

VERSION: 2.4

4/15/2010

Manufacturer: Arada

Model: Farrington 16

Date: 2/21/2017

Run: 2

Control #: 035-S-075-1

Test Duration: 310

Burn Category 1

Wood Moisture (% DRY):

20.3

Wood Moisture (% wet):

16.87

Load Weight (lb wet):

10.60

Burn Rate (dry kg/h):

0.77

Total Particulate Emissions:

5.49

g

Appliance Type:

Cat

(Cat, Non-Cat, Pe

Temp. Units

F

(F or C)

Weight Units

lb

(kg or lb)

Fuel Data

D. Fir

HHV

19,810

kJ/kg

%C

48.73

%H

6.87

%O

43.90

%Ash

0.50

Averages

210.9

70.0

9.89

10.70

0.08

Temp. (F)

Elapsed
Time (min)

Fuel Weight
Remaining (lb)

Flue
Gas

Room
Temp

Flue Gas Composition (%)
O2 CO2 CO

| | | | | | | |
|-----|------|-------|------|-------|-------|------|
| 0 | 10.6 | 229.0 | 70.0 | 14.76 | 5.07 | 0.01 |
| 10 | 9.9 | 244.0 | 70.0 | 13.89 | 6.46 | 0.04 |
| 20 | 9.3 | 233.0 | 70.0 | 11.01 | 9.85 | 0.03 |
| 30 | 8.7 | 234.0 | 70.0 | 11.71 | 9.05 | 0.03 |
| 40 | 8.2 | 230.0 | 70.0 | 10.41 | 10.67 | 0.02 |
| 50 | 7.5 | 249.0 | 69.0 | 5.09 | 15.49 | 1.49 |
| 60 | 6.6 | 264.0 | 70.0 | 5.79 | 15.31 | 0.23 |
| 70 | 5.8 | 270.0 | 70.0 | 5.88 | 15.34 | 0.09 |
| 80 | 5.1 | 270.0 | 70.0 | 6.19 | 14.90 | 0.10 |
| 90 | 4.4 | 262.0 | 70.0 | 7.85 | 12.96 | 0.01 |
| 100 | 4.0 | 246.0 | 71.0 | 6.93 | 13.48 | 0.16 |
| 110 | 3.6 | 248.0 | 71.0 | 9.60 | 10.92 | 0.04 |
| 120 | 3.3 | 237.0 | 70.0 | 10.05 | 10.58 | 0.02 |
| 130 | 3.0 | 226.0 | 70.0 | 10.24 | 10.32 | 0.02 |
| 140 | 2.8 | 217.0 | 70.0 | 10.45 | 10.15 | 0.02 |
| 150 | 2.6 | 212.0 | 70.0 | 9.56 | 10.99 | 0.02 |
| 160 | 2.3 | 208.0 | 70.0 | 9.40 | 11.31 | 0.01 |
| 170 | 2.0 | 207.0 | 70.0 | 9.67 | 11.19 | 0.01 |
| 180 | 1.8 | 206.0 | 70.0 | 10.06 | 10.55 | 0.02 |
| 190 | 1.7 | 197.0 | 70.0 | 10.37 | 10.09 | 0.02 |
| 200 | 1.5 | 189.0 | 70.0 | 10.41 | 9.98 | 0.01 |
| 210 | 1.4 | 184.0 | 70.0 | 10.70 | 9.64 | 0.01 |
| 220 | 1.3 | 179.0 | 70.0 | 10.79 | 9.57 | 0.01 |
| 230 | 1.2 | 175.0 | 70.0 | 9.68 | 10.95 | 0.02 |
| 240 | 1.0 | 173.0 | 70.0 | 9.99 | 10.43 | 0.02 |
| 250 | 0.8 | 172.0 | 70.0 | 10.20 | 10.20 | 0.01 |
| 260 | 0.8 | 169.0 | 70.0 | 10.62 | 9.75 | 0.02 |
| 270 | 0.5 | 179.0 | 70.0 | 10.99 | 9.59 | 0.02 |
| 280 | 0.4 | 169.0 | 70.0 | 11.42 | 9.05 | 0.01 |
| 290 | 0.3 | 162.0 | 70.0 | 11.37 | 9.01 | 0.02 |
| 300 | 0.1 | 156.0 | 70.0 | 10.77 | 9.62 | 0.01 |
| 310 | 0.0 | 153.0 | 70.0 | 10.53 | 9.87 | 0.02 |

ellet)

☒ Dougla

☐ Oak

Manufacturer: Arada
 Model: Farringdon 16
 Date: 2/21/2017
 Run: 2
 Control #: 035-S-075-1
 Test Duration: 310 min

| | HHV | LHV |
|-----------------|--------|-------|
| Eff | 83.4% | 90.1% |
| Comb Eff | 99.3% | 99.3% |
| HT Eff | 83.9% | 90.7% |
| Output | 12,781 | kJ/h |
| Burn Rate | 0.77 | kg/h |
| Grams CO | 49 | g |
| Input | 15,329 | kJ/h |
| MC wet | 16.87 | |
| Averages | 0.08 | 10.70 |

