Appendix F

C_2F_6 Spiking Report

2024 Clean Harbors PFAS Tests
C_2F_6 Spiking Report

by
Scott Neal
Superior Spiking Industries, LLC
Pearland, Texas 77584

Table of Contents

List of Tables

List of Figures

Abbreviations

CF_4	carbon tetrafluoride
C_2F_6	hexafluoroethane
CoA	certificate of analysis
DRE	destruction and removal efficiency
FTIR	fourier transform infrared
lb/hr	pound(s) per hour
MDC	minimum detectable concentration
MDL	method detection limit
MFM	mass flow meter
PFAS	per- and polyfluoroalkyl substances
Ppb	parts per billion
ppmv	parts per million by volume
SSI	Superior Spiking Industries

1 Summary

1.1 Overview

This report describes the process for and results of spiking hexafluoroethane (C_2F_6) into the rotary kiln during the per- and polyfluoroalkyl substances PFAS test conducted at Clean Harbors Aragonite Facility in Utah in November 2024. The purpose of spiking C_2F_6 was to demonstrate C_2F_6 destruction and removal efficiency (DRE) on a compound that has high thermal stability.

Spiking services were provided by Superior Spiking Industries (SSI). The project Work Plan was based on spiking C_2F_6 at a feed rate sufficient to achieve a concentration in the stack gas of 15 parts per million by volume (ppmv) if there were no destruction. This mass flow rate was estimated to be sufficient to demonstrate a C_2F_6 destruction and removal efficiency (DRE) value in excess of 99.99%. The C_2F_6 spiking rate required to achieve a target DRE is based on the stack gas flow rate and the analytical detection limit for C_2F_6. The analytical detection limit for C_2F_6 analyzed by OTM-50 was based on the Eurofins method detection limit (MDL) of 0.031 parts per billion (ppb). The estimated minimum detectable concentration (MDC) by Fourier transform infrared (FTIR) analysis was in the range of 10-25 ppb.

As described in Work Plan Table 9-1, a C_2F_6 spiking rate of 12.43 pounds per hour (lb/hour) was planned for Test Runs 1C, 2C, and 3C. However, FTIR monitoring results during Run 1C test showed the C_2F_6 concentration in the stack gas was close to the MDC when it was spiked at a feed rate of 12.41 lb/hr. After receiving the Run 1C FTIR monitoring results, the Test team and EPA personnel jointly decided to increase the C_2F_6 spiking rate to 45 lb/hr during Runs 2C and 3C to attempt to elicit a measurable concentration of C_2F_6 on the FTIR instrument.

1.2 Spiking Results Summary

The planned and measured amounts of gas spiked to the rotary kiln during each test run are summarized in Table F-1. The C_2F_6 feed rate is slightly below the gas flow rate because the purity of C_2F_6 in the gas is 99.9%.

Table F-1. C_2F_6 Spiking Results Summary

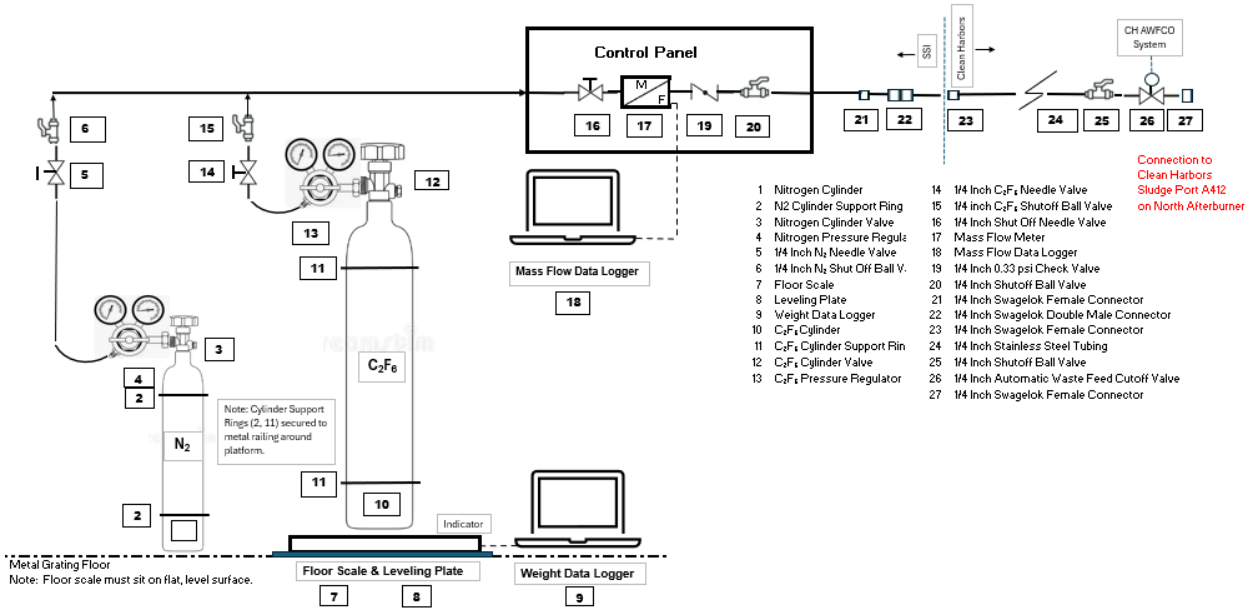
Run Number.	Gas Feed Rate (lb/hr)	Target Gas Feed rate (lb/hr)	Gas Feed Rate Accuracy (%)	C_2F_6 Feed Rate (lb/hr)
Run 1C	12.41	12.43	99.84	12.40
Run 2C	44.11	45.00	98.02	44.07
Run3C	44.68	45.00	99.29	44.64

2 Introduction

2.1 Spiking Equipment

The spiking system was comprised of a cylinder of C_2F_6 gas placed on a calibrated weigh scale, pressure gauges, pressure regulators, a weight data logger, a mass flow meter, a mass flow rate data logger, and a set of control and shutoff valves as shown on Figure F-1. A nitrogen system was used to purge the lines before each test run. A diagram of the C_2F_6 spiking system is shown on Figure F-1.

