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EGLE - Mailroom

Report of...

VOC Destruction Efficiency Sampling

Performed for...

Harbor Foam, Inc.

2950 Prairie Street SW
Grandville, Michigan

On the...

RTO

August 21, 2024

331.01

By...

Network Environmental, Inc.
Grand Rapids, MI

Performed for:

Harbor Foam, Inc.
2950 Prairie Street SW
Grandville, MI 49418
Contact: Tate Kuperus
Telephone: (616) 617-2216
e-mail: tate@harborfoam.com



Performed by:

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I. INTRODUCTION

Network Environmental, Inc. was retained by Harbor Foam, Inc. (SRN: N7754, Kent County) to conduct VOC (total hydrocarbons) destruction efficiency and emission sampling at their Prairie Street facility located in Grandville, MI. The purpose of the study was to document compliance with EGLE ROP No. MI-ROP-N7754-2024. MI-ROP-N7754-2024 has established a 98% destruction efficiency (DE) limit for the thermal oxidizer at this facility.

The DE of the thermal oxidizer was determined by employing the following reference test methods:

- VOC's – U.S. EPA Method 25A
- Exhaust Gas Parameters (air flow rate, temperature, moisture & density) – U.S. EPA Reference Methods 1 through 4.

The sampling was performed on August 21, 2024 by Stephan K. Byrd, Scott Cargill, Richard D. Eerdmans and David D. Engelhardt of Network Environmental, Inc.. Assisting in the study were Mr. Tate Kuperus and the operating staff of the facility. Ms. April Lazzaro and Mr. Trevor Drost of the Michigan Department of Environment, Great Lakes and Energy (EGLE) - Air Quality Division were present to observe the sampling and source operation.

**II.1 TABLE 1
VOC DESTRUCTION EFFICIENCY (DE) RESULTS
RTO
2950 PRAIRIE STREET SW
HARBOR FOAM, INC.
GRANDVILLE, MICHIGAN
AUGUST 21, 2024**

Sample	Time	Air Flow Rate SCFM ⁽¹⁾		Concentration PPM ⁽²⁾		Mass Emission Rate Lbs/Hr ⁽³⁾		Percent Destruction Efficiency ⁽⁴⁾
		Inlet	Exhaust	Inlet	Exhaust	Inlet	Exhaust	
1 (2)	12:10-13:10	18,023	17,334	660.5	8.7	81.34	1.03	98.73
2 (3)	14:13-15:13	17,951	17,336	662.7	8.9	81.28	1.05	98.71
3 (4)	15:55-16:55	18,166	17,023	722.0	9.2	89.62	1.07	98.81
Average		18.047	17,231	681.7	8.9	84.08	1.05	98.75

(1) SCFM = Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg).

(2) PPM = Parts Per Million (v/v) On An Actual (Wet) Basis As Propane

(3) Lbs/Hr = Pounds Per Hour Calculated As Propane

(4) Destruction Efficiencies were calculated using the mass emission rates (Lbs/Hr)

III. DISCUSSION OF RESULTS

Sample number one was not calculated because the RTO retention time, (valve switching set at 1 minute) was not sufficient or set as required. The manufacturer was contacted and the retention time was increased (valve switching set at 2 minutes) to help the destruction efficiency. Samples 2,3, and 4 were used in the DE calculations. Data for sample 1 is included in the appendices.

The results of the emission sampling are summarized in Table 1 (Section II.1). The results are presented as follows:

III.1 Total Hydrocarbon (VOC) Destruction Efficiency Results (Table 1)

Table 1 summarizes the VOC DE results for the thermal oxidizer as follows:

- Sample
- Time
- Air Flow Rate (SCFM) – Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- VOC Concentrations (PPM) – Parts Per Million (v/v) On An Actual (Wet) Basis As Propane
- VOC Mass Emission Rates (Lbs/Hr) – Pounds Of VOC Per Hour As Propane
- VOC Percent Destruction Efficiency (DE)

Both the inlet and exhaust concentrations (PPM) and mass rates (Lbs/Hr) are shown. The DE results were calculated using the mass rate results (Lbs/Hr).

IV. SAMPLING AND ANALYTICAL PROTOCOL

The exhaust sampling was conducted on the 33 inch I.D. exhaust stack at a location approximately six (6) duct diameters downstream and approximately three (3) duct diameters upstream from the nearest disturbances. The inlet sampling was conducted on the 32 inch I.D. inlet duct at a location approximately one (1) duct diameter downstream and less than one (1) duct diameter upstream from the nearest disturbances.

IV.1 Total Hydrocarbon (VOC) – The VOC sampling was conducted in accordance with U.S. EPA Method 25A. A J.U.M. Model 3-500 flame ionization detector (FID) analyzer was used to monitor the exhaust. A Thermo Environmental, Inc. Model 51 flame ionization detector (FID) analyzer was used to monitor the inlet. Heated Teflon sample lines were used to transport the gases to the analyzers. These analyzers produce instantaneous readouts of the total hydrocarbon concentrations (PPM).

The analyzers were calibrated by system injection (from the back of the stack probe to the analyzer) prior to the testing using propane calibration gases. Span gases of 2000.0 PPM (inlet) and 95.0 PPM (exhaust) were used to establish the initial instrument calibrations. Calibration gases of 991.0 PPM & 491.0 PPM (for the inlet) and 50.6 PPM & 29.9 PPM (for the exhaust) propane were used to determine the calibration error of the analyzers. After each sample, a system zero and system injection of 491.0 PPM (for the inlet) and 29.9 PPM (for the exhaust) propane were performed to establish system drift and system bias during the test period. All calibration gases used were EPA Protocol Calibration Gases. Three (3) samples were collected simultaneously from the inlet and exhaust. Each sample was sixty (60) minutes in duration.

The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the sources. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. Figure 1 is a diagram of the VOC sampling train.

IV.2 Exhaust Gas Parameters – The exhaust gas parameters (air flow rate, temperature, moisture and density) were determined in conjunction with the other sampling by employing U.S. EPA Methods 1 through 4.

Three (3) velocity traverses were conducted at both the inlet and the exhaust. The inlet airflows were determined by using a 3D probe due to the location of the inlet sampling ports. The sampling points are listed below.

Forty (40) sampling points (20 per port) were used for the inlet and twelve (12) sampling points (6 per port) for the exhaust.

RTO INLET	
1	0.42
2	1.25
3	2.14
4	3.10
5	4.13
6	5.28
7	6.52
8	8.00
9	9.79
10	12.42
11	19.58

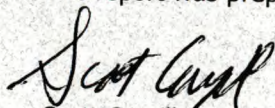
12	22.21
13	24.00
14	25.47
15	26.72
16	27.87
17	28.90
18	29.86
19	30.75
20	31.58

RTO EXHAUST	
1	1.45
2	4.82
3	9.77
4	23.23
5	28.18
6	31.55

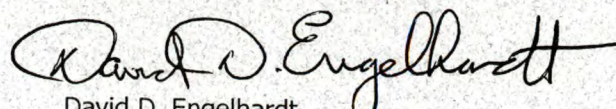
Moisture was determined by employing the wet bulb/dry bulb technique. One (1) bag sample was collected from each location and analyzed by Orsat to determine gas density.

