VERSION: 2.4 **4/15/2010**

lanufacturer: Arada
Model: Farringdon 16
Date: 2/21/2017
Run: 5
Control #: 035-S-075-1
est Duration: 120
urn Category 4

Appliance Type: Cat (Cat, Non-Cat, Pe

Temp. Units F (F or C)
Weight Units lb (kg or lb)

Wood Moisture (% DRY):	19.9
Wood Moisture (% wet):	16.60
Load Weight (lb wet):	10.60
Burn Rate (dry kg/h):	2.01
Total Particulate Emissions:	3.36 g

Fuel Data

	D. Fir	
HHV	19,810	kJ/kg
%C	48.73	
%H	6.87	
%O	43.90	
%Ash	0.50	

Averages		**482.3**	**71.5**	**11.14**	**9.51**	**0.29**
		Temp. (F)				
Elapsed Time (min)	**Fuel Weight Remaining (lb)**	**Flue Gas**	**Room Temp**	**Flue Gas Composition (%) O2**	**CO2**	**CO**
0	10.6	451.0	70.0	15.33	5.05	0.13
10	8.4	588.0	70.0	2.16	18.46	1.65
20	5.9	610.0	70.0	1.85	19.24	0.90
30	4.4	553.0	70.0	9.32	12.11	0.04
40	3.1	543.0	71.0	9.89	11.33	0.04
50	2.3	505.0	70.0	12.31	8.47	0.08
60	1.8	473.0	71.0	13.06	7.52	0.11
70	1.3	454.0	72.0	13.09	7.50	0.11
80	1.0	441.0	73.0	13.73	6.49	0.17
90	0.6	428.0	73.0	13.13	7.23	0.15
100	0.4	415.0	73.0	13.47	6.91	0.15
110	0.2	407.0	73.0	13.56	6.85	0.14
120	0.0	402.0	73.0	13.88	6.51	0.14

ellet)

Manufacturer:	Arada
Model:	Farringdon 16
Date:	2/21/2017
Run:	5
Control #:	035-S-075-1
Test Duration:	120 min

	HHV	LHV
Eff	71.7%	77.5%
Comb Eff	96.8%	96.8%
HT Eff	74.1%	80.1%
Output	28,489	kJ/h
Burn Rate	2.01	kg/h
Grams CO	183	g
Input	39,731	kJ/h
MC wet	16.60	

Ultimate CO2

CO2-ult 19.64

F_0 1.062

Averages	0.29	9.51	136.1%	20.29	10.63	250.2

INPUT DATA				**Oxygen Calculation**			**Input**
Elapsed Time	**Weight Remaining (kg)**	**% CO [e]**	**% CO2 [d]**	**Excess Air EA**	**Total O2**	**Calc. % O2 [g]**	**Flue Gas (ºC)**
0	4.81	0.13	5.05	279.2%	20.60	15.48	232.8
10	3.81	1.65	18.46	-2.3%	19.61	0.33	308.9
20	2.68	0.90	19.24	-2.5%	19.61	-0.08	321.1
30	2.00	0.04	12.11	61.7%	20.14	8.01	289.4
40	1.41	0.04	11.33	72.8%	20.19	8.84	283.9
50	1.04	0.08	8.47	129.7%	20.38	11.87	262.8
60	0.82	0.11	7.52	157.4%	20.44	12.86	245.0
70	0.59	0.11	7.50	158.1%	20.44	12.88	234.4
80	0.45	0.17	6.49	194.9%	20.50	13.93	227.2
90	0.27	0.15	7.23	166.2%	20.45	13.15	220.0
100	0.18	0.15	6.91	178.2%	20.47	13.49	212.8
110	0.09	0.14	6.85	181.0%	20.48	13.56	208.3
120	0.00	0.14	6.51	195.4%	20.50	13.92	205.6
0							

				Air Fuel Ratio (A/F)		
Overall Heating Efficiency:	71.7%		Dry Molecular Weight (Md)		29.95	
Combustion Efficiency:	96.8%		Dry Moles Exhaust Gas (Nr):		397.71	%HC
Heat Transfer Efficiency:	74.1%		Air Fuel Ratio (A/F)		11.40	0.88

Heat Output:	27,025	Btu/h	28,489	kJ/h
Heat Input:	37,689	Btu/h	39,731	kJ/h

2

Burn Duration:	2	h		
Burn Rate:	4.4	lb/h	2.0	kg/h
Stack Temp:	484.9	Deg. F	251.6	Deg. C

