FINAL REPORT

GAGE PRODUCTS COMPANY

FERNDALE, MICHIGAN

SOURCE TESTING REPORT:
CDFUELSCOND – USEPA METHOD 21 AND CONTROL EFFICIENCY

RWDI #2406373.01

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SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) was retained by Gage Products Company (Gage) to complete testing on the tanks connected to the condenser (referred to as CDFUELSCOND in Permit to Install 64-18B) for Volatile Organic Compound (VOC) leaks as well as VOC emission rate and control efficiency on the condenser at their facility located at 625 Wanda Avenue in Ferndale, Michigan. The test program consisted of two phases. The initial phase was conducted to identify any leaks that may be present on all pressure relief components on each of the tanks associated with CDFUELSCOND immediately prior to the control l efficiency testing. The second phase was the actual validation of the control efficiency of the condenser noted under CDFUELSCOND.

For the leak detection, the sampling was performed in accordance with the procedures outlined in Appendix A or 40 CFR part 60, Method 21. The program focused on the pressure relief components on each of the tanks connected to the tanks condenser system.

For the control efficiency, the measurements were taken continuously following USEPA Method 25A on the inlet and outlet (using a total hydrocarbon (THC) analyzer) as outlined in Method 25A. The measurement locations were taken at the centroidal area of each source.

On June 3, 2024, a comprehensive USEPA Method 21 testing program identified 20 leaks within the CDFUELDSCOND system. A leak is identified as any constant reading greater than 500 ppm (as methane). Along with the ppm value, additional comments regarding about the leak locations are outlined in the report.

Executive Table i: Average Emission Data – Control Efficiency – CDFUELSCOND - Condenser

Parameter	Concentration & Emission Rate (ppmv/ lb/hr & % Control Efficiency)			
	Run 1	Run 2	Run 3	Average
VOC Inlet (as propane)	531,474 $ppmv_d$ 51 lb/hr	538,367 $ppmv_d$ 52 lb/hr	464,457 $ppmv_d$ 35 lb/hr	511,433 $ppmv_d$ 46 lb/hr
VOC Outlet (as propane)	158,850 $ppmv_d$ 9.8 lb/hr	249,731 $ppmv_d$ 17.1 lb/hr	88,764 $ppmv_d$ 3.0 lb/hr	165,782 $ppmv_d$ 10.0 lb/hr
Control Efficiency	80.8 %	66.9 %	91.3 %	79.7 %

Note: All emission data is based on a volumetric flow rate expressed as cfm (dry, reference conditions)
"d" – refers to dry conditions
"lb/hr" – refers to pounds per hour (dry, reference conditions)
"$ppmv_d$" – refers to parts per million by volume (dry)

On June 4, 2024, control efficiency testing was completed on the condenser associated with CDFUELSCOND system. The overall results indicated that the control efficiency was 79.7%. The overall efficiency of the condenser is expected to meet 95% control efficiency of VOCs.

All testing was completed on June 4th, 2024. The testing methodologies and strategies followed the Test Plan dated August of 2023 with comments from May of 2024.

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1 INTRODUCTION

RWDI USA LLC (RWDI) was retained by Gage Products Company (Gage) to complete testing on the tanks connected to the condenser (referred to as CDFUELSCOND in Permit to Install 64-18B) for Volatile Organic Compound (VOC) leaks as well as VOC emission rate and control efficiency on the condenser at their facility located at 625 Wanda Avenue in Ferndale, Michigan. The test program is being conducted to identify any leaks that may be present on all pressure relief components on each of the tanks associated with CDFUELSCOND immediately prior to the control efficiency testing as well as the validation of the control efficiency of the condenser noted as CDFUELSCOND.

For the leak detection, the sampling was performed in accordance with the procedures outlined in Appendix A or 40 CFR part 60, Method 21. The program focused on the pressure relief components on each of the tanks connected to the tanks condenser system.

