

Alliance Source Testing  
4500 Ball Road N.E.  
Circle Pines, Minnesota 55014-1819

TEL: (763) 786-6020  
FAX: (763) 786-7854

**RESULTS OF THE MARCH 15-16, 2022  
AIR EMISSION COMPLIANCE TESTING  
AT THE LOUISIANA PACIFIC SIDING  
PLANT IN NEWBERRY, MICHIGAN**

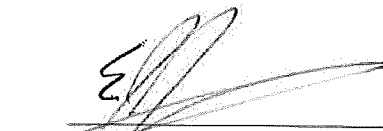
Submitted to:

**LOUISIANA-PACIFIC CORPORATION**  
7299 North C.R. 403  
Newberry, Michigan 49868

Attention:

Nick Waddell

Reviewed by:

  
Ed Juers  
Operations Manager  
Source Testing

Report Number 22-0766 (Press RCO)  
April 5, 2022  
SF/sef

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## ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	dry standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (°F)	degrees Fahrenheit
DIA.	Diameter
FT/SEC	feet per second
g	gram
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g/dscm	grams per dry standard meter
HP	horsepower
HRS	hours
IN.	inches
IN.HG.	inches of mercury
IN.WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/10 <sup>6</sup> BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
MW	megawatt
mg/dscm	milligrams per dry standard cubic meter
ug/dscm	micrograms per dry standard cubic meter
microns (um)	micrometer
MIN.	minutes
ng	nanograms
PM	particulate matter
PPH	pounds per hour
PPM	parts per million
ppmC	parts per million carbon
ppm,d	parts per million, dry
ppm,w	parts per million, wet
ppt	parts per trillion
PSI	pounds per square inch
SQ.FT.	square feet
TPD	tons per day
ug	micrograms
v/v	percent by volume
w/w	percent by weight

Standard conditions are defined as 68 °F (20 °C) and 29.92 IN. of mercury pressure

## 1 INTRODUCTION

On March 15-16, 2022, Alliance Source Testing personnel conducted Air Emission compliance testing on the Press RCO stack at the Louisiana Pacific Corporation (LP) OSB Plant located in Newberry, Michigan. On-site testing was performed by Scott Fjelsta, Luke Frahm, Ryan Schuth, and Tim Tolle-Macdonald. Coordination between testing activities and plant operation was provided by Nick Waddell of Louisiana Pacific Corp. The tests were witnessed by Trevor Drost of the State of Michigan Department of Environment, Great Lakes, and Energy.

Particulate evaluations were performed in accordance with EPA Methods 1-5, CFR Title 40, Part 60, and Appendix A (revised July 1, 2021). A preliminary determination of the gas linear velocity profile was made at each test location before the first particulate determination to allow selection of the appropriate nozzle diameter for isokinetic sample withdrawal. An Interpoll Labs sampling train, which meets or exceeds specifications in the above-cited reference was used to isokinetically extract particulate samples by means of a heated glass-lined probe. Wet catch samples were collected in the back half of the Method 5 sampling train and analyzed in accordance with EPA Method 202.

Oxygen, carbon dioxide, oxides of nitrogen, carbon monoxide and total hydrocarbon concentrations were determined in accordance with Methods 3A, 7E, 10 and 25A. A slipstream of sample gas was withdrawn from the exhaust gas stream using a heated stainless steel probe equipped with a filter to remove interfering particulate material. The particulate-free gas was transported to the analyzers by means of a heat-traced probe and filter assembly. After passing through the filter, the gas passed through a chilled condenser-type moisture removal system. The particulate-free dry gas was then transported to the analyzers with the excess exhausted to the atmosphere through a calibrated orifice, which was used to ensure that the flow from the stack exceeds the requirements of the analyzers. For the velocity determinations on the press stack, a 20 point traverse was used.

Total gaseous hydrocarbon concentrations at both the inlet and outlet sampling location of the RCO were determined instrumentally using a VIG Model 20/2 heated flame ionization detector (HFID) calibrated against propane in air standards. The THC concentration was continuously monitored by extracting a slipstream of exhaust gas by means of a heated probe and filter holder. A heat-traced Teflon line was used to transport the sample gas from the filter holder outlet to the

analyzer inlet.