21.9	98.4%	71.3%	70.2%	14.2	1.40	70.97	0.02	70.97
Data	**Combust**	**Heat**	**Net**	**Air**	**Wet Wt**	**% Wet**	**Dry Wt.**	**% Dry**
Room Temp (ºC)	**Eff %**	**Transfer %**	**Eff %**	**Fuel Ratio**	**Now Wt**	**Consumed x**	**Now Wtdn**	**Comsumed y**
21.1	98.7%	62.5%	61.7%	22.8	4.81	0.00	4.01	0.00
21.1	93.1%	76.9%	71.6%	5.8	3.81	20.75	3.18	20.75
21.1	96.2%	77.0%	74.1%	5.9	2.68	44.34	2.23	44.34
21.1	99.9%	73.6%	73.5%	9.8	2.00	58.49	1.67	58.49
21.7	99.9%	73.1%	73.0%	10.5	1.41	70.75	1.17	70.75
21.1	99.6%	70.1%	69.8%	13.9	1.04	78.30	0.87	78.30
21.7	99.3%	69.6%	69.1%	15.5	0.82	83.02	0.68	83.02
22.2	99.3%	70.6%	70.1%	15.6	0.59	87.74	0.49	87.74
22.8	98.4%	68.8%	67.7%	17.8	0.45	90.57	0.38	90.57
22.8	98.8%	71.4%	70.5%	16.0	0.27	94.34	0.23	94.34
22.8	98.8%	71.3%	70.5%	16.8	0.18	96.23	0.15	96.23
22.8	98.9%	71.6%	70.8%	16.9	0.09	98.11	0.08	98.11
22.8	98.8%	71.1%	70.3%	17.8	0.00	100.00	0.00	100.00
							0.00	

Combustion Efficiency:	96.8%		
Total Input (kJ):	79,462	75,366	(Btu)
Total Output (kJ):	56,978	54,041	(Btu)
Efficiency:	71.7%		
Total CO (g):	183.05		

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

80212	4.06	6.87	2.74	19810.00	16.60	79.56	21.10	2.42
Fuel Properties					**Mw**	**Mass Balance**		
Total Input	**Carbon /12= [a]**	**Hydrogen /1= [b]**	**Oxygen /16= [c]**	**Calorific Value**	**Moisture Fuel Burnt**	**(moles/100 mole dry [h]**	**[u]**	**[w]**
0	4.06	6.87	2.74	19810.00	16.60	79.34	21.04	1.27
25863	4.06	6.87	2.74	19810.00	16.60	79.56	21.10	5.01
14993	4.06	6.87	2.74	19810.00	16.60	79.94	21.20	4.99
10495	4.06	6.87	2.74	19810.00	16.60	79.84	21.18	2.99
7871	4.06	6.87	2.74	19810.00	16.60	79.79	21.16	2.80
4873	4.06	6.87	2.74	19810.00	16.60	79.58	21.11	2.10
3748	4.06	6.87	2.74	19810.00	16.60	79.51	21.09	1.88
2999	4.06	6.87	2.74	19810.00	16.60	79.51	21.09	1.87
2624	4.06	6.87	2.74	19810.00	16.60	79.41	21.06	1.64
2249	4.06	6.87	2.74	19810.00	16.60	79.47	21.08	1.82
1499	4.06	6.87	2.74	19810.00	16.60	79.45	21.07	1.74
2249	4.06	6.87	2.74	19810.00	16.60	79.45	21.07	1.72
750	4.06	6.87	2.74	19810.00	16.60	79.43	21.07	1.64

Moisture Content MCwb:	16.60

Moisture of Wood (wet basis):	16.60	Dry kg :	4.01
Initial Dry Weight Wtdo (kg):	4.01	CA:	48.73
Moisture Content Dry	19.90	HY:	6.87
		OX:	43.90

4.81

HHV	LHV		HHV	LHV
19810.00	18328.69	Btu/lb	8522.48	7885.21

8.27	0.03	0.24	39.82	59.74	0.95	0.04	390.04	34.44
flue gas)		**kg Wood per 100 mole dfp**	**Moles per kg of Dry Wood**					
[j]	**[k]**	**Nk**	**CO2**	**O2**	**CO**	**HC**	**N2**	**H2O**
4.39	-0.01	0.13	39.83	122.13	1.03	-0.05	625.80	34.62
16.73	0.24	0.50	37.02	0.66	3.31	0.48	159.57	33.56
16.88	0.13	0.50	38.74	-0.16	1.81	0.26	160.94	33.99
10.29	-0.01	0.30	40.70	26.91	0.13	-0.02	268.35	34.57
9.63	-0.01	0.28	40.70	31.75	0.14	-0.03	286.62	34.58
7.24	-0.01	0.21	40.47	56.69	0.38	-0.04	380.22	34.59
6.46	0.00	0.19	40.25	68.84	0.59	-0.02	425.55	34.57
6.44	0.00	0.19	40.25	69.13	0.59	-0.03	426.66	34.57
5.63	0.00	0.16	39.76	85.30	1.04	0.01	486.48	34.49
6.24	0.00	0.18	39.98	72.70	0.83	0.00	439.45	34.51
5.97	0.00	0.17	39.94	77.97	0.87	0.00	459.28	34.52
5.91	0.00	0.17	40.00	79.18	0.82	-0.01	463.99	34.54
5.63	0.00	0.16	39.97	85.46	0.86	-0.01	487.62	34.55

