

VERSION: 2.4

4/15/2010

Manufacturer: Arada

Appliance Type: Cat (Cat, Non-Cat, Pellet)

Model: Farrington 16

Date: 2/21/2017

Run: 4

Temp. Units: F (F or C)

Weight Units: lb (kg or lb)

Control #: 035-S-075-1

Test Duration: 190

Burn Category: 3

Wood Moisture (% DRY): 19.7

Wood Moisture (% wet): 16.46

Load Weight (lb wet): 10.80

Burn Rate (dry kg/h): 1.29

Total Particulate Emissions: 4.84 g

## Fuel Data

D. Fir

HHV: 19,810 kJ/kg

%C: 48.73

%H: 6.87

%O: 43.90

%Ash: 0.50

## Averages

357.1

68.2

11.14

9.63

0.43

Temp. (F)

Elapsed Time (min)	Fuel Weight Remaining (lb)	Flue Gas Temp (F)	Room Temp (F)	Flue Gas Composition (%)		
		O2	CO2	CO		
0	10.8	318.0	67.0	16.37	4.23	0.07
10	9.8	367.0	68.0	9.91	11.44	0.21
20	8.4	441.0	68.0	3.42	17.09	2.31
30	6.7	467.0	68.0	2.87	16.63	4.59
40	5.5	428.0	69.0	8.99	12.44	0.07
50	4.4	421.0	69.0	8.13	13.32	0.05
60	3.6	402.0	69.0	10.50	10.53	0.04
70	3.1	375.0	68.0	12.57	8.21	0.08
80	2.8	369.0	69.0	11.90	8.99	0.08
90	2.3	354.0	68.0	11.33	9.61	0.07
100	1.9	349.0	68.0	10.77	10.13	0.06
110	1.6	342.0	68.0	12.06	8.55	0.09
120	1.3	334.0	68.0	11.79	8.97	0.10
130	1.1	335.0	68.0	12.45	8.19	0.11
140	0.9	326.0	67.0	13.12	7.54	0.11
150	0.7	318.0	68.0	12.75	7.94	0.11
160	0.5	310.0	68.0	13.50	7.15	0.10
170	0.3	300.0	68.0	13.34	7.35	0.10
180	0.2	295.0	69.0	13.57	7.08	0.10
190	0.0	290.0	69.0	13.51	7.11	0.10

ellet)

☒ Dougla

☐ Oak

Manufacturer: Arada  
 Model: Farringdon 16  
 Date: 2/21/2017  
 Run: 4  
 Control #: 035-S-075-1  
 Test Duration: 190 min

	HHV	LHV
Eff	75.0%	81.0%
Comb Eff	95.8%	95.8%
HT Eff	78.3%	84.6%
Output	19,197	kJ/h
Burn Rate	1.29	kg/h
Grams CO	245	g
Input	25,609	kJ/h
MC wet	16.46	
<b>Averages</b>	0.43	9.63

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	4.90	0.07	4.23	356.8%	20.66	16.39	158.9
10	4.45	0.21	11.44	68.6%	20.17	8.63	186.1
20	3.81	2.31	17.09	1.3%	19.66	1.41	227.2
30	3.04	4.59	16.63	-7.4%	19.54	0.61	241.7
40	2.50	0.07	12.44	57.0%	20.11	7.64	220.0
50	2.00	0.05	13.32	46.9%	20.06	6.71	216.1
60	1.63	0.04	10.53	85.8%	20.24	9.69	205.6
70	1.41	0.08	8.21	136.9%	20.39	12.14	190.6
80	1.27	0.08	8.99	116.6%	20.34	11.31	187.2
90	1.04	0.07	9.61	102.9%	20.30	10.66	178.9
100	0.86	0.06	10.13	92.8%	20.27	10.11	176.1
110	0.73	0.09	8.55	127.3%	20.37	11.77	172.2
120	0.59	0.10	8.97	116.6%	20.34	11.32	167.8
130	0.50	0.11	8.19	136.7%	20.39	12.15	168.3
140	0.41	0.11	7.54	156.8%	20.43	12.84	163.3
150	0.32	0.11	7.94	144.0%	20.41	12.41	158.9
160	0.23	0.10	7.15	170.9%	20.46	13.26	154.4
170	0.14	0.10	7.35	163.7%	20.45	13.05	148.9
180	0.09	0.10	7.08	173.6%	20.47	13.34	146.1
190	0.00	0.10	7.11	172.4%	20.46	13.30	143.3

