

AFT Arrow Model

Title: AFT Arrow Model  
Analysis run on: 12/2/2011 4:59:51 PM  
Application version: AFT Arrow Version 4.0 (2007.06.05)  
Input File: H:\Projects\University of Wisconsin\10723-00 Platteville Master Plan\Mechanical\Flow Modeling\UWP Steam Flow Phase 2.aro

Execution Time= 1.03 seconds  
Total Number Of Pressure Iterations= 68  
Total Number Of Flow Iterations= 15  
Total Number Of Enthalpy Iterations= 15  
Number Of Pipes= 109  
Number Of Junctions= 109  
Matrix Method= Gaussian Elimination

Length March Solution Method with Mach Number Limits  
Segments Per Pipe= 2  
Mach Number Increment= 0.01  
Pressure Tolerance= 0.0001 relative change  
Mass Flow Rate Tolerance= 0.0001 relative change  
Enthalpy Tolerance= 0.0001 relative change  
Flow Relaxation= (Automatic)  
Pressure Relaxation= (Automatic)  
Resistance Relaxation= (Automatic)

Fluid Database: AFT Standard  
Fluid: Steam  
Max Fluid Temperature Data= 1500 deg. F  
Min Fluid Temperature Data= 200 deg. F  
Molecular Weight =18.016 amu  
Gas Constant =0.1102 Btu/lbm-R  
Critical Pressure =3208.22 psia  
Critical Temperature =1165.09 deg. R  
Acentric Factor =0.344  
Equation of State= Redlich-Kwong  
Enthalpy Model= Generalized  
Specific Heat Ratio Accuracy = High  
Atmospheric Pressure= 1 atm  
Gravitational Acceleration= 1 g  
Standard Pressure= 14.696 psia  
Standard Temperature= 60 deg. F  
Turbulent Flow Above Reynolds Number= 4000  
Laminar Flow Below Reynolds Number= 2300

Total Inflow= 75,370 lbm/hr  
Total Outflow= 75,370 lbm/hr  
Total Energy Inflow= 24,927 Btu/s  
Total Energy Outflow= 24,927 Btu/s  
Total Heat Transferred Into System= 0.000 Btu/s  
Maximum Pressure is 139.7 psia at Junction 1 Outlet  
Minimum Pressure is 130.6 psia at Junction 132 Inlet  
Maximum Static Temperature is 352.8 deg. F at Junction 116 Inlet  
Minimum Static Temperature is 350.7 deg. F at Junction 132 Inlet