11.06	523.32	9471.59	6959.91	6726.68	6660.80	9486.04	8036.41	295.07
Moisture Present	**Stack Temp K**	**Heat Content Change - Ambient to Stack Temperature Flue Gas Constituent**						**Room Temp K**
		CO2	**O2**	**CO**	**N2**	**CH4**	**H2O**	
11.06	505.93	8708.55	6431.04	6223.54	6160.89	8652.15	7437.87	294.26
11.06	582.04	12157.56	8842.07	8522.72	8444.13	12376.57	10174.80	294.26
11.06	594.26	12727.07	9234.11	8894.96	8814.13	13004.89	10617.39	294.26
11.06	562.59	11260.45	8221.16	7932.25	7857.40	11394.23	9472.45	294.26
11.06	557.04	10984.99	8028.03	7747.93	7674.39	11098.02	9252.98	294.82
11.06	535.93	10047.95	7375.15	7125.91	7056.57	10081.44	8512.72	294.26
11.06	518.15	9229.92	6798.34	6574.56	6509.32	9208.94	7855.96	294.82
11.06	507.59	8739.95	6450.57	6241.52	6178.89	8691.36	7459.07	295.37
11.06	500.37	8399.88	6208.03	6008.96	5948.22	8334.67	7181.82	295.93
11.06	493.15	8082.49	5982.31	5792.70	5733.67	8000.35	6924.05	295.93
11.06	485.93	7766.61	5757.07	5576.73	5519.45	7668.96	6666.58	295.93
11.06	481.48	7572.98	5618.69	5443.97	5387.79	7466.48	6508.29	295.93
11.06	478.71	7452.25	5532.29	5361.05	5305.56	7340.49	6409.41	295.93

SUMS							AVERAGE
4893.32	4928.96	3597.41	32054.24	504.53	23278.28	7474.39	5902.39
Energy Losses (kJ/kg of Dry Fuel)							**Total**
Flue Gas Constituent							**Loss**
CO2	**O2**	**CO**	**N2**	**CH4**	**H2O Comb**	**H2O Fuel MC**	**Rate**
346.90	785.41	296.51	3855.51	-42.26	1779.53	568.34	7589.94
450.10	5.80	964.66	1347.39	434.40	1817.07	598.59	5618.00
493.00	-1.48	528.89	1418.58	238.78	1855.60	603.49	5136.86
458.32	221.26	39.11	2108.53	-21.37	1847.47	590.83	5244.16
447.08	254.90	41.78	2199.63	-27.16	1840.57	588.40	5345.19
406.60	418.08	110.88	2683.03	-31.95	1815.53	580.22	5982.39
371.49	467.97	170.48	2770.02	-22.42	1791.72	572.96	6122.22
351.76	445.94	170.73	2636.29	-22.63	1778.02	568.57	5928.69
333.95	529.57	300.96	2893.68	13.08	1764.37	565.51	6401.12
323.13	434.92	239.53	2519.66	3.54	1756.56	562.66	5840.00
310.23	448.90	250.22	2534.97	0.85	1747.98	559.81	5852.96
302.94	444.88	235.82	2499.86	-7.37	1743.44	558.06	5777.63
297.83	472.80	247.83	2587.09	-10.96	1740.42	556.97	5891.97

SUMS						
22484	2551	19932.91	57727	2551	183.05	12.60
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
7334	1782	5552.58	18528	1782	120.96	10.05
3888	566	3321.53	11105	566	38.40	3.20
2778	9	2769.28	7717	9	1.99	-0.20
2124	5	2118.34	5747	5	1.60	-0.19
1471	19	1452.66	3401	19	2.63	-0.14
1158	27	1131.05	2590	27	3.12	-0.08
897	22	875.51	2101	22	2.50	-0.06
848	41	807.05	1776	41	3.86	0.03
663	27	635.94	1586	27	2.64	0.01
443	19	424.34	1056	19	1.84	0.00
656	25	630.47	1593	25	2.60	-0.01
223	9	214.17	527	9	0.91	-0.01

Dirigo Laboratories, Inc.

Manufacturer:	**Arada**
Model:	**Farringdon 16**
Date:	**2/21/2017**
Run:	**5**
Control #:	**035-S-075-1**
Test Duration:	**120**
Output Category:	**4**

	HHV Basis	LHV Basis	
Overall Efficiency	71.7%	77.5%	
Combustion Efficiency	96.8%	96.8%	
Heat Transfer Efficiency	74.1%	80.1%	
HHV Output Rate (kJ/h)	28,489	27,025	**(Btu/h)**
Burn Rate (kg/h)	2.01	4.42	**(lb/h)**
Input (kJ/h)	39,731	37,689	**(Btu/h)**
Test Load Weight (dry kg)	4.0	8.8	**dry lb**
MC wet (%)	16.60		
MC dry (%)	19.90		
Particulate (g)	3.36		
CO (g)	183		
Test Duration (h)	2		

Emissions	**Particulate**	**CO**
g/MJ Output	0.06	3.21
g/kg Dry Fuel	0.84	45.64
g/h	1.68	91.53
lb/MM Btu Output	0.14	7.47

Air/Fuel Ratio (A/F)	11.40

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