For the VOC emission rate and control efficiency, the measurements were taken continuously following USEPA Method 25A on the inlet and outlet (using a THC analyzer) as outlined in Method 25A. The measurement location were taken at the centroidal area of each source.

On June 3, 2024, a comprehensive USEPA Method 21 testing program identified 20 leaks within the CDFUELDSCOND system. A leak is identified as any constant reading greater than 500pm. Along with the ppm value, additional comments regarding about the leak locations are outlined in the report.

On June 4, 2024, control efficiency testing was completed on the condenser associated with CDFUELSCOND system. The overall results indicated that the control efficiency was 79.7%. The overall efficiency of the condenser is expected to meet 95% control efficiency of VOCs.

1.1 Description of Source

A series of tanks emit to the Condenser control unit which cools and drops out VOC as a condensate. A diagram of the process is attached (**Appendix A**).

1.2 Test Program Contacts

Table 1.2: Testing Personnel

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2 SAMPLING AND ANALYTICAL PROCEDURES

2.1 USEPA Method 21

A portable flame ionization detector (FID) was used to measure VOC emissions from pressure relief components on tanks connected to the condenser (CDFUELSCOND). The instrument was calibrated prior to use with certified zero air and a certified methane mixture for the upscale calibration. The probe of the FID was placed at the surface of the testing locations to detect potential leaks. The FID sampled each location for a minimum of two (2) times the response time. A leak is defined as a constant reading of 500 ppm above background.

2.2 Stack Velocity, Temperature, and Volumetric Flow Rate

The exhaust velocities and flow rates were determined following the USEPA Method 2C, "Determination of Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts (Standard Pitot Tube)". Velocity measurements were taken with a standard pitot tube and manometer. Volumetric flow rates were determined following the equal area method as outlined in USEPA Method 2C. Temperature measurements were made simultaneously with the velocity measurements and were conducted using a chromel-alumel type "k" thermocouple in conjunction with a digital temperature indicator.

The dry molecular weight of the stack gas was determined following calculations outlined in USEPA Method 3A, "Determination of Molecular Weight of Dry Stack Gas". Stack moisture content was determined through direct condensation and according to USEPA Method 4, "Determination of Moisture Content of Stack Gas". Moisture tests were conducted for 30 minutes during each of the Control Efficiency tests from both the inlet and outlet of the Condenser.

2.3 Volatile Organic Compounds

VOC concentrations were recorded for each test at the inlet and outlet concurrently of the Condenser.

The measurements were taken continuously following USEPA Method 25A on the inlet and outlet (using a THC analyzer) as outlined in Method 25A, the measurement location was taken at the centroidal area of each source.

The compliance test consisted of three (3) 60-minute tests. Regular performance checks on the continuous emissions monitoring system (CEMS) were carried out by zero and span calibration checks using USEPA Protocol calibration gases. These checks verified the ongoing precision of the monitor with time by introducing pollutant-free (zero) nitrogen followed by known calibration gas (span) into the monitor. The response of the monitor to pollutant-free nitrogen and the corresponding sensitivity to the span gases was reviewed frequently as an ongoing indication of analyzer performance.

Prior to testing, a 4-point analyzer calibration error check was conducted using USEPA protocol gases. The calibration error check was performed by introducing zero, low, mid, and high-level calibration gases up the heated line to the probe tip. The calibration error check was performed to confirm that the analyzer response was within ±5% of the certified calibration gas introduced. At the conclusion of each test run a system-bias check was performed to evaluate the percent drift from pre- and post-test system bias checks. The system bias check was used to confirm that the analyzer did not drift greater than ±3% throughout a test run.

Zero and mid gas calibration checks were conducted both before and after each test run to quantify measurement system calibration drift and sampling system bias. During these checks, the calibration gases were introduced into the sampling system at the probe tip so that the calibration gases were analyzed in the same manner as the flue gas samples.

