

**Clean Air Act Section 114  
Information Collection  
Request for National  
Emissions Standards for  
Hazardous Air Pollutants  
(NESHAP) for Stationary  
Combustion Turbines Air  
Emissions Test Report**

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Northern Natural Gas Company  
Clifton Compressor Station  
Unit 30  
2930 Gas City Road  
Clifton, KS 66937  
Report No. M224514  
December 5 through 8, 2022





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**Report Submittal Date  
December 27, 2022**

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**Report No. M224514**

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## 1.0 EXECUTIVE SUMMARY

Mostardi Platt performed an air emissions test program on Unit 30 for Northern Natural Gas Company (NNG), at its Clifton Compressor Station located in Clifton, Kansas. Testing was performed to determine the concentration of filterable particulate matter (FPM), metallic hazardous air pollutants (MHAP), carbon monoxide (CO), formaldehyde (HCHO), hydrogen chloride (HCl), and hydrogen fluoride (HF) from the exhaust of Unit 30 in accordance with United States Environmental Protection Agency (USEPA) Methods 1, 2, 3A, 4, 5/29, 10, and 320. All testing was performed while the unit was firing on pipeline natural gas.

The purpose of this test program was to meet the requirements of a "Stationary Combustion Turbine Emissions Information Collection Request" from USEPA under Clean Air Act (CAA) Section 114. (42 U.S.C. 7414)

All testing was performed in accordance with the Test Procedures, Methods, and Reporting Requirements for the Section 114 Request for Stationary Combustion Turbines document provided by USEPA with the initial letter.

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

Location	Address	Contact
Test Coordinator	Northern Natural Gas Company 1111 South 103 <sup>rd</sup> Street Omaha, NE 68124	Greg Ammon P: 402-398-7716 E: Gregory.Ammon@nngco.com
Test Facility	Clifton Facility 2930 Gas City Road Clifton, KS 66937	Naomi Cavalieri P: 402-398-7847 E: Naomi.Cavalieri@nngco.com
Test Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, IL 60126	Robert Carlisle P: 630.993.2100 E: ssands@mp-mail.com

The test crew consisted of M. Neessen, S. Sands, A. Wentworth, J. Kolodziejczyk, and R. Carlisle of Mostardi Platt.

Below is a brief overview of test results, detailed test results summaries are included in Section 4.0.

GASEOUS TEST RESULTS				
Test Location	Analyte	Emission Results		
		lb/hr	ppmvd	ppmvd @ 15% O <sub>2</sub>
Unit 30	HCHO*	ND	ND	ND
	CO	2.20	6.2	8.3
	HCl**	≤ 0.10	≤ 0.22	≤ 0.30
	HF**	≤ 0.05	≤ 0.20	≤ 0.25

\*All Emission Data was below the MDL of 0.1 ppmvw

\*\* All values below 0.1 ppmvw are reported as estimated values only



FPM TEST RESULTS			
Test Location	Analyte	Emission Results	
Unit 30	FPM	0.0002 grains/dscf	0.0002 grains/dscf @ 15% O <sub>2</sub>

MHAP TEST RESULTS				
Test Location	Analyte	Emission Results		
		mg/dscm	mg/dscm @15% O <sub>2</sub>	lb/hr
Unit 30	Mercury (Hg)	≤ 9.07E-05	≤ 1.28E-04	≤ 2.87E-05
	Antimony (Sb)	≤ 3.10E-01	≤ 7.71E-04	≤ 2.34E-04
	Arsenic (As)	≤ 1.10E-01	≤ 2.73E-04	≤ 8.13E-05
	Beryllium (Be)	≤ 2.57E-02	≤ 6.38E-05	≤ 1.80E-05
	Cadmium (Cd)	≤ 1.09E-01	≤ 2.52E-04	≤ 4.40E-05
	Chromium (Cr)	≤ 1.36E-03	≤ 1.92E-03	≤ 4.43E-04
	Cobalt (Co)	≤ 1.03E-04	≤ 1.42E-04	≤ 3.46E-05
	Lead (Pb)	≤ 5.79E-04	≤ 7.54E-04	≤ 1.14E-04
	Manganese (Mn)	1.72E-03	2.44E-03	5.57E-04
	Nickel (Ni)	2.72E-03	3.75E-03	8.57E-04
	Selenium (Se)	≤ 8.57E-04	≤ 1.19E-03	≤ 2.57E-04

## 2.0 PROCESS DESCRIPTION

Northern Natural Gas owns and operates the largest interstate natural gas pipeline system in the United States. Northern's pipeline system stretches across 11 states, from the Permian Basin in Texas to Michigan's Upper Peninsula, providing access to five of the major natural gas supply regions in North America. Northern provides natural gas transportation and storage services to numerous utilities, producers, energy marketing companies and industrial end users. Clifton Unit 30 serves to compress natural gas on the pipeline, to ensure proper pipeline operating pressures to supply our customers with required demand.

### 3.0 TEST METHODOLOGY

All testing was performed as described in the Title 40, *Code of Federal Regulations*, Part 60 (40CFR60), Appendix A, Methods 1, 2, 3A, 4, 5, 10, and 29, and 40CFR63, Appendix A, Method 320; the following provides description of the methodologies performed during the test program:

#### 3.1 Method 1 Sample and Velocity Traverse Determination

Test measurement points were selected in accordance with Method 1. The characteristics of the measurement location is summarized in the table below. A null-point pitot traverse was performed prior to testing to ensure the absence of cyclonic flow. Cyclonic flow is presented in Appendix F of this report.

<b>Sample Point Selection</b>					
<b>Test Location</b>	<b>Stack Dimensions</b>	<b>Upstream Diameters</b>	<b>Downstream Diameters</b>	<b>Test Parameters</b>	<b>Number of Sampling Points</b>
Unit 30	5.0' x 8.0'	0.5	2.0	FPM, MHAP, Volumetric Flow Rate	25
				CO, HCHO, HCl/HF	3

#### 3.2 Method 2 Volumetric Flow Rate Determination

Gas velocity was measured following Method 2, for purposes of calculating gas volumetric flow rate and emission rates on a mass basis in conjunction with isokinetic sampling. An S-type pitot tube, as a component of the isokinetic sampling train, differential pressure gauge, thermocouple, and temperature readout were used to determine gas velocity at each sample point. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the Appendix H of this report.

#### 3.3 Method 3A O<sub>2</sub> and CO<sub>2</sub> Determination

O<sub>2</sub> and CO<sub>2</sub> concentrations were determined in accordance with Method 3A. A Servomex and ECOM analyzer were used to determine O<sub>2</sub> concentrations during sampling to determine molecular weight of the stack gas and to calculate concentrations corrected to a 15% O<sub>2</sub> basis. During the particulate testing a number of the post calibrations for the O<sub>2</sub> did not meet drift or system bias requirements. These calibrations caused a high bias associated with the correction of emission rates to a 15% O<sub>2</sub> basis.

#### 3.4 Method 4 Moisture Determination

Stack gas moisture content was determined using a Method 4 sampling train as a component of the isokinetic sampling systems. In this technique, stack gas is drawn through a series of impingers. The impingers were prepared according to the underlying method. The entire impinger train was measured or weighed before and after each test run to determine the mass of moisture condensed.

During testing, the Method 4 sample train was incorporated in the manner specified in Method 5. All of the data specified in Method 4 (gas volume, delta H, impinger outlet well temperature, etc.) was recorded on field data sheets.

All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the Appendix H of this report.

### **3.5 Method 5 FPM Determination**

Flue gas FPM concentrations and emission rates were determined in accordance with Method 5 procedures. The probe and filter housing were maintained at a temperature of 248°F +/- 25°F. An Environmental Supply Company, Inc. sampling train was used to sample stack gas at an isokinetic rate. Impingers were utilized and recovered per Method 29 requirements. Impingers were weighed in order to determine moisture content. The total sample time per run was 200 minutes, with twenty-five (25) sample points being utilized (5 points per port, 5 total ports).

Particulate matter in a quartz-lined sample probe was recovered utilizing acetone; a minimum of three passes of the Teflon probe brush through the entire probe was performed, followed by a visual inspection of the acetone exiting the probe. Once the acetone solution exiting the probe was clear, the wash was considered complete, if not, another pass of the brush through the probe was made and inspected until the solution was clear. The nozzle was then removed from the probe and cleaned in a similar manner, utilizing an appropriately sized nozzle brush. The filter housing was washed a minimum of three times with acetone and inspected for cleanliness, and the filter was then placed in its' corresponding petri dish. The acetone wash and the filter were labeled and marked. Final sample analysis was performed off site by Mostardi Platt personnel in accordance with the method.

All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the Appendix H of this report

### **3.6 Method 29 Trace Metals Determination**

Stack gas trace metals concentrations and emission rates were determined in accordance with USEPA Method 29 procedures. The probe and filter housing were maintained at a temperature of 248°F +/- 25°F. An Environmental Supply Company, Inc. sampling train was used to sample stack gas at an isokinetic rate. The total sample time per run was 200 minutes, with twenty-five (25) sample points being utilized (5 points per port, 5 total ports).

Upon completion of particulate matter recovery, a 0.1N Nitric Acid ( $\text{HNO}_3$ ) rinse was performed on the quartz-lined sample probe; these washes were combined with the acetone wash and filter catch for front half metals determination. The filter housing was rinsed with 0.1N  $\text{HNO}_3$  and added to this fraction. Impingers one and two were initially charged with approximately 100mL of nitric peroxide, impinger three remained empty, and impingers four and five were each charged with approximately 100mL of acidic potassium permanganate, followed by impinger six which was charged with approximately 200g of silica gel. Impingers were recovered per Method 29 requirements. Impingers were weighed in order to determine moisture content. Sample analyses was performed off site by an approved laboratory in accordance with the method.

All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data is presented in the Appendix H of this report.

### 3.7 Method 301 Field Validation of Pollutant Measurement

The Limit of Detection (LOD) was determined for CO, HCHO, and HCl/HF in accordance with Section 15 of Method 301. The LOD is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. For this protocol, the LOD is defined as three times the standard deviation,  $S_o$ , at the blank level. Zero grade nitrogen was used to establish the blank value – such that seven (7) trials were performed with results determined accordingly.

METHOD DETECTION LIMITS	
Analyte	Detection Limit (ppmv wet)
Formaldehyde	0.1
CO	1.0
HCl	0.1
HF	0.1

### 3.8 Methods 10 and 320 Multigas CO, H<sub>2</sub>O, HCHO, and HCl/HF Determination

CO, H<sub>2</sub>O, HCHO, and HCl/HF were sampled via an MKS Multigas Fourier Transform Infrared (FTIR) analyzer. FTIR technology works on the principle that most gases absorb infrared light. This is true for all compounds with the exception of homonuclear diatomic molecules and noble gases such as: N<sub>2</sub>, O<sub>2</sub>, H<sub>2</sub>, He, Ne, and Ar. Vibrations, stretches, bends, and rotations within the bonds of a molecule determine the infrared absorption distinctiveness. The absorption creates a “fingerprint” which is unique to each given compound. The quantity of infrared light absorbed is proportional to the gas concentration. Most compounds have absorbencies at different infrared frequencies, thus allowing the simultaneous analysis of multiple compounds at one time. The FTIR software compares each sample spectrum to a user-selected list of calibration references and concentration data is generated.

Analyte spiking assured the ability of the FTIR to quantify constituents in the presence of effluent gas. All analyte spikes were introduced using an instrument grade stainless steel rotameter. All QA/QC procedures were within the acceptance criteria allowance of the applicable ASTM D6348-12 methodology and Method 320.

Per USEPA Method 4, 40CFR60, Appendix A, Section 16.3, USEPA Method 320 is an acceptable alternative to Method 4 for determining moisture. The gas sample is delivered to the FTIR by means of a heated probe, heated filter, heated sample line, heated pump, and heated jumper to generate a hot, wet sample heated to 375°F throughout the entire sample train for formaldehyde, acid gases, and moisture analyses. Results are collected on a wet basis and then converted to dry based utilizing H<sub>2</sub>O results. The dry concentration results were then corrected to 15% O<sub>2</sub> utilizing the Method 3A O<sub>2</sub> concentration determined simultaneously.

A stratification test was performed using oxygen (O<sub>2</sub>) prior to the testing. The results of the stratification test showed that all results were less than 5% on the unit. Consequently, all sampling was conducted from one port using one point. All samples below the FTIR detection limit were reported at the detection limit and used in averaging of each run. Stratification test is presented in Appendix D of this report.

FTIR QA/QC PROCEDURES						
QA/QC Specification	Purpose	Calibration Gas Analyte	Delivery	Frequency	Acceptance Criteria	Result
M320: Zero	Verify that the FTIR is free of contaminants & zero the FTIR	Nitrogen (zero)	Direct to FTIR	pre/post test	< MDL or Noise	<b>Pass</b>
M320: Calibration Transfer Standard (CTS) Direct	Verify FTIR stability, confirm optical path length	Ethylene	Direct to FTIR	pretest	+/- 5% cert. value	<b>Pass</b>
M320: CTS Response	Verify system stability, recovery, response time	Ethylene	Sampling System	Daily, pre/post test	+/- 5% of Direct Measurement	<b>Pass</b>
M320: Zero Response	Verify system is free of contaminants, system bias	Nitrogen (zero)	Sampling System	pretest	Bias correct data	<b>Pass</b>
M320: Analyte Spike	Verify system ability to deliver and quantify analyte of interest in the presence of other effluent gases	SF6 HCl	Dynamic Addition to Sampling System, ~1:10 effluent	pre test	+/- 30% theoretical recovery	<b>Pass</b>

Note: The determined concentrations from direct analyses were used in all system/spike recovery calculations.

## Analyte Spiking

HCl spiking were performed prior to testing and before each test run to verify the ability of the sampling system to quantitatively deliver a sample containing formaldehyde from the base of the probe to the FTIR. Analyte spiking assures the ability of the FTIR sampling system to recover acid gases in the presence of effluent gas.

As part of the spiking procedure, samples were measured to determine native formaldehyde and moisture concentrations to be used in the spike recovery calculations. Moisture in the stack gas prior to spiking and during spiking was used to determine dilution ratios of the formaldehyde. The spike target dilution ratio was 1:10 or less. The following equation illustrates the percent recovery calculation:

$$DF = 1 - \frac{H_2O (spike)}{(native)} \quad (\text{Sec. 9.2.3 (3) USEPA Method 320})$$

$$CS = DF * Spike_{dir} + Unspike(1 - DF) \quad (\text{Sec. 9.2.3 (4) USEPA Method 320})$$

DF = Dilution factor of the spike gas

$Spike_{dir}$  = Concentration of the analyte in the spike standard measure by the FTIR directly

CS = Expected concentration of the spiked samples

Unspike = Native concentration of analytes in unspiked samples

QA/QC data are found in Appendix G. Copies of gas cylinder certifications are found in Appendix I. The sample and data collection followed the procedures outlined in Method 320.

## 4.0 TEST RESULT SUMMARIES

Northern Natural Gas Clifton Compressor Station Unit 30 Formaldehyde Summary										
Run #	Run Date	Start Time	End Time	Flow, SCFH	H <sub>2</sub> O %	O <sub>2</sub> % (dry)	Formaldehyde ppmvw*	Formaldehyde ppmvd	Formaldehyde ppmvd @ 15% O <sub>2</sub>	Formaldehyde lb/hr
1	12/5/22	11:30	12:34	4,958,818	4.80%	16.7	ND	ND	ND	ND
2	12/5/22	12:55	13:54	5,039,940	4.81%	16.8	ND	ND	ND	ND
3	12/5/22	12:03	13:02	5,039,940	5.05%	16.3	ND	ND	ND	ND
4	12/5/22	15:28	16:27	5,039,940	5.07%	16.3	ND	ND	ND	ND
5	12/5/22	16:45	17:44	5,886,449	5.15%	16.3	ND	ND	ND	ND
6	12/5/22	18:01	19:00	5,886,449	5.19%	16.3	ND	ND	ND	ND
7	12/6/22	7:48	8:47	4,958,818	5.21%	16.1	ND	ND	ND	ND
<b>Average</b>				5,258,622	5.04%	16.4	ND	ND	ND	ND

\*All emission data was below the MDL of 0.1 ppmvw

Northern Natural Gas Clifton Compressor Station Unit 30 Hydrogen Fluoride Summary							
Run #	Run Date	Start Time	End Time	HF ppmvw*	HF ppmvd	HF ppmvd @ 15% O <sub>2</sub>	HF lb/hr
1	12/5/22	11:30	12:34	0.02	0.02	0.02	0.004
2	12/5/22	12:55	13:54	0.08	0.09	0.12	0.022
3	12/5/22	12:03	13:02	0.12	0.13	0.17	0.033
4	12/5/22	15:28	16:27	0.15	0.16	0.21	0.040
5	12/5/22	16:45	17:44	0.15	0.16	0.20	0.046
6	12/5/22	18:01	19:00	0.15	0.16	0.20	0.046
7	12/6/22	7:48	8:47	0.65	0.68	0.83	0.167
<b>Average</b>				0.19	0.20	0.25	0.051

\*Values below 0.1 ppmvw are reported as estimated values only

Northern Natural Gas Clifton Compressor Station Unit 30 Carbon Monoxide Summary							
Run #	Run Date	Start Time	End Time	CO ppmvw	CO ppmvd	CO ppmvd @ 15% O <sub>2</sub>	CO lb/hr
1	12/5/22	11:30	12:34	8.7	9.2	13.0	3.15
2	12/5/22	12:55	13:54	10.0	10.5	15.1	3.67
3	12/5/22	12:03	13:02	4.8	5.0	6.5	1.75
4	12/5/22	15:28	16:27	4.2	4.4	5.6	1.52
5	12/5/22	16:45	17:44	4.3	4.6	5.8	1.85
6	12/5/22	18:01	19:00	3.6	3.8	4.9	1.54
7	12/6/22	7:48	8:47	5.4	5.7	6.9	1.94
<b>Average</b>				5.9	6.2	8.3	2.20

Northern Natural Gas Clifton Compressor Station Unit 30 Hydrogen Chloride Summary							
Run #	Run Date	Start Time	End Time	HCl ppmvw	HCl ppmvd	HCl ppmvd @ 15% O <sub>2</sub>	HCl lb/hr
1	12/5/22	11:30	12:34	0.61	0.64	0.91	0.29
2	12/5/22	12:55	13:54	0.11	0.11	0.16	0.05
3	12/5/22	12:03	13:02	0.08	0.08	0.11	0.04
4	12/5/22	15:28	16:27	0.10	0.11	0.14	0.05
5	12/5/22	16:45	17:44	0.08	0.08	0.10	0.04
6	12/5/22	18:01	19:00	0.09	0.10	0.13	0.05
7	12/6/22	7:48	8:47	0.42	0.44	0.54	0.20
<b>Average</b>				0.21	0.22	0.30	0.10

\*Values below 0.1 ppmvw are reported as estimated values only

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Test Location: Unit 30  
 Test Method: 5/29

	Source Condition			Natural Gas				
	Date	12/5/22	12/6/22	12/6/22	12/7/22	12/7/22	12/7/22	12/8/22
	Start Time	12:55	7:21	11:37	7:34	11:32	15:23	8:52
	End Time	16:26	11:06	15:04	11:04	15:01	18:51	13:51
	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Average
<b>Stack Conditions</b>								
Average Gas Temperature, °F	926.9	940.1	870.8	937.5	935.5	937.9	934.6	926.2
Flue Gas Moisture, percent by volume	4.9%	5.3%	4.9%	5.1%	4.9%	5.4%	4.9%	5.1%
Average Flue Pressure, in. Hg	28.44	28.44	28.44	28.84	28.84	28.84	28.82	28.67
Gas Sample Volume, dscf	165.696	172.356	161.825	164.646	164.189	153.493	172.544	164.964
Average Gas Velocity, ft/sec	96.709	100.584	90.555	108.139	107.712	100.879	107.393	101.710
Gas Volumetric Flow Rate, acfm	232,102	241,403	217,333	259,533	258,509	242,109	257,743	244,105
Gas Volumetric Flow Rate, dscfm	79,854	81,971	77,995	89,721	89,636	83,416	89,377	84,567
Gas Volumetric Flow Rate, scfm	83,999	86,545	81,975	94,525	94,290	88,154	94,007	89,071
Average %CO <sub>2</sub> by volume, dry basis	2.6	2.8	2.5	2.7	2.5	2.6	2.2	2.6
Average %O <sub>2</sub> by volume, dry basis	16.3	16.1	17.0	16.8	16.7	16.6	17.4	16.7
Isokinetic Variance	102.2	103.5	102.1	90.3	90.2	90.6	95.0	96.3
Standard Fuel Factor Fd, dscf/mmBtu	8,710.0	8,710.0	8,710.0	8,710.0	8,710.0	8,710.0	8,710.0	4,977.1
<b>Filterable Particulate Matter (Method 5)</b>								
grams collected	0.00464	0.00117	0.00104	0.00081	0.00101	0.00091	0.00205	0.00166
mg/dscm	0.989	0.240	0.227	0.174	0.217	0.209	0.420	0.354
grains/dscf	0.0004	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002
grains/dscf @ 15% O <sub>2</sub>	0.0005	0.0001	0.0002	0.0001	0.0001	0.0001	0.0003	0.0002
lb/hr	0.296	0.074	0.066	0.058	0.073	0.065	0.140	0.110



Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Test Location: Unit 30  
 Test Method: 5/29

Source Condition	Natural Gas							
Date	12/5/22	12/6/22	12/6/22	12/7/22	12/7/22	12/7/22	12/8/22	
Start Time	12:55	7:21	11:37	7:34	11:32	15:23	8:52	
End Time	16:26	11:06	15:04	11:04	15:01	18:51	13:51	
	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Average
<b>Stack Conditions</b>								
Average Gas Temperature, °F	926.9	940.1	870.8	937.5	935.5	937.9	934.6	926.2
Flue Gas Moisture, percent by volume	4.9%	5.3%	4.9%	5.1%	4.9%	5.4%	4.9%	5.1%
Average Flue Pressure, in. Hg	28.44	28.44	28.44	28.84	28.84	28.84	28.82	28.67
Gas Sample Volume, dscf	165,696	172,356	161,825	164,646	164,189	153,493	172,544	164,964
Average Gas Velocity, ft/sec	96.709	100.584	90.555	108.139	107.712	100.879	107.393	101.710
Gas Volumetric Flow Rate, acfm	232,102	241,403	217,333	259,533	258,509	242,109	257,743	244,105
Gas Volumetric Flow Rate, dscfm	79,854	81,971	77,995	89,721	89,636	83,416	89,377	84,567
Gas Volumetric Flow Rate, scfm	83,999	86,545	81,975	94,525	94,290	88,154	94,007	89,071
Average %CO <sub>2</sub> by volume, dry basis	2.6	2.8	2.5	2.7	2.5	2.6	2.2	2.6
Average %O <sub>2</sub> by volume, dry basis	16.3	16.1	17.0	16.8	16.7	16.6	17.4	16.7
Isokinetic Variance	102.2	103.5	102.1	90.3	90.2	90.6	95.0	96.3
Standard Fuel Factor Fd, dscf/mmBtu	8,710.0	8,710.0	8,710.0	8,710.0	8,710.0	8,710.0	8,710.0	8,710.0
<b>Mercury (Hg) Emissions</b>								
ug of sample collected	≤ 0.57	≤ 0.43	≤ 0.35	≤ 0.45	≤ 0.44	≤ 0.37	≤ 0.39	≤ 0.43
ppb	≤ 0.02	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01
mg/dscm	≤ 1.21E-04	≤ 8.80E-05	≤ 7.55E-05	≤ 1.00E-04	≤ 9.00E-05	≤ 8.00E-05	≤ 8.00E-05	≤ 9.07E-05
mg/dscm @15% O <sub>2</sub>	≤ 1.55E-04	≤ 1.08E-04	≤ 1.14E-04	≤ 1.44E-04	≤ 1.26E-04	≤ 1.10E-04	≤ 1.35E-04	≤ 1.28E-04
lb/hr	≤ 3.60E-05	≤ 2.70E-05	≤ 2.20E-05	≤ 3.20E-05	≤ 3.10E-05	≤ 2.60E-05	≤ 2.70E-05	≤ 2.87E-05
<b>Antimony (Sb) Emissions</b>								
ug of sample collected	≤ 3.40	≤ 3.48	≤ 3.40	≤ 3.45	≤ 3.40	≤ 3.56	≤ 3.40	≤ 3.44
ppb	≤ 0.14	≤ 0.14	≤ 0.15	≤ 0.15	≤ 0.14	≤ 0.16	≤ 0.14	≤ 0.15
ug/dscm	≤ 7.20E-01	≤ 7.10E-01	≤ 7.40E-01	≤ 7.40E-04	≤ 7.30E-04	≤ 8.20E-04	≤ 7.00E-04	≤ 3.10E-01
mg/dscm @15% O <sub>2</sub>	≤ 1.71E-03	≤ 1.61E-03	≤ 2.07E-03	≤ 1.97E-06	≤ 1.89E-06	≤ 2.08E-06	≤ 2.18E-06	≤ 7.71E-04
lb/hr	≤ 2.17E-04	≤ 2.19E-04	≤ 2.17E-04	≤ 2.49E-04	≤ 2.46E-04	≤ 2.56E-04	≤ 2.33E-04	≤ 2.34E-04
<b>Arsenic (As) Emissions</b>								
ug of sample collected	≤ 1.20	≤ 1.20	≤ 1.20	≤ 1.20	≤ 1.20	≤ 1.20	≤ 1.20	≤ 1.20
ppb	≤ 0.08	≤ 0.08	≤ 0.08	≤ 0.08	≤ 0.08	≤ 0.09	≤ 0.08	≤ 0.08
ug/dscm	≤ 2.60E-01	≤ 2.50E-01	≤ 2.60E-01	≤ 2.60E-04	≤ 2.60E-04	≤ 2.80E-04	≤ 2.50E-04	≤ 1.10E-01
mg/dscm @15% O <sub>2</sub>	≤ 6.16E-04	≤ 5.68E-04	≤ 7.27E-04	≤ 6.91E-07	≤ 6.75E-07	≤ 7.10E-07	≤ 7.79E-07	≤ 2.73E-04
lb/hr	≤ 7.60E-05	≤ 7.50E-05	≤ 7.70E-05	≤ 8.60E-05	≤ 8.70E-05	≤ 8.60E-05	≤ 8.20E-05	≤ 8.13E-05
<b>Beryllium (Be) Emissions</b>								
ug of sample collected	≤ 0.27	≤ 0.27	≤ 0.27	≤ 0.27	≤ 0.27	≤ 0.27	≤ 0.27	≤ 0.27
ppb	≤ 0.15	≤ 0.15	≤ 0.16	≤ 0.15	≤ 0.16	≤ 0.17	≤ 0.15	≤ 0.15
ug/dscm	≤ 6.00E-02	≤ 6.00E-02	≤ 6.00E-02	≤ 6.00E-05	≤ 6.00E-05	≤ 6.00E-05	≤ 6.00E-05	≤ 2.57E-02
mg/dscm @15% O <sub>2</sub>	≤ 1.42E-04	≤ 1.36E-04	≤ 1.68E-04	≤ 1.60E-07	≤ 1.56E-07	≤ 1.52E-07	≤ 1.87E-07	≤ 6.38E-05
lb/hr	≤ 1.70E-05	≤ 1.70E-05	≤ 1.70E-05	≤ 1.90E-05	≤ 1.90E-05	≤ 1.90E-05	≤ 1.80E-05	≤ 1.80E-05
<b>Cadmium (Cd) Emissions</b>								
ug of sample collected	≤ 0.42	≤ 3.00	≤ 0.27	≤ 0.27	≤ 0.27	≤ 0.27	≤ 0.27	≤ 0.68
ppb	≤ 0.02	≤ 0.13	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.03
ug/dscm	≤ 9.00E-02	≤ 6.10E-01	≤ 6.00E-02	≤ 6.00E-05	≤ 6.00E-05	≤ 6.00E-05	≤ 6.00E-05	≤ 1.09E-01
mg/dscm @15% O <sub>2</sub>	≤ 2.13E-04	≤ 1.39E-03	≤ 1.68E-04	≤ 1.60E-07	≤ 1.56E-07	≤ 1.52E-07	≤ 1.87E-07	≤ 2.52E-04
lb/hr	≤ 2.70E-05	≤ 1.89E-04	≤ 1.70E-05	≤ 1.90E-05	≤ 1.90E-05	≤ 1.90E-05	≤ 1.80E-05	≤ 4.40E-05

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Test Location: Unit 30  
 Test Method: 5/29

	Source Condition		Natural Gas						
	Date		12/5/22	12/6/22	12/6/22	12/7/2022	12/7/22	12/7/22	12/8/22
Start Time	12:55	7:21	12:55	7:21	11:37	7:34	11:32	15:23	8:52
End Time	16:26	11:06	16:26	11:06	15:04	11:04	15:01	18:51	13:51
	Run 1	Run 2	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7
Average									
<b>Stack Conditions</b>									
Average Gas Temperature, °F	926.9	940.1	870.8	937.5	935.5	937.9	934.6	926.2	
Flue Gas Moisture, percent by volume	4.9%	5.3%	4.9%	0.1	4.9%	5.4%	4.9%	5.1%	
Average Flue Pressure, in. Hg	28.44	28.44	28.44	28.8	28.84	28.84	28.82	28.67	
Gas Sample Volume, dscf	165.696	172.356	161.825	164.6	164.189	153.493	172.544	164.964	
Average Gas Velocity, ft/sec	96.709	100.584	90.555	108.1	107.712	100.879	107.393	101.710	
Gas Volumetric Flow Rate, acfm	232,102	241,403	217,333	259533.0	258,509	242,109	257,743	244,105	
Gas Volumetric Flow Rate, dscfm	79,854	81,971	77,995	89721.0	89,636	83,416	89,377	84,567	
Gas Volumetric Flow Rate, scfm	83,999	86,545	81,975	94525.0	94,290	88,154	94,007	89,071	
Average %CO <sub>2</sub> by volume, dry basis	2.6	2.8	2.5	2.7	2.5	2.6	2.2	2.6	
Average %O <sub>2</sub> by volume, dry basis	16.3	16.1	17.0	16.8	16.7	16.6	17.4	16.7	
Isokinetic Variance	102.2	103.5	102.1	90.3	90.2	90.6	95.0	96.3	
Standard Fuel Factor Fd, dscf/mmBtu	8,710.0	8,710.0	8,710.0	8710.0	8,710.0	8,710.0	8,710.0	8,710.0	
<b>Chromium (Cr) Emissions</b>									
ug of sample collected	≤ 10.80	≤ 4.80	≤ 4.90	≤ 6.50	≤ 5.00	≤ 5.20	7.30	≤ 6.36	
ppb	≤ 1.06	≤ 0.46	≤ 0.49	≤ 0.64	≤ 0.50	≤ 0.55	0.69	≤ 0.63	
mg/dscm	≤ 2.30E-03	≤ 9.80E-04	≤ 1.07E-03	≤ 1.39E-03	≤ 1.08E-03	≤ 1.20E-03	1.49E-03	≤ 1.36E-03	
mg/dscm @ 15% O <sub>2</sub>	≤ 2.95E-03	≤ 1.20E-03	≤ 1.62E-03	≤ 2.00E-03	≤ 1.52E-03	≤ 1.65E-03	2.51E-03	≤ 1.92E-03	
lb/hr	≤ 7.00E-04	≤ 3.00E-04	≤ 3.00E-04	≤ 5.00E-04	≤ 4.00E-04	≤ 4.00E-04	5.00E-04	≤ 4.43E-04	
<b>Cobalt (Co) Emissions</b>									
ug of sample collected	1.30	≤ 0.28	0.42	≤ 0.48	≤ 0.31	≤ 0.27	0.30	≤ 0.48	
ppb	0.11	≤ 0.02	0.04	≤ 0.04	≤ 0.03	≤ 0.03	0.03	≤ 0.04	
mg/dscm	2.80E-04	≤ 6.00E-05	9.00E-05	≤ 1.00E-04	≤ 7.00E-05	≤ 6.00E-05	6.00E-05	≤ 1.03E-04	
mg/dscm @ 15% O <sub>2</sub>	3.59E-04	≤ 7.38E-05	1.36E-04	≤ 1.44E-04	≤ 9.83E-05	≤ 8.23E-05	1.01E-04	≤ 1.42E-04	
lb/hr	1.00E-04	≤ 1.80E-05	2.70E-05	≤ 3.50E-05	≤ 2.30E-05	≤ 1.90E-05	2.00E-05	≤ 3.46E-05	
<b>Lead (Pb) Emissions</b>									
ug of sample collected	2.69	1.15	≤ 1.01	≤ 0.98	≤ 0.99	1.04	≤ 1.00	≤ 1.27	
ppb	0.07	0.03	≤ 0.03	≤ 0.02	≤ 0.03	0.03	≤ 0.02	≤ 0.03	
mg/dscm	5.70E-04	2.40E-03	≤ 2.20E-04	≤ 2.10E-04	≤ 2.10E-04	2.40E-04	≤ 2.00E-04	≤ 5.79E-04	
mg/dscm @ 15% O <sub>2</sub>	7.31E-04	2.95E-03	≤ 3.33E-04	≤ 3.02E-04	≤ 2.95E-04	3.29E-04	≤ 3.37E-04	≤ 7.54E-04	
lb/hr	2.00E-04	1.00E-04	≤ 1.00E-04	≤ 1.00E-04	≤ 1.00E-04	1.00E-04	≤ 1.00E-04	≤ 1.14E-04	
<b>Manganese (Mn) Emissions</b>									
ug of sample collected	11.55	3.94	4.53	7.64	14.81	5.33	8.39	8.03	
ppb	1.08	0.35	0.43	0.72	1.39	0.54	0.75	0.75	
mg/dscm	2.46E-03	8.10E-04	9.90E-04	1.64E-03	3.19E-03	1.23E-03	1.72E-03	1.72E-03	
mg/dscm @ 15% O <sub>2</sub>	3.16E-03	9.96E-04	1.50E-03	2.36E-03	4.48E-03	1.69E-03	2.90E-03	2.44E-03	
lb/hr	7.00E-04	2.00E-04	3.00E-04	6.00E-04	1.10E-03	4.00E-04	6.00E-04	5.57E-04	
<b>Nickel (Ni) Emissions</b>									
ug of sample collected	30.26	12.06	10.68	10.69	6.08	11.04	8.16	12.71	
ppb	2.64	1.01	0.95	0.94	0.54	1.04	0.68	1.12	
mg/dscm	6.45E-03	2.47E-03	2.33E-03	2.29E-03	1.31E-03	2.54E-03	1.67E-03	2.72E-03	
mg/dscm @ 15% O <sub>2</sub>	8.27E-03	3.04E-03	3.52E-03	3.30E-03	1.84E-03	3.49E-03	2.82E-03	3.75E-03	
lb/hr	1.90E-03	8.00E-04	7.00E-04	8.00E-04	4.00E-04	8.00E-04	6.00E-04	8.57E-04	
<b>Selenium (Se) Emissions</b>									
ug of sample collected	≤ 10.10	≤ 3.00	≤ 3.00	≤ 3.00	≤ 3.00	≤ 3.00	≤ 3.00	≤ 4.01	
ppb	≤ 0.66	≤ 0.19	≤ 0.20	≤ 0.20	≤ 0.20	≤ 0.21	≤ 0.19	≤ 0.26	
mg/dscm	≤ 2.15E-03	≤ 6.10E-04	≤ 6.50E-04	≤ 6.40E-04	≤ 6.50E-04	≤ 6.90E-04	≤ 6.10E-04	≤ 8.57E-04	
mg/dscm @ 15% O <sub>2</sub>	≤ 2.76E-03	≤ 7.50E-04	≤ 9.83E-04	≤ 9.21E-04	≤ 9.13E-04	≤ 9.47E-04	≤ 1.03E-03	≤ 1.19E-03	
lb/hr	≤ 6.00E-04	≤ 2.00E-04	≤ 2.00E-04	≤ 2.00E-04	≤ 2.00E-04	≤ 2.00E-04	≤ 2.00E-04	≤ 2.57E-04	

## 5.0 CERTIFICATION


Mostardi Platt is pleased to have been of service to Northern Natural Gas. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

As the program 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.

MOSTARDI PLATT

  
\_\_\_\_\_  
Robert W. Carlisle

Program Manager

  
\_\_\_\_\_  
Eric L. Ehlers

Quality Assurance

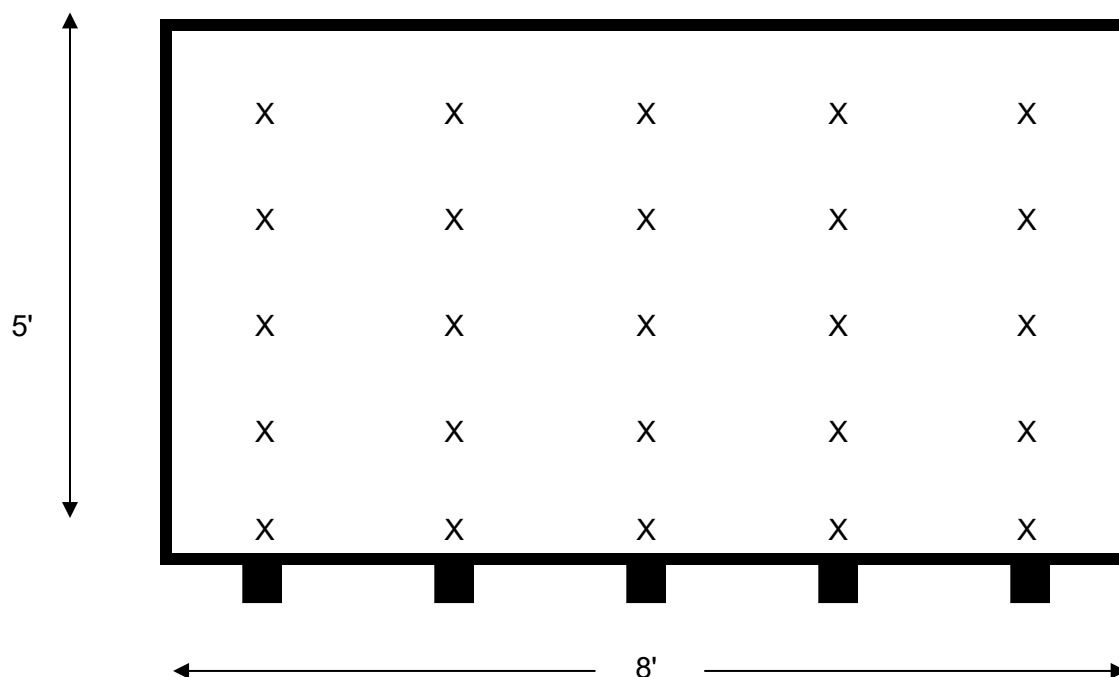
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## APPENDICES

**Appendix A - Test Section Diagrams**

# EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS

(Particulate Sampling)



Job: Northern Natural Gas Company  
Clifton Compressor Station  
Clifton, Kansas

Date: December 5 and 6, 2022

Area: 40.0 Square Feet

Test Location: Unit 30

No. Test Ports: 5

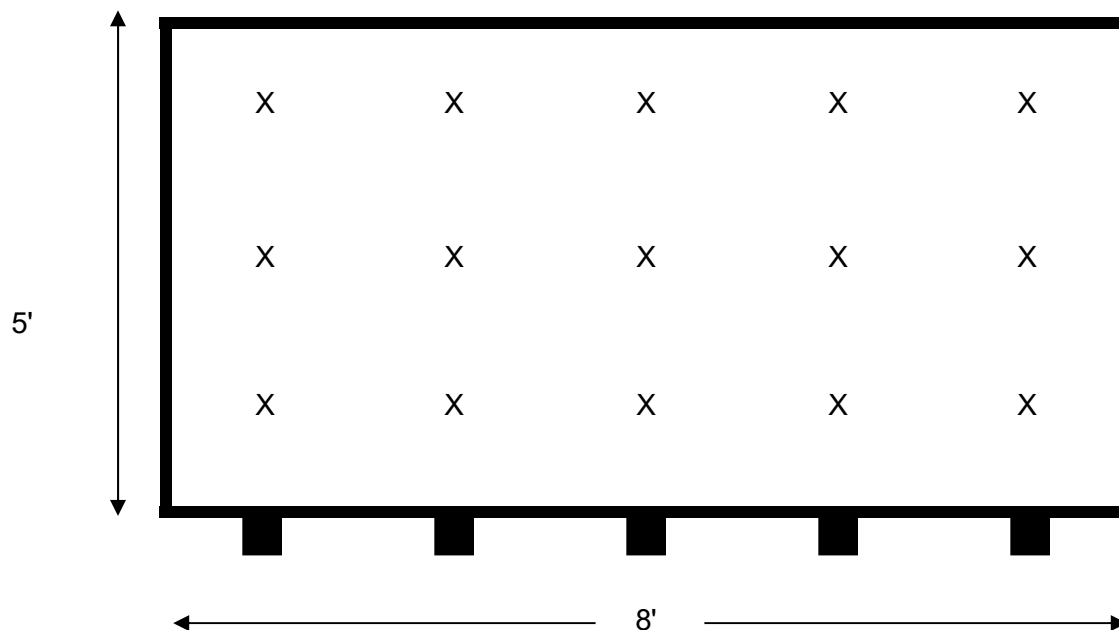
Length: 5.0 Feet

Tests Points per Port: 5

Width: 8.0 Feet

# EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS

(Gas Stratification)



Job: Northern Natural Gas Company  
Clifton Compressor Station  
Clifton, Kansas

Date: December 5, 2022

Area: 40 Square Feet

Test Location: Unit 30

No. Test Ports: 5

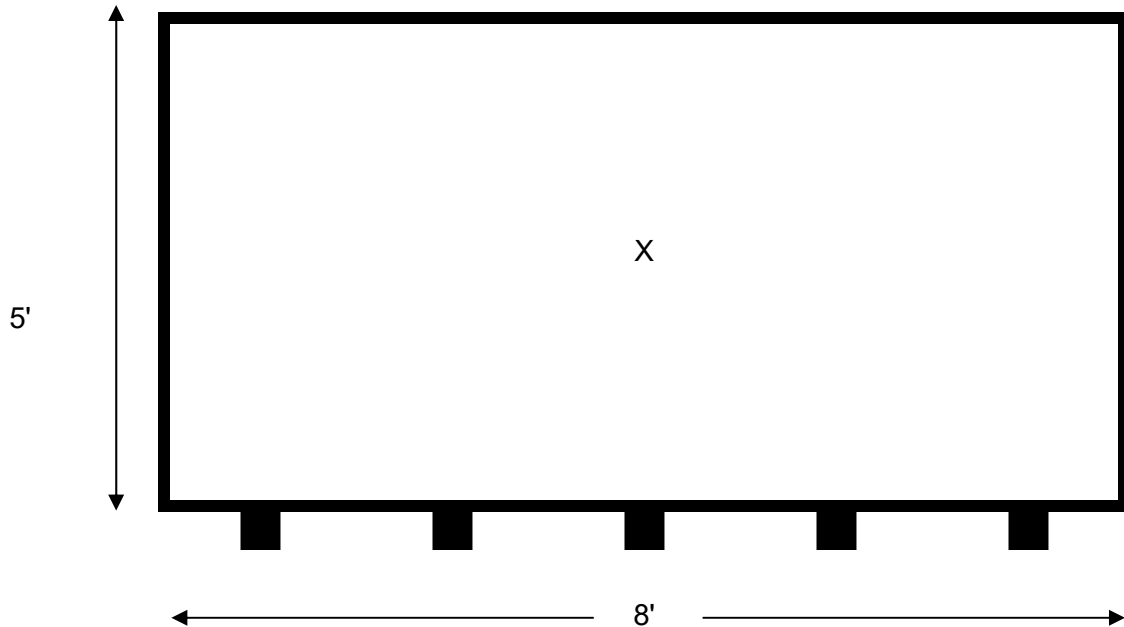
Length: 5 Feet

Tests Points per Port: 3

Width: 8 Feet

# EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS

(Gaseous Sample)



Job: Northern Natural Gas Company  
Clifton Compressor Station  
Clifton, Kansas

Date: December 5 and 6, 2022

Area: 40 Square Feet

Test Location: Unit 30

No. Test Ports: 1

Length: 5.0 Feet

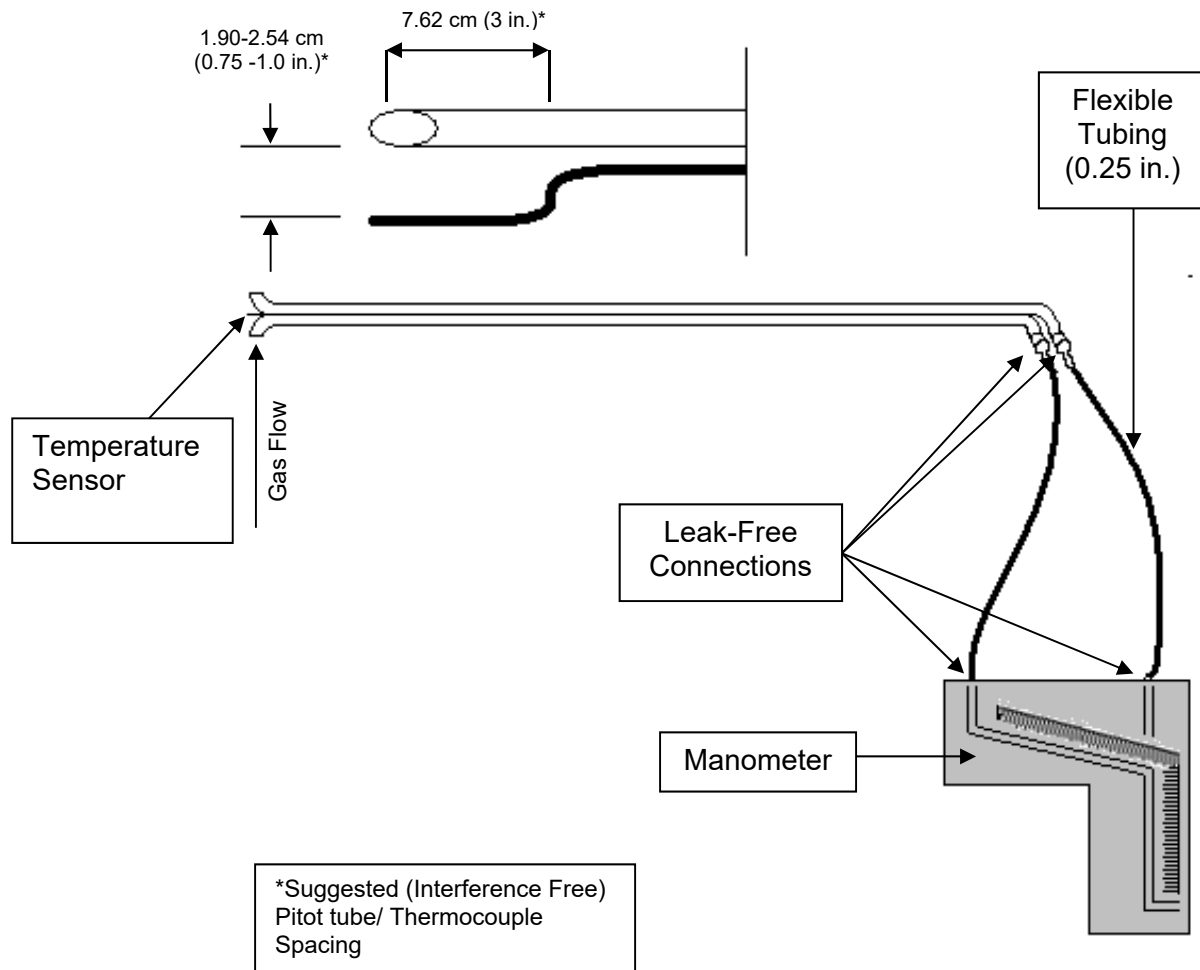
Tests Points per Port: 1

Width: 8.0 Feet

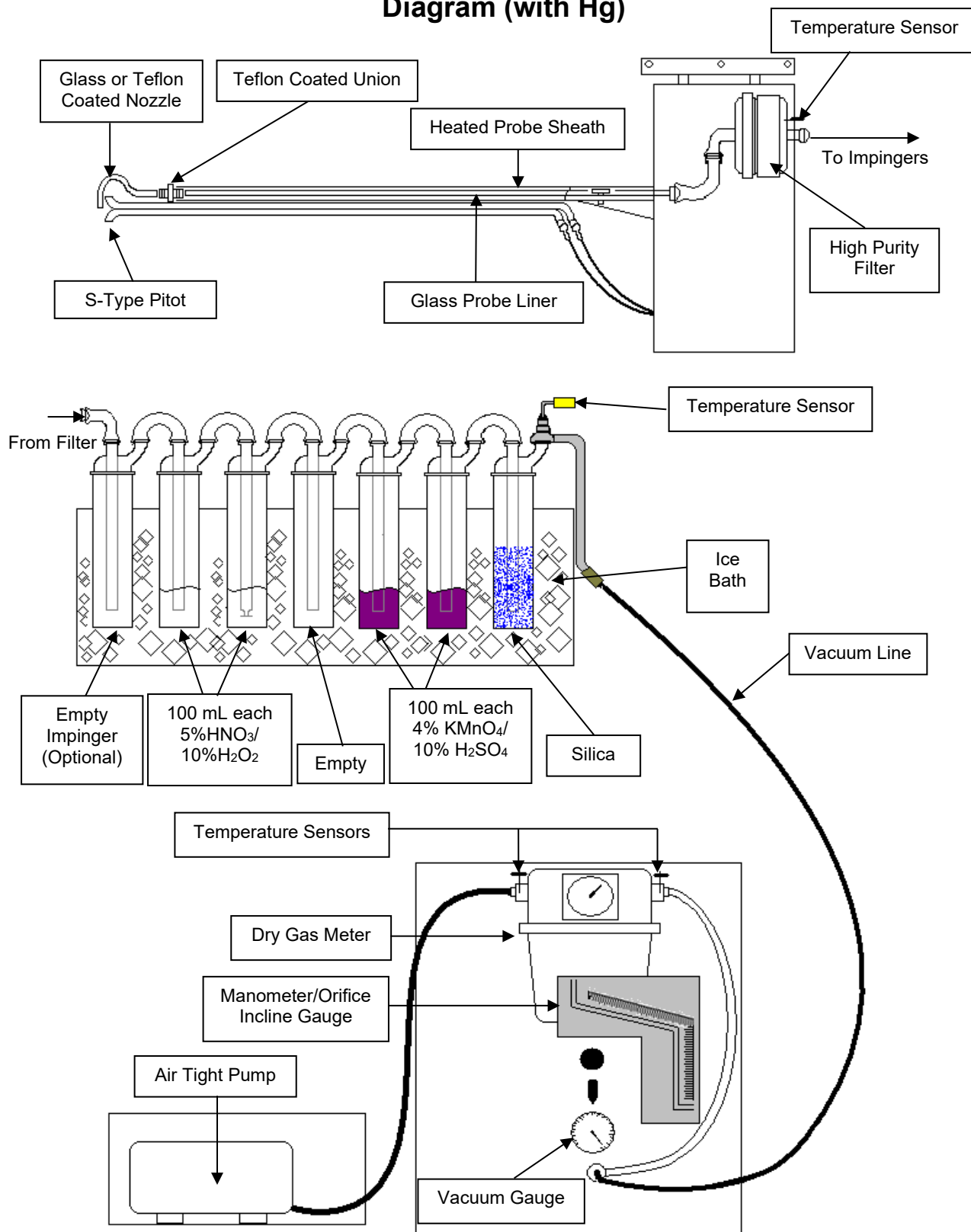


## Appendix B - Sample Train Diagrams

## USEPA Method 2 – Type S Pitot Tube Manometer Assembly



# USEPA Method 5/29- Particulate Matter/Metals Sample Train Diagram (with Hg)

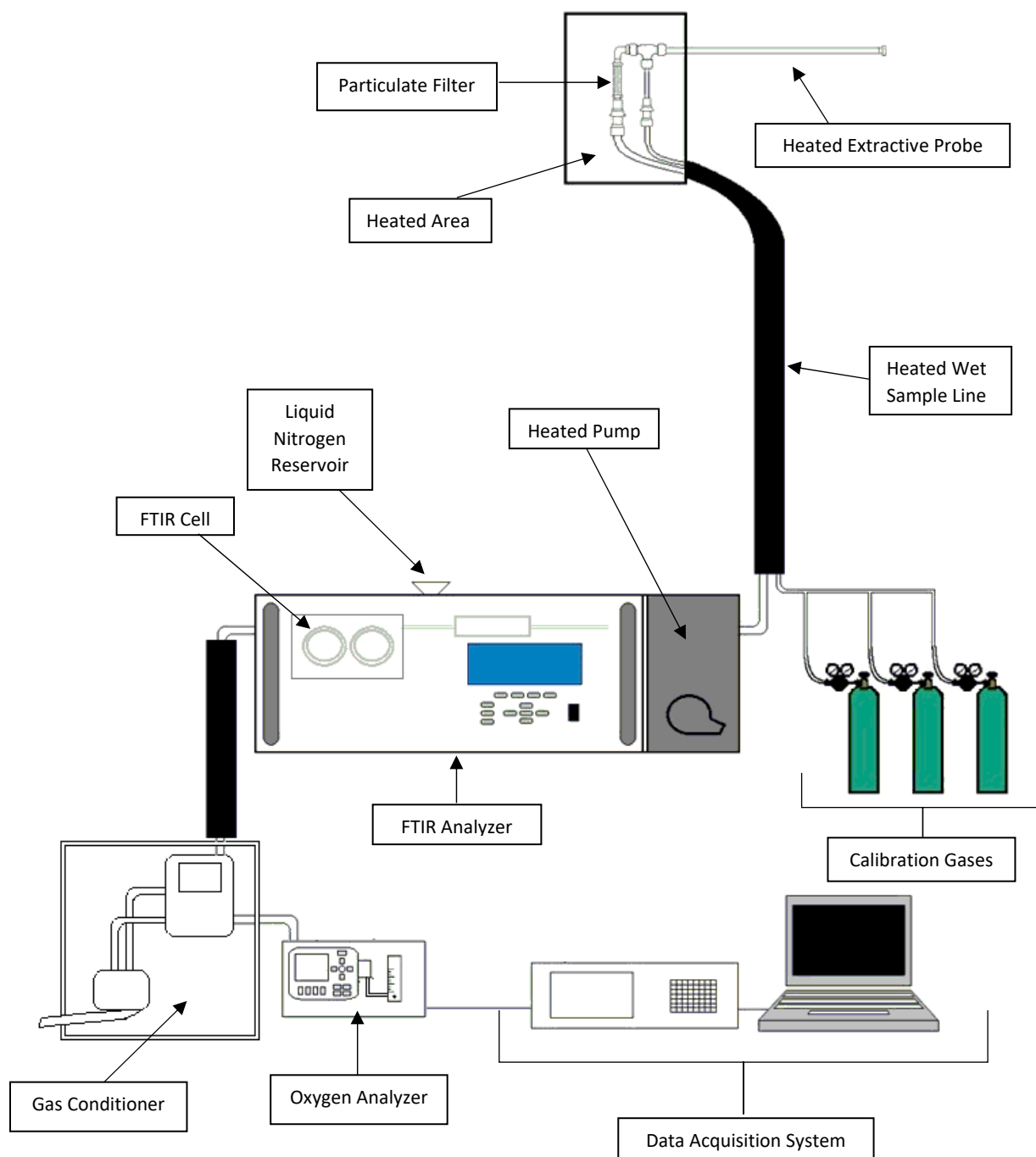


ATD-040 USEPA Method 5/29 (with Hg)

Rev. 1.2

1/1/2021

## USEPA Methods 3A, 10, and 320 – Sample Train Diagram



## **Appendix C - Calculation Nomenclature and Formulas**

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Project #:** Unit 30

**Test Location:** Unit 30  
**Date:** 12/5/22

### Sample Calculations

$$16.16 \% - -0.04 \% \quad \times \quad \frac{\text{O}_2 \% \text{ (dry)}}{\frac{10.120 \%}{12.11 \% - -0.04 \%}} = 13.5 \%$$

$$2.67 \% - 0.06 \% \quad \times \quad \frac{\text{CO}_2 \% \text{ (dry)}}{\frac{9.933 \%}{10.23 \% - 0.06 \%}} = 2.5 \%$$

$$C_{\text{gas}} = (C - C_o) \times \frac{C_{\text{ma}}}{C_m - C_o}$$

where:

$C_{\text{gas}}$  = Effluent gas concentration, dry basis, %

$C$  = Average gas concentration indicated by gas analyzer, dry basis, %

$C_o$  = Average of initial and final system calibration bias check responses for the zero gas, %

$C_m$  = Average of initial and final system calibration bias check responses for the upscale calibration gas, %

$C_{\text{ma}}$  = Actual concentration of the upscale calibration gas, %

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Test Location: Unit 30  
 Run: 1  
 Date: 12/5/2022  
 Method: 5/29  
 Source Condition: Normal

#### Dry Molecular Weight

$$M_d = 0.44 \times (\%CO_2) + 0.32 \times (\%O_2) + 0.28 \times \%N_2$$

$$\%CO_2 = \underline{2.6} \quad \%O_2 = \underline{16.3} \quad \%N_2 = \underline{81.1}$$

$$M_d = \underline{29.068}$$

#### Wet Molecular Weight

$$M_s = M_d \times (1 - B_{ws}) + (18.0 \times B_{ws})$$

$$M_d = \underline{29.068} \quad B_{ws} = \underline{0.049}$$

$$M_s = \underline{28.522}$$

#### Meter Volume at Standard Conditions

$$V_m(\text{std}) = 17.647 \times Y \times V_m \times \frac{(P_{\text{bar}} + DH/13.6)}{T_m}$$

$$Y = \underline{1.008} \quad V_m = \underline{173.596} \quad P_{\text{bar}} = \underline{28.37}$$

$$DH = \underline{2.43} \quad T_m = \underline{532.0}$$

$$V_m(\text{std}) = \underline{165.696}$$

#### Volume of Water Vapor Condensed

$$V_w(\text{std}) = 0.0471 \times (\text{net } H_2O \text{ gain})$$

$$\text{Net } H_2O = \underline{182.6}$$

$$V_w(\text{std}) = \underline{8.600}$$

#### Moisture Content

$$B_{ws} = \frac{V_w(\text{std})}{V_w(\text{std}) + V_m(\text{std})}$$

$$V_w(\text{std}) = \underline{8.600} \quad V_m(\text{std}) = \underline{165.696}$$

$$B_{ws} = \underline{0.049}$$

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Test Location: Unit 30  
 Run: 1  
 Date: 12/5/2022  
 Method: 5/29  
 Source Condition: Normal

#### Average Duct Velocity

$$V_s = 85.49 \times C_p \times \sqrt{DP \text{ (avg)}} \times (T_s \text{ (avg)} + 460 / (P_s \times M_s))^{1/2}$$

$$C_p = \frac{0.840}{28.44} \quad T_s \text{ (avg)} = \frac{926.9}{28.522} \quad \sqrt{DP \text{ (avg)}} = 1.030$$

$$V_s = 96.709$$

#### Volumetric Flow Rate (Actual Basis)

$$Q = V_s \times A \times 60$$

$$V_s = 96.709 \quad A = 40.000$$

$$Q = 232,102$$

#### Volumetric Flow Rate (Standard Basis)

$$Q_{std} = 17.647 \times Q \times \frac{P_s}{T_s \text{ (avg)} + 460}$$

$$Q = 232,102 \quad P_s = 28.44 \quad T_s \text{ (avg)} = 926.9$$

$$Q_{std} = 83,999$$

#### Volumetric Flow Rate (Standard Dry Basis)

$$Q_{std}(\text{dry}) = Q_{std} \times (1 - Bws)$$

$$Q_{std} = 83,999 \quad Bws = 0.049$$

$$Q_{std}(\text{dry}) = 79,854$$

#### Isokinetic Variation:

$$\%ISO = \frac{0.0945 \times (T_s + 460) \times V_m(\text{std})}{V_s \times \theta \times A_n \times P_s \times (1 - Bws)}$$

$$T_s = \frac{926.9}{0.0004065} \quad V_m(\text{std}) = \frac{165.696}{200} \quad V_s = \frac{96.709}{28.44}$$

$$Bws = 0.049$$

$$\%ISO = 102.2$$



Client: Northern Natural Gas Company  
Facility: Clifton Compressor Station  
Test Location: Unit 30  
Run: 1  
Date: 12/5/2022  
Method: 5/29  
Source Condition: Normal

**PM Concentration:**

This example represents the filterable fraction. For other fractions, use the obtained mn for that particulate fraction.

$$Co = \frac{m_n \times 15.43}{Vm(std)}$$

$$m_n (g) = \underline{0.00464} \quad Vm(std) = \underline{165.696}$$

$$Co = \underline{0.0004} \text{ gr/dscf}$$

**PM Emission Rate:**

$$\text{Emission Rate lb/hr} = \frac{Co}{7,000} \times Qstd(dry) \times 60$$

$$Co = \underline{0.0004} \quad Qstd(dry) = \underline{79,854}$$

$$\text{Emission Rate lb/hr} = \underline{0.296} \text{ lb/hr}$$

Client: Northern Natural Gas  
 Facility: Clifton Compressor Station  
 Project #: M224514  
 Test Location: Unit 30  
 Date: 12/5/22

## FTIR Sample Calculations

### Direct Recovery % of Calibration Transfer Standard

$$DR_{cts} = \frac{D_{cts}}{Cma} \times 100$$

$$Cma = 99.0$$

$$D_{cts} = 96.8$$

$$DR_{cts} = 97.7\%$$

### Recovery % with Calibration Transfer Standard System Purge

$$R_{cts} = \frac{Sys_{cts}}{D_{cts}} \times 100$$

$$Sys_{cts} = 97.5$$

$$D_{cts} = 96.8$$

$$R_{cts} = 101\%$$

### Direct Recovery % of Analyte Spike Gas

SF6

$$DR_{sf6} = \frac{D_{sf6}}{Cma} \times 100$$

$$Cma = 5.0$$

$$D_{sf6} = 4.8$$

$$DR_{sf6} = 95.1\%$$

HCl ppmvw

$$DR_{asg} = \frac{D_{asg}}{Cma} \times 100$$

$$Cma = 49.7$$

$$D_{asg} = 38.9$$

$$DR_{asg} = 78.3\%$$

### Dilution Factor for Analyte Spiking

$$DF = \frac{Spk_{sf6}}{D_{sf6}}$$

$$Spk_{sf6} = 0.383$$

$$D_{sf6} = 4.760$$

$$DF = 0.081$$

### Recovery % for Analyte Spike With HCl ppmvw

$$R_x = \frac{Spk_x}{(N_x \times (1-DF) + D_{asg} \times DF)}$$

$$Spk_x = 2.7$$

$$N_x = 0.0$$

$$DF = 0.081$$

$$D_{asg} = 38.9$$

$$R_x = 86.5 \quad \%$$

where:

**DR<sub>cts</sub>** = Recovery % of the calibration transfer standard directly to the analyzer

**Cma** = certified concentration of calibration gas, ppm

**D<sub>cts</sub>** = Concentration of the calibration transfer standard gas directly to the analyzer, ppm

**R<sub>cts</sub>** = Recovery % of the calibration transfer standard through the sampling system

**Sys<sub>cts</sub>** = Concentration of the calibration transfer standard gas through the system, ppm

**DF** = Dilution Factor of analyte spike gas

**Spk<sub>sf6</sub>** = SF6 concentration in effluent during spiking

**Spk<sub>x</sub>** = Analyte concentration in effluent during spiking

**D<sub>asg</sub>** = Concentration of the analyte spike gas directly to the analyzer, ppm

**D<sub>sf6</sub>** = Concentration of the SF6 directly to the analyzer, ppm

**R<sub>x</sub>** = Recovery % of the analyte spike gas

**N<sub>x</sub>** = Native effluent (HCl ppmvw) concentration prior to analyte spike

# MOSTARDI PLATT

## Volumetric Flow Nomenclature

- A = Cross-sectional area of stack or duct, ft<sup>2</sup>
- Bws = Water vapor in gas stream, proportion by volume
- Cp = Pitot tube coefficient, dimensionless
- Md = Dry molecular weight of gas, lb/lb-mole
- Ms = Molecular weight of gas, wet basis, lb/lb-mole
- Mw = Molecular weight of water, 18.0 lb/lb-mole
- Pbar = Barometric pressure at testing site, in. Hg
- Pg = Static pressure of gas, in. Hg (in. H<sub>2</sub>O/13.6)
- DH = Static pressure of gas, in. H<sub>2</sub>O
- Ps = Absolute pressure of gas, in. Hg = Pbar + Pg
- Pstd = Standard absolute pressure, 29.92 in. Hg
- Acfm = Actual volumetric gas flow rate
- Scfm = Volumetric gas flow rate, corrected to standard conditions
- Dscfm = Standard volumetric flow rate, corrected to dry conditions
- R = Ideal gas constant, 21.85 in. Hg-ft<sup>3</sup>/°R-lb-mole
- Ts = Average stack gas temperature, °F
- Tm = Average dry gas meter temperature, °F
- Tstd = Standard absolute temperature, 528°R
- vs = Gas velocity, ft/sec
- Vm(std) = Volume of gas sampled, corrected to standard conditions, scf
- Vw(std) = Volume of water vapor in gas sample, corrected to standard conditions, scf
- Vlc = Volume of liquid collected
- Y = Dry gas meter calibration factor
- Δp = Velocity head of gas, in. H<sub>2</sub>O
- K1 = 17.647 °R/in. Hg
- %EA = Percent excess air
- %CO<sub>2</sub> = Percent carbon dioxide by volume, dry basis
- %O<sub>2</sub> = Percent oxygen by volume, dry basis
- %N<sub>2</sub> = Percent nitrogen by volume, dry basis
- 0.264 = Ratio of O<sub>2</sub> to N<sub>2</sub> in air, v/v
- 0.28 = Molecular weight of N<sub>2</sub> or CO, divided by 100
- 0.32 = Molecular weight of O<sub>2</sub> divided by 100
- 0.44 = Molecular weight of CO<sub>2</sub> divided by 100
- 13.6 = Specific gravity of mercury (Hg)

# MOSTARDI PLATT

## Particulate Nomenclature

- A = Cross-sectional area of stack or duct, square feet  
 A<sub>n</sub> = Cross-sectional area of nozzle, square feet  
 B<sub>ws</sub> = Water vapor in gas stream, by volume  
 C<sub>a</sub> = Acetone blank residue concentration, g/g  
 C<sub>acf</sub> = Concentration of particulate matter in gas stream at actual conditions, gr/acf  
 C<sub>p</sub> = Pitot tube coefficient  
 C<sub>s</sub> = Concentration of particulate matter in gas stream, dry basis, corrected to standard conditions, gr/dscf  
 IKV = Isokinetic sampling variance, must be 90.0 % ≤ IKV ≤ 110.0%  
 M<sub>d</sub> = Dry molecular weight of gas, lb/lb-mole  
 M<sub>s</sub> = Molecular weight of gas, wet basis, lb/lb-mole  
 M<sub>w</sub> = Molecular weight of water, 18.0 lb/lb-mole  
 m<sub>a</sub> = Mass of residue of acetone after evaporation, grams  
 P<sub>bar</sub> = Barometric pressure at testing site, inches mercury  
 P<sub>g</sub> = Static pressure of gas, inches mercury (inches water/13.6)  
 P<sub>s</sub> = Absolute pressure of gas, inches mercury = P<sub>bar</sub> + P<sub>g</sub>  
 P<sub>std</sub> = Standard absolute pressure, 29.92 inches mercury  
 Q<sub>acfm</sub> = Actual volumetric gas flow rate, acfm  
 Q<sub>std</sub> = Dry volumetric gas flow rate corrected to standard conditions, dscfh  
 R = Ideal gas constant, 21.85 inches mercury cubic foot/°R-lb-mole  
 T<sub>m</sub> = Dry gas meter temperature, °R  
 T<sub>s</sub> = Gas temperature, °R  
 T<sub>std</sub> = Absolute temperature, 528°R  
 V<sub>a</sub> = Volume of acetone blank, ml  
 V<sub>aw</sub> = Volume of acetone used in wash, ml  
 W<sub>a</sub> = Weight of residue in acetone wash, grams  
 m<sub>n</sub> = Total amount of particulate matter collected, grams  
 V<sub>1c</sub> = Total volume of liquid collected in impingers and silica gel, ml  
 V<sub>m</sub> = Volume of gas sample as measured by dry gas meter, dcf  
 V<sub>m(std)</sub> = Volume of gas sample measured by dry gas meter, corrected to standard conditions, dscf  
 v<sub>s</sub> = Gas velocity, ft/sec  
 V<sub>w(std)</sub> = Volume of water vapor in gas sample, corrected to standard conditions, scf  
 Y = Dry gas meter calibration factor  
 ΔH = Average pressure differential across the orifice meter, inches water  
 Δp = Velocity head of gas, inches water  
 ρ<sub>a</sub> = Density of acetone, 0.7855 g/ml (average)  
 ρ<sub>w</sub> = Density of water, 0.002201 lb/ml  
 θ = Total sampling time, minutes  
 K<sub>1</sub> = 17.647 °R/in. Hg  
 K<sub>2</sub> = 0.04707 ft<sup>3</sup>/ml  
 K<sub>4</sub> = 0.09450/100 = 0.000945  
 K<sub>p</sub> = Pitot tube constant,  $85.49 \frac{\text{ft}}{\text{sec}} \left[ \frac{(\text{lb/lb-mole})(\text{in. Hg})}{(^{\circ}\text{R})(\text{in. H}_2\text{O})} \right]^{1/2}$   
 %EA = Percent excess air  
 %CO<sub>2</sub> = Percent carbon dioxide by volume, dry basis  
 %O<sub>2</sub> = Percent oxygen by volume, dry basis  
 %CO = Percent carbon monoxide by volume, dry basis  
 %N<sub>2</sub> = Percent nitrogen by volume, dry basis  
 0.264 = Ratio of O<sub>2</sub> to N<sub>2</sub> in air, v/v  
 28 = Molecular weight of N<sub>2</sub> or CO  
 32 = Molecular weight of O<sub>2</sub>  
 44 = Molecular weight of CO<sub>2</sub>  
 13.6 = Specific gravity of mercury (Hg)

# MOSTARDI PLATT

## Particulates Calculation Formulas

1.  $V_{w(std)} = V_{lc} \left( \frac{\rho_w}{M_w} \right) \left( \frac{RT_{std}}{P_{std}} \right) = K_2 V_{lc}$
2.  $V_{m(std)} = V_m Y \left( \frac{T_{std}}{T_m} \right) \left( \frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{P_{std}} \right) = K_1 V_m Y \frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{T_m}$
3.  $B_{ws} = \frac{V_{w(std)}}{(V_{m(std)} + V_{w(std)})}$
4.  $M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$
5.  $M_s = M_d (1 - B_{ws}) + 18.0(B_{ws})$
6.  $C_a = \frac{m_a}{V_a \rho_a}$
7.  $W_a = C_a V_{aw} \rho_a$
8.  $C_{acf} = 15.43 K_i \left( \frac{m_n P_s}{(V_{w(std)} + V_{m(std)}) T_s} \right)$
9.  $C_s = (15.43 \text{ grains/gram}) (m_n / V_{m(std)})$
10.  $v_s = K_p C_p \sqrt{\frac{\Delta P T_s}{P_s M_s}}$
11.  $Q_{acfm} = v_s A (60 \frac{\text{sec}}{\text{min}})$
12.  $Q_{sd} = (3600 \frac{\text{sec}}{\text{hr}}) (1 - B_{ws}) v_s \left( \frac{T_{std} P_s}{T_s P_{std}} \right) A$
13.  $E \text{ (emission rate, lbs/hr)} = Q_{std} (C_s / 7000 \text{ grains/lb})$
14.  $IKV = \frac{T_s V_{m(std)} P_{std}}{T_{std} v_s \theta A_n P_s 60 (1 - B_{ws})} = K_4 \frac{T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$
15.  $\%EA = \left( \frac{\%O_2 - (0.5 \%CO)}{0.264 \%N_2 - (\%O_2 - 0.5 \%CO)} \right) \times 100$

## **MOSTARDI PLATT**

### **ppm Conversion Calculations and Factors**

#### **ppm to lbs/scf**

$$(\text{ppm } X) \times (\text{conversion factor } X) = X \text{ lbs/scf}$$

#### **lbs/scf to lbs/hr**

Dry ppm's with dry flow, and wet ppm's with wet flow.

$$(X \text{ lbs/scf}) \times (\text{airflow scf/min}) \times (60 \text{ min/hr}) = X \text{ lbs/hr}$$

#### **lbs/scf to lbs/mmBtu**

Dry ppm's with dry diluent, and wet ppm's with wet diluent.

$$\text{CO}_2 - (X \text{ lbs/scf}) \times (F_c) \times (100/\text{CO}_2) = X \text{ lbs/mmBtu}$$

$$\text{O}_2 - (X \text{ lbs/scf}) \times (F_d) \times (20.9/(20.9-\text{O}_2)) = X \text{ lbs/mmBtu}$$

#### **Conversion Factors**

$$\text{CO} - 7.2664 \times 10^{-8}$$

$$\text{HCHO} - 7.7938 \times 10^{-8}$$

$$\text{HCl} - 9.4623 \times 10^{-8}$$

$$\text{HF} - 5.19309 \times 10^{-8}$$

## MOSTARDI PLATT

### Pollutant Concentration Correction 15% for Percent Oxygen

$$C_{adj} = C_d \frac{20.9 - 15\%}{20.9 - \%O_2}$$

where:

$C_{adj}$  = Pollutant concentration corrected to percent  $O_2$

20.9-15% = Percent  $O_2$ , the defined  $O_2$  correction value, percent

20.9 = Percent  $O_2$  in air

$\%O_2$  = Measured  $O_2$  concentration dry basis, percent

$C_d$  = Pollutant concentration measured, dry basis, ppm.