Figure F-1. C_2F_6 Spiking Equipment Diagram



Prior to the test, Clean Harbors ran a ¼-inch stainless steel tube from the sludge port on the rotary kiln to the spiking equipment. The spiking equipment was set up on a working platform on the north side of the afterburner. The stainless steel tubing was provided with a ¼-inch female Swagelok connector and a ¼-inch ball valve type shutoff. SSI set up their equipment and connected it to the tubing provided by Clean Harbors.

2.2 Spiking Procedures

The C_2F_6 spiking gas was injected through the Sludge Port on the Rotary Kiln. This port fires below the burner. The project team purposely chose to inject the C_2F_6 gas through this port to avoid feeding it through a burner flame. This feed location exposes the spiked gas material to lower temperature conditions than it would encounter if it were fed through a burner port. No other wastes were fed at this location during the spiking process to avoid back pressure in the lines.

Before each test run, the spiking system was primed with the C_2F_6 gas and the flow rate was set and stabilized at the target flow rate. The target C_2F_6 feed rate was then maintained for the duration of the test run. During the run, weigh scale recordings of the cylinder weight loss were also manually recorded at 5-minute time intervals. Records were kept both electronically and manually.

Two independent spiking rate measurement methods were used:

(1) The Weight Loss versus Time Method

(2) The Mass Flow Meter Method

For the Weight Loss versus Time Method, the spiking material is released out of the cylinder into the feed line. Consequently, the mass remaining in the cylinder and on the weight scale decreases. The rate at which the mass changes with time defines the spiking material injection rate. A computer-based data logger equipped with hyper terminal software was used to record the cylinder weight at 1-minute time intervals. The instantaneous and cumulative average spiking rates were subsequently calculated from these data. This method provides a continuous record of the spiking rate, and the accuracy of the scale system can be demonstrated simply by placing a weight standard on the scale. Weights are traced to the National Institute of Standards and Technology.

Weight measurements were also manually recorded on a paper log sheet at 5-minute time intervals. The 5-minute average feed rate and the cumulative feed rate are also recorded on the log. This provides a backup spiking record if the data logger were to fail during a test run.

The Mass Flow Meter Method uses a mass flow meter to provide a continuous flow rate measurement. The data from the mass flow meter was used during the test to adjust the flow rate of the spiked gas. These data are not used in mass balance calculations. The data from the mass flow meter was recorded on a data logger at 1-minute intervals but SSI could not recover the data from the disk at the end of the test program. However, SSI's inability to recover these data had no effect on meeting the test objectives.

2.3 Spiking Results

Detailed spiking results are presented in Attachment A-1. Table A-1 documents the start and stop time for each test run. A summary of spiking results recorded on the Weight Loss versus Time data logger is presented in Table A-2. This data was used for all mass balance and DRE calculations. Measured spiking accuracy values ranged from 98.01 to 99.83%. Detailed spiking data are presented in Table A-3.

Spiking results that were recorded manually are presented in Attachment A-2: Table A-4, Table A-5, Table A-6 for Run 1C, Run 2C, and Run 3 C, respectively. Spiking results are graphed in Figures A-1, Figure A-2, and Figure A-3 for Run 1C, Run 2C, and Run 3 C, respectively. Field log sheets for these data are presented in Attachment A-3 Figure A-4, Figure A-5, and Figure A-6 for Run 1C, Run 2C, and Run 3 C, respectively.

3 Quality Assurance/Quality Control Procedures

Quality assurance checks included spiking material composition documentation; test equipment calibration, performing leak checks, and having redundant systems to measure the C_2F_6 spiking rate. These checks included the following elements:

The composition of the C_2F_6 spiking gas was analyzed by Linde prior to the test. A certificate of analysis (CoA) for C_2F_6 spiking material is provided in Attachment A-4, Figure A-7.

The General Electronic platform scale was calibrated prior to the test by Carlton Scale in Knoxville, Tennessee, using certified weights. The calibration range is 0-400 pounds. Carlton Scale performed a

post-test calibration check when the scales were returned after the completion of the test. The post test calibration was performed on January 14, 2025, however, the Carlton Scale representative confirmed that the scale has not been used since it was returned on November 20, 2024. Certificates of calibration for the pre-test and post-test calibrations are included in Attachment A-4, Figure A-8, and Figure A-9.

The Emerson mass flow meter was calibrated by Coastal Flow Liquid Measurement, Inc. in Houston, Texas before the test. The calibration range is set for 0-20 lb/hr. A certificate of calibration is included in Attachment A-4, Figure A-10.

SSI performed leak checks on the spiking system and all valves prior to use during the test program. Upon completion of successful leak checks, the system was purged for 2 minutes with nitrogen gas before each test run.

Redundant electronic and manual C_2F_6 flow rate recording systems were used. These systems are described in Section 3.0.

The quality assessment determined that the data presented for this spiking program is sufficiently accurate and representative to be used to demonstrate the DRE of hexafluoroethane.

4 Conclusions

Applicable Quality Assurance/Quality Control Measures were implemented, and data quality criteria were met throughout the project. All required spiking rate results and associated uncertainties were quantified and reported in Section 3. Documentation supporting these conclusions is provided within the body of the report and attachments. This record is sufficiently complete to demonstrate the accuracy of the reported results as well as facilitate their independent derivation and assessment.