A gas sample was continuously extracted from the stack and delivered to the gas analyzer, which measures the pollutant or diluent concentrations in the gas. The probe tip was equipped with a sintered stainless-steel filter for particulate removal or heated filter system. The end of the probe was connected to a heated Teflon sample line, which delivered the sample gases from the stack to the CEM system. The heated sample line was designed to maintain the gas temperature above 250°F to prevent condensation of stack gas moisture within the line.

Due to the high concentrations of VOC at the inlet and outlet, a 100:1 stack gas dilution to dilution system was used to bring the gas to measurable concentration. Dilution rate and analyzer linearity checks were completed by introducing an undiluted known quantity of propane prior to the dilution system. This method confirmed the dilution ratio as well as the instrument response.

2.4 Gas Dilution System

Calibration gas were mixed using an Environics 4040 Gas Dilution System. The mass flow controllers are factory calibrated using a primary flow standard traceable to the United States National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. The calibration is done yearly, and the records are included in the Source Testing Report. A multi-point EPA Method 205 check was executed in the field prior to testing to ensure accurate gas-mixtures. The gas dilution system consisting of calibrated orifices or mass flow controllers and dilutes a high-level calibration gas to within ±2% of predicted values. The gas divider is capable of diluting gases at set increments and was evaluated for accuracy in the field in accordance with USEPA Method 205 "*Verification of Gas Dilution Systems for Field Instrument Calibrations*". The gas divider dilutions were measured to evaluate that the responses are within ±2% of predicted values. In addition, a certified mid-level calibration gas within ±10% of one of the tested dilution gases was introduced into the analyzer to ensure the response of the gas calibration is within ±2% of gas divider dilution concentration.

3 TEST RESULTS AND DISCUSSION

Leaks identified within the CDFUELSCOND system are found in **Appendix B** as well as **Table 4** (Table Section).

On June 3, 2024, a comprehensive USEPA Method 21 testing program identified 20 leaks within the CDFUELDSCOND system. A leak is identified as any constant reading greater than 500 ppm (as methane). Along with the ppm value, additional comments regarding about the leak locations can also be found in **Table B1**.Flow diagrams outlining all locations measured are contained in **Appendix B**.

On June 4, 2024, VOC emission rate and control efficiency testing was completed on the condenser associated with CDFUELSCOND system. The overall results indicated that the control efficiency was 79.7%. The overall efficiency of the condenser is expected to meet 95% control efficiency of VOCs. Process data for the event is provided in **Appendix C**. VOC, flow rate and moisture data is provided in **Appendix D**. Calibration Records are located in **Appendix E**. Example calculation for data analysis is provided in **Appendix F**. A copy of the Source Testing Plan is provided in **Appendix G**.

Table 3.1: Average Emission Data – Control Efficiency – CDFUELSCOND - Condenser

Parameter	Concentration & Emission Rate (ppmv/ lb/hr & % Control Efficiency)			
	Run 1	Run 2	Run 3	Average
VOC (as propane) Inlet	531,474 ppmv$_d$ 51 lb/hr	538,367 ppmv$_d$ 52 lb/hr	464,457 ppmv$_d$ 35 lb/hr	511,433 ppmv$_d$ 46 lb/hr
VOC (as propane) Outlet	158,850 ppmv$_d$ 9.8 lb/hr	249,731 ppmv$_d$ 17.1 lb/hr	88,764 ppmv$_d$ 3.0 lb/hr	165,782 ppmv$_d$ 10.0 lb/hr
Control Efficiency	80.8 %	66.9 %	91.3 %	79.7 %

Note: All emission data is based on a volumetric flow rate expressed as cfm (dry, reference conditions)
"d" – refers to dry conditions
"lb/hr" – refers to pounds per hour (dry, reference conditions)
"ppmv$_d$" – refers to parts per million by volume (dry)

4 CONCLUSION

All testing was completed on June 4th, 2024. The testing methodologies and strategies followed the Test Plan dated August 2023 with comments from May of 2024.