## AFT Arrow Model

Pipe Output Table

Pipe	Name	Pipe Nominal Size	Length (feet)	Mass Flow (lbm/hr)	Vel. In (feet/min)	Vel. Out (feet/min)	Mach # In	Mach # Out	dP Stag. Total (psid)	P Stag. In (psia)	P Stag. Out (psia)	P Static In (psia)	P Static Out (psia)
1	Pipe	8 inch	73.000	16,412.2	2,614.4	2,616.3	0.026698	0.026717	0.1022491	139.7	139.6	139.6	139.5
2	Pipe	8 inch	244.000	16,412.2	2,616.5	2,623.0	0.026719	0.026783	0.3423462	139.6	139.2	139.5	139.2
3	Pipe	6 inch	170.000	3,797.0	1,050.5	1,050.9	0.010726	0.010731	0.0574951	139.2	139.2	139.2	139.2
4	Pipe	6 inch	170.000	3,797.0	1,050.9	1,051.4	0.010731	0.010735	0.0575256	139.2	139.1	139.2	139.1
5	Pipe	6 inch	53.000	3,797.0	1,051.4	1,051.5	0.010735	0.010737	0.0179443	139.1	139.1	139.1	139.1
6	Pipe	6 inch	298.000	12,614.7	3,492.0	3,517.8	0.035658	0.035917	1.0223846	139.2	138.2	139.1	138.1
7	Pipe	8 inch	367.000	12,614.7	2,031.0	2,035.6	0.020735	0.020781	0.3123932	138.2	137.9	138.2	137.8
8	Pipe	8 inch	306.000	15,714.0	2,536.1	2,543.4	0.025890	0.025964	0.3995361	137.9	137.5	137.8	137.4
9	Pipe	4 inch	82.000	2,309.0	1,468.4	1,469.3	0.014989	0.014998	0.0855255	137.5	137.4	137.5	137.4
10	Pipe	4 inch	38.000	2,309.0	1,469.3	1,469.7	0.014999	0.015003	0.0396576	137.4	137.4	137.4	137.3
11	Pipe	4 inch	138.000	3,406.0	2,166.2	2,171.0	0.022113	0.022161	0.3040619	137.5	137.2	137.4	137.1
12	Pipe	8 inch	289.000	9,999.0	1,618.1	1,620.0	0.016518	0.016536	0.1580048	137.5	137.3	137.5	137.3
13	Pipe	8 inch	382.000	6,586.0	1,066.9	1,067.7	0.010891	0.010898	0.0942230	137.3	137.2	137.3	137.2
14	Pipe	4 inch	36.000	3,537.0	2,253.7	2,255.1	0.023006	0.023020	0.0854034	137.2	137.1	137.2	137.1
15	Pipe	6 inch	270.000	10,672.0	2,982.8	2,997.5	0.030452	0.030598	0.6741791	137.9	137.2	137.8	137.1
16	Pipe	6 inch	77.000	10,672.0	2,997.5	3,001.7	0.030598	0.030640	0.1928864	137.2	137.0	137.1	136.9
21	Pipe	6 inch	75.000	7,986.0	2,245.8	2,247.5	0.022923	0.022941	0.1071320	137.0	136.9	137.0	136.9
22	Pipe	6 inch	7.000	7,986.0	2,247.7	2,247.8	0.022943	0.022944	0.0100098	136.9	136.9	136.9	136.8
23	Pipe	6 inch	36.000	7,986.0	2,248.0	2,248.8	0.022946	0.022954	0.0514526	136.9	136.8	136.8	136.8
24	Pipe	6 inch	92.000	7,986.0	2,249.0	2,251.2	0.022956	0.022977	0.1316223	136.8	136.7	136.8	136.6
25	Pipe	6 inch	220.000	7,986.0	2,251.3	2,256.5	0.022979	0.023031	0.3152618	136.7	136.4	136.6	136.3
26	Pipe	3 inch	130.000	2,515.0	2,777.5	2,790.7	0.028349	0.028481	0.6426239	136.4	135.7	136.3	135.7
27	Pipe	3 inch	35.000	2,515.0	2,790.9	2,794.4	0.028482	0.028518	0.1735535	135.7	135.5	135.6	135.5
28	Pipe	6 inch	139.000	3,836.0	1,083.7	1,084.1	0.011060	0.011064	0.0489349	136.4	136.3	136.4	136.3
29	Pipe	3 inch	47.000	3,836.0	4,240.6	4,257.2	0.043285	0.043451	0.5297546	136.3	135.8	136.1	135.6
30	Pipe	3 inch	14.000	3,836.0	4,258.4	4,263.4	0.043463	0.043513	0.1582489	135.7	135.6	135.6	135.4
31	Pipe	3 inch	59.000	3,836.0	4,264.7	4,285.9	0.043525	0.043737	0.6691284	135.5	134.9	135.4	134.7
32	Pipe	3 inch	55.000	3,836.0	4,287.1	4,307.2	0.043750	0.043951	0.6269684	134.8	134.2	134.7	134.0
33	Pipe	3 inch	15.000	3,836.0	4,308.5	4,314.0	0.043964	0.044019	0.1715546	134.2	134.0	134.0	133.8
34	Pipe	6 inch	46.000	3,836.0	1,084.1	1,084.2	0.011064	0.011065	0.0162048	136.3	136.3	136.3	136.3
38	Pipe	6 inch	40.000	1,635.0	461.9	461.9	0.004714	0.004714	0.0028534	136.4	136.4	136.4	136.4
39	Pipe	6 inch	36.000	1,635.0	461.9	461.9	0.004714	0.004714	0.0025635	136.4	136.4	136.4	136.4
40	Pipe	6 inch	79.000	1,635.0	461.9	461.9	0.004714	0.004714	0.0056305	136.4	136.3	136.4	136.3
41	Pipe	6 inch	43.000	677.0	191.3	191.3	0.001952	0.001952	0.0006104	136.3	136.3	136.3	136.3
50	Pipe	8 inch	30.000	13,772.9	2,222.2	2,222.7	0.022685	0.022690	0.0302887	137.9	137.9	137.9	137.8
51	Pipe	8 inch	101.000	13,772.9	2,220.5	2,222.2	0.022669	0.022685	0.1019287	138.0	137.9	138.0	137.9