Attachment A
C_2F_6 Spiking Raw Data Files

Attachment A
C_2F_6 Spiking Records

Attachment A-1
Mass Flow Data Logger Records

Attachment A-2
Manual Weight Reading Records

Table A-5. Run 2C Spiking Gas Manual Feed Rate Data

		Short Term Average				Cumulative Average					
Time (hr:min)	Weight[(a)] (lb)	Delta Mass (lb)	Delta Time (minutes)	Feed Rate (lb/min)	Feed Rate (lb/hr)	Delta Mass (lb)	Delta Time (hr:min)	Delta Time (minutes)	Feed Rate (lb/min)	Feed Rate (lb/min)	Data Recorded By
14:58	230.67										SN
15:03	227.20	3.47	0.00	0.69	41.64	3.47	0.00	5.00	0.69	41.64	SN
15:08	224.04	3.16	0.00	0.63	37.92	6.63	0.01	10.00	0.66	39.78	SN
15:13	220.55	3.49	0.00	0.70	41.88	10.12	0.01	15.00	0.67	40.48	SN
15:18	216.81	3.74	0.00	0.75	44.88	13.86	0.01	20.00	0.69	41.58	SN
15:23	212.85	3.96	0.00	0.79	47.52	17.82	0.02	25.00	0.71	42.77	SN
15:28	209.25	3.60	0.00	0.72	43.20	21.42	0.02	30.00	0.71	42.84	SN
15:33	206.32	2.93	0.00	0.59	35.16	24.35	0.02	35.00	0.70	41.74	SN
15:38	202.64	3.68	0.00	0.74	44.16	28.03	0.03	40.00	0.70	42.05	SN
15:43	198.18	4.46	0.00	0.89	53.52	32.49	0.03	45.00	0.72	43.32	SN
15:48	195.13	3.05	0.00	0.61	36.60	35.54	0.03	50.00	0.71	42.65	SN
15:53	191.00	4.13	0.00	0.83	49.56	39.67	0.04	55.00	0.72	43.28	SN
15:58	187.17	3.83	0.00	0.77	45.96	43.50	0.04	60.00	0.73	43.50	SN
16:03	183.50	3.67	0.00	0.73	44.04	47.17	0.05	65.00	0.73	43.54	SN
16:08	179.32	4.18	0.00	0.84	50.16	51.35	0.05	70.00	0.73	44.01	SN
Total		51.35	1:10	17.117	1027.00						
Average[(c)]										42.37	

(a) All weights were recorded manually on Spiking Rate Data Log Sheet.

(b) SN = Scott Neal, PH = Patrick Hoey

(c) Average feed rate values are slightly different than calculated from data logger, data recording start and stop times are slightly different.