Ultimate CO:
 CO2-ult 19.64
 Fo
 1.062

| INPUT DATA | | | | Oxygen Calculation | | | Input |
|--------------|-----------------------|----------|-----------|--------------------|----------|----------------|---------------|
| Elapsed Time | Weight Remaining (kg) | % CO [e] | % CO2 [d] | Excess Air EA | Total O2 | Calc. % O2 [g] | Flue Gas (°C) |
| 0 | 4.81 | 0.01 | 5.07 | 286.7% | 20.60 | 15.53 | 109.4 |
| 10 | 4.49 | 0.04 | 6.46 | 202.2% | 20.51 | 14.03 | 117.8 |
| 20 | 4.22 | 0.03 | 9.85 | 98.8% | 20.29 | 10.42 | 111.7 |
| 30 | 3.95 | 0.03 | 9.05 | 116.3% | 20.34 | 11.28 | 112.2 |
| 40 | 3.72 | 0.02 | 10.67 | 83.8% | 20.23 | 9.55 | 110.0 |
| 50 | 3.40 | 1.49 | 15.49 | 15.7% | 19.82 | 3.58 | 120.6 |
| 60 | 2.99 | 0.23 | 15.31 | 26.4% | 19.91 | 4.49 | 128.9 |
| 70 | 2.63 | 0.09 | 15.34 | 27.3% | 19.92 | 4.54 | 132.2 |
| 80 | 2.31 | 0.10 | 14.90 | 31.0% | 19.95 | 5.00 | 132.2 |
| 90 | 2.00 | 0.01 | 12.96 | 51.4% | 20.08 | 7.12 | 127.8 |
| 100 | 1.81 | 0.16 | 13.48 | 44.0% | 20.04 | 6.48 | 118.9 |
| 110 | 1.63 | 0.04 | 10.92 | 79.2% | 20.22 | 9.28 | 120.0 |
| 120 | 1.50 | 0.02 | 10.58 | 85.3% | 20.24 | 9.65 | 113.9 |
| 130 | 1.36 | 0.02 | 10.32 | 90.0% | 20.26 | 9.93 | 107.8 |
| 140 | 1.27 | 0.02 | 10.15 | 93.1% | 20.27 | 10.11 | 102.8 |
| 150 | 1.18 | 0.02 | 10.99 | 78.4% | 20.21 | 9.21 | 100.0 |
| 160 | 1.04 | 0.01 | 11.31 | 73.5% | 20.19 | 8.88 | 97.8 |
| 170 | 0.91 | 0.01 | 11.19 | 75.4% | 20.20 | 9.01 | 97.2 |
| 180 | 0.82 | 0.02 | 10.55 | 85.8% | 20.24 | 9.68 | 96.7 |
| 190 | 0.77 | 0.02 | 10.09 | 94.3% | 20.27 | 10.17 | 91.7 |
| 200 | 0.68 | 0.01 | 9.98 | 96.6% | 20.28 | 10.30 | 87.2 |
| 210 | 0.64 | 0.01 | 9.64 | 103.6% | 20.30 | 10.66 | 84.4 |
| 220 | 0.59 | 0.01 | 9.57 | 105.0% | 20.31 | 10.73 | 81.7 |
| 230 | 0.54 | 0.02 | 10.95 | 79.1% | 20.22 | 9.26 | 79.4 |
| 240 | 0.45 | 0.02 | 10.43 | 88.0% | 20.25 | 9.81 | 78.3 |
| 250 | 0.36 | 0.01 | 10.20 | 92.4% | 20.27 | 10.06 | 77.8 |
| 260 | 0.36 | 0.02 | 9.75 | 101.1% | 20.29 | 10.53 | 76.1 |

| | | | | | | | |
|-----|------|------|------|--------|-------|-------|------|
| 270 | 0.23 | 0.02 | 9.59 | 104.4% | 20.31 | 10.71 | 81.7 |
| 280 | 0.18 | 0.01 | 9.05 | 116.8% | 20.34 | 11.29 | 76.1 |
| 290 | 0.14 | 0.02 | 9.01 | 117.5% | 20.34 | 11.32 | 72.2 |
| 300 | 0.05 | 0.01 | 9.62 | 104.0% | 20.30 | 10.68 | 68.9 |
| 310 | 0.00 | 0.02 | 9.87 | 98.6% | 20.29 | 10.41 | 67.2 |

| | | | | | |
|-----------------------------|-------|-----------------------------|--|--------|------|
| | | Air Fuel Ratio (A/F) | | | |
| Overall Heating Efficiency: | 83.4% | Dry Molecular Weight (Md) | | 30.09 | |
| Combustion Efficiency: | 99.3% | Dry Moles Exhaust Gas (Nr): | | 364.54 | %HC |
| Heat Transfer Efficiency: | 83.9% | Air Fuel Ratio (A/F) | | 10.46 | 0.88 |