The analog response of each analyzer was recorded with a computer datalogger. The O<sub>2</sub>, CO<sub>2</sub>, NO<sub>x</sub>, CO and VOC analyzers were calibrated with EPA Protocol 1 standard gases. The instrument was calibrated before and after each run.

MDI concentrations were determined in accordance with OTM-14 sampling method. This method employs collection of MDI with 1,2-PP in toluene reagent, with analysis by HPLC.

Formaldehyde and methane concentrations were determined using EPA Method 320 (FTIR). The on-line gas analysis was performed using a MKS MultiGas 2030 FTIR based analyzer. The MKS MultiGas 2030 FTIR has a fixed gas cell path length of 5.11 Meters and the detector was cooled by the use of liquid nitrogen. The gas was transported to the FTIR analyzer through a heat traced Teflon line originating from the manifold system described above. Three one-hour runs were conducted for each test condition. A leak-check was performed prior to and following the test on the sampling the system and was found to be acceptable. The Method 320 Data is contained in Appendix K. A dynamic spike (pre-test/post-test) was performed according to the guidelines spelled out in EPA Method 320. This was done using a compressed gas cylinder with certified quantities of acetaldehyde and sulfur hexafluoride. This data can be found in Appendix L.

NCASI 98.01 was used to measure Phenol concentrations. The stack gas sample was extracted using a heated glass probe and Teflon filter holder loaded with a glass fiber filter to remove any particulate material present. The sample collection system is composed of three midget impingers in series. Each of the three impingers is loaded with approximately 10ml of high purity water. The sampling rate was set at approximately 400 cc per minute. The volume sampled was recorded using a calibrated dry gas meter (DGM). One spike and one duplicate run were performed. During the spike test, one of the two systems was spiked with representative targeted analytes to determine compound capture efficiencies. Following the conclusion of sampling (typically 60 minutes), the impinger contents were recovered and labeled. All spike recoveries fell within the method requirements of 70-130%. All duplicate test runs also met the method criteria.

The results of the test are summarized in Section 2. Detailed results are presented in Section 3. Field data and all other supporting information are presented in the appendices.

2 SUMMARY AND DISCUSSION

The results of the compliance tests are summarized in the following table. An overview of all results is presented in the table below:

**Table 1: PRESS RCO OUTLET**

<u>PARAMETER</u>	<u>LIMIT</u>	<u>MEASURED</u>
Outlet CO (EPA Method 10) ..... <i>Lbs/Hr.</i>	3.39	< 0.21
Outlet NOx (EPA Method 7E) ..... <i>Lbs/Hr.</i>	2.77	1.00
Outlet VOC (EPA Method 25a) ..... <i>TGNM.Lbs.C./Hr.</i>	8.26	0.24
Inlet/Outlet VOC (EPA Method 25a) ..... <i>Removal.Efficiency(%)</i>	N/A	89.41
Outlet Formaldehyde (EPA Method 320) ..... <i>Lbs/Hr.</i>	4.1	0.36
Outlet Methanol (EPA Method 320) ..... <i>Lbs/Hr.</i>	N/A	≤ 0.20
Outlet Phenol (NCASI 98.01) ..... <i>Lbs/Hr.</i>	2.0	< 0.063
PM/PM10/PM2.5 (EPA Method 5/202) ..... <i>Lbs/Hr.</i>	11.6	≤ 1.217
MDI (OTM - 14) ..... <i>Lbs/Hr.</i>	0.53	≤ 0.0009

No difficulties were encountered in the field by Interpoll Labs or in the laboratory evaluation of the samples, which were conducted by Interpoll Labs. It should be noted that some results are presented with either a “<” sign or a “≤” sign. Those results showing the “<” indicate that all analytical fractions, or instrumental readings, were Below the Detection Level (BDL). If a “≤” sign is shown, it indicates that at least one analytical fraction or instrumental reading used to calculate final results, was below the detection level, however, there are also analytical fractions or instrumental

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readings which do include detectable hits, or Detection Level Limited (DLL). On the basis of these facts and a complete review of the data and results, it is our opinion that the results reported herein are accurate and closely reflect the actual values, which existed at the time the test was performed.

Test 1 Summary of the March 15, 2022, Particulate Emission Compliance Test on the Press RCO Outlet Stack at the LP facility located in Newberry, Michigan.