		Air Fuel Ratio (A/F)			
Overall Heating Efficiency:	75.0%	Dry Molecular Weight (Md)		29.96	
Combustion Efficiency:	95.8%	Dry Moles Exhaust Gas (Nr):		388.75	%HC
Heat Transfer Efficiency:	78.3%	Air Fuel Ratio (A/F)		11.14	0.88

Heat Output: 18,210 Btu/h 19,197 kJ/h  
Heat Input: 24,293 Btu/h 25,609 kJ/h

2

Burn Duration: 3.166666667 h

Burn Rate: 2.8 lb/h 1.3 kg/h

Stack Temp: 359.1 Deg. F 181.7 Deg. C

20.1	98.2%	77.6%	76.1%	13.3	1.50	69.49	0.03	69.49
<b>Data</b>	<b>Combust</b>	<b>Heat</b>	<b>Net</b>	<b>Air</b>	<b>Wet Wt</b>	<b>% Wet</b>	<b>Dry Wt.</b>	<b>% Dry</b>
<b>Room</b>	<b>Eff</b>	<b>Transfer</b>	<b>Eff</b>	<b>Fuel</b>	<b>Now</b>	<b>Consumed</b>	<b>Now</b>	<b>Consumed</b>
<b>Temp (°C)</b>	<b>%</b>	<b>%</b>	<b>%</b>	<b>Ratio</b>	<b>Wt</b>	<b>x</b>	<b>Wtdn</b>	<b>y</b>
19.4	99.7%	68.8%	68.7%	27.6	4.90	0.00	4.09	0.00
20.0	98.7%	79.4%	78.4%	10.2	4.45	9.26	3.71	9.26
20.0	90.1%	79.8%	71.9%	6.0	3.81	22.22	3.18	22.22
20.0	82.2%	78.4%	64.4%	5.3	3.04	37.96	2.54	37.96
20.6	99.7%	78.2%	77.9%	9.5	2.50	49.07	2.08	49.07
20.6	99.8%	79.0%	78.9%	8.9	2.00	59.26	1.67	59.26
20.6	99.9%	77.4%	77.4%	11.2	1.63	66.67	1.36	66.67
20.0	99.6%	75.7%	75.4%	14.3	1.41	71.30	1.18	71.30
20.6	99.6%	77.1%	76.8%	13.1	1.27	74.07	1.06	74.07
20.0	99.7%	78.3%	78.1%	12.3	1.04	78.70	0.87	78.70
20.0	99.8%	79.1%	78.9%	11.7	0.86	82.41	0.72	82.41
20.0	99.5%	77.7%	77.3%	13.7	0.73	85.19	0.61	85.19
20.0	99.4%	78.5%	78.1%	13.1	0.59	87.96	0.49	87.96
20.0	99.3%	77.5%	77.0%	14.3	0.50	89.81	0.42	89.81
19.4	99.3%	77.0%	76.4%	15.5	0.41	91.67	0.34	91.67
20.0	99.3%	78.0%	77.4%	14.7	0.32	93.52	0.27	93.52
20.0	99.4%	77.3%	76.8%	16.3	0.23	95.37	0.19	95.37
20.0	99.4%	78.1%	77.6%	15.9	0.14	97.22	0.11	97.22
20.6	99.4%	78.0%	77.5%	16.5	0.09	98.15	0.08	98.15
20.6	99.4%	78.3%	77.8%	16.4	0.00	100.00	0.00	100.00