Heat Output: 12,124 Btu/h 12,781 kJ/h
Heat Input: 14,541 Btu/h 15,329 kJ/h

2

Burn Duration: 5.166666667 h

Burn Rate: 1.7 lb/h 0.8 kg/h

Stack Temp: 210.3 Deg. F 99.1 Deg. C

| 21.1 | 99.8% | 84.5% | 84.4% | 11.6 | 1.60 | 66.83 | 0.04 | 66.83 |
|-----------|---------|----------|-------|-------|--------|----------|---------|----------|
| Data | Combust | Heat | Net | Air | Wet Wt | % Wet | Dry Wt. | % Dry |
| Room | Eff | Transfer | Eff | Fuel | Now | Consumed | Now | Consumed |
| Temp (°C) | % | % | % | Ratio | Wt | x | Wtdn | y |
| 21.1 | 100.7% | 78.6% | 79.2% | 23.4 | 4.81 | 0.00 | 4.00 | 0.00 |
| 21.1 | 100.1% | 79.9% | 80.0% | 18.3 | 4.49 | 6.60 | 3.73 | 6.60 |
| 21.1 | 100.1% | 83.4% | 83.5% | 12.0 | 4.22 | 12.26 | 3.51 | 12.26 |
| 21.1 | 100.1% | 82.9% | 83.0% | 13.1 | 3.95 | 17.92 | 3.28 | 17.92 |
| 21.1 | 100.1% | 84.0% | 84.1% | 11.1 | 3.72 | 22.64 | 3.09 | 22.64 |
| 20.6 | 92.7% | 84.5% | 78.3% | 6.9 | 3.40 | 29.25 | 2.83 | 29.25 |
| 21.1 | 98.8% | 84.5% | 83.5% | 7.7 | 2.99 | 37.74 | 2.49 | 37.74 |
| 21.1 | 99.6% | 84.4% | 84.0% | 7.7 | 2.63 | 45.28 | 2.19 | 45.28 |
| 21.1 | 99.5% | 84.2% | 83.8% | 7.9 | 2.31 | 51.89 | 1.92 | 51.89 |
| 21.1 | 100.1% | 83.8% | 83.9% | 9.2 | 2.00 | 58.49 | 1.66 | 58.49 |
| 21.7 | 99.1% | 84.5% | 83.8% | 8.7 | 1.81 | 62.26 | 1.51 | 62.26 |
| 21.7 | 99.9% | 83.5% | 83.4% | 10.8 | 1.63 | 66.04 | 1.36 | 66.04 |
| 21.1 | 100.1% | 83.7% | 83.8% | 11.2 | 1.50 | 68.87 | 1.24 | 68.87 |
| 21.1 | 100.1% | 84.0% | 84.1% | 11.5 | 1.36 | 71.70 | 1.13 | 71.70 |
| 21.1 | 100.1% | 84.2% | 84.3% | 11.7 | 1.27 | 73.58 | 1.06 | 73.58 |
| 21.1 | 100.1% | 84.8% | 84.8% | 10.8 | 1.18 | 75.47 | 0.98 | 75.47 |
| 21.1 | 100.2% | 85.0% | 85.2% | 10.5 | 1.04 | 78.30 | 0.87 | 78.30 |
| 21.1 | 100.2% | 85.0% | 85.2% | 10.6 | 0.91 | 81.13 | 0.75 | 81.13 |
| 21.1 | 100.1% | 84.8% | 84.9% | 11.2 | 0.82 | 83.02 | 0.68 | 83.02 |
| 21.1 | 100.1% | 85.0% | 85.1% | 11.8 | 0.77 | 83.96 | 0.64 | 83.96 |
| 21.1 | 100.2% | 85.2% | 85.4% | 11.9 | 0.68 | 85.85 | 0.57 | 85.85 |
| 21.1 | 100.2% | 85.3% | 85.5% | 12.3 | 0.64 | 86.79 | 0.53 | 86.79 |
| 21.1 | 100.2% | 85.5% | 85.7% | 12.4 | 0.59 | 87.74 | 0.49 | 87.74 |
| 21.1 | 100.1% | 86.1% | 86.2% | 10.8 | 0.54 | 88.68 | 0.45 | 88.68 |
| 21.1 | 100.1% | 86.0% | 86.1% | 11.4 | 0.45 | 90.57 | 0.38 | 90.57 |
| 21.1 | 100.2% | 86.0% | 86.2% | 11.6 | 0.36 | 92.45 | 0.30 | 92.45 |
| 21.1 | 100.1% | 85.9% | 86.1% | 12.2 | 0.36 | 92.45 | 0.30 | 92.45 |

| | | | | | | | | |
|------|--------|-------|-------|------|------|--------|------|--------|
| 21.1 | 100.2% | 85.5% | 85.6% | 12.4 | 0.23 | 95.28 | 0.19 | 95.28 |
| 21.1 | 100.3% | 85.7% | 85.9% | 13.1 | 0.18 | 96.23 | 0.15 | 96.23 |
| 21.1 | 100.2% | 86.0% | 86.1% | 13.2 | 0.14 | 97.17 | 0.11 | 97.17 |
| 21.1 | 100.2% | 86.4% | 86.6% | 12.3 | 0.05 | 99.06 | 0.04 | 99.06 |
| 21.1 | 100.1% | 86.6% | 86.7% | 12.0 | 0.00 | 100.00 | 0.00 | 100.00 |