## MOSTARDI PLATT

### Volumetric Air Flow Calculations

$$Vm (std) = 17.647 \times Vm \times \left[ \frac{\left( P_{bar} + \left[ \frac{DH}{13.6} \right] \right)}{(460 + Tm)} \right] \times Y$$

$$Vw (std) = 0.0471 \times Vlc$$

$$Bws = \left[ \frac{Vw (std)}{Vw (std) + Vm (std)} \right]$$

$$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + [0.28 \times (100 - \%CO_2 - \%O_2)]$$

$$Ms = Md \times (1 - Bws) + (18 \times Bws)$$

$$Vs = \sqrt{\frac{(Ts + 460)}{Ms \times Ps}} \times \sqrt{DP} \times Cp \times 85.49$$

$$Acfm = Vs \times Area (of\ stack\ or\ duct) \times 60$$

$$Scfm = Acfm \times 17.647 \times \left[ \frac{Ps}{(460 + Ts)} \right]$$

$$Scfh = Scfm \times 60 \frac{min}{hr}$$

$$Dscfm = Scfm \times (1 - Bws)$$



# MOSTARDI PLATT

## Moisture Calculations

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w RT_{std}}{P_{std}M_w} = 0.04707(V_f - V_i)$$

$$V_{wsg(std)} = \frac{(W_f - W_i)\rho_w RT_{std}}{P_{std}M_w} = 0.04715(W_f - W_i)$$

$$V_{m(std)} = 17.64 V_m Y \frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Where:

$B_{ws}$  = Water vapor in gas stream, proportion by volume

$M_w$  = Molecular weight of water, 18.015 lb/lb-mole

$P_{bar}$  = Barometric pressure at the testing site, in. Hg

$P_{std}$  = Standard absolute pressure, 29.92 in. Hg

$R$  = Ideal gas constant,  $0.048137 \text{ (in. Hg)(ft}^3\text{)/(g-mole)(}^\circ\text{R)} =$   
 $[21.8348 \text{ (in. Hg)(ft}^3\text{)/(lb-mole)(}^\circ\text{R)}]/453.592 \text{ g-mole/lb-mole}$

$T_m$  = Absolute average dry gas meter temperature,  $^\circ\text{R}$

$T_{std}$  = Standard absolute temperature, 528  $^\circ\text{R}$

$V_f$  = Final volume of condenser water, ml

$V_i$  = Initial volume of condenser water, ml

$V_m$  = Dry gas volume measured by dry gas meter, dcf

$V_{m(std)}$  = Dry gas volume measured by dry gas meter, corrected to standard conditions, scf

$V_{wc(std)}$  = Volume of condensed water vapor, corrected to standard conditions, scf

$V_{wsg(std)}$  = Volume of water vapor collected in silica gel, corrected to standard conditions, scf

$W_f$  = Final weight of silica gel, g

$W_i$  = Initial weight of silica gel, g

$Y$  = Dry gas meter calibration factor

$\Delta H$  = Average pressure exerted on dry gas meter outlet by gas sample bag, in.  $\text{H}_2\text{O}$

$\rho_w$  = Density of water, 0.9982 g/ml

13.6 = Specific gravity of mercury (Hg)

17.64 =  $T_{std}/P_{std}$

0.04707 =  $\text{ft}^3/\text{ml}$                       0.04715 =  $\text{ft}^3/\text{g}$

## MOSTARDI PLATT

### Derivation of Factors Used In Carbon Monoxide Calculations

Factors for calculating concentration as pounds per dry standard cubic feet:

$$\begin{aligned}\text{Factor for } C_{\text{CO}} &= \frac{28.01 \text{ grams/gram - mole}}{2 \frac{\text{gram - equivalents}}{\text{gram - mole}} \times 1000 \frac{\text{gram - milliequivalents}}{\text{gram - equivalent}} \times 453.592 \frac{\text{grams}}{\text{lb}}} \\ &= 3.087577 \times 10^{-5} \text{ lb/g - meq} \quad \text{Use } 3.0876 \times 10^{-5}\end{aligned}$$

---

Factors for calculating from lb/dscf to parts per million:

Using 22.414 liters of gas per gram-mole at 0°C and 1 atmosphere pressure,

One pound-mole of gas is contained in 359.04765 ft<sup>3</sup> at 32°F and 29.92 in. Hg, or 385.31943 ft<sup>3</sup> at 68°F and 29.92 in. Hg

$$\text{ppm} = \frac{M \text{ lb/lb-mole}}{385.31943 \text{ dscf/lb-mole} \times 10^6} = 2.5952494 \times 10^{-9} M \text{ lb/dscf}$$

Where M = pollutant molecular weight; CO = 28.01 lb/lb-mole

$$\text{Factor for ppm CO} = \frac{1}{28.01 \times 2.5952 \times 10^{-9}} = 1.3762 \times 10^7 \text{ dscf/lb}$$

## MOSTARDI PLATT

### Trace Metal (Including Mercury) Sample Calculations

#### Concentration

$$\frac{\mu g}{m^3} = \frac{\mu g \text{ of trace metal}}{dscf \text{ volume sampled} \times 0.02832 \frac{m^3}{ft^3}}$$

#### Emission Rate

$$\frac{\mu g \text{ of sample} \times \frac{1 \times 10^{-6} \text{ grams}}{\mu g}}{453.6 \text{ gr/lb}} = \text{lbs of trace metal}$$

$$\frac{\text{lbs of trace metal}}{V_m(\text{std})\text{sample}} \times dscfm \times 60 \frac{\text{min}}{\text{hr}} = \text{lbs of trace metal/hr}$$

# MOSTARDI PLATT

## Emission Rate Calculations

A pollutant emission rate (E), expressed as pounds of pollutant per million Btu heat input from the fuel combusted can be calculated by several methods as follows:

- A.  $C = C_s/7000$  where, C = pollutant concentration, lb/dscf  
 $c_s$  = pollutant concentration, grains/dscf
- B. If fuel flow is monitored and the fuel combusted during the test is sampled and analyzed for gross calorific value, then:

$$E = \frac{Q_{sd} C}{\text{fuel flow rate (lb/hr) GCV}} \times 10^6$$

Where E = lbs per million Btu  
 GCV = gross calorific value, Btu/lb  
 $Q_{sd}$  = dry volumetric gas flow at standard conditions, dscf/hr

- C. If an integrated gas sample is taken during the test and analyzed for %CO<sub>2</sub> or %O<sub>2</sub>, dry basis by volume, with an approved USEPA Method 3 or 3A gas analyzer, then

$$E = CF_c \frac{100}{\%CO_2} \text{ or } E = CF_d \frac{20.9}{(20.9 - \%O_2)}$$

Where %CO<sub>2</sub> and %O<sub>2</sub> are expressed as percent values:

$F_c$  = a factor representing a ratio of the volume of carbon dioxide generated to the calorific value of the specified fuel type combusted in Figure 1.

$F_d$  = a factor representing a ratio of the volume of dry flue gases generated to the calorific value of the specified fuel type combusted in Figure 1.

Fuel Type	$F_d$	$F_c$	Fuel Type	$F_d$	$F_c$
Coal, Anthracite	10100	1970	Fuel Oil	9190	1420
Coal, Bituminous	9780	1800	Municipal	9570	1820
Coal, Lignite	9860	1910	Natural Gas	8710	1040
Coal, Sub-Bituminous	9820	1840	Wood	9240	1830

Figure 1. Fuel Type

- D. If fuel sample increments are taken and composited during the test and an ultimate analysis is performed and the GCV is determined, then

$$F_c = \frac{321 \times 10^3 (\%C)}{GCV} \text{ where } \%C = \text{Carbon content by weight expressed as percent}$$

$$F_d = \frac{[3.64(\%H) + 1.53(\%C) + 0.57(\%S) + 0.14(\%N) - 0.46(\%O_2)]}{GCV} \times 10^6$$

H = Hydrogen, percent; C = Carbon, percent; S = Sulfur, percent; N = Nitrogen, percent;  
 O = Oxygen, percent

## Appendix D - Reference Method Test Data

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Test Location: Unit 30  
Date: 12/5/22

Run 1

Spectrum	Time	FTIR Data						Analyzer Data		
		H2O %	CO2 % (wet)	HCl ppmvw	HF	Formaldehyde	CO ppmvw	Cell Temp	Pressure	O2 % (dry)
R1_SYS_000661.LAB	11:30	4.55	2.2	1.3	ND	ND	15.4	191.0	0.97	16.77
R1_SYS_000662.LAB	11:31	4.60	2.2	1.2	ND	ND	14.6	191.0	0.97	16.59
R1_SYS_000663.LAB	11:32	4.73	2.3	1.3	ND	ND	13.4	191.0	0.97	16.14
R1_SYS_000664.LAB	11:33	5.16	2.5	1.4	ND	ND	9.9	191.0	0.97	15.82
R1_SYS_000665.LAB	11:34	5.50	2.8	2.5	ND	ND	7.5	191.0	0.97	16
R1_SYS_000666.LAB	11:35	5.33	2.7	3.6	ND	ND	7.7	191.0	0.97	15.93
R1_SYS_000667.LAB	11:36	5.40	2.7	3.2	ND	ND	6.3	191.0	0.97	16.03
R1_SYS_000668.LAB	11:37	5.30	2.6	2.4	ND	ND	5.6	191.0	0.97	15.96
R1_SYS_000669.LAB	11:38	5.38	2.7	1.7	ND	ND	5.4	190.9	0.97	15.87
R1_SYS_000670.LAB	11:39	5.45	2.7	1.4	ND	ND	4.9	190.9	0.97	15.89
R1_SYS_000671.LAB	11:40	5.42	2.7	1.2	ND	ND	4.6	190.9	0.97	15.87
R1_SYS_000672.LAB	11:41	5.45	2.7	1.0	ND	ND	4.2	191.0	0.97	15.87
R1_SYS_000674.LAB	11:43	5.05	2.5	0.7	ND	ND	4.9	191.0	0.97	16.59
R1_SYS_000675.LAB	11:44	4.89	2.4	0.6	ND	ND	6.2	191.1	0.97	16.26
R1_SYS_000676.LAB	11:45	5.22	2.6	0.6	ND	ND	6.1	191.1	0.97	16.23
R1_SYS_000677.LAB	11:46	4.74	2.3	0.6	ND	ND	7.3	191.1	0.97	16.78
R1_SYS_000678.LAB	11:47	4.32	2.1	0.5	ND	ND	8.4	191.0	0.97	17.07
R1_SYS_000679.LAB	11:48	4.20	2.0	0.4	ND	ND	8.9	191.0	0.97	17.18
R1_SYS_000680.LAB	11:49	4.13	2.0	0.3	ND	ND	9.5	191.0	0.97	17.25
R1_SYS_000681.LAB	11:50	4.08	2.0	0.2	ND	ND	9.8	191.0	0.97	17.29
R1_SYS_000682.LAB	11:51	4.05	1.9	0.2	ND	ND	10.3	190.9	0.97	17.22
R1_SYS_000683.LAB	11:52	4.06	1.9	0.3	ND	ND	10.8	190.9	0.97	17.22
R1_SYS_000684.LAB	11:53	4.06	1.9	0.2	ND	ND	11.3	190.9	0.97	17.29
R1_SYS_000685.LAB	11:54	4.11	2.0	0.3	ND	ND	11.5	190.9	0.97	17.23
R1_SYS_000687.LAB	11:56	4.79	2.4	ND	ND	ND	10.6	191.0	0.97	16.59
R1_SYS_000688.LAB	11:57	4.83	2.4	0.2	ND	ND	10.4	191.0	0.97	16.5
R1_SYS_000689.LAB	11:58	4.34	2.1	0.1	ND	ND	9.4	191.0	0.97	16.48
R1_SYS_000690.LAB	11:59	4.88	2.4	0.2	ND	ND	10.6	191.0	0.97	16.96
R1_SYS_000691.LAB	12:00	4.65	2.3	ND	ND	ND	11.8	190.9	0.97	16.46
R1_SYS_000692.LAB	12:01	4.23	2.0	0.1	ND	ND	14.0	190.9	0.97	16.94
R1_SYS_000693.LAB	12:02	4.66	2.3	0.1	ND	ND	10.8	190.9	0.97	16.99
R1_SYS_000694.LAB	12:03	5.15	2.7	0.1	ND	ND	7.6	191.0	0.97	16.42
R1_SYS_000695.LAB	12:04	5.23	2.7	ND	ND	ND	6.8	191.0	0.97	15.94
R1_SYS_000696.LAB	12:05	5.23	2.7	ND	ND	ND	6.4	191.0	0.97	16.01
R1_SYS_000697.LAB	12:06	5.19	2.7	0.1	ND	ND	5.9	191.1	0.97	16
R1_SYS_000698.LAB	12:07	5.21	2.7	ND	ND	ND	5.4	191.1	0.97	15.96
R1_SYS_000700.LAB	12:09	5.30	2.7	0.1	ND	ND	4.9	191.0	0.97	15.9
R1_SYS_000701.LAB	12:10	4.93	2.4	ND	ND	ND	4.5	190.9	0.97	15.95
R1_SYS_000702.LAB	12:11	4.71	2.2	0.1	ND	ND	6.3	190.9	0.97	16.16
R1_SYS_000703.LAB	12:12	4.68	2.2	0.1	ND	ND	7.5	190.9	0.97	16.69
R1_SYS_000704.LAB	12:13	4.71	2.2	ND	ND	ND	7.7	191.0	0.97	16.83
R1_SYS_000705.LAB	12:14	4.54	2.1	ND	ND	ND	8.4	191.0	0.97	16.77
R1_SYS_000706.LAB	12:15	4.41	2.1	ND	ND	ND	9.2	191.0	0.97	16.85
R1_SYS_000707.LAB	12:16	4.38	2.1	ND	ND	ND	9.5	191.0	0.97	16.96
R1_SYS_000708.LAB	12:17	4.36	2.1	0.1	ND	ND	10.1	191.0	0.97	17.03
R1_SYS_000709.LAB	12:18	4.42	2.1	ND	ND	ND	10.5	191.0	0.97	17.06
R1_SYS_000710.LAB	12:19	4.63	2.2	0.2	ND	ND	10.6	191.0	0.97	17.07
R1_SYS_000712.LAB	12:20	5.08	2.5	0.2	ND	ND	8.8	190.9	0.97	17.01
R1_SYS_000713.LAB	12:23	5.17	2.6	0.5	ND	ND	8.5	190.9	0.97	16.33
R1_SYS_000714.LAB	12:24	5.10	2.5	0.6	ND	ND	9.3	190.9	0.97	16.25
R1_SYS_000715.LAB	12:25	5.09	2.5	0.7	ND	ND	9.4	190.9	0.97	16.14
R1_SYS_000716.LAB	12:26	5.05	2.5	0.8	ND	ND	9.6	191.0	0.97	16.22
R1_SYS_000717.LAB	12:27	5.09	2.5	0.8	ND	ND	9.6	191.0	0.97	16.21
R1_SYS_000718.LAB	12:28	4.87	2.4	0.8	ND	ND	10.3	191.0	0.97	16.27
R1_SYS_000719.LAB	12:29	4.36	2.1	0.7	ND	ND	13.2	191.0	0.97	16.24
R1_SYS_000720.LAB	12:30	4.41	2.1	0.6	ND	ND	13.4	191.0	0.97	16.31
R1_SYS_000721.LAB	12:31	4.69	2.3	0.6	ND	ND	12.6	191.1	0.97	16.83
R1_SYS_000722.LAB	12:32	4.74	2.3	0.5	ND	ND	11.9	191.1	0.97	17.01
R1_SYS_000723.LAB	12:33	4.78	2.3	0.4	ND	ND	11.9	191.0	0.97	16.76
R1_SYS_000724.LAB	12:34	4.78	2.3	0.4	ND	ND	11.8	191.0	0.97	16.59
Average		4.80	2.35	0.74	ND	ND	9.06	191.01	0.97	16.52

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Test Location: Unit 30  
Date: 12/5/22

Run 2

Spectrum	Time	FTIR Data						Analyzer Data		
		H2O %	CO2 % (wet)	HCl ppmvw	HF	Formaldehyde	CO ppmvw	Cell Temp	Pressure	O2 % (dry)
R2_SYS_000819.LAB	12:55	4.31	2.1	0.7	ND	ND	15.3	190.9	0.97	17.03
R2_SYS_000820.LAB	12:56	4.25	2.1	0.4	0.1	ND	16.3	190.9	0.97	17.00
R2_SYS_000821.LAB	12:57	4.28	2.1	0.4	ND	ND	16.4	191.0	0.97	17.00
R2_SYS_000822.LAB	12:58	4.28	2.1	0.3	ND	ND	16.4	191.0	0.97	17.01
R2_SYS_000823.LAB	12:59	4.31	2.1	0.2	0.1	ND	16.1	191.0	0.97	16.95
R2_SYS_000824.LAB	13:00	4.43	2.2	0.1	0.1	ND	14.5	191.0	0.97	16.79
R2_SYS_000825.LAB	13:01	4.64	2.3	0.1	0.1	ND	12.0	191.0	0.97	16.57
R2_SYS_000826.LAB	13:02	4.84	2.4	0.2	ND	ND	10.0	191.0	0.97	16.34
R2_SYS_000827.LAB	13:03	5.05	2.6	0.2	ND	ND	8.8	191.0	0.97	16.14
R2_SYS_000828.LAB	13:04	5.19	2.6	0.2	ND	ND	7.9	191.0	0.97	16.03
R2_SYS_000829.LAB	13:05	5.10	2.6	0.2	0.1	ND	8.3	190.9	0.97	16.15
R2_SYS_000830.LAB	13:06	5.10	2.6	0.1	ND	ND	8.5	191.0	0.97	16.17
R2_SYS_000831.LAB	13:07	5.08	2.6	0.2	ND	ND	8.7	191.0	0.97	16.17
R2_SYS_000832.LAB	13:08	5.02	2.5	ND	ND	ND	9.1	191.1	0.97	16.23
R2_SYS_000833.LAB	13:09	5.13	2.6	0.1	ND	ND	8.1	191.1	0.97	16.13
R2_SYS_000834.LAB	13:10	5.15	2.6	0.1	ND	ND	7.8	191.0	0.97	16.09
R2_SYS_000835.LAB	13:11	5.19	2.6	ND	0.1	ND	7.3	190.9	0.97	16.10
R2_SYS_000836.LAB	13:12	5.19	2.6	ND	ND	ND	7.2	190.9	0.97	16.09
R2_SYS_000837.LAB	13:13	5.17	2.6	0.1	ND	ND	7.1	190.9	0.97	16.08
R2_SYS_000838.LAB	13:14	5.13	2.6	ND	ND	ND	7.1	191.0	0.97	16.11
R2_SYS_000839.LAB	13:15	5.08	2.5	0.2	ND	ND	7.7	191.0	0.97	16.16
R2_SYS_000840.LAB	13:16	5.10	2.6	0.2	ND	ND	7.8	190.9	0.97	16.20
R2_SYS_000841.LAB	13:17	5.03	2.5	0.3	ND	ND	8.3	190.9	0.97	16.15
R2_SYS_000842.LAB	13:18	4.99	2.5	0.2	ND	ND	8.7	190.9	0.97	16.21
R2_SYS_000843.LAB	13:19	4.99	2.5	0.2	ND	ND	9.0	190.9	0.97	16.25
R2_SYS_000844.LAB	13:20	5.03	2.5	0.2	0.1	ND	9.1	190.9	0.97	16.25
R2_SYS_000845.LAB	13:21	4.93	2.4	0.2	0.1	ND	9.4	190.9	0.97	16.22
R2_SYS_000846.LAB	13:22	4.97	2.5	ND	ND	ND	9.4	190.9	0.97	16.29
R2_SYS_000847.LAB	13:23	4.97	2.5	0.1	0.1	ND	9.5	191.0	0.97	16.28
R2_SYS_000848.LAB	13:24	4.94	2.5	0.2	0.1	ND	9.5	191.0	0.97	16.27
R2_SYS_000849.LAB	13:25	4.94	2.4	ND	ND	ND	9.7	191.0	0.97	16.27
R2_SYS_000850.LAB	13:26	4.49	2.2	ND	ND	ND	12.0	191.0	0.97	16.27
R2_SYS_000851.LAB	13:27	4.20	2.1	ND	ND	ND	13.6	191.1	0.97	16.46
R2_SYS_000852.LAB	13:28	4.37	2.1	ND	ND	ND	13.4	191.1	0.97	16.96
R2_SYS_000853.LAB	13:29	4.58	2.3	ND	ND	ND	12.7	191.0	0.97	17.03
R2_SYS_000854.LAB	13:30	4.64	2.3	ND	ND	ND	12.4	191.0	0.97	16.77
R2_SYS_000855.LAB	13:31	4.65	2.3	ND	ND	ND	12.3	191.0	0.97	16.64
R2_SYS_000856.LAB	13:32	4.67	2.3	ND	0.1	ND	11.9	191.0	0.97	16.59
R2_SYS_000857.LAB	13:33	4.67	2.3	0.1	ND	ND	12.1	191.0	0.97	16.59
R2_SYS_000858.LAB	13:34	4.66	2.3	ND	ND	ND	12.2	191.0	0.97	16.55
R2_SYS_000859.LAB	13:35	4.65	2.3	ND	ND	ND	12.2	191.0	0.97	16.59
R2_SYS_000860.LAB	13:36	4.33	2.1	ND	ND	ND	13.9	191.0	0.97	16.56
R2_SYS_000861.LAB	13:37	4.31	2.1	ND	ND	ND	14.7	191.0	0.97	16.59
R2_SYS_000862.LAB	13:38	4.40	2.2	ND	0.1	ND	14.4	191.0	0.97	16.86
R2_SYS_000863.LAB	13:39	4.37	2.2	ND	ND	ND	14.2	191.0	0.97	16.97
R2_SYS_000864.LAB	13:40	4.44	2.2	ND	ND	ND	14.1	191.0	0.97	16.84
R2_SYS_000865.LAB	13:41	4.50	2.2	ND	0.1	ND	12.7	190.9	0.97	16.83
R2_SYS_000866.LAB	13:42	4.70	2.3	ND	ND	ND	11.0	191.0	0.97	16.79
R2_SYS_000867.LAB	13:43	4.92	2.5	ND	ND	ND	8.8	191.0	0.97	16.71
R2_SYS_000868.LAB	13:44	5.15	2.6	ND	ND	ND	7.6	191.0	0.97	16.60
R2_SYS_000869.LAB	13:45	5.07	2.6	ND	ND	ND	7.6	191.0	0.97	16.38
R2_SYS_000870.LAB	13:46	5.07	2.6	ND	0.2	ND	7.5	191.0	0.97	16.13
R2_SYS_000871.LAB	13:47	5.05	2.6	ND	0.1	ND	7.6	191.0	0.97	16.00
R2_SYS_000872.LAB	13:48	5.02	2.6	ND	0.1	ND	7.6	190.9	0.97	16.10
R2_SYS_000873.LAB	13:49	4.90	2.5	ND	ND	ND	8.3	191.0	0.97	16.11
R2_SYS_000874.LAB	13:50	4.98	2.6	ND	ND	ND	8.3	191.1	0.97	16.11
R2_SYS_000875.LAB	13:51	4.94	2.5	ND	ND	ND	8.7	191.2	0.97	16.12
R2_SYS_000876.LAB	13:52	5.00	2.6	ND	ND	ND	8.4	191.1	0.97	16.21
R2_SYS_000877.LAB	13:53	5.09	2.6	ND	ND	ND	7.4	191.0	0.97	16.15
R2_SYS_000878.LAB	13:54	5.10	2.6	ND	0.3	ND	6.6	191.0	0.97	16.20
Average		4.81	2.41	0.21	0.13	ND	10.42	191.00	0.97	16.42

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Test Location: Unit 30  
Date: 12/5/22

Run 3										
FTIR Data										
Spectrum	Time	H2O %	CO2 % (wet)	HCl ppmvw	HF	Formaldehyde	CO ppmvw	Cell Temp	Pressure	Analyzer Data O2 % (dry)
R3_SYS_000953.LAB	12:03	4.77	2.5	0.4	ND	ND	8.6	191.0	0.98	16.16
R3_SYS_000954.LAB	12:04	4.76	2.5	0.4	ND	ND	8.9	191.0	0.98	16.17
R3_SYS_000955.LAB	12:05	4.80	2.5	0.2	0.1	ND	8.8	191.0	0.98	16.15
R3_SYS_000956.LAB	12:06	4.81	2.5	0.2	ND	ND	9.0	190.9	0.98	16.20
R3_SYS_000957.LAB	12:07	4.78	2.5	0.2	ND	ND	9.2	191.0	0.98	16.14
R3_SYS_000958.LAB	12:08	4.82	2.5	ND	ND	ND	9.1	191.0	0.98	16.19
R3_SYS_000959.LAB	12:09	4.84	2.5	ND	0.2	ND	9.1	191.0	0.98	16.08
R3_SYS_000960.LAB	12:10	4.82	2.5	0.1	0.1	ND	9.1	191.0	0.98	16.01
R3_SYS_000961.LAB	12:11	4.95	2.6	0.2	ND	ND	7.8	191.0	0.98	15.99
R3_SYS_000962.LAB	12:12	4.99	2.6	0.1	ND	ND	7.1	191.1	0.98	15.95
R3_SYS_000963.LAB	12:13	5.03	2.6	0.1	0.2	ND	6.5	191.1	0.98	15.90
R3_SYS_000964.LAB	12:14	5.07	2.7	ND	ND	ND	5.7	191.0	0.98	15.93
R3_SYS_000965.LAB	12:15	5.06	2.6	ND	ND	ND	5.6	190.9	0.98	15.89
R3_SYS_000966.LAB	12:16	5.12	2.6	0.1	ND	ND	4.8	191.0	0.98	15.85
R3_SYS_000967.LAB	12:17	5.16	2.7	0.1	ND	ND	4.6	191.0	0.98	15.86
R3_SYS_000968.LAB	12:18	5.17	2.7	ND	0.2	ND	4.3	191.0	0.98	15.84
R3_SYS_000969.LAB	12:19	5.18	2.7	0.2	0.2	ND	4.0	191.0	0.98	15.86
R3_SYS_000970.LAB	12:20	5.19	2.7	0.2	0.1	ND	3.8	191.0	0.98	15.93
R3_SYS_000971.LAB	12:21	5.11	2.6	ND	0.2	ND	3.8	191.1	0.98	16.21
R3_SYS_000972.LAB	12:22	4.93	2.5	0.2	ND	ND	4.4	191.0	0.98	16.29
R3_SYS_000973.LAB	12:23	4.77	2.4	ND	0.2	ND	5.1	190.9	0.98	16.01
R3_SYS_000974.LAB	12:24	5.08	2.6	ND	0.1	ND	5.0	190.9	0.98	16.03
R3_SYS_000975.LAB	12:25	5.09	2.6	0.1	ND	ND	5.4	190.9	0.98	16.23
R3_SYS_000976.LAB	12:26	4.89	2.4	0.1	ND	ND	5.7	191.0	0.98	16.55
R3_SYS_000977.LAB	12:27	4.59	2.3	ND	0.1	ND	7.1	191.0	0.98	16.36
R3_SYS_000978.LAB	12:28	4.74	2.4	ND	0.1	ND	6.6	191.0	0.98	15.84
R3_SYS_000979.LAB	12:29	5.23	2.7	ND	ND	ND	4.9	191.0	0.98	15.93
R3_SYS_000980.LAB	12:30	5.14	2.6	ND	0.1	ND	5.1	191.0	0.98	15.92
R3_SYS_000981.LAB	12:31	5.14	2.6	ND	0.1	ND	4.8	191.0	0.98	15.86
R3_SYS_000982.LAB	12:32	5.20	2.7	ND	ND	ND	4.4	191.0	0.98	15.87
R3_SYS_000983.LAB	12:33	5.19	2.7	ND	0.1	ND	4.1	190.9	0.98	15.84
R3_SYS_000984.LAB	12:34	5.21	2.7	ND	0.2	ND	3.9	190.9	0.98	15.85
R3_SYS_000985.LAB	12:35	5.24	2.7	ND	0.1	ND	3.7	190.9	0.98	15.91
R3_SYS_000986.LAB	12:36	5.21	2.6	ND	0.1	ND	3.7	191.0	0.98	15.95
R3_SYS_000987.LAB	12:37	5.16	2.6	ND	0.1	ND	3.8	191.1	0.98	15.95
R3_SYS_000988.LAB	12:38	5.16	2.6	0.1	0.2	ND	3.6	191.2	0.98	15.96
R3_SYS_000989.LAB	12:39	5.10	2.6	ND	0.1	ND	3.5	191.2	0.98	15.96
R3_SYS_000990.LAB	12:40	5.08	2.6	ND	0.1	ND	3.6	191.1	0.98	15.96
R3_SYS_000991.LAB	12:41	5.08	2.6	ND	0.2	ND	3.6	190.9	0.98	15.97
R3_SYS_000992.LAB	12:42	5.07	2.6	ND	0.1	ND	3.6	190.9	0.98	15.99
R3_SYS_000993.LAB	12:43	5.04	2.6	ND	0.1	ND	3.5	190.8	0.98	16.00
R3_SYS_000994.LAB	12:44	5.04	2.6	0.1	0.1	ND	3.6	190.8	0.98	15.98
R3_SYS_000995.LAB	12:45	5.04	2.6	ND	ND	ND	3.7	190.8	0.98	15.97
R3_SYS_000996.LAB	12:46	5.01	2.6	ND	ND	ND	3.6	190.9	0.98	15.98
R3_SYS_000997.LAB	12:47	5.03	2.6	ND	0.1	ND	3.6	191.1	0.98	15.97
R3_SYS_000998.LAB	12:48	5.04	2.6	ND	0.1	ND	3.8	191.1	0.98	15.98
R3_SYS_000999.LAB	12:49	5.09	2.6	ND	0.2	ND	3.7	191.0	0.98	15.96
R3_SYS_001000.LAB	12:50	5.16	2.6	ND	0.1	ND	3.8	191.0	0.97	15.97
R3_SYS_001001.LAB	12:51	5.17	2.6	ND	0.1	ND	3.8	191.0	0.97	15.98
R3_SYS_001002.LAB	12:52	5.14	2.6	ND	0.2	ND	3.8	191.0	0.97	16.09
R3_SYS_001003.LAB	12:53	5.17	2.6	ND	0.1	ND	3.8	191.0	0.97	15.96
R3_SYS_001004.LAB	12:54	5.14	2.6	ND	0.1	ND	3.9	190.9	0.97	15.97
R3_SYS_001005.LAB	12:55	5.13	2.6	ND	0.1	ND	3.8	190.9	0.97	15.98
R3_SYS_001006.LAB	12:56	5.13	2.6	ND	0.2	ND	3.8	190.9	0.97	15.97
R3_SYS_001007.LAB	12:57	5.12	2.6	ND	0.1	ND	3.9	191.0	0.97	15.98
R3_SYS_001008.LAB	12:58	5.12	2.6	ND	0.1	ND	3.8	191.0	0.98	15.96
R3_SYS_001009.LAB	12:59	5.10	2.6	ND	0.2	ND	4.1	191.1	0.97	15.97
R3_SYS_001010.LAB	13:00	5.08	2.6	ND	0.2	ND	3.9	191.1	0.98	15.99
R3_SYS_001011.LAB	13:01	5.12	2.6	ND	0.2	ND	3.9	191.1	0.97	15.97
R3_SYS_001012.LAB	13:02	5.14	2.6	ND	0.2	ND	3.9	191.0	0.98	15.96
Average		5.05	2.59	0.17	0.15	ND	5.02	191.01	0.98	16.00



Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Test Location: Unit 30  
Date: 12/5/22

Run 4										
FTIR Data										
Spectrum	Time	H2O %	CO2 % (wet)	HCl ppmvw	HF	Formaldehyde	CO ppmvw	Cell Temp	Pressure	Analyzer Data O2 % (dry)
R4_SYS_001103.LAB	15:28	4.88	2.6	0.3	0.2	ND	4.1	191.0	0.98	16.03
R4_SYS_001104.LAB	15:29	4.88	2.6	0.2	0.2	ND	3.9	191.0	0.98	16.05
R4_SYS_001105.LAB	15:30	4.89	2.6	0.1	0.1	ND	4.1	191.0	0.98	16.04
R4_SYS_001106.LAB	15:31	4.93	2.6	ND	0.2	ND	3.9	191.0	0.98	16.06
R4_SYS_001107.LAB	15:32	4.94	2.6	ND	0.2	ND	4.0	191.1	0.98	16.04
R4_SYS_001108.LAB	15:33	4.95	2.6	ND	0.1	ND	4.1	191.1	0.98	16.05
R4_SYS_001109.LAB	15:34	4.92	2.6	ND	0.2	ND	4.1	191.0	0.98	16.06
R4_SYS_001110.LAB	15:35	4.93	2.6	ND	0.2	ND	4.1	191.0	0.98	16.05
R4_SYS_001111.LAB	15:36	4.93	2.6	ND	0.2	ND	4.1	191.0	0.98	16.06
R4_SYS_001112.LAB	15:37	4.95	2.6	ND	0.1	ND	4.1	191.0	0.98	16.06
R4_SYS_001113.LAB	15:38	4.99	2.6	ND	0.2	ND	3.9	191.0	0.98	16.05
R4_SYS_001114.LAB	15:39	5.30	2.6	ND	0.1	ND	4.1	191.0	0.98	16.06
R4_SYS_001115.LAB	15:40	5.64	2.6	ND	0.2	ND	3.9	191.0	0.98	16.04
R4_SYS_001116.LAB	15:41	5.45	2.6	ND	0.2	ND	4.0	191.0	0.98	16.06
R4_SYS_001117.LAB	15:42	5.22	2.6	ND	0.2	ND	4.0	191.0	0.98	16.03
R4_SYS_001118.LAB	15:43	5.11	2.6	ND	0.2	ND	4.2	190.9	0.98	16.06
R4_SYS_001119.LAB	15:44	5.14	2.6	ND	ND	ND	4.0	191.0	0.98	16.05
R4_SYS_001120.LAB	15:45	5.12	2.6	0.2	0.2	ND	4.2	191.0	0.98	16.06
R4_SYS_001121.LAB	15:46	5.12	2.6	0.3	0.1	ND	4.1	191.0	0.98	16.05
R4_SYS_001122.LAB	15:47	5.06	2.6	0.2	0.1	ND	4.2	190.9	0.98	16.06
R4_SYS_001123.LAB	15:48	5.02	2.6	0.2	0.2	ND	4.1	190.9	0.98	16.06
R4_SYS_001124.LAB	15:49	5.00	2.6	0.2	ND	ND	4.1	191.0	0.98	16.05
R4_SYS_001125.LAB	15:50	5.01	2.6	0.2	0.1	ND	4.1	191.0	0.98	16.06
R4_SYS_001126.LAB	15:51	5.04	2.6	0.2	0.2	ND	4.2	190.9	0.98	16.06
R4_SYS_001127.LAB	15:52	5.06	2.6	0.1	0.1	ND	4.1	190.9	0.98	16.08
R4_SYS_001128.LAB	15:53	5.07	2.6	0.1	0.1	ND	4.1	190.9	0.98	16.05
R4_SYS_001129.LAB	15:54	5.06	2.6	0.2	0.2	ND	4.1	190.9	0.98	16.06
R4_SYS_001130.LAB	15:55	5.07	2.6	ND	0.1	ND	4.0	191.0	0.98	16.06
R4_SYS_001131.LAB	15:56	5.06	2.6	0.1	0.2	ND	4.3	191.1	0.98	16.08
R4_SYS_001132.LAB	15:57	5.08	2.6	ND	0.2	ND	4.0	191.1	0.98	16.05
R4_SYS_001133.LAB	15:58	5.06	2.6	0.2	0.1	ND	4.2	191.1	0.98	16.05
R4_SYS_001134.LAB	15:59	5.06	2.6	0.1	0.2	ND	4.2	191.1	0.98	16.06
R4_SYS_001135.LAB	16:00	5.28	2.6	ND	0.2	ND	4.1	191.0	0.98	16.07
R4_SYS_001136.LAB	16:01	5.69	2.6	ND	0.2	ND	4.2	190.9	0.98	16.05
R4_SYS_001137.LAB	16:02	5.50	2.6	ND	0.2	ND	4.1	190.9	0.98	16.07
R4_SYS_001138.LAB	16:03	5.20	2.6	ND	0.2	ND	4.1	190.9	0.98	16.06
R4_SYS_001139.LAB	16:04	5.08	2.6	ND	0.1	ND	4.1	191.0	0.98	16.06
R4_SYS_001140.LAB	16:05	5.03	2.6	ND	0.2	ND	4.1	190.9	0.98	16.06
R4_SYS_001141.LAB	16:06	5.00	2.6	ND	0.1	ND	4.1	190.9	0.98	16.04
R4_SYS_001142.LAB	16:07	4.97	2.6	0.1	0.2	ND	4.1	190.9	0.98	16.07
R4_SYS_001143.LAB	16:08	4.96	2.6	0.2	0.1	ND	4.3	190.9	0.98	16.08
R4_SYS_001144.LAB	16:09	4.97	2.6	0.1	0.1	ND	4.3	190.9	0.98	16.08
R4_SYS_001145.LAB	16:10	4.98	2.6	0.1	0.2	ND	4.4	190.9	0.98	16.10
R4_SYS_001146.LAB	16:11	5.01	2.6	0.2	0.2	ND	4.5	190.9	0.98	16.09
R4_SYS_001147.LAB	16:12	5.04	2.6	0.1	ND	ND	4.8	190.9	0.98	16.09
R4_SYS_001148.LAB	16:13	5.06	2.6	ND	0.2	ND	4.8	191.0	0.98	16.11
R4_SYS_001149.LAB	16:14	5.06	2.6	0.1	0.1	ND	4.8	191.0	0.98	16.10
R4_SYS_001150.LAB	16:15	5.03	2.6	ND	0.3	ND	4.9	191.0	0.98	16.10
R4_SYS_001151.LAB	16:16	5.01	2.6	ND	0.2	ND	5.1	191.0	0.98	16.10
R4_SYS_001152.LAB	16:17	5.03	2.6	0.1	0.1	ND	4.9	191.0	0.98	16.10
R4_SYS_001153.LAB	16:18	5.02	2.6	ND	0.1	ND	5.1	191.0	0.98	16.09
R4_SYS_001154.LAB	16:19	5.08	2.6	0.1	0.1	ND	4.9	191.0	0.98	16.11
R4_SYS_001155.LAB	16:20	5.08	2.6	0.1	0.1	ND	4.9	191.0	0.98	16.08
R4_SYS_001156.LAB	16:21	5.05	2.6	ND	0.1	ND	5.0	190.9	0.98	16.08
R4_SYS_001157.LAB	16:22	5.08	2.6	0.1	0.2	ND	5.0	190.9	0.98	16.09
R4_SYS_001158.LAB	16:23	5.07	2.6	ND	0.2	ND	5.2	190.9	0.98	16.08
R4_SYS_001159.LAB	16:24	5.06	2.6	ND	ND	ND	5.1	190.9	0.98	16.09
R4_SYS_001160.LAB	16:25	5.02	2.6	ND	0.2	ND	5.3	190.9	0.98	16.10
R4_SYS_001161.LAB	16:26	5.05	2.6	ND	0.1	ND	5.2	190.9	0.98	16.12
R4_SYS_001162.LAB	16:27	5.04	2.6	ND	0.2	ND	5.2	190.9	0.98	16.09
Average		5.07	2.62	0.17	0.16	ND	4.35	191.00	0.98	16.07

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Test Location: Unit 30  
Date: 12/5/22

Run 5

Spectrum	Time	H2O %	CO2 % (wet)	HCl ppmvw	FTIR Data				CO ppmvw	CO2 % (wet)	Cell Temp	Pressure	Analyzer Data
					HF	Formaldehyde							O2 % (dry)
R5_SYS_001256.LAB	16:45	3.86	2.0	0.2	0.1	ND			11.4	11.4	191.1	0.98	16.37
R5_SYS_001257.LAB	16:46	4.34	2.3	0.2	0.1	ND			9.9	9.9	191.0	0.98	16.14
R5_SYS_001258.LAB	16:47	4.64	2.5	0.2	0.2	ND			8.2	8.2	191.0	0.98	16.08
R5_SYS_001259.LAB	16:48	4.80	2.6	0.1	0.2	ND			7.6	7.6	191.0	0.98	16.09
R5_SYS_001260.LAB	16:49	4.86	2.6	0.2	0.2	ND			7.2	7.2	190.9	0.98	16.06
R5_SYS_001261.LAB	16:50	4.87	2.6	0.2	ND	ND			7.0	7.0	190.9	0.98	16.04
R5_SYS_001262.LAB	16:51	4.92	2.6	0.1	0.2	ND			6.5	6.5	190.9	0.98	16.04
R5_SYS_001263.LAB	16:52	4.99	2.6	ND	0.2	ND			6.0	6.0	191.0	0.98	16.04
R5_SYS_001264.LAB	16:53	5.03	2.6	0.1	0.2	ND			5.6	5.6	191.0	0.98	16.01
R5_SYS_001265.LAB	16:54	5.54	2.6	ND	0.2	ND			5.3	5.3	191.0	0.98	16.00
R5_SYS_001266.LAB	16:55	5.55	2.6	ND	0.2	ND			5.1	5.1	191.0	0.98	16.03
R5_SYS_001267.LAB	16:56	5.62	2.6	ND	0.2	ND			5.0	5.0	191.0	0.98	15.99
R5_SYS_001268.LAB	16:57	5.50	2.6	0.1	0.2	ND			4.8	4.8	191.0	0.98	15.99
R5_SYS_001269.LAB	16:58	5.25	2.7	ND	ND	ND			4.6	4.6	191.0	0.98	16.02
R5_SYS_001270.LAB	16:59	5.25	2.6	ND	0.2	ND			4.4	4.4	191.0	0.98	15.99
R5_SYS_001271.LAB	17:00	5.27	2.7	ND	0.2	ND			4.3	4.3	191.1	0.98	16.00
R5_SYS_001272.LAB	17:01	5.27	2.7	ND	0.2	ND			4.2	4.2	191.1	0.98	16.03
R5_SYS_001273.LAB	17:02	5.25	2.6	ND	ND	ND			4.2	4.2	191.0	0.98	16.02
R5_SYS_001274.LAB	17:03	5.28	2.6	0.1	0.2	ND			4.0	4.0	191.0	0.98	16.02
R5_SYS_001275.LAB	17:04	5.27	2.6	0.1	0.1	ND			3.9	3.9	191.0	0.98	16.05
R5_SYS_001276.LAB	17:05	5.23	2.6	0.1	ND	ND			4.1	4.1	191.0	0.98	16.05
R5_SYS_001277.LAB	17:06	5.25	2.6	0.1	0.1	ND			3.8	3.8	191.0	0.98	16.06
R5_SYS_001278.LAB	17:07	5.26	2.6	0.1	0.2	ND			4.0	4.0	191.0	0.98	16.08
R5_SYS_001279.LAB	17:08	5.25	2.6	ND	ND	ND			4.0	4.0	191.0	0.98	16.08
R5_SYS_001280.LAB	17:09	5.22	2.6	0.2	0.1	ND			3.9	3.9	190.9	0.98	16.06
R5_SYS_001281.LAB	17:10	5.23	2.6	0.2	0.2	ND			3.7	3.7	190.9	0.98	16.07
R5_SYS_001282.LAB	17:11	5.22	2.6	ND	0.1	ND			3.9	3.9	190.9	0.98	16.09
R5_SYS_001283.LAB	17:12	5.19	2.6	0.1	ND	ND			4.0	4.0	191.0	0.98	16.10
R5_SYS_001284.LAB	17:13	5.18	2.6	ND	0.2	ND			4.0	4.0	191.0	0.98	16.10
R5_SYS_001285.LAB	17:14	5.16	2.6	ND	0.1	ND			3.8	3.8	191.0	0.98	16.08
R5_SYS_001286.LAB	17:15	5.19	2.6	0.1	0.1	ND			4.0	4.0	191.0	0.98	16.08
R5_SYS_001287.LAB	17:16	5.17	2.6	ND	0.1	ND			3.9	3.9	191.0	0.98	16.09
R5_SYS_001288.LAB	17:17	5.16	2.6	ND	ND	ND			3.9	3.9	191.0	0.98	16.11
R5_SYS_001289.LAB	17:18	5.15	2.6	0.1	0.1	ND			3.9	3.9	190.9	0.98	16.08
R5_SYS_001290.LAB	17:19	5.16	2.6	ND	0.1	ND			4.0	4.0	190.9	0.98	16.09
R5_SYS_001291.LAB	17:20	5.17	2.6	ND	ND	ND			3.9	3.9	190.9	0.98	16.09
R5_SYS_001292.LAB	17:21	5.17	2.6	ND	0.1	ND			3.9	3.9	190.9	0.98	16.09
R5_SYS_001293.LAB	17:22	5.20	2.6	ND	0.2	ND			3.9	3.9	190.9	0.98	16.10
R5_SYS_001294.LAB	17:23	5.20	2.6	ND	0.1	ND			3.9	3.9	191.0	0.98	16.10
R5_SYS_001295.LAB	17:24	5.22	2.6	ND	0.1	ND			3.9	3.9	191.0	0.98	16.10
R5_SYS_001296.LAB	17:25	5.23	2.6	0.1	0.1	ND			3.9	3.9	191.1	0.98	16.08
R5_SYS_001297.LAB	17:26	5.27	2.6	ND	0.1	ND			4.0	4.0	191.1	0.98	16.08
R5_SYS_001298.LAB	17:27	5.25	2.6	ND	0.1	ND			4.0	4.0	191.1	0.98	16.09
R5_SYS_001299.LAB	17:28	5.22	2.6	0.1	0.2	ND			4.0	4.0	191.1	0.98	16.08
R5_SYS_001300.LAB	17:29	5.19	2.6	ND	0.2	ND			3.9	3.9	191.1	0.98	16.06
R5_SYS_001301.LAB	17:30	5.17	2.6	ND	0.2	ND			4.0	4.0	191.0	0.98	16.08
R5_SYS_001302.LAB	17:31	5.14	2.6	ND	0.2	ND			4.0	4.0	191.0	0.98	16.09
R5_SYS_001303.LAB	17:32	5.12	2.6	ND	0.1	ND			4.0	4.0	190.9	0.98	16.08
R5_SYS_001304.LAB	17:33	5.11	2.6	ND	0.1	ND			4.2	4.2	190.9	0.98	16.09
R5_SYS_001305.LAB	17:34	5.12	2.6	0.1	0.2	ND			4.0	4.0	190.9	0.98	16.08
R5_SYS_001306.LAB	17:35	5.13	2.6	ND	0.1	ND			3.9	3.9	190.9	0.98	16.07
R5_SYS_001307.LAB	17:36	5.13	2.6	ND	0.2	ND			3.9	3.9	190.9	0.98	16.08
R5_SYS_001308.LAB	17:37	5.11	2.6	ND	0.1	ND			4.1	4.1	190.9	0.98	16.10
R5_SYS_001309.LAB	17:38	5.12	2.6	ND	0.1	ND			4.1	4.1	190.9	0.98	16.09
R5_SYS_001310.LAB	17:39	5.17	2.6	ND	0.1	ND			4.1	4.1	191.0	0.98	16.09
R5_SYS_001311.LAB	17:40	5.22	2.6	ND	0.1	ND			4.0	4.0	191.0	0.98	16.08
R5_SYS_001312.LAB	17:41	5.22	2.6	ND	0.2	ND			4.0	4.0	191.0	0.98	16.09
R5_SYS_001313.LAB	17:42	5.23	2.6	ND	0.2	ND			4.0	4.0	191.0	0.98	16.09
R5_SYS_001314.LAB	17:43	5.19	2.6	ND	0.2	ND			4.0	4.0	191.0	0.98	16.09
R5_SYS_001315.LAB	17:44	5.20	2.6	ND	0.1	ND			3.9	3.9	191.0	0.98	16.08
Average		5.15	2.60	0.14	0.16	ND			4.63	4.63	191.02	0.98	16.07

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Test Location: Unit 30  
Date: 12/5/22

Run 6

Spectrum	Time	H2O %	CO2 % (wet)	FTIR Data		Formaldehyde	CO ppmvw	Cell Temp	Pressure	Analyzer Data
				HCl ppmvw	HF					O2 % (dry)
R6_SYS_001403.LAB	18:01	3.64	2.2	1.0	0.2	ND	3.4	190.9	0.98	16.05
R6_SYS_001404.LAB	18:02	4.68	2.6	0.5	0.2	ND	4.1	190.9	0.98	16.07
R6_SYS_001405.LAB	18:03	4.75	2.6	0.4	0.2	ND	4.2	191.0	0.98	16.06
R6_SYS_001406.LAB	18:04	4.78	2.6	0.3	0.2	ND	4.1	191.0	0.98	16.06
R6_SYS_001407.LAB	18:05	4.82	2.6	0.2	0.2	ND	4.1	191.0	0.98	16.07
R6_SYS_001408.LAB	18:06	4.86	2.6	0.2	0.2	ND	4.1	191.0	0.98	16.08
R6_SYS_001409.LAB	18:07	4.89	2.7	ND	0.1	ND	4.2	191.0	0.98	16.07
R6_SYS_001410.LAB	18:08	5.33	2.6	0.2	0.2	ND	4.3	191.0	0.98	16.07
R6_SYS_001411.LAB	18:09	5.59	2.6	0.2	0.2	ND	4.2	191.0	0.98	16.07
R6_SYS_001412.LAB	18:10	5.54	2.6	ND	0.2	ND	4.2	191.0	0.98	16.08
R6_SYS_001413.LAB	18:11	5.30	2.6	ND	0.2	ND	4.2	191.0	0.98	16.07
R6_SYS_001414.LAB	18:12	5.25	2.6	ND	0.1	ND	4.1	191.0	0.98	16.06
R6_SYS_001415.LAB	18:13	5.22	2.6	0.1	0.2	ND	4.1	191.0	0.98	16.06
R6_SYS_001416.LAB	18:14	5.19	2.6	0.2	0.2	ND	4.2	191.0	0.98	16.08
R6_SYS_001417.LAB	18:15	5.16	2.6	0.2	0.1	ND	4.3	191.0	0.97	16.08
R6_SYS_001418.LAB	18:16	5.15	2.6	0.2	0.2	ND	4.2	191.0	0.97	16.08
R6_SYS_001419.LAB	18:17	5.17	2.6	0.2	0.1	ND	4.3	191.0	0.97	16.06
R6_SYS_001420.LAB	18:18	5.17	2.6	0.2	0.1	ND	4.1	191.0	0.97	16.07
R6_SYS_001421.LAB	18:19	5.15	2.6	0.2	0.2	ND	4.1	190.9	0.97	16.09
R6_SYS_001422.LAB	18:20	5.20	2.6	ND	0.1	ND	4.3	191.0	0.97	16.09
R6_SYS_001423.LAB	18:21	5.21	2.6	0.1	0.2	ND	4.2	191.0	0.97	16.06
R6_SYS_001424.LAB	18:22	5.21	2.7	0.1	0.1	ND	4.2	191.0	0.97	16.08
R6_SYS_001425.LAB	18:23	5.18	2.6	0.1	0.1	ND	4.3	191.0	0.97	16.09
R6_SYS_001426.LAB	18:24	5.18	2.6	0.1	0.1	ND	4.3	191.0	0.97	16.10
R6_SYS_001427.LAB	18:25	5.20	2.6	0.2	0.2	ND	4.3	191.0	0.97	16.08
R6_SYS_001428.LAB	18:26	5.25	2.6	0.1	0.1	ND	4.3	191.0	0.97	16.09
R6_SYS_001429.LAB	18:27	5.32	2.6	ND	0.2	ND	4.3	191.0	0.97	16.08
R6_SYS_001430.LAB	18:28	5.29	2.7	ND	0.2	ND	4.2	191.0	0.97	16.07
R6_SYS_001431.LAB	18:29	5.32	2.6	ND	0.1	ND	4.2	191.0	0.97	16.08
R6_SYS_001432.LAB	18:30	5.27	2.7	ND	0.2	ND	4.4	190.9	0.97	16.10
R6_SYS_001433.LAB	18:31	5.27	2.6	ND	0.1	ND	4.3	191.0	0.97	16.08
R6_SYS_001434.LAB	18:32	5.27	2.7	ND	0.1	ND	4.3	191.0	0.97	16.10
R6_SYS_001435.LAB	18:33	5.29	2.6	ND	0.2	ND	4.3	191.0	0.97	16.09
R6_SYS_001436.LAB	18:34	5.29	2.6	ND	0.1	ND	4.2	191.0	0.97	16.09
R6_SYS_001437.LAB	18:35	5.27	2.6	ND	0.1	ND	4.2	191.0	0.97	16.10
R6_SYS_001438.LAB	18:36	5.25	2.6	ND	0.1	ND	4.2	190.9	0.97	16.10
R6_SYS_001439.LAB	18:37	5.22	2.6	ND	0.1	ND	4.4	190.9	0.97	16.09
R6_SYS_001440.LAB	18:38	5.21	2.7	ND	0.2	ND	4.3	190.9	0.97	16.11
R6_SYS_001441.LAB	18:39	5.24	2.6	ND	0.1	ND	4.3	190.9	0.97	16.10
R6_SYS_001442.LAB	18:40	5.30	2.6	ND	0.1	ND	4.3	191.0	0.97	16.10
R6_SYS_001443.LAB	18:41	5.27	2.6	ND	0.2	ND	4.3	191.0	0.97	16.10
R6_SYS_001444.LAB	18:42	5.21	2.7	0.2	0.1	ND	4.5	191.0	0.97	16.11
R6_SYS_001445.LAB	18:43	5.24	2.7	ND	0.1	ND	4.6	191.0	0.97	16.10
R6_SYS_001446.LAB	18:44	5.25	2.6	ND	0.1	ND	4.3	191.0	0.97	16.10
R6_SYS_001447.LAB	18:45	5.28	2.7	ND	0.1	ND	4.3	191.0	0.97	16.10
R6_SYS_001448.LAB	18:46	5.25	2.7	ND	0.1	ND	4.5	191.1	0.97	16.10
R6_SYS_001449.LAB	18:47	5.20	2.7	ND	0.1	ND	4.4	191.1	0.97	16.12
R6_SYS_001450.LAB	18:48	5.21	2.7	ND	ND	ND	4.5	191.1	0.97	16.11
R6_SYS_001451.LAB	18:49	5.24	2.7	ND	0.1	ND	4.5	191.0	0.97	16.11
R6_SYS_001452.LAB	18:50	5.34	2.6	ND	ND	ND	4.3	191.0	0.97	16.11
R6_SYS_001453.LAB	18:51	5.31	2.6	ND	0.2	ND	4.4	191.0	0.97	16.11
R6_SYS_001454.LAB	18:52	5.30	2.6	ND	0.1	ND	4.4	191.0	0.97	16.11
R6_SYS_001455.LAB	18:53	5.28	2.6	ND	0.2	ND	4.4	191.0	0.97	16.10
R6_SYS_001456.LAB	18:54	5.28	2.7	ND	0.2	ND	4.4	191.0	0.97	16.10
R6_SYS_001457.LAB	18:55	5.22	2.6	0.1	ND	ND	4.3	191.0	0.97	16.12
R6_SYS_001458.LAB	18:56	5.22	2.6	ND	0.1	ND	4.4	190.9	0.97	16.10
R6_SYS_001459.LAB	18:57	5.26	2.7	ND	0.1	ND	4.4	190.9	0.97	16.11
R6_SYS_001460.LAB	18:58	5.28	2.6	ND	ND	ND	4.3	190.9	0.97	16.09
R6_SYS_001461.LAB	18:59	5.31	2.7	ND	ND	ND	4.4	191.0	0.97	16.08
R6_SYS_001462.LAB	19:00	5.28	2.7	ND	0.1	ND	4.3	191.0	0.97	16.10
Average		5.19	2.63	0.23	0.16	ND	4.27	191.00	0.97	16.09

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Test Location: Unit 30  
Date: 12/6/22

Run 7

Spectrum	Time	FTIR Data					Analyzer Data			
		H2O %	CO2 % (wet)	HCl ppmvw	HF	Formaldehyde	CO ppmvw	Cell Temp	Pressure	O2 % (dry)
R7_SYS_000269.LAB	7:48	5.19	2.7	1.4	ND	ND	5.4	191.0	0.97	16.01
R7_SYS_000270.LAB	7:49	5.20	2.7	1.1	0.1	ND	5.3	191.0	0.97	15.95
R7_SYS_000271.LAB	7:50	5.27	2.7	1.2	0.1	ND	5.2	191.0	0.97	15.95
R7_SYS_000272.LAB	7:51	5.25	2.7	1.0	0.1	ND	5.4	190.9	0.97	15.93
R7_SYS_000273.LAB	7:52	5.26	2.7	1.0	0.1	ND	5.3	191.1	0.97	15.92
R7_SYS_000274.LAB	7:53	5.24	2.7	0.9	0.1	ND	5.3	191.1	0.97	15.92
R7_SYS_000275.LAB	7:54	5.24	2.7	0.8	0.1	ND	5.3	191.1	0.97	15.95
R7_SYS_000276.LAB	7:55	5.26	2.7	0.7	ND	ND	5.3	191.1	0.97	15.96
R7_SYS_000277.LAB	7:56	5.24	2.7	0.7	0.1	ND	5.3	191.0	0.97	15.98
R7_SYS_000278.LAB	7:57	5.22	2.7	0.7	ND	ND	5.4	190.9	0.97	15.93
R7_SYS_000279.LAB	7:58	5.25	2.7	0.7	0.1	ND	5.3	190.9	0.97	15.96
R7_SYS_000280.LAB	7:59	5.19	2.7	0.8	ND	ND	5.3	190.9	0.97	15.95
R7_SYS_000281.LAB	8:00	5.21	2.7	0.5	0.1	ND	5.3	190.9	0.97	15.93
R7_SYS_000282.LAB	8:01	5.21	2.7	0.5	0.1	ND	5.1	190.9	0.97	15.94
R7_SYS_000283.LAB	8:02	5.21	2.7	0.6	0.1	ND	5.3	190.9	0.97	15.91
R7_SYS_000284.LAB	8:03	5.18	2.7	0.6	0.2	ND	5.2	190.9	0.97	15.93
R7_SYS_000285.LAB	8:04	5.19	2.7	0.5	0.2	ND	5.3	191.0	0.97	15.93
R7_SYS_000286.LAB	8:05	5.21	2.7	0.5	0.2	ND	5.5	191.2	0.97	15.9
R7_SYS_000287.LAB	8:06	5.18	2.7	0.5	0.2	ND	5.4	191.1	0.97	15.92
R7_SYS_000288.LAB	8:07	5.19	2.7	0.5	0.2	ND	5.3	191.0	0.97	15.9
R7_SYS_000289.LAB	8:08	5.17	2.7	0.4	0.3	ND	5.3	191.0	0.97	15.88
R7_SYS_000290.LAB	8:09	5.16	2.7	0.4	0.3	ND	5.3	191.0	0.97	15.88
R7_SYS_000291.LAB	8:10	5.19	2.7	0.4	0.3	ND	5.2	191.0	0.97	15.88
R7_SYS_000292.LAB	8:11	5.20	2.7	0.4	0.3	ND	5.2	191.0	0.97	15.87
R7_SYS_000293.LAB	8:12	5.16	2.7	0.4	0.4	ND	5.2	191.0	0.97	15.87
R7_SYS_000294.LAB	8:13	5.16	2.7	0.4	0.4	ND	5.2	191.0	0.97	15.88
R7_SYS_000295.LAB	8:14	5.15	2.7	0.3	0.4	ND	5.2	191.0	0.97	15.87
R7_SYS_000296.LAB	8:15	5.15	2.7	0.3	0.4	ND	5.2	191.0	0.97	15.87
R7_SYS_000297.LAB	8:16	5.15	2.7	0.3	0.4	ND	5.2	191.0	0.97	15.87
R7_SYS_000298.LAB	8:17	5.15	2.7	0.3	0.5	ND	5.2	191.0	0.97	15.88
R7_SYS_000299.LAB	8:18	5.20	2.7	0.3	0.5	ND	5.4	191.0	0.97	15.88
R7_SYS_000300.LAB	8:19	5.23	2.7	0.2	0.6	ND	5.3	191.0	0.97	15.88
R7_SYS_000301.LAB	8:20	5.26	2.7	0.2	0.4	ND	5.3	191.0	0.97	15.85
R7_SYS_000302.LAB	8:21	5.27	2.7	0.2	0.6	ND	5.3	191.0	0.97	15.86
R7_SYS_000303.LAB	8:22	5.24	2.7	ND	0.6	ND	5.4	191.0	0.97	15.89
R7_SYS_000304.LAB	8:23	5.24	2.7	0.3	0.5	ND	5.2	191.0	0.97	15.85
R7_SYS_000305.LAB	8:24	5.22	2.7	0.2	0.7	ND	5.2	191.0	0.97	15.87
R7_SYS_000306.LAB	8:25	5.24	2.7	0.2	0.7	ND	5.4	191.0	0.97	15.87
R7_SYS_000307.LAB	8:26	5.25	2.7	0.2	0.7	ND	5.3	190.9	0.97	15.86
R7_SYS_000308.LAB	8:27	5.27	2.7	0.2	0.7	ND	5.4	190.9	0.97	15.86
R7_SYS_000309.LAB	8:28	5.26	2.7	0.2	0.8	ND	5.3	191.0	0.97	15.86
R7_SYS_000310.LAB	8:29	5.26	2.7	0.2	0.9	ND	5.3	191.0	0.97	15.86
R7_SYS_000311.LAB	8:30	5.26	2.7	0.2	1.0	ND	5.3	191.0	0.97	15.86
R7_SYS_000312.LAB	8:31	5.23	2.7	0.2	1.1	ND	5.3	191.0	0.97	15.86
R7_SYS_000313.LAB	8:32	5.19	2.7	0.2	1.1	ND	5.5	191.0	0.97	15.88
R7_SYS_000314.LAB	8:33	5.22	2.7	0.3	1.2	ND	5.4	191.0	0.97	15.86
R7_SYS_000315.LAB	8:34	5.20	2.7	0.3	1.2	ND	5.4	191.0	0.97	15.86
R7_SYS_000316.LAB	8:35	5.19	2.7	0.2	1.4	ND	5.3	191.0	0.97	15.87
R7_SYS_000317.LAB	8:36	5.19	2.7	0.2	1.3	ND	5.3	191.0	0.97	15.87
R7_SYS_000318.LAB	8:37	5.19	2.7	0.3	1.4	ND	5.6	191.1	0.97	15.87
R7_SYS_000319.LAB	8:38	5.21	2.7	0.2	1.4	ND	5.3	191.0	0.97	15.87
R7_SYS_000320.LAB	8:39	5.21	2.7	0.2	1.4	ND	5.4	191.1	0.97	15.85
R7_SYS_000321.LAB	8:40	5.20	2.7	0.2	1.4	ND	5.5	191.0	0.97	15.86
R7_SYS_000322.LAB	8:41	5.20	2.7	0.2	1.5	ND	5.4	191.0	0.97	15.86
R7_SYS_000323.LAB	8:42	5.21	2.7	0.2	1.5	ND	5.3	191.0	0.97	15.86
R7_SYS_000324.LAB	8:43	5.21	2.7	0.2	1.5	ND	5.4	191.0	0.97	15.86
R7_SYS_000325.LAB	8:44	5.22	2.7	0.2	1.5	ND	5.3	191.0	0.97	15.85
R7_SYS_000326.LAB	8:45	5.20	2.7	0.2	1.5	ND	5.4	190.9	0.97	15.87
R7_SYS_000327.LAB	8:46	5.23	2.7	0.3	1.6	ND	5.2	190.9	0.97	15.87
R7_SYS_000328.LAB	8:47	5.22	2.7	0.1	1.6	ND	5.4	191.0	0.97	15.84
Average		5.21	2.72	0.42	0.69	ND	5.31	191.01	0.97	15.89

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Project #:** M224514  
**Test Method:** 5/29  
**Test Engineer:** MAN  
**Test Technician:** ATW  
**lb/mmBtu Emissions by:** Standard, O2 Based  
**Type of Fuel Firing:** Natural Gas

	<u>Run 1</u>	<u>Run 2</u>	<u>Run 3</u>
<b>Standard Fuel Factor Fd, dscf/mmBtu:</b>	8,710.0	8,710.0	8,710.0
<b>Meter ID:</b>	CM47	CM47	CM47
<b>Pitot ID:</b>	711	711	711
<b>Nozzle Diameter (Inches):</b>	0.273	0.273	0.273
<b>Meter Calibration Date:</b>	12/1/2022	12/1/2022	12/1/2022
<b>Meter Calibration Factor (Y):</b>	1.008	1.008	1.008
<b>Meter Orifice Setting (Delta H):</b>	1.839	1.839	1.839
<b>Nozzle Kit ID Number and Material:</b>	Quartz 718	Quartz 718	Quartz 718
<b>Pitot Tube Coefficient:</b>		0.840	
<b>Probe Length (Feet):</b>		6.0	
<b>Probe Liner Material:</b>		Quartz	
<b>Sample Plane:</b>		Horizontal	
<b>Port Length (Inches):</b>		4.50	
<b>Port Size (Diameter, Inches):</b>		4.00	
<b>Port Type:</b>		Flange	
<b>Duct Shape:</b>		Rectangular	
<b>Length (Feet):</b>		5	
<b>Width (Feet):</b>		8	
<b>Duct Area (Square Feet):</b>		40.000	
<b>Equivalent Diameter Rectangular Duct (Feet):</b>		6.154	
<b>Upstream Diameters:</b>		0.5	
<b>Downstream Diameters:</b>		2.0	
<b>Number of Ports Sampled:</b>		5	
<b>Number of Points per Port:</b>		5	
<b>Minutes per Point:</b>		8.0	
<b>Minutes per Reading:</b>		4.0	
<b>Total Number of Traverse Points:</b>		25	
<b>Test Length (Minutes):</b>		200	
<b>Train Type:</b>		Anderson Box	
<b>Source Condition:</b>		Natural Gas	
<b>Diluent Model/Serial Number:</b>		Servomex, FTIR, & ECOM	
<b>Moisture Balance ID:</b>		1000g	
<b># of Runs</b>		3	
<b>Train Support Type:</b>		MP Rails	

## Run 1 - Method 5/29

Client: Northern Natural Gas Company

Facility: Clifton Compressor Station

Test Location: Unit 30

Source Condition: Natural Gas

Date: 12/5/22

Start Time: 12:55

End Time: 16:26

## DRY GAS METER CONDITIONS

$\Delta H$ : 2.43 in. H<sub>2</sub>O  
 Meter Temperature, Tm: 72.0 °F  
 Sqrt  $\Delta P$ : 1.030 in. H<sub>2</sub>O  
 Stack Temperature, Ts: 926.9 °F  
 Meter Volume, Vm: 173.596 ft<sup>3</sup>  
 Meter Volume, Vmstd: 165.696 dscf  
 Meter Volume, Vwstd: 8.600 wscf  
 Isokinetic Variance: 102.2 %  
 Test Length: 200.00 in mins.  
 Nozzle Diameter: 0.273 in inches  
 Barometric Pressure: 28.37 in Hg

## STACK CONDITIONS

Static Pressure: 1.00 in. H<sub>2</sub>O  
 Flue Pressure (Ps): 28.44 in. Hg. abs.  
 Carbon Dioxide: 2.60 %  
 Oxygen: 16.30 %  
 Nitrogen: 81.10 %  
 Gas Weight dry, Md: 29.068 lb/lb mole  
 Gas Weight wet, Ms: 28.522 lb/lb mole  
 Excess Air: --- %  
 Gas Velocity, Vs: 96.709 fps  
 Volumetric Flow: 232,102 acfm  
 Volumetric Flow: 79,854 dscfm  
 Volumetric Flow: 83,999 scfm  
 Calculated Fo: 1.77  
 Fo Validity: Pass

## MOISTURE DETERMINATION

Initial Impinger Content: 3394.1 ml  
 Final Impinger Content: 3545.1 ml  
 Impinger Difference: 151.0 ml  
 Silica Initial Wt: 907.4 grams  
 Silica Final Wt: 939.0 grams  
 Silica Difference: 31.6 grams

Total Water Gain: 182.6

Moisture, Bws: 0.049

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head Ap in. H <sub>2</sub> O	$\Delta H$ in. H <sub>2</sub> O	Meter Vol. ft <sup>3</sup>	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	12:55:00	0.36	0.85	711.675	828	62	62	272	243	52
1-1	12:59:00	0.37	0.87	713.260	833	62	62	270	249	48
1-2	13:03:00	0.64	1.40	715.200	911	63	63	270	256	50
1-2	13:07:00	0.63	1.40	718.360	923	63	63	269	257	51
1-3	13:11:00	0.75	1.80	721.160	945	64	64	270	253	52
1-3	13:15:00	0.78	1.70	723.900	939	64	64	269	254	52
1-4	13:19:00	0.80	1.70	725.470	932	65	65	265	255	52
1-4	13:23:00	0.81	1.80	729.810	933	65	65	262	255	52
1-5	13:27:00	0.83	1.80	732.810	932	67	67	272	255	51
1-5	13:31:00	0.80	1.70	735.850	918	67	67	271	254	50
	13:35:00			738.841						
2-1	13:37:00	0.56	1.30	738.841	866	68	68	272	255	50
2-1	13:41:00	0.58	1.30	741.330	881	68	68	270	259	48
2-2	13:45:00	0.70	1.70	743.980	835	69	69	268	257	47
2-2	13:49:00	0.74	1.70	746.780	856	69	69	269	257	48
2-3	13:53:00	0.65	1.50	749.790	871	70	70	271	256	48
2-3	13:57:00	0.65	1.50	752.550	910	71	71	268	255	50
2-4	14:01:00	0.67	1.50	755.260	931	72	72	262	254	50
2-4	14:05:00	0.68	1.50	758.060	946	72	72	268	256	50
2-5	14:09:00	1.00	2.20	760.800	939	73	73	269	255	49
2-5	14:13:00	1.10	2.40	764.190	937	73	73	270	256	49
	14:17:00			767.688						
3-1	14:19:00	0.94	2.10	767.688	938	73	73	268	247	48
3-1	14:23:00	0.94	2.10	770.950	939	73	73	269	250	46
3-2	14:27:00	0.90	2.00	774.150	942	73	73	270	251	48
3-2	14:31:00	1.10	2.40	777.330	950	74	74	272	250	48
3-3	14:35:00	1.50	3.30	780.880	952	75	75	270	250	49
3-3	14:39:00	1.20	2.60	784.990	947	75	75	271	250	50
3-4	14:43:00	1.40	3.10	788.670	940	76	76	270	250	51
3-4	14:47:00	1.40	3.10	792.000	932	75	75	268	249	50
3-5	14:51:00	1.50	3.30	797.140	934	76	76	268	251	50
3-5	14:55:00	1.50	3.30	800.870	934	76	76	267	248	49
	14:59:00			804.920						
4-1	15:04:00	1.80	3.50	804.920	934	76	76	271	249	50
4-1	15:08:00	1.60	3.60	809.020	940	76	76	271	253	48
4-2	15:12:00	1.50	3.30	812.850	943	76	76	270	252	49
4-2	15:16:00	1.50	3.30	816.930	944	76	76	272	250	49
4-3	15:20:00	1.40	3.10	820.850	946	76	76	270	252	50
4-3	15:24:00	1.40	3.10	825.370	945	77	77	272	251	51
4-4	15:28:00	1.30	2.90	829.660	944	76	76	269	249	51
4-4	15:32:00	1.40	3.20	833.660	944	76	76	266	249	50
4-5	15:36:00	1.10	2.50	837.370	943	76	76	271	250	49
4-5	15:40:00	1.10	2.50	841.270	939	76	76	272	250	49
	15:44:00			844.780						
5-1	15:46:00	1.40	3.10	844.780	942	76	76	270	249	49
5-1	15:50:00	1.50	3.30	848.840	943	75	75	267	248	48
5-2	15:54:00	1.50	3.30	853.140	943	75	75	268	249	49
5-2	15:58:00	1.40	3.10	857.270	945	74	74	269	249	49
5-3	16:02:00	1.30	2.90	861.310	945	75	75	269	250	49
5-3	16:06:00	1.40	3.10	865.020	947	75	75	269	250	49
5-4	16:10:00	1.50	3.30	868.500	945	75	75	270	251	49
5-4	16:14:00	1.50	3.30	873.450	945	75	75	269	250	50
5-5	16:18:00	1.50	3.30	877.240	949	74	74	269	250	50
5-5	16:22:00	1.40	3.10	881.320	947	74	74	269	249	50
	16:26:00			885.271						

Total 3:20:00 173.596 72.0 72.0  
 Average 1.10 2.43 926.9 72.0  
 Min 0.85 828.0 62.0  
 Max 3.60 952.0 77.0

# Impinger Weight Sheet - Run 1

Client:	Northern Natural Gas Company	Scale Calibration Check Date:	12/5/2022
Facility:	Clifton Compressor Station	<u>Scale Calibration Check (see QS-6.05C for procedure)</u>	
Test Location:	Unit 30	must be within $\pm 0.5g$ of certified mass	
Project #:	M224514	<u>Certified Weight, grams</u>	<u>Result, grams</u>
Date:	12/5/2022	250	250.0
Test Method:	5/29		
Weighed/Measured By:	RWC	500	500.0
Balance ID:	1000g	750	750.0

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
HNO3/H2O2	784.7	722.9	61.8
HNO3/H2O2	768.5	699.8	68.7
Empty	666.0	650.8	15.2
KMnO4/H2SO4	612.5	606.6	5.9
KMnO4/H2SO4	713.4	714.0	-0.6
Silica Gel	939.0	907.4	31.6

3,545.1	3,394.1	151.0
<u>Liquid Final</u>	<u>Liquid Initial</u>	<u>Liquid Gain</u>
939.0	907.4	31.6
<u>Silica Final</u>	<u>Silica Initial</u>	<u>Silica Gain</u>

## Run 2 - Method 5/29

Client: Northern Natural Gas Company

Facility: Clifton Compressor Station

Test Location: Unit 30

Source Condition: Natural Gas

Date: 12/6/22

Start Time: 7:21

End Time: 11:06

## DRY GAS METER CONDITIONS

$\Delta H$ : 2.49 in. H<sub>2</sub>O  
 Meter Temperature, Tm: 59.1 °F  
 $\sqrt{\text{Sqrt } \Delta P}$ : 1.066 in. H<sub>2</sub>O  
 Stack Temperature, Ts: 940.1 °F  
 Meter Volume, Vm: 176.156 ft<sup>3</sup>  
 Meter Volume, Vmstd: 172.356 dscf  
 Meter Volume, Vwstd: 9.618 wscf  
 Isokinetic Variance: 103.5 %  
 Test Length: 200.00 in mins.  
 Nozzle Diameter: 0.273 in inches  
 Barometric Pressure: 28.37 in Hg

## STACK CONDITIONS

Static Pressure: 1.00 in. H<sub>2</sub>O  
 Flue Pressure (Ps): 28.44 in. Hg. abs.  
 Carbon Dioxide: 2.80 %  
 Oxygen: 16.10 %  
 Nitrogen: 81.1 %  
 Gas Weight dry, Md: 29.092 lb/lb mole  
 Gas Weight wet, Ms: 28.506 lb/lb mole  
 Excess Air: --- %  
 Gas Velocity, Vs: 100.584 fps  
 Volumetric Flow: 241,403 acfm  
 Volumetric Flow: 81,971 dscfm  
 Volumetric Flow: 86,545 scfm  
 Calculated Fo: 1.71  
 Fo Validity: Pass

## MOISTURE DETERMINATION

Initial Impinger Content: 3681.6 ml  
 Final Impinger Content: 3859.9 ml  
 Impinger Difference: 178.3 ml  
 Silica Initial Wt: 869.7 grams  
 Silica Final Wt: 895.6 grams  
 Silica Difference: 25.9 grams