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Pipe	Name	Pipe Nominal Size	Length (feet)	Mass Flow (lbm/hr)	Vel. In (feet/min)	Vel. Out (feet/min)	Mach # In	Mach # Out	dP Stag. Total (psid)	P Stag. In (psia)	P Stag. Out (psia)	P Static In (psia)	P Static Out (psia)
52	Pipe	8 inch	21.000	13,772.9	2,220.0	2,220.4	0.022664	0.022668	0.0211792	138.0	138.0	138.0	138.0
53	Pipe	8 inch	63.000	16,704.9	2,691.2	2,693.0	0.027475	0.027493	0.0923462	138.1	138.0	138.1	138.0
57	Pipe	8 inch	300.000	16,704.9	2,682.6	2,691.2	0.027389	0.027475	0.4389648	138.6	138.1	138.5	138.1
58	Pipe	8 inch	5.000	2,932.0	472.5	472.5	0.004824	0.004824	0.0002747	138.0	138.0	138.0	138.0
59	Pipe	8 inch	153.000	16,704.9	2,678.3	2,682.6	0.027346	0.027389	0.2233276	138.8	138.6	138.7	138.5
60	j99	10 inch	230.000	31,612.6	3,207.7	3,216.1	0.032754	0.032838	0.3636475	139.2	138.8	139.1	138.7
61	Pipe	4 inch	92.000	5,716.0	3,593.1	3,607.3	0.036690	0.036832	0.5483551	139.2	138.6	139.0	138.5
62	Pipe	10 inch	245.000	37,328.4	3,773.9	3,788.4	0.038540	0.038685	0.5343628	139.7	139.2	139.6	139.0
63	Pipe	3 inch	49.000	855.0	927.4	927.6	0.009468	0.009470	0.0300751	138.8	138.8	138.8	138.8
64	Pipe	3 inch	75.000	855.0	927.6	927.9	0.009470	0.009473	0.0460510	138.8	138.7	138.8	138.7
65	Pipe	3 inch	52.000	855.0	927.9	928.1	0.009474	0.009476	0.0319214	138.7	138.7	138.7	138.7
67	Pipe	8 inch	427.000	14,052.0	2,252.7	2,260.0	0.023001	0.023073	0.4460297	138.8	138.4	138.8	138.3
68	Pipe	8 inch	17.000	14,052.0	2,260.0	2,260.3	0.023073	0.023076	0.0177917	138.4	138.3	138.3	138.3
69	Pipe	8 inch	22.000	853.0	137.2	137.2	0.001400	0.001400	0.0001221	138.3	138.3	138.3	138.3
70	Pipe	8 inch	350.000	13,199.0	2,123.0	2,128.0	0.021675	0.021725	0.3248444	138.3	138.0	138.3	138.0
71	Pipe	3 inch	131.000	1,182.0	1,291.3	1,292.7	0.013182	0.013196	0.1496429	137.8	137.7	137.8	137.6
72	Pipe	8 inch	213.000	13,199.0	2,128.0	2,131.1	0.021725	0.021755	0.1980591	138.0	137.8	138.0	137.8
73	Pipe	8 inch	210.000	10,317.0	1,665.6	1,667.1	0.017003	0.017018	0.1216278	137.8	137.7	137.8	137.7
79	Pipe	6 inch	210.000	1,990.0	556.7	556.8	0.005683	0.005684	0.0213318	137.7	137.7	137.7	137.7
80	Pipe	3 inch	17.000	995.0	1,088.1	1,088.2	0.011107	0.011108	0.0140076	137.7	137.7	137.7	137.6
81	Pipe	3 inch	23.000	995.0	1,088.2	1,088.4	0.011109	0.011110	0.0189514	137.7	137.6	137.6	137.6
82	Pipe	3 inch	70.000	995.0	1,088.1	1,088.5	0.011107	0.011112	0.0576935	137.7	137.6	137.7	137.6
83	Pipe	3 inch	9.000	995.0	1,088.6	1,088.6	0.011112	0.011113	0.0074158	137.6	137.6	137.6	137.6
84	Pipe	3 inch	8.000	995.0	1,088.6	1,088.7	0.011113	0.011113	0.0065918	137.6	137.6	137.6	137.6
85	Pipe	3 inch	9.000	995.0	1,088.7	1,088.8	0.011114	0.011114	0.0074158	137.6	137.6	137.6	137.6
86	Pipe	3 inch	80.000	995.0	1,088.8	1,089.3	0.011114	0.011120	0.0659790	137.6	137.5	137.6	137.5
87	Pipe	8 inch	372.000	6,773.0	1,094.3	1,095.1	0.011171	0.011179	0.0965118	137.7	137.6	137.7	137.6
88	Pipe	3 inch	29.000	1,020.0	1,116.0	1,116.2	0.011392	0.011395	0.0250549	137.6	137.6	137.6	137.6
89	Pipe	6 inch	400.000	4,331.0	1,212.6	1,214.2	0.012378	0.012394	0.1758881	137.6	137.4	137.6	137.4
90	Pipe	3 inch	48.000	1,020.0	1,117.5	1,117.8	0.011407	0.011410	0.0415344	137.4	137.4	137.4	137.4
91	Pipe	3 inch	93.000	2,031.0	2,225.9	2,230.8	0.022722	0.022771	0.3011780	137.4	137.1	137.3	137.0
92	Pipe	6 inch	243.000	2,031.0	569.3	569.4	0.005812	0.005813	0.0256958	137.4	137.4	137.4	137.4
93	Pipe	3 inch	12.000	1,020.0	1,120.1	1,120.2	0.011433	0.011434	0.0104065	137.1	137.1	137.1	137.1
94	Pipe	3 inch	168.000	1,011.0	1,110.2	1,111.4	0.011332	0.011344	0.1433716	137.1	136.9	137.1	136.9
95	Pipe	3 inch	38.000	1,011.0	1,111.4	1,111.7	0.011344	0.011347	0.0324402	136.9	136.9	136.9	136.9
96	Pipe	3 inch	60.000	1,011.0	1,111.7	1,112.1	0.011347	0.011351	0.0512390	136.9	136.9	136.9	136.8
97	Pipe	6 inch	340.000	21,345.0	5,896.6	6,039.6	0.060223	0.061653	3.2967529	139.7	136.4	139.4	136.1
98	Pipe	6 inch	243.000	19,670.0	5,564.1	5,649.0	0.056797	0.057646	2.0446930	136.4	134.4	136.1	134.1
99	Pipe	6 inch	215.000	19,670.0	5,649.0	5,727.4	0.057646	0.058431	1.8354340	134.4	132.5	134.1	132.2