Combustion Efficiency: 99.3%
 Total Input (kJ): 79,198 75,115 (Btu)
 Total Output (kJ): 66,033 62,629 (Btu)
 Efficiency: 83.4%
 Total CO (g): 49.06

Load Weight (kg):
 Fuel Heating:
 Value in kJ/kg - CV:

| 79571 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.73 | 21.15 | 2.65 |
|-----------------|--------------------|---------------------|--------------------|--------------------|------------------------------|-------------------------------------|-------|------|
| Fuel Properties | | | Oxygen /16= [c] | Calorific Value | Mw Moisture Fuel Burnt | Mass Balance (moles/100 mole dry | | |
| Total Input | Carbon /12= [a] | Hydrogen /1= [b] | | | | [h] | [u] | [w] |
| 0 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.39 | 21.06 | 1.25 |
| 7471 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.47 | 21.08 | 1.60 |
| 4483 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.70 | 21.14 | 2.43 |
| 4109 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.64 | 21.13 | 2.23 |
| 4483 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.76 | 21.16 | 2.63 |
| 5977 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.44 | 21.07 | 4.23 |
| 6351 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.97 | 21.21 | 3.83 |
| 5604 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 80.03 | 21.23 | 3.80 |
| 5230 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 80.00 | 21.22 | 3.70 |
| 4109 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.91 | 21.20 | 3.19 |
| 2989 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.88 | 21.19 | 3.36 |
| 2615 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.76 | 21.16 | 2.70 |
| 2241 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.75 | 21.15 | 2.61 |
| 1868 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.73 | 21.15 | 2.54 |
| 1494 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.72 | 21.15 | 2.50 |
| 1868 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.78 | 21.16 | 2.71 |
| 2241 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.80 | 21.17 | 2.78 |
| 1868 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.79 | 21.17 | 2.75 |
| 1121 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.75 | 21.15 | 2.60 |
| 1121 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.72 | 21.15 | 2.49 |
| 1121 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.71 | 21.14 | 2.46 |
| 747 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.69 | 21.14 | 2.37 |
| 747 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.69 | 21.14 | 2.36 |
| 1121 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.77 | 21.16 | 2.70 |
| 1494 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.74 | 21.15 | 2.57 |
| 747 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.73 | 21.15 | 2.51 |
| 1121 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.70 | 21.14 | 2.40 |

| | | | | | | | | |
|------|------|------|------|----------|-------|-------|-------|------|
| 1494 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.68 | 21.14 | 2.36 |
| 747 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.65 | 21.13 | 2.23 |
| 1121 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.65 | 21.13 | 2.22 |
| 1494 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.69 | 21.14 | 2.37 |
| 374 | 4.06 | 6.87 | 2.74 | 19810.00 | 16.87 | 79.70 | 21.14 | 2.43 |

Moisture Content MCwb: 16.87

Moisture of Wood (wet basis): 16.87
Initial Dry Weight Wtdo (kg): 4.00
Moisture Content Dry 20.30