Item	Run 1 03-15-22 1205 / 1309	Run 2 03-15-22 1345 / 1449	Run 3 03-15-22 1535 / 1643	Average
Date of test	03-15-22			
Time (Start/Finish)	(Hrs)			
Volumetric Flow				
Actual	113,900	106,886	106,706	109,164
Standard	98,436	92,273	91,957	94,222
Dry Standard	98,007	91,319	91,220	93,515
Gas Temperature	(°F)	139	140	139
Moisture Content	(%v/v)	0.44	1.03	0.76
Gas Composition	(%v/v, dry)			
Carbon Dioxide		0.18	0.14	0.17
Oxygen		20.56	20.59	20.59
Nitrogen		79.26	79.27	79.24
Sample Volume	(dscf)	36.68	36.10	36.31
Isokinetic Variation	(%)	99.3	104.8	103.1
<b>Particulate Results-EPA Methods 5 &amp; 202 (Dry Impinger Technique)</b>				
<i>Front Half Dry Catch Only (Filterable only)</i>				
Sample Mass (Nozzle, PW, Filter)	(g) <	0.0001	0.0004	0.0001
Concentration - Actual	(GR/ACF) <	0.00004	0.00015	0.00004
Concentration - Actual	(MG/ACM) <	0.082	0.334	0.082
Concentration - Standard	(GR/DSCF) <	0.00004	0.00017	0.00004
Emission Rate	(LB/HR) <	0.035	0.134	0.034
<b>Total Particulate (Dry + Organic + Inorganic)</b>				
Sample Mass	(g) ≤	0.0057	0.0027	0.0022
Concentration - Actual	(GR/ACF) ≤	0.00206	0.00099	0.00080
Concentration - Standard	(GR/DSCF) ≤	0.00240	0.00115	0.00094
Emission Rate	(LB/HR) ≤	2.014	0.903	0.734

"<" A minimum detectable mass of 0.0001g was used.



**Test 4 Summary of the March 15, 2022, Oxides of Nitrogen, Carbon Monoxide and VOC's Test on the Press RCO Outlet at the Louisiana Pacific facility located in Newberry, Michigan.**

Date of test	Item	Run 1 03-15-22 1205 / 1305	Run 2 03-15-22 1345 / 1445	Run 3 03-15-22 1535 / 1635	Average
Time runs were done	(Hrs)	1205 / 1305	1345 / 1445	1535 / 1635	
Volumetric Flow					
Actual	(ACFM)	113,900	106,886	106,706	109,164
Standard	(SCFM)	98,436	92,273	91,957	94,222
Standard	(DSCFM)	98,007	91,319	91,220	93,515
Gas Temperature	(°F)	138	139	140	139
Moisture Content	(%v/v)	0.44	1.03	0.80	0.76
Gas Composition	(%v/v, dry)				
Carbon Dioxide		0.18	0.14	0.17	0.17
Oxygen		20.56	20.59	20.62	20.59
Nitrogen		79.26	79.27	79.20	79.24
<b>Results:</b>					
Oxides of Nitrogen (EPA Method 7E)					
Concentration	(ppm, d)	1.53	1.51	1.46	1.50
Emission Rate	(pph)	1.08	0.99	0.95	1.00
				Permit Limit (pph) =	2.77
Carbon Monoxide (EPA Method 10)					
Concentration	(ppm, d)	<	0.51	<	<
Emission Rate	(pph)	<	0.20	<	<
				Permit Limit (pph) =	3.39
VOC (EPA Method 25a)					
Concentration	(ppm Carbon, d)	4.54	2.85	5.16	4.18
Concentration	(TGNM ppm Carbon, d)	1.58	0.04	2.48	1.37
Emission Rate (Lb x/Hr)	(p Carbon/h)	0.83	0.49	0.88	0.73
Emission Rate (Lb x/Hr)	(TGNM p Carbon/h)	0.29	0.01	0.42	0.24
				Permit Limit (pph) =	8.26
<b>Control Efficiency</b>					
Control Efficiency	(% RE)	85.88	99.69	82.67	89.41
Inlet VOC (EPA Method 25a)					
Concentration	(p Carbon/h)	2.35	2.56	2.72	2.54
Concentration	(TGNM p Carbon/h)	2.05	2.24	2.44	2.25

VOC Control Efficiency based on mass rates of inlet and outlet TGNM p Carbon/h  
 TGNM = Total Gaseous Non-methane  
 (<) Detection Limit based on 2% of span gas. n.m)

Test 1 Summary of the Results of the March 15, 2022 VOC's Test (EPA Method 25a) on the RCO Inlet Duct at the LP Facility located in Newberry, Michigan.