AFT Arrow Model

Pipe	Name	Pipe Nominal Size	Length (feet)	Mass Flow (lbm/hr)	Vel. In (feet/min)	Vel. Out (feet/min)	Mach # In	Mach # Out	dP Stag. Total (psid)	P Stag. In (psia)	P Stag. Out (psia)	P Static In (psia)	P Static Out (psia)
100	Pipe	6 inch	208.000	12,096.0	3,518.4	3,536.8	0.035890	0.036074	0.6900635	132.5	131.8	132.4	131.7
101	Pipe	6 inch	15.000	5,578.0	1,630.2	1,630.3	0.016626	0.016627	0.0111542	131.8	131.8	131.8	131.8
102	Pipe	6 inch	238.000	6,518.0	1,905.0	1,908.5	0.019429	0.019464	0.2388763	131.8	131.6	131.8	131.6
103	Pipe	4 inch	430.000	2,770.0	1,840.6	1,849.9	0.018771	0.018865	0.6656036	131.6	130.9	131.6	130.9
104	Pipe	3 inch	62.000	958.0	1,057.7	1,058.1	0.010795	0.010799	0.0480042	136.3	136.3	136.3	136.3
105	Pipe	3 inch	79.000	958.0	1,058.1	1,058.6	0.010799	0.010804	0.0612030	136.3	136.2	136.3	136.2
106	Pipe	6 inch	10.000	2,686.0	755.2	755.2	0.007708	0.007708	0.0017853	137.0	137.0	137.0	137.0
108	Pipe	3 inch	90.000	855.0	928.1	928.5	0.009476	0.009480	0.0552826	138.7	138.6	138.7	138.6
109	Pipe	3 inch	50.000	855.0	928.5	928.7	0.009480	0.009482	0.0307312	138.6	138.6	138.6	138.6
110	Pipe	3 inch	50.000	855.0	928.7	928.9	0.009482	0.009484	0.0307312	138.6	138.6	138.6	138.6
111	Pipe	3 inch	30.000	855.0	929.0	929.1	0.009484	0.009485	0.0184479	138.6	138.5	138.6	138.5
112	Pipe	3 inch	1.000	855.0	928.1	928.1	0.009476	0.009476	0.0006256	138.7	138.7	138.7	138.7
113	Pipe	2 inch	5.000	284.0	674.2	674.2	0.006885	0.006885	0.0027771	139.7	139.7	139.7	139.7
114	Pipe	3 inch	90.000	3,413.0	3,744.0	3,766.0	0.038221	0.038441	0.8016205	137.3	136.5	137.2	136.4
115	Pipe	3 inch	50.000	3,413.0	3,766.9	3,779.3	0.038450	0.038574	0.4474945	136.5	136.0	136.4	135.9
116	Pipe	8 inch	331.000	3,049.0	494.3	494.3	0.005045	0.005046	0.0192413	137.2	137.2	137.2	137.2
117	Pipe	3 inch	15.000	3,049.0	3,347.0	3,349.6	0.034167	0.034193	0.1069946	137.2	137.1	137.1	137.0
118	Pipe	3 inch	30.000	1,675.0	1,849.1	1,850.0	0.018871	0.018881	0.0674286	136.4	136.3	136.4	136.3
119	Pipe	6 inch	214.000	7,574.0	2,202.2	2,207.0	0.022463	0.022511	0.2854767	132.5	132.2	132.5	132.2
120	Pipe	6 inch	297.000	7,574.0	2,207.0	2,213.7	0.022511	0.022577	0.3972321	132.2	131.8	132.2	131.8