Total Water Gain: 204.2      Moisture, Bws: 0.053

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head Ap in. H <sub>2</sub> O	$\Delta H$ in. H <sub>2</sub> O	Meter Vol. ft <sup>3</sup>	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	7:21:00	0.55	1.20	885.866	934	42	42	258	250	36
1-1	7:25:00	0.57	1.20	888.030	934	42	42	263	250	37
1-2	7:29:00	0.81	1.70	890.580	934	43	43	269	251	37
1-2	7:33:00	0.82	1.70	893.280	936	43	43	271	251	38
1-3	7:37:00	0.93	2.00	896.160	934	45	45	271	251	40
1-3	7:41:00	0.92	2.00	899.520	933	45	45	270	250	42
1-4	7:45:00	0.98	2.10	902.450	933	47	47	269	251	43
1-4	7:49:00	0.98	2.10	905.830	937	48	48	268	248	43
1-5	7:53:00	1.00	2.10	908.920	937	49	49	269	249	41
1-5	7:57:00	1.10	2.30	912.520	937	49	49	271	250	41
	8:01:00			915.640						
2-1	8:17:00	1.00	2.20	915.640	925	51	51	271	257	40
2-1	8:21:00	0.97	2.10	918.520	940	52	52	270	251	36
2-2	8:25:00	1.10	2.40	921.850	941	52	52	270	252	38
2-2	8:29:00	1.10	2.40	925.270	942	53	53	269	251	39
2-3	8:33:00	1.00	2.10	928.610	938	54	54	269	250	40
2-3	8:37:00	1.00	2.10	931.840	941	54	54	270	248	41
2-4	8:41:00	0.96	2.10	935.040	942	55	55	270	254	41
2-4	8:45:00	0.95	2.00	939.250	942	55	55	269	247	42
2-5	8:49:00	1.00	2.20	941.480	940	55	55	269	255	42
2-5	8:53:00	1.00	2.20	944.850	942	57	57	269	249	42
	8:57:00			949.010						
3-1	9:00:00	1.20	2.60	949.010	925	58	58	259	247	40
3-1	9:04:00	1.30	2.80	952.360	928	58	58	260	248	40
3-2	9:08:00	1.40	3.00	956.050	940	59	59	264	254	40
3-2	9:12:00	1.60	3.40	960.040	946	59	59	267	249	43
3-3	9:16:00	1.50	3.30	964.030	943	61	61	270	247	43
3-3	9:20:00	1.40	3.00	968.150	946	61	61	270	252	43
3-4	9:24:00	1.20	2.60	972.150	945	62	62	270	248	43
3-4	9:28:00	1.20	2.60	974.620	944	63	63	270	250	42
3-5	9:32:00	1.20	2.60	979.250	944	64	64	271	251	42
3-5	9:36:00	1.20	2.60	983.040	945	64	64	271	249	43
	9:40:00			986.820						
4-1	9:45:00	1.50	3.30	986.820	926	64	64	269	252	41
4-1	9:49:00	1.50	3.30	990.590	949	65	64	270	250	42
4-2	9:53:00	1.40	3.00	994.360	951	65	65	271	251	43
4-2	9:57:00	1.40	3.00	998.350	950	66	66	272	248	44
4-3	10:01:00	1.10	2.40	1002.630	949	66	66	270	248	43
4-3	10:05:00	1.10	2.40	1006.010	949	67	67	270	251	43
4-4	10:09:00	1.20	2.60	1009.910	949	67	67	270	247	43
4-4	10:13:00	1.10	2.40	1013.140	941	68	68	269	248	41
4-5	10:17:00	1.10	2.40	1016.470	946	67	67	270	254	43
4-5	10:21:00	1.10	2.40	1020.140	939	68	68	270	253	43
	10:25:00			1023.850						
5-1	10:26:00	1.40	3.10	1023.850	945	68	68	269	251	45
5-1	10:30:00	1.40	3.10	1027.470	946	68	68	271	252	45
5-2	10:34:00	1.50	3.30	1031.490	942	69	69	271	250	46
5-2	10:38:00	1.50	3.30	1035.840	941	69	69	270	251	46
5-3	10:42:00	1.20	2.70	1039.490	941	69	69	269	250	47
5-3	10:46:00	1.40	3.10	1043.390	941	70	70	271	251	48
5-4	10:50:00	1.30	2.90	1047.160	939	70	70	270	250	48
5-4	10:54:00	1.30	2.90	1051.160	942	70	70	271	250	49
5-5	10:58:00	1.00	2.20	1055.040	941	70	70	269	250	50
5-5	11:02:00	1.00	2.20	1058.850	929	70	70	269	251	50
	11:06:00			1062.022						

Total 3:20:00      176.156      59.1      59.1  
 Average 2.49      940.1      59.1  
 Min 1.20      925.0      42.0  
 Max 3.40      951.0      70.0



## Impinger Weight Sheet - Run 2

Client:	Northern Natural Gas Company	Scale Calibration Check Date:	12/6/2022
Facility:	Clifton Compressor Station	<u>Scale Calibration Check (see QS-6.05C for procedure)</u>	
Test Location:	Unit 30	must be within $\pm 0.5g$ of certified mass	
Project #:	M224514	<u>Certified Weight, grams</u>	<u>Result, grams</u>
Date:	12/6/2022	250	250.0
Test Method:	5/29		
Weighed/Measured By:	RWC	500	500.0
Balance ID:	1000g	750	749.8

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
HNO3/H2O2	810.0	795.3	14.7
HNO3/H2O2	844.1	742.9	101.2
Empty	687.7	649.6	38.1
KMnO4/H2SO4	743.8	727.3	16.5
KMnO4/H2SO4	774.3	766.5	7.8
Silica Gel	895.6	869.7	25.9

<u>3,859.9</u> <b>Liquid Final</b>	<u>3,681.6</u> <b>Liquid Initial</b>	<u>178.3</u> <b>Liquid Gain</b>
<u>895.6</u> <b>Silica Final</b>	<u>869.7</u> <b>Silica Initial</b>	<u>25.9</u> <b>Silica Gain</b>

## Run 3 - Method 5/29

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Test Location: Unit 30  
 Source Condition: Natural Gas

Date: 12/6/22  
 Start Time: 11:37  
 End Time: 15:04

DRY GAS METER CONDITIONS					STACK CONDITIONS				
	?	2.31	In. H <sub>2</sub> O		Static Pressure	1.00	in. H <sub>2</sub> O		
Meter Temperature, Tm:	75.8	°F			Flue Pressure (Ps):	28.44	in. Hg. abs.		
Sqrt ΔP:	0.985	In. H <sub>2</sub> O			Carbon Dioxide:	2.50	%		
Stack Temperature, Ts:	870.8	°F			Oxygen:	17.00	%		
Meter Volume, Vm:	170.787	ft <sup>3</sup>			Nitrogen:	80.5	%		
Meter Volume, Vmsd:	161.825	dscf			Gas Weight dry, Md:	29.080	lb/lb mole		
Meter Volume, Vwstd:	8.257	wscf			Gas Weight wet, Ms:	28.542	lb/lb mole		
Isokinetic Variance:	102.1	%			Excess Air:	---	%		
					Gas Velocity, Vs:	90.555	fps		
Test Length:	200.00	in mins.			Volumetric Flow:	217,333	acfm		
Nozzle Diameter:	0.273	in inches			Volumetric Flow:	77,995	dscfm		
Barometric Pressure:	28.37	in Hg			Volumetric Flow:	81,975	scfm		
					Calculated Fo:	1.56			
					Fo Validity:	Fail			

## MOISTURE DETERMINATION

Initial Impinger Content:	3404.8	ml	Silica Initial Wt.	912.2	grams
Final Impinger Content:	3544.7	ml	Silica Final Wt.	947.6	grams
Impinger Difference:	139.9	ml	Silica Difference:	35.4	grams

Total Water Gain: 175.3      Moisture, Bws: 0.049

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head ΔP in. H <sub>2</sub> O	ΔH in. H <sub>2</sub> O	Meter Vol. ft <sup>3</sup>	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	11:37:00	1.50	3.30	64.074	930	70	70	271	250	65
1-1	11:41:00	1.50	3.30	67.950	942	71	71	270	251	58
1-2	11:45:00	1.60	3.50	72.140	938	71	71	270	250	60
1-2	11:49:00	1.70	3.80	76.830	941	70	70	268	255	60
1-3	11:53:00	1.40	3.10	80.570	934	71	71	267	254	60
1-3	11:57:00	1.50	3.30	84.820	933	71	71	268	250	59
1-4	12:01:00	1.30	2.90	89.210	932	72	72	266	250	57
1-4	12:05:00	1.40	3.10	92.730	929	72	72	269	250	54
1-5	12:09:00	1.30	2.90	96.590	933	73	73	270	250	55
1-5	12:13:00	1.20	2.70	100.830	889	73	73	271	249	55
	12:17:00			104.510						
2-1	12:18:00	1.20	2.70	104.510	931	73	73	269	251	53
2-1	12:22:00	1.20	2.70	108.020	934	74	74	270	251	53
2-2	12:26:00	1.20	2.70	111.520	944	74	74	270	251	53
2-2	12:30:00	1.00	2.20	115.450	940	74	74	271	251	53
2-3	12:34:00	0.95	2.10	118.730	938	74	74	270	250	55
2-3	12:38:00	1.10	2.50	122.100	939	76	76	271	250	54
2-4	12:42:00	1.30	2.90	125.290	919	75	75	267	251	55
2-4	12:46:00	0.98	2.20	129.630	910	76	76	268	250	52
2-5	12:50:00	0.95	2.20	132.630	891	77	77	271	250	52
2-5	12:54:00	0.92	2.10	136.420	903	77	77	270	249	53
	12:58:00			139.67						
3-1	13:00:00	1.00	2.20	139.670	945	77	78	266	248	49
3-1	13:04:00	1.10	2.50	143.150	945	78	78	268	252	50
3-2	13:08:00	0.95	2.10	146.360	944	78	78	267	251	50
3-2	13:12:00	0.89	2.00	149.950	939	78	78	270	251	52
3-3	13:16:00	0.92	2.10	153.320	936	78	78	271	250	53
3-3	13:20:00	0.90	2.00	156.560	940	78	78	272	251	53
3-4	13:24:00	1.10	2.50	159.470	941	79	79	270	249	54
3-4	13:28:00	1.00	2.20	163.420	944	79	79	268	251	54
3-5	13:32:00	0.90	2.00	166.880	938	79	79	271	249	54
3-5	13:36:00	0.95	2.10	169.970	936	79	79	272	250	54
	13:40:00			173.240						
4-1	13:42:00	0.66	1.60	173.240	845	78	78	271	254	53
4-1	13:46:00	0.68	1.60	176.250	853	78	78	267	253	53
4-2	13:50:00	0.72	1.70	179.120	851	78	78	266	251	50
4-2	13:54:00	0.72	1.80	181.850	825	79	79	271	250	53
4-3	13:58:00	0.73	1.80	185.190	821	78	78	269	247	54
4-3	14:02:00	0.70	1.80	188.340	799	78	78	271	253	54
4-4	14:06:00	0.67	1.70	191.420	782	78	78	267	250	54
4-4	14:10:00	0.74	1.90	194.240	770	77	77	268	252	52
4-5	14:14:00	0.72	1.90	197.370	748	78	78	270	250	52
4-5	14:18:00	0.77	2.00	200.570	742	77	77	268	250	52
	14:22:00			203.720						
5-1	14:24:00	0.37	1.00	203.720	694	77	77	263	258	55
5-1	14:28:00	0.37	1.00	206.240	684	77	77	264	248	54
5-2	14:32:00	0.54	1.50	208.460	684	76	76	265	245	53
5-2	14:36:00	0.53	1.50	211.260	685	77	77	267	251	53
5-3	14:40:00	0.58	1.60	213.940	687	77	77	267	253	52
5-3	14:44:00	0.55	1.50	216.590	674	76	76	262	247	53
5-4	14:48:00	0.96	2.70	219.690	675	76	76	263	248	53
5-4	14:52:00	1.20	2.70	223.560	936	76	76	268	252	53
5-5	14:56:00	1.70	3.80	226.920	940	75	75	267	251	50
5-5	15:00:00	1.10	2.60	231.550	885	76	76	269	252	50
	15:04:00			234.861						
Total	3:20:00			170.787		75.8	75.8			
Average			2.31		870.8	75.8				
Min			1.00		674.0	70.0				
Max			3.80		945.0	79.0				

### Impinger Weight Sheet - Run 3

Client:	Northern Natural Gas Company	Scale Calibration Check Date:	12/6/2022
Facility:	Clifton Compressor Station	<u>Scale Calibration Check (see QS-6.05C for procedure)</u>	
Test Location:	Unit 30	must be within $\pm 0.5g$ of certified mass	
Project #:	M224514	<u>Certified Weight, grams</u>	<u>Result, grams</u>
Date:	12/6/2022	250	250.0
Test Method:	5/29		
Weighed/Measured By:	RWC	500	500.0
Balance ID:	1000g	750	749.8

	IMPINGER		FINAL		INITIAL		GAIN	
	CONTENTS		MLS / GRAMS		MLS / GRAMS		MLS / GRAMS	
	HNO3/H2O2		760.9		725.4		35.5	
	HNO3/H2O2		686.4		707.8		-21.4	
	Empty		758.8		654.0		104.8	
	KMnO4/H2SO4		650.5		639.8		10.7	
	KMnO4/H2SO4		688.1		677.8		10.3	
	Silica Gel		947.6		912.2		35.4	

<u>3,544.7</u> <b>Liquid Final</b>	<u>3,404.8</u> <b>Liquid Initial</b>	<u>139.9</u> <b>Liquid Gain</b>
<u>947.6</u> <b>Silica Final</b>	<u>912.2</u> <b>Silica Initial</b>	<u>35.4</u> <b>Silica Gain</b>

Client: Northern Natural Gas Company  
Facility: Clifton Compressor Station  
Test Location: Unit 30  
Project #: M224514

Run 1		
Date:	12/5/2022	
Time	O2 % (dry)	CO2 % (dry)
12:55	17.03	
12:56	17.00	2.22
12:57	17.00	2.17
12:58	17.01	2.18
12:59	16.95	2.18
13:00	16.79	2.20
13:01	16.57	2.28
13:02	16.34	2.40
13:03	16.14	2.56
13:04	16.03	2.70
13:05	16.15	2.77
13:06	16.17	2.70
13:07	16.17	2.69
13:08	16.23	2.69
13:09	16.13	2.65
13:10	16.09	2.74
13:11	16.10	2.73
13:12	16.09	2.75
13:13	16.08	2.73
13:14	16.11	2.74
13:15	16.16	2.72
13:16	16.20	2.68
13:17	16.15	2.72
13:18	16.21	2.67
13:19	16.25	2.64
13:20	16.25	2.65
13:21	16.22	2.68
13:22	16.29	2.57
13:23	16.28	2.58
13:24	16.27	2.58
13:25	16.27	2.58
13:26	16.27	2.58
13:27	16.46	2.32
13:28	16.96	2.16
13:29	17.03	2.24
13:30	16.77	2.37
13:31	16.64	2.39
13:32	16.59	2.42
13:33	16.59	2.43
13:34	16.55	2.41
13:35	16.59	2.42
13:36	16.56	2.40
13:37	16.59	2.22
13:38	16.86	2.21
13:39	16.97	2.27
13:40	16.84	2.27
13:41	16.83	2.31
13:42	16.79	2.35
13:43	16.71	2.46
13:44	16.60	2.59
13:45	16.38	2.77
13:46	16.13	2.74
13:47	16.00	2.71
13:48	16.10	2.70
13:49	16.11	2.70
13:50	16.11	2.66
13:51	16.12	2.68
13:52	16.21	2.66
13:53	16.15	2.69
13:54	16.20	2.76
13:55	16.16	
13:56	16.04	
13:57	16.04	
13:58		
13:59		
14:00		
14:01		
14:02		
14:03		
14:04		
14:05		
14:06		

Run 2		
Date:	12/6/2022	
Time	O2 % (dry)	CO2 % (dry)
7:47	15.99	2.87
7:48	16.01	2.86
7:49	15.95	2.84
7:50	15.95	2.87
7:51	15.93	2.86
7:52	15.92	2.87
7:53	15.92	2.87
7:54	15.95	2.87
7:55	15.96	2.87
7:56	15.98	2.87
7:57	15.93	2.86
7:58	15.96	2.87
7:59	15.95	2.87
8:00	15.93	2.87
8:01	15.94	2.86
8:02	15.91	2.88
8:03	15.93	2.86
8:04	15.93	2.87
8:05	15.90	2.87
8:06	15.92	2.86
8:07	15.90	2.87
8:08	15.88	2.88
8:09	15.88	2.87
8:10	15.88	2.86
8:11	15.87	2.87
8:12	15.87	2.86
8:13	15.88	2.86
8:14	15.87	2.87
8:15	15.87	2.87
8:16	15.87	2.86
8:17	15.88	2.88
8:18	15.88	2.86
8:19	15.88	2.88
8:20	15.85	2.88
8:21	15.86	2.87
8:22	15.89	2.85
8:23	15.85	2.86
8:24	15.87	2.87
8:25	15.87	2.85
8:26	15.86	2.87
8:27	15.86	2.87
8:28	15.86	2.86
8:29	15.86	2.88
8:30	15.86	2.87
8:31	15.86	2.87
8:32	15.88	2.86
8:33	15.86	2.88
8:34	15.86	2.86
8:35	15.87	2.86
8:36	15.87	2.85
8:37	15.87	2.86
8:38	15.87	2.87
8:39	15.85	2.87
8:40	15.86	2.87
8:41	15.86	2.86
8:42	15.86	2.87
8:43	15.86	2.87
8:44	15.85	2.88
8:45	15.87	2.86
8:46	15.87	2.87
8:47	15.84	2.86
8:48	15.87	

Run 3		
Date:	12/6/2022	
Time	O2 % (dry)	CO2 % (dry)
11:41	17.10	2.70
11:42	17.10	2.70
11:43	17.10	2.70
11:44	17.10	2.70
11:45	17.10	2.70
11:46	17.10	2.70
11:47	17.00	2.70
11:48	17.10	2.70
11:49	17.10	2.70
11:50	17.00	2.70
11:51	17.10	2.70
11:52	17.10	2.70
11:53	17.00	2.70
11:54	17.10	2.70
11:55	17.10	2.70
11:56	17.10	2.70
11:57	17.10	2.70
11:58	17.10	2.70
11:59	17.20	2.70
12:00	17.20	2.70
12:01	17.20	2.70
12:02	17.10	2.70
12:03	17.10	2.70
12:04	17.10	2.70
12:05	17.20	2.70
12:06	17.20	2.70
12:07	17.40	2.60
12:08	17.70	2.40
12:09	17.90	2.30
12:10	18.00	2.30
12:11	17.90	2.30
12:12	17.80	2.40
12:13	17.60	2.50
12:14	17.30	2.70
12:15	17.30	2.70
12:16	17.30	2.70
12:17	17.30	2.60
12:18	17.30	2.60
12:19	17.30	2.60
12:20	17.40	2.60
12:21	17.30	2.60
12:22	17.30	2.60
12:23	17.40	2.60
12:24	17.40	2.60
12:25	17.40	2.60
12:26	17.40	2.60
12:27	17.40	2.60
12:28	17.40	2.60
12:29	17.40	2.60
12:30	17.50	2.60
12:31	17.40	2.60
12:32	17.50	2.60
12:33	17.50	2.60
12:34	17.50	2.60
12:35	17.50	2.50
12:36	17.50	2.60
12:37	17.60	2.50
12:38	17.50	2.60
12:39	17.70	2.50
12:40	18.30	2.20
12:41	18.50	2.10
12:42	18.30	2.20
12:43	18.20	2.30
12:44	18.00	2.30
12:45	18.00	2.40
12:46	18.00	2.30
12:47	18.00	2.40
12:48	18.40	2.20
12:49	18.50	2.10
12:50	18.30	2.20
12:51	18.20	2.30
12:52	18.10	2.30

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Project #:** M224514

Run 1  
Date: 12/5/2022

Run 2  
Date: 12/6/2022

Run 3  
Date: 12/6/2022

time	O2 % (dry)	CO2 % (dry)
14:07		
14:08		
14:09		
14:10	16.09	
14:11	16.15	
14:12	16.16	2.65
14:13	16.17	2.64
14:14	16.15	2.65
14:15	16.20	2.65
14:16	16.14	2.63
14:17	16.19	2.64
14:18	16.08	2.65
14:19	16.01	2.65
14:20	15.99	2.72
14:21	15.95	2.73
14:22	15.90	2.75
14:23	15.93	2.79
14:24	15.89	2.76
14:25	15.85	2.78
14:26	15.86	2.81
14:27	15.84	2.83
14:28	15.86	2.81
14:29	15.93	2.82
14:30	16.21	2.76
14:31	16.29	2.66
14:32	16.01	2.48
14:33	16.03	2.71
14:34	16.23	2.71
14:35	16.55	2.55
14:36	16.36	2.36
14:37	15.84	2.47
14:38	15.93	2.83
14:39	15.92	2.77
14:40	15.86	2.79
14:41	15.87	2.82
14:42	15.84	2.81
14:43	15.85	2.82
14:44	15.91	2.81
14:45	15.95	2.78
14:46	15.95	2.75
14:47	15.96	2.77
14:48	15.96	2.76
14:49	15.96	2.75
14:50	15.97	2.76
14:51	15.99	2.74
14:52	16.00	2.73
14:53	15.98	2.74
14:54	15.97	2.75
14:55	15.98	2.74
14:56	15.97	2.75
14:57	15.98	2.75
14:58	15.96	2.76
14:59	15.97	2.75
15:00	15.98	2.76
15:01	16.09	2.75
15:02	15.96	2.76
15:03	15.97	2.76
15:04	15.98	2.75
15:05	15.97	2.77
15:06	15.98	2.76
15:07	15.96	2.77
15:08	15.97	2.77
15:09	15.99	2.75
15:10	15.97	2.76
15:11	15.96	2.77
15:12	15.97	
15:13		
15:29	16.05	2.76
15:30	16.04	2.77
15:31	16.06	2.76
15:32	16.04	2.76
15:33	16.05	2.77

Time	O2 % (dry)	CO2 % (dry)
12:53	17.90	2.40
12:54	17.70	2.50
12:55	17.70	2.50
12:56	17.90	2.50
12:57	17.80	2.50
12:58		
12:59		
13:00	18.10	2.40
13:01	18.10	2.30
13:02	18.20	2.30
13:03	18.20	2.30
13:04	18.20	2.30
13:05	18.30	2.30
13:06	18.20	2.40
13:07	18.30	2.30
13:08	18.30	2.30
13:09	18.30	2.30
13:10	18.20	2.30
13:11	18.30	2.40
13:12	18.30	2.30
13:13	18.30	2.30
13:14	18.30	2.30
13:15	18.30	2.30
13:16	18.20	2.40
13:17	18.20	2.40
13:18	18.30	2.40
13:19	18.30	2.40
13:20	18.30	2.40
13:21	18.30	2.40
13:22	18.30	2.30
13:23	18.30	2.30
13:24	18.20	2.30
13:25	18.20	2.40
13:26	18.30	2.30
13:27	18.20	2.30
13:28	18.20	2.40
13:29	18.20	2.30
13:30	18.30	2.30
13:31	18.30	2.30
13:32	18.20	2.40
13:33	18.20	2.40
13:34	18.50	2.20
13:35		
13:36		
13:37		
13:38		
13:39		
13:40		
13:41		
13:42		
13:43		
13:44		
13:45		
13:46		
13:47		
13:48		
13:49		
13:50		
13:51		
13:52		
13:53		
13:54		
13:55		
13:56		
13:57		
13:58		
13:59		
14:15		
14:16		
14:17		
14:18		
14:19		

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Test Location: Unit 30  
 Project #: M224514

Run 1			Run 2			Run 3		
Date:	12/5/2022		Date:	12/6/2022		Date:	12/6/2022	
Time	O2 % (dry)	CO2 % (dry)	Time	O2 % (dry)	CO2 % (dry)	Time	O2 % (dry)	CO2 % (dry)
15:34	16.06	2.77				14:20		
15:35	16.05	2.76				14:21		
15:36	16.06	2.76				14:22		
15:37	16.06	2.77				14:23		
15:38	16.05	2.75				14:24		
15:39	16.06	2.75				14:25		
15:40	16.04	2.74				14:26		
15:41	16.06	2.76				14:27		
15:42	16.03	2.75				14:28		
15:43	16.06	2.75				14:29		
15:44	16.05	2.75				14:30		
15:45	16.06	2.77				14:31		
15:46	16.05	2.76				14:32		
15:47	16.06	2.78				14:33		
15:48	16.06	2.76				14:34		
15:49	16.05	2.76				14:35		
15:50	16.06	2.78				14:36		
15:51	16.06	2.77				14:37		
15:52	16.08	2.76				14:38		
15:53	16.05	2.76				14:39		
15:54	16.06	2.79				14:40		
15:55	16.06	2.77				14:41		
15:56	16.08	2.76				14:42		
15:57	16.05	2.77				14:43		
15:58	16.05	2.77				14:44		
15:59	16.06	2.77				14:45		
16:00	16.07	2.77				14:46		
16:01	16.05	2.77				14:47		
16:02	16.07	2.76				14:48		
16:03	16.06	2.76				14:49		
16:04	16.06	2.76				14:50		
16:05	16.06	2.76				14:51		
16:06	16.04	2.77				14:52		
16:07	16.07	2.76				14:53	18.30	2.30
16:08	16.08	2.75				14:54	18.20	2.30
16:09	16.08	2.75				14:55	18.20	2.30
16:10	16.10	2.74				14:56	18.10	2.30
16:11	16.09	2.74				14:57	18.10	2.30
16:12	16.09	2.75				14:58	18.10	2.30
16:13	16.11	2.74				14:59	18.10	2.40
16:14	16.10	2.74				15:00	18.10	2.40
16:15	16.10	2.75				15:01	18.40	2.20
16:16	16.10	2.75				15:02	18.30	2.30
16:17	16.10	2.75						
16:18	16.09	2.75						
16:19	16.11	2.74						
16:20	16.08	2.75						
16:21	16.08	2.76						
16:22	16.09	2.76						
16:23	16.08	2.76						
16:24	16.09	2.77						
16:25	16.10	2.75						
16:26	16.12	2.74						
Average	16.16	2.67	Average	15.89	2.87	Average	17.77	2.47
Min	15.84	2.16	Min	15.84	2.84	Min	17.00	2.10
Max	17.03	2.83	Max	16.01	2.88	Max	18.50	2.70

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Project #:** M224514  
**Test Method:** 5/29  
**Test Engineer:** MAN  
**Test Technician:** ATW  
**Type of Fuel Firing:** Natural Gas

	<u>Run 4</u>	<u>Run 5</u>	<u>Run 6</u>
<b>Meter ID:</b>	CM47	CM47	CM47
<b>Pitot ID:</b>	711	711	711
<b>Nozzle Diameter (Inches):</b>	0.273	0.273	0.273
<b>Meter Calibration Date:</b>	12/1/2022	12/1/2022	12/1/2022
<b>Meter Calibration Factor (Y):</b>	1.008	1.008	1.008
<b>Meter Orifice Setting (Delta H):</b>	1.839	1.839	1.839
<b>Nozzle Kit ID Number and Material:</b>	Quartz 718	Quartz 718	Quartz 718
<b>Pitot Tube Coefficient:</b>		0.840	
<b>Probe Length (Feet):</b>		6.0	
<b>Probe Liner Material:</b>		Quartz	
<b>Sample Plane:</b>		Horizontal	
<b>Port Length (Inches):</b>		4.50	
<b>Port Size (Diameter, Inches):</b>		4.00	
<b>Port Type:</b>		Flange	
<b>Duct Shape:</b>		Rectangular	
<b>Length (Feet):</b>		5	
<b>Width (Feet):</b>		8	
<b>Duct Area (Square Feet):</b>		40.000	
<b>Equivalent Diameter Rectangular Duct (Feet):</b>		6.154	
<b>Upstream Diameters:</b>		0.5	
<b>Downstream Diameters:</b>		2.0	
<b>Number of Ports Sampled:</b>		5	
<b>Number of Points per Port:</b>		5	
<b>Minutes per Point:</b>		8.0	
<b>Minutes per Reading:</b>		4.0	
<b>Total Number of Traverse Points:</b>		25	
<b>Test Length (Minutes):</b>		200	
<b>Train Type:</b>		Anderson Box	
<b>Source Condition:</b>		Normal	
<b>Diluent Model/Serial Number:</b>		ECOM	
<b>Moisture Balance ID:</b>		1000g	
<b># of Runs</b>		3	
<b>Train Support Type:</b>		MP Rails	

## Run 4 - Method 5/29

Client: Northern Natural Gas Company

Facility: Clifton Compressor Station

Test Location: Unit 30

Source Condition: Natural Gas

Date: 12/7/22

Start Time: 7:34

End Time: 11:04

## DRY GAS METER CONDITIONS

$\Delta H$ : 2.98 in. H<sub>2</sub>O  
 Meter Temperature, Tm: 66.5 °F  
 Sqrt  $\Delta P$ : 1.156 in. H<sub>2</sub>O  
 Stack Temperature, Ts: 937.5 °F  
 Meter Volume, Vm: 168.114 ft<sup>3</sup>  
 Meter Volume, Vmstd: 164.646 dscf  
 Meter Volume, Vwstd: 8.817 wscf  
 Isokinetic Variance: 90.3 %  
 Test Length: 200.00 in mins.  
 Nozzle Diameter: 0.273 in inches  
 Barometric Pressure: 28.77 in Hg

## STACK CONDITIONS

Static Pressure: 1.00 in. H<sub>2</sub>O  
 Flue Pressure (Ps): 28.84 in. Hg. abs.  
 Carbon Dioxide: 2.70 %  
 Oxygen: 16.80 %  
 Nitrogen: 80.50 %  
 Gas Weight dry, Md: 29.104 lb/lb mole  
 Gas Weight wet, Ms: 28.540 lb/lb mole  
 Excess Air: --- %  
 Gas Velocity, Vs: 108.139 fps  
 Volumetric Flow: 259,533 acfm  
 Volumetric Flow: 89,721 dscfm  
 Volumetric Flow: 94,525 scfm  
 Calculated Fo: 1.52  
 Fo Validity: Fail

## MOISTURE DETERMINATION

Initial Impinger Content: 3661.4 ml  
 Final Impinger Content: 3826.9 ml  
 Impinger Difference: 165.5 ml  
 Silica Initial Wt: 878.8 grams  
 Silica Final Wt: 900.5 grams  
 Silica Difference: 21.7 grams

Total Water Gain: 187.2      Moisture, Bws: 0.051

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head Ap in. H <sub>2</sub> O	$\Delta H$ in. H <sub>2</sub> O	Meter Vol. ft <sup>3</sup>	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	7:34:00	0.74	1.80	239.137	923	42	42	271	250	49
1-1	7:38:00	0.75	1.80	241.830	931	44	44	268	251	36
1-2	7:42:00	1.10	2.40	243.740	924	47	47	269	250	37
1-2	7:46:00	1.10	2.40	246.720	925	49	49	270	250	37
1-3	7:50:00	1.20	2.60	249.850	922	50	50	268	250	39
1-3	7:54:00	1.10	2.40	252.690	926	52	52	269	250	38
1-4	7:58:00	1.20	2.60	255.730	928	55	55	270	247	38
1-4	8:02:00	1.20	2.60	258.920	925	55	55	270	249	38
1-5	8:06:00	1.30	2.80	262.370	926	57	57	268	253	39
1-5	8:10:00	1.20	2.60	265.530	928	57	57	269	250	39
	8:14:00			268.570						
2-1	8:16:00	1.30	2.90	268.570	920	61	61	267	255	37
2-1	8:20:00	1.30	2.80	272.030	932	61	61	268	256	38
2-2	8:24:00	1.20	2.60	275.350	937	61	61	269	252	38
2-2	8:28:00	1.30	2.80	278.580	935	61	61	271	252	39
2-3	8:32:00	1.20	2.60	281.820	933	63	63	268	249	40
2-3	8:36:00	1.20	2.60	284.920	937	63	63	270	250	41
2-4	8:40:00	0.97	2.10	287.630	932	64	64	271	247	41
2-4	8:44:00	0.97	2.10	290.830	936	65	65	270	251	37
2-5	8:48:00	1.40	3.10	293.710	935	65	65	268	251	37
2-5	8:52:00	1.40	3.10	297.040	935	65	65	270	250	37
	8:56:00			300.410						
3-1	8:58:00	1.50	3.30	300.410	925	65	65	266	250	39
3-1	9:02:00	1.50	3.30	304.210	938	66	66	268	251	39
3-2	9:06:00	1.30	2.90	307.350	938	67	67	271	252	40
3-2	9:10:00	1.40	3.10	310.740	943	67	67	270	250	41
3-3	9:14:00	1.30	2.90	314.200	946	68	68	271	250	41
3-3	9:18:00	1.20	2.60	317.730	939	68	68	268	251	40
3-4	9:22:00	1.30	2.90	320.720	944	69	69	268	252	40
3-4	9:26:00	1.40	3.10	324.300	943	69	69	270	251	40
3-5	9:30:00	1.30	2.90	327.720	945	70	70	268	249	39
3-5	9:34:00	1.40	3.10	330.980	939	70	70	271	250	39
	9:38:00			334.520						
4-1	9:41:00	1.60	3.50	334.520	945	71	71	268	252	41
4-1	9:45:00	1.60	3.50	338.350	944	71	71	270	253	40
4-2	9:49:00	1.60	3.50	342.150	946	71	71	268	251	40
4-2	9:53:00	1.70	3.80	345.790	948	72	72	269	250	41
4-3	9:57:00	1.70	3.80	349.520	948	72	72	271	250	43
4-3	10:01:00	1.60	3.50	353.310	948	74	74	267	250	44
4-4	10:05:00	1.60	3.50	356.760	946	73	73	268	251	45
4-4	10:09:00	1.40	3.10	360.520	947	75	75	269	249	45
4-5	10:13:00	1.30	2.90	364.360	942	75	75	272	249	44
4-5	10:17:00	1.20	2.70	367.750	941	76	76	270	250	42
	10:21:00			370.720						
5-1	10:24:00	1.60	3.60	370.720	945	76	76	268	250	43
5-1	10:28:00	1.80	4.00	374.760	943	77	77	266	251	43
5-2	10:32:00	1.70	3.80	378.890	941	77	77	269	250	43
5-2	10:36:00	1.70	3.80	382.340	947	78	78	271	250	43
5-3	10:40:00	1.70	3.80	386.250	944	78	78	271	251	43
5-3	10:44:00	1.60	3.60	390.100	944	78	78	272	249	44
5-4	10:48:00	1.40	3.10	394.020	942	78	78	269	250	44
5-4	10:52:00	1.20	2.70	397.580	944	79	79	270	246	45
5-5	10:56:00	1.30	2.90	400.790	941	79	79	268	250	44
5-5	11:00:00	1.30	2.90	403.820	941	80	80	271	252	44
	11:04:00			407.251						

Total 3:20:00 168.114 66.5 66.5  
 Average 2.98 937.5 66.5  
 Min 1.80 920.0 42.0  
 Max 4.00 948.0 80.0



# Impinger Weight Sheet - Run 4

Client:	Northern Natural Gas Company	Scale Calibration Check Date:	12/7/2022
Facility:	Clifton Compressor Station	<u>Scale Calibration Check (see QS-6.05C for procedure)</u>	
Test Location:	Unit 30	must be within $\pm 0.5g$ of certified mass	
Project #:	M224514	<u>Certified Weight, grams</u>	<u>Result, grams</u>
Date:	12/7/2022	250	250.0
Test Method:	5/29		
Weighed/Measured By:	RWC	500	500.0
Balance ID:	1000g	750	750.0

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
HNO3/H2O2	856.8	786.4	70.4
HNO3/H2O2	807.9	737.3	70.6
Empty	669.2	651.0	18.2
KMnO4/H2SO4	766.5	760.4	6.1
KMnO4/H2SO4	726.5	726.3	0.2
Silica Gel	900.5	878.8	21.7

3,826.9	3,661.4	165.5
Liquid Final	Liquid Initial	Liquid Gain
900.5	878.8	21.7
Silica Final	Silica Initial	Silica Gain

## Run 5 - Method 5/29

Client: Northern Natural Gas Company

Facility: Clifton Compressor Station

Test Location: Unit 30

Source Condition: Natural Gas

Date: 12/7/22

Start Time: 11:32

End Time: 15:01

DRY GAS METER CONDITIONS				STACK CONDITIONS			
ΔH:	3.04	In. H <sub>2</sub> O		Static Pressure	1.00	in. H <sub>2</sub> O	
Meter Temperature, Tm:	81.3	°F		Flue Pressure (Ps):	28.84	in. Hg. abs.	
Sqrt ΔP:	1.152	In. H <sub>2</sub> O		Carbon Dioxide:	2.50	%	
Stack Temperature, Ts:	935.5	°F		Oxygen:	16.70	%	
Meter Volume, Vm:	172.339	ft <sup>3</sup>		Nitrogen:	80.8	%	
Meter Volume, Vmstd:	164.189	dscf		Gas Weight dry, Md:	29.068	lb/lb mole	
Meter Volume, Vwstd:	8.525	wscf		Gas Weight wet, Ms:	28.522	lb/lb mole	
Isokinetic Variance:	90.2	%I		Excess Air:	---	%	
Test Length:	200.00	in mins.		Gas Velocity, Vs:	107.712	fps	
Nozzle Diameter:	0.273	in inches		Volumetric Flow:	258,509	acfm	
Barometric Pressure:	28.77	in Hg		Volumetric Flow:	89,636	dscfm	
				Volumetric Flow:	94,290	scfm	
				Calculated Fo:	1.68		
				Fo Validity:	Pass		

## MOISTURE DETERMINATION

Initial Impinger Content:	3384.2	ml	Silica Initial Wt.	908.1	grams
Final Impinger Content:	3535.5	ml	Silica Final Wt.	937.8	grams
Impinger Difference:	151.3	ml	Silica Difference:	29.7	grams

Total Water Gain: 181.0      Moisture, Bws: 0.049

Port- Point No.	Clock Time	Velocity Head Δp in. H <sub>2</sub> O	Orifice ΔH in. H <sub>2</sub> O	Actual Meter Vol. ft <sup>3</sup>	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	11:32:00	1.40	3.20	408.365	933	79	79	258	256	57
1-1	11:36:00	1.50	3.40	411.940	940	80	80	265	252	60
1-2	11:40:00	1.60	3.60	415.610	938	79	79	267	250	60
1-2	11:44:00	1.60	3.60	419.460	942	80	80	271	251	61
1-3	11:48:00	1.60	3.60	423.110	944	80	80	268	250	60
1-3	11:52:00	1.50	3.40	426.810	941	80	80	269	250	61
1-4	11:56:00	1.40	3.20	430.650	943	80	80	271	250	55
1-4	12:00:00	1.40	3.20	434.020	943	80	80	268	250	52
1-5	12:04:00	1.30	2.90	437.510	941	81	81	269	249	51
1-5	12:08:00	1.30	2.90	441.040	938	80	80	271	250	49
	12:12:00			444.320						
2-1	12:14:00	1.50	3.40	444.320	939	81	81	271	250	48
2-1	12:18:00	1.40	3.20	448.030	934	80	80	267	252	48
2-2	12:22:00	1.60	3.60	451.670	931	81	81	270	250	48
2-2	12:26:00	1.60	3.60	455.260	935	81	81	268	251	48
2-3	12:30:00	1.60	3.60	459.140	941	82	82	267	250	48
2-3	12:34:00	1.50	3.40	462.820	939	82	82	271	250	49
2-4	12:38:00	1.60	3.70	466.500	940	83	83	270	250	51
2-4	12:42:00	1.50	3.50	470.650	938	83	83	270	250	50
2-5	12:46:00	1.50	3.50	474.020	940	84	84	271	249	49
2-5	12:50:00	1.30	3.00	477.720	937	84	84	270	250	49
	12:54:00			481.100						
3-1	12:56:00	1.50	3.70	481.100	940	83	83	268	250	51
3-1	13:00:00	1.60	3.70	484.920	933	84	84	271	252	47
3-2	13:04:00	1.40	3.20	488.670	933	84	84	272	252	47
3-2	13:08:00	1.30	3.00	492.150	937	84	84	271	250	48
3-3	13:12:00	1.20	2.70	495.530	935	84	84	268	250	48
3-3	13:16:00	1.20	2.70	498.920	936	85	85	271	250	49
3-4	13:20:00	1.30	3.00	502.320	938	84	84	267	251	48
3-4	13:24:00	1.30	3.00	505.670	936	84	84	271	250	48
3-5	13:28:00	1.40	3.20	508.960	933	84	84	273	250	48
3-5	13:32:00	1.40	3.20	512.520	933	83	83	270	250	47
	13:36:00			516.210						
4-1	13:38:00	1.30	3.00	516.210	930	83	83	266	243	50
4-1	13:42:00	1.30	3.00	519.720	932	82	82	266	245	49
4-2	13:46:00	1.20	2.70	523.360	936	82	82	263	251	46
4-2	13:50:00	1.10	2.50	526.460	935	82	82	268	250	45
4-3	13:54:00	1.00	2.30	529.630	934	81	81	271	251	45
4-3	13:58:00	1.00	2.30	532.550	932	81	81	272	250	46
4-4	14:02:00	1.10	2.50	535.690	931	81	81	268	249	46
4-4	14:06:00	1.10	2.50	538.930	932	80	80	269	250	46
4-5	14:10:00	1.10	2.50	542.640	932	81	81	270	250	47
4-5	14:14:00	1.30	3.00	545.010	929	81	81	268	250	46
	14:18:00			548.330						
5-1	14:21:00	0.98	2.20	548.330	920	80	80	265	247	48
5-1	14:25:00	0.96	2.20	551.580	934	79	79	266	253	46
5-2	14:29:00	1.20	2.70	554.480	933	80	80	270	254	47
5-2	14:33:00	1.20	2.70	557.660	934	79	79	272	251	47
5-3	14:37:00	1.10	2.50	560.930	937	80	80	273	249	47
5-3	14:41:00	1.20	2.70	564.030	934	79	79	270	250	47
5-4	14:45:00	1.30	2.90	567.290	934	80	80	268	250	48
5-4	14:49:00	1.20	2.70	570.730	932	79	79	266	250	48
5-5	14:53:00	1.30	2.90	573.940	931	79	79	268	250	47
5-5	14:57:00	1.40	3.20	577.320	932	79	79	270	249	47
	15:01:00			580.704						

Total	3:20:00		172.339		81.3	81.3				
Average			3.04		935.5	81.3				
Min			2.20		920.0	79.0				
Max			3.70		944.0	85.0				

# **Impinger Weight Sheet - Run 5**

<b>Client:</b>	<b>Northern Natural Gas Company</b>	<b>Scale Calibration Check Date:</b>	<u>12/7/2022</u>
<b>Facility:</b>	<b>Clifton Compressor Station</b>	<u>Scale Calibration Check (see QS-6.05C for procedure)</u>	
<b>Test Location:</b>	<b>Unit 30</b>	must be within $\pm 0.5g$ of certified mass	
<b>Project #:</b>	<b>M224514</b>	<u>Certified Weight, grams</u>	<u>Result, grams</u>
<b>Date:</b>	<b>12/7/2022</b>	250	<u>250.0</u>
<b>Test Method:</b>	<b>5/29</b>		
<b>Weighed/Measured By:</b>	<b>RWC</b>	500	<u>500.0</u>
<b>Balance ID:</b>	<b>1000g</b>	750	<u>750.0</u>

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
HNO3/H2O2	791.1	717.6	73.5
HNO3/H2O2	748.7	695.1	53.6
Empty	670.0	654.5	15.5
KMnO4/H2SO4	627.0	621.1	5.9
KMnO4/H2SO4	698.7	695.9	2.8
Silica Gel	937.8	908.1	29.7

<u>3,535.5</u> <b>Liquid Final</b>	<u>3,384.2</u> <b>Liquid Initial</b>	<u>151.3</u> <b>Liquid Gain</b>
<u>937.8</u> <b>Silica Final</b>	<u>908.1</u> <b>Silica Initial</b>	<u>29.7</u> <b>Silica Gain</b>

## Run 6 - Method 5/29

Client: Northern Natural Gas Company

Facility: Clifton Compressor Station

Test Location: Unit 30

Source Condition: Natural Gas

Date: 12/7/22

Start Time: 15:23

End Time: 18:51

DRY GAS METER CONDITIONS				STACK CONDITIONS			
ΔH:	2.61	In. H <sub>2</sub> O		Static Pressure	1.00	In. H <sub>2</sub> O	
Meter Temperature, Tm:	73.1	°F		Flue Pressure (Ps):	28.84	In. Hg. abs.	
Sqrt ΔP:	1.077	In. H <sub>2</sub> O		Carbon Dioxide:	2.60	%	
Stack Temperature, Ts:	937.9	°F		Oxygen:	16.60	%	
Meter Volume, Vm:	158.837	ft <sup>3</sup>		Nitrogen:	80.8	%	
Meter Volume, Vmstd:	153.493	dscf		Gas Weight dry, Md:	29.080	lb/lb mole	
Meter Volume, Vwstd:	8.718	wscf		Gas Weight wet, Ms:	28.484	lb/lb mole	
Isokinetic Variance:	90.6	%I		Excess Air:	---	%	
Test Length:	200.00	in mins.		Gas Velocity, Vs:	100.879	fps	
Nozzle Diameter:	0.273	in inches		Volumetric Flow:	242,109	acfm	
Barometric Pressure:	28.77	in Hg		Volumetric Flow:	83,416	dscfm	
				Volumetric Flow:	88,154	scfm	
				Calculated Fo:	1.65		
				Fo Validity:	Pass		

## MOISTURE DETERMINATION

Initial Impinger Content:	3678.7	ml	Silica Initial Wt.	879.3	grams
Final Impinger Content:	3839.4	ml	Silica Final Wt.	903.7	grams
Impinger Difference:	160.7	ml	Silica Difference:	24.4	grams

Total Water Gain: 185.1      Moisture, Bws: 0.054

Port- Point No.	Clock Time	Velocity Head Δp In. H <sub>2</sub> O	Orifice ΔH In. H <sub>2</sub> O	Actual Meter Vol. ft <sup>3</sup>	Stack Temp °F	Meter Temp Inlet °F	Meter Temp Outlet °F	Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	15:23:00	1.50	3.40	581.546	919	76	76	248	247	65
1-1	15:27:00	1.50	3.30	585.350	941	75	75	260	260	56
1-2	15:31:00	1.60	3.60	588.450	944	74	74	261	245	51
1-2	15:35:00	1.70	3.80	592.620	947	73	73	260	253	49
1-3	15:39:00	1.50	3.30	596.030	947	73	73	264	253	49
1-3	15:43:00	1.50	3.30	600.030	946	73	73	270	251	49
1-4	15:47:00	1.30	2.90	604.520	945	72	72	272	249	48
1-4	15:51:00	1.30	2.90	606.830	943	73	73	272	250	48
1-5	15:55:00	1.10	2.40	610.340	941	72	72	269	247	46
1-5	15:59:00	1.10	2.40	613.390	940	72	72	264	247	46
	16:03:00			616.590						
2-1	16:05:00	1.30	2.90	616.590	940	71	71	270	249	45
2-1	16:09:00	1.30	2.90	620.030	941	71	71	271	252	43
2-2	16:13:00	1.40	3.10	623.490	942	71	71	268	250	43
2-2	16:17:00	1.40	3.10	626.820	944	71	71	271	249	43
2-3	16:21:00	1.30	2.90	630.410	943	71	71	265	252	43
2-3	16:25:00	1.30	2.90	633.620	944	71	71	268	249	43
2-4	16:29:00	1.10	2.40	636.920	947	71	71	270	249	45
2-4	16:33:00	1.10	2.40	640.020	944	72	72	268	248	45
2-5	16:37:00	1.10	2.40	643.170	941	71	71	266	247	45
2-5	16:41:00	1.10	2.40	646.830	937	72	72	273	251	44
	16:45:00			649.260						
3-1	16:47:00	1.20	2.70	649.260	940	71	71	268	250	41
3-1	16:51:00	1.20	2.70	652.580	939	72	72	271	254	41
3-2	16:55:00	1.30	2.90	655.990	944	71	71	269	254	41
3-2	16:59:00	1.20	2.70	659.250	939	72	72	273	250	41
3-3	17:03:00	1.30	2.90	662.330	941	72	72	269	249	41
3-3	17:07:00	1.20	2.70	665.670	937	73	73	272	249	41
3-4	17:11:00	1.30	2.90	669.020	937	73	73	270	250	41
3-4	17:15:00	1.20	2.70	672.250	939	73	73	272	251	41
3-5	17:19:00	1.20	2.70	674.930	940	73	73	267	249	42
3-5	17:23:00	1.10	2.50	678.540	934	75	75	269	251	42
	17:27:00			681.770						
4-1	17:29:00	1.10	2.50	681.770	935	74	74	267	251	40
4-1	17:33:00	1.10	2.50	685.020	939	75	75	272	254	40
4-2	17:37:00	1.00	2.20	688.030	935	74	74	268	250	42
4-2	17:41:00	0.95	2.10	691.010	935	74	74	269	253	41
4-3	17:45:00	0.92	2.10	693.930	939	74	74	271	251	40
4-3	17:49:00	0.97	2.20	696.660	937	74	74	268	249	41
4-4	17:53:00	1.00	2.20	699.580	938	75	75	270	248	41
4-4	17:57:00	1.10	2.50	702.420	934	75	75	267	249	40
4-5	18:01:00	1.20	2.70	705.690	935	75	75	268	250	40
4-5	18:05:00	1.20	2.70	708.830	934	75	75	271	249	39
	18:09:00			712.140						
5-1	18:11:00	0.66	1.50	712.140	913	75	75	267	238	39
5-1	18:15:00	0.66	1.50	714.630	933	75	75	271	248	39
5-2	18:19:00	0.87	2.00	717.200	931	74	74	269	250	41
5-2	18:23:00	0.86	1.90	719.670	933	74	74	270	251	40
5-3	18:27:00	0.94	2.10	722.450	938	74	74	271	250	40
5-3	18:31:00	0.96	2.20	725.190	933	74	74	269	253	39
5-4	18:35:00	1.10	2.50	728.150	933	74	74	267	250	39
5-4	18:39:00	1.00	2.20	731.320	933	74	74	268	250	39
5-5	18:43:00	1.10	2.50	734.370	931	74	74	268	251	40
5-5	18:47:00	1.10	2.50	737.350	932	73	73	270	251	38
	18:51:00			740.383						

Total	3:20:00			158.837		73.1	73.1			
Average			2.61		937.9	73.1				
Min			1.50		913.0	71.0				
Max			3.80		947.0	76.0				

# **Impinger Weight Sheet - Run 6**

<b>Client:</b>	<b>Northern Natural Gas Company</b>	<b>Scale Calibration Check Date:</b>	<u>12/7/2022</u>
<b>Facility:</b>	<b>Clifton Compressor Station</b>	<u>Scale Calibration Check (see QS-6.05C for procedure)</u>	
<b>Test Location:</b>	<b>Unit 30</b>	must be within $\pm 0.5g$ of certified mass	
<b>Project #:</b>	<b>M224514</b>	<u>Certified Weight, grams</u>	<u>Result, grams</u>
<b>Date:</b>	<b>12/7/2022</b>	250	<u>250.0</u>
<b>Test Method:</b>	<b>5/29</b>		
<b>Weighed/Measured By:</b>	<b>RWC</b>	500	<u>500.0</u>
<b>Balance ID:</b>	<b>1000g</b>	750	<u>750.0</u>

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
HNO3/H2O2	891.1	791.0	100.1
HNO3/H2O2	779.8	734.7	45.1
Empty	660.9	652.0	8.9
KMnO4/H2SO4	779.4	775.5	3.9
KMnO4/H2SO4	728.2	725.5	2.7
Silica Gel	903.7	879.3	24.4

<u>3,839.4</u> <b>Liquid Final</b>	<u>3,678.7</u> <b>Liquid Initial</b>	<u>160.7</u> <b>Liquid Gain</b>
<u>903.7</u> <b>Silica Final</b>	<u>879.3</u> <b>Silica Initial</b>	<u>24.4</u> <b>Silica Gain</b>

Client: Northern Natural Gas Company  
Facility: Clifton Compressor Station  
Test Location: Unit 30  
Project #: M224514

Run 4		
Date:	12/7/2022	
Time	O2 % (dry)	CO2 % (dry)
8:28	17.90	2.70
8:29	17.90	2.70
8:30	17.90	2.70
8:31	17.90	2.70
8:32	17.90	2.70
8:33	17.80	2.70
8:34	17.90	2.70
8:35	17.80	2.70
8:36	17.80	2.70
8:37	17.90	2.70
8:38	17.90	2.70
8:39	17.90	2.70
8:40	17.90	2.70
8:41	17.90	2.70
8:42	17.90	2.70
8:43	17.80	2.70
8:44	17.80	2.70
8:45	17.80	2.70
8:46	17.80	2.70
8:47	17.90	2.70
8:48	17.90	2.70
8:49	17.90	2.70
8:50	17.90	2.70
8:51	17.90	2.70
8:52	17.90	2.70
8:53	17.80	2.70
8:54	17.80	2.70
8:55	17.80	2.80
8:56		
8:57		
8:58		
8:59		
9:00	17.90	2.70
9:01	17.80	2.80
9:02	17.80	2.80
9:03	17.80	2.70
9:04	17.80	2.70
9:05	17.80	2.70
9:06	17.80	2.70
9:07	17.80	2.70
9:08	17.80	2.70
9:09	17.80	2.70
9:10	17.80	2.70
9:11	17.80	2.70
9:12	17.80	2.70
9:13	17.80	2.70
9:14	17.80	2.70
9:15	17.80	2.70
9:16	17.80	2.70
9:17	17.80	2.70
9:18	17.80	2.70
9:19	17.80	2.70
9:20	17.80	2.70
9:21	17.80	2.70
9:22	17.80	2.70
9:23	17.80	2.70
9:24	17.80	2.70
9:25	17.80	2.70
9:26	17.80	2.70
9:27	17.80	2.70
9:28	17.80	2.70
9:29	17.80	2.80
9:30	17.80	2.80
9:31	17.80	2.70
9:32	17.80	2.70
9:33	17.80	2.70
9:34	17.80	2.70
9:35	17.80	2.70
9:36	17.80	2.70
9:37	17.80	2.70
9:38	17.80	2.70
9:39		

Run 5		
Date:	12/7/2022	
Time	O2 % (dry)	CO2 % (dry)
11:35	18.80	2.50
11:36	18.80	2.50
11:37	18.80	2.50
11:38	18.80	2.50
11:39	18.80	2.50
11:40	18.80	2.50
11:41	18.80	2.50
11:42	18.80	2.50
11:43	18.80	2.50
11:44	18.80	2.50
11:45	18.70	2.50
11:46	18.80	2.60
11:47	18.70	2.50
11:48	18.70	2.50
11:49	18.70	2.50
11:50	18.70	2.50
11:51	18.70	2.50
11:52	18.70	2.60
11:53	18.70	2.50
11:54	18.70	2.50
11:55	18.80	2.50
11:56	18.70	2.50
11:57	18.80	2.50
11:58	18.80	2.50
11:59	18.80	2.50
12:00	18.80	2.50
12:01	18.80	2.50
12:02	18.80	2.50
12:03	18.80	2.50
12:04	18.80	2.50
12:05	18.80	2.50
12:06	18.80	2.50
12:07	18.80	2.50
12:08	18.80	2.50
12:09	18.80	2.50
12:10	18.80	2.50
12:11	18.80	2.50
12:12	18.80	2.50
12:13	18.80	2.50
12:14	18.80	2.50
12:15	18.80	2.50
12:16	18.80	2.50
12:17	18.80	2.50
12:18	18.80	2.50
12:19	18.80	2.50
12:20	18.80	2.50
12:21	18.80	2.50
12:22	18.80	2.50
12:23	18.80	2.50
12:24	18.80	2.50
12:25	18.80	2.50
12:26	18.80	2.50
12:27	18.70	2.50
12:28	18.70	2.50
12:29	18.70	2.50
12:30	18.70	2.50
12:31	18.70	2.50
12:32	18.70	2.50
12:33	18.70	2.50
12:34	18.70	2.50
12:35	18.70	2.50
12:36	18.70	2.50
12:37	18.70	2.50
12:38	18.80	2.50
12:39	18.80	2.50
12:40	18.70	2.50
12:41	18.80	2.50
12:42	18.80	2.50
12:43	18.80	2.50
12:44	18.80	2.50
12:45	18.80	2.50
12:46	18.80	2.50

Run 6		
Date:	12/7/2022	
Time	O2 % (dry)	CO2 % (dry)
15:27	19.20	2.50
15:28	19.10	2.50
15:29	19.00	2.50
15:30	18.90	2.50
15:31	19.00	2.50
15:32	18.90	2.60
15:33	18.90	2.60
15:34	18.90	2.60
15:35	18.90	2.50
15:36	18.80	2.60
15:37	18.90	2.60
15:38	18.90	2.60
15:39	18.80	2.60
15:40	18.80	2.60
15:41	18.80	2.60
15:42	18.80	2.60
15:43	18.80	2.60
15:44	18.80	2.50
15:45	18.80	2.60
15:46	18.80	2.60
15:47	18.80	2.60
15:48	18.80	2.60
15:49	18.80	2.60
15:50	18.80	2.50
15:51	18.80	2.50
15:52	18.80	2.50
15:53	18.80	2.60
15:54	18.80	2.60
15:55	18.80	2.60
15:56	18.80	2.50
15:57	18.80	2.50
15:58	18.80	2.50
15:59	18.80	2.50
16:00	18.80	2.50
16:01	18.80	2.50
16:02	18.80	2.50
16:03		
16:04		
16:05		
16:06	19.10	2.40
16:07	19.20	2.40
16:08	19.10	2.40
16:09	19.10	2.50
16:10	19.00	2.50
16:11	19.00	2.50
16:12	19.00	2.50
16:13	19.00	2.50
16:14	19.00	2.50
16:15	18.90	2.50
16:16	18.90	2.50
16:17	18.90	2.50
16:18	18.90	2.50
16:19	18.90	2.50
16:20	18.90	2.50
16:21	18.90	2.50
16:22	18.90	2.50
16:23	18.80	2.50
16:24	18.80	2.60
16:25	18.80	2.60
16:26	18.80	2.60
16:27	18.80	2.60
16:28	18.70	2.60
16:29	18.80	2.60
16:30	18.80	2.60
16:31	18.70	2.60
16:32	18.80	2.60
16:33	18.80	2.60
16:34	18.80	2.60
16:35	18.70	2.60
16:36	18.70	2.60
16:37	18.80	2.60
16:38	18.70	2.60

Client: Northern Natural Gas Company  
Facility: Clifton Compressor Station  
Test Location: Unit 30  
Project #: M224514

Run 4		
Date:	12/7/2022	
Time	O2 % (dry)	CO2 % (dry)
9:40		
9:41		
9:42	18.00	2.60
9:43	17.80	2.70
9:44	17.80	2.70
9:45	17.80	2.80
9:46	17.80	2.70
9:47	17.80	2.70
9:48	17.80	2.70
9:49	17.80	2.70
9:50	17.80	2.80
9:51	17.80	2.80
9:52	17.80	2.80
9:53	17.80	2.70
9:54	17.80	2.70
9:55	17.80	2.70
9:56	17.80	2.70
9:57	17.80	2.70
9:58	17.80	2.70
9:59	17.80	2.80
10:00	17.80	2.70
10:01	17.80	2.70
10:02	17.80	2.70
10:03	17.80	2.80
10:04	17.80	2.70
10:05	17.90	2.70
10:06	17.90	2.70
10:07	17.80	2.70
10:08	17.90	2.70
10:09	17.90	2.70
10:10	17.80	2.70
10:11	17.80	2.70
10:12	17.90	2.70
10:13	17.90	2.70
10:14	17.90	2.70
10:15	17.90	2.70
10:16	17.90	2.70
10:17	17.90	2.70
10:18	17.90	2.70
10:19	17.90	2.70
10:20	17.90	2.70
10:21	17.90	2.70
10:22	17.90	2.70
10:23		
10:24		
10:25	18.00	2.60
10:26	18.00	2.70
10:27	18.00	2.70
10:28	18.00	2.70
10:29	18.00	2.70
10:30	18.00	2.70
10:31	18.00	2.70
10:32	18.00	2.70
10:33	18.00	2.70
10:34	18.00	2.70
10:35	18.00	2.70
10:36	18.00	2.70
10:37	18.00	2.70
10:38	18.00	2.70
10:39	18.10	2.70
10:40	18.10	2.70
10:41	18.10	2.70
10:42	18.10	2.70
10:43	18.10	2.70
10:44	18.10	2.70
10:45	18.20	2.70
10:46	18.20	2.70
10:47	18.20	2.70
10:48	18.20	2.70
10:49	18.20	2.70
10:50	18.20	2.70
10:51	18.20	2.70

Run 5		
Date:	12/7/2022	
Time	O2 % (dry)	CO2 % (dry)
12:47	18.90	2.50
12:48	18.90	2.50
12:49	18.90	2.50
12:50	18.90	2.40
12:51	18.90	2.50
12:52	18.90	2.50
12:53	18.90	2.50
12:54	18.90	2.50
12:55		
12:56		
12:57		
12:58		
12:59	19.00	2.40
13:00	19.00	2.50
13:01	19.00	2.50
13:02	19.00	2.50
13:03	19.00	2.50
13:04	19.00	2.50
13:05	19.00	2.50
13:06	19.00	2.50
13:07	19.00	2.50
13:08	19.00	2.50
13:09	19.00	2.50
13:10	19.00	2.50
13:11	19.00	2.50
13:12	19.00	2.50
13:13	19.00	2.50
13:14	19.00	2.50
13:15	19.00	2.50
13:16	19.00	2.50
13:17	19.00	2.50
13:18	19.00	2.50
13:19	19.00	2.50
13:20	19.00	2.50
13:21	19.00	2.50
13:22	19.00	2.50
13:23	19.00	2.50
13:24	19.00	2.50
13:25	19.10	2.40
13:26	19.00	2.50
13:27	19.10	2.40
13:28	19.10	2.40
13:29	19.10	2.40
13:30	19.10	2.40
13:31	19.10	2.40
13:32	19.10	2.40
13:33	19.20	2.40
13:34	19.20	2.40
13:35		
13:36		
13:37		
13:38		
13:39		
13:40	19.30	2.40
13:41	19.30	2.40
13:42	19.40	2.40
13:43	19.30	2.40
13:44	19.30	2.40
13:45	19.40	2.40
13:46	19.40	2.40
13:47	19.40	2.40
13:48	19.40	2.40
13:49	19.40	2.40
13:50	19.40	2.40
13:51	19.30	2.40
13:52	19.30	2.40
13:53	19.30	2.40
13:54	19.30	2.40
13:55	19.40	2.40
13:56	19.30	2.40
13:57	19.40	2.40
13:58	19.30	2.40

Run 6		
Date:	12/7/2022	
Time	O2 % (dry)	CO2 % (dry)
16:39	18.80	2.50
16:40	18.70	2.50
16:41	18.70	2.50
16:42	18.70	2.50
16:43	18.70	2.50
16:44	18.70	2.60
16:45		
16:46		
16:47	19.20	2.30
16:48	19.30	2.30
16:49	19.30	2.30
16:50	19.30	2.30
16:51	19.20	2.40
16:52	19.20	2.40
16:53	19.20	2.40
16:54	19.20	2.40
16:55	19.20	2.40
16:56	19.10	2.40
16:57	19.00	2.50
16:58	19.00	2.50
16:59	19.00	2.50
17:00	19.00	2.50
17:01	19.00	2.50
17:02	19.00	2.50
17:03	19.00	2.50
17:04	19.00	2.50
17:05	18.90	2.50
17:06	18.90	2.50
17:07	18.90	2.50
17:08	18.90	2.50
17:09	18.90	2.50
17:10	18.90	2.50
17:11	18.90	2.50
17:12	18.90	2.50
17:13	18.80	2.60
17:14	18.80	2.50
17:15	18.80	2.60
17:16	18.80	2.50
17:17	18.80	2.50
17:18	18.80	2.60
17:19	18.80	2.50
17:20	18.80	2.50
17:21	18.70	2.60
17:22	18.70	2.60
17:23	18.70	2.50
17:24	18.70	2.50
17:25	18.70	2.50
17:26	18.70	2.60
17:27		
17:28		
17:29		
17:30	19.10	2.30
17:31	19.10	2.40
17:32	19.10	2.40
17:33	19.10	2.40
17:34	19.10	2.40
17:35	19.10	2.40
17:36	19.10	2.40
17:37	19.10	2.40
17:38	19.10	2.40
17:39	19.10	2.40
17:40	19.10	2.40
17:41	19.10	2.40
17:42	19.00	2.40
17:43	19.00	2.40
17:44	19.00	2.50
17:45	19.00	2.50
17:46	19.00	2.40
17:47	19.00	2.50
17:48	19.00	2.50
17:49	19.00	2.40
17:50	19.00	2.40

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Test Location: Unit 30  
 Project #: M224514

Run 4  
 Date: 12/7/2022

Time	O2 % (dry)	CO2 % (dry)
10:52	18.20	2.70
10:53	18.20	2.70
10:54	18.20	2.70
10:55	18.30	2.70
10:56	18.20	2.70
10:57	18.30	2.70
10:58	18.30	2.70
10:59	18.30	2.70
11:00	18.30	2.70
11:01	18.30	2.70
11:02	18.70	2.30
11:03	18.30	2.60
11:04	18.30	2.70
11:05	18.30	2.70

Run 5  
 Date: 12/7/2022

Time	O2 % (dry)	CO2 % (dry)
13:59	19.20	2.40
14:00	19.20	2.40
14:01	19.20	2.40
14:02	19.20	2.40
14:03	19.20	2.40
14:04	19.20	2.50
14:05	19.20	2.50
14:06	19.20	2.50
14:07	19.10	2.50
14:08	19.20	2.50
14:09	19.10	2.40
14:10	19.20	2.40
14:11	19.20	2.40
14:12	19.20	2.40
14:13	19.20	2.40
14:14	19.30	2.40
14:15	19.20	2.40
14:16	19.20	2.40
14:17	19.20	2.40
14:20		
14:21		
14:22	19.30	2.30
14:23	19.30	2.40
14:24	19.30	2.40
14:25	19.30	2.40
14:26	19.30	2.40
14:27	19.20	2.40
14:28	19.20	2.40
14:29	19.30	2.40
14:30	19.20	2.40
14:31	19.20	2.40
14:32	19.20	2.40
14:33	19.30	2.40
14:34	19.20	2.40
14:35	19.20	2.40
14:36	19.20	2.40
14:37	19.20	2.40
14:38	19.20	2.40
14:39	19.20	2.40
14:40	19.20	2.40
14:41	19.20	2.40
14:42	19.20	2.40
14:43	19.20	2.40
14:44	19.20	2.40
14:45	19.20	2.40
14:46	19.20	2.40
14:47	19.20	2.40
14:48	19.20	2.40
14:49	19.20	2.40
14:50	19.20	2.40
14:51	19.20	2.40
14:52	19.20	2.40
14:53	19.20	2.40
14:54	19.10	2.40
14:55	19.10	2.40
14:56	19.10	2.40
14:57	19.10	2.40
14:58	19.20	2.40
14:59	19.10	2.40
15:00	19.10	2.40

Run 6  
 Date: 12/7/2022

Time	O2 % (dry)	CO2 % (dry)
17:51	19.00	2.40
17:52	19.10	2.40
17:53	19.00	2.50
17:54	18.90	2.50
17:55	18.90	2.50
17:56	18.80	2.50
17:57	18.90	2.50
17:58	18.90	2.50
17:59	18.90	2.50
18:00	18.90	2.50
18:01	18.90	2.50
18:02	18.90	2.50
18:03	18.90	2.50
18:04	18.80	2.60
18:05	18.80	2.60
18:06	18.80	2.60
18:07	18.80	2.60
18:08	18.80	2.60
18:09	18.80	2.60
18:12		
18:13	19.10	2.50
18:14	19.60	2.20
18:15	19.50	2.20
18:16	19.30	2.30
18:17	19.10	2.40
18:18	19.00	2.50
18:19	18.90	2.50
18:20	18.80	2.50
18:21	18.80	2.60
18:22	18.70	2.60
18:23	18.70	2.60
18:24	18.70	2.60
18:25	18.70	2.60
18:26	18.70	2.60
18:27	18.70	2.60
18:28	18.70	2.60
18:29	18.70	2.60
18:30	18.70	2.60
18:31	18.70	2.60
18:32	18.70	2.60
18:33	18.70	2.60
18:34	18.70	2.60
18:35	18.60	2.60
18:36	18.70	2.60
18:37	18.70	2.60
18:38	18.70	2.60
18:39	18.70	2.60
18:40	18.70	2.60
18:41	18.70	2.60
18:42	18.70	2.60
18:43	18.70	2.60
18:44	18.70	2.60
18:45	18.70	2.60
18:46	18.70	2.60
18:47	18.60	2.60
18:48	18.60	2.60
18:49	18.70	2.60
18:50	18.60	2.60

Average	17.92	2.70
Min	17.80	2.30
Max	18.70	2.80

Average	19.01	2.46
Min	18.70	2.30
Max	19.40	2.60

Average	18.89	2.52
Min	18.60	2.20
Max	19.60	2.60



<b>Client:</b>	Northern Natural Gas Company
<b>Facility:</b>	Clifton Compressor Station
<b>Test Location:</b>	Unit 30
<b>Project #:</b>	M224514
<b>Test Method:</b>	5/29
<b>Test Engineer:</b>	MAN
<b>Test Technician:</b>	ATW
<b>Type of Fuel Firing:</b>	Natural Gas
	<b><u>Run 7</u></b>
<b>Meter ID:</b>	CM47
<b>Pitot ID:</b>	711
<b>Nozzle Diameter (Inches):</b>	0.273
<b>Meter Calibration Date:</b>	12/1/2022
<b>Meter Calibration Factor (Y):</b>	1.008
<b>Meter Orifice Setting (Delta H):</b>	1.839
<b>Nozzle Kit ID Number and Material:</b>	Quartz 718
<b>Pitot Tube Coefficient:</b>	0.840
<b>Probe Length (Feet):</b>	6.0
<b>Probe Liner Material:</b>	Quartz
<b>Sample Plane:</b>	Horizontal
<b>Port Length (Inches):</b>	4.50
<b>Port Size (Diameter, Inches):</b>	4.00
<b>Port Type:</b>	Flange
<b>Duct Shape:</b>	Rectangular
<b>Length (Feet):</b>	5
<b>Width (Feet):</b>	8
<b>Duct Area (Square Feet):</b>	40.000
<b>Equivalent Diameter Rectangular Duct (Feet):</b>	6.154
<b>Upstream Diameters:</b>	0.5
<b>Downstream Diameters:</b>	2.0
<b>Number of Ports Sampled:</b>	5
<b>Number of Points per Port:</b>	5
<b>Minutes per Point:</b>	8.0
<b>Minutes per Reading:</b>	4.0
<b>Total Number of Traverse Points:</b>	25
<b>Test Length (Minutes):</b>	200
<b>Train Type:</b>	Anderson Box
<b>Source Condition:</b>	Normal
<b>Diluent Model/Serial Number:</b>	ECOM
<b>Moisture Balance ID:</b>	1000g
<b># of Runs</b>	3

## Run 7 - Method 5/29

Client: Northern Natural Gas Company

Facility: Clifton Compressor Station

Test Location: Unit 30

Source Condition: Natural Gas

Date: 12/8/22

Start Time: 8:52

End Time: 13:51

## DRY GAS METER CONDITIONS

$\Delta H$ : 3.21 in. H<sub>2</sub>O  
 Meter Temperature, Tm: 62.5 °F  
 Sqrt  $\Delta P$ : 1.148 in. H<sub>2</sub>O  
 Stack Temperature, Ts: 934.6 °F  
 Meter Volume, Vm: 174.843 ft<sup>3</sup>  
 Meter Volume, Vmstd: 172.544 dscf  
 Meter Volume, Vwstd: 8.940 wscf  
 Isokinetic Variance: 95.0 %  
 Test Length: 200.00 in mins.  
 Nozzle Diameter: 0.273 in inches  
 Barometric Pressure: 28.75 in Hg

## STACK CONDITIONS

Static Pressure: 1.00 in. H<sub>2</sub>O  
 Flue Pressure (Ps): 28.82 in. Hg. abs.  
 Carbon Dioxide: 2.20 %  
 Oxygen: 17.40 %  
 Nitrogen: 80.40 %  
 Gas Weight dry, Md: 29.048 lb/lb mole  
 Gas Weight wet, Ms: 28.504 lb/lb mole  
 Excess Air: --- %  
 Gas Velocity, Vs: 107.393 fps  
 Volumetric Flow: 257,743 acfm  
 Volumetric Flow: 89,377 dscfm  
 Volumetric Flow: 94,007 scfm  
 Calculated Fo: 1.59  
 Fo Validity: Fail

## MOISTURE DETERMINATION

Initial Impinger Content: 3377.1 ml  
 Final Impinger Content: 3532.9 ml  
 Impinger Difference: 155.8 ml  
 Silica Initial Wt: 881.5 grams  
 Silica Final Wt: 915.5 grams  
 Silica Difference: 34.0 grams

Total Water Gain: 189.8      Moisture, Bws: 0.049

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head Ap in. H <sub>2</sub> O	$\Delta H$ in. H <sub>2</sub> O	Meter Vol. ft <sup>3</sup>	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	8:52:00	1.50	3.50	740.988	934	45	45	247	245	50
1-1	8:56:00	1.50	3.50	744.680	936	47	47	257	243	44
1-2	9:00:00	1.70	4.00	748.390	937	48	48	263	258	46
1-2	9:04:00	1.70	4.00	752.210	940	49	49	266	255	49
1-3	9:08:00	1.60	3.80	755.760	941	51	51	268	251	53
1-3	9:12:00	1.60	3.80	759.770	937	52	52	271	251	54
1-4	9:16:00	1.30	3.10	763.570	941	54	54	269	250	57
1-4	9:20:00	1.40	3.30	766.920	938	56	56	267	250	57
1-5	9:24:00	1.30	3.10	770.460	936	57	57	271	249	56
1-5	9:28:00	1.30	3.10	773.820	937	58	58	268	249	57
	9:32:00			777.350						
2-1	9:34:00	1.50	3.60	777.350	937	59	59	267	249	46
2-1	9:38:00	1.40	3.40	781.420	938	60	60	270	251	51
2-2	9:42:00	1.70	4.10	784.730	939	61	61	267	252	54
2-2	9:46:00	1.70	4.10	788.830	942	61	61	269	251	55
2-3	9:50:00	1.60	3.90	792.680	939	63	63	271	250	55
2-3	9:54:00	1.60	3.90	796.460	940	64	64	268	249	56
2-4	9:58:00	1.50	3.60	800.390	941	64	64	271	249	55
2-4	10:02:00	1.40	3.40	803.560	937	65	65	272	250	54
2-5	10:06:00	1.40	3.40	807.720	935	64	64	269	249	54
2-5	10:10:00	1.30	3.20	811.440	938	64	64	267	249	53
	10:14:00			814.730						
3-1	10:16:00	1.50	3.60	814.730	936	64	64	267	252	46
3-1	10:20:00	1.50	3.60	818.630	937	64	64	271	256	48
3-2	10:24:00	1.30	3.20	822.260	935	64	64	271	255	49
3-2	10:28:00	1.30	3.20	825.730	937	64	64	269	255	48
3-3	10:32:00	1.40	3.40	829.040	938	64	64	269	252	49
3-3	10:36:00	1.30	3.20	832.420	934	64	64	270	249	50
3-4	10:40:00	1.20	2.90	836.310	939	66	66	271	250	50
3-4	10:44:00	1.30	3.20	840.030	937	65	65	267	250	50
3-5	10:48:00	1.40	3.40	843.040	938	66	66	268	250	49
3-5	10:52:00	1.40	3.40	846.610	934	66	66	267	249	48
	10:56:00			850.330						
4-1	10:58:00	1.30	3.20	850.330	936	66	66	271	253	43
4-1	11:02:00	1.30	3.20	854.130	933	66	66	268	256	45
4-2	11:06:00	1.20	2.90	857.420	936	66	66	267	254	49
4-2	11:10:00	1.10	2.70	860.820	935	66	66	265	252	50
4-3	11:14:00	0.97	2.40	863.610	936	66	66	268	249	51
4-3	11:18:00	0.95	2.30	866.920	931	66	66	270	249	52
4-4	11:22:00	1.10	2.70	869.830	933	66	66	268	248	50
4-4	11:26:00	1.10	2.70	873.040	931	66	66	269	247	49
4-5	11:30:00	1.30	3.20	876.300	929	66	66	271	248	47
4-5	11:34:00	1.30	3.20	879.830	927	66	66	271	250	46
	11:38:00			883.340						
5-1	11:43:00	0.78	2.00	883.340	893	66	66	270	258	43
5-1	11:47:00	0.83	2.00	886.210	932	67	67	268	254	48
5-2	11:51:00	1.10	2.70	889.040	933	67	67	270	250	49
5-2	11:55:00	1.20	2.70	892.410	932	67	67	268	250	49
5-3	11:59:00	1.10	2.70	895.720	933	67	67	271	250	48
5-3	12:03:00	1.10	2.70	898.930	932	68	68	269	250	48
5-4	12:07:00	1.30	3.20	901.940	932	68	68	270	250	48
5-4	12:11:00	1.20	2.90	905.640	932	68	68	268	248	48
5-5	12:15:00	1.20	3.00	908.820	929	68	68	270	251	49
5-5	12:19:00	1.30	3.20	912.330	926	69	69	270	248	50
	12:23:00			915.831						
Total	3:20:00			174.843		62.5	62.5			
Average			3.21		934.6	62.5				
Min			2.00		893.0	45.0				
Max			4.10		942.0	69.0				