Combustion Efficiency: 95.8%  
 Total Input (kJ): 81,097 76,916 (Btu)  
 Total Output (kJ): 60,790 57,656 (Btu)  
 Efficiency: 75.0%  
 Total CO (g): 244.76

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

81847	4.06	6.87	2.74	19810.00	16.46	79.51	21.09	2.49
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	16.46	79.31	21.04	1.05
12765	4.06	6.87	2.74	19810.00	16.46	79.72	21.15	2.87
11639	4.06	6.87	2.74	19810.00	16.46	79.19	21.00	4.86
10888	4.06	6.87	2.74	19810.00	16.46	78.17	20.73	5.39
8635	4.06	6.87	2.74	19810.00	16.46	79.85	21.18	3.08
7133	4.06	6.87	2.74	19810.00	16.46	79.92	21.20	3.29
4881	4.06	6.87	2.74	19810.00	16.46	79.74	21.15	2.60
3004	4.06	6.87	2.74	19810.00	16.46	79.57	21.11	2.04
3004	4.06	6.87	2.74	19810.00	16.46	79.62	21.12	2.23
3379	4.06	6.87	2.74	19810.00	16.46	79.66	21.13	2.38
2628	4.06	6.87	2.74	19810.00	16.46	79.70	21.14	2.51
2253	4.06	6.87	2.74	19810.00	16.46	79.59	21.11	2.13
1877	4.06	6.87	2.74	19810.00	16.46	79.61	21.12	2.23
1502	4.06	6.87	2.74	19810.00	16.46	79.55	21.10	2.04
1502	4.06	6.87	2.74	19810.00	16.46	79.51	21.09	1.88
1502	4.06	6.87	2.74	19810.00	16.46	79.54	21.10	1.98
1502	4.06	6.87	2.74	19810.00	16.46	79.49	21.08	1.78
1126	4.06	6.87	2.74	19810.00	16.46	79.50	21.09	1.83
1877	4.06	6.87	2.74	19810.00	16.46	79.48	21.08	1.77
751	4.06	6.87	2.74	19810.00	16.46	79.49	21.08	1.77

Moisture Content MCwb: 16.46

Moisture of Wood (wet basis): 16.46  
Initial Dry Weight Wtdo (kg): 4.09  
Moisture Content Dry 19.70

Dry kg : 4.09  
CA: 48.73  
HY: 6.87  
OX: 43.90

4.90  
HHV LHV HHV LHV  
19810.00 18328.69 Btu/lb 8522.48 7885.21

8.45	0.05	0.25	39.67	53.25	1.07	0.07	365.15	34.38
flue gas)		kg Wood per 100 mole dfp	Moles per kg of Dry Wood					
[j]	[k]	Nk	CO2	O2	CO	HC	N2	H2O
3.66	-0.02	0.10	40.30	156.16	0.67	-0.15	755.58	34.83
9.84	0.02	0.29	40.02	30.17	0.73	0.06	278.89	34.41
16.02	0.33	0.48	35.34	2.92	4.78	0.69	163.76	33.14
17.18	0.67	0.54	31.01	1.14	8.56	1.25	145.75	32.03
10.58	0.00	0.31	40.59	24.93	0.23	-0.01	260.55	34.54
11.31	0.00	0.33	40.67	20.49	0.15	-0.01	244.02	34.54
8.95	-0.01	0.26	40.70	37.46	0.15	-0.04	308.16	34.60
7.02	-0.01	0.20	40.46	59.84	0.39	-0.04	392.09	34.60
7.68	-0.01	0.22	40.48	50.93	0.36	-0.03	358.52	34.58
8.20	-0.01	0.24	40.55	44.96	0.30	-0.03	336.12	34.58
8.63	-0.01	0.25	40.60	40.51	0.24	-0.03	319.46	34.58
7.32	-0.01	0.21	40.41	55.66	0.43	-0.03	376.19	34.58
7.68	0.00	0.22	40.38	50.96	0.45	-0.02	358.36	34.56
7.02	0.00	0.20	40.29	59.75	0.54	-0.02	391.34	34.56
6.48	0.00	0.19	40.25	68.54	0.59	-0.02	424.44	34.57
6.81	0.00	0.20	40.27	62.97	0.56	-0.02	403.44	34.56
6.14	-0.01	0.18	40.29	74.72	0.56	-0.04	447.88	34.60
6.31	-0.01	0.18	40.30	71.54	0.55	-0.04	435.90	34.59
6.08	-0.01	0.18	40.28	75.88	0.57	-0.04	452.23	34.60
6.11	-0.01	0.18	40.28	75.38	0.57	-0.04	450.36	34.60