Dry kg : 4.00
CA: 48.73
HY: 6.87
OX: 43.90

4.81
HHV LHV HHV LHV
19810.00 18328.69 Btu/lb 8522.48 7885.21

| | | | | | | | | |
|-----------|-------|-----------------------------|--------------------------|--------|------|-------|--------|-------|
| 9.12 | 0.00 | 0.26 | 40.62 | 40.23 | 0.23 | -0.03 | 318.43 | 34.59 |
| flue gas) | | kg Wood per 100 mole dfp | Moles per kg of Dry Wood | | | | | |
| [j] | [k] | Nk | CO2 | O2 | CO | HC | N2 | H2O |
| 4.32 | -0.02 | 0.12 | 40.92 | 125.34 | 0.08 | -0.19 | 640.79 | 34.90 |
| 5.52 | -0.02 | 0.16 | 40.67 | 88.32 | 0.25 | -0.11 | 500.26 | 34.73 |
| 8.37 | -0.01 | 0.24 | 40.74 | 43.11 | 0.12 | -0.05 | 329.63 | 34.63 |
| 7.70 | -0.01 | 0.22 | 40.74 | 50.76 | 0.14 | -0.06 | 358.53 | 34.65 |
| 9.06 | -0.01 | 0.26 | 40.78 | 36.52 | 0.08 | -0.05 | 304.85 | 34.62 |
| 14.12 | 0.21 | 0.42 | 36.77 | 8.51 | 3.54 | 0.50 | 188.58 | 33.52 |
| 13.11 | 0.03 | 0.38 | 40.14 | 11.77 | 0.60 | 0.07 | 209.67 | 34.38 |
| 13.05 | 0.01 | 0.38 | 40.56 | 11.99 | 0.24 | 0.02 | 211.61 | 34.49 |
| 12.68 | 0.01 | 0.37 | 40.52 | 13.60 | 0.27 | 0.02 | 217.57 | 34.49 |
| 10.98 | -0.01 | 0.32 | 40.81 | 22.42 | 0.03 | -0.03 | 251.65 | 34.59 |
| 11.52 | 0.01 | 0.33 | 40.30 | 19.37 | 0.48 | 0.04 | 238.79 | 34.45 |
| 9.28 | -0.01 | 0.27 | 40.70 | 34.57 | 0.15 | -0.03 | 297.27 | 34.59 |
| 8.98 | -0.01 | 0.26 | 40.78 | 37.20 | 0.08 | -0.05 | 307.42 | 34.62 |
| 8.76 | -0.01 | 0.25 | 40.78 | 39.23 | 0.08 | -0.05 | 315.11 | 34.63 |
| 8.62 | -0.01 | 0.25 | 40.79 | 40.62 | 0.08 | -0.05 | 320.34 | 34.63 |
| 9.33 | -0.01 | 0.27 | 40.78 | 34.19 | 0.07 | -0.04 | 296.04 | 34.61 |
| 9.59 | -0.01 | 0.28 | 40.82 | 32.04 | 0.04 | -0.05 | 288.04 | 34.62 |
| 9.49 | -0.01 | 0.27 | 40.82 | 32.85 | 0.04 | -0.05 | 291.11 | 34.62 |
| 8.96 | -0.01 | 0.26 | 40.78 | 37.43 | 0.08 | -0.05 | 308.29 | 34.62 |
| 8.57 | -0.01 | 0.25 | 40.79 | 41.12 | 0.08 | -0.05 | 322.24 | 34.63 |
| 8.47 | -0.02 | 0.24 | 40.83 | 42.12 | 0.04 | -0.06 | 326.15 | 34.65 |
| 8.18 | -0.02 | 0.24 | 40.84 | 45.15 | 0.04 | -0.07 | 337.59 | 34.66 |
| 8.12 | -0.02 | 0.23 | 40.84 | 45.80 | 0.04 | -0.07 | 340.04 | 34.66 |
| 9.29 | -0.01 | 0.27 | 40.78 | 34.47 | 0.07 | -0.04 | 297.11 | 34.61 |
| 8.85 | -0.01 | 0.26 | 40.78 | 38.36 | 0.08 | -0.05 | 311.81 | 34.62 |
| 8.65 | -0.01 | 0.25 | 40.83 | 40.27 | 0.04 | -0.06 | 319.16 | 34.64 |
| 8.28 | -0.01 | 0.24 | 40.79 | 44.07 | 0.08 | -0.06 | 333.39 | 34.64 |

| | | | | | | | | |
|------|-------|------|-------|-------|------|-------|--------|-------|
| 8.15 | -0.01 | 0.24 | 40.79 | 45.53 | 0.09 | -0.06 | 338.91 | 34.64 |
| 7.68 | -0.02 | 0.22 | 40.84 | 50.94 | 0.05 | -0.08 | 359.47 | 34.67 |
| 7.66 | -0.02 | 0.22 | 40.79 | 51.27 | 0.09 | -0.07 | 360.58 | 34.66 |
| 8.16 | -0.02 | 0.24 | 40.84 | 45.33 | 0.04 | -0.07 | 338.29 | 34.66 |
| 8.38 | -0.01 | 0.24 | 40.79 | 43.01 | 0.08 | -0.06 | 329.37 | 34.64 |