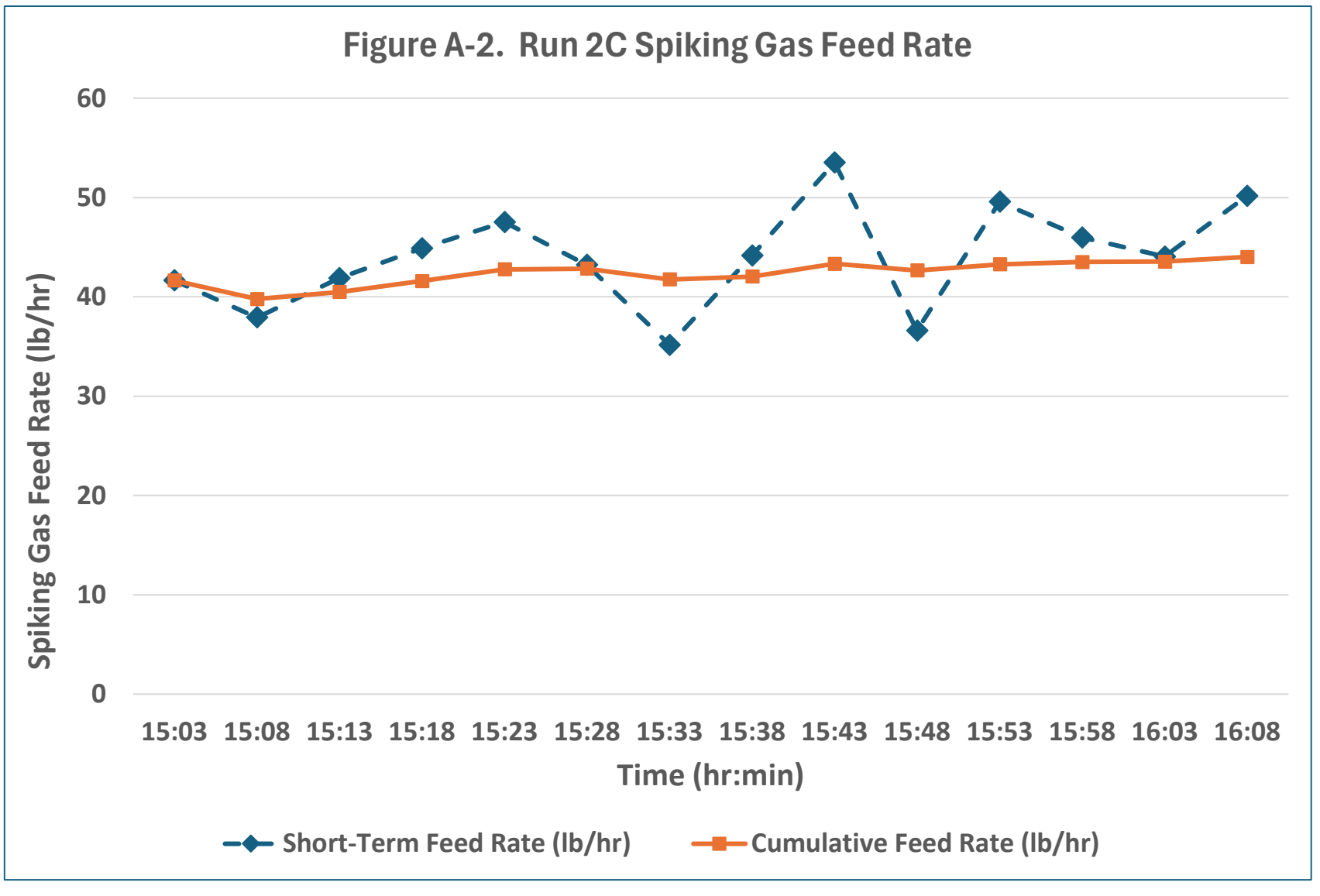


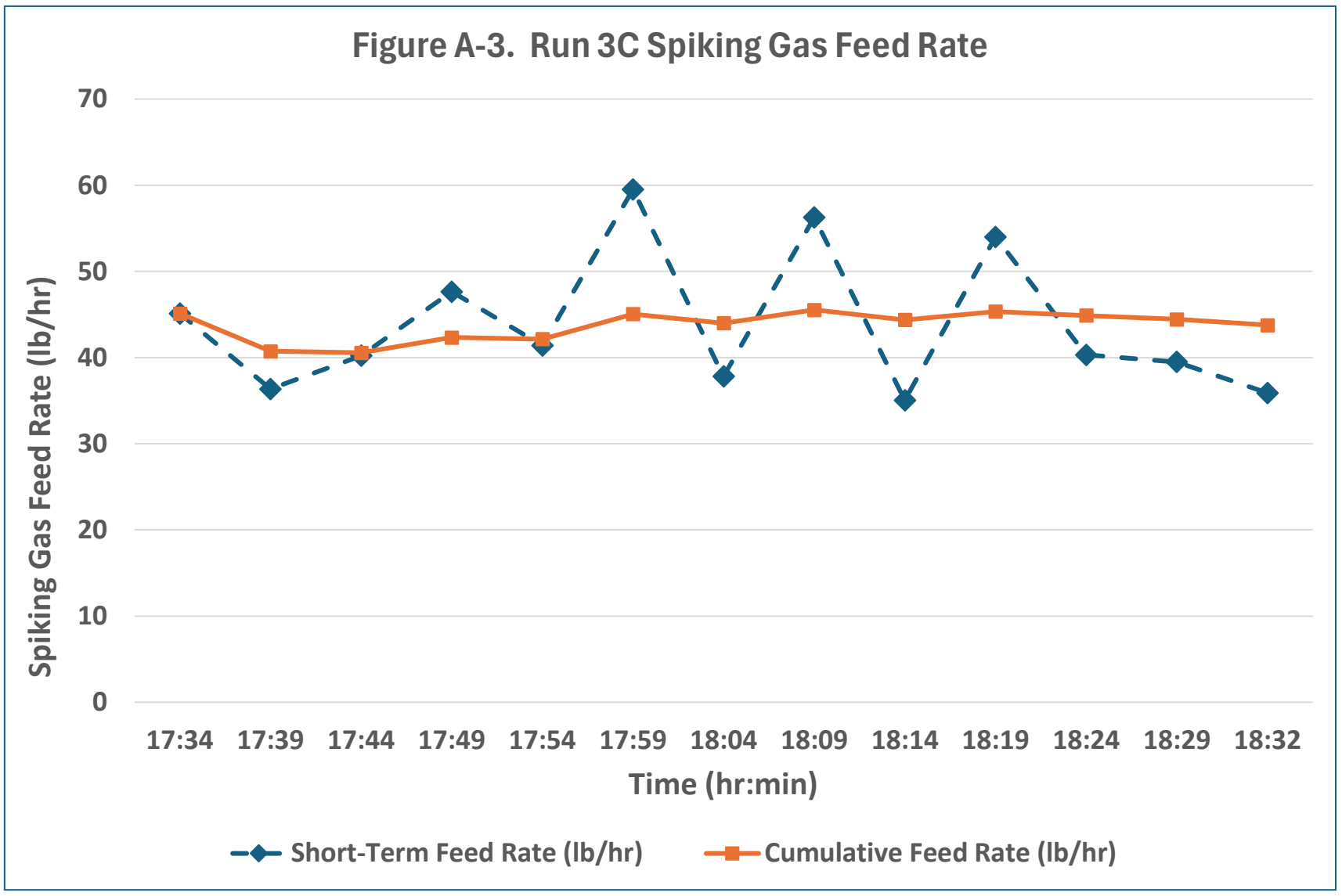
Table A-6. Run 3C Spiking Gas Manual Feed Rate Data

		Short Term Average				Cumulative Average					
Time (hr:min)	Weight[(a)] (lb)	Delta Mass (lb)	Delta Time (minutes)	Feed Rate (lb/min)	Feed Rate (lb/hr)	Delta Mass (lb)	Delta Time (hr:min)	Delta Time (minutes)	Feed Rate (lb/min)	Feed Rate (lb/min)	Data Recorded By
17:29	256.79										SN
17:34	253.03	3.76	0.00	0.75	45.12	3.76	0.00	5.00	0.75	45.12	SN
17:39	250.00	3.03	0.00	0.61	36.36	6.79	0.01	10.00	0.68	40.74	PH
17:44	246.65	3.35	0.00	0.67	40.20	10.14	0.01	15.00	0.68	40.56	PH
17:49	242.68	3.97	0.00	0.79	47.64	14.11	0.01	20.00	0.71	42.33	PH
17:54	239.23	3.45	0.00	0.69	41.40	17.56	0.02	25.00	0.70	42.14	PH
17:59	234.27	4.96	0.00	0.99	59.52	22.52	0.02	30.00	0.75	45.04	PH
18:04	231.12	3.15	0.00	0.63	37.80	25.67	0.02	35.00	0.73	44.01	PH
18:09	226.43	4.69	0.00	0.94	56.28	30.36	0.03	40.00	0.76	45.54	PH
18:14	223.51	2.92	0.00	0.58	35.04	33.28	0.03	45.00	0.74	44.37	PH
18:19	219.01	4.50	0.00	0.90	54.00	37.78	0.03	50.00	0.76	45.34	PH
18:24	215.65	3.36	0.00	0.67	40.32	41.14	0.04	55.00	0.75	44.88	PH
18:29	212.36	3.29	0.00	0.66	39.48	44.43	0.04	60.00	0.74	44.43	PH
18:32	209.37	2.99	0.00	0.60	35.88	47.42	0.04	65.00	0.73	43.77	PH
Total		47.42	1:03	15.807	0.00						
Average[(c)]										43.71	

(a) All weights were recorded manually on Spiking Rate Data Log Sheet.

