

Plant Gadsden Unit 2
Kurz Air Flow Probe Calibration
August 2nd, 2007

Generating plant performance (GPP) performed secondary air velocity traverses on Unit 2, August 2nd, 2007. The purpose of the test was to calibrate the Kurz air flow probes (hot wire anemometer) which would be used during the upcoming small woodchip test burn.

The results of the traverse indicated that the average air flow measured by the Kurz probes was within 2.1% (Test 1) and 3.5% (Test 2) of the GPP measured value. However, when comparing the air flows per side the difference between the GPP and Kurz measurements were -3.8% and 7.9% for Test 1 and -1.7% and 8.5% for Test 2, respectively on the RH and LH ducts. Test results are shown in the attached tables.

New calibration factors have been calculated for the Kurz probes and the average values for the two tests were 0.0974 and 1.090 for the RH (Box 52) and LH (Box 54), respectively. These correction factors can be entered into the Kurz modules to correct air flow to match the values measured by GPP, although on an average value basis, the results were likely within the uncertainty range of the test.

All pertinent Kurz data was recorded during the traverse from the local station by stepping through the data screens. This information is provided in the attached test data. It was observed that the 'D' temperature probe on Box 52 was incorrectly indicating temperature about 50 °F lower than the traverse data and this would create an error in the density and mass flow rate calculated value. However, this was on the side that measured closest in value to the GPP values. None of the hot wire anemometer flow values looked unusual, but without identification, could not be compared with the GPP velocity distribution.

The velocity traverse was conducted on a four port by three depth test grid at the air heater air outlet, on both the 'A' and 'B' ducts, just upstream of the take-off to the windbox. This is located on the 4th floor very near the Kurz probes. Velocity and temperature were measured at each point and static pressure at each port. Wet bulb and dry bulb temperatures and atmospheric pressure were also measured.

The tests were conducted on Unit 2 on August 2nd, 2007 from 10:25 am until 12:10 pm. Unit load was 67.9 MW's. Average O₂ from the plant probes was 4.14%. The plant FDF discharge pressure was 5.2 "wg.

Gadsden 2 Secondary Air Velocity Measurement

Kurz Probe Calibration

August 2, 2007

Percent Difference in Flow Measurement (GPP- Kurz) 2.1%

A or RH Side -3.8%

Traverse grid is just downstream of Kurz probes which is upstream of windbox B or LH Side 7.9%

Units						
Load	MW	67.9	68.0			
Date		8/2/2007	8/2/2007			
Time		10:41-11:05	10:25-10:41			
Side		A (RH)	B (LH)	%diff B from A	Total	
Test	#	1	1			
F/R Probe Velocity Pressure @ Traverse	" wg	0.438	0.460	5.0	NA	Vn3
Static Pressure @ Traverse	" wg	2.55	2.53	-1.0	NA	Ps3
Temperature @ Traverse	F	597.7	610.7	2.2	NA	T3
Dry Bulb @ Ambient Conditions	F	95.0	97.0	2.1	NA	Td
Wet Bulb @ Ambient Conditions	F	82.0	80.0	-2.4	NA	Tw
Barometric Pressure	" Hg	29.99	30.00	0.0	NA	Pb
Area @ Traverse	ft^2	40.00	40.00	0.0	NA	A3
Forward/Reverse Probe Calibration Factor		0.8163	0.8163	0.0	NA	

Calculations At Traverse Plane

Volumetric Flow	acfm	122,496	126,183	3.0	248,678	Q3
Mass Flow	lbs/hr	274,908	280,207	1.9	555,115	M3
Density @ Traverse	lb/ft^3	0.0374	0.0370	-1.1	NA	Rho1
Velocity @ Traverse	fpm	3,062	3,155	3.0	NA	V3
Avg. Temperature @ Traverse	Deg. F	597.7	610.7	2.2	NA	
Standard Velocity	sfp	1,527	1,557	1.9	NA	
Actual Velocity Pressure @ Traverse	" wg	0.292	0.307	5.0	NA	Pv3

