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# EMISSION TEST REPORT

REGULATION(S): 40 CFR 63 SUBPART ZZZZ AND MDEQ PERMIT

POLLUTANT(S): HCHO

## TRANSCANADA US PIPELINES WOOLFOLK COMPRESSOR STATION MECOSTA COUNTY, MI

# RECEIVED

## MAY 14 2018

### AIR QUALITY DIVISION

PERMIT NUMBER: MI-ROP-B7220-2017  
STATE REGISTRATION NUMBER (SRN): B7220  
FRS # / EPA REGISTRY ID: 110040962303  
SOURCE CLASSIFICATION CODE (SCC): 20200253

SOURCE ID: EUWL008  
EMISSION SOURCE: SPARK-IGNITED ENGINE  
4-STROKE/2-STROKE: 4-STROKE  
RICH/LEAN BURN: RICH BURN  
MAKE & MODEL: INGERSOLL-RAND KVG-123  
UNIT NUMBER: ENGINE 2008  
SERIAL NUMBER: 123KL574

TEST DATE: MARCH 15, 2018

NSPS ZZZZ Limit			
DAE (%)			
POLLUTANT	ZZZZ LIMIT	TESTED	PASS/FAIL
HCHO	276%	78.7%	PASS

Limits obtained from 40 CFR 63, Subpart ZZZZ.

*The contents of this document relate only to the items tested. I certify under penalty of law that I believe the information provided in this document is true, accurate and complete. I am aware that there are significant civil and criminal penalties, including the possibility of fine or imprisonment or both, for submitting false, inaccurate or incomplete information.*

CECO TEST LEADER:

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## Revision History

Version	Revision Date	Comments
0	<i>original</i>	Original Version of Document.

## Project Information

CECO Project No: 20180315-0421-1

## Contact Information

### Facility Information

Facility

TransCanada US Pipelines  
Woolfolk Compressor Station  
Mecosta County, MI

Contact

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## Testing Group Information

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## Introduction

CECO Training & Technical Services, a division of Compressor Engineering Corporation, conducted source emission testing at TransCanada US Pipelines, Woolfolk Compressor Station to fulfill the requirements of 40 CFR 63 Subpart ZZZZ and MDEQ Permit. This report details the test purpose, objectives, testing procedures, sampling and analysis methodology, and results of the source testing conducted on March 15, 2018.

## Process Description

The following source was tested:

- Unit Number Engine 2008 (Source ID EUWL008) SN 123KL574 – one (1) Ingersoll-Rand KVG-123 natural gas-fired, 4-Stroke, Rich Burn internal combustion engine, rated to 1000 brake horsepower (BHP) at 330 revolutions per minute (RPM). This source is equipped with a NSCR with an air-fuel ratio controller for emission control and drives a natural gas compressor.

## Test Purpose and Objectives

The purpose of this test was to fulfill the requirements of 40 CFR 63 Subpart ZZZZ and MDEQ Permit. The objective of this test was to conduct the required three (3) 60-minute test runs to measure the applicable emission species at the maximum achievable load.

**Results – Inlet**

Ingersoll-Rand KVG-123 SN: 123KL574 Source ID: EUWL008 Unit ID: Engine		Test Run			Average
		1st	2nd	3rd	
<b>Test Date &amp; Time</b>					
Date	3/15/2018	3/15/2018	3/15/2018		
Start Time	9:33 AM	10:45 AM	11:54 AM		
End Time	10:34 AM	11:45 AM	12:55 PM		
Interval (minutes)	61	61	61	61	
<b>Measured Concentrations (bias-corrected where applicable)</b>					
O <sub>2</sub> (%vd)	5.66	5.82	5.78	5.75	
HCHO (ppmvd)	13.928	13.585	13.381	13.631	
<b>Operating Conditions</b>					
Engine Horsepower (BHP)	972	980	980	977	
Load (%)	97.2	98.0	98.0	97.7	
Torque Load (%)	97.1	98.5	98.3	98.0	
Engine Speed (RPM)	330	328	329	329	
<b>Calculated Emissions</b>					
HCHO (ppmvd at 15% O <sub>2</sub> )	5.3921	5.3151	5.2214	5.3095	

**Results – Outlet**

Ingersoll-Rand KVG-123 SN: 123KL574 Source ID: EUWL008 Unit ID: Engine		Test Run			Average
		1st	2nd	3rd	
<b>Test Date &amp; Time</b>					
Date	3/15/2018	3/15/2018	3/15/2018		
Start Time	9:33 AM	10:45 AM	11:54 AM		
End Time	10:34 AM	11:45 AM	12:55 PM		
Interval (minutes)	60	60	61	60	
<b>Measured Concentrations (bias-corrected where applicable)</b>					
O <sub>2</sub> (%vd)	5.54	5.66	5.67	5.62	
HCHO (ppmvd)	2.968	2.890	2.911	2.923	
<b>Operating Conditions</b>					
Engine Horsepower (BHP)	972	980	980	977	
Load (%)	97.2	98.0	98.0	97.7	
Torque Load (%)	97.1	98.5	98.3	98.0	
Engine Speed (RPM)	330	328	329	329	
<b>Calculated Emissions</b>					
HCHO (ppmvd at 15% O <sub>2</sub> )	1.1401	1.1188	1.1277	1.1289	