| 11.28 | 372.54 | 3074.27 | 2332.65 | 2273.02 | 2246.84 | 2917.74 | 2721.51 | 294.28 |
|---------------------|--------------------|--|---------|---------|---------|---------|---------|-------------------|
| Moisture Present | Stack Temp K | Heat Content Change - Ambient to Stack Temperature Flue Gas Constituent | | | | | | Room Temp K |
| | | CO2 | O2 | CO | N2 | CH4 | H2O | |
| 11.28 | 382.59 | 3476.31 | 2634.79 | 2566.72 | 2537.31 | 3305.69 | 3072.94 | 294.26 |
| 11.28 | 390.93 | 3815.94 | 2886.98 | 2811.12 | 2779.17 | 3640.11 | 3365.14 | 294.26 |
| 11.28 | 384.82 | 3566.68 | 2701.98 | 2631.85 | 2601.76 | 3394.49 | 3150.82 | 294.26 |
| 11.28 | 385.37 | 3589.29 | 2718.79 | 2648.14 | 2617.88 | 3416.73 | 3170.30 | 294.26 |
| 11.28 | 383.15 | 3498.89 | 2651.59 | 2583.00 | 2553.42 | 3327.87 | 3092.41 | 294.26 |
| 11.28 | 393.71 | 3950.75 | 2987.54 | 2908.68 | 2875.70 | 3771.85 | 3481.81 | 293.71 |
| 11.28 | 402.04 | 4271.92 | 3224.21 | 3137.59 | 3102.33 | 4092.04 | 3755.35 | 294.26 |
| 11.28 | 405.37 | 4409.41 | 3325.59 | 3235.66 | 3199.43 | 4228.97 | 3872.55 | 294.26 |
| 11.28 | 405.37 | 4409.41 | 3325.59 | 3235.66 | 3199.43 | 4228.97 | 3872.55 | 294.26 |
| 11.28 | 400.93 | 4226.16 | 3190.44 | 3104.91 | 3069.98 | 4046.54 | 3716.30 | 294.26 |
| 11.28 | 392.04 | 3840.22 | 2904.30 | 2827.73 | 2795.65 | 3665.57 | 3384.94 | 294.82 |
| 11.28 | 393.15 | 3885.69 | 2937.99 | 2860.35 | 2827.94 | 3710.52 | 3423.94 | 294.82 |
| 11.28 | 387.04 | 3657.19 | 2769.22 | 2697.02 | 2666.25 | 3483.56 | 3228.73 | 294.26 |
| 11.28 | 380.93 | 3408.62 | 2584.43 | 2517.89 | 2488.99 | 3239.28 | 3014.55 | 294.26 |
| 11.28 | 375.93 | 3206.05 | 2433.49 | 2371.48 | 2344.13 | 3040.96 | 2839.47 | 294.26 |
| 11.28 | 373.15 | 3093.82 | 2349.73 | 2290.20 | 2263.71 | 2931.39 | 2742.27 | 294.26 |
| 11.28 | 370.93 | 3004.20 | 2282.78 | 2225.21 | 2199.42 | 2844.05 | 2664.53 | 294.26 |
| 11.28 | 370.37 | 2981.82 | 2266.04 | 2208.97 | 2183.35 | 2822.26 | 2645.11 | 294.26 |
| 11.28 | 369.82 | 2959.45 | 2249.32 | 2192.73 | 2167.28 | 2800.48 | 2625.68 | 294.26 |
| 11.28 | 364.82 | 2758.48 | 2098.88 | 2046.63 | 2022.77 | 2605.28 | 2450.91 | 294.26 |
| 11.28 | 360.37 | 2580.46 | 1965.34 | 1916.89 | 1894.44 | 2432.94 | 2295.69 | 294.26 |
| 11.28 | 357.59 | 2469.49 | 1881.97 | 1835.86 | 1814.29 | 2325.79 | 2198.73 | 294.26 |
| 11.28 | 354.82 | 2358.74 | 1798.67 | 1754.86 | 1734.20 | 2219.07 | 2101.82 | 294.26 |
| 11.28 | 352.59 | 2270.30 | 1732.08 | 1690.10 | 1670.16 | 2134.01 | 2024.31 | 294.26 |
| 11.28 | 351.48 | 2226.13 | 1698.80 | 1657.73 | 1638.15 | 2091.58 | 1985.58 | 294.26 |
| 11.28 | 350.93 | 2204.06 | 1682.17 | 1641.55 | 1622.14 | 2070.39 | 1966.21 | 294.26 |
| 11.28 | 349.26 | 2137.91 | 1632.28 | 1593.01 | 1574.15 | 2006.93 | 1908.12 | 294.26 |

| | | | | | | | | |
|-------|--------|---------|---------|---------|---------|---------|---------|--------|
| 11.28 | 354.82 | 2358.74 | 1798.67 | 1754.86 | 1734.20 | 2219.07 | 2101.82 | 294.26 |
| 11.28 | 349.26 | 2137.91 | 1632.28 | 1593.01 | 1574.15 | 2006.93 | 1908.12 | 294.26 |
| 11.28 | 345.37 | 1983.86 | 1515.97 | 1479.82 | 1462.23 | 1859.46 | 1772.63 | 294.26 |
| 11.28 | 342.04 | 1852.17 | 1416.39 | 1382.86 | 1366.37 | 1733.73 | 1656.57 | 294.26 |
| 11.28 | 340.37 | 1786.45 | 1366.63 | 1334.41 | 1318.47 | 1671.10 | 1598.57 | 294.26 |