# Impinger Weight Sheet - Run 7

Client:	Northern Natural Gas Company	Scale Calibration Check Date:	12/8/2022
Facility:	Clifton Compressor Station	<u>Scale Calibration Check (see QS-6.05C for procedure)</u>	
Test Location:	Unit 30	must be within $\pm 0.5g$ of certified mass	
Project #:	M224514	<u>Certified Weight, grams</u>	<u>Result, grams</u>
Date:	12/8/2022	250	250.0
Test Method:	5/29		
Weighed/Measured By:	RWC	500	499.8
Balance ID:	1000g	750	749.8

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
HNO3/H2O2	771.1	722.3	48.8
HNO3/H2O2	774.1	701.7	72.4
Empty	676.7	653.8	22.9
KMnO4/H2SO4	628.2	616.6	11.6
KMnO4/H2SO4	682.8	682.7	0.1
Silica Gel	915.5	881.5	34.0

3,532.9	3,377.1	155.8
Liquid Final	Liquid Initial	Liquid Gain
915.5	881.5	34.0
Silica Final	Silica Initial	Silica Gain

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Project #:** M224514

**Run 7**  
**Date:** 12/8/2022

<u>Time</u>	<u>O2 % (dry)</u>	<u>CO2 % (dry)</u>
9:35	17.90	2.10
9:36	17.90	2.10
9:37	17.90	2.20
9:38	17.90	2.10
9:39	17.90	2.10
9:40	17.90	2.10
9:41	17.90	2.10
9:42	17.90	2.20
9:43	17.90	2.20
9:44	18.00	2.10
9:45	18.00	2.20
9:46	18.00	2.20
9:47	18.00	2.20
9:48	18.10	2.10
9:49	18.10	2.20
9:50	18.10	2.10
9:51	18.10	2.20
9:52	18.10	2.20
9:53	18.20	2.20
9:54	18.10	2.20
9:55	18.10	2.20
9:56	18.20	2.20
9:57	18.20	2.20
9:58	18.20	2.20
9:59	18.20	2.20
10:00	18.20	2.20
10:01	18.30	2.20
10:02	18.20	2.20
10:03	18.20	2.20
10:04	18.20	2.20
10:05	18.30	2.20
10:06	18.30	2.20
10:07	18.30	2.20
10:08	18.30	2.20
10:09	18.30	2.20
10:10	18.30	2.20
10:11	18.40	2.20
10:12	18.40	2.20
10:13	18.50	2.20
10:15		
10:16	18.70	2.00
10:17	18.60	2.10

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Project #:** M224514

**Run 7**  
**Date:** 12/8/2022

<u>Time</u>	<u>O2 % (dry)</u>	<u>CO2 % (dry)</u>
10:18	18.60	2.10
10:19	18.60	2.10
10:20	18.60	2.10
10:21	18.60	2.10
10:22	18.60	2.10
10:23	18.60	2.10
10:24	18.60	2.10
10:25	18.60	2.10
10:26	18.60	2.10
10:27	18.60	2.10
10:28	18.60	2.10
10:29	18.60	2.10
10:30	18.50	2.10
10:31	18.60	2.10
10:32	18.60	2.10
10:33	18.60	2.10
10:34	18.50	2.10
10:35	18.60	2.10
10:36	18.60	2.10
10:37	18.50	2.10
10:38	18.50	2.10
10:39	18.50	2.10
10:40	18.50	2.10
10:41	18.50	2.10
10:42	18.50	2.10
10:43	18.50	2.10
10:44	18.50	2.20
10:45	18.50	2.10
10:46	18.50	2.10
10:47	18.50	2.10
10:48	18.50	2.10
10:49	18.50	2.10
10:50	18.50	2.10
10:51	18.50	2.10
10:52	18.50	2.10
10:53	18.50	2.10
10:54	18.50	2.10
10:55	18.50	2.10
10:58		
10:59	18.70	2.10
11:00	18.70	2.10
11:01	18.70	2.20

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Project #:** M224514

**Run 7**  
**Date:** 12/8/2022

<u>Time</u>	<u>O2 % (dry)</u>	<u>CO2 % (dry)</u>
11:02	18.60	2.20
11:03	18.70	2.20
11:04	18.70	2.10
11:05	18.70	2.10
11:06	18.70	2.20
11:07	18.70	2.20
11:08	18.70	2.10
11:09	18.60	2.20
11:10	18.60	2.10
11:11	18.60	2.20
11:12	18.60	2.20
11:13	18.60	2.20
11:14	18.50	2.10
11:15	18.50	2.10
11:16	18.50	2.10
11:17	18.50	2.10
11:18	18.50	2.10
11:19	18.50	2.10
11:20	18.50	2.10
11:21	18.50	2.10
11:22	18.50	2.10
11:23	18.50	2.10
11:24	18.50	2.10
11:25	18.50	2.10
11:26	18.50	2.10
11:27	18.50	2.10
11:28	18.50	2.10
11:29	18.50	2.10
11:30	18.50	2.10
11:31	18.50	2.10
11:32	18.50	2.10
11:33	18.40	2.10
11:34	18.40	2.10
11:35	18.40	2.10
11:36	18.40	2.20
11:37	18.40	2.20
11:42		
11:43	18.60	2.20
11:44	18.40	2.10
11:45	18.40	2.20
11:46	18.40	2.10
11:47	18.40	2.10

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Project #:** M224514

**Run 7**  
**Date:** 12/8/2022

<u>Time</u>	<u>O2 % (dry)</u>	<u>CO2 % (dry)</u>
11:48	18.40	2.10
11:49	18.40	2.10
11:50	18.40	2.10
11:51	18.40	2.10
11:52	18.40	2.10
11:53	18.40	2.10
11:54	18.40	2.10
11:55	18.40	2.10
11:56	18.40	2.10
11:57	18.40	2.10
11:58	18.40	2.10
11:59	18.40	2.10
12:00	18.40	2.10
12:01	18.40	2.10
12:02	18.40	2.10
12:03	18.40	2.10
12:04	18.40	2.10
12:05	18.40	2.10
12:06	18.40	2.10
12:07	18.40	2.10
12:08	18.40	2.10
12:09	18.40	2.10
12:10	18.40	2.10
12:11	18.40	2.10
12:12	18.40	2.10
12:13	18.40	2.10
12:14	18.40	2.10
12:15	18.40	2.10
12:16	18.40	2.10
12:17	18.40	2.10
12:18	18.40	2.10
12:19	18.40	2.10
12:20	18.40	2.10
12:21	18.40	2.10
12:22	18.40	2.10
<b>Average</b>	<b>18.41</b>	<b>2.13</b>
<b>Min</b>	17.90	2.00
<b>Max</b>	18.70	2.20

<b>Client:</b>	Northern Natural Gas Company	
<b>Facility:</b>	Clifton Compressor Station	
<b>Test Location:</b>	Unit 30	
<b>Project #:</b>	M224514	
<b>Test Method:</b>	2	
<b>Test Engineer:</b>	RWC	
<b>Test Technician:</b>	ATW	
<b>Meter ID:</b>	F3	
<b>Pitot ID:</b>	888	
<b>Pitot Type:</b>	S-Type	
<b>Pitot Tube Coefficient:</b>	0.84	
<b>Probe Length:</b>	12.0	ft
<b>Sample Plane:</b>	Horizontal	
<b>Port Length:</b>	4.50	in.
<b>Port Size (diameter):</b>	4.00	in.
<b>Port Type:</b>	Flange	
<b>Duct Shape:</b>	Rectangular	
<b>Length (traverse side of duct):</b>	5	ft
<b>Width:</b>	8	ft
<b>Location of Test Ports:</b>	Side of duct	
<b>Duct Area:</b>	40.00	Sq. Ft.
<b>Equivalent Diameter Rectangular Duct:</b>	6.154	
<b>Upstream Diameters:</b>	2.000	
<b>Downstream Diameters:</b>	2.000	
<b>Number of Ports Sampled:</b>	5	
<b>Number of Points per Port:</b>	5	
<b>Total Number of Traverse Points:</b>	25	
<b>Operating Level:</b>	Normal	



## METHOD 2 VOLUMETRIC FLOW DATA

<b>Project Number:</b>	M224514	<b>Operating Level:</b>	Normal
<b>Client:</b>	Northern Natural Gas Company	<b>Run No.:</b>	Pre 1
<b>Facility:</b>	Clifton Compressor Station	<b>Test Date:</b>	12/5/2022
<b>Test Location:</b>	Unit 30	<b>Start Time:</b>	11:41
<b>Pitot ID:</b>	888	<b>End Time:</b>	11:56
<b>Pitot Coefficient:</b>	0.840	<b>Test Engineer:</b>	RWC
<b>Probe Length, Feet:</b>	12	<b>Test Tech:</b>	ATW
		<b>Port Length, Inches:</b>	5

Port	Point	DP (in. H <sub>2</sub> O)	Sqrt. DP	Temp (°F)	Velocity (V)	Port	Point	DP (in. H <sub>2</sub> O)	Sqrt. DP	Temp (°F)	Velocity (V)
A	1	0.64	0.8000	920	74.91	D	1	0.44	0.6633	920	62.12
A	2	0.88	0.9381	920	87.85	D	2	0.80	0.8944	920	83.76
A	3	0.80	0.8944	920	83.76	D	3	0.93	0.9644	920	90.31
A	4	0.97	0.9849	920	92.23	D	4	0.92	0.9592	920	89.82
A	5	1.20	1.0954	920	102.58	D	5	0.94	0.9695	920	90.79
B	1	1.40	1.1832	920	110.80	E	1	0.36	0.6000	920	56.19
B	2	1.50	1.2247	920	114.69	E	2	0.66	0.8124	920	76.08
B	3	1.40	1.1832	920	110.80	E	3	0.72	0.8485	920	79.46
B	4	1.30	1.1402	920	106.77	E	4	0.79	0.8888	920	83.23
B	5	1.30	1.1402	920	106.77	E	5	0.88	0.9381	920	87.85
C	1	1.50	1.2247	920	114.69						
C	2	1.70	1.3038	920	122.10						
C	3	1.70	1.3038	920	122.10						
C	4	1.50	1.2247	920	114.69						
C	5	1.20	1.0954	920	102.58						

### Test Parameters

P <sub>bar</sub> - Barometric pressure, inches Hg	28.37	% CO <sub>2</sub>	2.47
P <sub>g</sub> - Stack Pressure, inches of H <sub>2</sub> O	1.00	% O <sub>2</sub>	16.70
P <sub>s</sub> - Absolute stack pressure, inches Hg	28.44	% N <sub>2</sub>	80.83
t <sub>s</sub> - Average stack temperature, °F	920.0	Md - dry basis lb/lb mole	29.06
Duct Shape:	Rectangular	Ms - wet basis lb/lb mole	28.532
Length, Feet	5	Wet Bulb Temp(t'):	
Width, Feet	8	Dry Bulb Temp(t'):	920
		<b>Bws - Moisture content fraction</b>	<b>0.048</b>
Cross Sectional Area of Stack, Ft <sup>2</sup>	40.00	Moisture determined by wb/db?	

### Method 2 Results

Average DP	1.0572	Q - ACFM	227,222
Average Sqrt DP	1.0110	Qsd - DSCFM	78,680
Average Velocity Vs (ft/sec)	94.676	Qs - SCFM	82,647
		Qs - SCFH	4,958,818

## METHOD 2 VOLUMETRIC FLOW DATA

<b>Project Number:</b>	M224514	<b>Operating Level:</b>	Normal
<b>Client:</b>	Northern Natural Gas Company	<b>Run No.:</b>	Post 5/Pre 6
<b>Facility:</b>	Clifton Compressor Station	<b>Test Date:</b>	12/5/2022
<b>Test Location:</b>	Unit 30	<b>Start Time:</b>	17:30
<b>Pitot ID:</b>	888	<b>End Time:</b>	17:44
<b>Pitot Coefficient:</b>	0.840	<b>Test Engineer:</b>	RWC
<b>Probe Length, Feet:</b>	12	<b>Test Tech:</b>	ATW
		<b>Port Length, Inches:</b>	5

Port	Point	DP (in. H <sub>2</sub> O)	Sqrt. DP	Temp (°F)	Velocity (V)	Port	Point	DP (in. H <sub>2</sub> O)	Sqrt. DP	Temp (°F)	Velocity (V)
A	1	0.72	0.8485	876.0	78.19	D	1	1.70	1.3038	922.0	122.20
A	2	1.10	1.0488	889.0	97.12	D	2	1.80	1.3416	926.0	125.92
A	3	1.30	1.1402	902.0	106.08	D	3	1.70	1.3038	930.0	122.55
A	4	1.30	1.1402	920.0	106.78	D	4	1.60	1.2649	933.0	119.02
A	5	1.20	1.0954	921.0	102.63	D	5	1.50	1.2247	932.0	115.20
B	1	1.30	1.1402	926.0	107.02	E	1	1.50	1.2247	927.0	114.99
B	2	1.20	1.0954	927.0	102.85	E	2	1.60	1.2649	926.0	118.72
B	3	1.40	1.1832	924.0	110.97	E	3	1.60	1.2649	925.0	118.68
B	4	1.50	1.2247	926.0	114.95	E	4	1.40	1.1832	922.0	110.89
B	5	1.40	1.1832	928.0	111.13	E	5	1.50	1.2247	924.0	114.87
C	1	1.60	1.2649	928.0	118.81						
C	2	1.60	1.2649	930.0	118.89						
C	3	1.50	1.2247	927.0	114.99						
C	4	1.60	1.2649	929.0	118.85						
C	5	1.60	1.2649	932.0	118.98						

### Test Parameters

P <sub>bar</sub> - Barometric pressure, inches Hg	28.37	% CO <sub>2</sub>	2.74
P <sub>g</sub> - Stack Pressure, inches of H <sub>2</sub> O	1.00	% O <sub>2</sub>	16.30
P <sub>s</sub> - Absolute stack pressure, inches Hg	28.44	% N <sub>2</sub>	80.96
t <sub>s</sub> - Average stack temperature, °F	922.1	Md - dry basis lb/lb mole	29.09
Duct Shape:	Rectangular	Ms - wet basis lb/lb mole	28.525
Length, Feet	5	Wet Bulb Temp(t'):	
Width, Feet	8	Dry Bulb Temp(t'):	922
		<b>Bws - Moisture content fraction</b>	<b>0.051</b>
Cross Sectional Area of Stack, Ft <sup>2</sup>	40.00	Moisture determined by wb/db (Y or N)	

### Method 2 Results

Average DP	1.4488	Q - ACFM	269,802
Average Sqrt DP	1.1994	Qsd - DSCFM	92,990
Average Velocity Vs (ft/sec)	112.418	Qs - SCFM	97,987
		Qs - SCFH	5,879,219

## METHOD 2 VOLUMETRIC FLOW DATA

<b>Project Number:</b>	M224514	<b>Operating Level:</b>	Normal
<b>Client:</b>	Northern Natural Gas Company	<b>Run No.:</b>	Post 6
<b>Facility:</b>	Clifton Compressor Station	<b>Test Date:</b>	12/5/2022
<b>Test Location:</b>	Unit 30	<b>Start Time:</b>	19:08
<b>Pitot ID:</b>	888	<b>End Time:</b>	19:22
<b>Pitot Coefficient:</b>	0.840	<b>Test Engineer:</b>	RWC
<b>Probe Length, Feet:</b>	12	<b>Port Length, Inches:</b>	5
		<b>Test Tech:</b>	ATW

Port	Point	DP (in. H <sub>2</sub> O)	Sqrt. DP	Temp (°F)	Velocity (V)	Port	Point	DP (in. H <sub>2</sub> O)	Sqrt. DP	Temp (°F)	Velocity (V)
A	1	1.30	1.1402	940.0	106.89	D	1	1.60	1.2649	922.0	117.82
A	2	1.50	1.2247	940.0	114.82	D	2	1.60	1.2649	924.0	117.90
A	3	1.60	1.2649	943.0	118.71	D	3	1.30	1.1402	921.0	106.16
A	4	1.30	1.1402	943.0	107.00	D	4	1.40	1.1832	920.0	110.13
A	5	1.10	1.0488	951.0	98.71	D	5	1.30	1.1402	914.0	105.89
B	1	0.87	0.9327	922.0	86.88	E	1	0.65	0.8062	915.0	74.90
B	2	0.85	0.9220	921.0	85.84	E	2	1.10	1.0488	921.0	97.65
B	3	0.89	0.9434	921.0	87.84	E	3	1.20	1.0954	920.0	101.96
B	4	0.90	0.9487	923.0	88.40	E	4	1.30	1.1402	922.0	106.20
B	5	0.80	0.8944	922.0	83.31	E	5	1.30	1.1402	921.0	106.16
C	1	1.80	1.3416	928.0	125.24						
C	2	1.60	1.2649	923.0	117.86						
C	3	1.50	1.2247	930.0	114.41						
C	4	1.60	1.2649	930.0	118.16						
C	5	1.40	1.1832	923.0	110.25						

### Test Parameters

P <sub>bar</sub> - Barometric pressure, inches Hg	28.72	% CO <sub>2</sub>	2.70
P <sub>g</sub> - Stack Pressure, inches of H <sub>2</sub> O	1.00	% O <sub>2</sub>	16.30
P <sub>s</sub> - Absolute stack pressure, inches Hg	28.79	% N <sub>2</sub>	81.00
t <sub>s</sub> - Average stack temperature, °F	926.4	Md - dry basis lb/lb mole	29.08
Duct Shape:	Rectangular	Ms - wet basis lb/lb mole	28.530
Length, Feet	5	Wet Bulb Temp(t'):	
Width, Feet	8	Dry Bulb Temp(t'):	926
		<b>Bws - Moisture content fraction</b>	<b>0.050</b>
Cross Sectional Area of Stack, Ft <sup>2</sup>	40.00	Moisture determined by wb/db (Y or N)	

### Method 2 Results

Average DP	1.2704	Q - ACFM	250,442
Average Sqrt DP	1.1185	Qsd - DSCFM	87,199
Average Velocity Vs (ft/sec)	104.351	Qs - SCFM	91,788
		Qs - SCFH	5,507,281

**Appendix E - Plant Operating Data**

TSP Name	ID	Date	BTU	CO2	N2	Gravity	Methane	Ethane	Propane	Ibutane	Nbutane	Ipentane	Npentane	C6	C7	H	Helium
Northern Natural Gas (9048		12/8/2022	1035.205	0.28	3.013	0.605	90.921	4.953	0.564	0.049	0.096	0.028	0.034	0.03	0.03	0	0
Northern Natural Gas (9048		12/7/2022	1027.21	0.176	3.321	0.601	91.72	3.799	0.634	0.073	0.143	0.036	0.04	0.027	0.027	0	0
Northern Natural Gas (9048		12/6/2022	1032.401	0.168	3.523	0.606	90.823	4.34	0.741	0.088	0.169	0.044	0.048	0.028	0.028	0	0
Northern Natural Gas (9048		12/5/2022	1029.572	0.2	2.901	0.599	92.2	3.861	0.518	0.055	0.116	0.033	0.042	0.035	0.035	0	0
Northern Natural Gas (9048		12/4/2022	1030.78	0.269	2.966	0.601	91.632	4.255	0.587	0.066	0.126	0.032	0.033	0.016	0.016	0	0
Northern Natural Gas (9048		12/3/2022	1025.856	0.043	3.236	0.597	91.705	4.371	0.506	0.031	0.069	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		12/2/2022	1025.463	0.063	3.125	0.596	91.934	4.264	0.48	0.029	0.066	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		12/1/2022	1025.333	0.064	3.124	0.596	91.948	4.254	0.477	0.029	0.066	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/30/2022	1025.273	0.064	3.113	0.596	91.974	4.241	0.475	0.029	0.065	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/29/2022	1025.278	0.064	3.113	0.596	91.976	4.241	0.473	0.029	0.065	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/28/2022	1025.25	0.063	3.123	0.596	91.961	4.243	0.476	0.029	0.066	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/27/2022	1025.291	0.062	3.138	0.596	91.929	4.257	0.479	0.03	0.067	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/26/2022	1025.162	0.063	3.137	0.596	91.936	4.256	0.475	0.029	0.066	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/25/2022	1025.017	0.064	3.142	0.596	91.929	4.263	0.472	0.029	0.064	0.011	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/24/2022	1025.022	0.064	3.148	0.596	91.916	4.269	0.473	0.029	0.064	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/23/2022	1025.075	0.061	3.165	0.596	91.883	4.285	0.476	0.029	0.065	0.011	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/22/2022	1025.097	0.064	3.214	0.597	91.767	4.339	0.485	0.029	0.065	0.011	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/21/2022	1023.99	0.074	3.194	0.596	91.945	4.174	0.477	0.03	0.067	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/20/2022	1023.205	0.065	3.196	0.595	92.047	4.087	0.472	0.03	0.065	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/19/2022	1021.336	0.081	3.098	0.593	92.444	3.807	0.44	0.029	0.062	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/18/2022	1022.42	0.053	3.243	0.595	92.074	4.024	0.473	0.03	0.066	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/17/2022	1017.784	0.131	3.102	0.592	92.63	3.656	0.393	0.021	0.046	0.007	0.007	0.004	0.004	0	0
Northern Natural Gas (9048		11/16/2022	1014.551	0.163	2.988	0.589	93.131	3.325	0.32	0.018	0.038	0.006	0.006	0.003	0.003	0	0
Northern Natural Gas (9048		11/15/2022	1015.032	0.133	2.76	0.587	93.62	3.133	0.288	0.015	0.032	0.006	0.006	0.003	0.003	0	0
Northern Natural Gas (9048		11/14/2022	1015.336	0.146	3.166	0.591	92.848	3.322	0.396	0.027	0.059	0.012	0.012	0.005	0.005	0	0
Northern Natural Gas (9048		11/13/2022	1020.589	0.133	3.459	0.598	91.606	4.221	0.444	0.031	0.062	0.013	0.014	0.008	0.008	0	0
Northern Natural Gas (9048		11/12/2022	988.957	0.059	4.165	0.584	94.03	1.401	0.215	0.027	0.053	0.014	0.015	0.01	0.01	0	0
Northern Natural Gas (9048		11/11/2022	988.115	0.064	4.209	0.584	94.025	1.357	0.217	0.026	0.053	0.013	0.015	0.01	0.01	0	0
Northern Natural Gas (9048		11/10/2022	987.668	0.063	4.283	0.584	93.925	1.376	0.222	0.027	0.054	0.014	0.016	0.01	0.01	0	0

TSP Name	ID	Date	BTU	CO2	N2	Gravity	Methane	Ethane	Propane	Ibutane	Nbutane	Ipentane	Npentane	C6	C7	H	Helium
Northern Natural Gas (9048		12/8/2022	1035.205	0.28	3.013	0.605	90.921	4.953	0.564	0.049	0.096	0.028	0.034	0.03	0.03	0	0
Northern Natural Gas (9048		12/7/2022	1027.21	0.176	3.321	0.601	91.72	3.799	0.634	0.073	0.143	0.036	0.04	0.027	0.027	0	0
Northern Natural Gas (9048		12/6/2022	1032.401	0.168	3.523	0.606	90.823	4.34	0.741	0.088	0.169	0.044	0.048	0.028	0.028	0	0
Northern Natural Gas (9048		12/5/2022	1029.572	0.2	2.901	0.599	92.2	3.861	0.518	0.055	0.116	0.033	0.042	0.035	0.035	0	0
Northern Natural Gas (9048		12/4/2022	1030.78	0.269	2.966	0.601	91.632	4.255	0.587	0.066	0.126	0.032	0.033	0.016	0.016	0	0
Northern Natural Gas (9048		12/3/2022	1025.856	0.043	3.236	0.597	91.705	4.371	0.506	0.031	0.069	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		12/2/2022	1025.463	0.063	3.125	0.596	91.934	4.264	0.48	0.029	0.066	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		12/1/2022	1025.333	0.064	3.124	0.596	91.948	4.254	0.477	0.029	0.066	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/30/2022	1025.273	0.064	3.113	0.596	91.974	4.241	0.475	0.029	0.065	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/29/2022	1025.278	0.064	3.113	0.596	91.976	4.241	0.473	0.029	0.065	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/28/2022	1025.25	0.063	3.123	0.596	91.961	4.243	0.476	0.029	0.066	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/27/2022	1025.291	0.062	3.138	0.596	91.929	4.257	0.479	0.03	0.067	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/26/2022	1025.162	0.063	3.137	0.596	91.936	4.256	0.475	0.029	0.066	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/25/2022	1025.017	0.064	3.142	0.596	91.929	4.263	0.472	0.029	0.064	0.011	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/24/2022	1025.022	0.064	3.148	0.596	91.916	4.269	0.473	0.029	0.064	0.012	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/23/2022	1025.075	0.061	3.165	0.596	91.883	4.285	0.476	0.029	0.065	0.011	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/22/2022	1025.097	0.064	3.214	0.597	91.767	4.339	0.485	0.029	0.065	0.011	0.011	0.007	0.007	0	0
Northern Natural Gas (9048		11/21/2022	1023.99	0.074	3.194	0.596	91.945	4.174	0.477	0.03	0.067	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/20/2022	1023.205	0.065	3.196	0.595	92.047	4.087	0.472	0.03	0.065	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/19/2022	1021.336	0.081	3.098	0.593	92.444	3.807	0.44	0.029	0.062	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/18/2022	1022.42	0.053	3.243	0.595	92.074	4.024	0.473	0.03	0.066	0.012	0.012	0.007	0.007	0	0
Northern Natural Gas (9048		11/17/2022	1017.784	0.131	3.102	0.592	92.63	3.656	0.393	0.021	0.046	0.007	0.007	0.004	0.004	0	0
Northern Natural Gas (9048		11/16/2022	1014.551	0.163	2.988	0.589	93.131	3.325	0.32	0.018	0.038	0.006	0.006	0.003	0.003	0	0
Northern Natural Gas (9048		11/15/2022	1015.032	0.133	2.76	0.587	93.62	3.133	0.288	0.015	0.032	0.006	0.006	0.003	0.003	0	0
Northern Natural Gas (9048		11/14/2022	1015.336	0.146	3.166	0.591	92.848	3.322	0.396	0.027	0.059	0.012	0.012	0.005	0.005	0	0
Northern Natural Gas (9048		11/13/2022	1020.589	0.133	3.459	0.598	91.606	4.221	0.444	0.031	0.062	0.013	0.014	0.008	0.008	0	0
Northern Natural Gas (9048		11/12/2022	988.957	0.059	4.165	0.584	94.03	1.401	0.215	0.027	0.053	0.014	0.015	0.01	0.01	0	0
Northern Natural Gas (9048		11/11/2022	988.115	0.064	4.209	0.584	94.025	1.357	0.217	0.026	0.053	0.013	0.015	0.01	0.01	0	0
Northern Natural Gas (9048		11/10/2022	987.668	0.063	4.283	0.584	93.925	1.376	0.222	0.027	0.054	0.014	0.016	0.01	0.01	0	0

## Unit 30 Performance

## Active Control Mode

OnLine

GAS HORSEPOWER (ASAD)	8823
BRAKE HORSEPOWER (CURVES)	12141
COMPRESSOR FLOW (CALC)	520

PT (LP) SPEED(0)	5836
PT (LP) SPEED(1)	5837
GP (HP) SPEED(0)	6157
GP (HP) SPEED(1)	6157
SUCTION PRESS	627
DISCHARGE PRESS	809
SUCTION TEMP	58
DISCHARGE TEMP	97
NOZZLE ANGLE	-151
EXHAUST GAS TEMP AVG	958.15
AXIAL AIR COMP DIS PRESS	5882
LUBE OIL PRESS	5480
FUEL GAS PRESS	155.30
INTERSTAGE PRESSURE	13.36
BELLMOUTH PRESSURE	4.20
FUEL ORF PRIMARY DIFF	38.53
FUEL ORF SECONDARY DIFF	38.31
TURBINE #1 BRG DRN TEMP	124.53
TURBINE #2 BRG DRN TEMP	140.57
TURBINE #3 BRG DRN TEMP	152.06
TURBINE #4 BRG DRN TEMP	145.50
TURBINE #5 BRG DRN TEMP	151.88
SEAL OIL DIFF PRESS	52.78

AXIAL AIR COMPR DISCH TEMP	384.7
FUEL GAS TEMP	37.20
FUEL FLOW - MCF / H	781.77
VERADIR DIFF	24.80

WHEEL SPACE TEMP GP - FORWARD(0)	428.94
WHEEL SPACE TEMP GP - FORWARD(1)	438.78
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	88.05
WHEEL SPACE TEMPERATURE PT - AFT(1)	300.70
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.90
FIN FAN COOLING WATER TEMP OUT	78.75
RELATIVE EFFICIENCY	0.88
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	12.81
TURBINE EXHAUST PRESSURE	0.98
TURBINE EXHAUST INTERSTAGE PRESSURE	13.36
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10438.84
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2829.19
BRAKE SPECIFIC FUEL CONS - COMPR BHP	8713.29

Ambient Air Temp	38.42
SHELL COOLING WATER TEMP-LEFT	180.42
SHELL COOLING WATER TEMP-RIGHT	112.47
FUEL ENERGY RATE MDTH / D	2.53

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.91
DISCHARGE COMPRESSIBILITY	0.91
GC MP BRG DRN #2 TEMP	139.61
GC DRV BRG DRN #1 TEMP	147.34
GC TNR BRG DRN #2 TEMP	139.87
ACTUAL COMPRESSOR VOL (ACF/H)	7482.07
ADIABATIC EFFICIENCY % CURVES	77.20
ADIABATIC HEAD 1-6mm/HFCALCULATED	10888.25
ADIABATIC HEAD 1-6mm/HFCURVES	14919.85
GAS HORSEPOWER	7058.63
GAS ADIAB.CORRECTED w MEAS.ADIAB.EFFICH	8823.29
BRAKE HORSEPOWER - CURVES	12141.50
MEDICAL EFFICIENCY - CURVES	0.88
CALC MEAS COMPRESSOR FLOW RATIO	1.32
% of RATED SPEED	93.97
% of SPEED BETWEEN MIN / MAX	87.93
SURGE MARGIN - SURGE 6 STONEWALL	44.38
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.99
VIBRATION GP BRG1 - VERTICAL	0.8823
VIBRATION GP BRG1 - HORIZONTAL	0.5101
VIBRATION GP BRG3 - VERTICAL	1.0296
VIBRATION GP BRG3 - HORIZONTAL	0.8168
VIBRATION POWER TURBINE - VERTICAL	0.1317

Curves Menu

UNIT 30 YEARLY START COUNT	121.8000
UNIT 30 MONTHLY RUN HOURS	48.7884
UNIT 30 YEARLY RUN HOURS	1176.331
UNIT 30 PREV MONTH RUN HOURS	0.9982
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1411.841

UNIT 30 CURR DAY STRT GAS LOSS	24.3854
UNIT 30 CURR MONTH STRT GAS LOSS	46.8483
UNIT 30 CURR YEAR STRT GAS LOSS	1958.882
UNIT 30 PREV DAY STRT GAS LOSS	0.8800
UNIT 30 PREV MONTH STRT GAS LOSS	68.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375



Station

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Fire &amp; Gas

Alarms / Events

Trend

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Unit 28

Unit 29

Unit 30

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CLIF-SRV-HMI-01

User:

HIMINGH129281

Wednesday, December 7, 2022

7:00:21 PM



# Clifton RTU Data

Date Time	B-Line	C-Line	D-Line	E-Line
BkFlo Current MMBTU Accumulator	10.205264	0.000000	0.000000	0.000000
BkFlo Current MMCFD Accumulator	10.205264	0.000000	0.000000	0.000000
BkFlo Prev. MMBTU Accumulator	15.845140	0.000000	408.263700	97.434730
BkFlo Prev. MMCFD Accumulator	16.343441	0.000000	414.301240	98.686966
Current MMBTU Accumulator	3099.97420	197891.130	253476.160	548613.200
Current MMCFD Accumulator	2993.70500	193768.560	249573.610	540107.750
Prev. MMBTU Accumulator	22239.6520	178966.970	199655.300	513955.720
Prev. MMCFD Accumulator	21650.5400	176253.750	196875.750	507083.970
Flowing Temp	44.390244	51.404152	52.933987	97.587700
Static Press	618.178700	651.840450	663.308500	735.428800
BkFlo MMBTU Rate	0.000000	0.000000	0.000000	0.000000
BkFlo MMCFD Rate	0.000000	0.000000	0.000000	0.000000
MMBTU Rate	3586.20600	222251.750	285203.530	582204.600
MMCFD Rate	3462.69700	217488.220	280275.470	582871.800
Quality Current BTU	1035.66830	1021.30247	1017.58250	1016.14030
Quality Current CO2 Factor	0.300606	0.108761	0.147208	0.174142
Quality Current Ethane	5.398612	4.469597	3.674820	3.396835
Quality Current H2O	0.403300	1.117126	0.601467	0.898709
Quality Current Hexane	0.019697	0.006261	0.004678	0.003294
Quality Current I-Butane	0.024958	0.021093	0.012516	0.011389
Quality Current I-Pentane	0.008825	0.008468	0.004608	0.003653
Quality Current Methane	90.340830	92.771890	92.342600	93.402000
Quality Current N-Butane	0.041441	0.047594	0.027328	0.023775
Quality Current N-Pentane	0.009290	0.009419	0.004879	0.003994
Quality Current N2 Factor	2.756636	3.860955	2.889587	2.721610
Quality Current Propane	0.475412	0.391600	0.288247	0.255301
Quality Current Specific Gravity	0.602521	0.593810	0.589861	0.587601



12/8/2022 6:17:03 AM  
12/8/2022 8:16:58 AM  
11/18/2022 2:54:05 AM

Station  
Unit 30  
Status  
STH\_PLG\_REM\_RUN  
U30\_PLG\_KEY\_SW\_ALM  
STH\_P3\_BK3\_LPA2

PLC keyswitch is NOT in RUN mode  
PLC keyswitch is NOT in RUN mode  
LPA3 Panel BPS Alarm



## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10190
BRAKE HORSEPOWER (CURVES)	12959
COMPRESSOR FLOW (CALC)	580

PT (LP) SPEED(0)	5902
PT (LP) SPEED(1)	5902
GP (HP) SPEED(0)	6441
GP (HP) SPEED(1)	6441
SUCTION PRESS	565
DISCHARGE PRESS	737
SUCTION TEMP	56
DISCHARGE TEMP	98
NOZZLE ANGLE	-2.78
EXHAUST GAS TEMP AVG	957.81
AXIAL AIR COMP DIS PRESS	64.82
LUBE OIL PRESS	54.85
FUEL GAS PRESS	163.01
INTERSTAGE PRESSURE	14.54
BELLMOUTH PRESSURE	4.03
FUEL OIL PRIMARY DIFF	47.74
FUEL OIL SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	120.54
TURBINE #2 BRG DRN TEMP	144.53
TURBINE #3 BRG DRN TEMP	156.77
TURBINE #4 BRG DRN TEMP	150.38
TURBINE #5 BRG DRN TEMP	130.08
SEAL OIL DIFF PRESS	54.00

AXIAL AIR COMP DISCH TEMP	400.21
FUEL GAS TEMP	35.01
FUEL FLOW - MCF / H	111.12
VERABAR DIFF	32.26

WHEEL SPACE TEMP GP - FORWARD(0)	452.06
WHEEL SPACE TEMP GP - FORWARD(1)	460.38
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	407.90
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	65.00
FIN FAN COOLING WATER TEMP OUT	78.89
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	8.93
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.54
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10525.75
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2891.79
BRAKE SPECIFIC FUEL CONS - COMP BHP	8879.91

AMBIENT AIR TEMP	34.00
SHELL COOLING WATER TEMP LEFT	101.29
SHELL COOLING WATER TEMP RIGHT	113.92
FUEL ENERGY RATE MDTH / D	2.78

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	143.91
GC DRV BRG DRN #1 TEMP	151.16
GC THR BRG DRN #2 TEMP	143.57
ACTUAL COMPRESSOR VOL. (ACFM)	8987.24
ADIABATIC EFFICIENCY % CURVES	71.32
ADIABATIC HEAD 4-6m3/GAL CALCULATED	11233.57
ADIABATIC HEAD 4-6m3/GAL CURVES	13847.78
GAS HORSEPOWER	8156.91
GAS ADIAB. CORRECTED w/ MEAS ADIAB. EFFICN	10190.14
BRAKE HORSEPOWER - CURVES	12959.00
MECHANICAL EFFICIENCY - CURVES	0.80
CALC. MEAS. COMPRESSOR FLOW RATIO	1.50
% of RATED SPEED	99.88
% of SPEED BETWEEN MIN / MAX	99.75
SURGE MARGIN - SURGE to STONERWALL	63.61
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.9387
VIBRATION GP BRG1 - HORIZONTAL	0.4938
VIBRATION GP BRG3 - VERTICAL	0.9324
VIBRATION GP BRG3 - HORIZONTAL	0.5204
VIBRATION POWER TURBINE - VERTICAL	0.1907

Curves Menu

UNIT 30 YEARLY START COUNT	121.8080
UNIT 30 MONTHLY RUN HOURS	54.7008
UNIT 30 YEARLY RUN HOURS	1190.264
UNIT 30 PREVIOUS MONTH RUN HOURS	0.9082
UNIT 30 PREVIOUS YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1424.973

UNIT 30 CURRDY STRT GAS LOSS	0.9080
UNIT 30 CURRMNTH STRT GAS LOSS	46.0483
UNIT 30 CURRYEAR STRT GAS LOSS	1958.082
UNIT 30 PREVDY STRT GAS LOSS	24.3854
UNIT 30 PREVMNTH STRT GAS LOSS	68.3743
UNIT 30 PREVEAR STRT GAS LOSS	793.5375

◀

Exit HMI

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CLIF-SRV-HMI-01

User:

HIMINGN1100884

Thursday, December 8, 2022

9:55:58 AM

## Unit 30 Performance

### Active Control Mode

Online

GAS HORSEPOWER (ABAD)	10160
BRAKE HORSEPOWER (CURVES)	13101
COMPRESSOR FLOW (CALC)	558

PT (LP) SPEED(0)	8002
PT (LP) SPEED(1)	8003
GP (HP) SPEED(0)	8433
GP (HP) SPEED(1)	8432
SUCTION PRESS	586
DISCHARGE PRESS	737
SUCTION TEMP	58
DISCHARGE TEMP	98
NOZZLE ANGLE	282
EXHAUST GAS TEMP AVG	961.88
AUXIAL AIR COMP DIS PRESS	64.80
LUBE OIL PRESS	54.87
FUEL GAS PRESS	963.23
INTERSTAGE PRESSURE	11.48
BELLMOUTH PRESSURE	4.43
FUEL ORF PRIMARY DIFF	48.11
FUEL ORF SECONDARY DIFF	38.51
TURBINE #1 BRG DRN TEMP	128.81
TURBINE #2 BRG DRN TEMP	144.78
TURBINE #3 BRG DRN TEMP	157.00
TURBINE #4 BRG DRN TEMP	158.08
TURBINE #5 BRG DRN TEMP	138.45
SEAL OIL DIFF PRESS	54.01

AXIAL AIR COMPR DISCH TEMP	400.87
FUEL GAS TEMP	35.83
FUEL FLOW - MCF / H	111.88
VERBAR DIFF	32.15

WHEEL SPACE TEMP GP - FORWARD(0)	451.77
WHEEL SPACE TEMP GP - FORWARD(1)	450.50
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	00.05
WHEEL SPACE TEMPERATURE PT - AFT(1)	400.68
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	70.35
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	9.20
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.49
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10581.70
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2931.47
BRACE SPECIFIC FUEL CONS - CNMPR BHP	8018.72

AMBIENT AIR TEMP	34.12
SHELL COOLING WATER TEMP LEFT	101.90
SHELL COOLING WATER TEMP RIGHT	114.56
FUEL ENERGY RATE MDTH / D	2.77

TOTAL OF COSTS 0.00

SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	144.20
GC DRV BRG DRN #1 TEMP	151.32
GC THR BRG DRN #2 TEMP	143.71
ACTUAL COMPRESSOR VOL (ACFM)	8928.58
ADIABATIC EFFICIENCY % CURVES	71.73
ADIABATIC HEAD $\frac{ft \cdot lb}{lb}$ / CALCULATED	11298.32
ADIABATIC HEAD $\frac{ft \cdot lb}{lb}$ / CURVES	13927.69
GAS HORSEPOWER	8128.10
GAS ADIAB. CORRECTED W MEAS. ADIAB. EFFICN	10100.13
BRAKE HORSEPOWER - CURVES	13101.26
MECHANICAL EFFICIENCY - CURVES	0.80
CALC. MEAS. COMPRESSOR FLOW RATIO	1.49
% @ RATED SPEED	100.06
% @ SPEED BETWEEN MIN / MAX	100.11
SURGE MARGIN - SURGE @ STONEWALL	62.20
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.06
VIBRATION CP BRG1 - VERTICAL	0.2680
VIBRATION CP BRG1 - HORIZONTAL	0.4932
VIBRATION CP BRG3 - VERTICAL	0.7979
VIBRATION CP BRG3 - HORIZONTAL	0.5213
VIBRATION POWER TURBINE - VERTICAL	0.1907

### Curves Menu

UNIT 30 YEARLY START COUNT	121.0000
UNIT 30 MONTHLY RUN HOURS	54.9702
UNIT 30 YEARLY RUN HOURS	1190.533
UNIT 30 PREVIOUS MONTH RUN HOURS	0.9992
UNIT 30 PREVIOUS YEAR RUN HOURS	22.7854
UNIT 30 LEFT TIME RUN HOURS	1425.243

UNIT 30 CURR DAY STR GAS LOSS	0.0000
UNIT 30 CURR MONTH STR GAS LOSS	46.0483
UNIT 30 CURR YEAR STR GAS LOSS	1958.082
UNIT 30 PREV DAY STR GAS LOSS	24.3864
UNIT 30 PREV MONTH STR GAS LOSS	69.3243
UNIT 30 PREV YEAR STR GAS LOSS	793.5375



## OnLine

UNIT 30 CURR DAY STRT GAS LOSS	0.0000
UNIT 30 CURR MONTH STRT GAS LOSS	46.0483
UNIT 30 CURR YEAR STRT GAS LOSS	1058.002
UNIT 30 PREV DAY STRT GAS LOSS	24.1854
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	795.5375

# Unit 30 Performance

Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10304
BRAKE HORSEPOWER (CURVES)	13052
COMPRESSOR FLOW (CALC)	562

PT (LP) SPEED(0)	6002
PT (LP) SPEED(1)	6002
GP (HP) SPEED(0)	6434
GP (HP) SPEED(1)	6434
SUCTION PRESS	564
DISCHARGE PRESS	736
SUCTION TEMP	56
DISCHARGE TEMP	90
NOZZLE ANGLE	-2.04
EXHAUST GAS TEMP AVG	957.56
AXIAL AIR COMP DIS PRESS	64.99
LUBE OIL PRESS	54.77
FUEL GAS PRESS	163.20
INTERSTAGE PRESSURE	14.64
BELLMOUTH PRESSURE	5.78
FUEL ORF PRIMARY DIFF	47.81
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	426.93
TURBINE #2 BRG DRN TEMP	444.02
TURBINE #3 BRG DRN TEMP	457.14
TURBINE #4 BRG DRN TEMP	459.78
TURBINE #5 BRG DRN TEMP	438.59
SEAL OIL DIFF PRESS	53.94

AXIAL AIR COMPR DISCH TEMP	400.03
FUEL GAS TEMP	35.08
FUEL FLOW - MCF / H	111.77
VERABAR DIFF	32.41

WHEEL SPACE TEMP GP - FORWARD(0)	451.94
WHEEL SPACE TEMP GP - FORWARD(1)	459.19
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	407.82
WHEEL SPACE TEMPERATURE PT - AFT(1)	407.82
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	78.84
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	9.75
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.64
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10570.50
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2931.06
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	8824.72

AMBIENT AIR TEMP	34.26
SHELL COOLING WATER TEMP LEFT	191.00
SHELL COOLING WATER TEMP RIGHT	114.27
FUEL ENERGY RATE NDT / D	2.76

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	144.39
GC DRV BRG DRN #1 TEMP	151.04
GC THR BRG DRN #2 TEMP	144.05
ACTUAL COMPRESSOR VOL (ACFW)	9069.00
ADIABATIC EFFICIENCY % CURVES	71.14
ADIABATIC HEAD 4-bm/bt CALCULATED	11222.85
ADIABATIC HEAD 4-bm/bt CURVES	13506.41
GAS HORSEPOWER	8243.55
GAS ADIAB. CORRECTED w MEAS ADIAB EFFICH	10304.43
BRAKE HORSEPOWER - CURVES	13052.27
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.51
% of RATED SPEED	180.05
% of SPEED BETWEEN MIN / MAX	108.10
SURGE MARGIN - SURGE to STONERAIL	64.71
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.9392
VIBRATION GP BRG1 - HORIZONTAL	0.5040
VIBRATION GP BRG3 - VERTICAL	0.8825
VIBRATION GP BRG3 - HORIZONTAL	0.5188
VIBRATION POWER TURBINE - VERTICAL	0.1907

Curves Menu

UNIT 30 YEARLY START COUNT	121.8090
UNIT 30 MONTHLY RUN HOURS	55.5193
UNIT 30 YEARLY RUN HOURS	1191.062
UNIT 30 PREV YEAR RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1425.792

UNIT 30 CURR DAY STRT GAS LOSS	0.0000
UNIT 30 CURR MONTH STRT GAS LOSS	45.8483
UNIT 30 CURR YEAR STRT GAS LOSS	1058.062
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

Station	Units	Communications	Fire & Gas	Alarms / Events	Trend
Unit 27	Unit 28	Unit 29	Unit 30	Unit 31	
Engine Cals	Trends	PID Screen	Process	Overview	Surge Map
					Diagnostics
					Parameters

Login: CLF-SRV-HUB-01

User: HMMINGW1100884

Thursday, December 9, 2022 9:45:04 AM



Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10191
BRAKE HORSEPOWER (CURVES)	12989
COMPRESSOR FLOW (CALC)	557

PT (LP) SPEED(0)	6002
PT (LP) SPEED(1)	6002
GP (HP) SPEED(0)	6437
GP (HP) SPEED(1)	6437
SUCTION PRESS	584
DISCHARGE PRESS	730
SUCTION TEMP	58
DISCHARGE TEMP	98
NOZZLE ANGLE	2.82
EXHAUST GAS TEMP AVG	658.58
AXIAL AIR COMP DIS PRESS	64.74
LUBE OIL PRESS	54.84
FUEL GAS PRESS	183.94
INTERSTAGE PRESSURE	14.54
BELLMOUTH PRESSURE	5.16
FUEL ORF PRIMARY DIFF	47.57
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	128.58
TURBINE #2 BRG DRN TEMP	144.80
TURBINE #3 BRG DRN TEMP	156.74
TURBINE #4 BRG DRN TEMP	158.35
TURBINE #5 BRG DRN TEMP	138.97
SEAL OIL DIFF PRESS	54.15

AXIAL AIR COMPR DISCH TEMP	400.97
FUEL GAS TEMP	35.74
FUEL FLOW - MCF / H	111.28
VERABAR DIFF	31.84

WHEEL SPACE TEMP GP - FORWARD(0)	451.90
WHEEL SPACE TEMP GP - FORWARD(1)	458.99
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	407.52
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.90
FIN FAN COOLING WATER TEMP OUT	78.28
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	10.00
TURBINE EXHAUST PRESSURE	0.90
TURBINE EXHAUST INTERSTAGE PRESSURE	14.54
MAX HORSEPOWER AVAILABLE - AHB UPRATE	18577.01
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2891.10
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	8797.19

AMBIENT AIR TEMP	34.26
SHELL COOLING WATER TEMP-LEFT	100.79
SHELL COOLING WATER TEMP-RIGHT	113.37
FUEL ENERGY RATE IN DTH / D	2.76

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	143.91
GC DRV BRG DRN #1 TEMP	151.32
GC THR BRG DRN #2 TEMP	143.85
ACTUAL COMPRESSOR VOL (ACF/H)	8983.09
ADIABATIC EFFICIENCY % CURVES	71.33
ADIABATIC HEAD 1-hm/ft CALCULATED	11255.13
ADIABATIC HEAD 1-hm/ft CURVES	13783.78
GAS HORSEPOWER	8153.53
GAS ADIAB. CORRECTED w MEAS ADIAB. EFFCN	10191.91
BRAKE HORSEPOWER - CURVES	12989.25
MECHANICAL EFFICIENCY - CURVES	0.80
CALC. MEAS. COMPRESSOR FLOW RATIO	1.50
% OF RATED SPEED	100.05
% OF SPEED BETWEEN MIN / MAX	100.10
SURGE MARGIN- SLURGE b STONEMILL	63.42
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.8837
VIBRATION GP BRG1 - HORIZONTAL	0.4982
VIBRATION GP BRG3 - VERTICAL	0.8319
VIBRATION GP BRG3 - HORIZONTAL	0.5198
VIBRATION POWER TURBINE - VERTICAL	0.1907

Curves Menu

UNIT 30 YEARLY START COUNT	121.0000
UNIT 30 MONTHLY RUN HOURS	55.7892
UNIT 30 YEARLY RUN HOURS	1181.332
UNIT 30 PREV MONTHLY RUN HOURS	0.9892
UNIT 30 PREV YEARLY RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1426.042

UNIT 30 CURR DAY STRT GAS LOSS	0.0000
UNIT 30 CURR MONTH STRT GAS LOSS	46.9483
UNIT 30 CURR YEAR STRT GAS LOSS	1058.082
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	69.3243
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

## Unit 30 Performance

## Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10062
BRAKE HORSEPOWER (CURVES)	13061
COMPRESSOR FLOW (CALC)	555

PT (LP) SPEED(0)	6000
PT (LP) SPEED(1)	6001
GP (HP) SPEED(0)	6404
GP (HP) SPEED(1)	6404
SUCTION PRESS	584
DISCHARGE PRESS	735
SUCTION TEMP	56
DISCHARGE TEMP	98
NOZZLE ANGLE	2.65
EXHAUST GAS TEMP AVG	953.64
AXIAL AIR COMP DIS PRESS	65.65
LUBE OIL PRESS	55.00
FUEL GAS PRESS	163.43
INTERSTAGE PRESSURE	14.59
BELLMOUTH PRESSURE	4.00
FUEL ORF PRIMARY DIFF	47.87
FUEL ORF SECONDARY DIFF	30.31
TURBINE #1 BRG DRN TEMP	125.43
TURBINE #2 BRG DRN TEMP	144.30
TURBINE #3 BRG DRN TEMP	156.24
TURBINE #4 BRG DRN TEMP	150.46
TURBINE #5 BRG DRN TEMP	130.86
SEAL OIL DIFF PRESS	54.15

AXIAL AIR COMPR DISCH TEMP	402.56
FUEL GAS TEMP	35.00
FUEL FLOW - MCF / H	111.21
VERABAR DIFF	31.47

WHEEL SPACE TEMP GP - FORWARD(0)	451.57
WHEEL SPACE TEMP GP - FORWARD(1)	400.24
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	407.24
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	77.82
RELATIVE EFFICIENCY	0.90
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	10.25
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.50
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10558.31
MN HORSEPOWER AVAILABLE - AMB UPRATE	2929.62
BRAKE SPECIFIC FUEL CONS - COMPR BHP	8797.90

AMBIENT AIR TEMP	34.83
SHELL COOLING WATER TEMP-LEFT	100.41
SHELL COOLING WATER TEMP-RIGHT	113.07
FUEL ENERGY RATE MMBT / D	2.76

TOTAL OF COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	143.74
GC DRV BRG DRN #1 TEMP	151.15
GC THR BRG DRN #2 TEMP	143.69
ACTUAL COMPRESSOR VOL (ACFW)	8936.43
ADIABATIC EFFICIENCY % CURVES	72.38
ADIABATIC HEAD 1-lbm/ft <sup>3</sup> CALCULATED	11225.96
ADIABATIC HEAD 1-lbm/ft <sup>3</sup> CURVES	14116.59
GAS HORSEPOWER	8050.36
GAS ADIAB. CORRECTED w MEAS ADIAB. EFFICN	10062.95
BRAKE HORSEPOWER - CURVES	13061.12
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.49
% of RATED SPEED	100.03
% of SPEED BETWEEN MIN / MAX	100.05
SURGE MARGIN - SURGE to STONEMILL	62.42
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.8944
VIBRATION GP BRG1 - HORIZONTAL	0.5137
VIBRATION GP BRG3 - VERTICAL	0.8931
VIBRATION GP BRG3 - HORIZONTAL	0.5076
VIBRATION POWER TURBINE - VERTICAL	0.1906

Curves Menu

UNIT 30 YEARLY START COUNT	121.9000
UNIT 30 MONTHLY RUN HOURS	56.0192
UNIT 30 YEARLY RUN HOURS	1191.582
UNIT 30 PREV MONTH RUN HOURS	0.9092
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1426.202

UNIT 30 CURR DAY STRT GAS LOSS	0.0000
UNIT 30 CURR MONTH STRT GAS LOSS	46.0403
UNIT 30 CURR YEAR STRT GAS LOSS	1958.082
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	69.3243
UNIT 30 PREV YEAR STRT GAS LOSS	792.5375



## Unit 30 Performance

Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10223
BRAKE HORSEPOWER (CURVES)	13015
COMPRESSOR FLOW (CALC)	560

PT (LP) SPEED(0)	0001
PT (LP) SPEED(1)	0001
GP (HP) SPEED(0)	0429
GP (HP) SPEED(1)	0429
SUCTION PRESS	564
DISCHARGE PRESS	735
SUCTION TEMP	68
DISCHARGE TEMP	98
NOZZLE ANGLE	-291
EXHAUST GAS TEMP AVG	957.02
AXIAL AIR COMP DIS PRESS	64.35
LUBE OIL PRESS	54.80
FUEL GAS PRESS	163.31
INTERSTAGE PRESSURE	14.38
BELLMOUTH PRESSURE	5.28
FUEL ORF PRIMARY DIFF	47.83
FUEL ORF SECONDARY DIFF	38.31
TURBINE #1 BRG DRN TEMP	125.24
TURBINE #2 BRG DRN TEMP	141.12
TURBINE #3 BRG DRN TEMP	136.40
TURBINE #4 BRG DRN TEMP	130.00
TURBINE #5 BRG DRN TEMP	130.95
SEAL OIL DIFF PRESS	54.25

AXIAL AIR COMP DISCH TEMP	491.85
FUEL GAS TEMP	35.30
FUEL FLOW - MCF / H	111.38
VERABAR DIFF	32.88

WHEEL SPACE TEMP GP - FORWARD(0)	451.73
WHEEL SPACE TEMP GP - FORWARD(1)	450.89
WHEEL SPACE TEMP PT - FORWARD(0)	2191.83
WHEEL SPACE TEMP PT - FORWARD(1)	2191.83
WHEEL SPACE TEMPERATURE PT - AFT(0)	88.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	407.87
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.83
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.83
FIN FAN COOLING WATER TEMP IN	55.80
FIN FAN COOLING WATER TEMP OUT	77.59
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	10.50
TURBINE EXHAUST PRESSURE	0.90
TURBINE EXHAUST INTERSTAGE PRESSURE	14.58
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10583.77
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2930.85
BRAKE SPECIFIC FUEL CONS - COMP BHP	8847.51

AMBIENT AIR TEMP	34.06
SHELL COOLING WATER TEMP-LEFT	100.15
SHELL COOLING WATER TEMP-RIGHT	112.79
FUEL ENERGY RATE MDT / D	2.77

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	143.49
GC DRV BRG DRN #1 TEMP	150.99
GC THR BRG DRN #2 TEMP	143.57
ACTUAL COMPRESSOR VOL (ACFM)	9084.97
ADIABATIC EFFICIENCY % CURVES	71.30
ADIABATIC HEAD 1-hr/MT CALCULATED	11235.73
ADIABATIC HEAD 1-hr/MT CURVES	13874.86
GAS HORSEPOWER	8178.94
GAS ADIAB. CORRECTED w/ MEAS ADIAB. EFFICH	10223.68
BRAKE HORSEPOWER - CURVES	13015.89
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.51
% of RATED SPEED	100.03
% of SPEED BETWEEN MIN / MAX	100.05
SURGE MARGIN - SURGE b/STONEWALL	64.78
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.9183
VIBRATION GP BRG1 - HORIZONTAL	0.5164
VIBRATION GP BRG3 - VERTICAL	0.9060
VIBRATION GP BRG3 - HORIZONTAL	0.5605
VIBRATION POWER TURBINE - VERTICAL	0.1906

Curves Menu

UNIT 30 YEARLY START COUNT	121.9000
UNIT 30 MONTHLY RUN HOURS	56.2691
UNIT 30 YEARLY RUN HOURS	1181.832
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1426.542

UNIT 30 CURR DAY STRG GAS LOSS	0.0000
UNIT 30 CURR MONTH STRG GAS LOSS	46.0483
UNIT 30 CURR YEAR STRG GAS LOSS	1958.002
UNIT 30 PREV DAY STRG GAS LOSS	24.3854
UNIT 30 PREV MONTH STRG GAS LOSS	69.3743
UNIT 30 PREV YEAR STRG GAS LOSS	793.5375

Station	Units	Communications	Fire & Gas	Alarms / Events	Trend	
Unit 27	Unit 28	Unit 29	Unit 30	Unit 31		
Engine Calcs	Trends	PID Screen	Process	Overview	Surge Map	Diagnostics
						Parameters

Login: CLF-SRV-HMI-01

User: HMININGH1100004

Thursday, December 8, 2022

10:30:04 A

## Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10183
BRAKE HORSEPOWER (CURVES)	13053
COMPRESSOR FLOW (CALC)	558

PT (LP) SPEED(0)	6003
PT (LP) SPEED(1)	6004
GP (HP) SPEED(0)	6450
GP (HP) SPEED(1)	6450
SUCTION PRESS	564
DISCHARGE PRESS	735
SUCTION TEMP	56
DISCHARGE TEMP	90
NOZZLE ANGLE	2.64
EXHAUST GAS TEMP AVG	957.06
AXIAL AIR COMP DIS PRESS	64.09
LUBE OIL PRESS	55.15
FUEL GAS PRESS	1053.58
INTERSTAGE PRESSURE	14.41
BELLMOUTH PRESSURE	4.53
FUEL ORF PRIMARY DIFF	47.62
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	128.24
TURBINE #2 BRG DRN TEMP	144.21
TURBINE #3 BRG DRN TEMP	150.53
TURBINE #4 BRG DRN TEMP	150.00
TURBINE #5 BRG DRN TEMP	130.05
SEAL OIL DIFF PRESS	54.21

AXIAL AIR COMPR DISCH TEMP	402.57
FUEL GAS TEMP	35.54
FUEL FLOW - WCF / H	111.31
VERBAR DIFF	31.87

WHEEL SPACE TEMP GP - FORWARD(0)	453.07
WHEEL SPACE TEMP GP - FORWARD(1)	461.45
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	60.05
WHEEL SPACE TEMPERATURE PT - AFT(1)	408.03
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.90
FIN FAN COOLING WATER TEMP OUT	77.49
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	10.75
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.41
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10550.20
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2929.40
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	8821.31

AMBIENT AIR TEMP	34.80
SHELL COOLING WATER TEMP-LEFT	100.29
SHELL COOLING WATER TEMP-RIGHT	112.92
FUEL ENERGY RATE MDTH / D	2.76

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	143.59
GC DRV BRG DRN #1 TEMP	150.96
GC THR BRG DRN #2 TEMP	143.55
ACTUAL COMPRESSOR VOL. (ACFM)	8989.39
ADIABATIC EFFICIENCY % CURVES	71.56
ADIABATIC HEAD 1-hr/MB/CALCULATED	11257.19
ADIABATIC HEAD 1-hr/MB/CURVES	13833.31
GAS HORSEPOWER	8147.06
GAS ADIAB. CORRECTED w/ MEAS. ADIAB. EFFICN	10183.83
BRAKE HORSEPOWER - CURVES	13053.98
MECHANICAL EFFICIENCY - CURVES	0.80
CALC. MEAS. COMPRESSOR FLOW RATIO	1.58
% of RATED SPEED	100.05
% of SPEED BETWEEN MIN / MAX	100.09
SURGE MARGIN - SURGE w/ STONEWALL	63.36
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.8904
VIBRATION GP BRG1 - HORIZONTAL	0.5023
VIBRATION GP BRG3 - VERTICAL	0.9457
VIBRATION GP BRG3 - HORIZONTAL	0.5570
VIBRATION POWER TURBINE - VERTICAL	0.1906

Curves Menu

UNIT 30 YEARLY START COUNT	121.0000
UNIT 30 MONTHLY RUN HOURS	56.5191
UNIT 30 YEARLY RUN HOURS	1182.002
UNIT 30 PREV MONTHLY RUN HOURS	0.9992
UNIT 30 PREV YEARLY RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1426.792

UNIT 30 CURR DAY STRT GAS LOSS	3.8090
UNIT 30 CURR MONTH STRT GAS LOSS	46.0483
UNIT 30 CURR YEAR STRT GAS LOSS	1958.002
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	89.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

Station	Units	Communications	Fire & Gas	Alarms / Events	Trend
Exit HMI	Unit 27	Unit 28	Unit 29	Unit 30	Unit 31
Print	Engine Calcs	Trends	PID Screen	Process	Overview
				Surge Map	Diagnostics
				Parameters	

Login CLIF-SRV-1-00-01

User: HMININGH1100884

Thursday, December 8, 2022

12:45:34 A



Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10090
BRAKE HORSEPOWER (CURVES)	13074
COMPRESSOR FLOW (CALC)	558

PT (LP) SPEED(0)	6001
PT (LP) SPEED(1)	6000
GP (HP) SPEED(0)	0405
GP (HP) SPEED(1)	0406
SUCTION PRESS	583
DISCHARGE PRESS	735
SUCTION TEMP	58
DISCHARGE TEMP	98
NOZZLE ANGLE	2.29
EXHAUST GAS TEMP AVG	951.27
AXIAL AIR COMP DIS PRESS	85.46
LUBE OIL PRESS	55.18
FUEL GAS PRESS	103.45
INTERSTAGE PRESSURE	14.51
BELLMOUTH PRESSURE	5.42
FUEL ORF PRIMARY DIFF	47.70
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	126.48
TURBINE #2 BRG DRN TEMP	141.49
TURBINE #3 BRG DRN TEMP	156.72
TURBINE #4 BRG DRN TEMP	158.13
TURBINE #5 BRG DRN TEMP	138.86
SEAL OIL DIFF PRESS	54.20

AXIAL AIR COMPR DISCH TEMP	494.47
FUEL GAS TEMP	35.53
FUEL FLOW - MCF / H	111.30
VERABAR DIFF	32.94

WHEEL SPACE TEMP GP - FORWARD(0)	454.28
WHEEL SPACE TEMP GP - FORWARD(1)	492.18
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	88.85
WHEEL SPACE TEMPERATURE PT - AFT(1)	407.37
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.80
FIN FAN COOLING WATER TEMP OUT	78.46
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	11.90
TURBINE EXHAUST PRESSURE	0.09
TURBINE EXHAUST INTERSTAGE PRESSURE	14.51
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10548.94
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2928.86
BRAKE SPECIFIC FUEL CONS - COMPR BHP	8815.15

AMBIENT AIR TEMP	35.11
SHELL COOLING WATER TEMP-LEFT	180.98
SHELL COOLING WATER TEMP-RIGHT	113.55
FUEL ENERGY RATE MDTB / D	2.76

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	143.69
GC DRV BRG DRN #1 TEMP	150.85
GC THR BRG DRN #2 TEMP	143.54
ACTUAL COMPRESSOR VOL (ACFM)	8974.95
ADIABATIC EFFICIENCY % CURVES	71.97
ADIABATIC HEAD 1-hm/ft CALCULATED	11249.78
ADIABATIC HEAD 1-hm/ft CURVES	14056.58
GAS HORSEPOWER	8972.13
GAS ADIAB. CORRECTED w/ MEAS ADIAB. EFFICH	10090.16
BRAKE HORSEPOWER - CURVES	13074.31
MECHANICAL EFFICIENCY - CURVES	0.80
CALC. MEAS. COMPRESSOR FLOW RATIO	1.58
% of RATED SPEED	100.02
% of SPEED BETWEEN MIN / MAX	100.04
SURGE WARN-IN - SURGE to STONEMILL	63.16
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.89
VIBRATION OP BRG1 - VERTICAL	0.9714
VIBRATION OP BRG1 - HORIZONTAL	0.5137
VIBRATION OP BRG3 - VERTICAL	0.9421
VIBRATION OP BRG3 - HORIZONTAL	0.5582
VIBRATION POWER TURBINE - VERTICAL	0.1679

Curves Menu

UNIT 30 YEARLY START COUNT	121.0000
UNIT 30 MONTHLY RUN HOURS	58.7694
UNIT 30 YEARLY RUN HOURS	1182.332
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1427.842

UNIT 30 CURR DAY STRT GAS LOSS	0.0000
UNIT 30 CURR MONTH STRT GAS LOSS	46.0483
UNIT 30 CURR YEAR STRT GAS LOSS	1958.882
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	753.5375

Station	Units	Communications	Fire & Gas	Alarms / Events	Trend
Unit 27	Unit 28	Unit 29	Unit 30	Unit 31	
Engine Calcs	Trends	PID Screen	Process	Overview	Surge Map
					Diagnostics
					Parameters

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User: HMINING-H100804

Thursday, December 8, 2022

11:55:34 A.

### Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10172
BRAKE HORSEPOWER (CURVES)	13120
COMPRESSOR FLOW (CALC)	560

PT (LP) SPEED(0)	0003
PT (LP) SPEED(1)	0004
GP (HP) SPEED(0)	0478
GP (HP) SPEED(1)	0478
SUCTION PRESS	563
DISCHARGE PRESS	735
SUCTION TEMP	58
DISCHARGE TEMP	88
NOZZLE ANGLE	251
EXHAUST GAS TEMP AVG	806.72
AXIAL AIR COMP DIS PRESS	85.33
LUBE OIL PRESS	55.00
FUEL GAS PRESS	103.48
INTERSTAGE PRESSURE	14.51
BELLMOUTH PRESSURE	4.38
FUEL ORF PRIMARYDIFF	47.83
FUEL ORF SECONDARYDIFF	30.31
TURBINE #1 BRG DRN TEMP	126.74
TURBINE #2 BRG DRN TEMP	144.81
TURBINE #3 BRG DRN TEMP	157.08
TURBINE #4 BRG DRN TEMP	158.51
TURBINE #5 BRG DRN TEMP	138.45
SEAL OIL DIFF PRESS	54.05

AXIAL AIR COMPR DISCH TEMP	404.82
FUEL GAS TEMP	35.40
FUEL FLOW - MCF/H	111.20
VERARAR DIFF	32.22

WHEEL SPACE TEMP GP - FORWARD(0)	453.57
WHEEL SPACE TEMP GP - FORWARD(1)	462.00
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.05
WHEEL SPACE TEMPERATURE PT - AFT(1)	408.11
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	78.83
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	11.25
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.51
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10542.43
MIN HORSEPOWER AVAILABLE - AMB UPRATE	29208.37
BRAKE SPECIFIC FUEL CONS. - COMP BHP	8764.00

AMBIENT AIR TEMP	35.31
SHELL COOLING WATER TEMP-LEFT	101.57
SHELL COOLING WATER TEMP-RIGHT	114.23
FUEL ENERGY RATE (MTH/D)	2.76

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	144.03
GC DRV BRG DRN #1 TEMP	151.21
GC THR BRG DRN #2 TEMP	143.76
ACTUAL COMPRESSOR VOL (ACF/W)	8073.72
ADIABATIC EFFICIENCY % CURVES	71.87
ADIABATIC HEAD $\dot{h}$ -lbm/ft <sup>3</sup> CALCULATED	11254.90
ADIABATIC HEAD $\dot{h}$ -lbm/ft <sup>3</sup> CURVES	14000.23
GAS HORSEPOWER	8138.10
GAS ADIAB. CORRECTED w/ MEAS ADIAB. EFFICIEN	10172.63
BRAKE HORSEPOWER - CURVES	13129.39
MECHANICAL EFFICIENCY - CURVES	0.80
CALC. MEAS. COMPRESSOR FLOW RATIO	1.49
% OF RATED SPEED	100.05
% OF SPEED BETWEEN MIN / MAX	100.10
SURGE MARGIN- SURGE b STONEWALL	63.06
CURRENT DAY CALC PURGE b FLOW DOWNG VOL	0.06
VIBRATION GP BRG1 - VERTICAL	0.9011
VIBRATION GP BRG3 - HORIZONTAL	0.5113
VIBRATION GP BRG3 - VERTICAL	0.0458
VIBRATION GP BRG5 - HORIZONTAL	0.5600
VIBRATION CONVERT TURBINE VERTICAL	0.1300

### Curves Menu

UNIT 30 YEARLY START COUNT	121.0000
UNIT 30 MONTHLY RUN HOURS	57.0191
UNIT 30 YEARLY RUN HOURS	1182.582
UNIT 30 PREV MONTH RUN HOURS	0.9982
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1427.292

UNIT 30 CURR DAY STRT GAS LOSS	0.0000
UNIT 30 CURR MONTH STRT GAS LOSS	46.0483
UNIT 30 CURR YEAR STRT GAS LOSS	1956.862
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

◀	Station	Units	Communications	Fire & Gas	Alarms / Events	Trend			
Exit HMI	Unit 27	Unit 28	Unit 29	Unit 30	Unit 31				
Print	Engine Calcs	Trends	PID Screen	Process	Overview	Surge Map	Diagnostics	Parameters	

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## Unit 30 Performance

## Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10131
BRAKE HORSEPOWER (CURVES)	13069
COMPRESSOR FLOW (CALC)	552

PT (LP) SPEED(0)	6003
PT (LP) SPEED(1)	6003
GP (HP) SPEED(0)	6469
GP (HP) SPEED(1)	6489
SUCTION PRESS	583
DISCHARGE PRESS	735
SUCTION TEMP	58
DISCHARGE TEMP	98
NOZZLE ANGLE	2.58
EXHAUST GAS TEMP AVG	958.00
AXIAL AIR COMP DIS PRESS	84.00
LUBE OIL PRESS	55.15
FUEL GAS PRESS	183.32
INTERSTAGE PRESSURE	14.51
BELLMOUTH PRESSURE	4.19
FUEL ORF PRIMARY DIFF	47.89
FUEL ORF SECONDARY DIFF	38.31
TURBINE #1 BRG DRN TEMP	126.88
TURBINE #2 BRG DRN TEMP	144.70
TURBINE #3 BRG DRN TEMP	157.42
TURBINE #4 BRG DRN TEMP	150.54
TURBINE #5 BRG DRN TEMP	138.28
SEAL OIL DIFF PRESS	54.11

AXIAL AIR COMP DISCH TEMP	404.32
FUEL GAS TEMP	35.53
FUEL FLOW - MCF / H	111.25
WEABAR DIFF	31.40

WHEEL SPACE TEMP GP - FORWARD(0)	453.97
WHEEL SPACE TEMP GP - FORWARD(1)	462.94
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	98.85
WHEEL SPACE TEMPERATURE PT - AFT(1)	408.87
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	56.80
FIN FAN COOLING WATER TEMP OUT	78.98
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	11.50
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.51
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10627.10
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2927.18
BRAKE SPECIFIC FUEL CONS. - COMP BHP	8804.74

AMBIENT AIR TEMP	35.76
SHELL COOLING WATER TEMP LEFT	191.32
SHELL COOLING WATER TEMP RIGHT	113.94
FUEL ENERGY RATE MDT / D	2.76

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	144.89
GC DRV BRG DRN #1 TEMP	151.31
GC THR BRG DRN #2 TEMP	143.85
ACTUAL COMPRESSOR VOL (ACFW)	8940.58
ADIABATIC EFFICIENCY % CURVES	71.84
ADIABATIC HEAD 1-10m / FCALCULATED	11258.83
ADIABATIC HEAD 1-10m / FCURVES	13998.25
GAS HORSEPOWER	8195.06
GAS ADIAB. CORRECTED w/ MEAS ADIAB. EFFICN	10131.33
BRAKE HORSEPOWER - CURVES	13069.63
MECHANICAL EFFICIENCY - CURVES	0.88
CALC MEAS COMPRESSOR FLOW RATIO	1.49
% of RATED SPEED	100.06
% of SPEED BETWEEN MIN / MAX	100.11
SURGE MARGIN - SURGE to STONEMILL	62.46
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.08
VIBRATION GP BRG1 - VERTICAL	0.8704
VIBRATION GP BRG1 - HORIZONTAL	0.4994
VIBRATION GP BRG3 - VERTICAL	0.8842
VIBRATION GP BRG3 - HORIZONTAL	0.5294
VIBRATION POWER TURBINE - VERTICAL	0.1906

Curves Menu

UNIT 30 YEARLY START COUNT	121.0000
UNIT 30 MONTHLY RUN HOURS	57.2695
UNIT 30 YEARLY RUN HOURS	1192.832
UNIT 30 PREV MONTH RUN HOURS	0.8982
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1427.542

UNIT 30 CURR DAY STRT GAS LOSS	0.3090
UNIT 30 CURR MONTH STRT GAS LOSS	46.8483
UNIT 30 CURR YEAR STRT GAS LOSS	1958.082
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

## Unit 30 Performance

## Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10027
BRAKE HORSEPOWER (CURVES)	13018
COMPRESSOR FLOW (CALC)	550

PT (LP) SPEED(0)	5986
PT (LP) SPEED(1)	5887
GP (HP) SPEED(0)	6455
GP (HP) SPEED(1)	6455
SUCTION PRESS	563
DISCHARGE PRESS	735
SUCTION TEMP	58
DISCHARGE TEMP	98
NOZZLE ANGLE	2.58
EXHAUST GAS TEMP AVG	980.51
AXIAL AIR COMP DIS PRESS	64.55
LUBE OIL PRESS	55.00
FUEL GAS PRESS	162.38
INTERSTAGE PRESSURE	14.26
BELLMOUTH PRESSURE	1.86
FUEL ORF PRIMARY DIFF	47.67
FUEL ORF SECONDARY DIFF	38.31
TURBINE #1 BRG DRN TEMP	127.78
TURBINE #2 BRG DRN TEMP	145.18
TURBINE #3 BRG DRN TEMP	157.57
TURBINE #4 BRG DRN TEMP	151.08
TURBINE #5 BRG DRN TEMP	139.65
SEAL OIL DIFF PRESS	53.70

AXIAL AIR COMPR DISCH TEMP	404.22
FUEL GAS TEMP	35.33
FUEL FLOW - MCF / H	111.18
VERABAR DIFF	31.03

WHEEL SPACE TEMP GP - FORWARD(0)	455.24
WHEEL SPACE TEMP GP - FORWARD(1)	463.37
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.05
WHEEL SPACE TEMPERATURE PT - AFT(1)	409.81
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	80.11
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	11.75
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.26
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10517.59
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2926.41
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	8833.90

AMBIENT AIR TEMP	36.05
SHELL COOLING WATER TEMP-LEFT	102.86
SHELL COOLING WATER TEMP-RIGHT	115.24
FUEL ENERGY RATE MDTH / D	2.76

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.02
DISCHARGE COMPRESSIBILITY	0.02
GC IMP BRG DRN #2 TEMP	144.47
GC DRV BRG DRN #1 TEMP	151.58
GC THR BRG DRN #2 TEMP	143.93
ACTUAL COMPRESSOR VOL (ACF/H)	8895.95
ADIABATIC EFFICIENCY % CURVES	72.25
ADIABATIC HEAD 1-lbm/h <sup>1/2</sup> CALCULATED	11230.88
ADIABATIC HEAD 1-lbm/h <sup>1/2</sup> CURVES	14149.88
GAS HORSEPOWER	8021.85
GAS ADIAB CORRECTED w/ MEAS ADIAB EFFICN	10027.91
BRAKE HORSEPOWER - CURVES	13018.88
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.49
% of RATED SPEED	89.78
% of SPEED BETWEEN MIN / MAX	90.56
SURGE MARGIN - SURGE b STONEWALL	62.00
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.9112
VIBRATION GP BRG1 - HORIZONTAL	0.5138
VIBRATION GP BRG3 - VERTICAL	0.9591
VIBRATION GP BRG3 - HORIZONTAL	0.5362
VIBRATION POWER TURBINE - VERTICAL	0.1907

Curves Menu

UNIT 30 YEARLY START COUNT	121.8080
UNIT 30 MONTHLY RUN HOURS	57.5190
UNIT 30 YEARLY RUN HOURS	1193.882
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1427.791

UNIT 30 CURR DAY STRT GAS LOSS	0.8000
UNIT 30 CURR MONTH STRT GAS LOSS	46.0483
UNIT 30 CURR YEAR STRT GAS LOSS	1958.082
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	69.3243
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

Station	Units	Communications	Fire & Gas	Alarms / Events	Trend
Unit 27	Unit 28	Unit 29	Unit 30	Unit 31	
Engine Calcs	Trends	PID Screen	Process	Overview	Surge Map
					Diagnostics
					Parameters

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User:

HMINING4100884

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## Unit 30 Performance

## Active Control Mode

On Line

GAS HORSEPOWER (ABAD)	10245
BRAKE HORSEPOWER (CURVES)	12973
COMPRESSOR FLOW (CALC)	590

PT (LP) SPEED(0)	5997
PT (LP) SPEED(1)	5998
GP (HP) SPEED(0)	6491
GP (HP) SPEED(1)	6491
SUCTION PRESS	563
DISCHARGE PRESS	735
SUCTION TEMP	56
DISCHARGE TEMP	96
NOZZLE ANGLE	2.58
EXHAUST GAS TEMP AVG	957.20
AXIAL AIR COMP DIS PRESS	64.89
LUBE OIL PRESS	55.04
FUEL GAS PRESS	163.18
INTERSTAGE PRESSURE	14.36
BELLMOUTH PRESSURE	4.82
FUEL ORF PRIMARY DIFF	47.51
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	127.82
TURBINE #2 BRG DRN TEMP	145.96
TURBINE #3 BRG DRN TEMP	128.15
TURBINE #4 BRG DRN TEMP	151.46
TURBINE #5 BRG DRN TEMP	140.13
SEAL OIL DIFF PRESS	53.70

AXIAL AIR COMPR DISCH TEMP	467.53
FUEL GAS TEMP	35.34
FUEL FLOW - MCF / H	110.96
VERABAR DIFF	32.27

WHEEL SPACE TEMP GP - FORWARD(0)	458.08
WHEEL SPACE TEMP GP - FORWARD(1)	465.48
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	08.05
WHEEL SPACE TEMPERATURE PT - AFT(1)	410.77
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	81.12
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	0.00
TOTAL RUN HOURS (Current Day)	12.90
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.36
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10489.44
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2924.19
BRAKE SPECIFIC FUEL CONS - COMPR BHP	8785.44

AMBIENT AIR TEMP	36.90
SHELL COOLING WATER TEMP-LEFT	103.58
SHELL COOLING WATER TEMP-RIGHT	118.17
FUEL ENERGY RATE MDT / D	2.46

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	144.98
GC DRV BRG DRN #1 TEMP	151.93
GC THR BRG DRN #2 TEMP	144.21
ACTUAL COMPRESSOR VOL (ACFM)	9050.59
ADIABATIC EFFICIENCY % CURVES	71.18
ADIABATIC HEAD 1-hm/h(CALCULATED)	11229.48
ADIABATIC HEAD 1-hm/h(CURVES)	13690.67
GAS HORSEPOWER	8198.59
GAS ADIAB CORRECTED w MEAS ADIAB EFFICN	10245.74
BRAKE HORSEPOWER - CURVES	12973.39
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.51
% OF RATED SPEED	99.96
% OF SPEED BETWEEN MIN / MAX	99.93
SURGE MARGIN - SURGE b STONERWALL	64.82
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.9265
VIBRATION GP BRG1 - HORIZONTAL	0.5874
VIBRATION GP BRG3 - VERTICAL	0.8509
VIBRATION GP BRG3 - HORIZONTAL	0.5323
VIBRATION POWER TURBINE - VERTICAL	0.1907

Curves Menu

UNIT 30 YEARLY START COUNT	121.8000
UNIT 30 MONTHLY RUN HOURS	57.7689
UNIT 30 YEARLY RUN HOURS	1103.332
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1428.041

UNIT 30 CURR DAY STRT GAS LOSS	9.8000
UNIT 30 CURR MONTH STRT GAS LOSS	46.0483
UNIT 30 CURR YEAR STRT GAS LOSS	1958.082
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	68.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

Station	Units	Communications	Fire & Gas	Alarms / Events	Trend
Unit 27	Unit 28	Unit 29	Unit 30	Unit 31	
Engine Calcs	Trends	PID Screen	Process	Overview	Surge Map
					Diagnostics
					Parameters

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### Active Control Mode

OnLine

UNIT 30 CURR DAY STRT GAS LOSS	0.0000
UNIT 30 CURR MONTH STRT GAS LOSS	40.0483
UNIT 30 CURR YEAR STRT GAS LOSS	1056.062
UNIT 30 PREV DAY STRT GAS LOSS	24.3854
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	790.5305

### Curves Menu

TSP Name	ID	Date	BTU	CO2	N2	Gravity	Methane	Ethane	Propane	Ibutane	Nbutane	Ipentane	Npentane	C6	C7	H	Helium	Oxygen	H2O
Northern Natural Gas Company	9049	12/5/2022	1020.555	0.105	3.081	0.593	92.372	3.986	0.36	0.021	0.048	0.009	0.008	0.005	0.005	0	0		
Northern Natural Gas Company	9049	12/4/2022	1024.171	0.077	3.158	0.596	91.946	4.24	0.451	0.028	0.063	0.012	0.011	0.007	0.007	0	0		
Northern Natural Gas Company	9049	12/3/2022	1024.906	0.136	3.195	0.598	91.754	4.232	0.531	0.035	0.081	0.013	0.012	0.006	0.006	0	0		
Northern Natural Gas Company	9049	12/2/2022	1025.411	0.126	3.234	0.598	91.588	4.389	0.521	0.032	0.071	0.012	0.012	0.007	0.007	0	0		
Northern Natural Gas Company	9049	12/1/2022	1025.292	0.091	3.286	0.598	91.534	4.457	0.497	0.03	0.068	0.012	0.011	0.007	0.007	0	0		
Northern Natural Gas Company	9049	11/30/2022	1022.314	0.132	3.181	0.596	91.921	4.24	0.419	0.024	0.055	0.009	0.009	0.005	0.005	0	0		
Northern Natural Gas Company	9049	11/29/2022	1019.452	0.164	3.085	0.593	92.312	4.013	0.344	0.019	0.042	0.007	0.007	0.004	0.004	0	0		
Northern Natural Gas Company	9049	11/28/2022	1021.333	0.131	3.104	0.594	92.167	4.123	0.379	0.022	0.049	0.008	0.008	0.004	0.004	0	0		
Northern Natural Gas Company	9049	11/27/2022	1020.72	0.107	3.126	0.594	92.233	4.065	0.379	0.021	0.047	0.007	0.007	0.004	0.004	0	0		
Northern Natural Gas Company	9049	11/26/2022	1023.614	0.069	3.244	0.596	91.811	4.309	0.45	0.026	0.06	0.01	0.009	0.006	0.006	0	0		
Northern Natural Gas Company	9049	11/25/2022	1025.407	0.177	2.972	0.596	91.896	4.42	0.436	0.023	0.052	0.008	0.008	0.004	0.004	0	0		
Northern Natural Gas Company	9049	11/24/2022	1022.394	0.177	2.756	0.592	92.638	4.001	0.358	0.018	0.037	0.005	0.005	0.002	0.002	0	0		
Northern Natural Gas Company	9049	11/23/2022	1020.988	0.18	2.595	0.589	93.184	3.642	0.319	0.018	0.041	0.007	0.007	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/22/2022	1022.757	0.189	2.85	0.593	92.445	4.038	0.382	0.021	0.047	0.008	0.009	0.006	0.006	0	0		
Northern Natural Gas Company	9049	11/21/2022	1022.832	0.199	2.986	0.595	92.142	4.159	0.411	0.023	0.051	0.009	0.01	0.006	0.006	0	0		
Northern Natural Gas Company	9049	11/20/2022	1020.978	0.169	2.943	0.593	92.509	3.887	0.396	0.022	0.05	0.008	0.009	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/19/2022	1017.785	0.16	2.733	0.589	93.314	3.396	0.324	0.017	0.037	0.006	0.006	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/18/2022	1014.673	0.176	3.26	0.592	92.596	3.478	0.385	0.022	0.053	0.009	0.009	0.005	0.005	0	0		
Northern Natural Gas Company	9049	11/17/2022	1014.444	0.178	3.306	0.593	92.514	3.512	0.387	0.022	0.052	0.008	0.009	0.006	0.006	0	0		
Northern Natural Gas Company	9049	11/16/2022	1013.256	0.17	3.309	0.592	92.625	3.443	0.363	0.019	0.047	0.007	0.008	0.005	0.005	0	0		
Northern Natural Gas Company	9049	11/15/2022	1011.794	0.155	3.179	0.589	93.067	3.21	0.314	0.016	0.04	0.006	0.006	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/14/2022	1011.603	0.15	3.309	0.591	92.858	3.243	0.359	0.018	0.044	0.007	0.007	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/13/2022	1015.315	0.122	3.234	0.592	92.605	3.603	0.359	0.018	0.041	0.007	0.007	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/12/2022	1053.063	0.981	1.132	0.607	90.676	6.647	0.501	0.02	0.035	0.004	0.003	0.001	0.001	0	0		
Northern Natural Gas Company	9049	11/11/2022	1065.811	1.322	0.475	0.614	89.742	7.887	0.526	0.018	0.026	0.002	0.002	0	0	0	0		
Northern Natural Gas Company	9049	11/10/2022	1054.315	1.07	0.926	0.607	90.708	6.79	0.457	0.015	0.027	0.003	0.002	0	0	0	0		
Northern Natural Gas Company	9049	11/9/2022	1062.53	1.262	0.595	0.612	90.074	7.462	0.551	0.019	0.032	0.003	0.003	0	0	0	0		
Northern Natural Gas Company	9049	11/8/2022	1061.31	1.24	0.671	0.612	90.097	7.395	0.541	0.019	0.032	0.003	0.002	0	0	0	0		
Northern Natural Gas Company	9049	11/7/2022	1059.364	1.251	0.745	0.612	90.133	7.29	0.525	0.018	0.031	0.003	0.002	0.001	0.001	0	0		
Northern Natural Gas Company	9049	11/6/2022	1059.41	1.268	0.817	0.613	89.937	7.386	0.534	0.019	0.032	0.003	0.003	0.001	0.001	0	0		
Northern Natural Gas Company	9049	11/5/2022	1061.389	1.239	0.691	0.612	90.062	7.387	0.565	0.018	0.032	0.002	0.002	0	0	0	0		

TSP Name	ID	Date	BTU	CO2	N2	Gravity	Methane	Ethane	Propane	Ibutane	Nbutane	Ipentane	Npentane	C6	C7	H	Helium	Oxygen	H2O
Northern Natural Gas Company	9049	12/5/2022	1020.555	0.105	3.081	0.593	92.372	3.986	0.36	0.021	0.048	0.009	0.008	0.005	0.005	0	0		
Northern Natural Gas Company	9049	12/4/2022	1024.171	0.077	3.158	0.596	91.946	4.24	0.451	0.028	0.063	0.012	0.011	0.007	0.007	0	0		
Northern Natural Gas Company	9049	12/3/2022	1024.906	0.136	3.195	0.598	91.754	4.232	0.531	0.035	0.081	0.013	0.012	0.006	0.006	0	0		
Northern Natural Gas Company	9049	12/2/2022	1025.411	0.126	3.234	0.598	91.588	4.389	0.521	0.032	0.071	0.012	0.012	0.007	0.007	0	0		
Northern Natural Gas Company	9049	12/1/2022	1025.292	0.091	3.286	0.598	91.534	4.457	0.497	0.03	0.068	0.012	0.011	0.007	0.007	0	0		
Northern Natural Gas Company	9049	11/30/2022	1022.314	0.132	3.181	0.596	91.921	4.24	0.419	0.024	0.055	0.009	0.009	0.005	0.005	0	0		
Northern Natural Gas Company	9049	11/29/2022	1019.452	0.164	3.085	0.593	92.312	4.013	0.344	0.019	0.042	0.007	0.007	0.004	0.004	0	0		
Northern Natural Gas Company	9049	11/28/2022	1021.333	0.131	3.104	0.594	92.167	4.123	0.379	0.022	0.049	0.008	0.008	0.004	0.004	0	0		
Northern Natural Gas Company	9049	11/27/2022	1020.72	0.107	3.126	0.594	92.233	4.065	0.379	0.021	0.047	0.007	0.007	0.004	0.004	0	0		
Northern Natural Gas Company	9049	11/26/2022	1023.614	0.069	3.244	0.596	91.811	4.309	0.45	0.026	0.06	0.01	0.009	0.006	0.006	0	0		
Northern Natural Gas Company	9049	11/25/2022	1025.407	0.177	2.972	0.596	91.896	4.42	0.436	0.023	0.052	0.008	0.008	0.004	0.004	0	0		
Northern Natural Gas Company	9049	11/24/2022	1022.394	0.177	2.756	0.592	92.638	4.001	0.358	0.018	0.037	0.005	0.005	0.002	0.002	0	0		
Northern Natural Gas Company	9049	11/23/2022	1020.988	0.18	2.595	0.589	93.184	3.642	0.319	0.018	0.041	0.007	0.007	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/22/2022	1022.757	0.189	2.85	0.593	92.445	4.038	0.382	0.021	0.047	0.008	0.009	0.006	0.006	0	0		
Northern Natural Gas Company	9049	11/21/2022	1022.832	0.199	2.986	0.595	92.142	4.159	0.411	0.023	0.051	0.009	0.01	0.006	0.006	0	0		
Northern Natural Gas Company	9049	11/20/2022	1020.978	0.169	2.943	0.593	92.509	3.887	0.396	0.022	0.05	0.008	0.009	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/19/2022	1017.785	0.16	2.733	0.589	93.314	3.396	0.324	0.017	0.037	0.006	0.006	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/18/2022	1014.673	0.176	3.26	0.592	92.596	3.478	0.385	0.022	0.053	0.009	0.009	0.005	0.005	0	0		
Northern Natural Gas Company	9049	11/17/2022	1014.444	0.178	3.306	0.593	92.514	3.512	0.387	0.022	0.052	0.008	0.009	0.006	0.006	0	0		
Northern Natural Gas Company	9049	11/16/2022	1013.256	0.17	3.309	0.592	92.625	3.443	0.363	0.019	0.047	0.007	0.008	0.005	0.005	0	0		
Northern Natural Gas Company	9049	11/15/2022	1011.794	0.155	3.179	0.589	93.067	3.21	0.314	0.016	0.04	0.006	0.006	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/14/2022	1011.603	0.15	3.309	0.591	92.858	3.243	0.359	0.018	0.044	0.007	0.007	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/13/2022	1015.315	0.122	3.234	0.592	92.605	3.603	0.359	0.018	0.041	0.007	0.007	0.003	0.003	0	0		
Northern Natural Gas Company	9049	11/12/2022	1053.063	0.981	1.132	0.607	90.676	6.647	0.501	0.02	0.035	0.004	0.003	0.001	0.001	0	0		
Northern Natural Gas Company	9049	11/11/2022	1065.811	1.322	0.475	0.614	89.742	7.887	0.526	0.018	0.026	0.002	0.002	0	0	0	0		
Northern Natural Gas Company	9049	11/10/2022	1054.315	1.07	0.926	0.607	90.708	6.79	0.457	0.015	0.027	0.003	0.002	0	0	0	0		
Northern Natural Gas Company	9049	11/9/2022	1062.53	1.262	0.595	0.612	90.074	7.462	0.551	0.019	0.032	0.003	0.003	0	0	0	0		
Northern Natural Gas Company	9049	11/8/2022	1061.31	1.24	0.671	0.612	90.097	7.395	0.541	0.019	0.032	0.003	0.002	0	0	0	0		
Northern Natural Gas Company	9049	11/7/2022	1059.364	1.251	0.745	0.612	90.133	7.29	0.525	0.018	0.031	0.003	0.002	0.001	0.001	0	0		
Northern Natural Gas Company	9049	11/6/2022	1059.41	1.268	0.817	0.613	89.937	7.386	0.534	0.019	0.032	0.003	0.003	0.001	0.001	0	0		
Northern Natural Gas Company	9049	11/5/2022	1061.389	1.239	0.691	0.612	90.062	7.387	0.565	0.018	0.032	0.002	0.002	0	0	0	0		



## Clifton RTU Data

	B-Line	C-Line	D-Line	E-Line
Date				
Time				
BkFlo Current MMBTU Accumulator	0.000000	0.000000	0.000000	0.000000
BkFlo Current MMCFD Accumulator	0.000000	0.000000	0.000000	0.000000
BkFlo Prev. MMBTU Accumulator	0.000000	2447.04610	4588.61430	0.000000
BkFlo Prev. MMCFD Accumulator	0.000000	2495.81300	4664.53100	0.000000
Current MMBTU Accumulator	303.116730	8366.55500	9608.49400	47946.2660
Current MMCFD Accumulator	294.812440	8198.46400	9442.77400	47258.0400
Prev. MMBTU Accumulator	5834.99300	55793.7070	60965.4300	475024.160
Prev. MMCFD Accumulator	5667.39900	54669.9840	59963.4650	467933.720
Flowing Temp	50.427350	68.315020	69.254280	86.167940
Static Press	631.584300	647.546000	648.656900	766.554750
BkFlo MMBTU Rate	0.000000	0.000000	0.000000	0.000000
BkFlo MMCFD Rate	0.000000	0.000000	0.000000	0.000000
MMBTU Rate	2889.35910	205122.600	265239.060	530740.700
MMCFD Rate	2807.65800	201089.020	260233.030	522583.630
Quality Current BTU	1029.09940	1020.05870	1019.23676	1015.60910
Quality Current CO2 Factor	0.222797	0.124657	0.138559	0.151366
Quality Current Ethane	4.100759	3.885949	3.843017	3.462839
Quality Current H2O	0.837153	1.190945	1.110025	0.516385
Quality Current Hexane	0.023857	0.005393	0.003441	0.000000
Quality Current I-Butane	0.051043	0.020724	0.020166	0.012160
Quality Current I-Pentane	0.020487	0.008685	0.008236	0.004874
Quality Current Methane	91.902245	92.550080	92.595440	93.305760
Quality Current N-Butane	0.097430	0.045904	0.044415	0.025534
Quality Current N-Pentane	0.020983	0.008354	0.007768	0.004920
Quality Current N2 Factor	2.949668	3.002294	3.001083	2.803766
Quality Current Propene	0.586877	0.342568	0.334434	0.224755
Quality Current Specific Gravity	0.599105	0.592277	0.591963	0.587758





Unit 30 Performance

Active Control Mode  
OnLine

GAS HORSEPOWER (ABAD)	4784
BRAKE HORSEPOWER (CURVES)	5792
COMPRESSOR FLOW (CALC)	467

PT (LP) SPEED(0)	4628
PT (LP) SPEED(1)	4629
GP (HP) SPEED(0)	5885
GP (HP) SPEED(1)	5885
SUCTION PRESS	565
DISCHARGE PRESS	857
SUCTION TEMP	52
DISCHARGE TEMP	75
NOZZLE ANGLE	235
EXHAUST GAS TEMP AVG	869.77
AXIAL AIR COMP DIS PRESS	43.43
LUBE OIL PRESS	54.84
FUEL GAS PRESS	167.52
INTERSTAGE PRESSURE	8.71
BELLMOUTH PRESSURE	2.98
FUEL ORF PRIMARY DIFF	21.19
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	115.19
TURBINE #2 BRG DRN TEMP	125.14
TURBINE #3 BRG DRN TEMP	130.50
TURBINE #4 BRG DRN TEMP	124.68
TURBINE #5 BRG DRN TEMP	117.51
SEAL OIL DIFF PRESS	46.10

AXIAL AIR COMPR DISCH TEMP	340.76
FUEL GAS TEMP	4368
FUEL FLOW - MCF / H	74.46
VERABAR DIFF	22.08

WHEEL SPACE TEMP GP - FORWARD(0)	358.71
WHEEL SPACE TEMP GP - FORWARD(1)	394.84
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.05
WHEEL SPACE TEMPERATURE PT - AFT(1)	329.05
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	76.89
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	1.01
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	8.71
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10276.81
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2913.82
BRAKE SPECIFIC FUEL CONS - COMPR BHP	13243.49

AMBIENT AIR TEMP	42.90
SHELL COOLING WATER TEMP LEFT	92.40
SHELL COOLING WATER TEMP RIGHT	100.44
FUEL ENERGY RATE MDTH / D	1.84

TOTAL OP COSTS 0.00

SUCTION COMPRESSIBILITY	0.91
DISCHARGE COMPRESSIBILITY	0.92
GC INP BRG DRN #2 TEMP	121.30
GC DRV BRG DRN #1 TEMP	129.40
GC THR BRG DRN #2 TEMP	124.71
ACTUAL COMPRESSOR VOL (ACFM)	7425.80
ADIABATIC EFFICIENCY % CURVES	69.00
ADIABATIC HEAD 1-bm/b/CALCULATED	6237.00
ADIABATIC HEAD 1-bm/b/CURVES	7138.74
GAS HORSEPOWER	3827.81
GAS ADIAB CORRECTED w/MEAS ADIAB EFFICHL	4784.77
BRAKE HORSEPOWER - CURVES	5792.91
MECHANICAL EFFICIENCY - CURVES	0.80
CALC AHBAS COMPRESSOR FLOW RATIO	1.60
% of RATED SPEED	77.15
% of SPEED BETWEEN MIN / MAX	54.30
SURGE MARGIN - SURGE b STONEWALL	75.01
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY GP BRG1 - VERTICAL	0.5756
VELOCITY GP BRG1 - HORIZONTAL	0.3839
VELOCITY GP BRG3 - VERTICAL	0.8532
VELOCITY GP BRG3 - HORIZONTAL	0.6126
VELOCITY POWER TURBINE - VERTICAL	0.0636

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	1.0055
UNIT 30 YEARLY RUN HOURS	1136.568
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1371.162

UNIT 30 CURR DAY STRT GAS LOSS	21.8629
UNIT 30 CURR MONTH STRT GAS LOSS	21.8629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.687
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	89.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

# Unit 30 Performance

## Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	8011
BRAKE HORSEPOWER (CURVES)	9757
COMPRESSOR FLOW (CALC)	561

PT (LP) SPEED(0)	5439
PT (LP) SPEED(1)	5438
GP (HP) SPEED(0)	6090
GP (HP) SPEED(1)	6090
SUCTION PRESS	553
DISCHARGE PRESS	673
SUCTION TEMP	58
DISCHARGE TEMP	90
NOZZLE ANGLE	3.45
EXHAUST GAS TEMP AVG	943.65
AXIAL AIR COMP DIS PRESS	54.46
LUBE OIL PRESS	54.32
FUEL GAS PRESS	166.36
INTERSTAGE PRESSURE	12.15
BELLMOUTH PRESSURE	3.52
FUEL ORF PRIMARY DIFF	34.30
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	119.60
TURBINE #2 BRG DRN TEMP	133.18
TURBINE #3 BRG DRN TEMP	139.87
TURBINE #4 BRG DRN TEMP	132.17
TURBINE #5 BRG DRN TEMP	125.92
SEAL OIL DIFF PRESS	53.12

AXIAL AIR COMP DISCH TEMP	386.77
FUEL GAS TEMP	43.38
FUEL FLOW - MCF / H	95.42
VERABAR DIFF	33.11

WHEEL SPACE TEMP GP - FORWARD(0)	423.18
WHEEL SPACE TEMP GP - FORWARD(1)	432.20
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	390.80
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	78.60
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	1.23
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	12.15
MAX HORSEPOWER AVAILABLE - AMB UPRATE	18247.12
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2912.97
BRAKE SPECIFIC FUEL CONS - COMPR BHP	18086.92

AMBIENT AIR TEMP	43.68
SHELL COOLING WATER TEMP-LEFT	99.04
SHELL COOLING WATER TEMP-RIGHT	109.17
FUEL ENERGY RATE MDT / D	2.36

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	131.12
GC DRY BRG DRN #1 TEMP	137.83
GC THR BRG DRN #2 TEMP	134.68
ACTUAL COMPRESSOR VOL (ACFM)	9279.52
ADIABATIC EFFICIENCY % CURVES	69.00
ADIABATIC HEAD 1-bm/b/cALCULATED	8296.36
ADIABATIC HEAD 1-bm/b/cCURVES	9862.22
GAS HORSEPOWER	6408.95
GAS ADIAB.CORRECTED w/MEAS.ADIAB.EFFICIEN	8011.19
BRAKE HORSEPOWER - CURVES	9757.24
MECHANICAL EFFICIENCY - CURVES	0.80
CALC./MEAS COMPRESSOR FLOW RATIO	1.71
% RATED SPEED	90.65
% of SPEED BETWEEN MIN / MAX	81.31
SURGE MARGIN - SURGE to STONERWALL	86.12
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY OF BRG1 - VERTICAL	0.4970
VELOCITY OF BRG1 - HORIZONTAL	0.4695
VELOCITY OF BRG3 - VERTICAL	0.3009
VELOCITY OF BRG3 - HORIZONTAL	0.6689
VELOCITY OF POWER TURBINE - VERTICAL	0.1180

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	1.2332
UNIT 30 YEARLY RUN HOURS	1136.796
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1371.389

UNIT 30 CURR DAY STRT GAS LOSS	21.8629
UNIT 30 CURR MONTH STRT GAS LOSS	21.8629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.687
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	89.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5305



Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	5216
BRAKE HORSEPOWER (CURVES)	6716
COMPRESSOR FLOW (CALC)	442

PT (LP) SPEED(0)	4830
PT (LP) SPEED(1)	4830
GP (HP) SPEED(0)	5653
GP (HP) SPEED(1)	5653
SUCTION PRESS	565
DISCHARGE PRESS	670
SUCTION TEMP	62
DISCHARGE TEMP	89
NOZZLE ANGLE	-3.75
EXHAUST GAS TEMP AVG	526.52
AXIAL AIR COMP DIS PRESS	42.84
LUBE OIL PRESS	54.53
FUEL GAS PRESS	168.86
INTERSTAGE PRESSURE	9.11
BELLMOUTH PRESSURE	2.58
FUEL ORF PRIMARY DIFF	21.86
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	121.33
TURBINE #2 BRG DRN TEMP	131.36
TURBINE #3 BRG DRN TEMP	140.11
TURBINE #4 BRG DRN TEMP	132.75
TURBINE #5 BRG DRN TEMP	124.88
SEAL OIL DIFF PRESS	48.37

AXIAL AIR COMP DISCH TEMP	146.20
FUEL GAS TEMP	44.55
FUEL FLOW - MCF / H	75.75
VERABAR DIFF	20.34

WHEEL SPACE TEMP GP - FORWARD(0)	396.54
WHEEL SPACE TEMP GP - FORWARD(1)	405.53
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.05
WHEEL SPACE TEMPERATURE PT - AFT(1)	364.23
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	78.87
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	1.48
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	9.11
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10195.24
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2911.82
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	11626.38

AMBIENT AIR TEMP	45.05
SHELL COOLING WATER TEMP-LEFT	96.50
SHELL COOLING WATER TEMP-RIGHT	105.55
FUEL ENERGY RATE MOTH / D	1.88

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	129.10
GC DRV BRG DRN #1 TEMP	138.96
GC THR BRG DRN #2 TEMP	133.51
ACTUAL COMPRESSOR VOL (ACFV)	7221.54
ADIABATIC EFFICIENCY % CURVES	71.55
ADIABATIC HEAD 1-8mmID CALCULATED	7256.09
ADIABATIC HEAD 1-8mmID CURVES	8955.81
GAS HORSEPOWER	4172.99
GAS ADIAB CORRECTED w/WEAS ADIAB EFFICN	5216.23
BRAKE HORSEPOWER - CURVES	6716.82
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.50
% of RATED SPEED	80.52
% of SPEED BETWEEN MIN / MAX	61.03
SURGE MARGIN - SURGE to SLOWDOWN	63.12
CURRENT DAY CALC PURGE / SLOWDOWN VOL	0.00
VELOCITY OF BRG1 - VERTICAL	0.4333
VELOCITY OF BRG1 - HORIZONTAL	0.4300
VELOCITY OF BRG3 - VERTICAL	0.7934
VELOCITY OF BRG3 - HORIZONTAL	0.5896
VELOCITY OF POWER TURBINE - VERTICAL	0.0408

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	1.4812
UNIT 30 YEARLY RUN HOURS	1137.844
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1371.637

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.697
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

Curves Menu

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	7109
BRAKE HORSEPOWER (CURVES)	8351
COMPRESSOR FLOW (CALC)	505

PT (LP) SPEED(0)	5309
PT (LP) SPEED(1)	5310
GP (HP) SPEED(0)	6432
GP (HP) SPEED(1)	6432
SUCTION PRESS	559
DISCHARGE PRESS	682
SUCTION TEMP	62
DISCHARGE TEMP	94
NOZZLE ANGLE	0.05
EXHAUST GAS TEMP AVG	347.45
AXIAL AIR COMP DIS PRESS	58.11
LUBE OIL PRESS	54.87
FUEL GAS PRESS	170.58
INTERSTAGE PRESSURE	10.68
BELLMOUTH PRESSURE	5.13
FUEL ORF PRIMARY DIFF	29.19
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	117.54
TURBINE #2 BRG DRN TEMP	128.93
TURBINE #3 BRG DRN TEMP	138.92
TURBINE #4 BRG DRN TEMP	129.24
TURBINE #5 BRG DRN TEMP	121.87
SEAL OIL DIFF PRESS	52.81

AXIAL AIR COMP DISCH TEMP	401.01
FUEL GAS TEMP	43.99
FUEL FLOW - NCF / H	88.23
VERABAR DIFF	26.87

WHEEL SPACE TEMP GP - FORWARD(0)	428.36
WHEEL SPACE TEMP GP - FORWARD(1)	437.40
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	380.54
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	83.33
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	1.73
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	10.68
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10196.64
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2911.16
BRAKE SPECIFIC FUEL CONS. - COMP BHP	16913.40

AMBIENT AIR TEMP	45.92
SHELL COOLING WATER TEMP-LEFT	103.89
SHELL COOLING WATER TEMP-RIGHT	114.48
FUEL ENERGY RATE MOTH / D	2.19

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	126.44
GC DRV BRG DRN #1 TEMP	141.21
GC THR BRG DRN #2 TEMP	134.79
ACTUAL COMPRESSOR VOL (ACFW)	8362.56
ADIABATIC EFFICIENCY % CURVES	69.00
ADIABATIC HEAD 1-bm/b(CALCULATED)	8482.65
ADIABATIC HEAD 1-bm/b(CURVES)	9400.21
GAS HORSEPOWER	5687.80
GAS ADIAB CORRECTED w MEAS ADIAB EFFICN	7109.75
BRAKE HORSEPOWER - CURVES	8351.26
MECHANICAL EFFICIENCY - CURVES	0.89
CALC MEAS COMPRESSOR FLOW RATIO	1.57
% of RATED SPEED	88.50
% of SPEED BETWEEN MIN / MAX	77.00
SURGE MARGIN - SURGE b STONEWALL	71.80
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY OF BRG1 - VERTICAL	0.5634
VELOCITY OF BRG1 - HORIZONTAL	0.4797
VELOCITY OF BRG3 - VERTICAL	0.8917
VELOCITY OF BRG3 - HORIZONTAL	0.6348
VELOCITY OF POWER TURBINE - VERTICAL	0.0999

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	17323
UNIT 30 YEARLY RUN HOURS	1137.295
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1371.888

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.697
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	68.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375



### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	5276
BRAKE HORSEPOWER (CURVES)	7137
COMPRESSOR FLOW (CALC)	425

PT (LP) SPEED(0)	4916
PT (LP) SPEED(1)	4916
GP (HP) SPEED(0)	5752
GP (HP) SPEED(1)	5753
SUCTION PRESS	568
DISCHARGE PRESS	880
SUCTION TEMP	65
DISCHARGE TEMP	93
NOZZLE ANGLE	2.77
EXHAUST GAS TEMP AVG	946.35
AXIAL AIR COMP DIS PRESS	44.62
LUBE OIL PRESS	54.17
FUEL GAS PRESS	171.93
INTERSTAGE PRESSURE	830
BELLMOUTH PRESSURE	230
FUEL ORF PRIMARY DIFF	22.18
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	114.61
TURBINE #2 BRG DRN TEMP	122.47
TURBINE #3 BRG DRN TEMP	133.96
TURBINE #4 BRG DRN TEMP	126.50
TURBINE #5 BRG DRN TEMP	136.89
SEAL OIL DIFF PRESS	50.50

AXIAL AIR COMP DISCH TEMP	351.12
FUEL GAS TEMP	44.45
FUEL FLOW - MCF / H	77.04
VERABAR DIFF	18.01

WHEEL SPACE TEMP GP - FORWARD(0)	401.25
WHEEL SPACE TEMP GP - FORWARD(1)	410.23
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	384.20
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	83.44
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	1.98
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	8.90
MAX HORSEPOWER AVAILABLE - AIR UP RATE	10114.73
MIN HORSEPOWER AVAILABLE - AIR UP RATE	2910.04
BRAKE SPECIFIC FUEL CONS - COMPR BHP	11161.71

AMBIENT AIR TEMP	47.18
SHELL COOLING WATER TEMP-LEFT	103.16
SHELL COOLING WATER TEMP-RIGHT	113.34
FUEL ENERGY RATE MDTN / D	1.91

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	121.58
GC DRY BRG DRN #1 TEMP	138.48
GC THR BRG DRN #2 TEMP	129.75
ACTUAL COMPRESSOR VOL (ACFM)	6851.56
ADIABATIC EFFICIENCY % CURVES	74.51
ADIABATIC HEAD 1-1000 BTU / CAL	7742.10
ADIABATIC HEAD 1-1000 BTU / CURVES	10350.85
GAS HORSEPOWER	4220.91
GAS ADIAB CORRECTED w MEAS ADIAB EFFICI	5276.13
BRAKE HORSEPOWER - CURVES	7137.89
MECHANICAL EFFICIENCY - CURVES	0.80
CALC / MEAS COMPRESSOR FLOW RATIO	1.41
% of RATED SPEED	81.94
% of SPEED BETWEEN MIN / MAX	63.88
SURGE MARGIN - SURGE to STONERWALL	54.27
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY GP BRG1 - VERTICAL	0.4332
VELOCITY GP BRG1 - HORIZONTAL	0.3941
VELOCITY GP BRG3 - VERTICAL	0.8394
VELOCITY GP BRG3 - HORIZONTAL	0.5519
VELOCITY POWER TURBINE - VERTICAL	0.0638

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	1.9814
UNIT 30 YEARLY RUN HOURS	1137.544
UNIT 30 PREV MONTH RUN HOURS	0.9862
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1372.138

UNIT 30 CUR DAY STRT GAS LOSS	21.8629
UNIT 30 CUR MONTH STRT GAS LOSS	21.8629
UNIT 30 CUR YEAR STRT GAS LOSS	1933.697
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375





## Unit 30 Performance

### Active Control Mode

Online

GAS HORSEPOWER (ABAD)	4193
BRAKE HORSEPOWER (CURVES)	5851
COMPRESSOR FLOW (CALC)	387

PT (LP) SPEED(0)	4590
PT (LP) SPEED(1)	4590
GP (HP) SPEED(0)	5682
GP (HP) SPEED(1)	5682
SUCTION PRESS	579
DISCHARGE PRESS	680
SUCTION TEMP	67
DISCHARGE TEMP	92
NOZZLE ANGLE	-2.13
EXHAUST GAS TEMP AVG	841.34
AXIAL AIR COMP DIS PRESS	41.98
LUBE OIL PRESS	54.45
FUEL GAS PRESS	988.75
INTERSTAGE PRESSURE	7.60
BELLMOUTH PRESSURE	2.25
FUEL ORF PRIMARY DIFF	17.75
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	119.00
TURBINE #2 BRG DRN TEMP	128.39
TURBINE #3 BRG DRN TEMP	137.91
TURBINE #4 BRG DRN TEMP	131.72
TURBINE #5 BRG DRN TEMP	122.33
SEAL OIL DIFF PRESS	47.34

AXIAL AIR COMP DISCH TEMP	343.12
FUEL GAS TEMP	44.15
FUEL FLOW - MCF / H	98.45
VERABAR DIFF	15.42

WHEEL SPACE TEMP GP - FORWARD(0)	375.29
WHEEL SPACE TEMP GP - FORWARD(1)	383.15
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.85
WHEEL SPACE TEMPERATURE PT - AFT(1)	358.81
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	79.99
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	2.48
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	7.60
MAX HORSEPOWER AVAILABLE - AIRB UPRATE	10066.79
MIN HORSEPOWER AVAILABLE - AIRB UPRATE	2908.97
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	12078.79

AMBIENT AIR TEMP	48.46
SHELL COOLING WATER TEMP-LEFT	96.95
SHELL COOLING WATER TEMP-RIGHT	106.07
FUEL ENERGY RATE MDTH / D	1.70

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	125.24
GC DRV BRG DRN #1 TEMP	137.74
GC THR BRG DRN #2 TEMP	130.31
ACTUAL COMPRESSOR VOL (ACF/H)	6216.09
ADIABATIC EFFICIENCY % CURVES	76.21
ADIABATIC HEAD 1-bm/hf/CALCULATED	6898.27
ADIABATIC HEAD 1-bm/hf/CURVES	9548.92
GAS HORSEPOWER	3355.10
GAS ADIAB CORRECTED w/HEAS ADIAB EFFICIEN	4193.87
BRAKE HORSEPOWER - CURVES	5851.50
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.35
% OF RATED SPEED	76.51
% OF SPEED BETWEEN MIN / MAX	53.01
SURGE MARGIN - SURGE to STONEWALL	47.68
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY OF BRG1 - VERTICAL	0.6230
VELOCITY OF BRG1 - HORIZONTAL	0.3833
VELOCITY OF BRG3 - VERTICAL	0.7640
VELOCITY OF BRG3 - HORIZONTAL	0.4817
VELOCITY OF POWER TURBINE - VERTICAL	0.9772

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	2.4821
UNIT 30 YEARLY RUN HOURS	1138.045
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1372.638

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.697
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375







## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	4826
BRAKE HORSEPOWER (CURVES)	6739
COMPRESSOR FLOW (CALC)	416

PT (LP) SPEED(0)	4766
PT (LP) SPEED(1)	4766
GP (HP) SPEED(0)	5887
GP (HP) SPEED(1)	5887
SUCTION PRESS	581
DISCHARGE PRESS	690
SUCTION TEMP	68
DISCHARGE TEMP	94
NOZZLE ANGLE	-3.41
EXHAUST GAS TEMP AVG	594.64
AXIAL AIR COMP DIS PRESS	42.88
LUBE OIL PRESS	54.05
FUEL GAS PRESS	168.21
INTERSTAGE PRESSURE	8.82
BELLMOUTH PRESSURE	3.22
FUEL ORF PRIMARY DIFF	21.12
FUEL ORF SECONDARY DIFF	38.31
TURBINE #1 BRG DRN TEMP	123.32
TURBINE #2 BRG DRN TEMP	132.82
TURBINE #3 BRG DRN TEMP	142.42
TURBINE #4 BRG DRN TEMP	136.76
TURBINE #5 BRG DRN TEMP	127.53
SEAL OIL DIFF PRESS	47.56

AXIAL AIR COMP DISCH TEMP	348.47
FUEL GAS TEMP	43.91
FUEL FLOW - MCF / H	74.58
VERABAR DIFF	17.78

WHEEL SPACE TEMP GP - FORWARD(0)	385.08
WHEEL SPACE TEMP GP - FORWARD(1)	382.36
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	371.42
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	81.88
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	3.23
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	8.82
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10037.92
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2908.34
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	11431.53

AMBIENT AIR TEMP	49.23
SHELL COOLING WATER TEMP-LEFT	99.61
SHELL COOLING WATER TEMP-RIGHT	109.09
FUEL ENERGY RATE MOTH / D	1.85

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.92
GC IMP BRG DRN #2 TEMP	130.78
GC DRV BRG DRN #1 TEMP	141.97
GC THR BRG DRN #2 TEMP	134.89
ACTUAL COMPRESSOR VOL (ACFM)	6653.66
ADIABATIC EFFICIENCY % CURVES	75.75
ADIABATIC HEAD 1-100% CURVED	7420.32
ADIABATIC HEAD 1-100% CURVED	10215.39
GAS HORSEPOWER	3861.47
GAS ADIAB CORRECTED w/ MEAS ADIAB EFFICH	4826.83
BRAKE HORSEPOWER - CURVES	6739.80
MECHANICAL EFFICIENCY CURVES	0.80
CALC / MEAS COMPRESSOR FLOW RATIO	1.39
% of RATED SPEED	79.78
% of SPEED BETWEEN MIN / MAX	59.56
SURGE MARGIN - SURGE to STONEMAN	51.65
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY GP BRG1 - VERTICAL	0.6773
VELOCITY GP BRG1 - HORIZONTAL	0.3827
VELOCITY GP BRG3 - VERTICAL	0.7959
VELOCITY GP BRG3 - HORIZONTAL	0.4532
VELOCITY POWER TURBINE - VERTICAL	0.0408

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	3.2323
UNIT 30 YEARLY RUN HOURS	1138.795
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1373.388

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.697
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375











## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10044
BRAKE HORSEPOWER (CURVES)	12203
COMPRESSOR FLOW (CALC)	589

PT (LP) SPEED(0)	5963
PT (LP) SPEED(1)	5962
GP (HP) SPEED(0)	6797
GP (HP) SPEED(1)	6797
SUCTION PRESS	564
DISCHARGE PRESS	718
SUCTION TEMP	66
DISCHARGE TEMP	105
NOZZLE ANGLE	-1.04
EXHAUST GAS TEMP AVG	558.09
AXIAL AIR COMP DIS PRESS	67.46
LUBE OIL PRESS	55.13
FUEL GAS PRESS	188.11
INTERSTAGE PRESSURE	13.52
BELLMOUTH PRESSURE	5.50
FUEL ORF PRIMARY DIFF	49.19
FUEL ORF SECONDARY DIFF	30.31
TURBINE #1 BRG DRN TEMP	129.84
TURBINE #2 BRG DRN TEMP	145.58
TURBINE #3 BRG DRN TEMP	156.61
TURBINE #4 BRG DRN TEMP	149.36
TURBINE #5 BRG DRN TEMP	139.29
SEAL OIL DIFF PRESS	53.73

AXIAL AIR COMP DISCH TEMP	439.94
FUEL GAS TEMP	41.89
FUEL FLOW - MCF / H	113.62
VERABAR DIFF	30.47

WHEEL SPACE TEMP GP - FORWARD(0)	472.95
WHEEL SPACE TEMP GP - FORWARD(1)	473.55
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	420.74
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	87.12
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	4.23
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	13.52
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10001.62
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2807.53
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	9603.83

AMBIENT AIR TEMP	50.19
SHELL COOLING WATER TEMP-LEFT	109.07
SHELL COOLING WATER TEMP-RIGHT	120.95
FUEL ENERGY RATE MDT / D	2.81

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.93
GC IMP BRG DRN #2 TEMP	143.66
GC DRY BRG DRN #1 TEMP	151.90
GC THR BRG DRN #2 TEMP	144.36
ACTUAL COMPRESSOR VOL (ACFM)	9708.17
ADIABATIC EFFICIENCY % CURVES	69.00
ADIABATIC HEAD 1-10000/CALCULATED	10503.26
ADIABATIC HEAD 1-10000/CURVES	11853.13
GAS HORSEPOWER	8035.60
GAS ADIAB CORRECTED w MEAS ADIAB EFFICI	10044.50
BRAKE HORSEPOWER - CURVES	12203.48
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.63
% of RATED SPEED	99.39
% of SPEED BETWEEN MIN / MAX	98.78
SURGE MARGIN- SURGE b STONEWALL	77.60
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY GP BRG1 - VERTICAL	0.8102
VELOCITY GP BRG1 - HORIZONTAL	0.5651
VELOCITY GP BRG3 - VERTICAL	0.9900
VELOCITY GP BRG3 - HORIZONTAL	0.5492
VELOCITY POWER TURBINE - VERTICAL	0.1316

Curves Menu

UNIT 30 YEARLY START COUNT	128.0000
UNIT 30 MONTHLY RUN HOURS	4.2310
UNIT 30 YEARLY RUN HOURS	1138.794
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1374.387

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.697
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	68.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375



## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10115
BRAKE HORSEPOWER (CURVES)	11892
COMPRESSOR FLOW (CALC)	561

PT (LP) SPEED(0)	8008
PT (LP) SPEED(1)	8008
GP (HP) SPEED(0)	6747
GP (HP) SPEED(1)	6747
SUCTION PRESS	561
DISCHARGE PRESS	725
SUCTION TEMP	68
DISCHARGE TEMP	108
NOZZLE ANGLE	-1.33
EXHAUST GAS TEMP AVG	951.92
AXIAL AIR COMP DIS PRESS	66.01
LUBE OIL PRESS	54.75
FUEL GAS PRESS	196.71
INTERSTAGE PRESSURE	13.43
BELLMOUTH PRESSURE	5.42
FUEL ORF PRIMARY DIFF	47.32
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	130.82
TURBINE #2 BRG DRN TEMP	146.25
TURBINE #3 BRG DRN TEMP	158.51
TURBINE #4 BRG DRN TEMP	150.39
TURBINE #5 BRG DRN TEMP	140.31
SEAL OIL DIFF PRESS	53.68

AXIAL AIR COMPR DISCH TEMP	437.66
FUEL GAS TEMP	41.57
FUEL FLOW - MCF / H	111.51
VERABAR DIFF	33.38

WHEEL SPACE TEMP GP - FORWARD(0)	490.81
WHEEL SPACE TEMP GP - FORWARD(1)	492.02
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	429.68
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	89.52
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	4.48
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	13.43
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10021.66
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2907.98
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	9648.48

AMBIENT AIR TEMP	49.66
SHELL COOLING WATER TEMP-LEFT	112.01
SHELL COOLING WATER TEMP-RIGHT	124.32
FUEL ENERGY RATE MOTH / D	2.75

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.93
GC IMP BRG DRN #2 TEMP	145.05
GC DRV BRG DRN #1 TEMP	154.26
GC THR BRG DRN #2 TEMP	146.07
ACTUAL COMPRESSOR VOL (ACFM)	9396.32
ADIABATIC EFFICIENCY % CURVES	69.00
ADIABATIC HEAD 1-hm/101-CALCULATED	11126.12
ADIABATIC HEAD 1-hm/101-CURVES	12042.12
GAS HORSEPOWER	8092.58
GAS ADIAB CORRECTED w/MEAS ADIAB EFFICN	10115.72
BRAKE HORSEPOWER - CURVES	11892.98
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.56
% of RATED SPEED	100.16
% of SPEED BETWEEN MIN / MAX	100.33
SURGE MARGIN - SURGE b STONEWALL	70.55
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY OF BRG1 - VERTICAL	0.6184
VELOCITY OF BRG1 - HORIZONTAL	0.5374
VELOCITY OF BRG3 - VERTICAL	0.7129
VELOCITY OF BRG3 - HORIZONTAL	0.4609
VELOCITY OF POWER TURBINE - VERTICAL	0.1317

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	4.4814
UNIT 30 YEARLY RUN HOURS	1148.944
UNIT 30 PREVIOUS MONTH RUN HOURS	0.9992
UNIT 30 PREVIOUS YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1374.638

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.687
UNIT 30 PREVIOUS DAY STRT GAS LOSS	0.0000
UNIT 30 PREVIOUS MONTH STRT GAS LOSS	69.3743
UNIT 30 PREVIOUS YEAR STRT GAS LOSS	793.5375

## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	9885
BRAKE HORSEPOWER (CURVES)	12396
COMPRESSOR FLOW (CALC)	545

PT (LP) SPEED(0)	8001
PT (LP) SPEED(1)	8000
GP (HP) SPEED(0)	8627
GP (HP) SPEED(1)	8628
SUCTION PRESS	563
DISCHARGE PRESS	729
SUCTION TEMP	69
DISCHARGE TEMP	110
NOZZLE ANGLE	-197
EXHAUST GAS TEMP AVG	957.35
AXIAL AIR COMP DIS PRESS	64.54
LUBE OIL PRESS	54.54
FUEL GAS PRESS	196.64
INTERSTAGE PRESSURE	13.52
BELLMOUTH PRESSURE	4.31
FUEL ORF PRIMARY DIFF	45.89
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	130.41
TURBINE #2 BRG DRN TEMP	145.02
TURBINE #3 BRG DRN TEMP	158.98
TURBINE #4 BRG DRN TEMP	150.06
TURBINE #5 BRG DRN TEMP	139.86
SEAL OIL DIFF PRESS	53.72

AXIAL AIR COMPR DISCH TEMP	430.10
FUEL GAS TEMP	41.42
FUEL FLOW - WCF / H	109.87
VERABAR DIFF	31.55

WHEEL SPACE TEMP GP - FORWARD(0)	485.07
WHEEL SPACE TEMP GP - FORWARD(1)	489.56
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	430.20
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	90.67
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	4.73
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	13.52
MAX HORSEPOWER AVAILABLE - AHB UPRATE	19022.26
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2907.99
BRAKE SPECIFIC FUEL CONS - COMPR BHP	9113.81

AMBIENT AIR TEMP	49.64
SHELL COOLING WATER TEMP-LEFT	113.20
SHELL COOLING WATER TEMP-RIGHT	125.68
FUEL ENERGY RATE MOTH / D	2.71

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.93
GC IMP BRG DRN #2 TEMP	144.61
GC DRV BRG DRN #1 TEMP	154.73
GC THR BRG DRN #2 TEMP	145.88
ACTUAL COMPRESSOR VOL (ACFM)	9083.94
ADIABATIC EFFICIENCY % CURVES	70.76
ADIABATIC HEAD 1-6mmID CALCULATED	11332.79
ADIABATIC HEAD 1-6mmID CURVES	13326.45
GAS HORSEPOWER	7900.35
GAS ADIAB CORRECTED w MEAS ADIAB EFFICIEN	9885.44
BRAKE HORSEPOWER - CURVES	12396.77
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.51
% of RATED SPEED	100.01
% of SPEED BETWEEN MIN / MAX	100.02
SURGE MARGIN - SURGE b STONEWALL	65.17
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY OF BRG1 - VERTICAL	0.6961
VELOCITY OF BRG1 - HORIZONTAL	0.5188
VELOCITY OF BRG3 - VERTICAL	0.7308
VELOCITY OF BRG3 - HORIZONTAL	0.4518
VELOCITY OF POWER TURBINE - VERTICAL	0.1317

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	4.7322
UNIT 30 YEARLY RUN HOURS	1140.295
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1374.888

UNIT 30 CURR DAY STRT GAS LOSS	21.8629
UNIT 30 CURR MONTH STRT GAS LOSS	21.8629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.697
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375





# Unit 30 Performance

## Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	9740
BRAKE HORSEPOWER (CURVES)	12481
COMPRESSOR FLOW (CALC)	531

PT (LP) SPEED(0)	5994
PT (LP) SPEED(1)	5994
GP (HP) SPEED(0)	6599
GP (HP) SPEED(1)	6599
SUCTION PRESS	567
DISCHARGE PRESS	735
SUCTION TEMP	71
DISCHARGE TEMP	112
NOZZLE ANGLE	-191
EXHAUST GAS TEMP AVG	9597
AXIAL AIR COMP DIS PRESS	6438
LUBE OIL PRESS	5439
FUEL GAS PRESS	10544
INTERSTAGE PRESSURE	1352
BELLMOUTH PRESSURE	491
FUEL ORF PRIMARY DIFF	4572
FUEL ORF SECONDARY DIFF	3931
TURBINE #1 BRG DRN TEMP	12956
TURBINE #2 BRG DRN TEMP	14423
TURBINE #3 BRG DRN TEMP	15840
TURBINE #4 BRG DRN TEMP	14990
TURBINE #5 BRG DRN TEMP	13945
SEAL OIL DIFF PRESS	5375

AXIAL AIR COMP DISCH TEMP	42569
FUEL GAS TEMP	4034
FUEL FLOW - MCF / H	10932
VERABAR DIFF	2976

WHEEL SPACE TEMP GP - FORWARD(0)	47959
WHEEL SPACE TEMP GP - FORWARD(1)	48497
WHEEL SPACE TEMP PT - FORWARD(0)	219193
WHEEL SPACE TEMP PT - FORWARD(1)	219193
WHEEL SPACE TEMPERATURE PT - AFT(0)	6865
WHEEL SPACE TEMPERATURE PT - AFT(1)	42907
WHEEL SPACE TEMPERATURE GP - AFT(0)	219193
WHEEL SPACE TEMPERATURE GP - AFT(1)	219193
FIN FAN COOLING WATER TEMP IN	5500
FIN FAN COOLING WATER TEMP OUT	8946
RELATIVE EFFICIENCY	000
TOTAL STARTS (Current Day)	100
TOTAL RUN HOURS (Current Day)	523
TURBINE EXHAUST PRESSURE	000
TURBINE EXHAUST INTERSTAGE PRESSURE	1352
MAX HORSEPOWER AVAILABLE - AHB UP RATE	1009879
MIN HORSEPOWER AVAILABLE - AHB UP RATE	299908
BRAKE SPECIFIC FUEL CONS - COMPR BHP	901393

AMBIENT AIR TEMP	4762
SHELL COOLING WATER TEMP-LEFT	11201
SHELL COOLING WATER TEMP-RIGHT	12465
FUEL ENERGY RATE MOTH / D	270

TOTAL OP COSTS	000
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SUCTION COMPRESSIBILITY	093
DISCHARGE COMPRESSIBILITY	093
GC IMP BRG DRN #2 TEMP	14422
GC DRV BRG DRN #1 TEMP	15507
GC THR BRG DRN #2 TEMP	14560
ACTUAL COMPRESSOR VOL (ACFM)	885613
ADIABATIC EFFICIENCY % CURVES	7178
ADIABATIC HEAD - CALCULATED	1145614
ADIABATIC HEAD - CURVES	1381927
GAS HORSEPOWER	779268
GAS ADIAB CORRECTED w MEAS ADIAB EFFICI	974000
BRAKE HORSEPOWER - CURVES	1248177
MECHANICAL EFFICIENCY CURVES	080
CALC MEAS COMPRESSOR FLOW RATIO	148
% of RATED SPEED	9991
% of SPEED BETWEEN MIN / MAX	9982
SURGE MARGIN - SURGE b STONEWALL	6117
CURRENT DAY CALC PURGE / BLOWDOWN VOL	000
VELOCITY GP BRG1 - VERTICAL	08065
VELOCITY GP BRG1 - HORIZONTAL	05608
VELOCITY GP BRG3 - VERTICAL	08755
VELOCITY GP BRG3 - HORIZONTAL	04832
VELOCITY POWER TURBINE - VERTICAL	01181

Curves Menu

UNIT 30 YEARLY START COUNT	1200000
UNIT 30 MONTHLY RUN HOURS	52343
UNIT 30 YEARLY RUN HOURS	1140797
UNIT 30 PREV MONTH RUN HOURS	09982
UNIT 30 PREV YEAR RUN HOURS	227854
UNIT 30 LIFETIME RUN HOURS	1375380

UNIT 30 CURR DAY STRT GAS LOSS	216629
UNIT 30 CURR MONTH STRT GAS LOSS	216629
UNIT 30 CURR YEAR STRT GAS LOSS	1933697
UNIT 30 PREV DAY STRT GAS LOSS	00000
UNIT 30 PREV MONTH STRT GAS LOSS	683743
UNIT 30 PREV YEAR STRT GAS LOSS	7835375



## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	9897
BRAKE HORSEPOWER (CURVES)	12542
COMPRESSOR FLOW (CALC)	543

PT (LP) SPEED(0)	5894
PT (LP) SPEED(1)	5893
GP (HP) SPEED(0)	6625
GP (HP) SPEED(1)	6625
SUCTION PRESS	568
DISCHARGE PRESS	738
SUCTION TEMP	71
DISCHARGE TEMP	112
NOZZLE ANGLE	-1.74
EXHAUST GAS TEMP AVG	956.08
AXIAL AIR COMP DIS PRESS	64.77
LUBE OIL PRESS	54.99
FUEL GAS PRESS	185.44
INTERSTAGE PRESSURE	13.58
BELLMOUTH PRESSURE	6.14
FUEL ORF PRIMARY DIFF	46.42
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	129.97
TURBINE #2 BRG DRN TEMP	144.43
TURBINE #3 BRG DRN TEMP	158.65
TURBINE #4 BRG DRN TEMP	149.93
TURBINE #5 BRG DRN TEMP	139.48
SEAL OIL DIFF PRESS	53.62

AXIAL AIR COMP DISCH TEMP	427.15
FUEL GAS TEMP	40.46
FUEL FLOW - MCF / H	110.19
VERABAR DIFF	31.06

WHEEL SPACE TEMP GP - FORWARD(0)	479.12
WHEEL SPACE TEMP GP - FORWARD(1)	484.85
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	428.13
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	89.09
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	5.48
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	13.58
MAX HORSEPOWER AVAILABLE - A/B UPRATE	10094.00
MIN HORSEPOWER AVAILABLE - A/B UPRATE	2909.58
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	9045.86

AMBIENT AIR TEMP	47.74
SHELL COOLING WATER TEMP-LEFT	111.85
SHELL COOLING WATER TEMP-RIGHT	124.55
FUEL ENERGY RATE MDTH / D	2.72

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.93
DISCHARGE COMPRESSIBILITY	0.93
GC INP BRG DRN #2 TEMP	144.25
GC DRV BRG DRN #1 TEMP	155.15
GC THR BRG DRN #2 TEMP	145.57
ACTUAL COMPRESSOR VOL (ACFM)	8998.90
ADIABATIC EFFICIENCY % CURVES	71.48
ADIABATIC HEAD 1-100% CALCULATED	11527.03
ADIABATIC HEAD 1-100% CURVES	13745.89
GAS HORSEPOWER	7918.05
GAS ADIAB CORRECTED w MEAS ADIAB EFFICN	9897.56
BRAKE HORSEPOWER - CURVES	12542.44
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.50
% OF RATED SPEED	99.91
% OF SPEED BETWEEN MIN / MAX	99.82
SURGE MARGIN - SURGE @ STONEWALL	63.76
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY OF BRG1 - VERTICAL	0.7208
VELOCITY OF BRG1 - HORIZONTAL	0.5368
VELOCITY OF BRG3 - VERTICAL	0.8360
VELOCITY OF BRG3 - HORIZONTAL	0.4277
VELOCITY OF POWER TURBINE - VERTICAL	0.1180

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	5.4838
UNIT 30 YEARLY RUN HOURS	1141.047
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1375.840

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.687
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	68.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375





## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	8419
BRAKE HORSEPOWER (CURVES)	11699
COMPRESSOR FLOW (CALC)	489

PT (LP) SPEED(0)	5747
PT (LP) SPEED(1)	5748
GP (HP) SPEED(0)	6233
GP (HP) SPEED(1)	6233
SUCTION PRESS	577
DISCHARGE PRESS	739
SUCTION TEMP	73
DISCHARGE TEMP	112
NOZZLE ANGLE	-3.14
EXHAUST GAS TEMP AVG	559.12
AXIAL AIR COMP DIS PRESS	57.41
LUBE OIL PRESS	54.32
FUEL GAS PRESS	155.12
INTERSTAGE PRESSURE	12.42
BELLMOUTH PRESSURE	4.17
FUEL ORF PRIMARY DIFF	38.43
FUEL ORF SECONDARY DIFF	38.31
TURBINE #1 BRG DRN TEMP	128.96
TURBINE #2 BRG DRN TEMP	141.74
TURBINE #3 BRG DRN TEMP	155.86
TURBINE #4 BRG DRN TEMP	148.76
TURBINE #5 BRG DRN TEMP	137.48
SEAL OIL DIFF PRESS	51.94

AXIAL AIR COMP DISCH TEMP	388.09
FUEL GAS TEMP	36.81
FUEL FLOW - MCF / H	66.15
VERABAR DIFF	25.51

WHEEL SPACE TEMP GP - FORWARD(0)	452.15
WHEEL SPACE TEMP GP - FORWARD(1)	483.08
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	418.82
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	88.22
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	5.98
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	12.42
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10114.07
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2910.02
BRAKE SPECIFIC FUEL CONS. - COMP BHP	8725.91

AMBIENT AIR TEMP	47.21
SHELL COOLING WATER TEMP-LEFT	110.33
SHELL COOLING WATER TEMP-RIGHT	122.80
FUEL ENERGY RATE MOTH / D	2.45

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.93
GC IMP BRG DRN #2 TEMP	142.34
GC DRV BRG DRN #1 TEMP	153.89
GC THR BRG DRN #2 TEMP	144.19
ACTUAL COMPRESSOR VOL. (ACFM)	8004.44
ADIABATIC EFFICIENCY % CURVES	75.41
ADIABATIC HEAD 1-6m3/c CALCULATED	10610.13
ADIABATIC HEAD 1-6m3/c CURVES	14581.86
GAS HORSEPOWER	6735.27
GAS ADIAB CORRECTED w MEAS ADIAB EFFICI	8419.08
BRAKE HORSEPOWER - CURVES	11699.13
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.39
% of RATED SPEED	95.80
% of SPEED BETWEEN MIN / MAX	91.60
SURGE WARNIN - SURGE to STONEWALL	51.88
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.7393
VIBRATION GP BRG1 - HORIZONTAL	0.4703
VIBRATION GP BRG3 - VERTICAL	0.7245
VIBRATION GP BRG3 - HORIZONTAL	0.4004
VIBRATION POWER TURBINE - VERTICAL	0.0999

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	5.9824
UNIT 30 YEARLY RUN HOURS	1141.545
UNIT 30 PREV MONTH RUN HOURS	0.9892
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1378.139

UNIT 30 CURR DAY START GAS LOSS	21.6629
UNIT 30 CURR MONTH START GAS LOSS	21.6629
UNIT 30 CURR YEAR START GAS LOSS	1933.687
UNIT 30 PREV DAY START GAS LOSS	0.0000
UNIT 30 PREV MONTH START GAS LOSS	69.3743
UNIT 30 PREV YEAR START GAS LOSS	793.5375

## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	5437
BRAKE HORSEPOWER (CURVES)	7947
COMPRESSOR FLOW (CALC)	356

PT (LP) SPEED(0)	5189
PT (LP) SPEED(1)	5189
GP (HP) SPEED(0)	5691
GP (HP) SPEED(1)	5691
SUCTION PRESS	582
DISCHARGE PRESS	737
SUCTION TEMP	80
DISCHARGE TEMP	114
NOZZLE ANGLE	4.11
EXHAUST GAS TEMP AVG	889.43
AXIAL AIR COMP DIS PRESS	44.08
LUBE OIL PRESS	53.97
FUEL GAS PRESS	164.58
INTERSTAGE PRESSURE	9.56
BELLMOUTH PRESSURE	2.33
FUEL ORF PRIMARY DIFF	23.43
FUEL ORF SECONDARY DIFF	38.31
TURBINE #1 BRG DRN TEMP	128.64
TURBINE #2 BRG DRN TEMP	139.00
TURBINE #3 BRG DRN TEMP	153.53
TURBINE #4 BRG DRN TEMP	144.26
TURBINE #5 BRG DRN TEMP	134.81
SEAL OIL DIFF PRESS	48.30

AXIAL AIR COMP DISCH TEMP	355.58
FUEL GAS TEMP	40.36
FUEL FLOW - MCF / H	71.56
VERABAR DIFF	13.28

WHEEL SPACE TEMP GP - FORWARD(0)	419.62
WHEEL SPACE TEMP GP - FORWARD(1)	430.07
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	394.73
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	86.33
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	6.23
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	9.56
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10139.22
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2910.58
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	19134.59

AMBIENT AIR TEMP	46.54
SHELL COOLING WATER TEMP-LEFT	106.27
SHELL COOLING WATER TEMP-RIGHT	116.21
FUEL ENERGY RATE MDTN / D	1.93

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.93
DISCHARGE COMPRESSIBILITY	0.93
GC IMP BRG DRN #2 TEMP	138.99
GC DRY BRG DRN #1 TEMP	151.20
GC THR BRG DRN #2 TEMP	141.62
ACTUAL COMPRESSOR VOL (ACFM)	5756.83
ADIABATIC EFFICIENCY % CURVES	79.00
ADIABATIC HEAD 1-lbm/lb(CURVES)	9614.90
ADIABATIC HEAD 1-lbm/lb(CURVES)	14389.28
GAS HORSEPOWER	4349.82
GAS ADIAB CORRECTED w MEAS ADIAB EFFICI	5437.40
BRAKE HORSEPOWER - CURVES	7947.11
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.11
% of RATED SPEED	88.49
% of SPEED BETWEEN MIN / MAX	72.97
SURGE MARGIN - SURGE to STONEMAN	21.00
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY GP BRG1 - VERTICAL	0.8365
VELOCITY GP BRG1 - HORIZONTAL	0.3688
VELOCITY GP BRG3 - VERTICAL	0.8306
VELOCITY GP BRG3 - HORIZONTAL	0.3670
VELOCITY POWER TURBINE - VERTICAL	0.1000

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	6.2312
UNIT 30 YEARLY RUN HOURS	1141.794
UNIT 30 PREV MONTH RUN HOURS	0.9902
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1378.387

UNIT 30 CURR DAY STRT GAS LOSS	21.8629
UNIT 30 CURR MONTH STRT GAS LOSS	21.8629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.697
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375



# Unit 30 Performance

## Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	9899
BRAKE HORSEPOWER (CURVES)	11668
COMPRESSOR FLOW (CALC)	583

PT (LP) SPEED(0)	5883
PT (LP) SPEED(1)	5884
GP (HP) SPEED(0)	6542
GP (HP) SPEED(1)	6542
SUCTION PRESS	581
DISCHARGE PRESS	738
SUCTION TEMP	70
DISCHARGE TEMP	108
NOZZLE ANGLE	-2.13
EXHAUST GAS TEMP AVG	965.05
AXIAL AIR COMP DIS PRESS	64.24
LUBE OIL PRESS	54.79
FUEL GAS PRESS	165.16
INTERSTAGE PRESSURE	13.52
BELLMOUTH PRESSURE	437
FUEL ORF PRIMARY DIFF	47.44
FUEL ORF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	128.57
TURBINE #2 BRG DRN TEMP	142.81
TURBINE #3 BRG DRN TEMP	155.30
TURBINE #4 BRG DRN TEMP	148.40
TURBINE #5 BRG DRN TEMP	137.49
SEAL OIL DIFF PRESS	53.51

AXIAL AIR COMPR DISCH TEMP	418.44
FUEL GAS TEMP	39.50
FUEL FLOW - MCF / H	111.34
VERABAR DIFF	34.63

WHEEL SPACE TEMP GP - FORWARD(0)	454.41
WHEEL SPACE TEMP GP - FORWARD(1)	459.93
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	417.75
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	84.99
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	6.48
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	13.52
MAX HORSEPOWER AVAILABLE - AMB UPRATE	19176.66
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2911.41
BRAKE SPECIFIC FUEL CONS - COMPR BHP	9798.56

AMBIENT AIR TEMP	45.55
SHELL COOLING WATER TEMP-LEFT	197.47
SHELL COOLING WATER TEMP-RIGHT	119.04
FUEL ENERGY RATE MOTH / D	2.74

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.93
GC IMP BRG DRN #2 TEMP	142.26
GC DRV BRG DRN #1 TEMP	152.61
GC THR BRG DRN #2 TEMP	143.66
ACTUAL COMPRESSOR VOL (ACF/H)	9424.22
ADIABATIC EFFICIENCY % CURVES	69.00
ADIABATIC HEAD 1-bm/h/CALCULATED	10547.26
ADIABATIC HEAD 1-bm/h/CURVES	11542.08
GAS HORSEPOWER	7919.04
GAS ADIAB CORRECTED w/MEAS ADIAB EFFICH	9898.80
BRAKE HORSEPOWER - CURVES	11668.32
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.60
% of RATED SPEED	98.07
% of SPEED BETWEEN MIN / MAX	96.14
SURGE MARGIN - SURGE to STONEWALL	74.71
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.3776
VIBRATION GP BRG1 - HORIZONTAL	0.5724
VIBRATION GP BRG3 - VERTICAL	0.7629
VIBRATION GP BRG3 - HORIZONTAL	0.3982
VIBRATION POWER TURBINE - VERTICAL	0.1181

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	6.4807
UNIT 30 YEARLY RUN HOURS	1142.044
UNIT 30 PREVIOUS MONTH RUN HOURS	0.9922
UNIT 30 PREVIOUS YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1378.637

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.687
UNIT 30 PREVIOUS DAY STRT GAS LOSS	0.0000
UNIT 30 PREVIOUS MONTH STRT GAS LOSS	89.3743
UNIT 30 PREVIOUS YEAR STRT GAS LOSS	793.5375





# Unit 30 Performance

## Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10617
BRAKE HORSEPOWER (CURVES)	12641
COMPRESSOR FLOW (CALC)	609

PT (LP) SPEED(0)	5999
PT (LP) SPEED(1)	5998
GP (HP) SPEED(0)	6767
GP (HP) SPEED(1)	6767
SUCTION PRESS	571
DISCHARGE PRESS	729
SUCTION TEMP	67
DISCHARGE TEMP	197
NOZZLE ANGLE	-1.46
EXHAUST GAS TEMP AVG	952.81
AXIAL AIR COMP DIS PRESS	68.30
LUBE OIL PRESS	55.13
FUEL GAS PRESS	185.10
INTERSTAGE PRESSURE	14.02
BELLMOUTH PRESSURE	5.35
FUEL ORF PRIMARY DIFF	50.75
FUEL ORF SECONDARY DIFF	28.31
TURBINE #1 BRG DRN TEMP	130.46
TURBINE #2 BRG DRN TEMP	140.26
TURBINE #3 BRG DRN TEMP	160.15
TURBINE #4 BRG DRN TEMP	150.65
TURBINE #5 BRG DRN TEMP	140.08
SEAL OIL DIFF PRESS	53.94

AXIAL AIR COMPR DISCH TEMP	433.40
FUEL GAS TEMP	39.02
FUEL FLOW - MCF /H	115.74
VERABAR DIFF	38.14

WHEEL SPACE TEMP GP - FORWARD(0)	486.17
WHEEL SPACE TEMP GP - FORWARD(1)	487.78
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	433.01
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	86.72
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	6.98
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.02
MAX HORSEPOWER AVAILABLE - AMB UPRATE	10244.48
MIN HORSEPOWER AVAILABLE - AMB UPRATE	2912.91
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	9358.29

AMBIENT AIR TEMP	43.76
SHELL COOLING WATER TEMP-LEFT	110.01
SHELL COOLING WATER TEMP-RIGHT	122.47
FUEL ENERGY RATE MDTN /D	2.84

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.93
GC IMP BRG DRN #2 TEMP	144.47
GC DRV BRG DRN #1 TEMP	154.95
GC THR BRG DRN #2 TEMP	145.72
ACTUAL COMPRESSOR VOL (ACF/H)	10046.17
ADIABATIC EFFICIENCY % CURVES	89.00
ADIABATIC HEAD 1-6m3/D/CALCULATED	10708.90
ADIABATIC HEAD 1-6m3/D/CURVES	12001.07
GAS HORSEPOWER	8493.86
GAS ADIAB CORRECTED w/MEAS ADIAB EFFICH	10617.33
BRAKE HORSEPOWER - CURVES	12641.57
MECHANICAL EFFICIENCY CURVES	0.80
CALC/MEAS COMPRESSOR FLOW RATIO	1.67
% of RATED SPEED	100.00
% of SPEED BETWEEN MIN / MAX	99.99
SURGE MARGIN - SURGE to STONEWALL	82.85
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VELOCITY GP BRG1 - VERTICAL	0.8589
VELOCITY GP BRG1 - HORIZONTAL	0.6130
VELOCITY GP BRG3 - VERTICAL	0.7918
VELOCITY GP BRG3 - HORIZONTAL	0.4934
VELOCITY POWER TURBINE - VERTICAL	0.1180

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	6.9820
UNIT 30 YEARLY RUN HOURS	1142.545
UNIT 30 PREV MONTH RUN HOURS	0.9902
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1377.138

