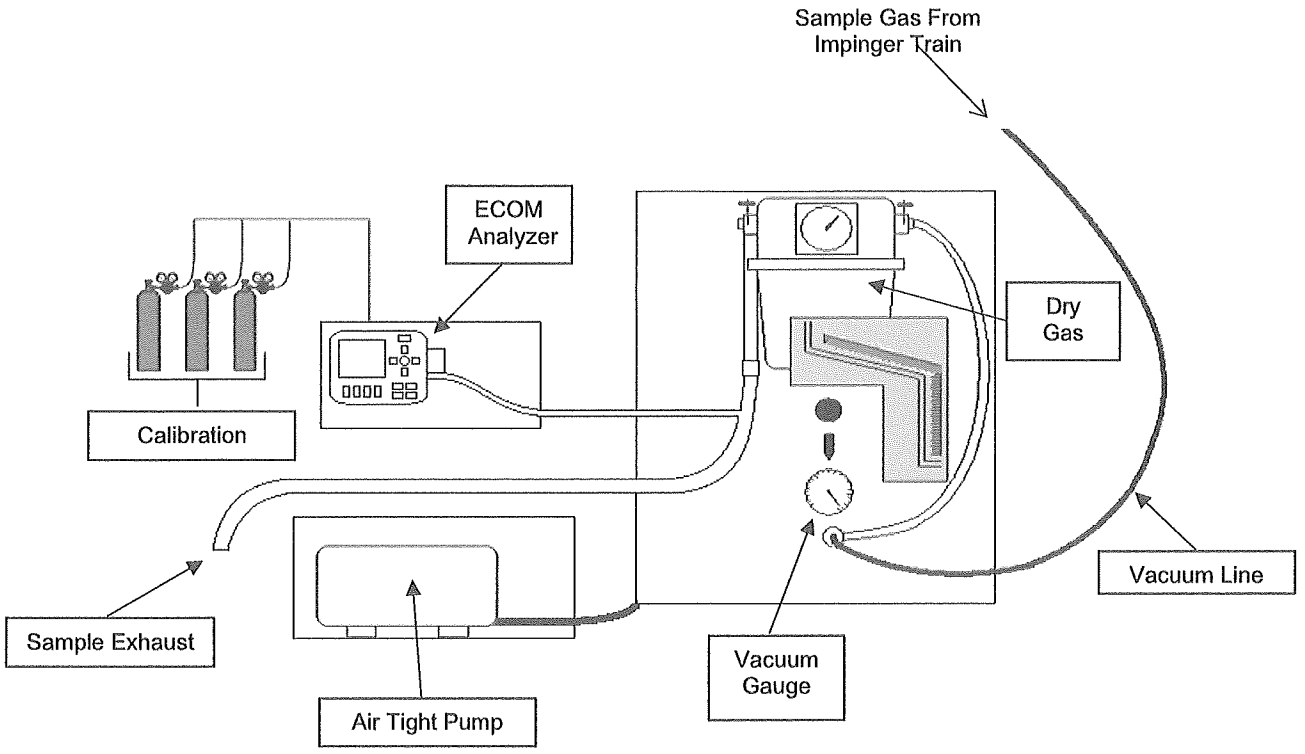
Job:	Knauf Insulation Albion Facility
Date:	May 10, 2022
Test Location:	SV-Furnace 1, 3, and 4 Stack
Duct Diameter:	3.95 Feet
Duct Area:	12.254 Square Feet
No. Points Across Diameter:	12
No. of Ports:	2
Port Length:	6 inches

Appendix B - Sample Train Diagrams

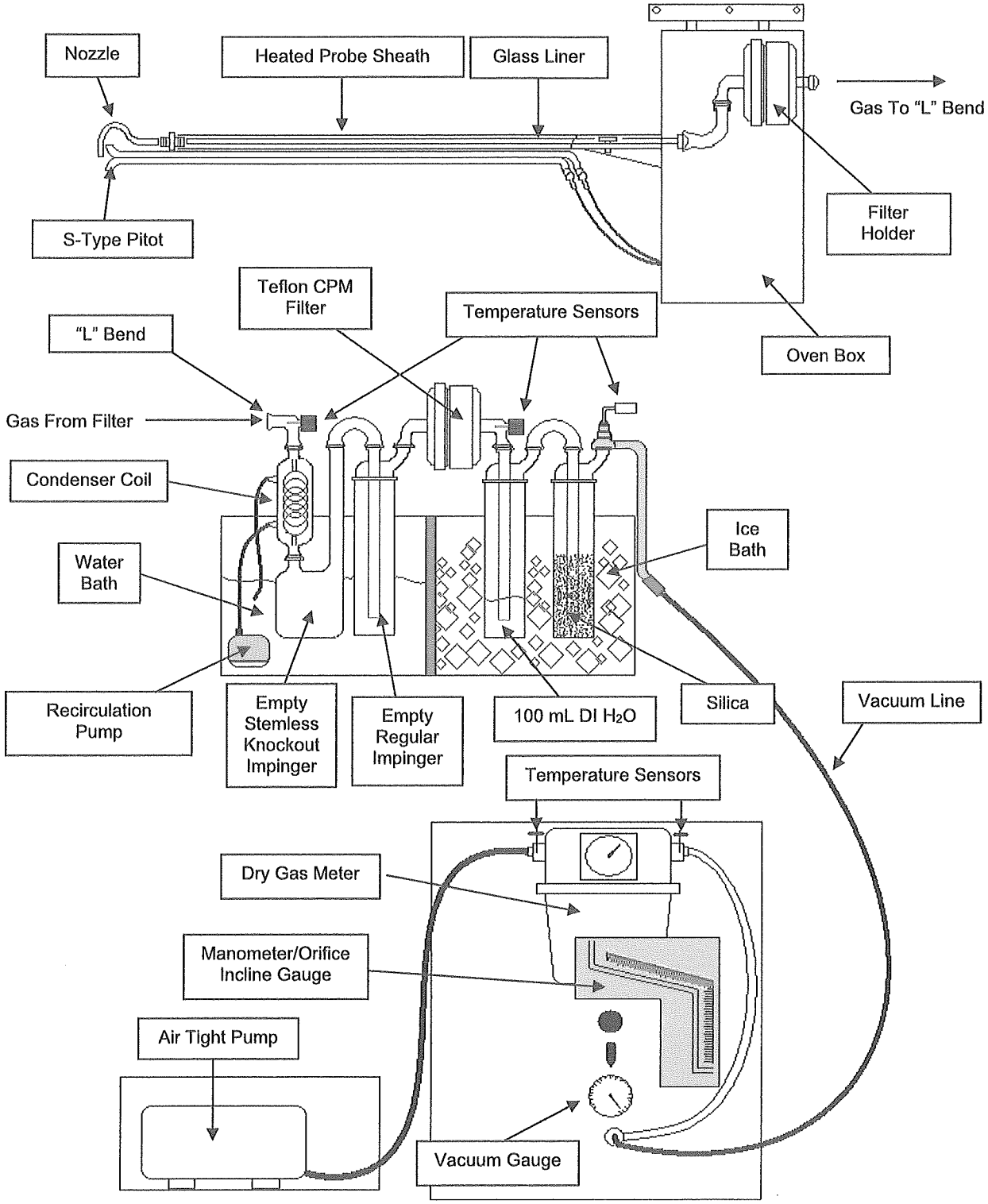
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



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



USEPA Method 5/202- Filterable/Condensable Particulate Matter



USEPA Method 5E- Particulate Matter Sample Train Diagram for the Wool Fiberglass Insulation Industry