| SUMS | | | | | | | AVERAGE |
|-----------------------------------|---------|---------|----------|---------|----------|-------------|-----------------------|
| 3990.05 | 2896.47 | 2076.42 | 22498.54 | -902.71 | 51672.99 | 16850.22 | 3096.31 |
| Energy Losses (kJ/kg of Dry Fuel) | | | | | | | Total Loss Rate |
| Flue Gas Constituent | | | | | | | |
| CO2 | O2 | CO | N2 | CH4 | H2O Comb | H2O Fuel MC | |
| 142.26 | 330.26 | 23.05 | 1625.87 | -169.67 | 1641.88 | 530.53 | 4124.17 |
| 155.18 | 254.99 | 71.97 | 1390.32 | -94.20 | 1644.08 | 533.83 | 3956.15 |
| 145.30 | 116.48 | 35.44 | 857.61 | -45.81 | 1631.53 | 531.41 | 3271.97 |
| 146.23 | 138.00 | 38.58 | 938.58 | -55.38 | 1633.21 | 531.63 | 3370.84 |
| 142.70 | 96.83 | 21.83 | 778.40 | -42.54 | 1629.16 | 530.75 | 3157.14 |
| 145.28 | 25.42 | 1011.31 | 542.30 | 448.69 | 1590.49 | 535.14 | 4298.64 |
| 171.48 | 37.95 | 172.54 | 650.47 | 61.67 | 1640.99 | 538.23 | 3273.33 |
| 178.84 | 39.89 | 68.11 | 677.03 | 13.77 | 1650.14 | 539.55 | 3167.33 |
| 178.68 | 45.22 | 77.84 | 696.11 | 15.89 | 1649.92 | 539.55 | 3203.21 |
| 172.48 | 71.52 | 9.01 | 772.56 | -28.15 | 1649.22 | 537.79 | 3184.43 |
| 154.74 | 56.25 | 136.70 | 667.56 | 34.46 | 1631.13 | 534.05 | 3214.91 |
| 158.14 | 101.57 | 42.61 | 840.65 | -30.29 | 1639.34 | 534.49 | 3286.51 |
| 149.15 | 103.01 | 22.03 | 819.66 | -43.44 | 1633.98 | 532.29 | 3216.68 |
| 139.02 | 101.39 | 22.57 | 784.30 | -46.10 | 1626.84 | 529.87 | 3157.90 |
| 130.76 | 98.85 | 22.93 | 750.93 | -47.91 | 1620.97 | 527.90 | 3104.43 |
| 126.17 | 80.33 | 21.17 | 670.15 | -39.46 | 1616.72 | 526.80 | 3001.90 |
| 122.64 | 73.15 | 10.29 | 633.52 | -41.34 | 1614.23 | 525.93 | 2938.42 |
| 121.73 | 74.45 | 10.40 | 635.59 | -42.45 | 1613.67 | 525.71 | 2939.10 |
| 120.70 | 84.19 | 22.05 | 668.15 | -43.71 | 1613.13 | 525.49 | 2990.00 |
| 112.51 | 86.30 | 23.04 | 651.81 | -48.54 | 1607.58 | 523.52 | 2956.22 |
| 105.37 | 82.79 | 11.66 | 617.88 | -55.17 | 1602.90 | 521.77 | 2887.19 |
| 100.85 | 84.97 | 12.07 | 612.48 | -59.32 | 1599.97 | 520.67 | 2871.69 |
| 96.32 | 82.37 | 12.15 | 589.70 | -60.20 | 1596.70 | 519.58 | 2836.63 |
| 92.59 | 59.71 | 21.21 | 496.23 | -39.80 | 1591.91 | 518.71 | 2740.55 |
| 90.79 | 65.17 | 22.26 | 510.79 | -44.89 | 1591.10 | 518.27 | 2753.48 |
| 89.99 | 67.75 | 11.39 | 517.73 | -52.61 | 1591.22 | 518.05 | 2743.53 |
| 87.20 | 71.94 | 23.81 | 524.81 | -52.38 | 1589.18 | 517.40 | 2761.96 |

| | | | | | | | |
|-------|-------|-------|--------|--------|---------|--------|---------|
| 96.21 | 81.90 | 24.22 | 587.74 | -54.31 | 1596.09 | 519.58 | 2851.44 |
| 87.32 | 83.14 | 12.84 | 565.87 | -67.24 | 1590.71 | 517.40 | 2790.04 |
| 80.92 | 77.72 | 25.76 | 527.26 | -61.80 | 1585.46 | 515.87 | 2751.18 |
| 75.64 | 64.21 | 12.07 | 462.23 | -59.53 | 1581.20 | 514.56 | 2650.38 |
| 72.86 | 58.77 | 23.50 | 434.26 | -50.96 | 1578.32 | 513.90 | 2630.66 |