On June 3, 2024, a comprehensive USEPA Method 21 testing program identified 20 leaks within the CDFUELDSCOND system. A leak is identified as any constant reading greater than 500 ppm(as methane). Along with the ppm value, additional comments regarding about the leak locations are outlined in the report.

On June 4, 2024, VOC emission rate and control efficiency testing was completed on the condenser associated with CDFUELSCOND system. The overall results indicated that the control efficiency was 79.7%. The overall efficiency of the condenser is expected to meet 95% control efficiency of VOCs.

TABLES

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Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
Condenser	3	Velocity, Temperature and Flow Rate	U.S. EPA [1] Methods 1-4
	3	Oxygen, Carbon Dioxide	U.S. EPA [1] Method 3
	3	VOC	U.S. EPA [1] Method 25A
CDFUELSCOND System	1	VOC Leaks	U.S. EPA [1] Methods 21

Notes:

[1] U.S. EPA - United States Environmental Protection Agency

Table 2: Sampling Summary and Sample Log

Source and Test #	Sampling Date	Start Time	End Time
CDFUELSCOND System			
Leak Detection	3-Jun-24	8:00	17:00
Condenser Control Efficiency			
Test #1	4-Jun-24	13:00	13:59
Test #2	4-Jun-24	15:00	15:59
Test #3	4-Jun-24	16:30	17:29

Table 3: Sampling Summary - Flow Characteristics - CDFUELSCOND

		Test 1		Test 2		Test 3		AVERAGE	AVERAGE
		Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	Inlet	Out.let
Testing Date		4-Jun-24		4-Jun-24		4-Jun-24		-	-
Stack Temperature	°F	92	70	92	70	80	83	81	79
Moisture	%	13.44%	6.10%	21.25%	11.59%	9.40%	2.00%	12.36%	10.07%
Velocity	ft/s	1.8	1.8	1.9	2.2	1.3	1.0	1.8	1.6
Referenced Flow Rate	CFM	14	9	14	10	11	5	12	10

Notes:

[1] Referenced flow rate expressed as dry at 101.3 kPa, 68 °F, and Actual Oxygen

Table 4: Summary of Locations Above 500 ppm (as Methane)

Tank #	Description of Fitting	Highest PPM Recorded 6/3/24	Additional Comments
7	Lid Seal	1,146	Highest reading was taken directly at seal to system
8	Fitting Seal	7,566	flange
10	Fitting Seal	17,000	Flange
11	Lid Seal	908	Highest reading was taken directly under the wingnuts.
69	Lid Seal	12,000	Highest reading was taken directly under the wingnuts
203	Swagelok	5,216	
	Swagelok	15,200	
	Threaded Fitting	204,000	Leak was between the device and the reducer it's directly screwed into.
204	Threaded Fitting	992	N/A
207	Bolted Cap Seal	942	N/A
209	Flange Seal	8,729	N/A
212	Flange Seal	871	N/A
220	Lid Seal	5,089	Highest reading was taken directly under the wingnuts.
229	Lid Seal	120,000	Highest reading was taken directly under the wingnuts.
232	Flange Seal	6,347	N/A
233	Flange Seal	1,642	N/A
234	Flange Seal	1,634	N/A
235	Flange Seal	4,645	N/A
	Flange Seal	1,566	N/A
	Flange Seal	4,007	N/A