Density Calculation

Ambient Air Density, ρ_0	lb/ft^3	0.07086	0.07073	-0.2
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Kurz Probes Air Flow

		Box 52 RH	Box 54 LH		
Flow Rate	lbs/hr	285,366	258,076	-9.6	543,442
Avg. Velocity (Standard)	SFM	1580.2	1456.2	-7.8	NA
Avg. Temperature	Deg. F	576.3	614.38	6.6	NA
Probe A Flow	SFM	1597.6	1507.6	-5.6	NA
Probe C Flow	SFM	1986.6	1898.4	-4.4	NA
Probe E Flow	SFM	1759.4	1667.6	-5.2	NA
Probe F Flow	SFM	1783.2	1637.2	-8.2	NA
Probe B Temperature	%	610.7	608.7	-0.3	NA
Probe D Temperature	%	541.8	619.9	14.4	NA

Estimated Req. Kurz Calibration Factor	-	0.96335	1.08576
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Gadsden 2 Secondary Air Velocity Measurement
Kurz Probe Calibration
August 2, 2007 1

Date 8/2/2007 Pb ("Hg) 29.99
 Start Time 10:41 AM Td (F) 95
 End Time 11:05 AM Tw (F) 82

RH or 'A' Secondary Air Duct

Port 1 (inside right)	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.47	0.6856	590.8	2.6
B	0.46	0.6782	591.1	
C	0.43	0.6557	590.1	

Port 2	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.495	0.7036	593.3	2.5
B	0.5	0.7071	592.3	
C	0.465	0.6819	591	

Port 3	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.31	0.5568	599.1	2.5
B	0.36	0.6000	600.7	
C	0.425	0.6519	601.8	

Port 4 (far left)	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.435	0.6595	607.1	2.6
B	0.45	0.6708	607.3	
C	0.48	0.6928	607.7	

Port 5	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 6	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Average 0.4400 0.4382 597.6917 2.5500
 0.6620

A (Box 52)	282170	A (SFM)	1585
Flow Rate	285868		1601
#/hr	288292		1607
	284204		1591
	286298		1604

avg 285366.4 avg 1597.6

Avg Velocity (SFM)	1582	C (SFM)	1971
	1580		1998
	1581		1987
	1580		1963
	1578		2014

avg 1580.2 avg 1986.6

Avg. Temperature (Deg. F)	576.9	E (SFM)	1753
	576.2		1776
	576.2		1755
	576.2		1745
	575.9		1768

avg 576.28 avg 1759.4

RH or 'A' Secondary Air Duct

Port 7	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 8	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 9	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 10	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 11	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 12	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

F (SFM)	1764
	1799
	1778
	1778
	1797

avg 1783.2

B (Deg. F)	610.9
	610.3
	610.5
	610.9
	610.8

avg 610.68

D (Deg. F)	542.6
	542.2
	541.9
	541.5
	540.6

avg 541.76

Gadsden 2 Secondary Air Velocity Measurement
Kurz Probe Calibration
August 2, 2007 _____ 1

Date 8/2/2007 Pb ("Hg) 30
 Start Time 10:25 AM Td (F) 97
 End Time 10:41 AM Tw (F) 80

LH or 'B' Secondary Air Duct

Port 1 (inside right)	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.41	0.6403	620.3	2.5
B	0.425	0.6519	621.5	
C	0.365	0.6042	622.9	

Port 2	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.47	0.6856	613.6	2.5
B	0.57	0.7550	616.3	
C	0.5	0.7071	616.7	

Port 3	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.365	0.6042	603.5	2.5
B	0.4	0.6325	603.1	
C	0.5	0.7071	602.1	

Port 4 (far left)	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.49	0.7000	603.3	2.6
B	0.505	0.7106	603.7	
C	0.55	0.7416	601.3	

Port 5	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 6	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Average 0.4625 0.4601 610.6917 2.5250
 0.6783