Date of test	Item	Run 1 03-15-22 1205 / 1305	Run 2 03-15-22 1345 / 1445	Run 3 03-15-22 1535 / 1635	Average
Time runs were done	(Hrs)				
Volumetric Flow					
Actual	(ACFM)	92,508	98,513	97,069	96,030
Standard	(SCFM)	84,997	90,354	88,872	88,074
Standard	(DSCFM)	84,077	89,266	88,167	87,170
Gas Temperature	(°F)	103	104	105	104
Moisture Content	(%v/v)	1.08	1.20	0.79	1.03
Gas Composition	(%v/v, dry)				
Carbon Dioxide		0.11	0.11	0.09	0.10
Oxygen		20.90	20.90	20.90	20.90
Nitrogen		78.99	78.99	79.01	79.00
Results					
VOC - EPA Method 25a					
Concentration	(ppm Propane, d)	4.98	5.11	5.50	5.20
Concentration	(TGNM ppm Propane, d)	4.35	4.47	4.93	4.58
Concentration	(ppm Carbon, d)	14.94	15.33	16.50	15.59
Concentration	(TGNM ppm Carbon, d)	13.05	13.40	14.79	13.75
Emission Rate (Lb x/Hr)	(LB Carbon/HR)	2.35	2.56	2.72	2.54
Emission Rate (Lb x/Hr)	(TGNM LB Carbon/HR)	2.05	2.24	2.44	2.25

TGNM = Total Gaseous Non-methane

Test 3 Summary of the Results of the March 15, 2022, Method 320 (Methane) Emission Test on the Press RCO Inlet Duct at the LP Facility located in Newberry, Michigan.

Item		Run 1	Run 2	Run 3	Average
Date of test		03-15-22	03-15-22	03-15-22	
Time runs were done		1205 / 1305	1335 / 1435	1535 / 1635	
Volumetric Flow	(Hrs)				
	Actual (ACFM)	92,508	98,513	97,069	96,030
	Standard (SCFM)	84,962	90,115	89,095	88,057
	Standard (DSCFM)	84,077	89,266	88,167	87,170
Gas Temperature	(°F)	103	104	105	104
Moisture Content	(%v/v)	1.04	0.94	1.04	1.01
Gas Composition	(%v/v, dry)				
	Carbon Dioxide	0.11	0.11	0.09	0.10
	Oxygen	20.90	20.90	20.90	20.90
	Nitrogen	78.99	78.99	79.01	79.00
Methane	Concentration (ppm, d)	1.88	1.93	1.70	1.84

Test 2 Summary of the March 15, 2022, Method 320 (VOC/HAP's) Emission Test on the Press RCO Outlet Stack at the Louisiana Pacific facility located in Newberry, Michigan.

Item	Run 1 03-15-22 1205 / 1305	Run 2 03-15-22 1345 / 1445	Run 3 03-15-22 1535 / 1635	Average
Date of test	03-15-22			
Time runs were done	(Hrs)			
Volumetric Flow	Actual (ACFM)	106,886	106,704	109,163
	Standard (SCFM)	99,176	92,319	94,601
	Standard (DSCFM)	98,007	91,226	93,517
Gas Temperature	(°F)	138	140	139
Gas Composition	(%v/v, dry)			
	Carbon Dioxide	0.14	0.17	0.17
	Oxygen	20.56	20.62	20.59
	Nitrogen	79.26	79.20	79.24
<b>Formaldehyde</b>				
	Concentration (ppm, d)	0.84	0.82	0.83
	Emission Rate (LB/HR)	0.383	0.349	0.364
		Permit Limit (pph) =		4.100
Methane				
	Concentration (ppm, d)	2.81	2.68	2.82

**Results of NCASI 98.01 Determinations**

Interpoll Laboratories Report Number 21-39244  
 Louisiana Pacific  
 Newberry, MI