(b) SN = Scott Neal, PH = Patrick Hoey

(c) Average feed rate values are slightly different than calculated from data logger, data recording start and stop times are slightly different.



Attachment A-3
Spiking Rate Data Log Sheets

Figure A-4. Run 1C Spiking Rate Data Log Sheet

Spiking Rate Data Log sheet, Project Id:

Date: 11/12/2024	**TC** 1 **/Run** 1C	**Spiking Matl:** C2F6		**Lot#:**		**Drum #:** __ of __		Logsheet Page	**of**		
Equipment ID:		**Spike Mgr:**		**Pump ID:**		**Weigh Scale:** F-	**Weather Conditions:**				
Lb/Hr 12.43	**Lb/Min** 0.207			**Pump Back-Pressure =**		**Ave** psig, **Range**		**MFM:**			
Spiking Rate Data:		**Spiking Rate Calculations:**						**Spiking Rate Data [MFM]**			
		Short-Term Average			**Cumulative Run Average**						
Time [T], 00:00	**Mass** [M], Lb	ΔM_i	ΔT_i	Rate = $\Delta M/\Delta T_i$	$\Sigma_i \Delta M_i$	$\Sigma_i \Delta T_i$	Run Ave = $\Sigma_i \Delta M/\Sigma_i \Delta T_i$	**Time** [T], 00:00	**Mass** [M], Lb	**Cumm Run Ave,** Lb M/Hr	Notes:
1823	233.39								5.81		
1828	232.52								6.72		ST #1
1833	231.24	1.28	5	0.256	1.28	5	0.256/12.5				1830
1838	230.21	1.03	5	0.206	2.31	10	0.231/12.5				
1843	229.18	1.03	5	0.206	3.34	15	0.223/12.5		8.78		
1848	228.16	1.02	5	0.204	4.36	20	0.218/12.5		9.82		
1853	227.14	1.02	5	0.204	5.38	25	0.215/12.5				
1858	226.11	1.03	5	0.206	6.41	30	0.214/12.5				
1903	225.08	1.03	5	0.206	7.44	35	0.213/12.5				
1908	224.04	1.04	5	0.208	8.48	40	0.212/12.5		14.00		
1913	223.00	1.04	5	0.208	9.52	45	0.212/12.5		15.03		
1918	221.85	1.15	5	0.230	10.67	50	0.213/12.5				
1923	220.93	0.92	5	0.184	11.59	55	0.211/12.5				1931
1928	219.89	1.04	5	0.208	12.63	60	0.211/12.5				END #1
1931	219.27										+730 #2
Confirming Signature & Date:							Scott Vinet 11/12/24				

Figure A-5. Run 2C Spiking Rate Data Log Sheet

Spiking Rate Data Log sheet, Project Id:

Date: 11/13/2024 TC 1 /Run 2C Spiking Matl: C2F6 Lot#: Drum #: __ of __ Logsheet Page of

Equipment ID: Spike Mgr: 2 Pump ID: Weigh Scale: F- Weather Conditions:

Lb/Hr 45.00 Lb/Min 0.75 Pump Back-Pressure = Ave psig, Range MFM:

Spiking Rate Data: 0.375 Spiking Rate Calculations:

Time [T], 00:00	Mass [M], Lb	Short-Term Average ΔMi	ΔTi	Rate = ΔMi/ΔTi	Cumulative Run Average ΣiΔMi	ΣiΔTi	Run Avei = ΣiΔMi/ΣiΔTi	Spiking Rate Data [MFM] Time [T], 00:00	Mass [M], Lb	Cumm Run Ave, Lb M/Hr	Notes:
1458	230.47							1458	0.00		
1503	220.347							1503			
1508	224.04	3.20	5			5		1508			Start #2 1505
1513	220.55	3.50	5			10		1513	16.70		
1518	216.81	3.74	5			15		1518			
1523	212.85	3.96	5			20		1523	19.23		
1528	209.25	3.60	5			25		1528			
1533	206.32	2.93				30		1533			Offload of C2F6
1538	202.64	3.68				35		1538			
1543	198.80	3.84				40		1543			
1548	195.13	3.68				45		1546			
1553	191.00					50		1552			44.75
1558	187.17					55		1558		42.7	1557 44.12
1603	183.50					58					END #2 1605
1608	179.32										

Confirming Signature & Date: Scott Hart 11/13/24

Figure A-6. Run 3C Spiking Rate Data Log Sheet

Spiking Rate Data Log sheet, Project Id:

Date: 11/13/20	**TC /Run** 3C	**Spiking Matl:** C2F6	**Lot#:**	**Drum #:** __ of __	Logsheet Page of
Equipment ID:	**Spike Mgr:** 2	**Pump ID:**	**Weigh Scale:** F-	**Weather Conditions:**	
Lb/Hr 45.0	**Lb/Min** 0.75	**Pump Back-Pressure =**	**Ave psig,**	**Range**	**MFM:**

Spiking Rate Data:		**Spiking Rate Calculations:**						**Spiking Rate Data [MFM]**			
Time [T], 00:00	**Mass** [M], Lb	**Short-Term Average** ΔMi	ΔTi	Rate = ΔMi/ΔTi	**Cumulative Run Average** ΣiΔMi	ΣiΔTi	Run Avei = ΣiΔMi/ΣiΔTi	**Time** [T], 00:00	**Mass** [M], Lb	**Cumm Run Ave,** Lb M/Hr	Notes:
~~1729~~ ~~250.00~~	256.79							17			#3 START
1734	253.03										1730
1739	250.00	3.03									
1744	246.65	3.35									
1749	242.68	3.97									
1754	239.23	3.45									
1759	234.27	4.96									
1804	231.12	3.15									
1809	226.43	4.69									
1814	223.51										
1819	219.01	4.50									
1824	215.65										
1829	212.36										END #3
1832	209.37										1830