All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis.

This report was prepared by:


 Scott Cargill
 Project Manager

This report was reviewed by:


 David D. Engelhardt
 Vice President

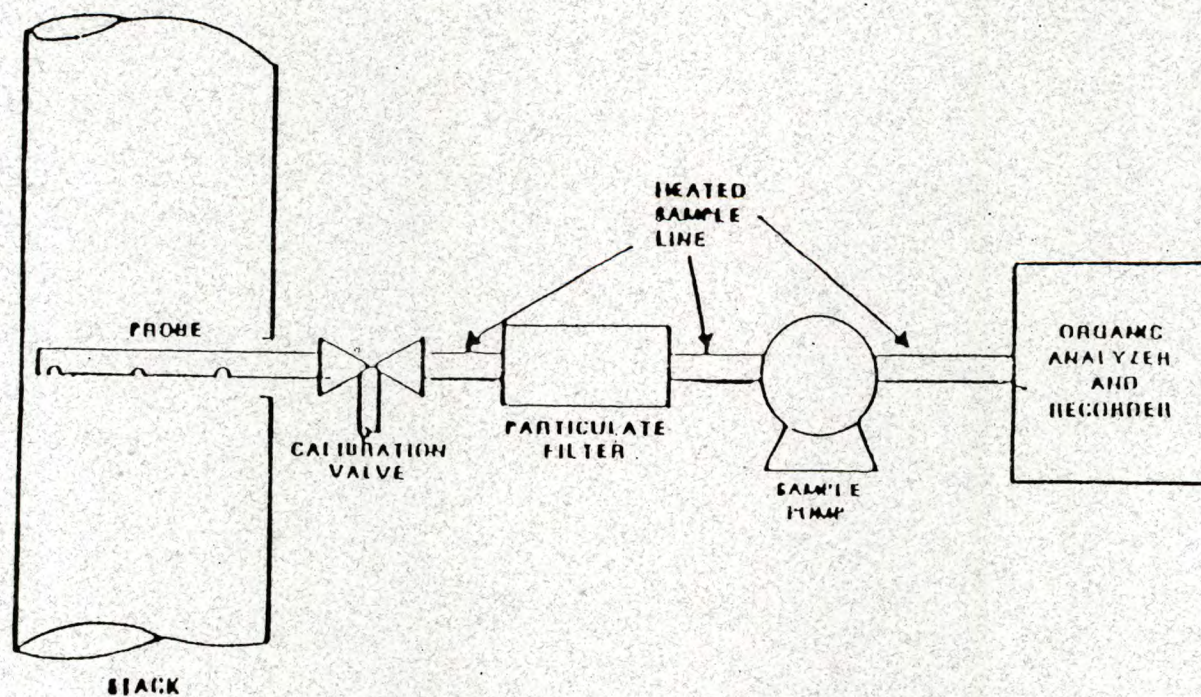


Figure 1
Total VOC Sampling Train

APPENDIX A

EXHAUST GAS PARAMETERS

Company: Harbor Foam
 Location: Grandville, MI
 Source: RTO Inlet
 Date 8/21/2024

Sample: 2

Stack Dia.= 32
 Area sq ft= 5.585054
 % Mois.= 1.8
 % O2= 20.9
 % CO2= 0
 % CO= 0
 %N2= 79.1
 Temp= 93
 Baro Press= 29.63
 Static= 19
 Cp= 0.99

Port: 1			Port: 2		
Point:	ΔP	Deg. F	Point	ΔP	Deg. F
1	0.643	91	1	0.912	94
2	0.786	91	2	0.894	94
3	0.606	92	3	0.835	94
4	1.251	92	4	0.779	94
5	1.204	93	5	1.16	94
6	1.059	93	6	0.815	94
7	1.232	93	7	0.949	94
8	0.908	93	8	0.817	93
9	1	93	9	0.835	93
10	0.943	93	10	0.642	93
11	0.357	93	11	0.573	93
12	0.3	93	12	0.304	93
13	0.375	93	13	0.43	93
14	0.188	93	14	0.61	93
15	0.25	93	15	0.84	93
16	0.333	93	16	0.775	93
17	0.211	93	17	0.69	93
18	0.574	93	18	0.724	93
19	0.532	93	19	1.028	93
20	0.242	93	20	0.923	93

Avg. Sq Rt V.P.= 0.813380157

Excess Air= -118750

Density

Dry @ STP= 0.0745527

Moist @ STP= 0.074047751

Moist @ Stack= 0.073308042

Mol. Weight= 28.84443963

FPM=	3259.594023
ACFM=	18205.00736
SCFM=	18023.14607
DSCFM=	17698.72944

Company: Harbor Foam
 Location: Grandville, MI
 Source: RTO Inlet
 Date 8/21/2024

Sample: 3

Stack Dia.= 32
 Area sq ft= 5.585054
 % Mois.= 1.8
 % O2= 20.9
 % CO2= 0
 % CO= 0
 %N2= 79.1
 Temp= 96
 Baro Press= 29.63
 Static= 19
 Cp= 0.99

Port: 1			Port: 2		
Point:	ΔP	Deg. F	Point	ΔP	Deg. F
1	0.67	95	1	0.9241	95
2	0.821	95	2	0.9127	95
3	0.654	96	3	0.8833	95
4	1.187	96	4	0.824	95
5	1.221	97	5	1.237	95
6	1.158	97	6	0.8821	96
7	1.241	97	7	0.9332	96
8	1.072	97	8	0.8852	96
9	0.987	97	9	0.8317	97
10	0.321	97	10	0.6021	97
11	0.426	97	11	0.5431	97
12	0.381	97	12	0.3548	97
13	0.32	96	13	0.4117	96
14	0.212	96	14	0.5897	96
15	0.187	96	15	0.8652	96
16	0.285	96	16	0.821	96
17	0.208	96	17	0.7234	96
18	0.477	96	18	0.8876	95
19	0.546	96	19	0.903	97
20	0.266	96	20	1.007	94

Avg. Sq Rt V.P.= 0.812395868

Excess Air= -118750

Density

Dry @ STP= 0.0745527

Moist @ STP= 0.074047751

Moist @ Stack= 0.072900625

Mol. Weight= 28.84443963

FPM=	3264.734197
ACFM=	18233.7155
SCFM=	17951.24406
DSCFM=	17628.12167

Company: Harbor Foam
 Location: Grandville, MI
 Source: RTO Inlet
 Date 8/21/2024

Sample: 4

Stack Dia.= 32
 Area sq ft= 5.585054
 % Mois.= 1.8
 % O2= 20.9
 % CO2= 0
 % CO= 0
 %N2= 79.1
 Temp= 96
 Baro Press= 29.63
 Static= 20
 Cp= 0.99