Table 5: VOC EMISSIONS TABLE

Source: Condenser

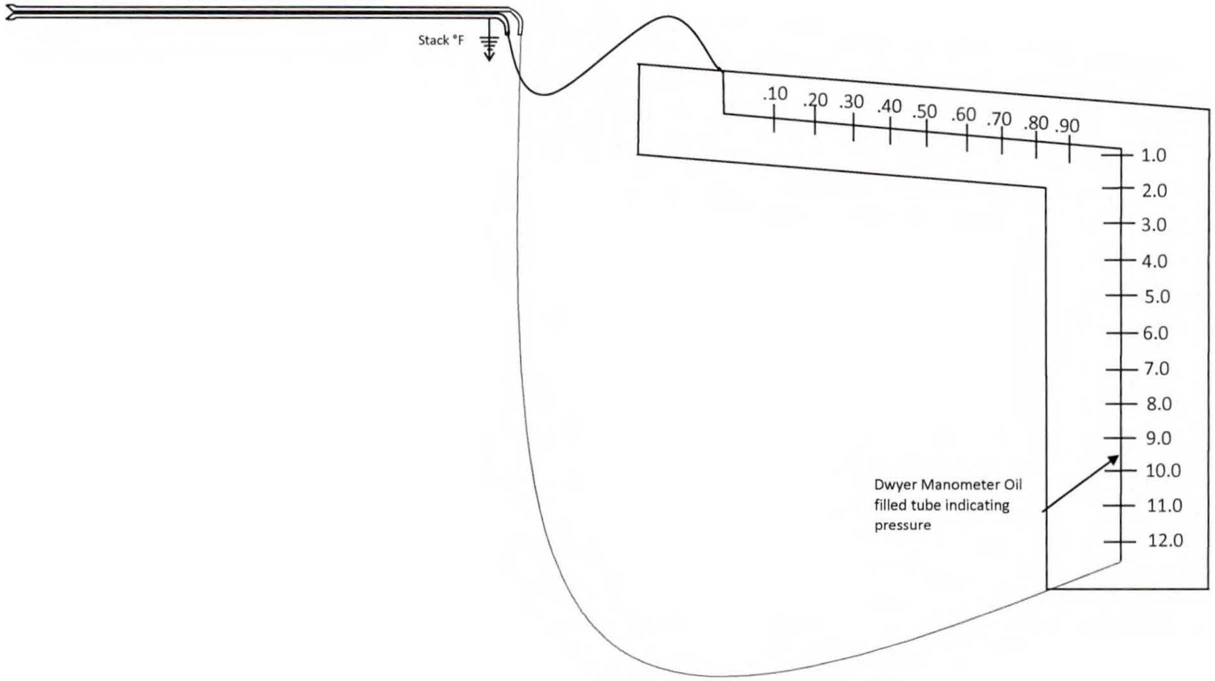
RWDI Project # 2406637

Parameter	1	2	3	Average
Date	4-Jun-24	4-Jun-24	4-Jun-24	--
Start Time:	13:00	15:00	16:30	--
Stop Time:	13:59	15:59	17:29	--
Duration (mins):	60	60	60	--
Inlet Flow Rate (dscfm):	14	14	11	13
Inlet Flow Rate (dm^3/s):	0.007	0.007	0.005	0.006
Moisture:	0.134	0.213	0.094	0.147
Inlet VOC Concentration (as propane) (ppm_w) (diluted):	4,600	4,240	4,208	4,349
Dilution Ratio:	100:1	100:1	100:1	--
Inlet VOC Concentration (as propane) (ppm_w) (undiluted):	460,044	423,964	420,798	434,935
Inlet VOC Concentration (as propane) (ppm_d):	531,474	538,367	464,457	511,433
Inlet VOC Concentration (as propane) ($mg/m^3{}_d$):	974,147	986,782	851,312	937,414
Inlet VOC Concentration (as propane) (lb/hrd):	51	52	35	46
Outlet Flow Rate (dscfm):	9	10	5	8
Outlet Flow Rate (dm^3/s):	0.004	0.005	0.002	0.00
Moisture:	0.061	0.116	0.020	0.066
Outlet VOC Concentration (as propane) (ppmw):	1,492	2,208	870	1,523
Dilution Ratio:	100:1	100:1	100:1	--
Outlet VOC Concentration (as propane) (ppm_w) (undiluted):	149,160	220,787	86,989	152,312
Outlet VOC Concentration (as propane) (ppmd):	158,850	249,731	88,764	165,782
Outlet VOC Concentration (as propane) (mg/m3d):	291,159	457,736	162,698	303,864
Outlet VOC Concentration (as propane) (lb/hrd):	9.8	17.1	3.0	10.0
Control Efficiency (VOC) (%):	80.8%	66.9%	91.3%	79.7%