Confirming Signature & Date: Scott Neal 11/13/24

Attachment A-4
QA/QC Records

Figure A-7. Linde Gas Certificate of Analysis

Making our world more productive

Linde Gas & Equipment Inc.
10205 Sweetwater Ln
Houston, TX 77037
Tel: 1-281-880-4445
Fax: 1-281-880-4449

Customer & Order Information:

SUPERIOR SPIKING INDUSTRIES SST LLC
11600 N APTUS RD, CLEAN HARBORS PROJECT
ARAGONITE, UT 84029

Linde Order Number: **52261219**
Customer PO Number: **2336**

Certificate Issuance Date: **11/1/2024**
Revision Number: **0**
Certification Date: **11/1/2024**
Lot Number: **112679**
Part Number: **HA 1163.0-KN**
DocNumber: **793744**
Expiration Date: **10/28/2029**

CERTIFICATE OF ANALYSIS

Halocarbon 116, 3.6 Semiconductor Process Gas

Analytes	Specification	Analytical Results	Analytical Reference	Analytical Uncertainty
Halocarbon 116	**≥ 99.9 %**	**≥ 99.9 %**	**1**	**± 5%**
Nitrogen	**≤ 500 ppmv**	**23.5 ppmv**	**1**	**± 5%**
Oxygen	**≤ 100 ppmv**	**6.2 ppmv**	**1**	**± 5%**
Water	**≤ 20.00 ppmv**	**< 0.1 ppmv**	**1**	**± 5%**
Carbon Monoxide	**≤ 10 ppmv**	**< 1.0 ppmv**	**1**	**± 5%**
Carbon Dioxide	**≤ 10 ppmv**	**< 1.0 ppmv**	**1**	**± 5%**
Other Halocarbons	**≤ 200 ppmv**	**< 1.0 ppmv**	**1**	**± 5%**
Acidity (as Hydrogen Fluoride)	**≤ 0.1 ppmw**	**< 0.0019 ppmw**	**1**	**± 5%**

Cylinder Style: **K**
Cylinder Pressure @ 70 F: **265 psig**
Cylinder Volume: **95 lbs**
Valve Outlet Connection: **CGA 660**
Cylinder Number(s): **7616515Y, 7616519Y**
Analyzed Cylinder Number(s): **7616515Y**

Fill Date: **10/28/2024**
Analysis Date: **10/28/2024**

Filling Method: **Gravimetric**

Approved Signer: **Luis Salgado**

QA Reviewer: **Steven Mewis**

Key to Analytical Techniques:

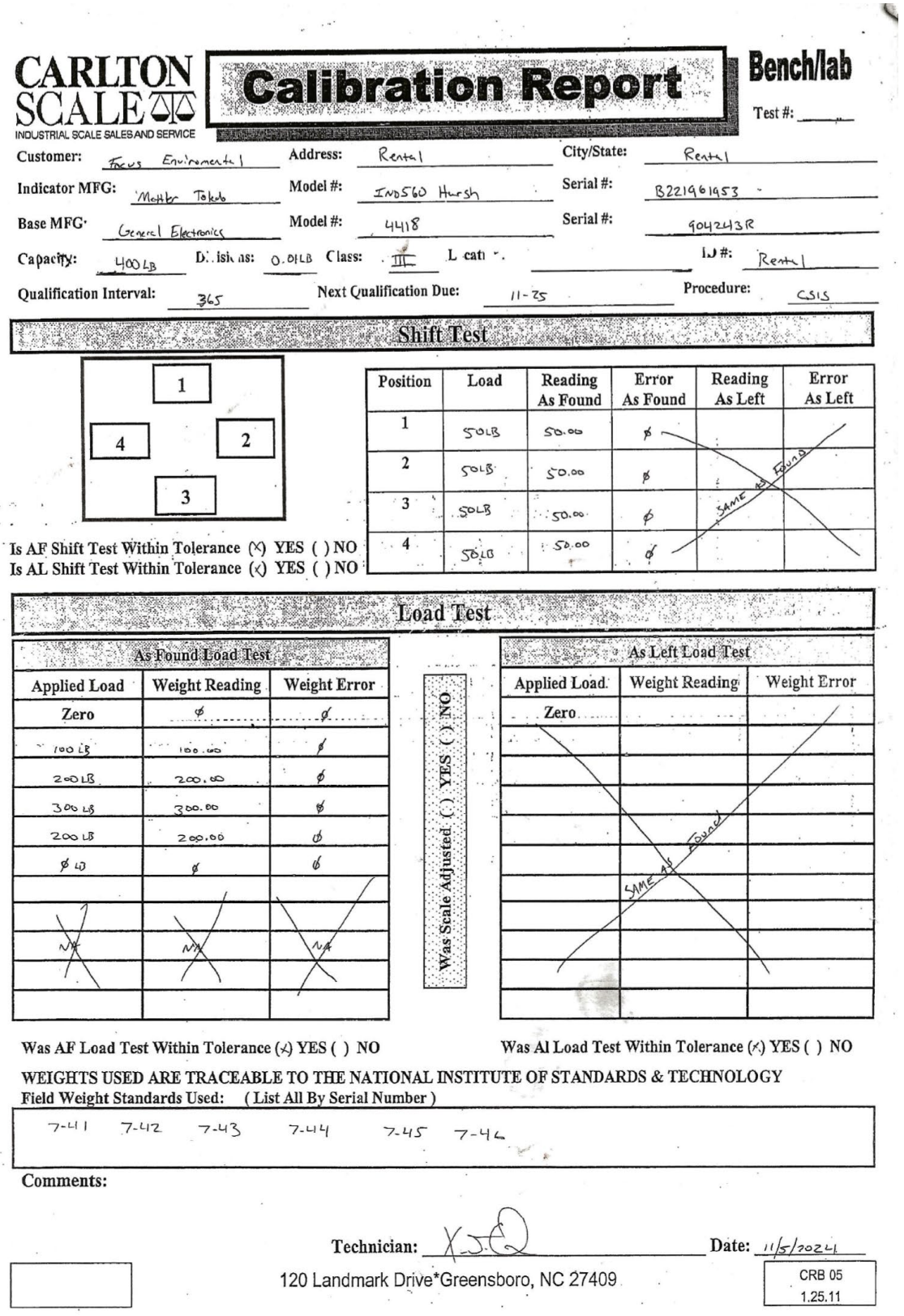
Reference	Analytical Instrument - Analytical Principle
1	Vendor Guaranteed Specification - Vendor Analysis

This analysis of the product described herein was prepared by Linde Gas & Equipment Inc. using instruments whose calibration is certified using Linde Gas & Equipment Inc. Reference Materials which are traceable to the International System of Units (SI) through either weights traceable to the National Institute of Standards and Technology (NIST) or Measurement Canada, or through NIST Standard Reference Materials or equivalent where available.