Port: 1			Port: 2		
Point:	ΔP	Deg. F	Point	ΔP	Deg. F
1	0.67	95	1	0.8914	95
2	0.811	95	2	0.9237	95
3	0.637	96	3	0.8914	96
4	1.18	96	4	0.8377	96
5	1.219	97	5	1.2281	96
6	1.077	97	6	0.8923	97
7	1.193	97	7	0.9427	97
8	0.971	97	8	0.8212	98
9	0.992	96	9	0.8376	98
10	0.916	96	10	0.621	97
11	0.401	97	11	0.5431	97
12	0.325	97	12	0.332	97
13	0.338	97	13	0.4312	96
14	0.197	97	14	0.5446	96
15	0.231	96	15	0.8414	96
16	0.357	96	16	0.8012	97
17	0.203	96	17	0.6817	97
18	0.461	96	18	0.8811	97
19	0.539	96	19	1.044	97
20	0.303	96	20	1.017	97

Avg. Sq Rt V.P.= 0.821334325

Excess Air= -118750

Density

Dry @ STP= 0.0745527

Moist @ STP= 0.074047751

Moist @ Stack= 0.073036624

Mol. Weight= 28.84443963

FPM=	3297.580269
ACFM=	18417.16257
SCFM=	18165.67498
DSCFM=	17838.69283

SOURCE: Harbor Foam
Grandville, MI
RTO Exhaust

VELOCITY TRAVERSE
8/21/2024

Run 2

STACK DIAMETER (INCHES) = 33

PITOT (CP) = 0.8

%O2 = 19.7

AREA (SQ.FT) = 5.939573611

STATIC (IN H2O) = -0.75

%CO2 = 1.2

BAR. PRESS. (IN HG) = 29.63

% MOISTURE = 2.2

%CO = 0

AVG TEMP (DEG.F) = 196

%N2 = 79.1

PORT: 1			PORT: 2		
POINT	V.PRESS	TEMP	POINT	V.PRESS	TEMP
1	0.95	201	1	0.79	155
2	1.10	195	2	0.78	149
3	0.94	175	3	1.30	256
4	0.90	164	4	0.95	230
5	1.30	220	5	1.10	208
6	1.30	217	6	1.10	183

AVG SQRT VEL PRESS = 1.01721

% EXCESS AIR = 1666.103

DENSITY, DRY, @STP (LBS/CU.FT) = 0.07492

DENSITY, WET, @STP (LBS/CU.FT) = 0.07430

DENSITY, WET, @STACK COND (LBS/CU.FT) = 0.05910

MOLECULAR WEIGHT, DRY (LBS/MOLE) = 28.9884

AVG. GAS VELOCITY (FPM) = 3668.61

ACFM = 21789.95

SCFM = 17333.73

DSCFM = 16952.39

SOURCE: Harbor Foam
Grandville, MI
RTO Exhaust

VELOCITY TRAVERSE
8/21/2024

Run 3

STACK DIAMETER (INCHES) = 33

PITOT (CP) = 0.8

%O2 = 19.7

AREA (SQ.FT) = 5.939573611

STATIC (IN H2O) = -0.58

%CO2 = 1.2

BAR. PRESS. (IN HG) = 29.63

% MOISTURE = 2.23

%CO = 0

AVG TEMP (DEG.F) = 183

%N2 = 79.1

PORT: 1				PORT: 2		
POINT	V.PRESS	TEMP		POINT	V.PRESS	TEMP
1	0.73	179		1	0.87	248
2	0.86	171		2	1.00	234
3	0.83	158		3	0.94	217
4	0.94	120		4	1.10	179
5	1.20	147		5	1.20	168
6	1.30	221		6	1.30	157

AVG SQRT VEL PRESS = 1.00706

% EXCESS AIR = 1666.103

DENSITY, DRY, @STP (LBS/CU.FT) = 0.07492

DENSITY, WET, @STP (LBS/CU.FT) = 0.07429

DENSITY, WET, @STACK COND (LBS/CU.FT) = 0.06030

MOLECULAR WEIGHT, DRY (LBS/MOLE) = 28.9884

AVG. GAS VELOCITY (FPM) = 3595.73

ACFM = 21357.10

SCFM = 17335.68

DSCFM = 16949.09

SOURCE: Harbor Foam
Grandville, MI
RTO Exhaust

VELOCITY TRAVERSE
8/21/2024

Run 4

STACK DIAMETER (INCHES) = 33

PITOT (CP) = 0.8

%O2 = 19.9

AREA (SQ.FT) = 5.939573611

STATIC (IN H2O) = -0.65

%CO2 = 1

BAR. PRESS. (IN HG) = 29.63

% MOISTURE = 2.2

%CO = 0

AVG TEMP (DEG.F) = 190

%N2 = 79.1

PORT: 1				PORT: 2		
POINT	V.PRESS	TEMP		POINT	V.PRESS	TEMP
1	0.78	184		1	0.82	161
2	0.86	175		2	0.90	152
3	0.89	171		3	0.92	230
4	0.92	219		4	0.95	223
5	1.30	210		5	1.20	210
6	1.30	158		6	1.10	187

AVG SQRT VEL PRESS = 0.99381

% EXCESS AIR = 2025.651

DENSITY, DRY, @STP (LBS/CU.FT) = 0.07486

DENSITY, WET, @STP (LBS/CU.FT) = 0.07424

DENSITY, WET, @STACK COND (LBS/CU.FT) = 0.05962

MOLECULAR WEIGHT, DRY (LBS/MOLE) = 28.9644

AVG. GAS VELOCITY (FPM) = 3568.58

ACFM = 21195.87

SCFM = 17023.18

DSCFM = 16648.67

APPENDIX B

DATA ACQUISITION & CALIBRATION DATA

Company: Harbor Foam

Location: Grandville, MI

Source: RTO

Date: 08/21/24

Channel:	1	2	3	4	5	6	7	8	9	10
Compound:	THC IN	THC OUT								
Units:	PPM	PPM								

Summary Table

Sample	THC IN PPM	THC OUT PPM								
1	565.3	11.5								
2	669.4	8.7								
3	673.1	9.0								

Monitor:	Thermo Environmental Model 51
Operator:	SKB / DDE
Cal. Span Value:	2000
Page #:	1 of 1

[illegible]

Monitor:	J.U.M. Model 3-500
Operator:	SKB / DDE
Cal. Span Value:	95
Page #:	1 of 1

[illegible]

Harbor Foam
Grandville, MI
RTO (Stratification Test)
Sample # 1
Start Time 8:43:22
Date 08/21/24

Date	Time	IN THC PPM	OUT THC PPM
08/21/24	8:43:22	534.7	12.0
08/21/24	8:44:22	558.2	13.0
08/21/24	8:45:22	600.5	9.6
08/21/24	8:46:22	498.7	10.8
08/21/24	8:47:22	604.7	12.3
08/21/24	8:48:22	499.7	10.4
08/21/24	8:49:22	623.1	12.4
08/21/24	8:50:22	500.5	12.8
08/21/24	8:51:22	622.7	10.8
08/21/24	8:52:22	503.8	10.4
08/21/24	8:53:22	613.4	12.5
08/21/24	8:54:22	558.7	11.2
Average		559.9	11.5
Point 1	Average	548.0	11.4
Point 2	Average	557.0	12.0
Point 3	Average	574.7	11.2
Point 1	% Diff.	-2.1	-1.5
Point 2	% Diff.	-0.5	4.0
Point 3	% Diff.	2.6	-2.6