## Methodology and Sampling Procedures

### Methodology

Parameter	Sampling Method
Oxygen (O <sub>2</sub> )	40 CFR 60, Appendix A, Method 3A
Volumetric Exhaust Flow Rate	40 CFR 60, Appendix A, Method 19
Gas Dilution System	40 CFR 60, Appendix A, Method 205
Formaldehyde (HCHO)	ASTM D6348

### Horsepower and Fuel Flow Determination

For this test, horsepower was calculated from the load percentage displayed on the engine panel and fuel flow was obtained from the engine panel. The Engine Torque Load averaged 98.0% for the test. This was the highest achievable load based on the operating parameters during the test, which are included in Appendix A.

### Sampling System

Compressor Engineering Corporation designed and assembled a versatile, emission testing unit (ETU), which houses all analyzers, computers and auxiliary equipment. Effluent stack gas enters the ETU through a heated Teflon sample line. A heated head pump with a Teflon diaphragm pulls the sample into the trailer, through a heated filter, and sends the wet gas directly to the inlet of the FTIR. The heated pump, sample lines, and filter have their temperatures maintained at approximately 191 °C. The FTIR analyzer gas cell and gas inlet temperatures are also maintained at approximately 191 °C. The sample is routed from the exit of the FTIR through a heated Teflon line to a gas conditioner for moisture removal. The dry gas exiting the gas conditioner is routed to a gas distribution panel which sends a portion of the gas to the paramagnetic oxygen analyzer.

The MKS Instruments MultiGas 2030 FTIR analyzer is used to determine the HCHO emission concentrations. The FTIR serves as the instrument for Methods 7E and 10, and meets the requirements of Section 13 of Method 7E. All measured concentrations are corrected to a dry basis via the MKS MG2000 operating software. The FTIR analyzer is configured with a fixed optical pathlength of 5.11 meters. The measured concentrations are collected at a 0.5 cm<sup>-1</sup> resolution. Each spectrum is derived from the co-addition of 60 scans. Data is collected continuously during each test run. A new data point is generated every 60 seconds.

A software package (CECOTest) is used to collect and processes data. CECOTest continually logs data every 15 seconds from the oxygen analyzer and the FTIR during the 60 minute runs.

Refer to **FIGURE 1** for a schematic of the sampling system.

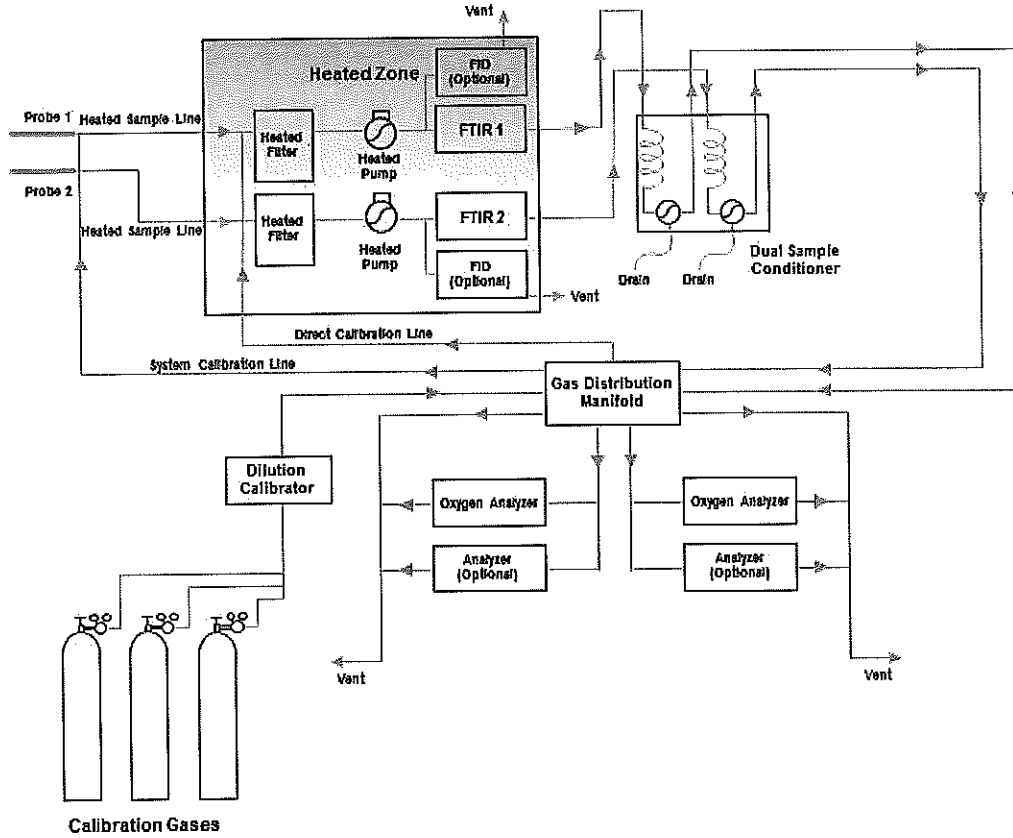


Figure 1: Sampling System Schematic

## Instrument Specifications

Description: Oxygen Analyzer  
Manufacturer: Servomex  
Model: 1440C  
Serial Number: 2582 & 2581  
Technology Type: Paramagnetic  
Range: 0-25%  
Repeatability: +/- 0.1% O2  
Response Time (90%): Typically less than 10 sec  
Linearity: +/- 0.1% O2