Note: "d" indicated based on dry conditions

FIGURES

FIGURES



USEPA Method 2C

Gage Products Company

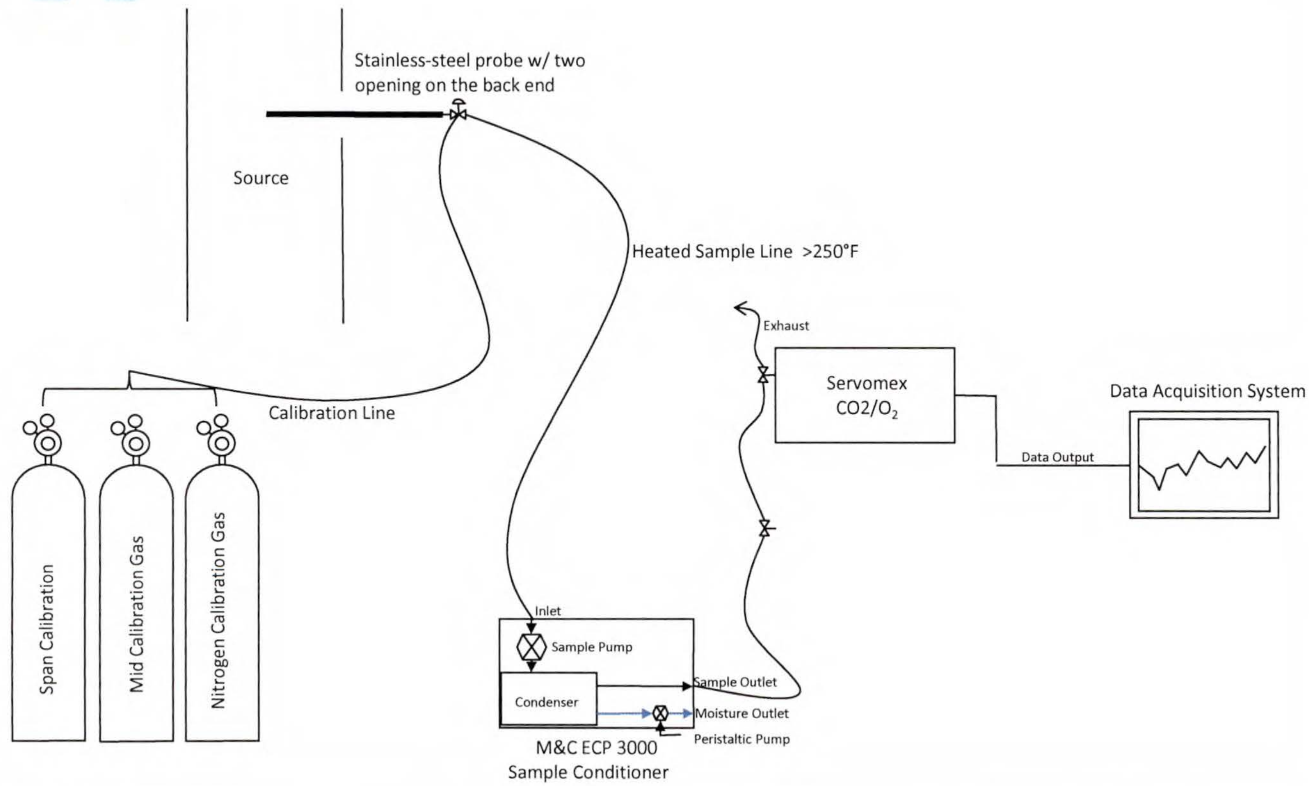
Gage Products Company
Condenser
Ferndale, Michigan