Harbor Foam

Grandville, MI

RTO

Sample # 1

Start Time 9:00:16

Date 08/21/24

Date	Time	THC IN PPM	THC OUT PPM
08/21/24	9:00:16	524.7	11.9
08/21/24	9:01:16	567.1	11.5
08/21/24	9:02:16	599.6	10.6
08/21/24	9:03:16	508.2	12.6
08/21/24	9:04:16	624.7	13.3
08/21/24	9:05:16	488.5	10.4
08/21/24	9:06:16	622.6	12.7
08/21/24	9:07:16	484.5	11.8
08/21/24	9:08:16	642.7	8.6
08/21/24	9:09:16	497.4	8.1
08/21/24	9:10:16	612.5	12.5
08/21/24	9:11:16	556.4	12.5
08/21/24	9:12:16	572.5	11.8
08/21/24	9:13:16	571.7	12.5
08/21/24	9:14:16	562.9	13.2
08/21/24	9:15:16	597.8	13.1
08/21/24	9:16:16	570.8	12.9
08/21/24	9:17:16	609.2	11.1
08/21/24	9:18:16	587.1	12.8
08/21/24	9:19:16	614.5	11.1
08/21/24	9:20:16	618.4	8.1
08/21/24	9:21:16	584.1	9.0
08/21/24	9:22:16	664.6	13.2
08/21/24	9:23:16	535.0	11.6
08/21/24	9:24:16	685.5	12.9
08/21/24	9:25:16	525.2	11.1
08/21/24	9:26:16	679.6	13.6
08/21/24	9:27:16	513.4	13.8
08/21/24	9:28:16	682.1	13.8
08/21/24	9:29:16	540.6	11.4
08/21/24	9:30:16	654.6	11.9
08/21/24	9:31:16	578.3	14.0
08/21/24	9:32:16	596.7	3.9
08/21/24	9:33:16	593.3	13.1
08/21/24	9:34:16	595.7	11.9
08/21/24	9:35:16	607.5	12.3
08/21/24	9:36:16	582.3	11.2
08/21/24	9:37:16	610.9	13.5
08/21/24	9:38:16	595.6	10.9
08/21/24	9:39:16	594.3	13.1
08/21/24	9:40:16	546.6	12.4
08/21/24	9:41:16	479.2	9.8
08/21/24	9:42:16	549.1	12.3
08/21/24	9:43:16	473.4	10.1
08/21/24	9:44:16	558.0	5.2
08/21/24	9:45:16	494.7	10.4
08/21/24	9:46:16	570.3	13.5
08/21/24	9:47:16	502.2	10.6
08/21/24	9:48:16	541.2	13.7
08/21/24	9:49:16	498.0	12.3
08/21/24	9:50:16	542.1	12.6
08/21/24	9:51:16	507.4	11.0
08/21/24	9:52:16	542.6	11.8
08/21/24	9:53:16	518.5	12.4
08/21/24	9:54:16	533.4	10.9
08/21/24	9:55:16	513.3	12.4
08/21/24	9:56:16	539.2	4.2
08/21/24	9:57:16	504.7	12.0
08/21/24	9:58:16	541.7	11.1
08/21/24	9:59:16	512.0	12.2

Sample 1 Average 565.3 11.5

Harbor Foam
Grandville, MI
RTO
Sample # 2
Start Time 12:09:42
Date 08/21/24

Date	Time	THC IN PPM	THC OUT PPM
08/21/24	12:09:42	674.0	4.2
08/21/24	12:10:42	607.0	13.2
08/21/24	12:11:42	704.8	2.9
08/21/24	12:12:42	612.2	13.6
08/21/24	12:13:42	734.4	4.9
08/21/24	12:14:42	612.5	11.8
08/21/24	12:15:42	717.3	3.1
08/21/24	12:16:42	630.6	13.0
08/21/24	12:17:42	689.7	5.0
08/21/24	12:18:42	678.0	12.3
08/21/24	12:19:42	653.3	3.1
08/21/24	12:20:42	669.4	13.5
08/21/24	12:21:42	643.4	4.6
08/21/24	12:22:42	686.3	10.5
08/21/24	12:23:42	618.5	2.9
08/21/24	12:24:42	682.8	12.9
08/21/24	12:25:42	612.2	4.6
08/21/24	12:26:42	670.8	12.1
08/21/24	12:27:42	638.5	2.9
08/21/24	12:28:42	640.0	14.1
08/21/24	12:29:42	678.4	4.6
08/21/24	12:30:42	621.8	11.4
08/21/24	12:31:42	684.8	3.0
08/21/24	12:32:42	616.8	13.6
08/21/24	12:33:42	688.5	5.0
08/21/24	12:34:42	622.5	12.3
08/21/24	12:35:42	704.5	3.3
08/21/24	12:36:42	658.0	13.8
08/21/24	12:37:42	699.1	5.6
08/21/24	12:38:42	709.8	11.8
08/21/24	12:39:42	663.4	3.3
08/21/24	12:40:42	761.0	13.7
08/21/24	12:41:42	653.2	5.3
08/21/24	12:42:42	799.3	12.3
08/21/24	12:43:42	642.7	3.4
08/21/24	12:44:42	805.2	14.9
08/21/24	12:45:42	657.8	5.4
08/21/24	12:46:42	776.7	14.1
08/21/24	12:47:42	707.4	3.3
08/21/24	12:48:42	743.1	15.5
08/21/24	12:49:42	713.3	5.3
08/21/24	12:50:42	695.3	14.0
08/21/24	12:51:42	720.8	3.5
08/21/24	12:52:42	681.4	15.2
08/21/24	12:53:42	723.0	5.9
08/21/24	12:54:42	682.4	13.2
08/21/24	12:55:42	699.9	3.5
08/21/24	12:56:42	717.5	14.7
08/21/24	12:57:42	658.8	5.6
08/21/24	12:58:42	751.7	13.0
08/21/24	12:59:42	635.1	3.4
08/21/24	13:00:42	826.7	15.6
08/21/24	13:01:42	327.1	3.7
08/21/24	13:02:42	436.2	8.3
08/21/24	13:03:42	615.4	2.6
08/21/24	13:04:42	724.7	15.6
08/21/24	13:05:42	683.9	4.7
08/21/24	13:06:42	694.2	14.5
08/21/24	13:07:42	665.8	3.1
08/21/24	13:08:42	443.7	14.5
Sample 2 Average		669.4	8.7