| SUMS | | | | | | |
|---------------|--------------------|-----------------------------|-----------------|----------------|----------------|-------|
| 13165 | 523 | 12642.26 | 66406 | 523 | 49.06 | 0.49 |
| Total Loss | Chemical Loss 1 | Sensible and Latent Loss | Total Output | Chem Loss 2 | Grams Produced | |
| | | | | | CO | HC |
| 0 | 0 | 0.00 | 0 | 0 | 0.00 | 0.00 |
| 1492 | -9 | 1500.60 | 5979 | -9 | 2.66 | -0.64 |
| 740 | -2 | 742.81 | 3742 | -2 | 0.79 | -0.19 |
| 699 | -4 | 702.75 | 3410 | -4 | 0.78 | -0.21 |
| 714 | -5 | 719.14 | 3768 | -5 | 0.48 | -0.17 |
| 1297 | 437 | 860.17 | 4680 | 437 | 29.88 | 2.42 |
| 1049 | 74 | 974.99 | 5301 | 74 | 5.41 | 0.35 |
| 896 | 23 | 873.01 | 4708 | 23 | 1.88 | 0.07 |
| 846 | 24 | 821.18 | 4384 | 24 | 2.01 | 0.08 |
| 661 | -4 | 664.53 | 3449 | -4 | 0.18 | -0.10 |
| 485 | 26 | 459.41 | 2504 | 26 | 2.02 | 0.09 |
| 434 | 2 | 432.25 | 2181 | 2 | 0.55 | -0.07 |
| 364 | -2 | 366.39 | 1877 | -2 | 0.24 | -0.09 |
| 298 | -2 | 299.98 | 1570 | -2 | 0.21 | -0.08 |
| 234 | -2 | 236.06 | 1260 | -2 | 0.17 | -0.06 |
| 283 | -2 | 284.78 | 1585 | -2 | 0.20 | -0.07 |
| 332 | -4 | 335.98 | 1909 | -4 | 0.11 | -0.08 |
| 277 | -3 | 280.14 | 1591 | -3 | 0.10 | -0.07 |
| 169 | -1 | 170.38 | 952 | -1 | 0.12 | -0.04 |
| 167 | -1 | 168.69 | 953 | -1 | 0.13 | -0.05 |
| 163 | -2 | 165.80 | 957 | -2 | 0.06 | -0.06 |
| 108 | -2 | 110.09 | 639 | -2 | 0.04 | -0.04 |
| 107 | -2 | 108.80 | 640 | -2 | 0.05 | -0.04 |
| 155 | -1 | 156.10 | 966 | -1 | 0.12 | -0.04 |
| 208 | -2 | 209.41 | 1287 | -2 | 0.17 | -0.06 |
| 103 | -2 | 105.03 | 644 | -2 | 0.04 | -0.04 |
| 156 | -2 | 157.87 | 964 | -2 | 0.13 | -0.05 |

| | | | | | | |
|-----|----|--------|------|----|------|-------|
| 215 | -2 | 217.36 | 1279 | -2 | 0.18 | -0.07 |
| 105 | -2 | 107.28 | 642 | -2 | 0.05 | -0.05 |
| 156 | -2 | 157.68 | 965 | -2 | 0.14 | -0.06 |
| 200 | -4 | 203.50 | 1294 | -4 | 0.09 | -0.08 |
| 50 | -1 | 50.13 | 324 | -1 | 0.04 | -0.02 |

Dirigo Laboratories, Inc.

Manufacturer: Arada
Model: Farringdon 16
Date: 2/21/2017
Run: 2
Control #: 035-S-075-1
Test Duration: 310
Output Category: 1

| | HHV Basis | LHV Basis |
|--------------------------|-----------|-----------|
| Overall Efficiency | 83.4% | 90.1% |
| Combustion Efficiency | 99.3% | 99.3% |
| Heat Transfer Efficiency | 83.9% | 90.7% |

| | | | |
|------------------------|--------|--------|---------|
| HHV Output Rate (kJ/h) | 12,781 | 12,124 | (Btu/h) |
| Burn Rate (kg/h) | 0.77 | 1.71 | (lb/h) |
| Input (kJ/h) | 15,329 | 14,541 | (Btu/h) |

| | | | |
|---------------------------|-------------|-----|--------|
| Test Load Weight (dry kg) | 4.0 | 8.8 | dry lb |
| MC wet (%) | 16.87 | | |
| MC dry (%) | 20.30 | | |
| Particulate (g) | 5.49 | | |
| CO (g) | 49 | | |
| Test Duration (h) | 5.166666667 | | |

| Emissions | Particulate | CO |
|------------------|-------------|-------|
| g/MJ Output | 0.08 | 0.74 |
| g/kg Dry Fuel | 1.37 | 12.27 |
| g/h | 1.06 | 9.49 |
| lb/MM Btu Output | 0.19 | 1.73 |

| | |
|----------------------|-------|
| Air/Fuel Ratio (A/F) | 10.46 |
|----------------------|-------|

Test Results in Accordance with CSA B415.1-10

Default Fuel Values

| | D. Fir | Oak |
|-------------|--------|--------|
| HHV (kJ/kg) | 19,810 | 19,887 |
| %C | 48.73 | 50 |
| %H | 6.87 | 6.6 |
| %O | 43.9 | 42.9 |
| %Ash | 0.5 | 0.5 |