B (Box 54)	258680	A (SFM)	1523
Flow Rate	261172		1517
#/hr	258671		1521
	257874		1490
	253982		1487

avg 258075.8 avg 1507.6

Avg Velocity (SFM)	1466	C (SFM)	1919
	1478		1915
	1459		1922
	1446		1871
	1432		1865

avg 1456.2 avg 1898.4

Avg. Temperature (Deg. F)	615	E (SFM)	1678
	613		1680
	614.5		1690
	615.5		1643
	613.9		1647

avg 614.38 avg 1667.6

LH or 'B' Secondary Air Duct

Port 7	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 8	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 9	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 10	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 11	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 12	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

F (SFM)	1656
	1660
	1664
	1594
	1612

avg 1637.2

B (Deg. F)	608.8
	608
	608.7
	610
	607.9

avg 608.68

D (Deg. F)	620.1
	619.6
	620.3
	620.8
	618.9

avg 619.94

**Gadsden 2 Secondary Air Velocity Measurement
Kurz Probe Calibration
August 2, 2007**

Percent Difference in Flow Measurement (GPP- Kurz) 3.5%

A or RH Side -1.7%

Traverse grid is just downstream of Kurz probes which is upstream of windbox B or LH Side 8.5%

Units						
Load	MW	68.3	67.4			
Date		8/2/2007	8/2/2007			
Time		11:10-11:24	11:25-12:10			
Side		A (RH)	B (LH)	%diff B from A	Total	
Test	#	2	2			
F/R Probe Velocity Pressure @ Traverse	" wg	0.438	0.476	8.7	NA	Vn3
Static Pressure @ Traverse	" wg	2.58	2.55	-1.0	NA	Ps3
Temperature @ Traverse	F	594.4	608.8	2.4	NA	T3
Dry Bulb @ Ambient Conditions	F	97.0	96.0	-1.0	NA	Td
Wet Bulb @ Ambient Conditions	F	80.0	80.0	0.0	NA	Tw
Barometric Pressure	" Hg	30.00	30.00	0.0	NA	Pb
Area @ Traverse	ft^2	40.00	40.00	0.0	NA	A3
Forward/Reverse Probe Calibration Factor		0.8163	0.8163	0.0	NA	

GPP Calculations At Traverse Plane

Volumetric Flow	acfm	122,149	128,233	5.0	250,382	Q3
Mass Flow	lbs/hr	275,478	285,233	3.5	560,711	M3
Density @ Traverse	lb/ft^3	0.0376	0.0371	-1.4	NA	Rho1
Velocity @ Traverse	fpm	3,054	3,206	5.0	NA	V3
Avg. Temperature @ Traverse	Deg. F	594.4	608.8	2.4	NA	
Standard Velocity	sfp	1,530	1,585	3.5	NA	
Actual Velocity Pressure @ Traverse	" wg	0.292	0.317	8.7	NA	Pv3

Density Calculation

Ambient Air Density, ρ_0	lb/ft^3	0.07073	0.07084	0.2
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Kurz Probes Air Flow

		Box 52 RH	Box 54 LH		
Flow Rate	lbs/hr	280,028	260,856	-6.8	540,884
Kurz Calibration Factor (Internal)	-	0.905	0.810	-10.5	
Avg. Velocity (Standard)	SFM	1580.2	1470.0	-7.0	NA
Avg. Temperature	Deg. F	573.3	612.84	6.9	NA
Probe A Flow	SFM	1572.6	1517.6	-3.5	NA
Probe C Flow	SFM	1947.8	1918.2	-1.5	NA
Probe E Flow	SFM	1718.0	1673.4	-2.6	NA
Probe F Flow	SFM	1741.8	1642.8	-5.7	NA
Probe B Temperature	%	608.6	607.3	-0.2	NA
Probe D Temperature	%	538.0	618.5	15.0	NA

Estimated Req. Kurz Calibration Factor	-	0.98375	1.09345
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Gadsden 2 Secondary Air Velocity Measurement
Kurz Probe Calibration
August 2, 2007 2