Project #2306466

Figure 2: Schematic of USEPA Method 2

Date: June 4, 2024

Figure 2: USEPA Method 3A Schematic



USEPA Method 3A

Gage Products Company

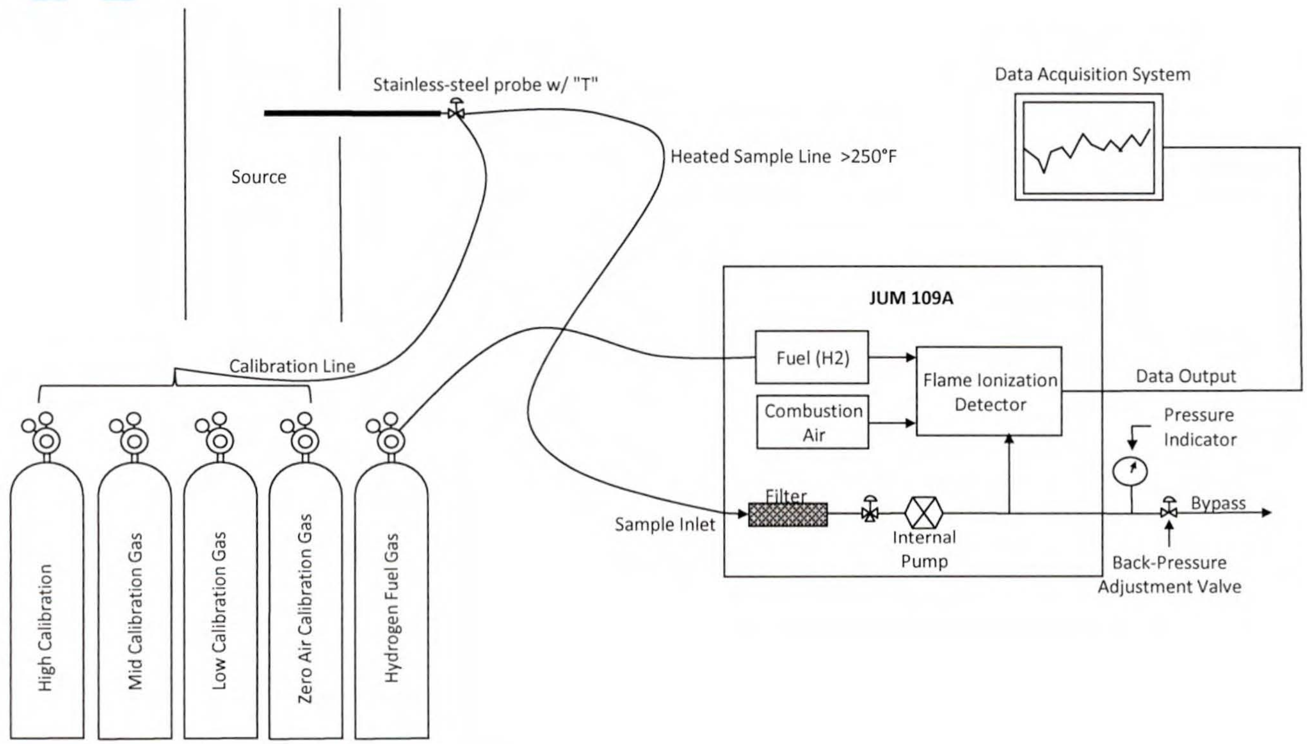
Gage Products Company

Ferndale, Michigan

Project# 2406373

Date: June 4, 2024

Figure 4: USEPA Method 25A Schematic



USEPA Method 25A

Gage Product Company

Gage Product Company

Ferndale, Michigan

Project# 2406373

Date: June 4, 2024