Test Number 3  
 Press RCO Outlet

	Run 1	Run 2	Run 3	Average
Date of Test	03-15-22	03-15-22	03-15-22	
Time of Runs				
Start (Hrs)	1205	1345	1230	
End (Hrs)	1305	0000	1330	
Total (Min)	60	60	60	
Moisture Content (%v/v)	0.4	1.0	0.8	
Volumetric Flow Rate (DSCFM)	98,007	91,319	91,220	
Sample Volume (DSL)	26.21	27.01	23.57	
	Spike/Duplicate	Spike/Duplicate	Spike/Duplicate	
	27.66	29.41	25.28	
Phenol (ppm,d of duplicate)	<	0.05	<	0.99
	0.04	0.05	0.05	<
(LB/HR)	<	<	<	0.05
	0.06	0.06	0.06	<
(Spike %)		96.19		90.08
(Duplicate %)	2.84%	6.69%		4.40%

Test 5 Summary of the March 16, 2022 (OTM-14) MDI Emission Compliance Test on the Press RCO Stack at the Louisiana Pacific facility located in Newberry, Michigan.

Date of test	Item	Run 1 03-16-22	Run 2 03-16-22	Run 3 09-19-18	Average
Time runs were done	(Hrs)	0840 / 0946	1115 / 1219	1255 / 1359	
Volumetric Flow					
Actual	(ACFM)	113,794	111,219	111,368	112,127
Standard	(SCFM)	98,030	95,283	95,129	96,147
Standard	(DSCFM)	97,234	94,151	94,496	95,294
Gas Temperature	(°F)	135	139	140	138
Moisture Content	(%v/v)	0.81	1.19	0.67	0.89
Gas Composition	(%v/v, dry)				
Carbon Dioxide		0.30	0.39	0.30	0.33
Oxygen		20.64	20.54	20.64	20.61
Nitrogen		79.06	79.06	79.06	79.06
Isokinetic Variation	(%)	99.8	100.3	99.0	99.7
<b>MDI Results</b>					
Sample Volume	(DSCF)	37.47	36.45	36.12	36.68
Total Micrograms in Sample	(ug)	≤	≤	≤	≤
Concentration	(gr/dscf)	≤	≤	≤	≤
Concentration	(ppm,d)	0.0000012	0.0000010	0.0000010	0.0000011
Emission Rate	(LB/HR)	0.00026	0.00022	0.00022	0.00023
		0.0010	0.00081	0.00082	0.0009

The results of all field and laboratory evaluations are presented in this section. Gas composition and moisture is presented first followed by the computer printout of the particulate, and trace metals sampling data. Preliminary measurements including test port locations are given in the appendices.

The results have been calculated on a personal computer using programs written in using Microsoft Excel spreadsheets specifically for source testing calculations. EPA-published equations have been used as the basis of the calculation techniques in these programs. The emission rates have been calculated using the product of the concentration times flow method.

### 3.1 Results of Gas Composition and Moisture Determinations



Interpoll Laboratories Report Number 22-0766  
 Louisiana Pacific  
 Newberry, MI

Test Number 1  
 Press RCO Outlet

**Results of Gas Composition and Moisture Analyses --- Methods 3A and 4 (% v/v)**

		<b>Run 1</b>	<b>Run 2</b>	<b>Run 3</b>
<b>Date of Run</b>		03-15-22	03-15-22	03-15-22
<b>Dry basis</b>				
Carbon Dioxide.....	( % )	0.18	0.14	0.17
Oxygen.....	( % )	20.56	20.59	20.62
Nitrogen.....	( % )	79.26	79.27	79.20
<b>Wet basis</b>				
Carbon Dioxide.....	( % )	0.18	0.14	0.17
Oxygen.....	( % )	20.47	20.37	20.46
Nitrogen.....	( % )	78.92	78.45	78.57
Water Vapor.....		0.44	1.03	0.80
Dry Molecular Weight.....	(g/gmole)	28.85	28.85	28.85
Wet Molecular Weight.....	(g/gmole)	28.80	28.73	28.77
Specific Gravity.....		0.995	0.993	0.994
Water Mass Flow.....	(lb/hr)	1202	2676	2069