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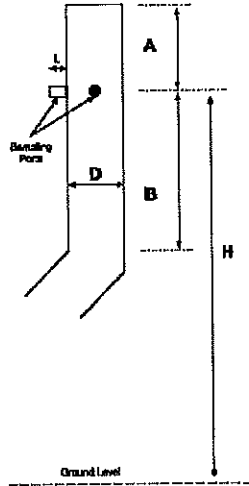
Description: FTIR Analyzer  
Manufacturer: MKS Instruments  
Model: 2030  
Serial Number: 017641800 & 017679246  
Technology Type: FTIR Spectrometry  
Range: between 10ppb and 100% fullscale  
Spectral Resolution: 0.5-128 1/cm  
Scan Speed: 1/sec @ 0.5 1/cm  
Detector Type: LN2-cooled MCT

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Manufacturer: Teledyne  
Model: T700  
Serial Number: 1364  
Technology Type: Mass Flow Controller  
MFC's: 0LPM, 2LPM, and 200ccm  
Flow Measurement Accuracy: +/-1.0% of Full Scale  
Repeatability of Flow Control: +/-0.2% of full Scale  
Linearity of Flow Measurement: +/-0.5% of Full Scale  
Flow Range of Diluent Air: 0 to 10 SLPM  
Optional Ranges: 0 to 5 SLPM; 0 to 20 SLPM  
Flow Range of Cylinder Gasses: 0 to 100 cc/min  
Optional Ranges: 0 to 50 cc/min; 0 to 200 cc/min  
Zero Air Required: 10 SLPM @ 30 PSIG  
Optional: 20 SLPM @ 30 PSIG  
CAL Gas Input Ports: 4 (configurable)  
Diluent Gas Input Ports: 1  
Response Time: 60 Seconds (98%)

## Description of Sampling Location

### Physical Duct Parameters



D =	16	in	Duct Diameter
L =	2	in	Port Length
A =	24	in	Distance to Downstream Disturbance
B =	36	in	Distance to Upstream Disturbance
H =	25	ft	Approximate Height Above Grade
	1.5 D		Distance to Downstream Disturbance (A)
	0.5 D		EPA M1 Requirement
	TRUE		EPA M1 Requirement Met?
	2.3 D		Distance to Upstream Disturbance (B)
	2.0 D		EPA M1 Requirement
	TRUE		EPA M1 Requirement Met?
	TRUE		<b>EPA M1 Requirements Met for Distances to Up/Downstream Disturbances</b>

### EPA JJJJ/ZZZ Sampling Point Requirements

Duct Diameter	Ports
D ≤ 6 inches	N/A
6 < D ≤ 12 inches	N/A
D > 12 inches	M1 Ports
D > 12 inches	no M1 Ports

### Sampling Strategy

Single Point Located at Duct Centroid  
 3 Traverse Points (16.7, 50.0, and 83.3%) across the duct  
 3 Traverse Points (16.7, 50.0, and 83.3%) across the duct  
 Stratification Check Required

### REQUIRED SAMPLING STRATEGY:

13.3 in  
 8.0 in  
 2.7 in  
 15.3 in  
 10.0 in  
 4.7 in

**3 Traverse Points (16.7, 50.0, and 83.3%) across the duct**  
 Point 1  
 Point 2  
 Point 3  
 Point 1 Probe Mark (Includes port length)  
 Point 2 Probe Mark (Includes port length)  
 Point 3 Probe Mark (Includes port length)

### STRATIFICATION CHECK REQUIREMENTS

For every point (where Da=Deviation from Average (%) for a given point.)

Da < 5 %  
 5% ≤ Da < 10 %  
 Otherwise

Single Point Located at Duct Centroid  
 3 Traverse Points (16.7, 50.0, and 83.3%) across the duct  
 Full M1 Points Required

### STRATIFICATION CHECK RESULTS

Point 1	Point 2	Point 3
5.47	5.46	5.48
5.48	5.48	5.47
5.48	5.46	5.45
5.47	5.47	5.46
5.47	5.48	5.48
5.46	5.49	5.46
5.46	5.47	5.47
5.47	5.47	5.47
5.46	5.47	5.46
5.46	5.47	5.48
5.46	5.47	5.48
5.47	5.47	5.47

Point Average (% O2)	5.47	5.47	5.47
Point Deviation from Average (%)	- 0.04	0.04	- 0.01
Point Deviation from Average (% O2)	- 0.00	0.00	- 0.00
Average of Point Averages (% O2)	5.47		

### STRATIFICATION CHECK RESULTANT STRATEGY

**Single Point Located at Duct Centroid**