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1833.687
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	783.5375

## OnLine

UNIT 10 CUMM DAY STRT GAS LOSS	21.6629
UNIT 10 CUMM MONTH STRT GAS LOSS	21.6629
UNIT 10 CUMM YEAR STRT GAS LOSS	1933.687
UNIT 10 PREV DAY STRT GAS LOSS	0.0000
UNIT 10 PREV MONTH STRT GAS LOSS	88.3743
UNIT 10 PREV YEAR STRT GAS LOSS	793.5375



## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10630
BRAKE HORSEPOWER (CURVES)	12835
COMPRESSOR FLOW (CALC)	620

PT (LP) SPEED(0)	8800
PT (LP) SPEED(1)	5989
GP (HP) SPEED(0)	8759
GP (HP) SPEED(1)	8759
SUCTION PRESS	566
DISCHARGE PRESS	716
SUCTION TEMP	66
DISCHARGE TEMP	105
NOZZLE ANGLE	-164
EXHAUST GAS TEMP AVG	950.95
AXIAL AIR COMP DIS PRESS	68.44
LUBE OIL PRESS	54.94
FUEL GAS PRESS	164.11
INTERSTAGE PRESSURE	14.11
BELLMOUTH PRESSURE	5.21
FUEL ORF PRIMARY DIFF	51.00
FUEL ORF SECONDARY DIFF	36.31
TURBINE #1 BRG DRN TEMP	130.11
TURBINE #2 BRG DRN TEMP	145.94
TURBINE #3 BRG DRN TEMP	190.09
TURBINE #4 BRG DRN TEMP	150.48
TURBINE #5 BRG DRN TEMP	139.87
SEAL OIL DIFF PRESS	53.76

AXIAL AIR COMP DISCH TEMP	431.09
FUEL GAS TEMP	38.53
FUEL FLOW - MCF / H	115.90
VERABAR DIFF	38.94

WHEEL SPACE TEMP GP - FORWARD(0)	486.18
WHEEL SPACE TEMP GP - FORWARD(1)	487.82
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	434.19
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	86.14
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	7.48
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.11
MAX HORSEPOWER AVAILABLE - AHB UPRATE	10295.30
MIN HORSEPOWER AVAILABLE - AHB UPRATE	2914.03
BRAKE SPECIFIC FUEL CONS. - COMP BHP	8226.50

AMBIENT AIR TEMP	42.42
SHELL COOLING WATER TEMP-LEFT	109.70
SHELL COOLING WATER TEMP-RIGHT	122.28
FUEL ENERGY RATE MDTN / D	2.84

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.93
GC IMP BRG DRN #2 TEMP	144.08
GC DRY BRG DRN #1 TEMP	154.91
GC THR BRG DRN #2 TEMP	145.47
ACTUAL COMPRESSOR VOL. (ACFM)	10205.45
ADIABATIC EFFICIENCY % CURVES	69.00
ADIABATIC HEAD 1-6m3/CALCULATED	10466.45
ADIABATIC HEAD 1-6m3/CURVES	11994.41
GAS HORSEPOWER	8504.39
GAS ADIAB CORRECTED w MEAS ADIAB EFFICH	10630.49
BRAKE HORSEPOWER - CURVES	12835.04
MECHANICAL EFFICIENCY - CURVES	0.90
CALC MEAS COMPRESSOR FLOW RATIO	1.70
% of RATED SPEED	100.01
% of SPEED BETWEEN MIN / MAX	100.02
SURGE MARGIN - SURGE to STONEWALL	85.55
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.8685
VIBRATION GP BRG1 - HORIZONTAL	0.5898
VIBRATION GP BRG3 - VERTICAL	0.7378
VIBRATION GP BRG3 - HORIZONTAL	0.4120
VIBRATION POWER TURBINE - VERTICAL	0.1316

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	7.4818
UNIT 30 YEARLY RUN HOURS	1143.045
UNIT 30 PREV MONTH RUN HOURS	0.9992
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1377.638

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.687
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375





## Unit 30 Performance

### Active Control Mode

OnLine

GAS HORSEPOWER (ABAD)	10523
BRAKE HORSEPOWER (CURVES)	12844
COMPRESSOR FLOW (CALC)	620

PT (LP) SPEED(0)	6001
PT (LP) SPEED(1)	6000
GP (HP) SPEED(0)	6716
GP (HP) SPEED(1)	6716
SUCTION PRESS	560
DISCHARGE PRESS	708
SUCTION TEMP	65
DISCHARGE TEMP	104
NOZZLE ANGLE	-1.86
EXHAUST GAS TEMP AVG	561.61
AXIAL AIR COMP DIS PRESS	68.20
LUBE OIL PRESS	54.87
FUEL GAS PRESS	164.38
INTERSTAGE PRESSURE	14.29
BELLMOUTH PRESSURE	4.54
FUEL OLF PRIMARY DIFF	51.26
FUEL OLF SECONDARY DIFF	39.31
TURBINE #1 BRG DRN TEMP	129.70
TURBINE #2 BRG DRN TEMP	145.44
TURBINE #3 BRG DRN TEMP	159.75
TURBINE #4 BRG DRN TEMP	150.37
TURBINE #5 BRG DRN TEMP	139.64
SEAL OIL DIFF PRESS	53.83

AXIAL AIR COMP DISCH TEMP	426.52
FUEL GAS TEMP	38.11
FUEL FLOW - MCF / H	116.14
VERABAR DIFF	40.17

WHEEL SPACE TEMP GP - FORWARD(0)	481.14
WHEEL SPACE TEMP GP - FORWARD(1)	484.69
WHEEL SPACE TEMP PT - FORWARD(0)	2191.93
WHEEL SPACE TEMP PT - FORWARD(1)	2191.93
WHEEL SPACE TEMPERATURE PT - AFT(0)	68.65
WHEEL SPACE TEMPERATURE PT - AFT(1)	433.37
WHEEL SPACE TEMPERATURE GP - AFT(0)	2191.93
WHEEL SPACE TEMPERATURE GP - AFT(1)	2191.93
FIN FAN COOLING WATER TEMP IN	55.00
FIN FAN COOLING WATER TEMP OUT	83.44
RELATIVE EFFICIENCY	0.00
TOTAL STARTS (Current Day)	1.00
TOTAL RUN HOURS (Current Day)	7.98
TURBINE EXHAUST PRESSURE	0.00
TURBINE EXHAUST INTERSTAGE PRESSURE	14.29
MAX HORSEPOWER AVAILABLE - AUB UPRATE	10359.77
MIN HORSEPOWER AVAILABLE - AUB UPRATE	2915.46
BRAKE SPECIFIC FUEL CONS. - COMPR BHP	9229.95

AMBIENT AIR TEMP	40.69
SHELL COOLING WATER TEMP-LEFT	107.33
SHELL COOLING WATER TEMP-RIGHT	119.95
FUEL ENERGY RATE MDT / D	2.85

TOTAL OP COSTS	0.00
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SUCTION COMPRESSIBILITY	0.92
DISCHARGE COMPRESSIBILITY	0.93
GC IMP BRG DRN #2 TEMP	143.79
GC DRV BRG DRN #1 TEMP	154.76
GC THR BRG DRN #2 TEMP	145.30
ACTUAL COMPRESSOR VOL (ACFM)	10343.42
ADIABATIC EFFICIENCY % CURVES	69.00
ADIABATIC HEAD - CALCULATED	10262.87
ADIABATIC HEAD - CURVES	12000.33
GAS HORSEPOWER	8418.46
GAS ADIAB CORRECTED w MEAS ADIAB EFFICI	10523.08
BRAKE HORSEPOWER - CURVES	12844.31
MECHANICAL EFFICIENCY - CURVES	0.80
CALC MEAS COMPRESSOR FLOW RATIO	1.72
% of RATED SPEED	100.00
% of SPEED BETWEEN MIN / MAX	100.01
SURGE WARN - SURGE b STONEWALL	88.09
CURRENT DAY CALC PURGE / BLOWDOWN VOL	0.00
VIBRATION GP BRG1 - VERTICAL	0.8982
VIBRATION GP BRG1 - HORIZONTAL	0.5853
VIBRATION GP BRG3 - VERTICAL	0.7587
VIBRATION GP BRG3 - HORIZONTAL	0.4459
VIBRATION POWER TURBINE - VERTICAL	0.1316

Curves Menu

UNIT 30 YEARLY START COUNT	120.0000
UNIT 30 MONTHLY RUN HOURS	7.9812
UNIT 30 YEARLY RUN HOURS	1143.544
UNIT 30 PREV MONTH RUN HOURS	0.9982
UNIT 30 PREV YEAR RUN HOURS	22.7854
UNIT 30 LIFETIME RUN HOURS	1378.137

UNIT 30 CURR DAY STRT GAS LOSS	21.6629
UNIT 30 CURR MONTH STRT GAS LOSS	21.6629
UNIT 30 CURR YEAR STRT GAS LOSS	1933.687
UNIT 30 PREV DAY STRT GAS LOSS	0.0000
UNIT 30 PREV MONTH STRT GAS LOSS	69.3743
UNIT 30 PREV YEAR STRT GAS LOSS	793.5375

## Appendix F - Field Data Sheets



# Isokinetic Sampling Cover Sheet

Client:	Northern Natural Gas Company	Pitot Tube Cp:	0.840
Facility:	Clifton Compressor Station	Probe Length (Feet):	6.
Test Location:	Unit 30	Probe Liner Material:	Quartz
Project #:	M22/514	Sample Plane:	Hztl. or Vert.
Test Method(s):	5/29	Port Length ("):	4.5
Test Engineer:	MAN	Port Diameter ("):	4
Test Technician:	ATW	Port Type:	Flange
Upstream Diameters:	20 0.5 RWC 12/13/22	Duct Shape:	Circ. or Rect.
Downstream Diameters:	20 0.5 2.0	Diameter (Feet):	
# of Ports Sampled:	5	Length (Feet):	5
# of Points per Port:	5	Width (Feet):	8
Source Condition:	Gas	Duct Area (Sq. Feet):	40
Diluent Model/SN:	Servomex + ECOM	Minutes per Point:	8
Mid Gas ID/concentration:	%CO2 %O2	Total Traverse Points:	25
High Gas ID/concentration:	%CO2 %O2	Test Length (Min.):	200
Moisture Balance ID:	1000g	Train Type:	Aubson Oven

R# 1

R# 2

R# 3

Meter ID:	CM47	CM47	CM47
Pitot ID:	711	711	711
Filter ID:			
Filter Pre-Weight (g):			
Nozzle Diameter ("):	0.273	0.273	0.273
Meter Cal Factor (Y):	1.008	1.008	1.008
Meter Orifice Setting (DH):	1.839	1.839	1.839
Nozzle Kit ID:	718	718	718
Individual Nozzle ID:	<del>119</del>	<del>119</del>	<del>119</del>
Pre Pitot Leak Check:	0.00 @ 5 "H2O	0.00 @ 5 "H2O	0.00 @ 5 "H2O
Post Pitot Leak Check:	0.00 @ 5 "H2O	0.00 @ 5 "H2O	0.00 @ 5 "H2O
Pre Nozzle Leak Check:	0.000 @ 26 "Hg	0.000 @ 21 "Hg	0.000 @ 21 "Hg
Post Nozzle Leak Check:	0.000 @ 20 "Hg	0.000 @ 23 "Hg	0.000 @ 20 "Hg
Barometric Pressure, "Hg:	28.37	28.37	28.37
Static Pressure, "H2O:	1.0	1.0	1.0
CO2 %:	2.6	2.8 2.7 (2.8)	2.5
O2 %:	16.3	16.2 16.7 (16.1)	16.7 17.0

Comments:

RWC  
12/13/22

# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-5-22  
 Test Location: Stack  
 Test Method: 5/29

Test Number: 1  
 Operator: MAN Test Tech: ATW  
 Page Number: 1 of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)				
			K' x ΔP									Square Root, ΔP	K=	x _____	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
11	1255	.36	.85	711.675	818	62	62	-5	272	243	52					
11	1259	.37	.87	713.26	833	62	62	-5	270	249	48					
12	1303	.64	1.4	715.20	911	63	63	-5	270	256	50					
12	1307	.63	1.4	718.36	923	63	63	-5	269	257	51					
13	1311	.75	1.6	721.16	945	64	64	-5	270	253	52					
13	1315	.78	1.7	723.90	939	64	64	-5	269	254	52					
14	1319	.80	1.7	725.47	932	65	65	-5	265	255	52					
14	1323	.81	1.8	729.81	933	65	65	-5	262	255	52					
15	1327	.83	1.8	732.81	932	67	67	-6	272	255	51					
15	1331	.80	1.7	735.85	918	67	67	-6	271	254	50					
	1335			738.841												
21	1337	.56	1.3	738.841	866	68	68	-5	272	255	50					
21	1341	.58	1.3	741.33	881	68	68	-5	270	259	48					
22	1345	.70	1.7	743.98	835	69	69	-6	268	257	47					
22	1349	.74	1.7	746.78	856	69	69	-6	269	257	48					
23	1353	.65	1.5	749.79	871	70	70	-6	271	256	48					
23	1357	.65	1.5	752.55	910	71	71	-6	268	255	50					
24	1401	.67	1.5	755.26	931	72	72	-7	262	254	50					
24	1405	.68	1.5	758.06	946	72	72	-7	268	256	50					
25	1409	1.00	2.2	760.80	939	73	73	-5	269	255	49					
25	1413	1.1	2.4	764.19	937	73	73	-5	270	256	49					
	1417			767.688												
31	1419	.94	2.1	767.688	938	73	73	-7	268	247	48					
31	1423	.94	2.1	770.95	939	73	73	-7	269	250	46					
32	1427	.90	2.0	774.15	942	73	73	-7	270	251	48					
32	1431	1.1	2.4	777.33	950	74	74	-7	272	250	48					
33	1435	1.5	3.3	780.88	952	75	75	-6	270	250	49					

# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-5-22  
 Test Location: Stacks  
 Test Method: 5/29

Test Number: 1  
 Operator: MAN Test Tech: ATW  
 Page Number: 2 of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)					
			Orifice Setting (ΔH)									K' x ΔP	Square Root, ΔP	K=	x	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
														Meter Rate, Cubic Feet/ Min.			
33	1439	1.2	2.6	784.99	947	75	75	-6	271	250	50						
34	1443	1.4	3.1	788.67	940	76	76	-7	270	250	51						
34	1447	1.4	3.1	792.00	932	75	75	-7	268	249	50						
35	1451	1.5	3.3	797.14	934	76	76	-7	268	251	50						
35	1455	1.5	3.3	800.87	934	76	76	-7	267	248	49						
	1459			804.92													
41	1504	1.6	3.5	804.92	934	76	76	-8	271	249	50						
41	1508	1.6	3.6	809.02	940	76	76	-8	271	253	48						
42	1512	1.5	3.3	812.85	943	76	76	-7	270	252	49						
42	1516	1.5	3.3	816.93	944	76	76	-7	272	250	49						
43	1520	1.4	3.1	820.85	946	76	76	-7	270	252	50						
43	1524	1.4	3.1	825.37	945	77	77	-7	272	251	51						
44	1528	1.3	2.9	828.66	944	76	76	-6	269	249	51						
44	1532	1.4	3.2	833.66	944	76	76	-6	266	249	50						
45	1536	1.1	2.5	837.37	943	76	76	-5	271	250	49						
45	1540	1.1	2.5	841.27	939	76	76	-5	272	250	49						
	1544			844.78													
51	1546	1.4	3.1	844.78	942	76	76	-6	270	249	49						
51	1550	1.5	3.3	848.84	943	75	75	-6	267	248	48						
52	1554	1.5	3.3	853.14	943	75	75	-6	268	249	49						
52	1558	1.4	3.1	857.27	945	74	74	-6	269	249	49						
53	1602	1.3	2.9	861.31	945	75	75	-6	269	250	49						
53	1606	1.4	3.1	865.02	947	75	75	-7	269	250	49						
54	1610	1.5	3.3	868.50	945	75	75	-7	270	251	49						
54	1614	1.5	3.3	873.45	945	75	75	-6	269	250	50						
55	1618	1.5	3.3	877.24	949	74	74	-6	269	250	50						
55	1622	1.4	3.1	881.32	947	74	74	-5	269	249	50						
162.6				885.271													

# IMPINGER WEIGHT SHEET

PLANT: Northern NG - Clifton

Scale ID Number 168

UNIT NO: 30

Scale Calibration Check Date: 12/5/22

LOCATION: Outlet

Scale Calibration Check (see QS-6.05C for procedure)  
must be within  $\pm 0.5g$  of certified mass

DATE: 12/5/22

250 grams 250.0

TEST NO: 1

500 grams 500.0

METHOD: 5/29

750 grams 750.0

WEIGHED/MEASURED BY: RWC

	FINAL WEIGHT	INITIAL WEIGHT	IMPINGER	IMPINGER
Circle One:	MLS / GRAMS	MLS / GRAMS	GAIN	CONTENTS
IMPINGER 1	<u>784.7</u>	<u>722.9</u>	<u>61.8</u>	<u>HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub></u>
IMPINGER 2	<u>768.5</u>	<u>699.8</u>	<u>68.7</u>	<u>HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub></u>
IMPINGER 3	<u>666.0</u>	<u>650.8</u>	<u>15.2</u>	<u>Empty</u>
IMPINGER 4	<u>612.5</u>	<u>606.6</u>	<u>5.9</u>	<u>KMnO<sub>4</sub></u>
IMPINGER 5	<u>713.4</u>	<u>714.0</u>	<u>-0.6</u>	<u>KMnO<sub>4</sub></u>
IMPINGER 6	<u>939.0</u>	<u>907.4</u>	<u>31.6</u>	<u>Silica</u>
IMPINGER 7				
IMPINGER 8				

IMPINGERS 3545.1 3394.1 151.0  
FINAL TOTAL INITIAL TOTAL TOTAL IMPINGER GAIN

SILICA 939.0 907.4 31.6  
FINAL TOTAL INITIAL TOTAL TOTAL SILICA GAIN



# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-6-22  
 Test Location: Stacks  
 Test Method: 5/29

Test Number: 2  
 Operator: MAJ Test Tech: ATN  
 Page Number: 1 of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)					
			K' x ΔP									Orifice Setting (ΔH)	Square Root, ΔP	K=	x _____	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
														Meter Rate, Cubic Feet/ Min.			
1 1	721	.55	1.2	885.866	934	42	42	-6	258	250	36						
1 1	725	.57	1.2	888.03	934	42	42	-6	263	256	37						
1 2	724	.81	1.7	890.58	934	43	43	-7	269	251	37						
1 2	733	.82	1.7	893.28	936	43	43	-7	271	251	39						
1 3	737	.93	2.0	896.16	934	45	45	-8	271	251	40						
1 3	741	.92	2.0	899.52	933	45	45	-8	270	250	42						
1 4	745	.98	2.1	902.45	933	47	47	-8	269	251	43						
1 4	749	.98	2.1	905.83	937	48	48	-7	268	248	43						
1 5	753	1.0	2.1	908.92	937	49	49	-7	269	249	41						
1 5	757	1.1	2.3	912.52	937	49	49	-7	271	256	41						
	801			915.64													
2 1	817	1.0	2.2	915.64	925	51	51	-8	271	257	40						
2 1	821	.97	2.1	918.52	940	51	51	-8	270	251	36						
2 2	825	1.1	2.4	921.85	941	52	52	-9	270	252	38						
2 2	829	1.1	2.4	925.27	942	53	53	-9	269	251	39						
2 3	833	1.0	2.1	928.61	938	54	54	-9	269	250	40						
2 3	837	1.0	2.1	931.84	941	54	54	-9	270	248	41						
2 4	841	.96	2.1	935.04	942	55	55	-9	270	254	41						
2 4	845	.95	2.0	939.25	942	55	55	-9	269	247	42						
2 5	849	1.0	2.2	941.48	940	55	55	-9	269	255	42						
2 5	853	1.0	2.2	944.85	942	57	57	-9	269	244	42						
	857			949.01													
3 1	900	1.2	2.6	949.01	925	58	58	-7	259	247	40						
3 1	904	1.3	2.8	952.36	928	58	58	-7	260	248	40						
3 2	908	1.4	3.0	956.05	940	59	59	-7	264	254	40						
3 2	912	1.6	3.4	960.04	946	59	59	-8	267	249	43						
3 3	916	1.5	3.3	964.03	943	61	61	-8	270	247	43						

# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-6-12  
 Test Location: Stack  
 Test Method: 5/29

Test Number: 2  
 Operator: MAN Test Tech: ATW  
 Page Number: 2 of 2

Port-Point #	Time	(ΔP)	K' = K' x ΔP Orifice Setting (ΔH)	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)			
												Square Root, ΔP	K= Meter Rate, Cubic Feet/ Min.	x Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
33	920	1.4	3.0	988.15	945	61	61	-7	270	252	43				
34	924	1.2	2.6	972.15	945	62	62	-7	270	248	43				
34	928	1.2	2.6	974.62	944	63	63	-8	270	250	42				
35	932	1.2	2.6	979.25	944	64	64	-8	271	251	42				
35	936	1.2	2.6	983.04	945	64	64	-8	271	249	43				
	940			986.82											
41	945	1.5	3.3	986.82	926	64	64	-8	269	252	41				
41	949	1.5	3.3	990.59	949	65	64	-8	270	250	42				
42	953	1.4	3.0	994.36	951	65	65	-8	271	251	43				
42	957	1.4	3.0	998.35	950	66	66	-8	272	248	44				
43	1001	1.1	2.4	1002.63	949	66	66	-8	270	248	43				
43	1005	1.1	2.4	1006.01	949	67	67	-8	270	251	43				
44	1009	1.2	2.6	1009.91	949	67	67	-8	270	247	43				
44	1013	1.1	2.4	1013.14	941	68	68	-8	269	248	41				
45	1017	1.1	2.4	1016.47	946	67	67	-7	270	254	43				
45	1021	1.1	2.4	1020.14	939	68	68	-9	270	253	43				
	1025			1023.85											
51	1026	1.4	3.1	1023.85	945	68	68	-9	269	251	45				
51	1030	1.4	3.1	1027.47	946	68	68	-9	271	252	45				
52	1034	1.5	3.3	1031.49	942	69	69	-9	271	250	46				
52	1038	1.5	3.3	1035.84	941	69	69	-9	270	251	46				
53	1042	1.2	2.7	1039.49	941	69	69	-8	269	250	47				
53	1046	1.4	3.1	1043.39	941	70	70	-7	271	251	48				
54	1050	1.3	2.9	1047.16	939	70	70	-9	270	250	48				
54	1054	1.3	2.9	1051.16	942	70	70	-7	271	250	49				
55	1058	1.0	2.2	1055.04	941	70	70	-7	269	250	50				
75	1102	1.0	2.2	1058.85	929	70	70	-7	269	251	50				

1062.022

# IMPINGER WEIGHT SHEET

PLANT: Northern NG - Clifton

Scale ID Number 168

UNIT NO: 30

Scale Calibration Check Date: 12/6/22

LOCATION: Outlet

Scale Calibration Check (see QS-6.05C for procedure)  
must be within  $\pm 0.5g$  of certified mass

DATE: 12/6/22

250 grams 250.0

TEST NO: 2

500 grams 500.0

METHOD: 2 5/29

750 grams 749.5

WEIGHED/MEASURED BY: RWC 12/5/22

	FINAL WEIGHT	INITIAL WEIGHT	IMPINGER	IMPINGER
Circle One:	MLS / GRAMS	MLS / GRAMS	GAIN	CONTENTS
IMPINGER 1	<u>810.0</u>	<u>795.3</u>	<u>14.7</u>	<u>HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub></u>
IMPINGER 2	<u>844.1</u>	<u>742.9</u>	<u>101.2</u>	<u>HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub></u>
IMPINGER 3	<u>687.7</u>	<u>649.6</u>	<u>38.1</u>	<u>Empty</u>
IMPINGER 4	<u>743.8</u>	<u>727.3</u>	<u>16.5</u>	<u>KMnO<sub>4</sub></u>
IMPINGER 5	<u>774.3</u>	<u>766.5</u>	<u>7.8</u>	<u>KMnO<sub>4</sub></u>
IMPINGER 6	<u>895.6</u>	<u>869.7</u>	<u>25.9</u>	<u>Silica</u>
IMPINGER 7				
IMPINGER 8				

IMPINGERS 3859.9 3681.6 178.3  
FINAL TOTAL INITIAL TOTAL TOTAL IMPINGER GAIN

SILICA 895.6 869.7 25.9  
FINAL TOTAL INITIAL TOTAL TOTAL SILICA GAIN



# Isokinetic Sampling Field Data Sheet

Project Number:

M224514

Client:

Northern Natural Gas

Plant:

Clifton Facility

Date:

12-6-21

Test Location:

Stack

Test Method:

5/29

Test Number:

3

Operator:

MAN

Test Tech:

ATV

Page Number:

1

of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)					
			Orifice Setting (ΔH)									K' x ΔP	Square Root, ΔP	K=	x	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
														Meter Rate, Cubic Feet/ Min.			
11	1137	1.5	3.3	61.074	930	70	70	-8	271	250	65						
11	1141	1.5	3.3	67.95	942	71	71	-8	270	251	68						
12	1145	1.6	3.5	72.14	938	71	71	-9	270	250	60						
12	1149	1.7	3.8	76.83	941	70	70	-9	268	255	60						
13	1153	1.4	3.1	80.57	934	71	71	-10	267	257	60						
13	1157	1.5	3.3	84.82	933	71	71	-9	268	250	59						
14	1201	1.3	2.9	89.21	932	72	72	-9	266	250	57						
14	1205	1.4	3.1	92.73	929	72	72	-8	269	250	54						
15	1209	1.3	2.9	96.59	933	73	73	-8	270	250	55						
15	1213	1.2	2.7	100.83	889	73	73	-8	271	249	55						
	1217			104.51													
21	1218	1.2	2.7	104.51	931	73	73	-7	269	251	53						
21	1222	1.2	2.7	108.02	934	74	74	-7	270	251	53						
22	1226	1.2	2.7	111.52	944	74	74	-8	270	251	53						
22	1230	1.0	2.2	115.45	940	74	74	-8	271	251	53						
23	1234	.95	2.1	118.73	938	74	74	-7	270	250	55						
23	1238	1.1	2.5	122.10	939	76	76	-6	271	250	54						
24	1242	1.3	2.9	125.29	919	75	75	-6	267	251	55						
24	1246	.98	2.2	129.63	910	76	76	-5	268	250	52						
25	1250	.95	2.2	132.63	891	77	77	-5	271	250	52						
25	1254	.92	2.1	136.12	903	77	77	-5	270	249	53						
	1258			139.67													
31	1300	1.0	2.2	139.67	945	77	78	-6	266	248	49						
31	1304	1.1	2.5	143.15	945	78	78	-6	268	252	50						
32	1308	.95	2.1	146.36	944	78	78	-5	267	251	50						
32	1312	.89	2.0	149.95	939	78	78	-6	270	251	52						
33	1316	.92	2.1	153.32	936	78	78	-6	271	250	53						

# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-6-22  
 Test Location: Hack  
 Test Method: 5/29

Test Number: 3  
 Operator: MAN Test Tech: ATW  
 Page Number: 2 of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)					
			Orifice Setting (ΔH)									K' x ΔP	Square Root, ΔP	K=	x	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
														Meter Rate, Cubic Feet/ Min.			
33	1320	.90	2.0	156.56	940	78	78	-8	272	251	53						
34	1324	1.1	2.5	159.47	941	79	79	-8	270	249	54						
34	1328	1.0	2.2	163.42	944	79	79	-8	268	251	54						
35	1332	.90	2.0	166.88	938	79	79	-7	271	249	54						
35	1335	.95	2.1	169.97	936	79	79	-7	272	250	54						
	1340			173.24													
41	1342	.66	1.6	173.24	845	78	78	-6	271	284	53						
41	1346	.68	1.6	176.25	855	78	78	-5	267	253	53						
42	1350	.72	1.7	179.12	851	78	78	-5	266	251	50						
42	1354	.72	1.8	181.85	825	79	79	-5	271	250	53						
43	1358	.73	1.8	185.19	821	78	78	-5	269	247	54						
43	1402	.70	1.8	188.34	799	78	78	-5	271	253	54						
44	1406	.67	1.7	191.42	782	78	78	-6	267	250	54						
44	1410	.74	1.9	194.24	770	77	77	-6	268	252	51						
45	1414	.72	1.9	197.37	748	78	78	-6	270	250	52						
45	1418	.77	2.0	200.57	742	77	77	-6	268	250	52						
	1422		MAN	203.72													
51	1424	.37	2.51.0	203.72	694	77	77	-6	263	258	55						
51	1428	.37	1.0	206.24	684	77	77	-6	264	248	54						
52	1432	.54	1.5	208.46	684	76	76	-5	265	245	53						
52	1436	.53	1.5	211.26	685	77	77	-5	267	251	53						
53	1440	.58	1.6	213.84	687	77	77	-6	267	253	52						
53	1444	.55	1.5	216.59	674	76	76	-6	267	247	53						
54	1448	.56	1.7	219.69	675	76	76	-7	263	248	53						
54	1452	1.2	2.7	223.56	936	76	76	-7	268	257	53						
55	1456	1.7	3.8	226.92	940	75	75	-7	267	251	50						
55	1500	1.1	2.6	231.55	885	76	76	-7	269	252	50						

# IMPINGER WEIGHT SHEET

PLANT: Northern NG-Clifton Scale ID Number 168  
 UNIT NO: 30 Scale Calibration Check Date: 12/6/22  
 LOCATION: Outlet Scale Calibration Check (see QS-6.05C for procedure)  
 DATE: 12/6/22 must be within  $\pm 0.5g$  of certified mass  
 TEST NO: 3 250 grams 250.0  
 METHOD: 5/29 500 grams 500.0  
 WEIGHED/MEASURED BY: RWC 750 grams 749.8

	FINAL WEIGHT	INITIAL WEIGHT	IMPINGER	IMPINGER
Circle One:	MLS / GRAMS	MLS / GRAMS	GAIN	CONTENTS
IMPINGER 1	760.9	725.4	35.5	HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub>
IMPINGER 2	686.4	707.8	-21.4	HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub>
IMPINGER 3	758.8	654.0	104.8	Empty
IMPINGER 4	650.5	639.8	10.7	KMnO <sub>4</sub>
IMPINGER 5	683.1	677.8	10.3	KMnO <sub>4</sub>
IMPINGER 6	947.6	912.2	35.4	Silica
IMPINGER 7				
IMPINGER 8				

IMPINGERS 3544.7 3404.8 139.9  
 FINAL TOTAL INITIAL TOTAL TOTAL IMPINGER GAIN  
 SILICA 947.6 912.2 35.4  
 FINAL TOTAL INITIAL TOTAL TOTAL SILICA GAIN

# Isokinetic Sampling Cover Sheet

Client:	Northern Natural Gas Company	Pitot Tube Cp:	0.840
Facility:	Clifton Compressor Station	Probe Length (Feet):	6
Test Location:	Unit 30	Probe Liner Material:	Quartz
Project #:	M224514	Sample Plane:	Hrztl. or Vert.
Test Method(s):	5-29	Port Length ("):	4.5
Test Engineer:	MAN	Port Diameter ("):	4
Test Technician:	ATW	Port Type:	Flange
Upstream Diameters:	20 0.5 RWC 12/13/22	Duct Shape:	Circ. or Rect.
Downstream Diameters:	20	Diameter (Feet):	
# of Ports Sampled:	5	Length (Feet):	5
# of Points per Port:	5	Width (Feet):	8
Source Condition:	Gas	Duct Area (Sq. Feet):	40
Diluent Model/SN:	ECOM	Minutes per Point:	8
Mid Gas ID/concentration:	%CO <sub>2</sub> %O <sub>2</sub>	Total Traverse Points:	25
High Gas ID/concentration:	%CO <sub>2</sub> %O <sub>2</sub>	Test Length (Min.):	200
Moisture Balance ID:	1000g	Train Type:	Anderson Over

R# 4

R# 5

R# 6

Meter ID:	CM47	CM47	CM47
Pitot ID:	711	711	711
Filter ID:			
Filter Pre-Weight (g):			
Nozzle Diameter ("):	0.273	0.273	0.273
Meter Cal Factor (Y):	1.008	1.008	1.008
Meter Orifice Setting (DH):	1.839	1.839	1.839
Nozzle Kit ID:	718	718	718
Individual Nozzle ID:	119	119	119
Pre Pitot Leak Check:	0.00 @ 5 "H <sub>2</sub> O	0.00 @ 5 "H <sub>2</sub> O	0.00 @ 5 "H <sub>2</sub> O
Post Pitot Leak Check:	0.00 @ 5 "H <sub>2</sub> O	0.00 @ 5 "H <sub>2</sub> O	0.00 @ 5 "H <sub>2</sub> O
Pre Nozzle Leak Check:	0.000 @ 20 "Hg	0.000 @ 21 "Hg	0.000 @ 22 "Hg
Post Nozzle Leak Check:	0.000 @ 20 "Hg	0.000 @ 21 "Hg	0.000 @ 22 "Hg
Barometric Pressure, "Hg:	28.77	28.77	28.77
Static Pressure, "H <sub>2</sub> O:	1.6	1.0	1.0
CO <sub>2</sub> %:	2.7	2.5	2.6
O <sub>2</sub> %:	16.8	16.7	16.6

Comments:



# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-7-22  
 Test Location: Stack  
 Test Method: 5/29

Test Number: 4  
 Operator: MAN Test Tech: ATW  
 Page Number: 1 of 2

Port-Point #	Time	(ΔP)	K¹ = _____	Meter Volume (V <sub>m</sub> ) ft³, Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)					
			K¹ x ΔP									Orifice Setting (ΔH)	Square Root, ΔP	K=	x	Theoretical Meter Volume, (V <sub>m</sub> ) ft³, per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft³, total
														Meter Rate, Cubic Feet/ Min.			
11	734	.74	1.8	239.131	923	42	42	-4	271	250	49						
11	738	.75	1.8	241.83	931	44	44	-4	268	251	38						
12	742	1.1	2.4	243.74	924	47	47	-5	269	250	37						
12	746	1.1	2.4	246.12	925	49	49	-5	270	250	37						
13	750	1.2	2.6	249.85	926	50	50	-5	268	250	39						
13	754	1.1	2.4	252.69	926	52	52	-5	269	250	38						
14	758	1.2	2.6	255.73	928	55	55	-5	270	247	38						
14	802	1.2	2.6	258.92	925	55	55	-5	270	249	38						
15	806	1.3	2.8	262.37	926	57	57	-6	268	253	39						
15	810	1.2	2.6	265.53	928	57	57	-6	269	250	39						
	814			268.57													
21	816	1.3	2.9	268.57	920	61	61	-6	267	255	37						
21	820	1.3	2.8	272.03	932	61	61	-6	268	256	38						
22	824	1.2	2.6	275.35	937	61	61	-5	269	252	38						
22	828	1.3	2.8	278.58	935	61	61	-5	271	252	39						
23	832	1.2	2.6	281.82	933	63	63	-5	268	249	40						
23	836	1.2	2.6	284.92	937	63	63	-5	270	250	41						
24	840	.97	2.1	287.63	932	64	64	-6	271	247	39						
24	844	.97	2.1	290.83	936	64	65	-5	270	251	37						
25	848	1.4	3.1	293.71	935	65	65	-5	268	251	37						
25	852	1.4	3.1	297.04	935	65	65	-5	270	250	37						
	856			300.41													
3 61	858	1.5	3.3	300.41	925	65	65	-5	266	250	39						
3 71	902	1.5	3.3	304.21	938	66	66	-5	268	251	39						
3 72	906	1.3	2.9	307.35	938	67	67	-5	271	252	40						
3 2	910	1.4	3.1	310.74	943	67	67	-5	270	250	41						
3 3	914	1.3	2.9	314.20	946	68	68	-6	271	250	41						

# Isokinetic Sampling Field Data Sheet

Project Number:

M224514

Date:

12-2-22

Test Number:

4

Client:

Northern Natural Gas

Test Location:

Stack

Operator:

WAC

Test Tech: ATW

Plant:

Clifton Facility

Test Method:

5/29

Page Number:

2

of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)				
			K' x ΔP									Square Root, ΔP	K=	x _____	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
33	918	1.2	2.6	317.73	939	68	68	-5	268	251	40					
34	922	1.3	2.9	320.77	944	69	69	-6	268	252	40					
34	926	1.4	3.1	324.30	943	69	69	-6	270	251	40					
35	930	1.3	2.9	327.77	945	70	70	-6	268	249	39					
35	934	1.4	3.1	330.88	939	70	70	-6	271	250	39					
	938			334.52												
41	947	1.6	3.5	337.82	945	71	71	-5	268	252	41					
41	945	1.6	3.5	338.35	944	71	71	-5	270	253	40					
42	949	1.6	3.5	342.15	946	71	71	-5	268	251	40					
42	953	1.7	3.8	348.79	948	72	72	-5	269	250	41					
43	957	1.7	3.8	349.52	948	72	72	-6	271	250	43					
43	1001	1.6	3.5	353.31	948	74	74	-5	267	250	44					
44	1005	1.6	3.5	356.76	946	73	73	-5	268	251	45					
44	1009	1.4	3.1	360.52	947	75	75	-6	269	249	45					
45	1013	1.3	2.9	364.36	947	75	75	-6	272	249	44					
45	1017	1.2	2.7	367.75	941	76	76	-5	270	250	42					
	1021			370.72												
51	1024	1.6	3.6	370.72	945	76	76	-5	268	250	43					
51	1028	1.8	4.0	374.76	943	77	77	-5	266	251	43					
52	1032	1.7	3.8	378.89	941	77	77	-6	269	250	43					
52	1036	1.7	3.8	382.34	947	78	78	-6	271	250	43					
53	1040	1.7	3.8	386.25	944	78	78	-5	271	251	43					
53	1044	1.6	3.6	390.10	944	78	78	-5	272	249	44					
54	1048	1.4	3.1	394.02	942	78	78	-5	269	256	44					
54	1052	1.2	2.7	397.68	944	79	79	-5	270	246	45					
55	1056	1.3	2.9	400.79	941	79	79	-5	268	250	44					
55	1100	1.3	2.9	403.82	941	80	80	-5	271	252	44					

# IMPINGER WEIGHT SHEET

PLANT: Northern NG - Clifton

Scale ID Number 168

UNIT NO: 30

Scale Calibration Check Date: 12/6/22 12/7/22

LOCATION: Outlet

Scale Calibration Check (see QS-6.05C for procedure)  
must be within  $\pm 0.5g$  of certified mass

DATE: 12/6/22 <sup>RWC</sup> 12/7/22

250 grams 250.0 250.0

TEST NO: 4

500 grams 500.0 500.0

RWC

METHOD: 5/29

750 grams 749.8 750.0

12/7/22

WEIGHED/MEASURED BY: RWC

	FINAL WEIGHT	INITIAL WEIGHT	IMPINGER	IMPINGER
Circle One:	MLS / GRAMS	MLS / GRAMS	GAIN	CONTENTS
IMPINGER 1	856.8	786.4	70.4	HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub>
IMPINGER 2	807.9	737.3	70.6	HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub>
IMPINGER 3	669.2	651.0	18.2	Empty
IMPINGER 4	766.5	760.4	6.1	KMnO <sub>4</sub>
IMPINGER 5	726.5	726.3	0.2	KMnO <sub>4</sub>
IMPINGER 6	900.5	878.8	21.7	Silica
IMPINGER 7				
IMPINGER 8				

IMPINGERS 3826.9 3666.4 160.5  
FINAL TOTAL INITIAL TOTAL TOTAL IMPINGER GAIN

SILICA 900.5 878.8 21.7  
FINAL TOTAL INITIAL TOTAL TOTAL SILICA GAIN



# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-7-22  
 Test Location: Stack  
 Test Method: 5/29

Test Number: 5  
 Operator: MAN Test Tech: ATW  
 Page Number: 1 of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)					
			K' x ΔP									Orifice Setting (ΔH)	Square Root, ΔP	K=	x _____	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
11	11:32	1.4	3.2	408.365	933	79	79	-5	258	256	57						
11	11:36	1.5	3.4	411.94	940	80	80	-6	265	252	60						
12	11:40	1.6	3.6	415.61	938	79	79	-5	267	256	60						
12	11:44	1.6	3.6	419.46	947	80	80	-6	271	251	61						
13	11:48	1.6	3.6	423.11	944	80	80	-6	268	250	60						
13	11:52	1.5	3.4	426.81	941	80	80	MAN-6	269	250	61						
14	11:56	1.4	3.2	430.65	943	80	80	271-6	271	250	55						
14	12:00	1.4	3.2	434.02	943	80	80	268-6	268	250	52						
15	12:04	1.3	2.9	437.51	941	81	81	269-5	269	249	51						
15	12:08	1.3	2.9	441.04	938	80	80	-6	271	250	49						
	12:12			444.32													
21	12:14	1.5	3.4	447.32	939	81	81	-6	271	250	48						
21	12:18	1.4	3.2	448.03	934	80	80	-7	267	252	48						
22	12:22	1.6	3.6	451.67	931	81	81	-7	270	250	48						
22	12:26	1.6	3.6	455.26	935	81	81	-8	268	251	48						
23	12:30	1.6	3.6	459.14	941	82	82	-8	267	250	48						
23	12:34	1.5	3.4	462.82	939	82	82	-7	271	250	49						
24	12:38	1.6	3.7	466.50	940	83	83	-10	270	250	51						
24	12:42	1.5	3.5	470.65	938	83	83	-13	270	250	50	→ RWE	fills in	for MAN			
25	12:46	1.5	3.5	474.02	940	84	84	-13	271	249	49						
25	12:50	1.3	3.0	477.72	937	84	84	-7	270	250	49						
	12:54			481.10													
31	12:56	1.5	3.7	481.10	940	83	83	-11	268	250	51						
31	13:00	1.6	3.7	484.72	933	84	84	-12	271	252	47						
32	13:04	1.4	3.2	488.67	933	84	84	-9	272	252	47						
32	13:08	1.3	3.0	492.15	937	84	84	-7	271	250	48						
33	13:12	1.2	2.7	495.53	935	84	84	-7	268	250	48						

→ RWE fills in for MAN

# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-7-22  
 Test Location: Stacks  
 Test Method: 5/29

Test Number: 5  
 Operator: MAN Test Tech: ATW  
 Page Number: 2 of 2

Port-Point #	Time	(ΔP)	K' = K' x ΔP Orifice Setting (ΔH)	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)			
												Square Root, ΔP	K=	x	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point
33	1316	1.2	2.7	498.92	936	85	85	-7	271	250	49				
34	1320	1.3	3.0	502.32	938	84	84	-8	267	251	48				
34	1324	1.3	3.0	505.67	936	84	84	-7	271	250	48				
35	1328	1.4	3.2	508.96	933	84	84	-9	273	250	48				
35	1332	1.4	3.2	512.52	933	83	83	-9	270	250	47				
	1336			516.21											
41	1338	1.3	3.0	516.21	930	83	83	-9	266	243	50				
41	1342	1.3	3.0	519.72	932	82	82	-9	266	245	49				
42	1346	1.2	3.0	523.36	936	82	82	-8	263	251	46				
42	1350	1.1	3.1	526.46	935	82	82	-8	268	250	45				
43	1354	1.0	2.3	529.63	934	81	81	-8	271	251	45				
43	1358	1.0	2.3	532.55	932	81	81	-7	272	250	46				
44	1402	1.1	2.5	535.69	931	81	81	-7	268	249	46				
44	1406	1.1	2.5	538.93	932	80	80	-7	269	250	46				
45	1410	1.1	2.5	542.64	932	81	81	-7	270	250	47				
45	1414	1.3	3.0	545.01	929	81	81	-6	268	250	46				
	1418			548.33											
51	1421	.98	2.2	548.33	920	80	80	-5	265	247	48				
51	1425	.96	2.2	551.58	934	79	79	-6	266	253	46				
52	1429	1.2	2.7	554.48	933	80	80	-7	270	254	47				
52	1433	1.2	2.7	557.66	934	79	79	-7	272	251	47				
53	1437	1.1	2.5	560.93	937	80	80	-8	273	249	47				
53	1441	1.2	2.7	564.03	934	79	79	-7	270	250	47				
54	1445	1.3	2.9	567.29	934	80	80	-7	268	250	48				
54	1449	1.2	2.7	570.73	932	79	79	-8	266	250	48				
55	1453	1.3	2.9	573.94	931	79	79	-8	268	250	47				
55	1457	1.4	3.2	577.32	932	79	79	-7	270	249	47				

580.204

# IMPINGER WEIGHT SHEET

PLANT: Northern-NG-Clifton Scale ID Number 168  
 UNIT NO: 30 Scale Calibration Check Date: 12/7/22  
 LOCATION: Outlet Scale Calibration Check (see QS-6.05C for procedure)  
 DATE: 12/7/22 must be within  $\pm 0.5g$  of certified mass  
 TEST NO: 5 250 grams 250.0  
 METHOD: 5/24 500 grams 500.0  
 WEIGHED/MEASURED BY: RWC 750 grams 750.0

	FINAL WEIGHT	INITIAL WEIGHT	IMPINGER	IMPINGER
Circle One:	MLS / GRAMS	MLS / GRAMS	GAIN	CONTENTS
IMPINGER 1	791.1	717.6	73.5	HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub>
IMPINGER 2	748.7	695.1	53.6	HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub>
IMPINGER 3	670.0	654.5	15.5	Empty
IMPINGER 4	627.0	621.1	5.9	KMnO <sub>4</sub>
IMPINGER 5	698.7	695.9	2.8	KMnO <sub>4</sub>
IMPINGER 6	937.8	<del>690.0</del> 908.1	29.7	Silica
IMPINGER 7		RWC 12/6/22		
IMPINGER 8				

IMPINGERS 3535.5 3384.2 151.3  
 FINAL TOTAL INITIAL TOTAL TOTAL IMPINGER GAIN

SILICA 937.8 908.1 29.7  
 FINAL TOTAL INITIAL TOTAL TOTAL SILICA GAIN

# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-7-22  
 Test Location: Stacks  
 Test Method: 5/29

Test Number: 6  
 Operator: MAN  
 Page Number: 1  
 Test Tech: ATW  
 of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)				
			K' x ΔP									Square Root, ΔP	K=	x	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
													Orifice Setting (ΔH)	Meter Rate, Cubic Feet/ Min.		
11	15:23	1.5	3.4	581.546	919	76	76	-8	248	247	65					
11	15:27	1.5	3.3	585.35	941	75	75	-8	260	260	56					
12	15:31	1.6	3.6	588.45	944	74	74	-9	261	245	51					
12	15:35	1.7	3.8	592.82	947	73	73	-10	260	253	49					
13	15:39	1.5	3.3	546.03	947	73	73	-10	264	263	49					
13	15:43	1.5	3.3	600.03	946	73	73	-9	270	251	49					
14	15:47	1.3	2.9	604.52	945	72	72	-9	272	249	48					
14	15:51	1.3	2.9	606.83	943	73	73	-9	272	250	48					
15	15:55	1.1	2.4	610.34	941	72	72	-8	269	247	46					
15	15:59	1.1	2.4	613.39	940	72	72	-8	264	247	46					
	16:03			616.59												
21	16:05	1.3	2.9	616.59	940	71	71	-9	270	249	45					
21	16:09	1.3	2.9	620.03	941	71	71	-8	271	252	43					
22	16:13	1.4	3.1	623.49	942	71	71	-8	268	250	43					
22	16:17	1.4	3.1	626.82	944	71	71	-8	271	249	43					
23	16:21	1.3	2.9	630.41	943	71	71	-9	265	252	43					
23	16:25	1.3	2.9	633.62	944	71	71	-10	268	249	43					
24	16:29	1.1	2.4	636.92	947	71	71	-7	270	249	45					
24	16:33	1.1	2.4	640.02	944	72	72	-6	268	248	45					
25	16:37	1.1	2.4	643.17	941	71	71	-5	266	247	45					
25	16:41	1.1	2.4	646.83	937	72	72	-5	273	251	44					
	16:45			649.26												
31	16:47	1.2	2.7	649.26	946	71	71	-6	268	250	41					
31	16:51	1.2	2.7	652.58	939	72	72	-6	271	254	41					
32	16:55	1.3	2.9	655.99	944	71	71	-6	269	254	41					
32	16:59	1.2	2.7	659.25	939	72	72	-7	273	250	41					
33	17:03	1.3	2.9	662.33	941	72	72	-7	269	249	41					

# Isokinetic Sampling Field Data Sheet

Project Number:

M224514

Date:

12-7-22

Test Number:

6

Client:

Northern Natural Gas

Test Location:

Stack

Operator:

MAW

Test Tech: ATW

Plant:

Clifton Facility

Test Method:

5/29

Page Number:

2

of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)				
			K' x ΔP									Square Root, ΔP	K=	x	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
													Meter Rate, Cubic Feet/ Min.			
33	1707	1.2	2.7	665.67	937	73	73	-6	272	249	41					
34	1711	1.3	2.9	669.02	937	73	73	-7	270	250	41					
34	1715	1.2	2.7	677.25	939	73	73	-6	272	251	41					
35	1719	1.2	2.7	674.93	940	73	73	-7	267	249	41					
35	1723	1.1	2.5	678.54	934	73	73	-5	269	251	42					
	1727			681.77												
41	1729	1.1	2.5	681.77	935	74	74	-7	267	251	40					
41	1733	1.1	2.5	685.02	939	75	75	-8	272	254	40					
42	1737	1.0	2.2	688.03	935	74	74	-7	268	250	42					
42	1741	0.85	2.1	691.01	935	74	74	-7	269	253	41					
43	1745	0.82	2.1	693.93	939	74	74	-6	271	251	40					
43	1749	0.97	2.2	696.66	937	74	74	-6	268	249	41					
44	1753	1.0	2.2	699.58	938	75	75	-7	270	248	41					
44	1757	1.1	2.5	702.42	934	75	75	-7	267	249	40					
45	1801	1.2	2.7	705.69	935	75	75	-7	268	250	40					
45	1805	1.2	2.7	708.83	934	75	75	-7	271	249	39					
	1809			712.14												
51	1811	0.66	1.5	712.14	913	75	75	-8	267	238	39					
51	1815	0.66	1.5	714.63	933	75	75	-8	271	248	39					
52	1819	0.87	2.0	717.20	931	74	74	-8	269	250	41					
52	1823	0.86	1.9	719.67	933	74	74	-8	270	251	40					
53	1827	0.94	2.1	722.45	938	74	74	-7	271	250	40					
53	1831	0.96	2.2	725.19	933	74	74	-7	269	253	39					
54	1835	1.1	2.5	728.15	933	74	74	-7	267	250	39					
54	1839	1.0	2.2	731.32	933	74	74	-8	268	250	39					
55	1843	1.1	2.5	734.31	931	74	74	-8	268	251	40					
55	1847	1.1	2.5	737.25	932	73	73	-8	270	251	38					

740,383



# IMPINGER WEIGHT SHEET

PLANT: Northen NG-Clifton

Scale ID Number 168

UNIT NO: 30

Scale Calibration Check Date: 12/7/22

LOCATION: Outlet

Scale Calibration Check (see QS-6.05C for procedure)  
must be within  $\pm 0.5g$  of certified mass

DATE: 12/7/22

250 grams 250.0

TEST NO: 6

500 grams 500.0

METHOD: 5/29

750 grams 750.0

WEIGHED/MEASURED BY: RWC

	FINAL WEIGHT	INITIAL WEIGHT	IMPINGER	IMPINGER
Circle One:	MLS / GRAMS	MLS / GRAMS	GAIN	CONTENTS
IMPINGER 1	<u>896.1</u>	<u>796.0</u>	<u>100.1</u>	<u>HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub></u>
IMPINGER 2	<u>779.8</u>	<u>734.7</u>	<u>45.1</u>	<u>HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub></u>
IMPINGER 3	<u>660.9</u>	<u>652.0</u>	<u>8.9</u>	<u>Empty</u>
IMPINGER 4	<u>779.4</u>	<u>775.5</u>	<u>3.9</u>	<u>KMnO<sub>4</sub></u>
IMPINGER 5	<u>728.2</u>	<u>725.5</u>	<u>2.7</u>	<u>KMnO<sub>4</sub></u>
IMPINGER 6	<u>908.7</u>	<u>879.3</u>	<u>24.4</u>	<u>Silica</u>
IMPINGER 7				
IMPINGER 8				

IMPINGERS 3839.4 3678.7 160.7  
FINAL TOTAL INITIAL TOTAL TOTAL IMPINGER GAIN

SILICA 908.7 879.3 24.4  
FINAL TOTAL INITIAL TOTAL TOTAL SILICA GAIN



# Isokinetic Sampling Cover Sheet

Client:	Northern Natural Gas Company	Pitot Tube Cp:	0.840
Facility:	Clifton Compressor Station	Probe Length (Feet):	6
Test Location:	Unit 30	Probe Liner Material:	Quartz
Project #:	M224514	Sample Plane:	Hztl. or Vert.
Test Method(s):	5/29	Port Length ("):	4.5
Test Engineer:	MAW	Port Diameter ("):	4
Test Technician:	ATW	Port Type:	Flange
Upstream Diameters:	<del>2.0</del> 0.5 RWC 12/13/22	Duct Shape:	Circ. or Rect.
Downstream Diameters:	2.0	Diameter (Feet):	
# of Ports Sampled:	5	Length (Feet):	5
# of Points per Port:	5	Width (Feet):	8
Source Condition:	Gas	Duct Area (Sq. Feet):	40
Diluent Model/SN:	ECOM	Minutes per Point:	8
Mid Gas ID/concentration:	%CO <sub>2</sub> %O <sub>2</sub>	Total Traverse Points:	25
High Gas ID/concentration:	%CO <sub>2</sub> %O <sub>2</sub>	Test Length (Min.):	200
Moisture Balance ID:	1000	Train Type:	Anderson Over

R# 1

R#

R#

Meter ID:	CNH7		
Pitot ID:	711		
Filter ID:			
Filter Pre-Weight (g):			
Nozzle Diameter ("):	0.273		
Meter Cal Factor (Y):	1.008		
Meter Orifice Setting (DH):	1.839		
Nozzle Kit ID:	718		
Individual Nozzle ID:			
Pre Pitot Leak Check:	0.60 @ 5 "H <sub>2</sub> O	@ "H <sub>2</sub> O	@ "H <sub>2</sub> O
Post Pitot Leak Check:	0.00 @ 5 "H <sub>2</sub> O	@ "H <sub>2</sub> O	@ "H <sub>2</sub> O
Pre Nozzle Leak Check:	0.00 @ 22 "Hg	@ "Hg	@ "Hg
Post Nozzle Leak Check:	0.00 @ 24 "Hg	@ "Hg	@ "Hg
Barometric Pressure, "Hg:	28.75		
Static Pressure, "H <sub>2</sub> O:	1.0		
CO <sub>2</sub> %:	2.2		
O <sub>2</sub> %:	17.4		

Comments:

# Isokinetic Sampling Field Data Sheet

Project Number: M224514  
 Client: Northern Natural Gas  
 Plant: Clifton Facility

Date: 12-8-22  
 Test Location: Stack  
 Test Method: 5/29

Test Number: 7  
 Operator: MAN Test Tech: ATW  
 Page Number: 1 of 2

Port-Point #	Time	(ΔP)	K' = _____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)				
			K' x ΔP									Square Root, ΔP	K=	x	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
11	8:52	1.5	3.5	740.988	934	45	45	-7	244	245	50					
11	8:56	1.5	3.5	744.68	936	47	47	-6	247	243	44					
12	9:00	1.7	4.0	748.39	937	48	48	-8	263	258	46					
12	9:04	1.7	4.0	752.21	940	49	49	-11	265	255	49					
13	9:08	1.6	3.8	755.76	941	51	51	-12	268	251	53					
13	9:12	1.6	3.8	759.77	937	52	52	-12	271	251	54					
14	9:16	1.3	3.1	763.57	941	54	54	-8	269	250	57					
14	9:20	1.4	3.3	766.92	938	56	56	-7	267	250	57					
15	9:24	1.3	3.1	770.46	936	57	57	-6	271	249	56					
15	9:28	1.3	3.1	773.82	937	58	58	-6	268	249	57					
	9:32			777.35												
21	9:34	1.5	3.6	777.35	937	59	59	-8	269	249	46					
21	9:38	1.4	3.4	781.42	938	60	60	-8	270	251	51					
22	9:42	1.7	4.1	784.73	939	61	61	-10	267	252	54					
22	9:46	1.7	4.1	788.83	942	61	61	-10	269	251	55					
23	9:50	1.6	3.9	792.68	939	63	63	-9	271	250	55					
23	9:54	1.6	3.9	796.46	940	64	64	-9	268	249	56					
24	9:58	1.5	3.6	800.39	941	64	64	-8	271	249	55					
24	10:02	1.4	3.4	803.56	937	65	65	-8	272	250	54					
25	10:06	1.4	3.4	807.72	935	64	64	-7	269	249	54					
25	10:10	1.3	3.2	811.44	938	64	64	-7	267	249	53					
	10:14			814.73												
31	10:16	1.5	3.6	814.73	936	64	64	-7	267	252	46					
31	10:20	1.5	3.6	818.63	937	64	64	-8	271	255	48					
32	10:24	1.3	3.2	822.26	935	64	64	-8	271	255	49					
32	10:28	1.3	3.2	825.73	937	64	64	-7	269	255	48					
33	10:32	1.4	3.4	829.04	938	64	64	-7	269	252	48					

# Isokinetic Sampling Field Data Sheet

Project Number:

M224514  
Northern Natural Gas  
Clifton Facility

Date:

12-8-22

Test Number:

7

Client:

Test Location:

Stack

Operator:

MAN

Test Tech: ARW

Plant:

Test Method:

512g

Page Number:

2

of 2

Port-Point #	Time	(ΔP)	K' = ____	Meter Volume (V <sub>m</sub> ) ft <sup>3</sup> , Actual	Stack Temp, °F	Meter Temp Inlet, °F	Meter Temp Outlet, °F	Pump Vacuum, "Hg	Probe Temp. °F	Filter Temp. °F	Impinger Outlet Well Temp. °F	K-Calcs (Optional)			
			Orifice Setting (ΔH)									K=	x	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , per point	Theoretical Meter Volume, (V <sub>m</sub> ) ft <sup>3</sup> , total
33	1036	1.3	3.2	832.42	934	64	64	-8	270	249	50				
34	1040	1.2	2.9	836.31	939	66	66	-8	271	250	50				
34	1044	1.3	3.2	840.03	937	65	65	-8	267	250	50				
35	1048	1.4	3.4	843.04	938	66	66	-9	268	250	49				
35	1052	1.4	3.4	846.61	934	66	66	-9	267	249	48				
	1056			850.33											
41	1058	1.3	3.2	850.33	936	66	66	-8	271	253	43				
41	1102	1.3	3.2	854.13	933	66	66	-8	268	250	45				
42	1106	1.2	2.9	857.42	936	66	66	-9	267	254	49				
42	1110	1.1	2.7	860.82	935	66	66	-8	265	252	50				
43	1114	0.97	2.4	863.61	936	66	66	-7	268	249	51				
43	1118	0.95	2.3	866.42	931	66	66	-6	270	249	52				
44	1122	1.1	2.7	869.83	933	66	66	-7	268	248	50				
44	1126	1.1	2.7	873.04	931	66	66	-7	269	247	49				
45	1130	1.3	3.2	876.30	929	66	66	-8	271	248	47				
45	1134	1.3	3.2	879.83	927	66	66	-8	271	250	46				
	1138			883.34											
51	1143	0.78	2.0	883.34	893	66	66	-6	270	258	43				
51	1147	0.83	2.0	886.21	932	67	67	-6	268	254	48				
52	1151	1.1	2.7	889.04	933	67	67	-9	270	250	49				
52	1155	1.2	2.7	892.41	932	67	67	-9	268	250	49				
53	1159	1.1	2.7	895.72	933	67	67	-8	271	256	48				
53	1203	1.1	2.7	898.93	932	68	68	-8	269	250	48				
54	1207	1.3	3.2	901.94	932	68	68	-9	270	250	48				
54	1211	1.2	2.9	905.64	932	68	68	-8	268	248	48				
55	1215	1.2	3.0	908.82	929	68	68	-9	270	251	49				
55	1219	1.3	3.2	912.33	926	69	69	-10	270	248	50				

1223

915,831

# IMPINGER WEIGHT SHEET

PLANT: Northern NG-Clifton

Scale ID Number 168

UNIT NO: 30

Scale Calibration Check Date: 12/8/22

LOCATION: Outlet

Scale Calibration Check (see QS-6.05C for procedure)  
must be within  $\pm 0.5g$  of certified mass

DATE: 12/8/22

250 grams 250.0

TEST NO: 7

500 grams 499.8

METHOD: 5/29

750 grams 749.8

WEIGHED/MEASURED BY: RWC

	FINAL WEIGHT	INITIAL WEIGHT	IMPINGER	IMPINGER
Circle One:	MLS / GRAMS	MLS / GRAMS	GAIN	CONTENTS
IMPINGER 1	<u>771.1</u>	<u>722.3</u>	<u>48.8</u>	<u>HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub></u>
IMPINGER 2	<u>774.1</u>	<u>701.7</u>	<u>72.4</u>	<u>HNO<sub>3</sub>/H<sub>2</sub>O<sub>2</sub></u>
IMPINGER 3	<u>676.7</u>	<u>653.8</u>	<u>22.9</u>	<u>Empty</u>
IMPINGER 4	<u>628.2</u>	<u>616.6</u>	<u>11.6</u>	<u>KMnO<sub>4</sub></u>
IMPINGER 5	<u>682.8</u>	<u>682.7</u>	<u>0.1</u>	<u>KMnO<sub>4</sub></u>
IMPINGER 6	<u>915.5</u>	<u>881.5</u>	<u>34.0</u>	<u>Silica</u>
IMPINGER 7				
IMPINGER 8				

IMPINGERS 3532.9 3377.1 155.8  
FINAL TOTAL INITIAL TOTAL TOTAL IMPINGER GAIN

SILICA 915.5 881.5 34.0  
FINAL TOTAL INITIAL TOTAL TOTAL SILICA GAIN

(During Ri)

Date: 5 Pre 1, FTIR  
 Test Number: 12-5-22  
 Start Time: 1141  
 End Time: 1156  
 Test Tech: ATW

Duct Diameter 6.154 ft Upstream Disturbance, Diameters 2.0  
 Flue Area 40.00 ft<sup>2</sup> Downstream Disturbance, Diameters 2.0  
 Port Length 4.5 " Port Size 4 " Port Type Flange Pitot ID 888 Pitot Coefficient (C<sub>p</sub>) .84  
 P<sub>bar</sub> 28.37 "Hg CO<sub>2</sub> % 2.47 Wet Bulb Temp — Leak Checks Passed@  
 Static 1.0 "H<sub>2</sub>O O<sub>2</sub> % 16.7 Dry Bulb Temp — Pre 0.0 Inches H<sub>2</sub>O @5  
 Static — "Hg N<sub>2</sub> % 80.83 B<sub>ws</sub> .049.048 RWC Post 0.0 Inches H<sub>2</sub>O @5  
 P<sub>s</sub> 28/44"Hg Meter No. F3 Fluke # — 12/12/24 Umbilical ID —

[illegible]

$$.44 \times \text{CO}_2\% + .32 \times \text{O}_2\% + .28 \times \text{N}_2\% = \text{_____ (Md)}$$

$$(\text{Md} \times 1 - \text{Bws}) + (18 \times \text{Bws}) = (\text{Ms})$$

$$85.49 \times \text{Cp} \times \sqrt{\frac{(\text{ ) Ts } ^\circ\text{R}}{\text{Ms} \times \text{Ps}}} \times \sqrt{\Delta P} = \text{ft/sec (Vs)}$$

$$\text{Vs} \times \text{Flue Area} \times 60 = \text{acfm}$$

$$17.647 \times \text{acfm} \times \frac{P_s}{T_s \text{ } ^\circ\text{R}} = \text{scfm} \times 60 = \text{scfh}$$



Date: 11-5-22 (During RS)  
Test Number: Post 5, FTIR  
Start Time: 1731230  
End Time: 1744  
Test Tech: ATW

Duct Diameter 6.154 ft  
Flue Area 40.00 ft<sup>2</sup>  
Port Length 4.5 " Port Size 40 " Port Type Flange Pitot ID 888 Pitot Coefficient (C<sub>p</sub>) 0.84  
P<sub>bar</sub> 28.37 "Hg CO<sub>2</sub> % 2.74 Wet Bulb Temp — Leak Checks Passed @  
Static 1.0 "H<sub>2</sub>O O<sub>2</sub> % 16.3 Dry Bulb Temp — Pre 0.0 Inches H<sub>2</sub>O @ 5  
Static — "Hg N<sub>2</sub> % 80.96 B<sub>ws</sub> 0.049 0.051 Post 0.0 Inches H<sub>2</sub>O @ 5  
P<sub>s</sub> 26.44 "Hg Meter No. F3 Fluke # — <sup>2nd</sup> 12/12/22 Umbilical ID —

$$.44 \times \text{CO}_2\% + .32 \times \text{O}_2\% + .28 \times \text{N}_2\% = \underline{\hspace{2cm}} \text{ (Md)}$$

$$(\text{Md} \times 1 - \text{Bws}) + (18 \times \text{Bws}) = (\text{Ms})$$

$$\underline{\hspace{1cm}} \text{ Vs } \times \underline{\hspace{1cm}} \text{ Flue Area } \times 60 = \underline{\hspace{1cm}} \text{ acfm}$$

$$17.647 \times \text{acfm} \times \frac{P_s}{T_s \text{ } ^\circ\text{R}} = \text{scfm} \times 60 = \text{scfm}$$

Project Number:	M224514	Date:	12/5/22
Client:	Northern Natural Gas <i>Clifton</i>	Test Number:	Run 6 Gas Flow Traverse
Test Location:	Unit 30	Start Time:	1845-1908
Source Condition:	Natural	End Time:	1922
Test Engineer:	STS	Test Tech:	AW

Duct Diameter 5.8 ft  
Flue Area 40 ft<sup>2</sup>  
Port Length 4 " Port Size 6 " Port Type Flange Pitot ID 888 Pitot Coefficient (C<sub>p</sub>) 0.84  
P<sub>bar</sub> 28.72 "Hg CO<sub>2</sub> % 2.7 Wet Bulb Temp — Leak Checks Passed @  
Static 1.0 "H<sub>2</sub>O O<sub>2</sub> % 16.0 Dry Bulb Temp — Pre 3 Inches H<sub>2</sub>O  
Static — "Hg N<sub>2</sub> % — B<sub>ws</sub> 0.05 Post 3 Inches H<sub>2</sub>O  
P<sub>s</sub> — "Hg Meter No. F3 Fluke # — Umbilical ID —

[illegible]

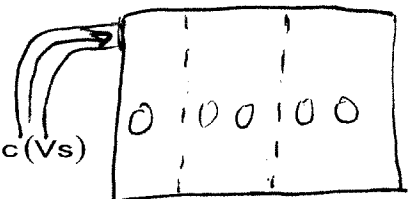
$$.44 \times \text{CO}_2\% + .32 \times \text{O}_2\% + .28 \times \text{N}_2\% = \text{_____ (Md)}$$

$$(\text{Md} \times 1 - \text{Bws}) + (18 \times \text{Bws}) = \text{Ms}$$

$$85.49 \times \text{Cp} \times \sqrt{\frac{(\text{ ) Ts } ^\circ\text{R}}{\text{Ms} \times \text{Ps}}} \times \sqrt{\Delta P} = \text{ft/sec (Vs)}$$

         Vs x          Flue Area x 60 =          acfm

$$17.647 \times \text{acfm} \times \frac{P_s}{T_s \text{ } ^\circ\text{R}} = \text{scfm} \times 60 = \text{scfh}$$



## Appendix G – QA/QC Data

Client: Northern Natural Gas  
 Facility: Clifton Compressor Station  
 Project #: M224514

Test Location: Unit 30  
 Date: 12/5/2022  
 Operator: S. Sands  
 FTIR s/n: 111171031

Operating Condition: Normal

System Leak Check: 0.0 mL/min

#### Nitrogen (Zero) Direct to FTIR

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
N2_DIR_000007.LAB	12/5/22	7:27:36	0.0	191.0	1.28	-0.1	0.0	0.000
N2_DIR_000008.LAB	12/5/22	7:27:44	0.0	191.0	1.28	-0.1	0.0	0.000
N2_DIR_000009.LAB	12/5/22	7:29:02	0.0	191.0	0.96	-0.1	0.2	0.000
N2_DIR_000010.LAB	12/5/22	7:29:10	0.0	191.0	0.96	0.1	-0.1	0.000
N2_DIR_000011.LAB	12/5/22	7:29:18	0.0	191.0	0.96	0.0	0.1	0.000
N2_DIR_000012.LAB	12/5/22	7:29:26	0.0	191.0	0.96	0.0	0.0	0.000
N2_DIR_000013.LAB	12/5/22	7:29:35	0.0	191.0	0.96	-0.1	0.0	0.000
N2_DIR_000014.LAB	12/5/22	7:29:43	0.0	191.0	0.96	-0.1	0.0	0.000
N2_DIR_000015.LAB	12/5/22	7:29:51	0.0	191.0	0.96	-0.1	0.0	0.000

#### Calibration Transfer Standard (CTS), Direct to FTIR

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS_DIR_000062.LAB	12/5/22	7:50:30	0.0	191.0	0.96	96.9	-0.1	0.000	97.8%
CTS_DIR_000063.LAB	12/5/22	7:50:38	0.0	191.0	0.96	96.4	-0.1	0.000	97.3%
CTS_DIR_000064.LAB	12/5/22	7:50:46	0.0	191.0	0.96	96.6	-0.2	0.000	97.5%
CTS_DIR_000065.LAB	12/5/22	7:50:54	0.0	191.0	0.96	96.7	0.1	0.000	97.7%
CTS_DIR_000066.LAB	12/5/22	7:51:03	0.0	191.0	0.96	96.9	0.0	0.000	97.9%
CTS_DIR_000067.LAB	12/5/22	7:51:11	0.0	191.0	0.96	96.8	0.0	0.000	97.7%
CTS_DIR_000068.LAB	12/5/22	7:51:19	0.0	191.0	0.96	96.9	0.2	0.000	97.8%
CTS_DIR_000069.LAB	12/5/22	7:51:27	0.0	191.0	0.96	96.9	-0.1	0.000	97.8%
Average						96.8			97.7%

#### Analyte Spike Gas (HCl ppmvw) Direct to FTIR

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % HCl ppmvw
HCL_DIR_000599.LAB	12/5/22	10:59:36	0.0	191.0	0.97	-0.3	38.7	4.796	77.9%
HCL_DIR_000600.LAB	12/5/22	10:59:45	0.0	191.1	0.97	-0.3	37.4	4.752	75.2%
HCL_DIR_000601.LAB	12/5/22	10:59:53	0.0	191.1	0.97	-0.3	38.2	4.747	76.9%
HCL_DIR_000602.LAB	12/5/22	11:00:01	0.0	191.1	0.97	-0.4	38.6	4.767	77.7%
HCL_DIR_000603.LAB	12/5/22	11:00:09	0.0	191.1	0.97	-0.2	39.3	4.741	79.1%
HCL_DIR_000604.LAB	12/5/22	11:00:18	0.0	191.1	0.97	-0.6	39.6	4.755	79.8%
HCL_DIR_000605.LAB	12/5/22	11:00:26	0.0	191.1	0.97	-0.5	39.0	4.762	78.5%
HCL_DIR_000606.LAB	12/5/22	11:00:34	0.0	191.1	0.97	-0.5	40.4	4.759	81.4%
Average							38.9	4.760	78.3%

#### CTS, System Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS_RT_000389.LAB	12/5/22	9:45:03	0.0	191.0	0.97	97.5	-0.1	0.000	100.8%
CTS_RT_000390.LAB	12/5/22	9:45:11	0.0	191.0	0.97	96.7	0.1	0.000	100.0%
CTS_RT_000391.LAB	12/5/22	9:45:19	0.0	191.0	0.97	96.5	0.1	0.000	99.7%
CTS_RT_000392.LAB	12/5/22	9:45:27	0.0	191.0	0.97	97.3	0.1	0.000	100.6%
CTS_RT_000393.LAB	12/5/22	9:45:36	0.0	191.0	0.97	97.2	0.2	0.000	100.4%
CTS_RT_000394.LAB	12/5/22	9:45:44	0.0	191.0	0.97	96.2	0.2	0.000	99.5%
CTS_RT_000395.LAB	12/5/22	9:45:52	0.0	191.0	0.96	97.2	-0.1	0.000	100.5%
CTS_RT_000396.LAB	12/5/22	9:46:00	0.0	191.0	0.97	97.8	0.0	0.000	101.1%

Method 320/321 QA/QC

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Operating Condition: Normal

Test Location: Unit 30  
Date: 12/5/2022  
Operator: S. Sands  
FTIR s/n: 111171031

Response Time Test

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Response Time (sec)
CTS_RT_000378.LAB	12/5/22	9:43:32	0.6	191.0	0.97	0.0	0.1	0.000	-
CTS_RT_000379.LAB	12/5/22	9:43:40	0.3	191.0	0.97	41.5	0.2	0.000	16.276
CTS_RT_000380.LAB	12/5/22	9:43:48	0.0	191.0	0.97	95.5	0.0	0.000	24.276

Zero Gas System Purge and Response Time Test

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Response Time (sec)
CTS_RT_000409.LAB	12/5/22	9:47:48	0.0	190.9	0.97	96.2	0.0	0.000	-
CTS_RT_000410.LAB	12/5/22	9:47:56	0.0	190.9	0.97	89.0	0.0	0.000	16.254
CTS_RT_000411.LAB	12/5/22	9:48:04	0.5	190.9	0.97	1.8	0.2	0.000	24.520

Pre 1 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
HCL_SPIKE_000615.LAB	12/5/22	11:02:21	4.2	191.2	0.97	-0.1	-0.1	0.001
HCL_SPIKE_000616.LAB	12/5/22	11:02:30	4.3	191.2	0.97	-0.2	0.3	-0.012
HCL_SPIKE_000617.LAB	12/5/22	11:02:38	4.3	191.2	0.97	0.7	-0.1	-0.001
						0.0		-0.004

Pre 1 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCl ppmvw
HCL_SPIKE_000628.LAB	12/5/22	11:04:09	4.1	190.9	0.97	-0.2	2.7	0.383	0.081	86.5%
HCL_SPIKE_000629.LAB	12/5/22	11:04:17	4.0	190.9	0.97	0.5	2.9	0.363	0.076	96.7%
HCL_SPIKE_000630.LAB	12/5/22	11:04:25	4.1	190.9	0.97	-0.2	2.8	0.344	0.072	99.6%
HCL_SPIKE_000631.LAB	12/5/22	11:04:33	4.0	190.9	0.97	0.1	2.9	0.353	0.074	99.9%
HCL_SPIKE_000632.LAB	12/5/22	11:04:42	4.1	190.9	0.97	0.0	2.8	0.355	0.074	97.2%
HCL_SPIKE_000633.LAB	12/5/22	11:04:50	4.0	190.9	0.97	0.2	2.9	0.344	0.072	101.1%
HCL_SPIKE_000634.LAB	12/5/22	11:04:58	4.1	190.9	0.97	0.0	2.6	0.353	0.074	87.6%
HCL_SPIKE_000635.LAB	12/5/22	11:05:06	4.0	190.9	0.97	0.1	2.9	0.339	0.071	101.9%