10.94	453.73	6489.68	4840.66	4696.55	4646.73	6342.09	5616.79	293.26
Moisture Present	Stack Temp K	Heat Content Change - Ambient to Stack Temperature Flue Gas Constituent						Room Temp K
		CO2	O2	CO	N2	CH4	H2O	
10.94	432.04	5584.36	4189.31	4070.52	4026.09	5404.97	4869.99	292.59
10.94	459.26	6719.19	5011.22	4861.86	4810.32	6567.79	5814.45	293.15
10.94	500.37	8505.66	6289.79	6088.99	6027.25	8431.79	7277.76	293.15
10.94	514.82	9144.97	6742.62	6522.39	6457.30	9109.18	7794.18	293.15
10.94	493.15	8167.13	6047.72	5856.73	5796.90	8078.09	7000.81	293.71
10.94	489.26	7996.86	5926.38	5740.40	5681.51	7899.28	6862.13	293.71
10.94	478.71	7536.89	5597.70	5425.08	5368.79	7418.22	6486.17	293.71
10.94	463.71	6909.96	5148.71	4994.07	4941.38	6764.74	5972.18	293.15
10.94	460.37	6745.69	5029.23	4878.90	4827.27	6597.53	5834.69	293.71
10.94	452.04	6410.41	4788.17	4647.27	4597.62	6250.10	5558.38	293.15
10.94	449.26	6292.05	4702.51	4564.81	4515.90	6128.69	5459.97	293.15
10.94	445.37	6126.73	4582.70	4449.43	4401.57	5959.44	5322.27	293.15
10.94	440.93	5938.32	4445.95	4317.69	4271.02	5767.05	5165.00	293.15
10.94	441.48	5961.84	4463.03	4334.15	4287.33	5791.04	5184.65	293.15
10.94	436.48	5771.62	4325.71	4202.05	4156.39	5595.15	5027.03	292.59
10.94	432.04	5563.23	4172.97	4054.52	4010.29	5385.60	4850.80	293.15
10.94	427.59	5376.54	4036.74	3923.10	3880.11	5196.53	4693.88	293.15
10.94	422.04	5143.99	3866.71	3758.98	3717.55	4961.74	4497.87	293.15
10.94	419.26	5006.91	3765.46	3660.99	3620.54	4825.61	4380.75	293.71
10.94	416.48	4891.19	3680.61	3579.04	3539.39	4709.30	4282.86	293.71