Test Number 5  
 Press RCO Outlet

**Results of Gas Composition and Moisture Analyses --- Methods 3A and 4 (% v/v)**

Date of Run		Run 1 03-16-22	Run 2 03-16-22	Run 3 09-19-18
<b>Dry basis</b>				
Carbon Dioxide.....	( % )	0.30	0.39	0.30
Oxygen.....	( % )	20.64	20.54	20.64
Nitrogen.....	( % )	79.06	79.06	79.06
<b>Wet basis (Orsat)</b>				
Carbon Dioxide.....	( % )	0.29	0.39	0.29
Oxygen.....	( % )	20.48	20.30	20.51
Nitrogen.....	( % )	78.42	78.12	78.53
Water Vapor.....		0.81	1.19	0.67
Dry Molecular Weight.....	(g/gmole)	28.87	28.88	28.87
Wet Molecular Weight.....	(g/gmole)	28.78	28.76	28.80
Specific Gravity.....		0.994	0.993	0.995
Water Mass Flow.....	(lb/hr)	2231	3177	1764

### 3.2 Particulate Sampling Data

**Test Number 1**  
**Press RCO Outlet**

**Results of EPA Method 5/202 Sampling Data**

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		<b>Run 1</b>	<b>Run 2</b>	<b>Run 3</b>
Date of Test		03-15-22	03-15-22	03-15-22
Time of Runs	(Hrs)	1205 / 1309	1345 / 1449	1535 / 1643
Static Pressure	(In. of WC)	-0.70	-0.70	-0.70
Cross Sectional Area	(Sq. ft)	34.039	34.039	34.039
Pitot Tube Coefficient		0.84	0.84	0.84
Avg. Sq. root of Delta p		0.922	0.864	0.862
Water in Sample Gas				
Impingers	(g)	0.9	1.0	2.3
Desiccant	(g)	2.5	7.0	3.9
Total	(g)	3.4	8.0	6.2
Gas Meter Coefficient		0.9957	0.9957	0.9957
Barometric Pressure	(In. of Hg)	29.35	29.35	29.35
Avg. Orifice Pressure Drop	(In. of WC)	1.30	1.15	1.15
Avg. Gas Meter Temperature	(°F)	67.4	67.8	69.8
Volume Through Gas Meter				
Meter Conditions	(CF)	37.40	36.85	37.04
Standard Conditions	(DSCF)	36.68	36.10	36.15
Total Sampling Time	(Min.)	60.00	60.00	60.00
Nozzle Diameter	(In.)	0.198	0.198	0.198
Avg. Stack Gas Temperature	(°F)	138	139	140
Volumetric Flow Rate				
Actual	(ACFM)	113,900	106,886	106,706
Dry Standard	(DSCFM)	98,007	91,319	91,220
Isokinetic Variation	(%)	99.3	104.8	105.1

### 3.3 MDI Sampling Data

**Test Number 5**  
**Press RCO Outlet**

**Results of EPA OTM-14 (MDI) Sampling Data**

		Run 1	Run 2	Run 3
Date of Test		03-16-22	03-16-22	09-19-18
Time of Runs	(Hrs)	0840 / 0946	1115 / 1219	1255 / 1359
Static Pressure	(In. of WC)	-0.70	-0.70	-0.70
Cross Sectional Area	(Sq. ft)	34.04	34.04	34.04
Pitot Tube Coefficient		0.84	0.84	0.84
Water in Sample Gas				
Impingers	(g)	2.8	-10.5	3.4
Desiccant	(g)	3.7	19.8	1.7
Total	(g)	6.5	9.3	5.1
Gas Meter Coefficient		0.9957	0.9957	0.9957
Barometric Pressure	(In. of Hg)	29.11	29.11	29.11
Avg. Orifice Pressure Drop	(In. of WC)	1.36	1.29	1.28
Avg. Gas Meter Temperature	(°F)	66.4	67.0	69.5
Volume Through Gas Meter				
Meter Conditions	(CF)	38.45	37.45	37.29
Standard Conditions	(DSCF)	37.47	36.45	36.12
Total Sampling Time	(Min.)	60.00	60.00	60.00
Nozzle Diameter	(In.)	0.200	0.200	0.200
Avg. Stack Gas Temperature	(°F)	135	139	140
Volumetric Flow Rate				
Actual	(ACFM)	113,794	111,219	111,368
Standard	(SCFM)	98,030	95,283	95,129
Dry Standard	(DSCFM)	97,234	94,151	94,496
Isokinetic Variation	(%)	99.8	100.3	99.0

# **APPENDIX A**

## **TEST PROTOCOL**