Post 1 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
R1_SYS_000723.LAB	12/5/22	12:36:30	4.8	191.0	0.97	0.1	0.4	0.004
R1_SYS_000724.LAB	12/5/22	12:37:34	4.8	191.0	0.97	0.2	0.4	0.010
R1_SYS_000725.LAB	12/5/22	12:38:38	4.8	191.0	0.97	0.2	0.5	0.006
						0.4		0.007

Post 1 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCl ppmvw
R1_SPIKESYS_000749.LAB	12/5/22	12:43:57	4.2	191.0	0.97	0.3	2.6	0.360	0.076	79.20%
R1_SPIKESYS_000750.LAB	12/5/22	12:44:05	4.2	191.0	0.97	0.7	2.8	0.341	0.072	87.48%
R1_SPIKESYS_000751.LAB	12/5/22	12:44:14	4.1	191.0	0.97	0.2	2.7	0.373	0.078	79.91%
R1_SPIKESYS_000752.LAB	12/5/22	12:44:22	4.1	191.0	0.97	-0.2	2.8	0.347	0.073	85.91%
R1_SPIKESYS_000753.LAB	12/5/22	12:44:30	4.1	191.0	0.97	-0.2	2.9	0.354	0.074	87.32%
R1_SPIKESYS_000754.LAB	12/5/22	12:44:38	4.1	191.0	0.97	-0.3	2.7	0.339	0.071	85.12%
R1_SPIKESYS_000755.LAB	12/5/22	12:44:46	4.2	191.0	0.97	0.1	3.0	0.335	0.070	97.08%
R1_SPIKESYS_000756.LAB	12/5/22	12:44:55	4.1	191.0	0.97	0.4	2.7	0.334	0.070	86.74%



Method 320/321 QA/QC

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Operating Condition: Normal

Test Location: Unit 30  
Date: 12/5/2022  
Operator: S. Sands  
FTIR s/n: 111171031

Post 2 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
R2_SYS_000874.LAB	12/5/22	13:54:53	5.0	191.1	0.97	0.1	0.0	-0.001
R2_SYS_000875.LAB	12/5/22	13:55:56	4.9	191.2	0.97	0.1	0.0	0.001
R2_SYS_000876.LAB	12/5/22	13:57:00	5.0	191.1	0.97	0.2	0.0	0.001
							0.0	0.000

Post 2 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCl ppmvw
R2_SPIKESYS_000894.LAB	12/5/22	14:01:19	4.7	191.0	0.98	0.2	3.1	0.331	0.070	115.64%
R2_SPIKESYS_000895.LAB	12/5/22	14:01:27	4.8	191.0	0.98	0.3	2.9	0.324	0.068	111.08%
R2_SPIKESYS_000896.LAB	12/5/22	14:01:35	4.7	191.0	0.97	0.1	3.1	0.313	0.066	122.32%
R2_SPIKESYS_000897.LAB	12/5/22	14:01:43	4.7	191.0	0.97	-0.1	3.0	0.304	0.064	120.71%
R2_SPIKESYS_000898.LAB	12/5/22	14:01:51	4.7	191.0	0.97	0.1	3.3	0.328	0.069	123.22%
R2_SPIKESYS_000899.LAB	12/5/22	14:02:00	4.7	190.9	0.97	0.4	2.8	0.302	0.063	114.61%
R2_SPIKESYS_000900.LAB	12/5/22	14:02:08	4.7	191.0	0.98	0.1	2.8	0.327	0.069	105.75%
R2_SPIKESYS_000901.LAB	12/5/22	14:02:16	4.7	191.0	0.98	0.1	3.0	0.302	0.063	121.00%

Post 2 CTS, System Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
R2_POSTCALSYS_000933.LAB	12/5/22	14:07:10	0.1	191.0	0.98	97.5	-0.2	0.008	100.8%
R2_POSTCALSYS_000934.LAB	12/5/22	14:07:18	0.1	191.0	0.97	98.7	0.0	0.010	102.0%
R2_POSTCALSYS_000935.LAB	12/5/22	14:07:27	0.1	191.0	0.97	98.4	0.0	0.017	101.7%
R2_POSTCALSYS_000936.LAB	12/5/22	14:07:35	0.1	190.9	0.98	97.8	0.2	0.012	101.1%
R2_POSTCALSYS_000937.LAB	12/5/22	14:07:43	0.1	190.9	0.97	98.7	0.1	0.014	102.0%
R2_POSTCALSYS_000938.LAB	12/5/22	14:07:51	0.1	191.0	0.98	98.1	0.2	0.009	101.4%
R2_POSTCALSYS_000939.LAB	12/5/22	14:08:00	0.1	191.0	0.98	98.4	0.1	0.007	101.7%
R2_POSTCALSYS_000940.LAB	12/5/22	14:08:08	0.1	191.0	0.98	97.7	0.0	0.011	101.0%

Post 3 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
R3_SYS_001008.LAB	12/5/22	15:08:41	5.1	191.0	0.98	-0.1	0.0	0.003
R3_SYS_001009.LAB	12/5/22	15:09:43	5.1	191.1	0.97	0.2	-0.1	0.004
R3_SYS_001010.LAB	12/5/22	15:10:44	5.1	191.1	0.98	0.2	-0.1	0.003
							-0.1	0.003

Post 3 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCl ppmvw
R3_SPIKE_SYS_001026.LAB	12/5/22	15:16:07	4.8	191.0	0.97	0.1	3.0	0.357	0.075	103.73%
R3_SPIKE_SYS_001027.LAB	12/5/22	15:16:16	4.7	191.0	0.98	-0.2	2.8	0.340	0.071	104.47%
R3_SPIKE_SYS_001028.LAB	12/5/22	15:16:24	4.7	191.0	0.98	0.0	2.7	0.346	0.073	96.66%
R3_SPIKE_SYS_001029.LAB	12/5/22	15:16:32	4.7	191.0	0.98	0.2	3.0	0.351	0.074	105.31%
R3_SPIKE_SYS_001030.LAB	12/5/22	15:16:40	4.7	190.9	0.98	0.3	2.9	0.334	0.070	109.46%
R3_SPIKE_SYS_001031.LAB	12/5/22	15:16:48	4.7	190.9	0.98	0.3	2.8	0.323	0.068	106.89%
R3_SPIKE_SYS_001032.LAB	12/5/22	15:16:57	4.7	190.9	0.98	0.3	2.8	0.321	0.067	109.19%
R3_SPIKE_SYS_001033.LAB	12/5/22	15:17:05	4.8	190.9	0.98	0.2	2.7	0.311	0.065	109.74%

Client: Northern Natural Gas  
 Facility: Clifton Compressor Station  
 Project #: M224514

Operating Condition: Normal

Test Location: Unit 30  
 Date: 12/5/2022  
 Operator: S. Sands  
 FTIR s/n: 111171031

#### Post 3 CTS, System Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
R3_GASCAL_SYS_001039.LAB	12/5/22	15:18:18	0.6	190.9	0.98	97.7	1.0	0.006	101.0%
R3_GASCAL_SYS_001040.LAB	12/5/22	15:18:27	0.6	191.0	0.98	97.0	1.0	0.018	100.3%
R3_GASCAL_SYS_001041.LAB	12/5/22	15:18:35	0.5	191.0	0.97	97.8	0.6	0.028	101.1%
R3_GASCAL_SYS_001042.LAB	12/5/22	15:18:43	0.5	191.0	0.98	97.4	0.6	0.021	100.6%
R3_GASCAL_SYS_001043.LAB	12/5/22	15:18:51	0.4	191.0	0.98	97.8	0.4	0.034	101.1%
R3_GASCAL_SYS_001044.LAB	12/5/22	15:19:00	0.4	191.0	0.98	97.9	0.3	0.016	101.1%
R3_GASCAL_SYS_001045.LAB	12/5/22	15:19:08	0.4	191.0	0.98	97.2	0.3	-0.002	100.5%
R3_GASCAL_SYS_001046.LAB	12/5/22	15:19:16	0.4	191.0	0.98	98.1	0.3	0.029	101.4%

#### Post 4 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
R4_SYS_001159.LAB	12/5/22	16:26:38	5.1	190.9	0.98	0.3	0.1	0.009
R4_SYS_001160.LAB	12/5/22	16:27:40	5.0	190.9	0.98	0.0	0.1	0.001
R4_SYS_001161.LAB	12/5/22	16:28:42	5.1	190.9	0.98	0.2	0.1	0.013
							0.1	0.008

#### Post 4 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCl ppmvw
R4SPIKE_SYS_001173.LAB	12/5/22	16:31:39	4.6	190.9	0.98	0.7	3.0	0.345	0.072	103.72%
R4SPIKE_SYS_001174.LAB	12/5/22	16:31:48	4.7	190.9	0.98	0.2	2.9	0.345	0.072	100.58%
R4SPIKE_SYS_001175.LAB	12/5/22	16:31:56	4.7	190.9	0.98	0.9	3.0	0.348	0.073	102.21%
R4SPIKE_SYS_001176.LAB	12/5/22	16:32:04	4.7	190.9	0.98	-0.1	3.0	0.344	0.072	102.84%
R4SPIKE_SYS_001177.LAB	12/5/22	16:32:12	4.6	190.9	0.98	-0.1	3.0	0.357	0.075	98.83%
R4SPIKE_SYS_001178.LAB	12/5/22	16:32:21	4.7	190.9	0.98	0.3	3.0	0.337	0.071	105.05%
R4SPIKE_SYS_001179.LAB	12/5/22	16:32:29	4.7	190.9	0.98	0.6	2.9	0.334	0.070	103.96%
R4SPIKE_SYS_001180.LAB	12/5/22	16:32:37	4.7	190.9	0.98	0.1	3.0	0.329	0.069	108.52%

#### Post 4 CTS, System Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
R4GASCAL_SYS_001187.LAB	12/5/22	16:33:54	0.7	190.9	0.98	97.9	0.3	0.015	101.2%
R4GASCAL_SYS_001188.LAB	12/5/22	16:34:02	0.6	190.9	0.98	97.6	0.5	0.024	100.9%
R4GASCAL_SYS_001189.LAB	12/5/22	16:34:11	0.6	190.9	0.98	97.5	0.4	0.005	100.8%
R4GASCAL_SYS_001190.LAB	12/5/22	16:34:19	0.5	190.9	0.98	97.4	0.6	0.019	100.7%
R4GASCAL_SYS_001191.LAB	12/5/22	16:34:27	0.5	190.9	0.98	97.3	0.3	0.004	100.5%
R4GASCAL_SYS_001192.LAB	12/5/22	16:34:35	0.5	190.9	0.98	97.6	0.3	0.007	100.8%
R4GASCAL_SYS_001193.LAB	12/5/22	16:34:43	0.5	190.9	0.98	97.4	0.4	0.016	100.7%
R4GASCAL_SYS_001194.LAB	12/5/22	16:34:52	0.4	190.9	0.98	98.1	0.5	-0.007	101.4%

#### Post 5 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
R5_SYS_001313.LAB	12/5/22	17:43:31	5.2	191.0	0.98	0.2	0.0	0.009
R5_SYS_001314.LAB	12/5/22	17:44:32	5.2	191.0	0.98	0.3	0.0	0.006
R5_SYS_001315.LAB	12/5/22	17:45:34	5.2	191.0	0.98	0.1	-0.1	0.000
							0.0	0.005

Client: Northern Natural Gas  
 Facility: Clifton Compressor Station  
 Project #: M224514

Operating Condition: Normal

Test Location: Unit 30  
 Date: 12/5/2022  
 Operator: S. Sands  
 FTIR s/n: 111171031

## Post 5 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCl ppmvw
R5SPIKE_SYS_001340.LAB	12/5/22	17:49:23	4.7	191.0	0.98	0.5	2.9	0.339	0.071	106.91%
R5SPIKE_SYS_001341.LAB	12/5/22	17:49:31	4.6	191.0	0.98	-0.1	2.7	0.383	0.080	87.23%
R5SPIKE_SYS_001342.LAB	12/5/22	17:49:39	4.7	191.0	0.98	0.0	2.9	0.380	0.080	95.42%
R5SPIKE_SYS_001343.LAB	12/5/22	17:49:47	4.7	191.0	0.98	-0.1	2.9	0.376	0.079	96.22%
R5SPIKE_SYS_001344.LAB	12/5/22	17:49:55	4.7	191.0	0.98	0.1	2.9	0.384	0.081	93.89%
R5SPIKE_SYS_001345.LAB	12/5/22	17:50:04	4.7	191.0	0.98	-0.1	3.0	0.369	0.078	98.55%
R5SPIKE_SYS_001346.LAB	12/5/22	17:50:12	4.7	191.0	0.98	0.2	3.0	0.379	0.080	97.37%
R5SPIKE_SYS_001347.LAB	12/5/22	17:50:20	4.7	191.0	0.98	0.0	3.0	0.373	0.078	97.61%

## Post 5 CTS, System Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
R5GASCAL_SYS_001363.LAB	12/5/22	17:52:57	0.3	191.0	0.98	97.5	0.5	0.023	100.8%
R5GASCAL_SYS_001364.LAB	12/5/22	17:53:05	0.3	191.0	0.98	97.3	0.4	0.006	100.5%
R5GASCAL_SYS_001365.LAB	12/5/22	17:53:13	0.3	191.0	0.98	98.6	0.7	0.006	101.9%
R5GASCAL_SYS_001366.LAB	12/5/22	17:53:21	0.3	191.0	0.98	98.0	0.3	0.000	101.3%
R5GASCAL_SYS_001367.LAB	12/5/22	17:53:30	0.2	191.0	0.98	97.7	0.2	0.013	101.0%
R5GASCAL_SYS_001368.LAB	12/5/22	17:53:38	0.3	191.0	0.98	98.4	0.6	0.000	101.7%
R5GASCAL_SYS_001369.LAB	12/5/22	17:53:46	0.2	191.0	0.98	97.6	0.1	-0.006	100.9%
R5GASCAL_SYS_001370.LAB	12/5/22	17:53:54	0.2	191.0	0.98	98.6	0.1	0.030	101.9%

## Post 6 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
R6_SYS_001459.LAB	12/5/22	18:59:03	5.3	190.9	0.97	0.2	0.0	0.006
R6_SYS_001460.LAB	12/5/22	19:00:04	5.3	190.9	0.97	0.1	0.0	0.002
R6_SYS_001461.LAB	12/5/22	19:01:06	5.3	191.0	0.97	0.2	-0.1	0.006
							0.0	0.005

## Post 6 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCl ppmvw
R6_SPIKESYS_001479.LAB	12/5/22	19:05:13	4.9	190.9	0.97	0.1	2.7	0.342	0.072	98.44%
R6_SPIKESYS_001480.LAB	12/5/22	19:05:21	4.9	190.9	0.97	-0.2	2.7	0.369	0.078	90.90%
R6_SPIKESYS_001481.LAB	12/5/22	19:05:29	4.8	190.9	0.97	0.0	2.8	0.356	0.075	95.77%
R6_SPIKESYS_001482.LAB	12/5/22	19:05:37	5.0	190.9	0.97	-0.2	2.6	0.328	0.069	97.57%
R6_SPIKESYS_001483.LAB	12/5/22	19:05:46	4.9	191.0	0.97	0.4	2.6	0.329	0.069	97.47%
R6_SPIKESYS_001484.LAB	12/5/22	19:05:54	4.8	191.0	0.97	-0.2	2.6	0.333	0.070	96.73%
R6_SPIKESYS_001485.LAB	12/5/22	19:06:02	4.9	191.0	0.97	0.3	2.6	0.345	0.072	92.05%
R6_SPIKESYS_001486.LAB	12/5/22	19:06:10	4.9	191.0	0.97	0.1	2.5	0.306	0.064	101.31%

Method 320/321 QA/QC

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514

Test Location: Unit 30  
Date: 12/5/2022  
Operator: S. Sands  
FTIR s/n: 111171031

Operating Condition: Normal

Post 6 CTS, System Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
R6_GASCALSYS_001493.LAB	12/5/22	19:07:28	0.7	191.0	0.97	98.2	0.4	0.009	101.5%
R6_GASCALSYS_001494.LAB	12/5/22	19:07:36	0.6	191.0	0.97	98.1	0.3	0.033	101.4%
R6_GASCALSYS_001495.LAB	12/5/22	19:07:44	0.5	191.0	0.97	98.2	0.3	0.002	101.4%
R6_GASCALSYS_001496.LAB	12/5/22	19:07:53	0.4	191.0	0.97	98.3	0.1	0.023	101.6%
R6_GASCALSYS_001497.LAB	12/5/22	19:08:01	0.4	191.0	0.97	98.8	0.2	-0.005	102.2%
R6_GASCALSYS_001498.LAB	12/5/22	19:08:09	0.3	191.0	0.97	98.0	0.2	0.009	101.3%
R6_GASCALSYS_001499.LAB	12/5/22	19:08:17	0.2	191.0	0.97	98.1	0.1	0.016	101.4%
R6_GASCALSYS_001500.LAB	12/5/22	19:08:26	0.2	191.0	0.97	98.0	0.1	-0.009	101.3%

Post Test CTS, Direct Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
R6_CTS_DIR_001557.LAB	12/5/22	19:28:05	0.0	191.1	0.97	96.1	0.2	0.009	99.4%
R6_CTS_DIR_001558.LAB	12/5/22	19:28:13	0.0	191.1	0.97	96.5	-0.1	0.007	99.7%
R6_CTS_DIR_001559.LAB	12/5/22	19:28:22	0.0	191.1	0.97	96.1	-0.3	0.012	99.3%
R6_CTS_DIR_001560.LAB	12/5/22	19:28:30	0.0	191.1	0.97	96.3	0.2	0.004	99.6%
R6_CTS_DIR_001561.LAB	12/5/22	19:28:38	0.0	191.1	0.97	96.3	-0.1	0.017	99.5%
R6_CTS_DIR_001562.LAB	12/5/22	19:28:46	0.0	191.1	0.97	96.0	-0.3	0.007	99.2%
R6_CTS_DIR_001563.LAB	12/5/22	19:28:55	0.0	191.1	0.97	96.0	0.1	0.009	99.2%
R6_CTS_DIR_001564.LAB	12/5/22	19:29:03	0.0	191.1	0.97	96.3	0.1	0.006	99.5%
Average						96.2			

Post Test N2, Direct Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
N2_DIR_001569.LAB	12/5/22	19:32:14	0.0	191.1	0.97	0.2	0.0	0.001
N2_DIR_001570.LAB	12/5/22	19:34:26	0.0	191.0	0.97	0.1	0.1	0.001

Client: Northern Natural Gas  
 Facility: Clifton Compressor Station  
 Project #: M224514  
 Operating Condition: Normal

Test Location: Unit 30  
 Date: 12/6/2022  
 Operator: S. Sands  
 FTIR s/n: 111171031

System Leak Check: 0.0 mL/min

#### Nitrogen (Zero) Direct to FTIR

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
N2_DIR_000056.LAB	12/6/22	7:10:31	0.0	191.0	1.28	0.1	0.0	0.000
N2_DIR_000057.LAB	12/6/22	7:10:39	0.0	191.0	1.28	0.0	-0.1	0.003
N2_DIR_000058.LAB	12/6/22	7:10:48	0.0	191.0	1.28	-0.1	-0.1	-0.006
N2_DIR_000059.LAB	12/6/22	7:10:56	0.0	190.9	1.28	0.0	0.1	-0.008
N2_DIR_000060.LAB	12/6/22	7:11:04	0.0	190.9	1.28	0.0	-0.1	0.002
N2_DIR_000061.LAB	12/6/22	7:11:12	0.0	191.0	1.28	0.0	0.1	-0.004
N2_DIR_000062.LAB	12/6/22	7:11:20	0.0	191.0	1.28	0.1	0.1	0.000
N2_DIR_000063.LAB	12/6/22	7:12:04	0.0	190.9	0.97	-0.1	-0.1	0.004
N2_DIR_000064BKG.LAB	12/6/22	7:14:25	0.0	191.0	0.97	0.0	0.0	0.000

#### Calibration Transfer Standard (CTS), Direct to FTIR

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS_DIR_000081.LAB	12/6/22	7:17:12	0.0	191.0	0.97	96.3	-0.1	0.003	97.2%
CTS_DIR_000082.LAB	12/6/22	7:17:21	0.0	191.1	0.97	96.6	0.0	0.004	97.6%
CTS_DIR_000083.LAB	12/6/22	7:17:29	0.0	191.1	0.97	96.2	-0.2	-0.004	97.1%
CTS_DIR_000084.LAB	12/6/22	7:17:37	0.0	191.1	0.97	96.5	-0.1	0.016	97.5%
CTS_DIR_000085.LAB	12/6/22	7:17:45	0.0	191.1	0.97	96.4	0.0	0.014	97.4%
CTS_DIR_000086.LAB	12/6/22	7:17:54	0.0	191.1	0.97	96.6	0.1	0.005	97.6%
CTS_DIR_000087.LAB	12/6/22	7:18:02	0.0	191.0	0.97	96.4	-0.1	0.002	97.4%
CTS_DIR_000088.LAB	12/6/22	7:18:10	0.0	191.0	0.97	97.0	-0.2	0.003	98.0%
Average						96.5			97.5%

#### Analyte Spike Gas (HCl ppmvw) Direct to FTIR

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % HCl ppmvw
HCL_DIR_000095.LAB	12/6/22	7:20:05	0.0	191.0	0.97	-0.5	43.4	4.810	87.4%
HCL_DIR_000096.LAB	12/6/22	7:20:14	0.0	191.0	0.97	-0.6	44.3	4.799	89.1%
HCL_DIR_000097.LAB	12/6/22	7:20:22	0.0	191.0	0.97	-0.6	44.6	4.795	89.8%
HCL_DIR_000098.LAB	12/6/22	7:20:30	0.0	191.0	0.97	-0.5	45.0	4.808	90.5%
HCL_DIR_000099.LAB	12/6/22	7:20:38	0.0	190.9	0.97	-0.3	45.0	4.800	90.6%
HCL_DIR_000100.LAB	12/6/22	7:20:47	0.0	191.0	0.97	-0.5	44.0	4.790	88.5%
HCL_DIR_000101.LAB	12/6/22	7:20:55	0.0	191.0	0.97	-0.6	45.2	4.795	90.9%
HCL_DIR_000102.LAB	12/6/22	7:21:03	0.0	191.0	0.97	-0.3	45.3	4.797	91.2%
Average							44.6	4.799	89.8%

#### CTS, System Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS_RT_000192.LAB	12/6/22	7:35:06	0.5	190.9	0.97	99.2	0.0	0.006	102.7%
CTS_RT_000193.LAB	12/6/22	7:35:15	0.5	191.0	0.97	100.2	0.0	-0.002	103.8%
CTS_RT_000194.LAB	12/6/22	7:35:23	0.5	190.9	0.97	99.8	0.0	0.031	103.5%
CTS_RT_000195.LAB	12/6/22	7:35:31	0.4	190.9	0.97	98.9	-0.1	0.006	102.4%
CTS_RT_000196.LAB	12/6/22	7:35:39	0.4	190.9	0.97	99.9	0.0	0.020	103.5%
CTS_RT_000197.LAB	12/6/22	7:35:48	0.3	190.9	0.97	99.9	0.2	0.039	103.5%
CTS_RT_000198.LAB	12/6/22	7:35:56	0.4	190.9	0.97	98.8	0.1	-0.004	102.4%
CTS_RT_000199.LAB	12/6/22	7:36:04	0.3	190.9	0.97	99.0	-0.1	0.026	102.6%

#### Response Time Test

Method 320/321 QA/QC

Client: Northern Natural Gas  
Facility: Clifton Compressor Station  
Project #: M224514  
Operating Condition: Normal

Test Location: Unit 30  
Date: 12/6/2022  
Operator: S. Sands  
FTIR s/n: 111171031

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Response Time (sec)
CTS_RT_000188.LAB	12/6/22	7:34:33	4.7	190.9	0.97	0.9	0.1	0.006	-
CTS_RT_000189.LAB	12/6/22	7:34:41	2.1	190.9	0.97	63.3	0.3	-0.011	16.265
CTS_RT_000190.LAB	12/6/22	7:34:50	0.9	190.9	0.97	99.0	0.2	0.030	24.265

Zero Gas System Purge and Response Time Test

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Response Time (sec)
CTS_RT_000200.LAB	12/6/22	7:36:12	0.3	190.9	0.97	99.6	0.0	0.044	-
CTS_RT_000201.LAB	12/6/22	7:36:21	0.8	190.9	0.97	66.6	0.1	0.011	16.267
CTS_RT_000202.LAB	12/6/22	7:36:29	0.3	190.9	0.97	0.3	-0.1	-0.011	24.542

Pre 1 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
R7_PRESPIKE_SYS_000240.LAB	12/6/22	7:42:13	4.9	191.1	0.97	-0.1	0.2	0.006
R7_PRESPIKE_SYS_000241.LAB	12/6/22	7:42:21	4.9	191.0	0.97	-0.5	0.2	0.009
R7_PRESPIKE_SYS_000242.LAB	12/6/22	7:42:29	4.9	191.0	0.97	-0.2	0.4	-0.011
							0.3	0.002

Pre 1 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCl ppmvw
R7_PRESPIKE_SYS_000260.LAB	12/6/22	7:44:58	4.7	191.1	0.97	-0.1	3.3	0.385	0.080	85.7%
R7_PRESPIKE_SYS_000261.LAB	12/6/22	7:45:06	4.7	191.0	0.97	0.2	3.3	0.366	0.076	91.2%
R7_PRESPIKE_SYS_000262.LAB	12/6/22	7:45:14	4.7	191.0	0.97	0.0	3.2	0.380	0.079	83.6%
R7_PRESPIKE_SYS_000263.LAB	12/6/22	7:45:23	4.8	191.0	0.97	0.1	3.1	0.372	0.078	82.5%
R7_PRESPIKE_SYS_000264.LAB	12/6/22	7:45:31	4.8	190.9	0.97	-0.1	2.9	0.369	0.077	77.6%
R7_PRESPIKE_SYS_000265.LAB	12/6/22	7:45:39	4.7	191.0	0.97	0.3	3.0	0.362	0.075	82.1%
R7_PRESPIKE_SYS_000266.LAB	12/6/22	7:45:47	4.7	191.0	0.97	-0.1	3.0	0.363	0.076	81.6%
R7_PRESPIKE_SYS_000267.LAB	12/6/22	7:45:56	4.7	191.0	0.97	-0.3	2.8	0.346	0.072	81.2%

Post 1 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
R7_SYS_000326.LAB	12/6/22	8:47:24	5.2	190.9	0.97	0.0	0.2	0.006
R7_SYS_000327.LAB	12/6/22	8:48:26	5.2	190.9	0.97	0.0	0.3	-0.004
R7_SYS_000328.LAB	12/6/22	8:49:28	5.2	191.0	0.97	0.0	0.1	-0.007
							0.2	-0.002

Post 1 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCl ppmvw
R7_POSTSPIKE_SYS_000337.LAB	12/6/22	8:51:19	4.8	191.0	0.97	0.3	2.9	0.362	0.075	81.17%
R7_POSTSPIKE_SYS_000338.LAB	12/6/22	8:51:27	4.9	191.0	0.97	0.4	3.3	0.371	0.077	90.58%
R7_POSTSPIKE_SYS_000339.LAB	12/6/22	8:51:35	4.8	191.0	0.97	0.0	3.1	0.352	0.073	90.25%
R7_POSTSPIKE_SYS_000340.LAB	12/6/22	8:51:43	4.9	191.0	0.97	0.5	3.0	0.348	0.073	89.14%
R7_POSTSPIKE_SYS_000341.LAB	12/6/22	8:51:52	4.9	191.0	0.97	0.4	3.1	0.336	0.070	95.24%
R7_POSTSPIKE_SYS_000342.LAB	12/6/22	8:52:00	4.9	191.0	0.97	0.0	3.0	0.327	0.068	94.43%
R7_POSTSPIKE_SYS_000343.LAB	12/6/22	8:52:08	4.9	190.9	0.97	0.3	3.1	0.352	0.073	90.65%
R7_POSTSPIKE_SYS_000344.LAB	12/6/22	8:52:16	4.9	190.9	0.97	0.1	3.1	0.326	0.068	95.94%

Post 1 CTS, System Purge



Method 320/321 QA/QC

Client: Northern Natural Gas  
 Facility: Clifton Compressor Station  
 Project #: M224514  
 Operating Condition: Normal

Test Location: Unit 30  
 Date: 12/6/2022  
 Operator: S. Sands  
 FTIR s/n: 111171031

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
R7_CTS_SYS_000365.LAB	12/6/22	8:55:34	0.0	191.0	0.97	98.9	-0.1	0.023	102.5%
R7_CTS_SYS_000366.LAB	12/6/22	8:55:42	0.0	191.0	0.97	99.3	0.2	0.010	102.9%
R7_CTS_SYS_000367.LAB	12/6/22	8:55:50	0.0	191.0	0.97	99.0	0.1	0.023	102.6%
R7_CTS_SYS_000368.LAB	12/6/22	8:55:58	0.0	190.9	0.97	98.7	0.2	0.005	102.3%
R7_CTS_SYS_000369.LAB	12/6/22	8:56:07	0.0	191.0	0.97	99.7	0.0	-0.002	103.4%
R7_CTS_SYS_000370.LAB	12/6/22	8:56:15	0.0	191.0	0.97	99.2	-0.1	0.019	102.8%
R7_CTS_SYS_000371.LAB	12/6/22	8:56:23	0.0	191.0	0.97	98.9	0.0	0.010	102.5%
R7_CTS_SYS_000372.LAB	12/6/22	8:56:31	0.0	191.0	0.97	99.7	0.0	-0.008	103.3%

Post Test CTS, Direct Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS_DIR_000441.LAB	12/6/22	9:08:20	0.0	191.2	0.97	96.0	0.0	0.007	99.5%
CTS_DIR_000442.LAB	12/6/22	9:08:28	0.0	191.2	0.97	96.1	0.0	0.010	99.6%
CTS_DIR_000443.LAB	12/6/22	9:08:36	0.0	191.1	0.97	96.0	0.0	0.008	99.5%
CTS_DIR_000444.LAB	12/6/22	9:08:44	0.0	191.1	0.97	96.0	0.1	0.010	99.4%
CTS_DIR_000445.LAB	12/6/22	9:08:53	0.0	191.1	0.97	96.3	0.2	0.009	99.8%
CTS_DIR_000446.LAB	12/6/22	9:09:01	0.0	191.1	0.97	95.8	0.1	0.006	99.3%
CTS_DIR_000447.LAB	12/6/22	9:09:09	0.0	191.1	0.97	96.0	-0.2	0.000	99.5%
CTS_DIR_000448.LAB	12/6/22	9:09:17	0.0	191.0	0.97	96.4	0.0	0.009	99.8%
Average						96.1			

Post Test N2, Direct Purge

Spectrum	Date	Time	H2O% %v	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCl ppmvw ppmv wet	SF6 ppmv wet
N2_DIR_000458.LAB	12/6/22	9:11:44	0.0	191.0	0.97	0.1	0.2	-0.003
N2_DIR_000459.LAB	12/6/22	9:11:52	0.0	191.0	0.97	0.1	-0.1	-0.001
N2_DIR_000460.LAB	12/6/22	9:12:00	0.0	191.0	0.97	0.0	0.3	0.006

Northern Natural Gas  
Clifton Compressor Station  
Unit 30  
301 Validation LOD Calculations

<u>Date</u>	<u>Time</u>	<u>H<sub>2</sub>O zero</u>	<u>HCl Zero</u>	<u>HF Zero</u>	<u>Formaldehyde Zero</u>
12/5/2022	10:14:05	0.01	0.0	0.0	0.4
12/5/2022	10:14:13	0.00	0.1	0.1	0.4
12/5/2022	10:14:21	0.00	0.0	0.1	-0.2
12/5/2022	10:14:29	0.01	0.0	0.0	0.2
12/5/2022	10:14:38	0.02	0.2	0.0	0.0
12/5/2022	10:14:46	0.03	0.0	-0.1	-0.5
12/5/2022	10:14:54	0.00	0.2	0.1	0.0
12/5/2022	10:15:02	0.03	-0.2	-0.1	0.3
12/5/2022	10:15:11	0.01	0.1	-0.1	0.0
12/5/2022	10:15:19	0.01	0.2	-0.1	0.0
<b>Average</b>		<b>0.010376</b>	<b>0.044833</b>	<b>0.001256</b>	<b>0.061809</b>

<u>Date</u>	<u>Time</u>	<u>H<sub>2</sub>O zero</u>	<u>HCl Zero</u>	<u>HF Zero</u>	<u>Formaldehyde Zero</u>
12/5/2022	12:52:36	0.01	0.1	0.0	-0.1
12/5/2022	12:52:44	0.02	0.1	0.1	0.0
12/5/2022	12:52:52	0.00	0.1	0.0	0.0
12/5/2022	12:53:00	0.01	0.2	0.1	0.1
12/5/2022	12:53:09	0.04	-0.2	-0.1	0.0
12/5/2022	12:53:17	0.03	0.1	0.2	0.0
12/5/2022	12:53:25	0.02	0.0	0.0	0.0
12/5/2022	12:53:33	0.01	0.0	0.0	0.0
12/5/2022	12:53:42	0.02	0.0	0.0	0.0
<b>Average</b>		<b>0.016458</b>	<b>0.054344</b>	<b>0.043359</b>	<b>-0.007659</b>

12/5/2022	14:09:10	0.04	0.0	-0.1	0.0
12/5/2022	14:09:18	0.00	-0.1	-0.1	0.0
12/5/2022	14:09:26	0.02	-0.2	0.0	0.0
12/5/2022	14:09:34	0.00	0.0	-0.1	0.0
12/5/2022	14:09:43	0.04	0.1	0.1	0.0
12/5/2022	14:09:51	0.02	0.0	0.0	0.0
12/5/2022	14:09:59	0.03	0.0	-0.1	0.0
12/5/2022	14:10:07	0.01	-0.2	0.0	0.0
12/5/2022	14:10:16	0.04	0.1	0.0	0.0
12/5/2022	14:10:24	0.01	0.1	0.0	0.0
<b>Average</b>		<b>0.020467</b>	<b>-0.030375</b>	<b>-0.027951</b>	<b>0.006864</b>

<u>Date</u>	<u>Time</u>	<u>H<sub>2</sub>O zero</u>	<u>HCl Zero</u>	<u>HF Zero</u>	<u>Formaldehyde Zero</u>
12/5/2022	15:25:40	0.19	0.4	0.0	0.0
12/5/2022	15:25:48	0.22	0.0	0.0	0.0
12/5/2022	15:25:57	0.20	0.2	0.0	0.0
12/5/2022	15:26:05	0.20	0.2	0.0	0.0
12/5/2022	15:26:13	0.20	-0.1	0.0	0.0
12/5/2022	15:26:21	0.18	0.0	0.1	0.0
12/5/2022	15:26:29	0.16	0.0	0.1	0.0
12/5/2022	15:26:38	0.17	0.0	0.0	0.0
<b>Average</b>		<b>0.189003</b>	<b>0.097658</b>	<b>0.015401</b>	<b>0.001740</b>

<u>Date</u>	<u>Time</u>	<u>H<sub>2</sub>O zero</u>	<u>HCl Zero</u>	<u>HF Zero</u>	<u>Formaldehyde Zero</u>
12/5/2022	16:38:51	0.29	0.0	-0.1	0.0
12/5/2022	16:38:59	0.30	0.1	-0.1	0.0
12/5/2022	16:39:08	0.32	-0.1	0.0	0.0
12/5/2022	16:39:16	0.27	0.0	0.0	0.0
12/5/2022	16:39:24	0.27	0.0	0.3	0.0
12/5/2022	16:39:32	0.30	0.2	0.1	0.0
12/5/2022	16:39:41	0.31	0.1	0.1	0.0
12/5/2022	16:39:49	0.28	0.1	0.1	0.1
12/5/2022	16:39:57	0.26	0.2	-0.1	0.0
<b>Average</b>		<b>0.291611</b>	<b>0.021139</b>	<b>0.038278</b>	<b>0.019830</b>

<u>Date</u>	<u>Time</u>	<u>H<sub>2</sub>O zero</u>	<u>HCl Zero</u>	<u>HF Zero</u>	<u>Formaldehyde Zero</u>
12/5/2022	17:58:49	0.06	0.1	0.1	0.0
12/5/2022	17:58:57	0.03	0.0	0.0	0.0
12/5/2022	17:59:05	0.05	0.0	-0.1	0.0
12/5/2022	17:59:13	0.04	0.1	0.0	0.0
12/5/2022	17:59:22	0.05	-0.1	0.2	0.0
12/5/2022	17:59:30	0.06	0.4	0.1	0.0
12/5/2022	17:59:38	0.03	0.1	0.1	0.0
12/5/2022	17:59:46	0.05	0.3	-0.1	0.0
12/5/2022	17:59:54	0.05	0.0	0.1	0.0
12/5/2022	18:00:03	0.05	0.0	0.0	0.0
<b>Average</b>		<b>0.049058</b>	<b>0.037485</b>	<b>-0.032057</b>	<b>0.016319</b>

<u>Date</u>	<u>Time</u>	<u>H<sub>2</sub>O zero</u>	<u>HCl Zero</u>	<u>HF Zero</u>	<u>Formaldehyde Zero</u>
12/5/2022	19:13:50	0.19	0.2	0.0	0.0
12/5/2022	19:13:58	0.11	0.1	0.0	0.0
12/5/2022	19:14:06	0.09	0.2	0.1	0.0
12/5/2022	19:14:15	0.11	0.0	0.0	0.0
12/5/2022	19:14:23	0.10	-0.1	-0.1	0.0
12/5/2022	19:14:31	0.10	0.3	0.0	0.0
12/5/2022	19:14:39	0.08	0.1	0.1	0.0
12/5/2022	19:14:48	0.09	-0.1	0.1	0.0
12/5/2022	19:14:56	0.09	-0.1	0.1	0.0
1/0/1900	0:00:00	0.00	0.0	0.0	0.0
<b>Average</b>		<b>0.093730</b>	<b>0.074120</b>	<b>0.040005</b>	<b>-0.001027</b>

<u>Date</u>	<u>Time</u>	<u>H<sub>2</sub>O zero</u>	<u>HCl Zero</u>	<u>HF Zero</u>	<u>Formaldehyde Zero</u>
12/6/2022	9:04:53	0.00	0.0	-0.1	-0.1
12/6/2022	9:05:01	0.01	-0.1	0.1	0.0
12/6/2022	9:05:09	0.05	0.2	-0.1	0.0
12/6/2022	9:05:18	0.03	-0.2	0.0	0.0
12/6/2022	9:05:26	0.03	-0.1	0.0	0.0
12/6/2022	9:05:34	0.04	0.1	-0.1	0.0
12/6/2022	9:05:42	0.02	0.0	0.0	0.0
12/6/2022	9:05:51	0.02	0.0	0.1	0.0
12/6/2022	9:05:59	0.03	0.0	0.2	0.0
12/6/2022	9:06:07	0.08	-0.2	0.0	0.0
12/6/2022	9:06:15	0.17	0.0	0.2	0.0
1/0/1900	0:00:00	0.00	0.0	0.0	0.0
<b>Average</b>		<b>0.039353</b>	<b>-0.024552</b>	<b>0.019483</b>	<b>-0.001174</b>

<b>Average of blanks</b>	<b>0.089</b>	<b>0.034</b>	<b>0.012</b>	<b>0.012</b>
<b>Standard Deviation</b>	<b>0.094</b>	<b>0.042</b>	<b>0.028</b>	<b>0.021</b>
<b>MDL</b>	<b>0.28</b>	<b>0.125</b>	<b>0.083</b>	<b>0.062</b>

## Appendix H - Calibration and Response Time Data

**Client:** Northern Natural Gas  
**Facility:** Clifton Compressor Station  
**Project #:** M224514  
**Test Location:** Unit 30  
**Date:** 12/5/2022  
**Operator:** S. Sands  
**Operating Condition** Normal

<b>Sample System:</b>	FTIR			
<b>Probe Length:</b>	3.0	ft		
<b>Probe Type:</b>	FTIR		<b>Point Markings (including port length):</b>	
<b>Sample Plane:</b>	FTIR		<b>Point #</b>	<b>Inches</b>
<b>Port Length:</b>	4	in.	1	14.02
<b>Port Size (diameter):</b>	4	in.	2	34.00
<b>Port Type:</b>	Flange		3	53.98
<b>Duct Shape:</b>	Rectangular			
<b>Length (traverse side of duct):</b>	5	ft		
<b>Width:</b>	8	ft		
<b>Location of Test Ports:</b>	Side of duct			
<b>Duct Area:</b>	40.00	Sq. Ft.		
<b>Number of Ports Sampled:</b>	1		Ideal Upstream Distance	12.3 Feet
<b>Number of Points per Port:</b>	3		Ideal Downstream Distance	49.2 Feet
<b>Total Number of Traverse Points:</b>	3			

### Calibration Gases

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder	Final Bottle Pressure, PSI
CO ppmvw	Zero	CC54995	0	-0.42	0.94%	7/6/2030		>500
	Mid	CC15116	19.79	19.82	-0.07%	2/8/2029	44.28%	>500
	High	SG9167243BAL	44.69	43.83	1.93%	4/27/2029		>500
O2 % (dry)	Zero	CC15116	0.0	0.01	-0.04%	2/8/2029		>500
	Mid	CC54995	12.24	12.21	0.13%	7/6/2030	54.64%	>500
	High	CC332317	22.4	22.41	-0.04%	7/15/2029		>500

Type	Compound	Cylinder ID	Cylinder Value	Expiration Date	Final Bottle Pressure, PSI
Zero Gas	Nitrogen		0.0000	N/A	>500
Calibration Transfer Standard	Ethylene	AAL070174	99.03	5/18/2030	>500
Analyte Spike Gas	HCl ppmvw	CC506930	49.67	9/19/2024	>500
	SF6		5.006		>500

### Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
CO ppmvw	MKS 2030	111171031	1000	44.69
O2 % (dry)	ECOM	01440D1/3935	25	22.4
Start			95% Response	Time (min)
Upscale				0.25
Downscale				0.25

for use on common stacks with multiple dissimilar boilers or wet scrubber s

**Part 75 Stratification Test Results Summary**

**Northern Natural Gas**

**Clifton Compressor Station**

**Unit 30**

**December 5, 2022**

Number of Ports Sampled: 5  
Number of Points per Port: 3  
Total Number of Traverse Points: 15

Port No.	Point No.	Point Marking, Inches	Time	O <sub>2</sub> %	Actual % Difference O <sub>2</sub> %
1	1	14	11:33	15.82	3.86
	2	34	11:37	15.96	3.01
	3	54	11:41	15.87	3.55
2	1	74	11:43	16.59	0.82
	2	94	11:47	17.07	3.74
	3	114	11:51	17.22	4.65
3	1	14	11:56	16.59	0.82
	2	34	12:00	16.46	0.03
	3	54	12:04	15.94	3.13
4	4	74	12:09	15.90	3.37
	5	94	12:13	16.83	2.28
	6	114	12:17	17.03	3.50
5	1	14	12:22	17.01	3.37
	2	34	12:26	16.22	1.43
	3	54	12:30	16.31	0.88
Average				16.45	



Client: Northern Natural Gas  
 Facility: Clifton Compressor Station  
 Project #: M224514  
 O2 % Correction: 15

Test Location: Unit 30  
 Date: 12/5/22  
 Operator: S. Sands

CO ppmvw Correction Data

Run #	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
1	19.79	20.42	20.57	-0.07	0.09	0.01	20.50	9.06	8.7	-1.67	0.33	-1.14	0.34
2	19.79	20.57	20.29	0.09	0.18	0.14	20.43	10.42	10.0	-1.05	-0.62	-1.36	0.22
3	19.79	20.29	20.31	0.18	0.15	0.17	20.30	5.02	4.8	-1.09	0.03	-1.27	-0.08
4	19.79	20.31	20.33	0.15	0.08	0.11	20.32	4.35	4.2	-1.14	0.05	-1.12	-0.15
5	19.79	20.33	20.52	0.08	0.36	0.22	20.42	4.63	4.3	-1.55	0.41	-1.75	0.62
6	19.79	20.52	20.90	0.36	0.87	0.61	20.71	4.27	3.6	-2.40	0.85	-2.88	1.13

O2 % (dry) Correction Data

Run #	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
1	12.24	12.14	11.97	0.09	-0.23	-0.07	12.06	16.52	16.7	1.07	-0.76	1.07	-1.43
2	12.24	11.97	11.94	-0.23	0.09	-0.07	11.96	16.42	16.8	1.21	-0.13	-0.36	1.43
3	12.24	11.94	12.01	0.09	-0.17	-0.04	11.98	16.00	16.3	0.89	0.31	0.80	-1.16
4	12.24	12.01	12.05	-0.17	-0.17	-0.17	12.03	16.07	16.3	0.71	0.18	0.80	0.00
5	12.24	12.05	12.01	-0.17	-0.17	-0.17	12.03	16.07	16.3	0.89	-0.18	0.80	0.00
6	12.24	12.01	12.06	-0.17	-0.05	-0.11	12.04	16.09	16.3	0.67	0.22	0.27	0.54

Concentration of Cal Gas  
 Average Pre and Post Span

C = Average value of test  
 Cgas = Corrected gas value of test

Co = Average Pre and Post Zero

Calibration Corrected and Calculated Data

Run #	Run Date	Start Time	End Time	HCl ppmw	HF ppmw	Formaldehyde ppmw	CO ppmvw	O2 % (dry)	H2O	Flow, SCFH	HCl ppmvd @ 15% O2	HF ppmvd @ 15% O2	HCHO ppmvd @ 15% O2	CO ppmvd @ 15% O2	HCl lb/hr	HF lb/hr
1	12/5/22	11:30	12:34	0.61	0.02	0.03	8.7	16.7	4.80%	4,958,818	0.9	0.0	0.0	13.0	0.288	0.004
2	12/5/22	12:55	13:54	0.11	0.08	0.03	10.0	16.8	4.81%		0.2	0.1	0.0	15.1	0.000	0.000
3	12/5/22	12:03	13:02	0.08	0.12	0.03	4.8	16.3	5.05%		0.1	0.2	0.0	6.5	0.000	0.000
4	12/5/22	15:28	16:27	0.10	0.15	0.03	4.2	16.3	5.07%		0.1	0.2	0.0	5.6	0.000	0.000
5	12/5/22	16:45	17:44	0.08	0.15	0.03	4.3	16.3	5.15%	5,886,449	0.1	0.0	0.0	5.8	0.042	0.046
6	12/5/22	18:01	19:00	0.09	0.15	0.03	3.6	16.3	5.19%	5,886,449	0.1	0.0	0.0	4.9	0.052	0.046
7	12/6/22	7:48	8:47	0.42	0.65	0.02	5.4	16.1	5.21%	4,958,818	0.5	0.0	0.0	6.9	0.197	0.167

**Client:** Northern Natural Gas  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Date:** 12/5/22  
**Project #:** M224514

**Linearity Cal/Pre 1 Cal**

<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
9:17:50	43.82587	ih	
9:17:58	44.660338		
9:18:06	44.942563		
9:21:33	-0.670871		
9:21:41	-0.653975		
9:21:50	-0.42077	iz	
9:21:58	0.667823		
9:22:06	22.633794		
9:22:15	20.079747		
9:22:23	19.692989		
9:22:31	19.821868	im	
9:38:07	20.301594		
9:38:15	20.421956	m	
9:38:23	20.211122		
9:38:32	11.749942		
9:38:40	0.017577		
9:38:48	-0.06505	z	
9:38:56	0.229928		
9:15:00			0.01 iz
9:16:00			1.65
9:17:00			4.65
9:18:00			26.17
9:19:00			23.35
9:20:00			22.41 ih
9:21:00			4.11
9:22:00			-0.03
9:23:00			18.96
9:24:00			12.78
9:25:00			12.22
9:26:00			12.21
9:27:00			12.21 im
9:38:00			12.14 m
9:39:00			12.16
9:40:00			14.29
9:41:00			20.93
9:42:00			15.98
9:43:00			0.66
9:44:00			0.03
9:45:00			0.09 z
9:46:00			0.11

**Client:** Northern Natural Gas  
**Facility:** Clifton Compressor Station  
**Project #:** M224514  
**Test Location:** Unit 30  
**Date:** 12/5/22

Post 1/Pre 2			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
12:45	20.57	m	
12:46	20.23		
12:49	0.28		
12:50	0.09	z	
12:46			-0.23 z
12:47			-0.24
12:48			2.09
12:49			11.87
12:50			11.97 m

Post 2/Pre 3			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
14:04	20.15		
14:04	20.29	m	
14:05	-0.02		
14:05	0.18	z	
14:04			11.94 m
14:05			9.94
14:06			0.09 z

Post 3/Pre 4			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
15:21	20.31	m	
15:21	20.09		
15:22	0.15	z	
15:22	0.16		
15:20			-0.17 z
15:21			6.46
15:22			12.01 m

Post 4/Pre 5			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
16:36	0.08	z	
16:37	0.19		
16:38	20.80		
16:38	20.33	m	
16:35			11.96
16:36			12.05 m
16:37			6.12
16:38			-0.10
16:39			-0.17 z

**Client:** Northern Natural Gas  
**Facility:** Clifton Compressor Station  
**Project #:** M224514  
**Test Location:** Unit 30  
**Date:** 12/5/22

Post 5/Pre 6			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
17:55	0.36	z	
17:55	0.57		
17:56	20.52	m	
17:56	20.77		
17:54			12.01 m
17:55			6.13
17:56			-0.12
17:57			-0.17 z

Post 6/Pre 7			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
19:09	21.22		
19:09	20.90	m	
19:10	0.77		
19:10	0.87	z	
19:07			-0.05 z
19:08			0.39
19:09			10.14
19:10			12.06 m

Post 7/Pre 8			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
18:25	4.25		
18:26	4.27	z	
18:35	4.19		
18:36	4.18	m	

Post 8/Pre 9			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>

**Client:** Northern Natural Gas  
**Facility:** Clifton Compressor Station  
**Project #:** M224514  
**Test Location:** Unit 30  
**Date:** 12/6/2022  
**Operator:** S. Sands  
**Operating Condition** Normal

<b>Sample System:</b>	FTIR			
<b>Probe Length:</b>	6.0	ft	<b>Point Markings (including port length):</b>	
<b>Probe Type:</b>	FTIR		<b>Point #</b>	<b>Inches</b>
<b>Sample Plane:</b>	FTIR		1	14.02
<b>Port Length:</b>	4	in.	2	34.00
<b>Port Size (diameter):</b>	4	in.	3	53.98
<b>Port Type:</b>	Flange			
<b>Duct Shape:</b>	Rectangular			
<b>Length (traverse side of duct):</b>	5	ft		
<b>Width:</b>	8	ft		
<b>Location of Test Ports:</b>	Side of duct			
<b>Duct Area:</b>	40.00	Sq. Ft.		
<b>Number of Ports Sampled:</b>	1		Ideal Upstream Distance	12.3 Feet
<b>Number of Points per Port:</b>	3		Ideal Downstream Distance	49.2 Feet
<b>Total Number of Traverse Points:</b>	3			

### Calibration Gases

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder	Final Bottle Pressure, PSI
CO ppmvw	Zero	CC54995	0	-0.55	1.24%	7/6/2030		>500
	Mid	CC15116	19.79	19.68	0.26%	2/8/2029	44.28%	>500
	High	SG9167243BAL	44.69	44.27	0.95%	4/27/2029		>500
O2 % (dry)	Zero	CC15116	0.0	-0.04	0.18%	2/8/2029		>500
	Mid	CC54995	12.24	12.07	0.76%	7/6/2030	54.64%	>500
	High	CC332317	22.4	22.45	-0.22%	7/15/2029		>500

Type	Compound	Cylinder ID	Cylinder Value	Expiration Date	Final Bottle Pressure, PSI
Zero Gas	Nitrogen		0.0000	N/A	>500
Calibration Transfer Standard	Ethylene	AAL070174	99.03	5/18/2030	>500
Analyte Spike Gas	HCl ppmvw	CC506930	49.67	9/19/2030	>500
	SF6		5.006		>500

### Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
CO ppmvw	MKS 2030	111171031	1000	44.69
O2 % (dry)	Servomex	01440D1/3935	25	22.4
	Start		95% Response	Time (min)
Upscale				0.25
Downscale				0.25

Client: Northern Natural Gas  
 Facility: Clifton Compressor Station  
 Project #: M224514  
 O2 % Correction: 15

Test Location: Unit 30  
 Date: 12/6/22  
 Operator: S. Sands

**CO ppmvw Correction Data**

Run #	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
7	19.79	20.34	19.83	-0.11	-0.33	-0.22	20.09	5.31	5.4	-0.35	-1.13	-0.50	-0.50

**O2 % (dry) Correction Data**

Run #	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
7	12.24	12.13	12.00	-0.15	-0.18	-0.17	12.07	15.89	16.1	0.31	-0.58	0.63	-0.13

Concentration of Cal Gas      C = Average value of test      Co=Average Pre and Post Zero  
 Average Pre and Post Span      Cgas = Corrected gas value of test

**Calibration Corrected and Calculated Data**

Run #	Run Date	Start Time	End Time	HCl ppmw	HF ppmw	Formaldehyde ppmw	CO ppmvw	O2 % (dry)	H2O	Flow, SCFH	HCl ppmvd @ 15% O2	HF ppmvd @ 15% O2	HCHO ppmvd @ 15% O2	CO ppmvd @ 15% O2	HCl lb/hr	HF lb/hr
7	12/6/22	7:48	8:47	0.42	0.65	0.02	5.4	16.1	5.21%	4,958,818	0.5	0.0	0.0	6.9	0.197	0.167



**Client:** Northern Natural Gas  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Date:** 12/6/22  
**Project #:** M224514

Linearity Cal/Pre 7 Cal			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
7:24:07	-0.554655	iz	
7:24:15	-0.50931		
7:25:13	44.63223		
7:25:21	44.265705	ih	
7:28:56	19.591945		
7:29:04	19.67573	im	
7:38:08	-0.084796		
7:38:16	-0.10707	z	
7:38:58	20.189933		
7:39:06	20.338667	m	
6:57:00			-0.04 iz
6:58:00			-0.05
7:22:00			22.53
7:23:00			22.45 ih
7:26:00			12.07 im
7:35:00			-0.19
7:36:00			-0.15 z
7:39:00			12.08
7:40:00			12.13 m

**Client:** Northern Natural Gas  
**Facility:** Clifton Compressor Station  
**Project #:** M224514  
**Test Location:** Unit 30  
**Date:** 12/6/22

<b>Post 7</b>			
<u>Time</u>	<u>CO ppmvw</u>		<u>O2 % (dry)</u>
8:58	19.83	m	
8:58	19.88		
8:59	-0.61		
8:59	-0.33	z	
8:59			12.00 m
9:00			12.01
9:01			2.94
9:02			-0.16
9:03			-0.18 z

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Project #: M224514

Test Location: Unit 30  
 Operator: STS  
 Test Methods: 3A,5/29

### Calibration Gases - Linearity

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder
CO <sub>2</sub> %	Zero	Zero Nitrogen	0	0.01	-0.04%	N/A	
	Mid	CC54995	9.981	10.08	-0.53%	7/6/2030	52.56%
	High	CC332317	18.99	19.07	-0.45%	7/15/2029	
O <sub>2</sub> %	Zero	Zero Nitrogen	0	-0.03	0.13%	N/A	
	Mid	CC54995	12.24	12.21	0.13%	7/6/2030	54.64%
	High	CC332317	22.4	22.41	-0.04%	7/15/2029	

### Analyzer Data

Type	Model/Serial #
CO <sub>2</sub> %	Servomex + FTIR
O <sub>2</sub> %	Servomex + FTIR

### CO<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 1	Normal	12:55	16:26	12/5/2022	9.98	10.27	10.18	0.05	0.07	0.06	10.23	2.67	2.6	-0.50	-0.52	-0.34	0.10

### O<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 1	Normal	12:55	16:26	12/5/2022	12.24	12.16	12.05	0.03	-0.10	-0.04	12.11	16.16	16.3	0.71	-0.49	0.31	-0.58

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Project #: M224514

Test Location: Unit 30  
 Operator: STS  
 Test Methods: 3A,5/29

### Calibration Gases - Linearity

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder
CO <sub>2</sub> %	Zero	Zero Nitrogen	0	0.00	-0.01%	N/A	
	Mid	CC54995	9.981	10.13	-0.80%	7/6/2030	52.56%
	High	CC332317	18.99	19.04	-0.26%	7/15/2029	
O <sub>2</sub> %	Zero	Zero Nitrogen	0	-0.04	0.18%	N/A	
	Mid	CC54995	12.24	12.07	0.76%	7/6/2030	54.64%
	High	CC332317	22.4	22.45	-0.22%	7/15/2029	

### Analyzer Data

Type	Model/Serial #
CO <sub>2</sub> %	Servomex + FTIR
O <sub>2</sub> %	Servomex + FTIR

### CO<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 2	Normal	7:21	11:06	12/6/2022	9.98	10.28	10.24	-0.02	0.00	-0.01	10.26	2.87	2.8	-0.57	-0.22	0.00	0.11

### O<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 2	Normal	7:21	11:06	12/6/2022	12.24	12.13	12.01	-0.02	-0.16	-0.09	12.07	15.89	16.1	0.27	-0.54	0.54	-0.63

Client: Northern Natural Gas Company  
Facility: Clifton Compressor Station  
Project #: M224514

Test Location: Unit 30  
Operator: MAN  
Test Methods: 3A,5/29

### Calibration Gases - Linearity

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder
CO <sub>2</sub> %	Zero	Zero Nitrogen	0	0.00	0.00%	N/A	
	Mid	BLM005211	9.933	9.60	1.80%	2/16/2029	53.66%
	High	LL107625	18.51	18.60	-0.49%	6/29/2028	
O <sub>2</sub> %	Zero	Zero Nitrogen	0	0.00	0.00%	N/A	
	Mid	BLM005211	10.12	10.00	0.61%	2/16/2029	51.21%
	High	LL107625	19.76	19.70	0.30%	6/29/2028	

### Analyzer Data

Type	Model/Serial #
CO <sub>2</sub> %	ECOM
O <sub>2</sub> %	ECOM

### CO<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 3	Normal	11:37	15:04	12/6/2022	9.93	9.70	9.70	0.00	0.00	0.00	9.70	2.47	2.5	-0.54	0.00	0.00	-0.01

### O<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 3	Normal	11:37	15:04	12/6/2022	10.12	10.10	11.00	-0.16	0.00	-0.08	10.55	17.77	17.0	-5.06	4.55	0.00	0.81

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Project #:** Unit 30  
**Test Location:** M224514

**Linearity Cal/Pre Run 1 Cal**  
**Date:** 12/5/2022

<u>Time</u>	<u>O2 % (dry)</u>		<u>CO2 % (dry)</u>	
9:19	23.35			
9:20	22.41	ih		
9:21	4.11			
9:22	-0.03	iz		
9:23	18.96			
9:24	12.78			
9:25	12.22			
9:26	12.21	im		
9:27	12.21			
9:20			19.03	
9:20			19.07	ih
9:20			19.05	
9:23			0.04	
9:23			0.01	iz
9:23			0.02	
9:28			10.12	
9:28			10.08	im
9:28			10.11	
9:38	12.14			
9:39	12.16	m		
9:40	14.29			
9:41	20.93			
9:42	15.98			
9:43	0.66			
9:44	0.03	z		
9:45	0.09			
9:40			10.32	
9:40			10.27	m
9:40			10.33	
9:43			0.06	
9:43			0.05	z
9:43			0.07	



**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Project #:** Unit 30  
**Test Location:** M224514

**Linearity Cal/Pre Run 1 Cal**  
**Date:** 12/5/2022

<u>Time</u>	<u>O2 % (dry)</u>	<u>CO2 % (dry)</u>	
6:56	-0.03		
6:57	-0.04	iz	
6:58	-0.05		
7:23	22.45	ih	
7:24	6.46		
7:25	8.29		
7:26	12.07	im	
7:27	9.82		
7:28	7.60		
7:29	16.25		
7:30	8.40		
7:31	1.79		
7:32	0.39		
7:33	13.00		
7:34	0.42		
7:35	-0.19		
7:36	-0.15		
7:37	-0.02	z	
7:38	3.74		
7:39	12.08		
7:40	12.13	m	
7:41	15.54		
7:00		0.00	
7:00		0.00	iz
7:00		0.02	
7:22		19.03	
7:22		19.04	ih
7:23		19.01	
7:26		10.09	
7:26		10.13	im
7:26		10.09	
7:33		0.00	
7:33		-0.02	z
7:33		0.01	
7:40		10.27	
7:41		10.28	m
7:41		10.30	

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Project #:** Unit 30  
**Test Location:** M224514

**Linearity Cal/Pre 2 Cal**  
**Date:** 12/6/2022

<u>Time</u>	<u>O2 % (dry)</u>		<u>CO2 % (dry)</u>	
7:32	19.70	ih	18.60	ih
7:32	19.70	h	18.60	h
7:33	19.50		16.60	
7:33	7.50		5.70	
7:33	2.00		1.80	
7:33	0.70		0.50	
7:33	0.40		0.20	
7:33	0.20		0.00	
7:34	0.10		0.00	
7:34	0.10		0.00	
7:34	0.10		0.00	
7:34	0.00	iz	0.00	iz
7:34	0.00	z	0.00	z
7:34	1.40		2.50	
7:35	7.60		6.00	
7:35	9.40		7.90	
7:35	9.80		8.80	
7:35	9.90		9.30	
7:35	10.00		9.60	im
7:35	10.00	im	9.70	m
7:36	10.10	m	9.80	

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station

**Test Location:** Unit 30  
**Project #:** M224514

**Post 1**

<u>Time</u>	<u>O2 % (dry)</u>	<u>CO2 % (dry)</u>
16:35	11.96	
16:36	12.05	m
16:37	6.12	
16:38	-0.10	z
16:39	-0.17	
16:35		10.13
16:35		10.18
16:35		10.15
16:38		0.38
16:38		0.07
16:38		0.03

**Post 2/Pre 3**

<u>Time</u>	<u>O2 % (dry)</u>	<u>CO2 % (dry)</u>
8:59	12.00	
9:00	12.01	m
9:01	2.94	
9:02	-0.16	z
9:03	-0.18	
9:01		10.27
9:01		10.24
9:01		10.27
9:02		0.05
9:02		0.00
9:02		0.01

**Post 3**

<u>Time</u>	<u>O2 % (dry)</u>	<u>CO2 % (dry)</u>
15:17	0.00	0.00
15:18	0.00	z
15:19	9.30	5.10
15:20	11.00	9.70
15:21	11.00	m
15:22	11.00	9.70

Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Project #: M224514

Test Location: Unit 30  
 Operator: MAN  
 Test Methods: 3A,5/29

### Calibration Gases - Linearity

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder
CO <sub>2</sub> %	Zero	Zero Nitrogen	0	0.00	0.00%	N/A	
	Mid	BLM005211	9.933	9.90	0.18%	2/16/2029	53.66%
	High	LL107625	18.51	18.50	0.05%	6/29/2028	
O <sub>2</sub> %	Zero	Zero Nitrogen	0	0.00	0.00%	N/A	
	Mid	BLM005211	10.12	10.20	-0.40%	2/16/2029	51.21%
	High	LL107625	19.76	19.60	0.81%	6/29/2028	

### Analyzer Data

Type	Model/Serial #
CO <sub>2</sub> %	ECOM
O <sub>2</sub> %	ECOM

### CO<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 4	Normal	7:34	11:04	12/7/2022	9.93	9.90	9.70	0.00	0.00	0.00	9.80	2.70	2.7	1.08	-1.08	0.00	0.00
Run 5	Normal	11:32	15:01	12/7/2022	9.93	9.70	9.70	0.00	0.00	0.00	9.70	2.46	2.5	1.08	0.00	0.00	0.00
Run 6	Normal	15:23	18:51	12/7/2022	9.93	9.70	9.70	0.00	0.00	0.00	9.70	2.52	2.6	1.08	0.00	0.00	0.00

### O<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 4	Normal	7:34	11:04	12/7/2022	10.12	10.20	11.40	0.00	0.00	0.00	10.80	17.92	16.8	-6.07	6.07	0.00	0.00
Run 5	Normal	11:32	15:01	12/7/2022	10.12	11.40	11.60	0.00	0.00	0.00	11.50	19.01	16.7	-7.09	1.01	0.00	0.00
Run 6	Normal	15:23	18:51	12/7/2022	10.12	11.60	11.50	0.00	0.00	0.00	11.55	18.89	16.6	-6.58	-0.51	0.00	0.00

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Project #:** Unit 30  
**Test Location:** M224514

**Linearity Cal/Pre Run 4 Cal**  
**Date:** 12/7/2022

<u>Time</u>	<u>O2 % (dry)</u>		<u>CO2 % (dry)</u>	
7:15	19.60	ih	18.50	ih
7:15	19.60	h	18.50	h
7:15	18.60		13.00	
7:15	8.30		4.30	
7:15	3.20		1.30	
7:16	1.30		0.40	
7:16	0.70		0.10	
7:16	0.40		0.00	
7:16	0.30		0.00	
7:16	0.20		0.00	
7:16	0.10		0.00	
7:17	0.10		0.00	
7:17	0.10		0.00	
7:17	0.10		0.00	
7:17	0.00		0.00	
7:17	0.00		0.00	
7:17	0.00		0.00	
7:18	0.00		0.00	
7:18	0.00		0.00	
7:18	0.00		0.00	
7:18	0.00		0.00	
7:18	0.00	iz	0.00	iz
7:18	0.00	z	0.00	z
7:19	0.00		0.00	
7:19	0.00		0.00	
7:19	0.00		0.00	
7:19	0.00		0.00	
7:19	0.00		0.00	
7:20	0.00		0.00	
7:20	3.60		4.20	
7:20	7.80		7.20	
7:20	9.30		8.30	
7:20	9.70		9.30	
7:20	9.90		9.60	
7:21	10.00		9.80	
7:21	10.10		9.90	
7:21	10.10		9.90	
7:21	10.10		9.90	
7:21	10.10		9.90	
7:21	10.10		9.90	
7:22	10.10		9.90	
7:22	10.20	im	9.90	im
7:22	10.20	m	9.90	m
7:22	10.20		9.90	

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station

**Test Location:** Unit 30  
**Project #:** M224514

**Post 4/Pre 5**

<u>Time</u>	<u>O2 % (dry)</u>		<u>CO2 % (dry)</u>	
11:08	0.00		0.00	
11:09	0.00	z	0.00	z
11:10	11.40		9.40	
11:11	11.40	m	9.70	m
11:12	11.40		9.70	

**Post 5/Pre 6**

<u>Time</u>	<u>O2 % (dry)</u>		<u>CO2 % (dry)</u>	
15:07	0.00		0.00	
15:08	0.00	z	0.00	z
15:09	11.70		9.50	
15:10	11.70		9.70	
15:11	11.60	m	9.70	m
15:12	11.60		9.70	

**Post 6**

<u>Time</u>	<u>O2 % (dry)</u>		<u>CO2 % (dry)</u>	
18:56	0.00		0.00	
18:57	0.00	z	0.00	z
18:58	11.40		7.90	
18:59	11.50	m	9.70	m
19:00	11.50		9.70	



Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Project #: M224514

Test Location: Unit 30  
 Operator: MAN  
 Test Methods: 3A,5/29

### Calibration Gases - Linearity

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder
CO <sub>2</sub> %	Zero	Zero Nitrogen	0	0.00	0.00%	N/A	
	Mid	BLM005211	9.933	9.90	0.18%	2/16/2029	53.66%
	High	LL107625	18.51	18.40	0.59%	6/29/2028	
O <sub>2</sub> %	Zero	Zero Nitrogen	0	0.10	-0.51%	N/A	
	Mid	BLM005211	10.12	10.20	-0.40%	2/16/2029	51.21%
	High	LL107625	19.76	20.00	-1.21%	6/29/2028	

### Analyzer Data

Type	Model/Serial #
CO <sub>2</sub> %	ECOM
O <sub>2</sub> %	ECOM

### CO<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 7	Normal	8:52	13:51	12/8/2022	9.93	9.90	9.70	0.00	0.00	0.00	9.80	2.13	2.2	1.08	-1.08	0.00	0.00

### O<sub>2</sub> % Correction Data

	Source Condition	Start Time	End Time	Date	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
Run 7	Normal	8:52	13:51	12/8/2022	10.12	10.20	11.30	0.10	0.10	0.10	10.75	18.41	17.4	-5.57	5.57	0.00	0.00

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Project #:** Unit 30  
**Test Location:** M224514

**Linearity Cal/Pre Run 7 Cal**  
**Date:** 12/8/2022

<u>Time</u>	<u>O2 % (dry)</u>		<u>CO2 % (dry)</u>	
8:40	20.00	ih	18.40	ih
8:40	20.00	h	18.40	h
8:41	0.10	iz	0.00	iz
8:41	0.10	z	0.00	z
8:44	10.20	im	9.90	im
8:44	10.20	m	9.90	m

ECOM would not connect, values recorded manually

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Test Location:** Unit 30  
**Project #:** M224514

**Post 1/Pre 2**

<u>Time</u>	<u>O2 % (dry)</u>		<u>CO2 % (dry)</u>	
12:26	0.10		0.00	
12:27	0.10	z	0.00	z
12:28	4.10		2.30	
12:29	11.30		9.70	
12:30	11.30	m	9.70	m
12:31	11.30		9.70	

# **MOSTARDI PLATT**

## **Procedures for Method 5 and Flow Calibration**

### **Nozzles**

The nozzles are measured according to Method 5, Section 10.1

### **Dry Gas Meters**

The test meters are calibrated according to Method 5, Section 10.3 and 16.1. and “Procedures for Calibrating and Using Dry Gas Volume Meters as Calibration Standards” by P.R. Westlin and R.T. Shigehara, March 10, 1978.

### **Analytical Balance**

The accuracy of the analytical balance is checked with Class S, Stainless Steel Type 303 weights manufactured by F. Hopken and Son, Jersey City, New Jersey.

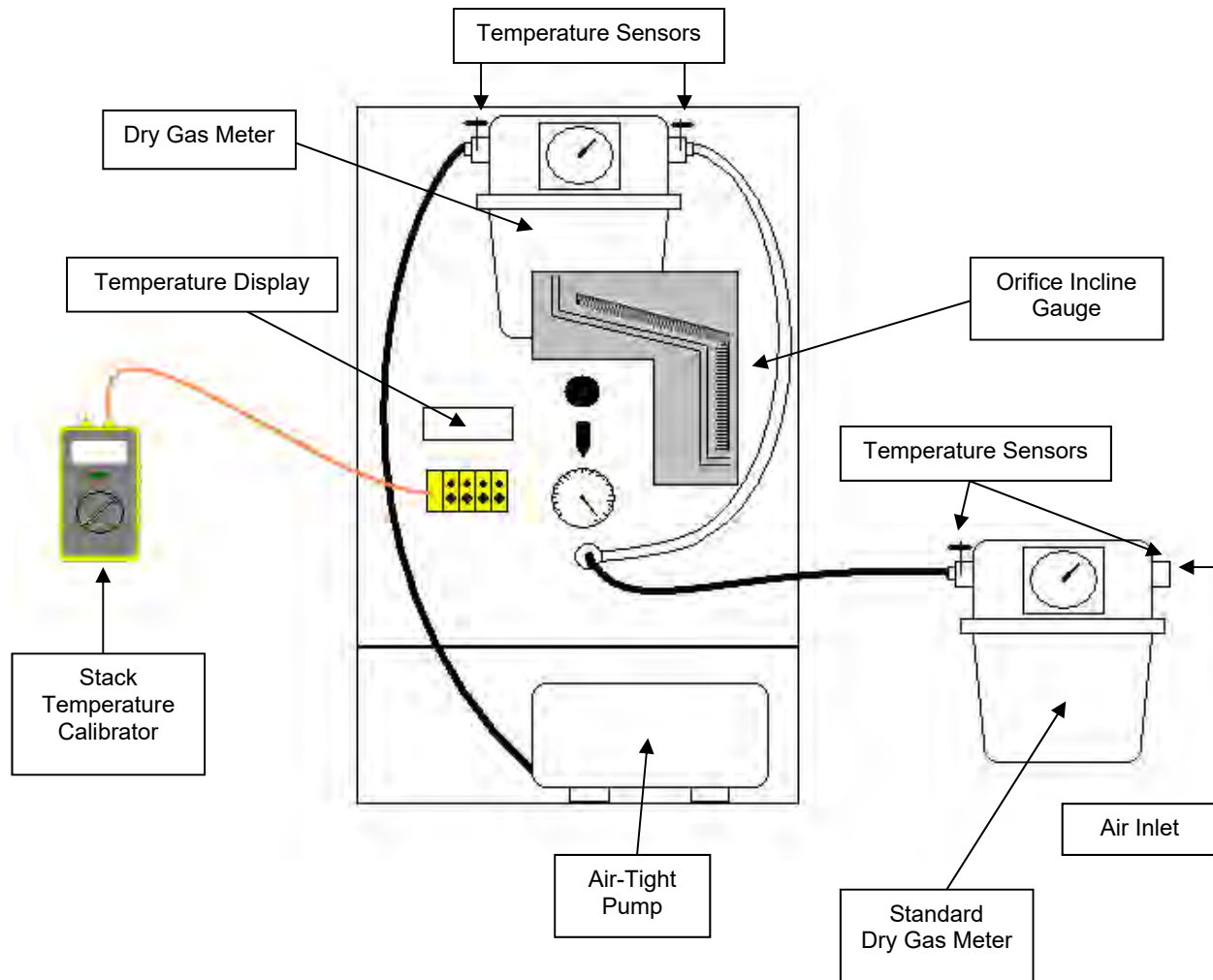
### **Temperature Sensing Devices**

The potentiometer and thermocouples are calibrated utilizing a NIST traceable millivolt source.

### **Pitot Tubes**

The pitot tubes utilized during this test program are manufactured according to the specification described and illustrated in the *Code of Federal Regulations*, Title 40, Part 60, Appendix A, Methods 1 and 2. The pitot tubes comply with the alignment specifications in Method 2, Section 10.1; and the pitot tube assemblies are in compliance with specifications in the same section.