Date 8/2/2007
 Start Time 11:10 AM
 End Time 11:24 AM

Pb ("Hg) 30
 Td (F) 97
 Tw (F) 80

RH or 'A' Secondary Air Duct

RH or 'A' Secondary Air Duct

Port 1 (inside right)	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.465	0.6819	589.1	2.7
B	0.46	0.6782	588.4	
C	0.42	0.6481	588.1	

Port 7	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 2	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.48	0.6928	590.1	2.5
B	0.49	0.7000	589	
C	0.47	0.6856	587.9	

Port 8	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 3	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.33	0.5745	597.3	2.6
B	0.37	0.6083	598.1	
C	0.425	0.6519	596.9	

Port 9	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 4 (far left)	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.45	0.6708	601.5	2.5
B	0.44	0.6633	602.4	
C	0.47	0.6856	603.9	

Port 10	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 5	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 11	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 6	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 12	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Average 0.4392 0.4379 594.3917 2.5750
 0.6617

A (Box 52)	281032	A (SFM)	1578
Flow Rate	280212		1573
#/hr	279993		1566
	279620		1566
	279285		1580
avg	280028.4	avg	1572.6
Avg Velocity (SFM)	1582	C (SFM)	1957
	1580		1944
	1581		1933
	1580		1951
	1578		1954
avg	1580.2	avg	1947.8
Avg. Temperature (Deg. F)	573.6	E (SFM)	1719
	573.9		1721
	573.6		1707
	572.8		1720
	572.7		1723
avg	573.32	avg	1718

F (SFM)	1741
	1730
	1738
	1744
	1756
avg	1741.8
B (Deg. F)	608.8
	609.3
	609.2
	607.8
	608.1
avg	608.6
D (Deg. F)	538.3
	538.2
	538.1
	537.9
	537.5
avg	538

Gadsden 2 Secondary Air Velocity Measurement
Kurz Probe Calibration
August 2, 2007 _____ 2

Date 8/2/2007 Pb ("Hg) _____ 30
 Start Time 11:24 AM Td (F) _____ 96
 End Time 12:10 PM Tw (F) _____ 80

LH or 'B' Secondary Air Duct

Port 1 (inside right)	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.48	0.6928	616.3	2.6
B	0.47	0.6856	617.5	
C	0.4	0.6325	618.9	

Port 2	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.47	0.6856	614.6	2.5
B	0.48	0.6928	615.9	
C	0.5	0.7071	617.7	

Port 3	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.37	0.6083	603.5	2.5
B	0.44	0.6633	601.6	
C	0.53	0.7280	598.9	

Port 4 (far left)	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)
A	0.5	0.7071	601.5	2.6
B	0.52	0.7211	601.4	
C	0.57	0.7550	598.2	

Port 5	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 6	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Average 0.4775 0.4760 608.8333 2.5500
 0.6899

B (Box 54)	262657	A (SFM)	1540
Flow Rate	264962		1530
#/hr	256735		1493
	259012		1521
	260914		1504

avg 260856 avg 1517.6

Avg Velocity (SFM)	1488	C (SFM)	1956
	1480		1917
	1447		1890
	1464		1928
	1471		1900

avg 1470 avg 1918.2

Avg. Temperature (Deg. F)	610.5	E (SFM)	1705
	613.1		1679
	614.3		1649
	612.8		1682
	613.5		1652

avg 612.8 avg 1673.4

LH or 'B' Secondary Air Duct

Port 7	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 8	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 9	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 10	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 11	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

Port 12	Pv ("wg)	SQRT (Pv)	Temp (F)	Ps ("wg)

F (SFM)	1666
	1650
	1616
	1657
	1625

avg 1642.8

B (Deg. F)	604.7
	607.7
	608.9
	607.2
	608.0

avg 607.3

D (Deg. F)	616.3
	618.9
	619.8
	618.1
	619.6

avg 618.5