Harbor Foam

Grandville, MI

RTO

Sample # 3

Start Time 14:13:01

Date 08/21/24

Date	Time	THC IN PPM	THC OUT PPM
08/21/24	14:13:01	617.0	5.6
08/21/24	14:14:01	706.8	14.6
08/21/24	14:15:01	600.9	4.1
08/21/24	14:16:01	689.5	12.2
08/21/24	14:17:01	607.5	5.7
08/21/24	14:18:01	635.9	13.4
08/21/24	14:19:01	543.8	3.7
08/21/24	14:20:01	603.2	12.1
08/21/24	14:21:01	544.3	6.0
08/21/24	14:22:01	595.3	13.1
08/21/24	14:23:01	534.2	3.6
08/21/24	14:24:01	587.2	11.9
08/21/24	14:25:01	540.7	5.6
08/21/24	14:26:01	590.6	13.0
08/21/24	14:27:01	549.3	3.7
08/21/24	14:28:01	595.5	12.1
08/21/24	14:29:01	564.5	5.8
08/21/24	14:30:01	607.1	13.1
08/21/24	14:31:01	944.5	4.6
08/21/24	14:32:01	711.3	13.1
08/21/24	14:33:01	594.5	6.8
08/21/24	14:34:01	637.3	14.0
08/21/24	14:35:01	596.4	4.0
08/21/24	14:36:01	802.3	13.3
08/21/24	14:37:01	733.9	7.7
08/21/24	14:38:01	764.0	14.7
08/21/24	14:39:01	652.0	4.5
08/21/24	14:40:01	763.1	12.6
08/21/24	14:41:01	629.2	6.0
08/21/24	14:42:01	782.9	14.1
08/21/24	14:43:01	652.3	4.3
08/21/24	14:44:01	776.1	12.7
08/21/24	14:45:01	689.7	6.2
08/21/24	14:46:01	736.9	13.6
08/21/24	14:47:01	712.0	4.3
08/21/24	14:48:01	703.6	12.7
08/21/24	14:49:01	736.9	6.4
08/21/24	14:50:01	674.0	13.2
08/21/24	14:51:01	735.8	4.4
08/21/24	14:52:01	679.4	12.6
08/21/24	14:53:01	732.3	6.5
08/21/24	14:54:01	718.0	13.2
08/21/24	14:55:01	691.9	4.4
08/21/24	14:56:01	798.6	12.6
08/21/24	14:57:01	356.1	4.8
08/21/24	14:58:01	445.9	11.3
08/21/24	14:59:01	625.7	3.2
08/21/24	15:00:01	746.6	11.9
08/21/24	15:01:01	682.3	6.4
08/21/24	15:02:01	812.6	13.4
08/21/24	15:03:01	702.2	4.3
08/21/24	15:04:01	767.9	12.4
08/21/24	15:05:01	733.8	6.2
08/21/24	15:06:01	706.3	12.7
08/21/24	15:07:01	767.7	4.3
08/21/24	15:08:01	706.0	12.1
08/21/24	15:09:01	803.5	6.7
08/21/24	15:10:01	686.3	12.7
08/21/24	15:11:01	792.9	4.4
08/21/24	15:12:01	690.2	12.2

Sample 3 Average 673.1 9.0

Harbor Foam
Grandville, MI
RTO
Sample # 4
Start Time 15:55:28
Date 08/21/24

Date	Time	IN THC PPM	OUT THC PPM
08/21/24	15:55:28	708.7	3.8
08/21/24	15:56:28	717.3	14.3
08/21/24	15:57:28	714.6	5.6
08/21/24	15:58:28	719.2	13.4
08/21/24	15:59:28	715.6	3.7
08/21/24	16:00:28	718.4	15.2
08/21/24	16:01:28	735.0	5.6
08/21/24	16:02:28	683.5	13.1
08/21/24	16:03:28	773.9	3.6
08/21/24	16:04:28	633.7	14.1
08/21/24	16:05:28	798.9	5.7
08/21/24	16:06:28	627.1	13.5
08/21/24	16:07:28	808.5	3.8
08/21/24	16:08:28	616.9	13.6
08/21/24	16:09:28	795.1	6.0
08/21/24	16:10:28	637.9	13.2
08/21/24	16:11:28	794.1	3.8
08/21/24	16:12:28	662.1	13.1
08/21/24	16:13:28	779.4	5.9
08/21/24	16:14:28	719.3	12.9
08/21/24	16:15:28	713.3	3.8
08/21/24	16:16:28	730.6	13.8
08/21/24	16:17:28	703.3	5.8
08/21/24	16:18:28	626.5	12.3
08/21/24	16:19:28	668.8	3.7
08/21/24	16:20:28	656.7	13.2
08/21/24	16:21:28	660.8	5.7
08/21/24	16:22:28	656.2	12.1
08/21/24	16:23:28	666.0	3.7
08/21/24	16:24:28	642.6	12.5
08/21/24	16:25:28	691.7	5.6
08/21/24	16:26:28	781.1	13.5
08/21/24	16:27:28	762.9	3.7
08/21/24	16:28:28	727.5	13.9
08/21/24	16:29:28	780.0	5.8
08/21/24	16:30:28	722.8	12.3
08/21/24	16:31:28	797.6	3.9
08/21/24	16:32:28	698.1	12.4
08/21/24	16:33:28	807.8	5.9
08/21/24	16:34:28	717.8	11.5
08/21/24	16:35:28	823.2	4.1
08/21/24	16:36:28	751.6	12.2
08/21/24	16:37:28	777.2	6.2
08/21/24	16:38:28	797.7	11.5
08/21/24	16:39:28	735.1	4.0
08/21/24	16:40:28	805.7	13.3
08/21/24	16:41:28	729.2	6.2
08/21/24	16:42:28	806.9	17.6
08/21/24	16:43:28	730.9	4.0
08/21/24	16:44:28	830.2	15.9
08/21/24	16:45:28	738.7	6.2
08/21/24	16:46:28	802.9	15.6
08/21/24	16:47:28	765.6	3.8
08/21/24	16:48:28	753.2	15.0
08/21/24	16:49:28	804.9	6.1
08/21/24	16:50:28	719.3	13.5
08/21/24	16:51:28	829.6	4.0
08/21/24	16:52:28	697.2	14.2
08/21/24	16:53:28	695.7	5.7
08/21/24	16:54:28	652.4	12.1
Sample 4 Average		730.3	9.2

APPENDIX C

ANALYZER & CALIBRATION GAS SPECIFICATIONS



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DocNumber: 538581



Linde Gas & Equipment Inc.
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Fax: +1 (419) 729-2411
PGVP ID: F12023

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

LGEPKG GRAND RAPIDS MI HS
1000 SCRIBNER AVE NW
GRAND RAPIDS MI 49504-4212

Certificate Issuance Date: 04/19/2023

Linde Order Number: 72414631

Part Number: NI PR30ME-AS

Customer PO Number: 80422912

Fill Date: 04/12/2023

Lot Number: 700013102UB

Cylinder Style & Outlet: AS

CGA 350

Cylinder Pressure and Volume: 2000 psig 140 ft³

Certified Concentration

Expiration Date:	04/19/2031	NIST Traceable
Cylinder Number:	CC149173	Expanded Uncertainty
29.9 ppm	Propane	± 0.2 ppm
Balance	Nitrogen	