## Dry Gas Meter/Control Module Calibration Diagram



Meter Box Calibration

Dry Gas Meter Calibration Data

Dry Gas Meter No. CM47  
 Standard Meter No. 25125408  
 Standard Meter (Y) 1.00050

Date: December 1, 2022  
 Calibrated By: EMC  
 Barometric Pressure: 29.72

Run Number	Orifice Setting in H <sub>2</sub> O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final		34.616	28.946	64	68	68					
Initial		25.778	20.108	64	67	67					
Difference	1   0.20	8.838	8.838	64	68	68	68	35	16	1.007	1.775
Final		50.804	45.135	64	69	69					
Initial		34.972	29.296	64	68	68					
Difference	2   0.50	15.832	15.839	64	69	69	69	40	33	1.007	1.825
Final		68.669	63.032	64	70	70					
Initial		51.150	45.496	64	69	69					
Difference	3   0.70	17.519	17.536	64	70	70	70	37	53	1.008	1.817
Final		92.134	86.553	64	71	71					
Initial		68.986	63.370	64	70	70					
Difference	4   0.90	23.148	23.183	64	71	71	71	44	50	1.009	1.871
Final		116.787	111.259	64	72	72					
Initial		92.584	87.001	64	71	71					
Difference	5   1.20	24.203	24.258	64	72	72	72	40	28	1.010	1.856
Final		25.625	19.957	64	67	67					
Initial		15.369	9.746	64	66	66					
Difference	6   2.00	10.256	10.211	64	67	67	67	13	21	1.005	1.892

Average 1.008 1.839

### Stack Temperature Sensor Calibration

Meter Box # : CM47 Name : EMC

Ambient Temperature : 59.5 °F Date : December 1, 2022

Calibrator Model # : CL23A

Serial # : T-285568

Date Of Certification : May 18, 2022

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

<b>Reference Source Temperature (° F)</b>	<b>Test Thermometer Temperature (° F)</b>	<b>Temperature Difference %</b>
0	1	0.2
250	251	0.1
600	601	0.1
1200	1204	0.2

$$\frac{(\text{Ref. Temp., } ^\circ\text{F} + 460) - (\text{Test Therm. Temp., } ^\circ\text{F} + 460)}{\text{Ref. Temp., } ^\circ\text{F} + 460} * 100 \leq 1.5 \%$$

Ref. Temp., °F + 460



Client: Northern Natural Gas Company  
 Facility: Clifton Compressor Station  
 Test Location: Unit 30  
 Test Method: 5/29  
 Meter ID: CM47

USEPA Method 5, Section 16.3 Post Calibration Procedure

	Run Time (min):	Vm (dscf):	Tm (oR):	Pbar ("Hg):	DHavg ("H2O):	Md:	Orifice DH@:	Meter Y1:	Ycp:	Calibration Status:
Test Run 1	200	165.70	532.04	28.37	2.43	29.068	1.839	1.0080	1.069	Pass
Test Run 2	200	172.36	519.11	28.37	2.49	29.092	1.839	1.0080	1.027	
Test Run 3	200	161.82	535.79	28.37	2.31	29.08	1.839	1.0080	1.071	
								1.0080	1.056	

**Stack Temperature Sensor Calibration**

Meter Box # : PFD-3 Name : NJC

Ambient Temperature : 80.7 °F Date : August 2, 2022

Calibrator Model # : CL23A

Serial # : T-314718

Date Of Certification : November 19, 2022

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

<b>Reference Source Temperature (° F)</b>	<b>Test Thermometer Temperature (° F)</b>	<b>Temperature Difference %</b>
0	0	0.0
250	249	0.1
600	599	0.1
1200	1201	0.1

$$\frac{(\text{Ref. Temp., } ^\circ\text{F} + 460) - (\text{Test Therm. Temp., } ^\circ\text{F} + 460)}{\text{Ref. Temp., } ^\circ\text{F} + 460} * 100 \leq 1.5 \%$$

**Stack Temperature Sensor Calibration**

Meter Box # : PFD-3 Name : JMG

Ambient Temperature : 57 °F Date : December 16, 2022

Calibrator Model # : CL23A

Serial # : T-314718

Date Of Certification : November 19, 2022

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

<b>Reference Source Temperature (° F)</b>	<b>Test Thermometer Temperature (° F)</b>	<b>Temperature Difference %</b>
0	0	0.0
250	249	0.1
600	600	0.0
1200	1201	0.1

$$\frac{(\text{Ref. Temp., } ^\circ\text{F} + 460) - (\text{Test Therm. Temp., } ^\circ\text{F} + 460)}{\text{Ref. Temp., } ^\circ\text{F} + 460} * 100 \leq 1.5 \%$$

# S TYPE PITOT TUBE INSPECTION WORKSHEET

Pitot Tube No: 711

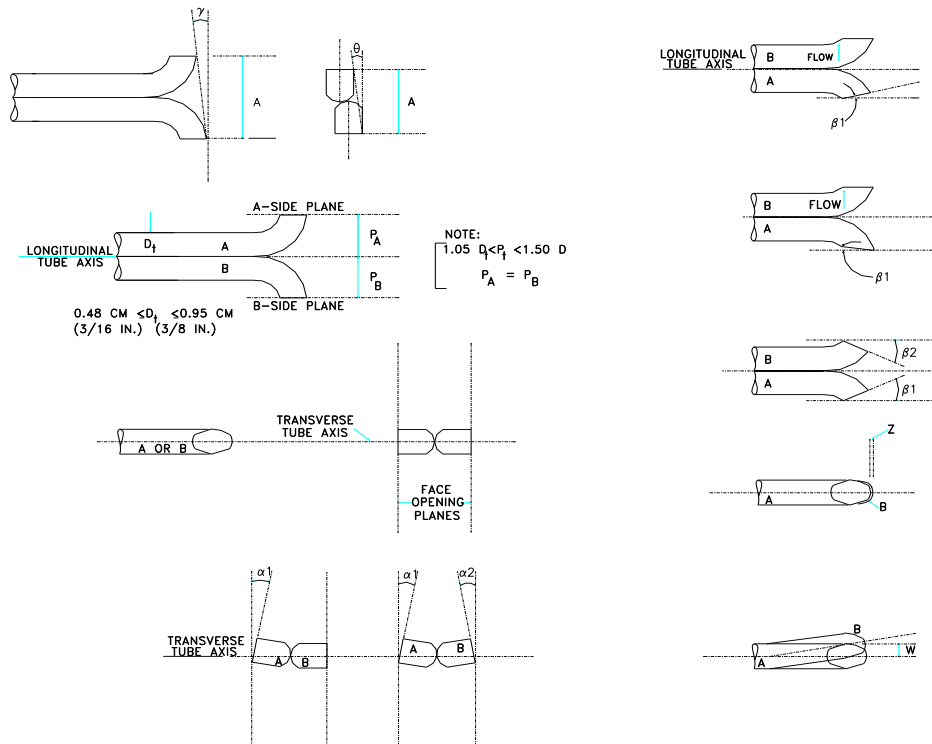
Date: 6/8/2021

Inspectors Name: EJP

Type of Probe: (circle one)

M2	M5	M17
	X	

Probe Length: 6 ft.



Pitot tube assembly level? X yes        no

Pitot tube openings damaged?        yes (explain below) X no

$$a_1 = \underline{0}^{\circ} (\leq 10^{\circ})$$

$$a_2 = \underline{0}^{\circ} (\leq 10^{\circ})$$

$$z = A \sin \gamma = \underline{0.016} \text{ (in.)}; (\leq 0.125 \text{ in.})$$

$$b_1 = \underline{0}^{\circ} (\leq 5^{\circ})$$

$$b_2 = \underline{1}^{\circ} (\leq 5^{\circ})$$

$$w = A \sin \theta = \underline{0.00000} \text{ (in.)}; (\leq 0.03125 \text{ in.})$$

$$\gamma = \underline{1}^{\circ} \quad \theta = \underline{0}^{\circ} \quad A = \underline{0.933} \text{ (in.)}$$

$$P_A = \underline{0.467} \text{ (in.)}, P_B = \underline{0.467} \text{ (in.)}, D_t = \underline{0.375} \text{ (in.)}$$

Calibration required?        yes X no

# S TYPE PITOT TUBE INSPECTION WORKSHEET

Pitot Tube No: 711

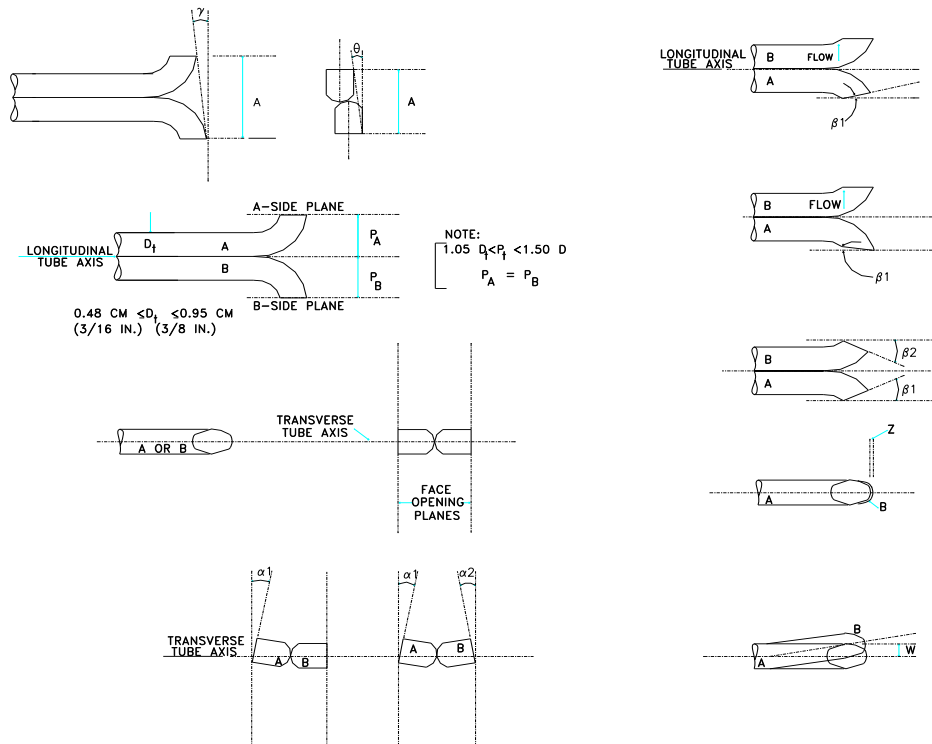
Date: 12/9/2022

Inspectors Name: SWK

Type of Probe: (circle one)

M2	M5	M17
	X	

Probe Length: 6 ft.



Pitot tube assembly level? X yes        no

Pitot tube openings damaged?        yes (explain below) X no

$$a_1 = \underline{4.5}^\circ (\leq 10^\circ)$$

$$a_2 = \underline{1.5}^\circ (\leq 10^\circ)$$

$$z = A \sin \gamma = \underline{0.024} \text{ (in.)}; (\leq 0.125 \text{ in.})$$

$$b_1 = \underline{1.5}^\circ (\leq 5^\circ)$$

$$b_2 = \underline{0}^\circ (\leq 5^\circ)$$

$$w = A \sin \theta = \underline{0.01618} \text{ (in.)}; (\leq 0.03125 \text{ in.})$$

$$\gamma = \underline{1.5}^\circ \quad \theta = \underline{1}^\circ \quad A = \underline{0.927} \text{ (in.)}$$

$$P_A = \underline{0.464} \text{ (in.)}, P_B = \underline{0.464} \text{ (in.)}, D_t = \underline{0.375} \text{ (in.)}$$

Calibration required?        yes X no

# S TYPE PITOT TUBE INSPECTION WORKSHEET

Pitot Tube No: 888

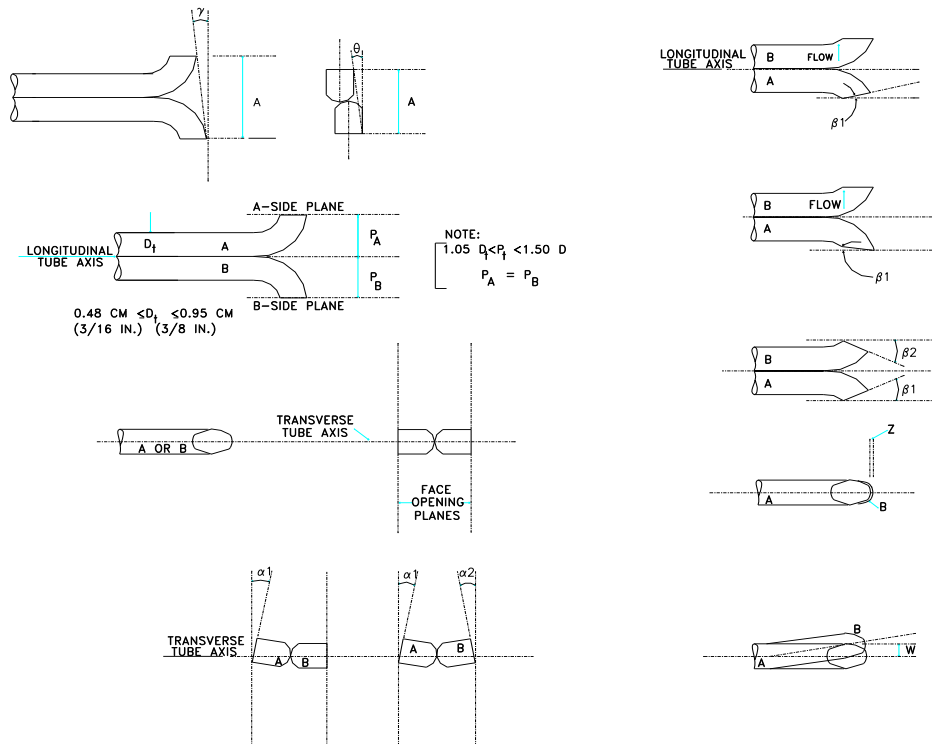
Date: 7/25/2022

Inspectors Name: EMC

Type of Probe: (circle one)

M2	M5	M17
X		

Probe Length: 12 ft.



Pitot tube assembly level? X yes        no

Pitot tube openings damaged?        yes (explain below) X no

$$a_1 = \underline{3}^{\circ} (\leq 10^{\circ})$$

$$a_2 = \underline{2.5}^{\circ} (\leq 10^{\circ})$$

$$z = A \sin \gamma = \underline{0.015} \text{ (in.)}; (\leq 0.125 \text{ in.})$$

$$b_1 = \underline{1.5}^{\circ} (\leq 5^{\circ})$$

$$b_2 = \underline{4}^{\circ} (\leq 5^{\circ})$$

$$w = A \sin \theta = \underline{0.00000} \text{ (in.)}; (\leq 0.03125 \text{ in.})$$

$$\gamma = \underline{1}^{\circ} \quad \theta = \underline{0}^{\circ} \quad A = \underline{0.860} \text{ (in.)}$$

$$P_A = \underline{0.430} \text{ (in.)}, P_B = \underline{0.430} \text{ (in.)}, D_t = \underline{0.375} \text{ (in.)}$$

Calibration required?        yes X no

# S TYPE PITOT TUBE INSPECTION WORKSHEET

Pitot Tube No: 888

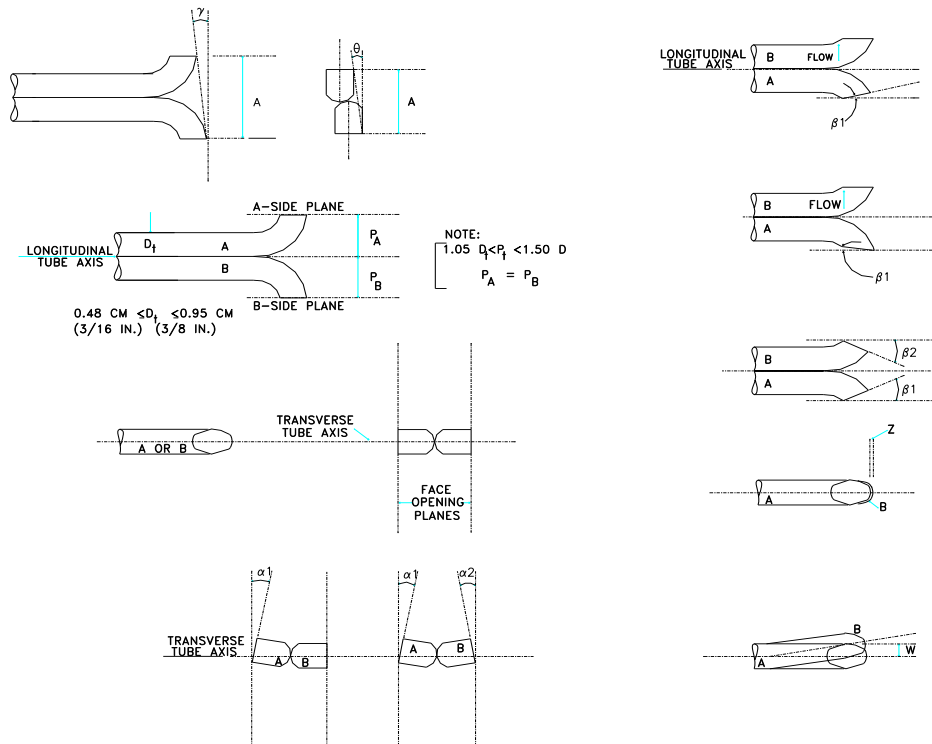
Date: 12/14/2022

Inspectors Name: ATW

Type of Probe: (circle one)

M2	M5	M17
X		

Probe Length: 12 ft.



Pitot tube assembly level? X yes        no

Pitot tube openings damaged?        yes (explain below) X no

$a_1 =$  3  $^{\circ}$  ( $\leq 10^{\circ}$ )

$a_2 =$  2  $^{\circ}$  ( $\leq 10^{\circ}$ )

$z = A \sin \gamma =$  0.008 (in.); ( $\leq 0.125$  in.)

$b_1 =$  1  $^{\circ}$  ( $\leq 5^{\circ}$ )

$b_2 =$  1  $^{\circ}$  ( $\leq 5^{\circ}$ )

$w = A \sin \theta =$  0.01501 (in.); ( $\leq 0.03125$  in.)

$\gamma =$  0.5  $^{\circ}$   $\theta =$  1  $^{\circ}$   $A =$  0.860 (in.)

$P_A =$  0.430 (in.),  $P_B =$  0.430 (in.),  $D_t =$  0.375 (in.)

Calibration required?        yes X no



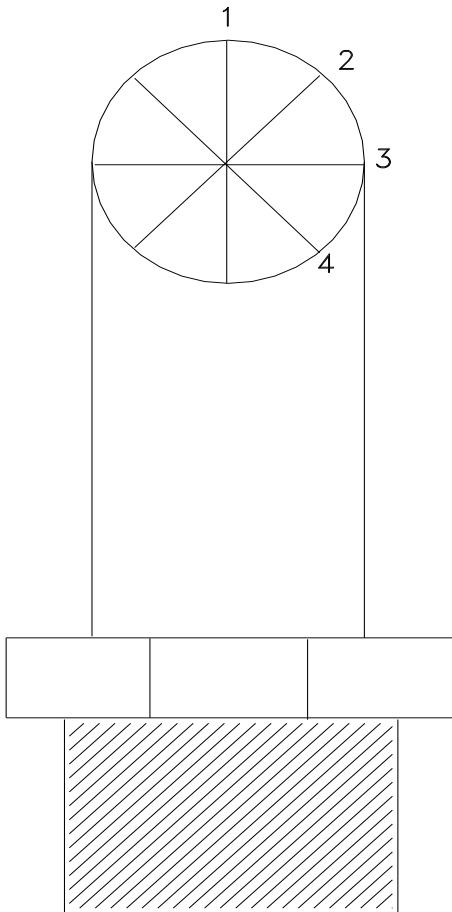
# Nozzle Calibration

Date: 3/9/2021

Nozzle ID No.: 119

Analyst: RGO

Material/Type: Quartz



0.273 1

0.273 2

0.273 3

0.273 4



Average
<u>0.273</u>

**Appendix I - Calibration Gas Cylinder Data**

## CERTIFICATE OF ANALYSIS

### Grade of Product: CERTIFIED STANDARD-SPEC

Part Number:	X02NI99C15A1268	Reference Number:	153-402442686-1
Cylinder Number:	AAL070174	Cylinder Volume:	144.0 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
Analysis Date:	May 18, 2022	Valve Outlet:	350
Lot Number:	153-402442686-1		

**Expiration Date: May 18, 2030**

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

### ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	99.03 PPM	+/- 2%
NITROGEN	Balance		



Signature on file

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI80E80A7767	Reference Number:	153-402016151-1
Cylinder Number:	BLM005211	Cylinder Volume:	87.4 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2214 PSIG
PGVP Number:	B72021	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Feb 16, 2021

**Expiration Date: Feb 16, 2029**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	10.00 %	9.933 %	G1	+/- 0.7% NIST Traceable	02/16/2021
OXYGEN	10.00 %	10.12 %	G1	+/- 0.8% NIST Traceable	02/16/2021
NITROGEN	Balance				

### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060802	CC411741	13.359 % CARBON DIOXIDE/NITROGEN	0.6%	May 14, 2025
NTRM	98051010	SG9161286BAL	12.05 % OXYGEN/NITROGEN	0.7%	Dec 14, 2023

### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA-510 SV4MEUTJ CO2	CO2 NDIR (Dixon)	Feb 04, 2021
Horiba MPA-510 W603MM58 O2	O2 Paramagnetic (Mason)	Feb 01, 2021

Triad Data Available Upon Request



Signature on file

# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E02NI99E15A0094	Reference Number:	153-402022542-1
Cylinder Number:	CC15116	Cylinder Volume:	144.3 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72021	Valve Outlet:	350
Gas Code:	CO,BALN	Certification Date:	Feb 08, 2021

**Expiration Date: Feb 08, 2029**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON MONOXIDE	20.00 PPM	19.79 PPM	G1	+/- 0.5% NIST Traceable	02/08/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	15010203	KAL003073	24.35 PPM CARBON MONOXIDE/NITROGEN	0.3%	Sep 04, 2021

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Thermo 48i-TLE 1163640031 CO	CO NDIR (Mason)	Feb 01, 2021

Triad Data Available Upon Request



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# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI78E15A1066	Reference Number:	153-402477756-1
Cylinder Number:	CC54995	Cylinder Volume:	151.1 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72022	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Jul 06, 2022

**Expiration Date: Jul 06, 2030**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	10.00 %	9.981 %	G1	+/- 1.0% NIST Traceable	07/06/2022
OXYGEN	12.00 %	12.24 %	G1	+/- 0.8% NIST Traceable	07/06/2022
NITROGEN	Balance				

### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060405	CC411744	7.489 % CARBON DIOXIDE/NITROGEN	0.6%	May 14, 2025
NTRM	98051010	SG9161286BAL	12.05 % OXYGEN/NITROGEN	0.7%	Dec 14, 2023

### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA-510 SV4MEUTJ CO2	CO2 NDIR (Dixon)	Jun 23, 2022
Horiba MPA-510 W603MM58 O2	O2 Paramagnetic (Mason)	Jun 23, 2022

Triad Data Available Upon Request



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# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI59E15A3452	Reference Number:	153-402157382-1
Cylinder Number:	CC332317	Cylinder Volume:	159.0 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72021	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Jul 15, 2021

**Expiration Date: Jul 15, 2029**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	19.00 %	18.99 %	G1	+/- 0.6% NIST Traceable	07/15/2021
OXYGEN	22.00 %	22.40 %	G1	+/- 0.3% NIST Traceable	07/15/2021
NITROGEN	Balance				

### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060802	CC415397	24.04 % CARBON DIOXIDE/NITROGEN	0.6%	Dec 11, 2025
NTRM	12062008	CC367433	22.883 % OXYGEN/NITROGEN	0.2%	May 14, 2024

### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA-510 SV4MEUTJ CO2	CO2 NDIR (Dixon)	Jun 17, 2021
Horiba MPA-510 W603MM58 O2	O2 Paramagnetic (Mason)	Jul 12, 2021

Triad Data Available Upon Request



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# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI62E80A0014	Reference Number:	153-401839627-1
Cylinder Number:	LL107625	Cylinder Volume:	92.2 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2214 PSIG
PGVP Number:	B72020	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Jun 29, 2020

**Expiration Date: Jun 29, 2028**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	19.00 %	18.51 %	G1	+/- 0.6% NIST Traceable	06/29/2020
OXYGEN	19.00 %	19.76 %	G1	+/- 0.3% NIST Traceable	06/29/2020
NITROGEN	Balance				

### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	06011806	K012669	23.04 % CARBON DIOXIDE/NITROGEN	0.5%	Jun 27, 2022
NTRM	12062008	CC367433	22.883 % OXYGEN/NITROGEN	0.2%	May 14, 2024

### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA-510 SV4MEUTJ CO2	CO2 NDIR (Dixon)	Jun 11, 2020
Horiba MPA-510 W603MM58 O2	O2 Paramagnetic (Mason)	Jun 18, 2020

Triad Data Available Upon Request



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# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E02NI99E15A0223	Reference Number:	153-402097728-1
Cylinder Number:	SG9167243BAL	Cylinder Volume:	144.3 CF
Laboratory:	124 - Tooele (SAP) - UT	Cylinder Pressure:	2015 PSIG
PGVP Number:	B72021	Valve Outlet:	350
Gas Code:	CO,BALN	Certification Date:	Apr 27, 2021

**Expiration Date: Apr 27, 2029**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON MONOXIDE	45.00 PPM	44.69 PPM	G1	+/- 0.7% NIST Traceable	04/27/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	14060737	CC434385	49.88 PPM CARBON MONOXIDE/NITROGEN	0.6%	Feb 13, 2026

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AMP0900119 CO LCO	FTIR	Apr 14, 2021

Triad Data Available Upon Request



Signature on file

## **Appendix J – Laboratory Sample Analysis**

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Project Number:** M224514  
**Test Location:** Unit 30  
**Test Method:** 5/29  
**Filterable Analysis Date:** 12/13/2022

**Filter Drying Temp °F:** Ambient-Des. 24 hrs  
**Analyst:** JMG

Description	Sample Date	ID#	vol. (ml)	Initial Weight (grams)	Final Weight (grams)	Net Weight Gain (grams)
<b>Filterable Particulate</b>						
Run 1	12/5/2022					
Source Condition: Normal						
M5 Filter		6023		0.44759	0.44651	≤ 0.00015
Acetone Wash (M5 Pans)		6225	100 mL	21.02213	21.02700	0.00487
Acetone Blank						0.00038
Total Filterable Weight						≤ 0.00464
<b>Filterable Particulate</b>						
Run 2	12/6/2022					
Source Condition: Normal						
M5 Filter		6021		0.43762	0.43709	≤ 0.00015
Acetone Wash (M5 Pans)		6227	100 mL	21.21037	21.21177	0.00140
Acetone Blank						0.00038
Total Filterable Weight						≤ 0.00117
<b>Filterable Particulate</b>						
Run 3	12/6/2022					
Source Condition: Normal						
M5 Filter		5043		0.45559	0.45220	≤ 0.00015
Acetone Wash (M5 Pans)		6229	100 mL	21.06772	21.06899	0.00127
Acetone Blank						0.00038
Total Filterable Weight						≤ 0.00104
<b>Reagent Blank Summary</b>						
Acetone Wash (M5 Pans)		6239	100 mL	21.43654	21.43692	0.00038
<b>RDL/MDL Summary</b>						
<b>Media</b>	<b>MDL, grams</b>			<b>RDL, grams</b>		
M5 Filter	0.00005			0.00015		
Acetone Wash (M5 Pans)	0.00008			0.00025		

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Project Number:** M224514  
**Test Location:** Unit 30  
**Test Method:** 5/29  
**Filterable Analysis Date:** 12/13/2022

**Filter Drying Temp °F:** Ambient-Des. 24 hrs  
**Analyst:** JMG

Description	Sample Date	ID#	vol. (ml)	Initial Weight (grams)	Final Weight (grams)	Net Weight Gain (grams)
<b>Filterable Particulate</b>						
Run 4	12/7/2022					
Source Condition: Normal						
M5 Filter		5051		0.45083	0.44787	≤ 0.00015
Acetone Wash (M5 Pans)		6231	100 mL	21.05805	21.05909	0.00104
Acetone Blank						0.00038
Total Filterable Weight						≤ 0.00081
<b>Filterable Particulate</b>						
Run 5	12/7/2022					
Source Condition: Normal						
M5 Filter		5050		0.45468	0.45171	≤ 0.00015
Acetone Wash (M5 Pans)		6233	100 mL	21.33773	21.33897	0.00124
Acetone Blank						0.00038
Total Filterable Weight						≤ 0.00101
<b>Filterable Particulate</b>						
Run 6	12/7/2022					
Source Condition: Normal						
M5 Filter		6036		0.44018	0.44025	≤ 0.00015
Acetone Wash (M5 Pans)		6235	100 mL	20.93337	20.93451	0.00114
Acetone Blank						0.00038
Total Filterable Weight						≤ 0.00091
<b>Reagent Blank Summary</b>						
Acetone Wash (M5 Pans)		6239	100 mL	21.43654	21.43692	0.00038
<b>RDL/MDL Summary</b>						
<b>Media</b>	<b>MDL, grams</b>			<b>RDL, grams</b>		
M5 Filter	0.00005			0.00015		
Acetone Wash (M5 Pans)	0.00008			0.00025		
Sample Vials (M202)	0.00008			0.00025		

**Client:** Northern Natural Gas Company  
**Facility:** Clifton Compressor Station  
**Project Number:** M224514  
**Test Location:** Unit 30  
**Test Method:** 5/29  
**Filterable Analysis Date:** 12/13/2022

**Filter Drying Temp °F:** Ambient-Des. 24 hrs  
**Analyst:** JMG

Description	Sample Date	ID#	vol. (ml)	Initial Weight (grams)	Final Weight (grams)	Net Weight Gain (grams)
<b>Filterable Particulate</b>						
Run 7	12/8/2022					
Source Condition: Normal						
M5 Filter		5045		0.45195	0.44903	≤ 0.00015
Acetone Wash (M5 Pans)		6237	100 mL	21.02613	21.02841	0.00228
Acetone Blank						0.00038
Total Filterable Weight						≤ 0.00205
<b>Reagent Blank Summary</b>						
Acetone Wash (M5 Pans)		6239	100 mL	21.43654	21.43692	0.00038
<b>RDL/MDL Summary</b>						
<b>Media</b>	<b>MDL, grams</b>			<b>RDL, grams</b>		
M5 Filter	0.00005			0.00015		
Acetone Wash (M5 Pans)	0.00008			0.00025		
Sample Vials (M202)	0.00008			0.00025		



Your Project #: M224514  
 Site#: NORTHERN NATURAL GAS  
 Site Location: CLIFTON

**Attention: Data Reporting**

Mostardi Platt  
 888 Industrial Rd  
 Elmhurst, IL  
 USA 60126-1121

**Report Date: 2022/12/20**  
 Report #: R7438632  
 Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C2AF790**

**Received: 2022/12/13, 16:46**

Sample Matrix: Stack Sampling Train  
 # Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury 3C in HCl Rinse	8	2022/12/19	2022/12/20	BRL SOP-00104	EPA M29/M0060 m
Mercury 2B in HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub> Imp.	8	2022/12/15	2022/12/20	BRL SOP-00104	EPA M29/M0060 m
Mercury 3A in HNO <sub>3</sub> Rinse	8	2022/12/15	2022/12/20	BRL SOP-00104	EPA M29/M0060 m
Mercury 3B in KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub> Imp.	8	2022/12/17	2022/12/20	BRL SOP-00104	EPA M29/M0060 m
Mercury 1B in Filter + Rinse (M29)	8	2022/12/19	2022/12/20	BRL SOP-00104	EPA 29 m
Metals B.H. in H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub> Imp.(6020B m)	8	2022/12/19	2022/12/20	BRL SOP-00103 / BRL SOP-00102	EPA M29/CARB 436 m
Metals F.H. in Filter + Rinses (6020B m)	8	2022/12/19	2022/12/20	BRL SOP-00103/ BRL SOP-00102	EPA M29/CARB 436 m

**Remarks:**

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

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Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

\* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.





Your Project #: M224514  
Site#: NORTHERN NATURAL GAS  
Site Location: CLIFTON

**Attention: Data Reporting**

Mostardi Platt  
888 Industrial Rd  
Elmhurst, IL  
USA 60126-1121

**Report Date: 2022/12/20**  
Report #: R7438632  
Version: 1 - Final

**CERTIFICATE OF ANALYSIS**

**BUREAU VERITAS JOB #: C2AF790**

**Received: 2022/12/13, 16:46**

**Encryption Key**

Please direct all questions regarding this Certificate of Analysis to:  
Clayton Johnson, CET LEAD-Air Toxics, Source Evaluation  
Email: Clayton.Johnson@bureauveritas.com  
Phone# (905)817-5769

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Total Cover Pages : 2  
Page 2 of 15

Bureau Veritas 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvna.com

Project No. M224514  
Unit 30

Microbiology testing is conducted at 6660 Campobello Rd. Chemistry testing is conducted at 6740 Campobello Rd.

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### EPA M29 MERCURY (STACK SAMPLING TRAIN)

Bureau Veritas ID		UOQ088		UOQ089	UOQ089		UOQ090		UOQ091		
Sampling Date		2022/12/08		2022/12/05	2022/12/05		2022/12/06		2022/12/06		
	UNITS	M29- BLANK	RDL	M29- T1	M29- T1 Lab-Dup	RDL	M29- T2	RDL	M29- T3	RDL	QC Batch
1B Mercury (Hg)	ug	<0.015	0.015	<0.015	<0.015	0.015	<0.015	0.015	<0.015	0.015	8411329
2B Mercury (Hg)	ug	<0.15	0.15	<0.22	<0.22	0.22	<0.22	0.22	<0.17	0.17	8405627
3A Mercury (Hg)	ug	<0.005	0.005	<0.0056	<0.0056	0.0056	<0.0067	0.0067	<0.1	0.1	8405301
3B Mercury (Hg)	ug	0.04	0.02	<0.025	<0.025	0.025	<0.025	0.025	<0.025	0.025	8410328
3C Mercury (Hg)	ug	0.033	0.013	0.168	0.172	0.018	0.163	0.015	0.036	0.018	8410325

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas ID		UOQ100		UOQ101		UOQ102		UOQ103		
Sampling Date		2022/12/07		2022/12/07		2022/12/07		2022/12/08		
	UNITS	M29- T4	RDL	M29- T5	RDL	M29- T6	RDL	M29- T7	RDL	QC Batch
1B Mercury (Hg)	ug	<0.015	0.015	<0.015	0.015	<0.015	0.015	<0.015	0.015	8411329
2B Mercury (Hg)	ug	<0.23	0.23	<0.28	0.28	<0.21	0.21	<0.23	0.23	8405627
3A Mercury (Hg)	ug	<0.0059	0.0059	<0.0051	0.0051	<0.0055	0.0055	<0.0062	0.0062	8405301
3B Mercury (Hg)	ug	0.034	0.028	<0.025	0.025	<0.028	0.028	0.032	0.025	8410328
3C Mercury (Hg)	ug	0.026	0.015	0.111	0.015	0.110	0.015	0.106	0.015	8410325

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch



Bureau Veritas Job #: C2AF790  
Report Date: 2022/12/20

Mostardi Platt  
Client Project #: M224514  
Site Location: CLIFTON

### ELEMENTS BY ICP/MS (STACK SAMPLING TRAIN)

Bureau Veritas ID		UOQ088	UOQ089	UOQ089	UOQ090	UOQ091	UOQ100	UOQ101		
Sampling Date		2022/12/08	2022/12/05	2022/12/05	2022/12/06	2022/12/06	2022/12/07	2022/12/07		
	UNITS	M29- BLANK	M29- T1	M29- T1 Lab-Dup	M29- T2	M29- T3	M29- T4	M29- T5	RDL	QC Batch
Front Half Antimony (Sb)	ug	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3.0	8411336
Front Half Arsenic (As)	ug	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	0.80	8411336
Front Half Beryllium (Be)	ug	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	0.18	8411336
Front Half Cadmium (Cd)	ug	<0.18	0.33	0.34	2.91	<0.18	<0.18	<0.18	0.18	8411336
Front Half Chromium (Cr)	ug	<3.0	9.3	8.7	3.3	<3.0	5.0	<3.0	3.0	8411336
Front Half Cobalt (Co)	ug	<0.18	0.92	0.88	0.19	0.20	0.39	<0.18	0.18	8411336
Front Half Lead (Pb)	ug	<0.60	1.92	1.94	0.67	<0.60	<0.60	<0.60	0.60	8411336
Front Half Manganese (Mn)	ug	<1.2	10.4	10.1	2.7	2.3	3.1	13.1	1.2	8411336
Front Half Nickel (Ni)	ug	8.1	28.9	29.0	11.2	3.9	9.6	3.6	1.0	8411336
Front Half Selenium (Se)	ug	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	8411336
Back Half Antimony (Sb)	ug	<0.40	<0.40	<0.40	0.48	<0.40	0.45	<0.40	0.40	8409041
Back Half Arsenic (As)	ug	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8409041
Back Half Beryllium (Be)	ug	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	0.090	8409041
Back Half Cadmium (Cd)	ug	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090	0.090	8409041
Back Half Chromium (Cr)	ug	<1.5	<1.5	<1.5	<1.5	1.9	<1.5	2.0	1.5	8409041
Back Half Cobalt (Co)	ug	<0.090	0.380	0.365	<0.090	0.218	<0.090	0.134	0.090	8409041
Back Half Lead (Pb)	ug	<0.30	0.77	0.78	0.48	0.41	0.38	0.39	0.30	8409041
Back Half Manganese (Mn)	ug	<0.60	1.15	1.11	1.24	2.23	4.54	1.71	0.60	8409041
Back Half Nickel (Ni)	ug	<0.50	1.36	1.30	0.86	6.78	1.09	2.48	0.50	8409041
Back Half Selenium (Se)	ug	<1.0	8.1	8.0	<1.0	<1.0	<1.0	<1.0	1.0	8409041

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate



### ELEMENTS BY ICP/MS (STACK SAMPLING TRAIN)

Bureau Veritas ID		UOQ102	UOQ103		
Sampling Date		2022/12/07	2022/12/08		
	UNITS	M29- T6	M29- T7	RDL	QC Batch
Front Half Antimony (Sb)	ug	<3.0	<3.0	3.0	8411336
Front Half Arsenic (As)	ug	<0.80	<0.80	0.80	8411336
Front Half Beryllium (Be)	ug	<0.18	<0.18	0.18	8411336
Front Half Cadmium (Cd)	ug	<0.18	<0.18	0.18	8411336
Front Half Chromium (Cr)	ug	3.7	4.7	3.0	8411336
Front Half Cobalt (Co)	ug	<0.18	0.18	0.18	8411336
Front Half Lead (Pb)	ug	0.69	<0.60	0.60	8411336
Front Half Manganese (Mn)	ug	1.9	2.7	1.2	8411336
Front Half Nickel (Ni)	ug	10.1	5.3	1.0	8411336
Front Half Selenium (Se)	ug	<2.0	<2.0	2.0	8411336
Back Half Antimony (Sb)	ug	0.56	<0.40	0.40	8409041
Back Half Arsenic (As)	ug	<0.40	<0.40	0.40	8409041
Back Half Beryllium (Be)	ug	<0.090	<0.090	0.090	8409041
Back Half Cadmium (Cd)	ug	<0.090	<0.090	0.090	8409041
Back Half Chromium (Cr)	ug	<1.5	2.6	1.5	8409041
Back Half Cobalt (Co)	ug	<0.090	0.115	0.090	8409041
Back Half Lead (Pb)	ug	0.35	0.40	0.30	8409041
Back Half Manganese (Mn)	ug	3.43	5.69	0.60	8409041
Back Half Nickel (Ni)	ug	0.94	2.86	0.50	8409041
Back Half Selenium (Se)	ug	<1.0	<1.0	1.0	8409041
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					



Bureau Veritas Job #: C2AF790

Report Date: 2022/12/20

Mostardi Platt

Client Project #: M224514

Site Location: CLIFTON

## TEST SUMMARY

**Bureau Veritas ID:** UOQ088  
**Sample ID:** M29- BLANK  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/08  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury 3C in HCl Rinse	CV/AA	8410325	2022/12/19	2022/12/20	Thuy Linh Nguyen
Mercury 2B in HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub> Imp.	CV/AA	8405627	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3A in HNO <sub>3</sub> Rinse	CV/AA	8405301	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3B in KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub> Imp.	CV/AA	8410328	2022/12/17	2022/12/20	Thuy Linh Nguyen
Mercury 1B in Filter + Rinse (M29)	CV/AA	8411329	2022/12/19	2022/12/20	Thuy Linh Nguyen
Metals B.H. in H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub> Imp.(6020B m)	ICP1/MS	8409041	2022/12/19	2022/12/20	Nan Raykha
Metals F.H. in Filter + Rinses (6020B m)	ICP1/MS	8411336	2022/12/19	2022/12/20	Nan Raykha

**Bureau Veritas ID:** UOQ089  
**Sample ID:** M29- T1  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/05  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury 3C in HCl Rinse	CV/AA	8410325	2022/12/19	2022/12/20	Thuy Linh Nguyen
Mercury 2B in HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub> Imp.	CV/AA	8405627	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3A in HNO <sub>3</sub> Rinse	CV/AA	8405301	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3B in KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub> Imp.	CV/AA	8410328	2022/12/17	2022/12/20	Thuy Linh Nguyen
Mercury 1B in Filter + Rinse (M29)	CV/AA	8411329	2022/12/19	2022/12/20	Thuy Linh Nguyen
Metals B.H. in H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub> Imp.(6020B m)	ICP1/MS	8409041	2022/12/19	2022/12/20	Nan Raykha
Metals F.H. in Filter + Rinses (6020B m)	ICP1/MS	8411336	2022/12/19	2022/12/20	Nan Raykha

**Bureau Veritas ID:** UOQ089 Dup  
**Sample ID:** M29- T1  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/05  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury 3C in HCl Rinse	CV/AA	8410325	2022/12/19	2022/12/20	Thuy Linh Nguyen
Mercury 2B in HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub> Imp.	CV/AA	8405627	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3A in HNO <sub>3</sub> Rinse	CV/AA	8405301	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3B in KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub> Imp.	CV/AA	8410328	2022/12/17	2022/12/20	Thuy Linh Nguyen
Mercury 1B in Filter + Rinse (M29)	CV/AA	8411329	2022/12/19	2022/12/20	Thuy Linh Nguyen
Metals B.H. in H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub> Imp.(6020B m)	ICP1/MS	8409041	2022/12/19	2022/12/20	Nan Raykha
Metals F.H. in Filter + Rinses (6020B m)	ICP1/MS	8411336	2022/12/19	2022/12/20	Nan Raykha

**Bureau Veritas ID:** UOQ090  
**Sample ID:** M29- T2  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/06  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury 3C in HCl Rinse	CV/AA	8410325	2022/12/19	2022/12/20	Thuy Linh Nguyen
Mercury 2B in HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub> Imp.	CV/AA	8405627	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3A in HNO <sub>3</sub> Rinse	CV/AA	8405301	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3B in KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub> Imp.	CV/AA	8410328	2022/12/17	2022/12/20	Thuy Linh Nguyen
Mercury 1B in Filter + Rinse (M29)	CV/AA	8411329	2022/12/19	2022/12/20	Thuy Linh Nguyen
Metals B.H. in H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub> Imp.(6020B m)	ICP1/MS	8409041	2022/12/19	2022/12/20	Nan Raykha



Bureau Veritas Job #: C2AF790  
Report Date: 2022/12/20

Mostardi Platt  
Client Project #: M224514  
Site Location: CLIFTON

## TEST SUMMARY

**Bureau Veritas ID:** UOQ090  
**Sample ID:** M29- T2  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/06  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals F.H. in Filter + Rinses (6020B m)	ICP1/MS	8411336	2022/12/19	2022/12/20	Nan Raykha

**Bureau Veritas ID:** UOQ091  
**Sample ID:** M29- T3  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/06  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury 3C in HCl Rinse	CV/AA	8410325	2022/12/19	2022/12/20	Thuy Linh Nguyen
Mercury 2B in HNO3/H2O2 Imp.	CV/AA	8405627	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3A in HNO3 Rinse	CV/AA	8405301	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3B in KMnO4/H2SO4 Imp.	CV/AA	8410328	2022/12/17	2022/12/20	Thuy Linh Nguyen
Mercury 1B in Filter + Rinse (M29)	CV/AA	8411329	2022/12/19	2022/12/20	Thuy Linh Nguyen
Metals B.H. in H2O2/HNO3 Imp.(6020B m)	ICP1/MS	8409041	2022/12/19	2022/12/20	Nan Raykha
Metals F.H. in Filter + Rinses (6020B m)	ICP1/MS	8411336	2022/12/19	2022/12/20	Nan Raykha

**Bureau Veritas ID:** UOQ100  
**Sample ID:** M29- T4  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/07  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury 3C in HCl Rinse	CV/AA	8410325	2022/12/19	2022/12/20	Thuy Linh Nguyen
Mercury 2B in HNO3/H2O2 Imp.	CV/AA	8405627	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3A in HNO3 Rinse	CV/AA	8405301	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3B in KMnO4/H2SO4 Imp.	CV/AA	8410328	2022/12/17	2022/12/20	Thuy Linh Nguyen
Mercury 1B in Filter + Rinse (M29)	CV/AA	8411329	2022/12/19	2022/12/20	Thuy Linh Nguyen
Metals B.H. in H2O2/HNO3 Imp.(6020B m)	ICP1/MS	8409041	2022/12/19	2022/12/20	Nan Raykha
Metals F.H. in Filter + Rinses (6020B m)	ICP1/MS	8411336	2022/12/19	2022/12/20	Nan Raykha

**Bureau Veritas ID:** UOQ101  
**Sample ID:** M29- T5  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/07  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury 3C in HCl Rinse	CV/AA	8410325	2022/12/19	2022/12/20	Thuy Linh Nguyen
Mercury 2B in HNO3/H2O2 Imp.	CV/AA	8405627	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3A in HNO3 Rinse	CV/AA	8405301	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3B in KMnO4/H2SO4 Imp.	CV/AA	8410328	2022/12/17	2022/12/20	Thuy Linh Nguyen
Mercury 1B in Filter + Rinse (M29)	CV/AA	8411329	2022/12/19	2022/12/20	Thuy Linh Nguyen
Metals B.H. in H2O2/HNO3 Imp.(6020B m)	ICP1/MS	8409041	2022/12/19	2022/12/20	Nan Raykha
Metals F.H. in Filter + Rinses (6020B m)	ICP1/MS	8411336	2022/12/19	2022/12/20	Nan Raykha



Bureau Veritas Job #: C2AF790  
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## TEST SUMMARY

**Bureau Veritas ID:** UOQ102  
**Sample ID:** M29- T6  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/07  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury 3C in HCl Rinse	CV/AA	8410325	2022/12/19	2022/12/20	Thuy Linh Nguyen
Mercury 2B in HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub> Imp.	CV/AA	8405627	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3A in HNO <sub>3</sub> Rinse	CV/AA	8405301	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3B in KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub> Imp.	CV/AA	8410328	2022/12/17	2022/12/20	Thuy Linh Nguyen
Mercury 1B in Filter + Rinse (M29)	CV/AA	8411329	2022/12/19	2022/12/20	Thuy Linh Nguyen
Metals B.H. in H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub> Imp.(6020B m)	ICP1/MS	8409041	2022/12/19	2022/12/20	Nan Raykha
Metals F.H. in Filter + Rinses (6020B m)	ICP1/MS	8411336	2022/12/19	2022/12/20	Nan Raykha

**Bureau Veritas ID:** UOQ103  
**Sample ID:** M29- T7  
**Matrix:** Stack Sampling Train

**Collected:** 2022/12/08  
**Shipped:**  
**Received:** 2022/12/13

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Mercury 3C in HCl Rinse	CV/AA	8410325	2022/12/19	2022/12/20	Thuy Linh Nguyen
Mercury 2B in HNO <sub>3</sub> /H <sub>2</sub> O <sub>2</sub> Imp.	CV/AA	8405627	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3A in HNO <sub>3</sub> Rinse	CV/AA	8405301	2022/12/15	2022/12/20	Thuy Linh Nguyen
Mercury 3B in KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub> Imp.	CV/AA	8410328	2022/12/17	2022/12/20	Thuy Linh Nguyen
Mercury 1B in Filter + Rinse (M29)	CV/AA	8411329	2022/12/19	2022/12/20	Thuy Linh Nguyen
Metals B.H. in H <sub>2</sub> O <sub>2</sub> /HNO <sub>3</sub> Imp.(6020B m)	ICP1/MS	8409041	2022/12/19	2022/12/20	Nan Raykha
Metals F.H. in Filter + Rinses (6020B m)	ICP1/MS	8411336	2022/12/19	2022/12/20	Nan Raykha





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## GENERAL COMMENTS

### ELEMENTS BY ICP/MS (STACK SAMPLING TRAIN)

Metals F.H. in Filter + Rinses (6020B m): Post digestion duplicate and spike were done on sample UOQ089.

Metals B.H. in H<sub>2</sub>O<sub>2</sub>/HNO<sub>3</sub> Imp.(6020B m): Post digestion duplicate and spike were done on sample UOQ089.

**Results relate only to the items tested.**



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### QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	% Recovery	UNITS	QC Limits
8405301	TLG	Matrix Spike(UOQ089)	3A Mercury (Hg)	2022/12/20		96	%	75 - 125
8405301	TLG	Matrix Spike DUP(UOQ089)	3A Mercury (Hg)	2022/12/20		97	%	75 - 125
8405301	TLG	MS/MSD RPD	3A Mercury (Hg)	2022/12/20	1.4		%	20
8405301	TLG	Spiked Blank	3A Mercury (Hg)	2022/12/20		98	%	90 - 110
8405301	TLG	Spiked Blank DUP	3A Mercury (Hg)	2022/12/20		99	%	90 - 110
8405301	TLG	RPD	3A Mercury (Hg)	2022/12/20	0.81		%	20
8405301	TLG	Method Blank	3A Mercury (Hg)	2022/12/20	<0.005		ug	
8405301	TLG	RPD - Sample/Sample Dup	3A Mercury (Hg)	2022/12/20	NC		%	20
8405627	TLG	Matrix Spike(UOQ089)	2B Mercury (Hg)	2022/12/20		96	%	75 - 125
8405627	TLG	Matrix Spike DUP(UOQ089)	2B Mercury (Hg)	2022/12/20		96	%	75 - 125
8405627	TLG	MS/MSD RPD	2B Mercury (Hg)	2022/12/20	0.73		%	20
8405627	TLG	Spiked Blank	2B Mercury (Hg)	2022/12/20		100	%	90 - 110
8405627	TLG	Spiked Blank DUP	2B Mercury (Hg)	2022/12/20		99	%	90 - 110
8405627	TLG	RPD	2B Mercury (Hg)	2022/12/20	0.10		%	20
8405627	TLG	Method Blank	2B Mercury (Hg)	2022/12/20	<0.15		ug	
8405627	TLG	RPD - Sample/Sample Dup	2B Mercury (Hg)	2022/12/20	NC		%	20
8409041	N_R	Matrix Spike(UOQ089)	Back Half Antimony (Sb)	2022/12/20		103	%	75 - 125
			Back Half Arsenic (As)	2022/12/20		100	%	75 - 125
			Back Half Beryllium (Be)	2022/12/20		100	%	75 - 125
			Back Half Cadmium (Cd)	2022/12/20		98	%	75 - 125
			Back Half Chromium (Cr)	2022/12/20		100	%	75 - 125
			Back Half Cobalt (Co)	2022/12/20		102	%	75 - 125
			Back Half Lead (Pb)	2022/12/20		99	%	75 - 125
			Back Half Manganese (Mn)	2022/12/20		101	%	75 - 125
			Back Half Nickel (Ni)	2022/12/20		101	%	75 - 125
			Back Half Selenium (Se)	2022/12/20		97	%	75 - 125
8409041	N_R	Matrix Spike DUP(UOQ089)	Back Half Antimony (Sb)	2022/12/20		102	%	75 - 125
			Back Half Arsenic (As)	2022/12/20		98	%	75 - 125
			Back Half Beryllium (Be)	2022/12/20		104	%	75 - 125
			Back Half Cadmium (Cd)	2022/12/20		98	%	75 - 125
			Back Half Chromium (Cr)	2022/12/20		98	%	75 - 125
			Back Half Cobalt (Co)	2022/12/20		101	%	75 - 125
			Back Half Lead (Pb)	2022/12/20		101	%	75 - 125
			Back Half Manganese (Mn)	2022/12/20		99	%	75 - 125
			Back Half Nickel (Ni)	2022/12/20		99	%	75 - 125
			Back Half Selenium (Se)	2022/12/20		97	%	75 - 125
8409041	N_R	MS/MSD RPD	Back Half Antimony (Sb)	2022/12/20	0.67		%	20
			Back Half Arsenic (As)	2022/12/20	1.4		%	20
			Back Half Beryllium (Be)	2022/12/20	3.4		%	20
			Back Half Cadmium (Cd)	2022/12/20	0.63		%	20
			Back Half Chromium (Cr)	2022/12/20	2.0		%	20
			Back Half Cobalt (Co)	2022/12/20	1.7		%	20
			Back Half Lead (Pb)	2022/12/20	1.9		%	20
			Back Half Manganese (Mn)	2022/12/20	1.9		%	20
			Back Half Nickel (Ni)	2022/12/20	1.8		%	20
			Back Half Selenium (Se)	2022/12/20	0.083		%	20
8409041	N_R	Spiked Blank	Back Half Antimony (Sb)	2022/12/20		102	%	85 - 115
			Back Half Arsenic (As)	2022/12/20		97	%	85 - 115
			Back Half Beryllium (Be)	2022/12/20		102	%	85 - 115
			Back Half Cadmium (Cd)	2022/12/20		98	%	85 - 115
			Back Half Chromium (Cr)	2022/12/20		97	%	85 - 115
			Back Half Cobalt (Co)	2022/12/20		98	%	85 - 115



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## QUALITY ASSURANCE REPORT(CONT'D)

QA/QC	Batch	Init	QC Type	Parameter	Date Analyzed	Value	% Recovery	UNITS	QC Limits
8409041	N_R	Spiked Blank DUP		Back Half Lead (Pb)	2022/12/20		99	%	85 - 115
				Back Half Manganese (Mn)	2022/12/20		99	%	85 - 115
				Back Half Nickel (Ni)	2022/12/20		98	%	85 - 115
				Back Half Selenium (Se)	2022/12/20		97	%	85 - 115
				Back Half Antimony (Sb)	2022/12/20		103	%	85 - 115
				Back Half Arsenic (As)	2022/12/20		100	%	85 - 115
				Back Half Beryllium (Be)	2022/12/20		104	%	85 - 115
				Back Half Cadmium (Cd)	2022/12/20		99	%	85 - 115
				Back Half Chromium (Cr)	2022/12/20		98	%	85 - 115
				Back Half Cobalt (Co)	2022/12/20		100	%	85 - 115
				Back Half Lead (Pb)	2022/12/20		101	%	85 - 115
				Back Half Manganese (Mn)	2022/12/20		100	%	85 - 115
				Back Half Nickel (Ni)	2022/12/20		99	%	85 - 115
				Back Half Selenium (Se)	2022/12/20		99	%	85 - 115
8409041	N_R	RPD		Back Half Antimony (Sb)	2022/12/20	1.5		%	20
				Back Half Arsenic (As)	2022/12/20	2.4		%	20
				Back Half Beryllium (Be)	2022/12/20	2.4		%	20
				Back Half Cadmium (Cd)	2022/12/20	0.63		%	20
				Back Half Chromium (Cr)	2022/12/20	1.8		%	20
				Back Half Cobalt (Co)	2022/12/20	2.0		%	20
				Back Half Lead (Pb)	2022/12/20	1.8		%	20
				Back Half Manganese (Mn)	2022/12/20	0.35		%	20
				Back Half Nickel (Ni)	2022/12/20	0.59		%	20
				Back Half Selenium (Se)	2022/12/20	1.4		%	20
				Back Half Antimony (Sb)	2022/12/20	<0.40		ug	
				Back Half Arsenic (As)	2022/12/20	<0.40		ug	
				Back Half Beryllium (Be)	2022/12/20	<0.090		ug	
				Back Half Cadmium (Cd)	2022/12/20	<0.090		ug	
8409041	N_R	Method Blank		Back Half Chromium (Cr)	2022/12/20	<1.5		ug	
				Back Half Cobalt (Co)	2022/12/20	<0.090		ug	
				Back Half Lead (Pb)	2022/12/20	<0.30		ug	
				Back Half Manganese (Mn)	2022/12/20	<0.60		ug	
				Back Half Nickel (Ni)	2022/12/20	<0.50		ug	
				Back Half Selenium (Se)	2022/12/20	<1.0		ug	
				Back Half Antimony (Sb)	2022/12/20	NC		%	20
				Back Half Arsenic (As)	2022/12/20	NC		%	20
				Back Half Beryllium (Be)	2022/12/20	NC		%	20
				Back Half Cadmium (Cd)	2022/12/20	NC		%	20
				Back Half Chromium (Cr)	2022/12/20	NC		%	20
				Back Half Cobalt (Co)	2022/12/20	4.0		%	20
				Back Half Lead (Pb)	2022/12/20	0.16		%	20
				Back Half Manganese (Mn)	2022/12/20	3.6		%	20
	Back Half Nickel (Ni)	2022/12/20	4.5		%	20			
	Back Half Selenium (Se)	2022/12/20	0.21		%	20			
8410325	TLG	Reagent Blank		3C Mercury (Hg)	2022/12/20	<0.013		ug	
8410325	TLG	Matrix Spike(UOQ089)		3C Mercury (Hg)	2022/12/20		92	%	75 - 125
8410325	TLG	Matrix Spike DUP(UOQ089)		3C Mercury (Hg)	2022/12/20		93	%	75 - 125
8410325	TLG	MS/MSD RPD		3C Mercury (Hg)	2022/12/20	0.87		%	20
8410325	TLG	Spiked Blank		3C Mercury (Hg)	2022/12/20		94	%	90 - 110
8410325	TLG	Spiked Blank DUP		3C Mercury (Hg)	2022/12/20		96	%	90 - 110
8410325	TLG	RPD		3C Mercury (Hg)	2022/12/20	2.1		%	20
8410325	TLG	Method Blank		3C Mercury (Hg)	2022/12/20	<0.013		ug	



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### QUALITY ASSURANCE REPORT(CONT'D)

QA/QC	Batch	Init	QC Type	Parameter	Date Analyzed	Value	% Recovery	UNITS	QC Limits
8410325	TLG	RPD - Sample/Sample Dup	3C Mercury (Hg)	2022/12/20	2.1			%	20
8410328	TLG	Reagent Blank	3B Mercury (Hg)	2022/12/20	<0.013			ug	
8410328	TLG	Matrix Spike(UOQ089)	3B Mercury (Hg)	2022/12/20			91	%	75 - 125
8410328	TLG	Matrix Spike DUP(UOQ089)	3B Mercury (Hg)	2022/12/20			90	%	75 - 125
8410328	TLG	MS/MSD RPD	3B Mercury (Hg)	2022/12/20	0.77			%	20
8410328	TLG	Spiked Blank	3B Mercury (Hg)	2022/12/20			95	%	90 - 110
8410328	TLG	Spiked Blank DUP	3B Mercury (Hg)	2022/12/20			96	%	90 - 110
8410328	TLG	RPD	3B Mercury (Hg)	2022/12/20	0.84			%	20
8410328	TLG	Method Blank	3B Mercury (Hg)	2022/12/20	<0.013			ug	
8410328	TLG	RPD - Sample/Sample Dup	3B Mercury (Hg)	2022/12/20	NC			%	20
8411329	TLG	Reagent Blank	1B Mercury (Hg)	2022/12/20	<0.015			ug	
8411329	TLG	Matrix Spike(UOQ089)	1B Mercury (Hg)	2022/12/20			90	%	75 - 125
8411329	TLG	Matrix Spike DUP(UOQ089)	1B Mercury (Hg)	2022/12/20			91	%	75 - 125
8411329	TLG	MS/MSD RPD	1B Mercury (Hg)	2022/12/20	1.3			%	20
8411329	TLG	Spiked Blank	1B Mercury (Hg)	2022/12/20			97	%	90 - 110
8411329	TLG	Spiked Blank DUP	1B Mercury (Hg)	2022/12/20			97	%	90 - 110
8411329	TLG	RPD	1B Mercury (Hg)	2022/12/20	0.21			%	20
8411329	TLG	Method Blank	1B Mercury (Hg)	2022/12/20	<0.015			ug	
8411329	TLG	RPD - Sample/Sample Dup	1B Mercury (Hg)	2022/12/20	NC			%	20
8411336	N_R	Matrix Spike(UOQ089)	Front Half Antimony (Sb)	2022/12/20			105	%	75 - 125
			Front Half Arsenic (As)	2022/12/20			101	%	75 - 125
			Front Half Beryllium (Be)	2022/12/20			100	%	75 - 125
			Front Half Cadmium (Cd)	2022/12/20			100	%	75 - 125
			Front Half Chromium (Cr)	2022/12/20			98	%	75 - 125
			Front Half Cobalt (Co)	2022/12/20			100	%	75 - 125
			Front Half Lead (Pb)	2022/12/20			101	%	75 - 125
			Front Half Manganese (Mn)	2022/12/20			100	%	75 - 125
			Front Half Nickel (Ni)	2022/12/20			98	%	75 - 125
			Front Half Selenium (Se)	2022/12/20			99	%	75 - 125
8411336	N_R	Matrix Spike DUP(UOQ089)	Front Half Antimony (Sb)	2022/12/20			104	%	75 - 125
			Front Half Arsenic (As)	2022/12/20			98	%	75 - 125
			Front Half Beryllium (Be)	2022/12/20			100	%	75 - 125
			Front Half Cadmium (Cd)	2022/12/20			98	%	75 - 125
			Front Half Chromium (Cr)	2022/12/20			95	%	75 - 125
			Front Half Cobalt (Co)	2022/12/20			98	%	75 - 125
			Front Half Lead (Pb)	2022/12/20			101	%	75 - 125
			Front Half Manganese (Mn)	2022/12/20			97	%	75 - 125
			Front Half Nickel (Ni)	2022/12/20			96	%	75 - 125
			Front Half Selenium (Se)	2022/12/20			99	%	75 - 125
8411336	N_R	MS/MSD RPD	Front Half Antimony (Sb)	2022/12/20	1.4			%	20
			Front Half Arsenic (As)	2022/12/20	2.2			%	20
			Front Half Beryllium (Be)	2022/12/20	0.77			%	20
			Front Half Cadmium (Cd)	2022/12/20	1.3			%	20
			Front Half Chromium (Cr)	2022/12/20	2.3			%	20
			Front Half Cobalt (Co)	2022/12/20	2.3			%	20
			Front Half Lead (Pb)	2022/12/20	0.51			%	20
			Front Half Manganese (Mn)	2022/12/20	3.3			%	20
			Front Half Nickel (Ni)	2022/12/20	2.0			%	20
			Front Half Selenium (Se)	2022/12/20	0.17			%	20
8411336	N_R	Spiked Blank	Front Half Antimony (Sb)	2022/12/20			101	%	85 - 115
			Front Half Arsenic (As)	2022/12/20			99	%	85 - 115
			Front Half Beryllium (Be)	2022/12/20			103	%	85 - 115



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### QUALITY ASSURANCE REPORT(CONT'D)

QA/QC												
Batch	Init	QC Type		Parameter	Date Analyzed	Value	% Recovery	UNITS	QC Limits			
8411336	N_R	Spiked Blank DUP		Front Half Cadmium (Cd)	2022/12/20		98	%	85 - 115			
				Front Half Chromium (Cr)	2022/12/20		96	%	85 - 115			
				Front Half Cobalt (Co)	2022/12/20		99	%	85 - 115			
				Front Half Lead (Pb)	2022/12/20		99	%	85 - 115			
				Front Half Manganese (Mn)	2022/12/20		97	%	85 - 115			
				Front Half Nickel (Ni)	2022/12/20		97	%	85 - 115			
				Front Half Selenium (Se)	2022/12/20		99	%	85 - 115			
				Front Half Antimony (Sb)	2022/12/20		104	%	85 - 115			
				Front Half Arsenic (As)	2022/12/20		101	%	85 - 115			
				Front Half Beryllium (Be)	2022/12/20		105	%	85 - 115			
				Front Half Cadmium (Cd)	2022/12/20		101	%	85 - 115			
				Front Half Chromium (Cr)	2022/12/20		98	%	85 - 115			
				Front Half Cobalt (Co)	2022/12/20		99	%	85 - 115			
				Front Half Lead (Pb)	2022/12/20		101	%	85 - 115			
				Front Half Manganese (Mn)	2022/12/20		100	%	85 - 115			
8411336	N_R	RPD		Front Half Nickel (Ni)	2022/12/20		98	%	85 - 115			
				Front Half Selenium (Se)	2022/12/20		101	%	85 - 115			
				Front Half Antimony (Sb)	2022/12/20	3.3		%	20			
				Front Half Arsenic (As)	2022/12/20	1.4		%	20			
				Front Half Beryllium (Be)	2022/12/20	1.9		%	20			
				Front Half Cadmium (Cd)	2022/12/20	2.5		%	20			
				Front Half Chromium (Cr)	2022/12/20	1.3		%	20			
				Front Half Cobalt (Co)	2022/12/20	0.20		%	20			
				Front Half Lead (Pb)	2022/12/20	1.7		%	20			
				Front Half Manganese (Mn)	2022/12/20	2.2		%	20			
				Front Half Nickel (Ni)	2022/12/20	0.81		%	20			
				Front Half Selenium (Se)	2022/12/20	2.0		%	20			
			8411336	N_R	Method Blank		Front Half Antimony (Sb)	2022/12/20	<3.0		ug	
							Front Half Arsenic (As)	2022/12/20	<0.80		ug	
							Front Half Beryllium (Be)	2022/12/20	<0.18		ug	
	Front Half Cadmium (Cd)	2022/12/20				<0.18		ug				
	Front Half Chromium (Cr)	2022/12/20				<3.0		ug				
	Front Half Cobalt (Co)	2022/12/20				<0.18		ug				
	Front Half Lead (Pb)	2022/12/20				<0.60		ug				
	Front Half Manganese (Mn)	2022/12/20				<1.2		ug				
	Front Half Nickel (Ni)	2022/12/20				<1.0		ug				
	Front Half Selenium (Se)	2022/12/20				<2.0		ug				
8411336	N_R	RPD - Sample/Sample Dup					Front Half Antimony (Sb)	2022/12/20	NC		%	20
							Front Half Arsenic (As)	2022/12/20	NC		%	20
							Front Half Beryllium (Be)	2022/12/20	NC		%	20
							Front Half Cadmium (Cd)	2022/12/20	1.6		%	20
							Front Half Chromium (Cr)	2022/12/20	6.7		%	20
				Front Half Cobalt (Co)	2022/12/20	4.9		%	20			
				Front Half Lead (Pb)	2022/12/20	0.83		%	20			
				Front Half Manganese (Mn)	2022/12/20	3.0		%	20			
				Front Half Nickel (Ni)	2022/12/20	0.38		%	20			



Bureau Veritas Job #: C2AF790  
Report Date: 2022/12/20

Mostardi Platt  
Client Project #: M224514  
Site Location: CLIFTON

### QUALITY ASSURANCE REPORT(CONT'D)

QA/QC		QC Type	Parameter	Date Analyzed	Value	% Recovery	UNITS	QC Limits
Batch	Init							
			Front Half Selenium (Se)	2022/12/20	NC		%	20
<p>Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.</p> <p>Reagent Blank: A blank matrix containing all reagents used in the analytical procedure. Used to determine any analytical contamination.</p> <p>Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.</p> <p>Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.</p> <p>Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.</p> <p>NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <math>\leq 2 \times \text{RDL}</math>).</p>								





Bureau Veritas Job #: C2AF790  
Report Date: 2022/12/20

Mostardi Platt  
Client Project #: M224514  
Site Location: CLIFTON

### VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by {0}, {1} responsible for {2} {3} laboratory operations.



Pre/Post	Date	Time	Analyst	Ambient Temperature degrees F	Relative Humidity %	Barometric Pressure inches Hg	Calibration Standard 50.0000g	% Error	Calibration Standard 5.0000g	% Error	Calibration Standard 0.5000g	% Error
Pre	11/28/2022											
Post	11/28/2022											
Pre	11/29/2022	9:30 AM	JMG	72	30.0	28.95	50.00004	0.00	5.00001	0.00	0.50002	0.00
Post	11/29/2022	2:30 PM	JMG	72	30.0	28.95	50.00004	0.00	5.00001	0.00	0.50002	0.00
Pre	11/30/2022	8:30 AM	JMG	71	29.0	29.25	50.00007	0.00	5.00003	0.00	0.50001	0.00
Post	11/30/2022	2:30 PM	JMG	71	29.0	29.25	50.00007	0.00	5.00003	0.00	0.50001	0.00
Pre	12/1/2022	9:00 AM	JMG	71	22.0	29.76	50.00010	0.00	5.00001	0.00	0.50001	0.00
Post	12/1/2022	2:00 PM	JMG	71	22.0	29.76	50.00010	0.00	5.00001	0.00	0.50001	0.00
Pre	12/2/2022											
Post	12/2/2022											
Pre	12/5/2022	1:45 PM	JMG	70	23.0	29.13	50.00008	0.00	5.00002	0.00	0.50006	-0.01
Post	12/5/2022	2:15 PM	JMG	70	23.0	29.13	50.00008	0.00	5.00002	0.00	0.50006	-0.01
Pre	12/6/2022	8:45 AM	JMG	70	25.0	29.31	50.00007	0.00	5.00003	0.00	0.50004	-0.01
Post	12/6/2022	2:00 PM	JMG	70	25.0	29.42	50.00006	0.00	5.00002	0.00	0.50004	-0.01
Pre	12/7/2022	10:00 AM	JMG	70	28.0	29.53	50.00004	0.00	5.00001	0.00	0.50006	-0.01
Post	12/7/2022	2:30 PM	JMG	71	28.0	29.58	50.00008	0.00	5.00002	0.00	0.50005	-0.01
Pre	12/8/2022	9:00 AM	JMG	71	27.0	29.65	50.00009	0.00	5.00003	0.00	0.50002	0.00
Post	12/8/2022											
Pre	12/9/2022											
Post	12/9/2022											
Pre	12/12/2022											
Post	12/12/2022											
Pre	12/13/2022	10:45 AM	JMG	72	28.0	29.51	50.00008	0.00	4.99989	0.00	0.49995	0.01
Post	12/13/2022	3:00 PM	JMG	72	28.0	29.51	50.00008	0.00	4.99989	0.00	0.49995	0.01
Pre	12/14/2022	9:15 AM	JMG	72	28.0	29.12	50.00009	0.00	4.99992	0.00	0.49995	0.01
Post	12/14/2022	2:30 PM	JMG	72	28.0	29.12	50.00009	0.00	4.99992	0.00	0.49995	0.01
Pre	12/15/2022	9:30 AM	JMG	71	31.0	28.87	50.00006	0.00	5.00000	0.00	0.50004	-0.01
Post	12/15/2022											
Pre	12/16/2022											
Post	12/16/2022											

Balance ID: Sartorius  
Model QUINTIX65-1S  
S/N 0034209777



1100 N. Villa Avenue  
Villa Park IL 60181  
Tel: 630-833-3800/Fax: 630-833-0044  
acmemetrology.com

# Certificate of Calibration

Certificate No. 173254

## Customer Information

MOSTARDI-PLATT  
888 INDUSTRIAL DR.  
ELMHURST, IL 60126

## Equipment Information

ID Number: 0034209777  
Type: SCALE  
Description: 60 G X 0.00001  
Manufacturer: SARTORIOUS  
Model: QUINTIX65  
Serial Number: 0034209777  
Department:

## Calibration Information

As Found In Tolerance  
As Left In Tolerance  
Calibration Date: 2/22/2022  
Next Due: 2/22/2023  
Temperature: 73.6 °F  
Humidity: 20 %  
Procedure: PPCA503  
PPCA101  
Purchase Order: VBL/BEN

## Base Information

Serial Number: N/A  
Manufacturer: N/A  
Model: N/A

Description	Std. Nominal	Tolerance - +		As Found	As Left	Units
LINEARITY (SPAN)	0.00000	0.00000	0.00000	0.00000	0.00000	G
LINEARITY (SPAN)	15.00000	14.99300	15.00300	15.00000	14.99991	G
LINEARITY (SPAN)	30.00000	29.99300	30.00300	30.00012	29.99992	G
LINEARITY (SPAN)	45.00000	44.99300	45.00300	45.00017	44.99988	G
LINEARITY (SPAN)	60.00000	59.99300	60.00300	60.00022	59.99993	G
LINEARITY (SPAN)	0.00000	-0.00300	0.00300	0.00000	0.00000	G
SHIFT (POSITION 1)	20.00000	19.99300	20.00300	20.00017	19.99995	G
SHIFT (POSITION 2)	20.00000	19.99300	20.00300	20.00017	19.99998	G
SHIFT (POSITION 3)	20.00000	19.99300	20.00300	20.00017	19.99998	G
SHIFT (POSITION 4)	20.00000	19.99300	20.00300	20.00017	19.99995	G

"A" - Adjusted and returned in tolerance

"F" - Indicates out of tolerance result

Standards Used	I.D. Number	Last Cal.	Cal. Due
1KG - 1GR WT SET	AM0028	4/12/2021	4/30/2023
TEMP/HUM GAUGE	AM0269A	3/30/2021	3/31/2023

## Calibration Notes

This measurement equipment was tested using certified standards and was found in customer tolerances. A full calibration was performed to nominalize the equipment, and was left indicating within customer specifications.

JAMES TRAIL

Certified/Authorized By

Signature

2/22/2022

Date

ACME Metrology, certifies the instrument listed above has been tested, calibrated (if necessary), and meets the criteria established in the associated test procedure unless otherwise noted. The standards used are traceable to the National Institute of Standards and Technology (NIST). Statements of compliance, where applicable, are based upon the test results falling within the specified limits with no reduction by the uncertainty of the measurement. The calibration interval has been specified by the customer. Any number of factors may cause the calibration to drift out of tolerance before the recommended interval has expired. This Certificate of Calibration shall not be reproduced, except in full, without the written approval of ACME Metrology.



1100 N. Villa Avenue  
Villa Park IL 60181  
Tel: 630-833-3800/Fax: 630-833-0044  
acmescaletechnologies.com

# Certificate of Verification

Certificate No. 173255

Customer Information		Calibration Information	
MOSTARDI-PLATT 888 INDUSTRIAL DR. ELMHURST, IL. 60126		<b>Verification Date:</b>	2/22/2022
		<b>Next Due Date:</b>	2/28/2023
		<b>Temperature:</b>	72 F
		<b>Humidity:</b>	22%
		<b>Department:</b>	
		<b>Purchase Order:</b>	VBL/JENNA
Equipment Information			
<b>ID Number:</b>	W-01		
<b>Serial Number:</b>	W-01		
<b>Manufacturer:</b>			
<b>Model:</b>			
<b>Type:</b>	WEIGHT KIT		
<b>Size:</b>	50G, 5G, .5G		

## Calibration Notes

\* This test weight was compared on customers scale against Acme NIST traceable test weight and was found to weigh within acceptable limits of the indicated value.

Description	Std. Nominal	As Found	Units
Weight	0.50000	0.50000	mg
Weight	5.00000	4.99999	g
Weight	50.00000	49.99995	g

JAMES TRAIL

Certified/Authorized By

Signature

2/22/2022

Date

Acme Metrology, certifies the instrument listed above has been verified according to the associated test procedure unless otherwise noted. The standards used are traceable to the National Institute of Standards and Technology (NIST). The verification interval has been specified by the customer. This Certificate of Verification shall not be reproduced, except in full, without the written approval of Acme Metrology.

END OF THE REPORT