Note: All expressions for concentration (e.g., % or ppm) are for gas phase, by mole unless otherwise noted. Analytical uncertainty is expressed as a Relative % unless otherwise noted.

1 Of 1

Figure A-8. Carlton Scale Pre-test Calibration Record



CARLTON SCALE
INDUSTRIAL SCALE SALES AND SERVICE

Calibration Report

Bench/lab
Test #: ____

Customer: Focus Environmental | Address: Rental | City/State: Rental
Indicator MFG: Mettler Toledo | Model #: IND560 Harsh | Serial #: B221961953
Base MFG: General Electronics | Model #: 4418 | Serial #: 9042A3R
Capacity: 400 LB | Division: 0.01LB | Class: III | Location: | ID #: Rental
Qualification Interval: 365 | Next Qualification Due: 11-25 | Procedure: CSIS

Shift Test

Position	Load	Reading As Found	Error As Found	Reading As Left	Error As Left
1	50LB	50.00	ø		
2	50LB	50.00	ø		
3	50LB	50.00	ø	SAME AS FOUND	
4	50LB	50.00	ø		

Is AF Shift Test Within Tolerance (X) YES ( ) NO
Is AL Shift Test Within Tolerance (X) YES ( ) NO

Load Test

As Found Load Test

Applied Load	Weight Reading	Weight Error
Zero	ø	ø
100 LB	100.00	ø
200 LB	200.00	ø
300 LB	300.00	ø
200 LB	200.00	ø
ø LB	ø	ø
NA	NA	NA

Was Scale Adjusted ( ) YES (X) NO

As Left Load Test

Applied Load	Weight Reading	Weight Error
Zero		

SAME AS FOUND

Was AF Load Test Within Tolerance (X) YES ( ) NO

Was Al Load Test Within Tolerance (X) YES ( ) NO

WEIGHTS USED ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY
Field Weight Standards Used: (List All By Serial Number)

7-41 7-42 7-43 7-44 7-45 7-46

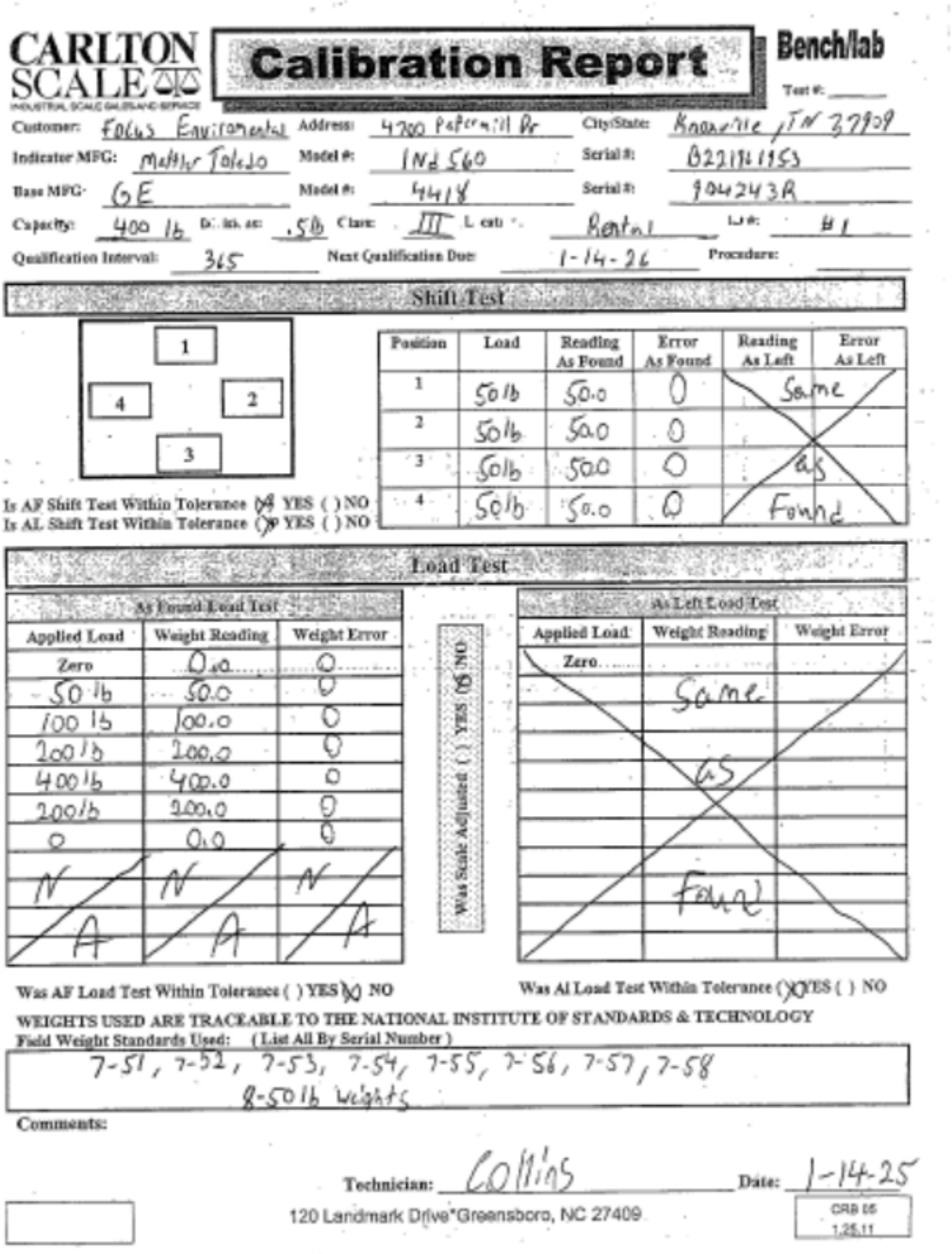
Comments:

Technician: [signature] Date: 11/5/2024

120 Landmark Drive*Greensboro, NC 27409

CRB 05
1.25.11

Figure A-9. Carlton Scale Post-test Calibration Record



CARLTON SCALE
INDUSTRIAL SCALE CALIBRATION SERVICE

Calibration Report

Bench/lab

Test #: _____

Customer: Focus Environmental Address: 4700 Petermill Rd City/State: Knoxville, TN 37909

Indicator MFG: Mettler Toledo Model #: IND 560 Serial #: B221141153

Base MFG: GE Model #: 4418 Serial #: 904243R

Capacity: 400 lb Div. Int. as: .5lb Class: III Loc: Rental I.D. #: #1

Qualification Interval: 365 Next Qualification Due: 1-14-26 Procedure: _____

Shift Test

Position	Load	Reading As Found	Error As Found	Reading As Left	Error As Left
1	50lb	50.0	0	Same	
2	50lb	50.0	0		
3	50lb	50.0	0	as	
4	50lb	50.0	0	Found	

Is AF Shift Test Within Tolerance (X) YES ( ) NO
Is AL Shift Test Within Tolerance (X) YES ( ) NO

Load Test

As Found Load Test

Applied Load	Weight Reading	Weight Error
Zero	0.0	0
50 lb	50.0	0
100 lb	100.0	0
200 lb	200.0	0
400 lb	400.0	0
200 lb	200.0	0
0	0.0	0
N	N	N
A	A	A

Was Scale Adjusted ( ) YES (X) NO

As Left Load Test

Applied Load	Weight Reading	Weight Error
Zero		
	Same	
	as	
	Found	

Was AF Load Test Within Tolerance ( ) YES (X) NO

Was Al Load Test Within Tolerance (X) YES ( ) NO

WEIGHTS USED ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY

Field Weight Standards Used: (List All By Serial Number)

7-51, 7-52, 7-53, 7-54, 7-55, 7-56, 7-57, 7-58
8-50lb weights

Comments:

Technician: Collins Date: 1-14-25

120 Landmark Drive*Greensboro, NC 27409

CRB 05
1.25.11

Figure A-10. Coastal Flow Mass Flow Meter Calibration Record

Certificate of Calibration

Meter: 0030_0467757_P - Superior
Secondary ID:
Location: NEWCANEY_FLOWLAB
Task ID: 1729544694
Date Performed: 10/21/2024 10:04:54AM

CoastalFlow™
A Quorum Business Solutions Company
22210 McCloskey Rd. New Caney, TX 77357 Phone: 713-477-1956

Identification

Customer: 0030 - Superior SSI
Federal ID:

Characteristics

Meter

Brand: Micro Motion
Model: CMF010
Serial: 467757
Proving Mode: Inferred Mass
Frequency SP: 400
Flow Rate SP: 4
Flow Calib Factor: .423524.26

Temp:	77.6	°F
Press:	30.00	psig
Size:	0.10	in
NKF:	6,000.0000	N/lb
K1:	9657.36	
D1:	0	
K2:	10728.18	
D2:	.99696	

Master Meter

Brand: Calibron
Model: MN-4
Serial: MT9405013
Prover Mode: Inferred Mass

Temp:	77.6 °F
Press:	15.0 psig
Size:	0.10 in
MF:	1.0000
KF:	9,827.46 N/lb

Product

Product Type: Water Table(2003)
Product Name: MPMS 11.4.1 2003 water table
Density: 0.9980 Rel

Run Data

	GSMp	ISMm	Meter Factor	Flow Rate (lb/min)	Meter Error %	Meter Frequency	Net K
	0.657520	0.657540	0.99997	3.91	0.00	390.45	6000.18
	0.539110	0.538760	1.00065	3.19	-0.06	318.18	5996.10
	0.433330	0.433420	0.99979	2.53	0.02	252.95	6001.26
	0.290440	0.290330	1.00038	1.68	-0.04	167.62	5997.72
	0.150190	0.150220	0.99980	0.88	0.02	88.07	6001.20
Avg:	0.414120	0.414060	1.0001				

Repeatability: 0.086 %
Linearity: ± 0.043 %
Average Error: -0.012 %

Notes

Crystal XP2i Pressure Gauge SN# 473626
Thermoprobe TL1-A SN# 1-20027
Overall Expanded Uncertainty: +/- 0.05%

Customer Satisfaction Survey

As Left
Adjusted Density (.96305 to .99696 g/cc)
Adjusted Flow Cal

Authorized By: Chris Espitia, Quality Manager
Coastal Flow Liquid Measurement

ilac-MRA
PJLA Calibration Accreditation #93765

This method will meet or exceed the requirements of the American Petroleum Institute, Manual of Petroleum Measurement Standards Chapter 4, Section 9, Part 4, "Determination of the Volume of Displacement and Tank Provers by the Gravimetric Method of Calibration."
Calibration results published in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI) and applies only to the listed flow meter. Coastal Flow Liquid Measurement is an ISO/IEC 17025:2017 accredited laboratory. This certification meets ISO/IEC 17025:2017 standards and should not be reproduced in full, without the written consent of Coastal Flow Liquid Measurement.

Technician: Joe Stanton
Company:

Witness:
Company:

TESTit 3.8.0.0

10/21/2024 11:06 Page: 1 of 1
Revision: 1