ProSpec EZ Cert



Certification Information:

Certification Date: 04/19/2023

Term: 96 Months

Expiration Date: 04/19/2031

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Uncertainty above is expressed as absolute expanded uncertainty at a level of confidence of approximately 95% with a coverage factor k = 2. Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component: Propane

Requested Concentration: 30.0 ppm
Certified Concentration: 29.9 ppm
Instrument Used: MKS 2030
Analytical Method: FTIR
Last Multipoint Calibration: 04/07/2023

Reference Standard:

Type / Cylinder #: GMIS / CC147213

Concentration / Uncertainty: 50.0 ppm ± 0.1 ppm

Expiration Date: 07/02/2026

Traceable to: SRM # / Sample # / Cylinder #: 1667b / 83-K-25 / FF55547

SRM Concentration / Uncertainty: 49.61 PPM / ± 0.11 PPM

SRM Expiration Date: 07/01/2024

First Analysis Data:				Date
				04/19/2023
Z:	0	R:	49	C:
R:	48.8	Z:	0	C:
Z:	0	C:	29.3	R:
UOM:	ppm	Mean Test Assay:	29.9	ppm

Second Analysis Data:				Date
Z:	0	R:	0	C:
R:	0	Z:	0	C:
Z:	0	C:	0	R:
UOM:	ppm	Mean Test Assay:		ppm

Analyzed By

Mike Monnette

Certified By

Edward E. Zucal

DocNumber: 235415



Praxair Distribution, Inc.
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Fax: +1 (419) 729-2411
PGVP ID: F12019

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PRAXAIR PKG SOUTH BEND IN HP
59624 LINDEN RD
SOUTH BEND IN 46614

Certificate Issuance Date: 02/19/2019

Praxair Order Number: 70877394

Part Number: EV NIPR50ME-AS

Fill Date: 02/11/2019

Lot Number: 700019042GC

Cylinder Style & Outlet: AS CGA 350

Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

Expiration Date:	02/15/2027	NIST Traceable
Cylinder Number:	SA20657	Expanded Uncertainty
50.6 ppm	Propane	± 0.4 %
Balance	Nitrogen	

ProSpec EZ Cert



Certification Information:

Certification Date: 02/15/2019

Term: 96 Months

Expiration Date: 02/15/2027

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1.

Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component: Propane

Requested Concentration: 50.0 ppm

Certified Concentration: 50.6 ppm

Instrument Used: MKS 2030

Analytical Method: FTIR

Last Multipoint Calibration: 01/23/2019

Reference Standard:

Type / Cylinder #: GMIS / CC198808

Concentration / Uncertainty: 50.0 ppm ±0.3%

Expiration Date: 03/08/2026

Traceable to: SRM # / Sample # / Cylinder #: 1667b / 83-K-25 / FF55547

SRM Concentration / Uncertainty: 49.61 PPM / ±0.19 ppm

SRM Expiration Date: 07/01/2024

First Analysis Data:				Date
Z:	0	R:	49.71	C: 50.35
R:	49.8	Z:	0	C: 50.36
Z:	0	C:	50.35	R: 49.74
UOM: ppm				Mean Test Assay: 50.6 ppm

Second Analysis Data:				Date
Z:	0	R:	0	C: 0
R:	0	Z:	0	C: 0
Z:	0	C:	0	R: 0
UOM: ppm				Mean Test Assay: ppm

Analyzed By

Mike Monnette

Certified By

Edward E. Zucal



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DocNumber: 538582



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PGVP ID: F12023

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

LGEPKG GRAND RAPIDS MI HS
1000 SCRIBNER AVE NW
GRAND RAPIDS MI 49504-4212

Certificate Issuance Date: 04/20/2023

Linde Order Number: 72414631

Part Number: NI PR95ME-AS

Customer PO Number: 80422912

Fill Date: 04/12/2023

Lot Number: 700013102U1

Cylinder Style & Outlet: AS CGA 350

Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

Expiration Date:	04/19/2031	NIST Traceable
Cylinder Number:	CC187237	Expanded Uncertainty
95.0 ppm	Propane	± 0.3 ppm
Balance	Nitrogen	

ProSpec EZ Cert



Certification Information:

Certification Date: 04/19/2023

Term: 96 Months

Expiration Date: 04/19/2031

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Uncertainty above is expressed as absolute expanded uncertainty at a level of confidence of approximately 95% with a coverage factor $k = 2$. Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component:

Propane

Requested Concentration: 95.0 ppm

Certified Concentration: 95.0 ppm

Instrument Used: MKS 2030

Analytical Method: FTIR

Last Multipoint Calibration: 04/07/2023

Reference Standard:

Type / Cylinder #: GMIS / CC167694

Concentration / Uncertainty: 100.9 ppm ±0.3 ppm

Expiration Date: 07/06/2026

Traceable to: SRM # / Sample # / Cylinder #: 1668b / 82-K-12 / CAL017534

SRM Concentration / Uncertainty: 98.74 ppm / ±0.23 ppm

SRM Expiration Date: 09/09/2019

First Analysis Data:				Date	04/19/2023
Z:	0	R:	98.3	C:	92.5
R:	98.4	Z:	0	C:	92.6
Z:	0	C:	92.5	R:	98
UOM: ppm				Mean Test Assay:	95 ppm

Second Analysis Data:				Date	
Z:	0	R:	0	C:	0
R:	0	Z:	0	C:	0
Z:	0	C:	0	R:	0
UOM: ppm				Mean Test Assay:	ppm

Analyzed By

Mike Monnette

Certified By

Edward E Zucal



CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PRAXAIR PKG SOUTH BEND IN HP
59624 LINDEN RD
SOUTH BEND IN 46614

Certificate Modification Date: 08/13/2018

Praxair Order Number: 70689643

Part Number: NI PR490E-AS

Fill Date: 08/07/2018

Lot Number: 700018219UI

Cylinder Style & Outlet: AS

CGA 350

Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

Expiration Date:	08/13/2026	NIST Traceable
Cylinder Number:	CC154544	Expanded Uncertainty
491 ppm	Propane	± 0.9 %
Balance	Nitrogen	

ProSpec EZ Cert



Certification Information:

Certification Date: 08/13/2018

Term: 96 Months

Expiration Date: 08/13/2026

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1.

Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component: Propane

Requested Concentration: 490 ppm
Certified Concentration: 491 ppm
Instrument Used: MKS 2030
Analytical Method: FTIR
Last Multipoint Calibration: 07/31/2018

Reference Standard: Type / Cylinder #: GMS / EB0022810

Concentration / Uncertainty: 504 ppm ±0.8%

Expiration Date: 07/21/2025

Traceable to: SRM # / Sample # / Cylinder #: 1669b / 81-H-24 / XF003689B

SRM Concentration / Uncertainty: 488 PPM / ±4.1 PPM

SRM Expiration Date: 07/12/2015

First Analysis Data:				Date
Z:	0	R:	363	08/13/2018
C:	354	Conc:	491	
R:	363	Z:	0	
C:	354	Conc:	491	
Z:	0	C:	353	
R:	364	Conc:	490	
UOM:	ppm	Mean Test Assay:	491	ppm

Second Analysis Data:				Date
Z:	0	R:	0	
C:	0	Conc:	0	
R:	0	Z:	0	
C:	0	Conc:	0	
Z:	0	C:	0	
R:	0	Conc:	0	
UOM:	ppm	Mean Test Assay:		ppm

Analyzed By

Mike Monnette

Certified By

Edward E Zucal

DocNumber: 316679



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PGVP ID: F12020

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

PRAXAIR PKG GRAND RAPIDS MI HS
1000 SCRIBNER AVE NW
GRAND RAPIDS MI 49504-4212

Certificate Issuance Date: 10/29/2020

Praxair Order Number: 71490088

Part Number: NI PR980E-AS

Customer PO Number: 79484452

Fill Date: 10/15/2020

Lot Number: 700010289FA

Cylinder Style & Outlet: AS CGA 350

Cylinder Pressure and Volume: 2000 psig 140 ft3

Certified Concentration

Expiration Date:	10/28/2028	NIST Traceable
Cylinder Number:	DT0032897	Expanded Uncertainty
991 ppm	Propane	± 0.2 %
Balance	Nitrogen	

ProSpec EZ Cert



Certification Information:

Certification Date: 10/28/2020

Term: 96 Months

Expiration Date: 10/28/2028

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Uncertainty above is expressed as relative expanded uncertainty at a level of confidence of approximately 95% with a coverage factor $k = 2$. Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component:

Propane

Requested Concentration: 990 ppm
Certified Concentration: 991 ppm
Instrument Used: MKS 2031
Analytical Method: FTIR
Last Multipoint Calibration: 10/28/2020

Reference Standard:

Type / Cylinder #: GMIS / EB0029347

Concentration / Uncertainty: 1015 ppm ±0.21%

Expiration Date: 05/25/2024

Traceable to: SRM # / Sample # / Cylinder #: 2646a / 100-C-40 / XF000887B

SRM Concentration / Uncertainty: 979.1 / ± 6.6 PPM

SRM Expiration Date: 03/04/2019

First Analysis Data:				Date
Z:	-0.14	R:	1334	10/28/2020
R:	1335	Z:	-0.77	
C:	1304	C:	1299	
Z:	-0.89	R:	1335	
C:	1305	C:	1304	
UOM: ppm				
Mean Test Assay: 991 ppm				

Second Analysis Data:				Date
Z:	0	R:	0	
R:	0	Z:	0	
C:	0	C:	0	
Z:	0	R:	0	
C:	0	C:	0	
UOM: ppm				
Mean Test Assay: ppm				

Analyzed By

Mike Monnette

Certified By

Edward E Zucal



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DocNumber: 488651



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PGVP ID: F12022

CERTIFICATE OF ANALYSIS / EPA PROTOCOL GAS

Customer & Order Information

LGEPKG GRAND RAPIDS MI HS
1000 SCRIBNER AVE NW
GRAND RAPIDS MI 49504-4212

Certificate Issuance Date: 07/14/2022

Lindo Order Number: 72128034

Part Number: NI PR2000E-AS

Customer PO Number: 80132152

Fill Date: 07/05/2022

Lot Number: 700012186UF

Cylinder Style & Outlet: AS CGA 350

Cylinder Pressure and Volume: 2000 psig 144 ft3

Certified Concentration

Expiration Date:	07/14/2030	NIST Traceable
Cylinder Number:	SA11292	Expanded Uncertainty
2000 ppm	Propane	± 12 ppm
Balance	Nitrogen	

ProSpec EZ Cert



Certification Information:

Certification Date: 07/14/2022

Term: 96 Months

Expiration Date: 07/14/2030

This cylinder was certified according to the 2012 EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. Uncertainty above is expressed as absolute expanded uncertainty at a level of confidence of approximately 95% with a coverage factor k = 2. Do Not Use this Standard if Pressure is less than 100 PSIG.

Analytical Data:

(R=Reference Standard, Z=Zero Gas, C=Gas Candidate)

1. Component:

Propane

Requested Concentration: 2000 ppm

Certified Concentration: 2000 ppm

Instrument Used: MKS 2031

Analytical Method: FTIR

Last Multipoint Calibration: 06/15/2022

Reference Standard:

Type / Cylinder #: GMIS / EB0005645

Concentration / Uncertainty: 2505 ppm ±14 ppm

Expiration Date: 12/08/2023

Traceable to: SRM # / Sample # / Cylinder #: 2647a / 104-C-37 / XF000216B

SRM Concentration / Uncertainty: 2467 ppm / ±13.0 ppm

SRM Expiration Date: 05/02/2024

First Analysis Data:				Date	07/14/2022
Z: 0	R: 2395	C: 1912	Conc: 1999		
R: 2398	Z: 0	C: 1914	Conc: 2001		
Z: 0	C: 1915	R: 2396	Conc: 2002		
UOM: ppm				Mean Test Assay: 2000 ppm	

Second Analysis Data:				Date	
Z: 0	R: 0	C: 0	Conc: 0		
R: 0	Z: 0	C: 0	Conc: 0		
Z: 0	C: 0	R: 0	Conc: 0		
UOM: ppm				Mean Test Assay: ppm	

Analyzed By

Kanykey Karabaeva

Certified By

Edward E Zucal

Information contained herein has been prepared at your request by qualified experts within Linde Gas & Equipment Inc. While we believe that the information is accurate within the limits of the analytical methods employed and is complete to the extent of the specific analyses performed, we make no warranty or representation as to the suitability of the use of the information for any purpose. The information is offered with the understanding that any use of the information is at the sole discretion and risk of the user. In no event shall the liability of Linde Gas & Equipment Inc., arising out of the use of the information contained herein exceed the fee established for providing such information.



Users Manual

***Please read this manual
thoroughly and follow all
warnings and instructions!***



WARNING



A person who has not read and does not understand all operating instructions is not qualified to operate this instrument. Failure to read and understand safety instructions and warnings can result in injury or death!

J.U.M. Engineering Ges.m.b.H., the manufacturer, assumes no responsibility, directly or indirectly, for financial losses or claims from third parties resulting from the use of this product in any of its operations.

Information provided in this manual is subject to change without notice.