SUMS							AVERAGE
5116.20	4732.37	6167.93	32354.99	1262.24	34089.28	10853.87	4728.84
Energy Losses (kJ/kg of Dry Fuel)							Total
Flue Gas Constituent							Loss
CO2	O2	CO	N2	CH4	H2O Comb	H2O Fuel MC	Rate
225.05	654.20	191.41	3042.04	-137.94	1701.09	534.52	6210.37
268.90	151.21	211.46	1341.55	52.49	1712.83	544.86	4283.30
300.62	18.39	1381.02	987.04	621.53	1698.28	560.87	5567.75
283.57	7.72	2477.81	941.14	1120.23	1658.04	566.52	7055.03
331.51	150.74	65.97	1510.37	-6.11	1760.30	557.84	4370.63
325.24	121.46	44.08	1386.38	-9.63	1755.91	556.32	4179.76
306.72	209.67	44.59	1654.47	-33.86	1745.65	552.21	4479.45
279.56	308.08	113.53	1937.46	-34.80	1727.98	546.58	4878.38
273.08	256.16	103.70	1730.68	-26.40	1722.29	545.08	4604.58
259.92	215.27	84.95	1545.34	-26.25	1712.71	542.05	4334.00
255.47	190.50	69.15	1442.63	-27.00	1709.39	540.98	4181.13
247.61	255.06	122.28	1655.82	-24.67	1704.38	539.47	4499.94
239.78	226.58	129.33	1530.57	-14.67	1697.84	537.75	4347.18
240.19	266.68	155.48	1677.81	-15.46	1698.61	537.96	4561.27
232.31	296.49	168.64	1764.14	-22.11	1693.89	536.24	4669.60
224.06	262.75	160.16	1617.90	-17.88	1687.34	534.31	4468.63
216.60	301.63	161.66	1737.83	-34.10	1683.68	532.59	4599.91
207.30	276.63	157.22	1620.48	-31.49	1676.61	530.45	4437.21
201.69	285.71	163.10	1637.34	-35.03	1672.94	529.17	4454.91
197.04	277.44	162.37	1594.00	-34.62	1669.51	528.09	4393.83



SUMS						
20306	3430	16876.78	61541	3430	244.76	17.18
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
2760	168	2592.54	10005	168	13.25	0.60
3271	1156	2115.16	8368	1156	78.59	6.50
3878	1941	1936.95	7010	1941	131.71	10.95
1905	26	1879.65	6730	26	2.79	-0.05
1505	12	1492.99	5628	12	1.54	-0.06
1104	3	1101.15	3777	3	1.07	-0.15
740	12	727.98	2264	12	1.67	-0.09
698	11	686.66	2305	11	1.53	-0.07
739	10	729.45	2640	10	1.41	-0.08
555	5	549.23	2073	5	0.89	-0.06
512	11	500.80	1741	11	1.35	-0.05
412	11	401.26	1465	11	1.19	-0.02
346	10	335.34	1156	10	1.15	-0.02
354	11	343.07	1148	11	1.25	-0.03
339	11	328.14	1163	11	1.18	-0.02
349	10	339.20	1153	10	1.20	-0.05
252	7	245.25	874	7	0.87	-0.03
422	12	410.20	1455	12	1.51	-0.06
167	5	161.77	584	5	0.60	-0.02

## Dirigo Laboratories, Inc.

Manufacturer: Arada  
Model: Farringdon 16  
Date: 2/21/2017  
Run: 4  
Control #: 035-S-075-1  
Test Duration: 190  
Output Category: 3

	HHV Basis	LHV Basis
Overall Efficiency	75.0%	81.0%
Combustion Efficiency	95.8%	95.8%
Heat Transfer Efficiency	78.3%	84.6%

HHV Output Rate (kJ/h)	19,197	18,210	(Btu/h)
Burn Rate (kg/h)	1.29	2.85	(lb/h)
Input (kJ/h)	25,609	24,293	(Btu/h)

Test Load Weight (dry kg)	4.1	9.0	dry lb
MC wet (%)	16.46		
MC dry (%)	19.70		
Particulate (g )	4.84		
CO (g)	245		
Test Duration (h)	3.166666667		

Emissions	Particulate	CO
g/MJ Output	0.08	4.03
g/kg Dry Fuel	1.18	59.79
g/h	1.53	77.29
lb/MM Btu Output	0.19	9.36

Air/Fuel Ratio (A/F)	11.14
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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