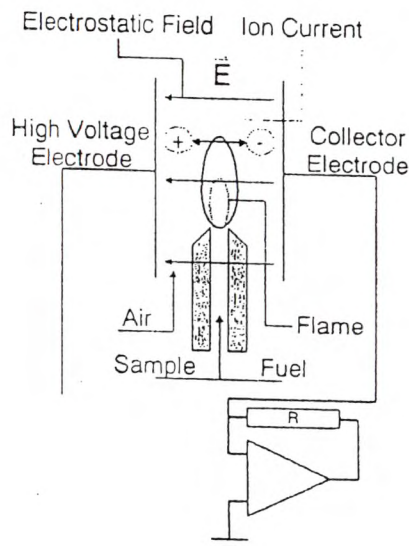
J.U.M. FID Model 3-500
Users Manual

3. The FID Principle

All J.U.M. Engineering heated total hydrocarbon analyzers, our non-methane hydrocarbon analyzer and our non-methane/non-ethane hydrocarbon analyzer use the Flame Ionization Detection (FID) method to determine the presence of total hydrocarbon concentrations in a gaseous sample:

Burning hydrocarbon-free hydrogen in hydrocarbon-free air produces a negligible number of ions.

Once a sample containing hydrocarbons is introduced into this flame a very complex ionization process is started. This process creates a large number of ions. A high polarizing voltage is applied between the two electrodes around the burner nozzle and produces an electrostatic field. Now negative ions migrate to the collector electrode and positive ions migrate to the high voltage electrode. The so generated ionization current between the two electrodes is directly proportional to the hydrocarbon concentration in the sample that is burned by the flame. This signal is measured and amplified by our electrometer-unit.



Technical Data (cont.)

Oven

Heater	500 Watts
Temperature	190°C (374°F)
Temperature Sensor	Thermocouple Type "J" (Fe-CuNi)

Supply Gas Plumbing

Solenoid Valves	Brass
Plunger	Stainless Steel/Viton®
Seal	Viton® O-ring
Supply Voltage	24 VDC
Tubing	PA / Teflon® / Viton®
Fittings	Brass, Brass Ni-plated

Sample Gas Plumbing

Sample Inlet Fitting	Swagelok®, 1/4", 316 SS
Tubing	Stainless Steel 1.4571, 1/4" & 1/8"
Oven Fittings	Swagelok®, 1/4" & 1/8", 316 SS

Electrometer

Supply voltage	+/- 15 VDC
Input Impedance	$5 \times 10^{12} \Omega$
Noise	$5 \times 10^{-14} \text{ A}$
Electrical Drift	0,02% / Week
Sensitivity	10^{-12} A FSD

Signal Display

Supply Voltage	+5 VDC
6 digit	Engineering Unit

continued on next page

4. Description

The J.U.M. Flame Ionization Analyzer Model 3-500 is a heated analyzer designed to continuously measure the concentration of total organic hydrocarbons in a gaseous sample. The sample can be ambient air, or the exhaust gases from a combustion process etc. The measurement is obtained by using the Flame Ionization Detector (FID).

It meets the requirements for 2. BlmSchV, 13 BlmSchV and 17. BlmSchV and meets the requirements of EPA CFR 60 Method 25A and EPA CFR 40 Method 503.

The Model 3-500 is supplied in various versions through the use of options. The standard instrument has five total hydrocarbons measuring ranges: from 0-10 to 100,000 ppm with 10:1 decade range adjustment; Flame Out Indication on the front panel via dual color LED (red LED - flame is out, green LED - flame is lit); 0-10 VDC and 4-20 mA recorder outputs. Calibration gases are introduced into the analyzer through the sample inlet (overflow setup required! see also page 43).

A sample pressure regulator provides a controlled back pressure at the sample capillary which gives admittance of a constant sample flow rate to the burner. This technique without the conventional back pressure regulator is used by J.U.M. Engineering for over 30 years to provide the highest possible sample flow rate stability and lowest maintenance. Our compactly designed flow control module for controlling the fuel and air flow rates via needle valves use high precision pressure regulators. The needle valves are factory adjusted and sealed to ensure the optimization of the burner.

The Model 3-500 is specially cleaned at the factory, and "burned in" for 14 days under continuous operating conditions at 190°C (375°F), to remove any residual hydrocarbons in the piping system. Thus, when this instrument reaches the end user, it is totally hydrocarbon background free (less than 0.1 ppm background), so it is extremely important that you equip this analyzer with the highest grade, cleanest gas plumbing system available, in order to allow the analyzer to reach its full potential of measuring trace hydrocarbons.

15. Technical Data

Dimensions

Width	19" (483 mm)
Height	3 Panel Units (132 mm)
Depth	460 mm (18 1/8")
Weight	23 kg (50 lbs)

Line Voltage/Fuses

230 VAC/50 Hz	4 A medium
115 VAC/60 Hz	6.3 A medium

Sample Filter

Type	Single use cartridge
Material Filter	2 µm glass fiber
Seal	Viton® O-ring
Material Housing/Cap	Stainless Steel 1.4571
Inlet Fitting	Swagelok®, 1/4", 316 SS
Outlet Fitting	Swagelok®, 1/8", 316 SS

Sample Pump

Type	Diaphragm
Material Head	Stainless Steel 1.4571
Material Chamber	Stainless Steel 1.4571
Material Diaphragm	Viton®
Material Valves	Viton®
max. Flow (unrestricted)	2,5 Liters/Minute

Air Pump

Type	Diaphragm
Material Head	Polyamid 11
Material Chamber	Polyamid 11
Material Diaphragm	Viton®
Material Valves	Viton®
max. Flow (unrestricted)	2,5 Liters/Minute

continued on next page

Technical Data (cont.)

Detector

Dynamic Range	10 ⁶ to 10 ⁷
Sensitivity	1 ppb
Voltage	-300 VDC
Material Burner	Stainless Steel 1.4571
Material Nozzle	Stainless Steel 1.4571
Igniter	Platinum Coil 3V / 1A
O ₂ -Synergism	< 1.2%
Burner Air Flow	70 - 250 cc/min (depending on fuel gas)
Sample Flow	25 cc/min (standard analyzer)
Fuel Consumption 100% H ₂ ..	17 - 25 cc/min
Fuel Consumption 60%He/40%H ₂ (Option)	80 - 120 cc/min

Measuring ranges

5 Ranges (ppm, o. mgC/m ³)	10/100/1.000/10.000/100.000
6 Ranges (ppm, o. mgC/m ³)	25/100/250/1.000/2.500/10.000
Other Range Configuration ..	Upon Request, see page 38

Signal Output

Voltage	0-10 VDC (or 0-5 VDC instead or 0-1 VDC instead; see page 38)
Current	either 4-20 mA (Standard), or 0-20 mA instead (Option; see page 38)
Serial (ASCII)	RS 232 output

Supply Gases

Fuel Gas	1,5 bar (0.15 MPa, 21 psig)
Span Gas	1 bar (0.1 MPa, 15 psig) @ 2.8-3.3 liters/minute free overflow
Zero Gas	1 bar (0.1 MPa, 15 psig) @ 2.8-3.3 liters/minute free overflow
Sample	NO PRESSURE!

Analyzer Results

Response Time (90% FSD) ..	< 1.2 seconds
Linearity	Up to 10.000 ppm within 1% FSD

Viton* is a registered trademark of DuPont Dow Elastomers; Teflon* is a registered trademark of DuPont; Swagelok* is a registered trademark of the Crawford Fitting Company