121	Pipe	4 inch	125.000	6,624.0	4,396.8	4,432.2	0.044847	0.045202	1.0519867	131.8	130.8	131.7	130.6
122	Pipe	6 inch	135.000	950.0	277.6	277.6	0.002831	0.002831	0.0036774	131.8	131.8	131.8	131.8
123	Pipe	3 inch	293.000	950.0	1,084.9	1,086.8	0.011065	0.011084	0.2311554	131.8	131.6	131.8	131.6
125	Pipe	3 inch	264.000	950.0	1,086.8	1,088.5	0.011084	0.011101	0.2086334	131.6	131.4	131.6	131.4
126	Pipe	3 inch	18.000	950.0	1,088.5	1,088.7	0.011101	0.011102	0.0142365	131.4	131.4	131.4	131.4
127	Pipe	4 inch	109.000	3,748.0	2,490.8	2,496.5	0.025403	0.025460	0.3019409	131.6	131.3	131.5	131.2
128	Pipe	3 inch	70.000	1,700.0	1,857.3	1,859.5	0.018960	0.018982	0.1603088	137.8	137.7	137.8	137.6
129	Pipe	3 inch	165.000	1,554.0	1,701.5	1,705.4	0.017369	0.017408	0.3188629	137.5	137.2	137.5	137.2
130	Pipe	8 inch	307.000	1,422.0	229.9	229.9	0.002347	0.002347	0.0043793	137.6	137.6	137.6	137.6
131	Pipe	6 inch	83.000	1,422.0	398.1	398.1	0.004064	0.004064	0.0045319	137.6	137.6	137.6	137.6
132	Pipe	3 inch	250.000	1,280.0	1,402.4	1,405.8	0.014315	0.014349	0.3335571	137.4	137.1	137.4	137.1
133	Pipe	3 inch	80.000	1,280.0	1,406.8	1,407.9	0.014359	0.014370	0.1069946	137.0	136.9	137.0	136.9
134	Pipe	3 inch	70.000	1,280.0	1,405.8	1,406.7	0.014349	0.014359	0.0935516	137.1	137.0	137.1	137.0
135	Pipe	3 inch	90.000	1,554.0	1,699.3	1,701.4	0.017347	0.017368	0.1735992	137.7	137.5	137.7	137.5

All Junction Table

AFT Arrow Model

Jct	Name	Mass Flow Rate Thru Jct (lbm/hr)
1	Boiler	N/A
2	Bend	16,412.2
3	Pit 9	N/A
4	Bend	3,797.0
5	Bend	3,797.0
6	Williams Fieldhouse	3,797.0
7	PIT 8	12,614.7
10	Bend	2,309.0
11	Karrmann Library	2,309.0
12	Student Center/S9/S10	3,406.0
15	Russell Hall	3,537.0
16	Pit 6	10,672.0
25	Bend	7,986.0
26	Bend	7,986.0
27	Bend	7,986.0
28	Bend	7,986.0
29	Pit 2	N/A
30	Bend	2,515.0
31	Center for Arts/A5/A6	2,515.0
32	Pit 1	3,836.0
33	Bend	3,836.0
34	Bend	3,836.0
35	Bend	3,836.0
36	Bend	3,836.0
37	Ullsvik Center	3,836.0
41	Bend	1,635.0
42	Bend	1,635.0
44	Art Building	677.0
53	Branch	13,772.9
54	Bend	13,772.9
59	Pit 15	16,704.9
60	Tee or Wye	N/A
61	Boebel Hall	2,932.0
62	Pit 16	N/A
63	Pit 17	N/A
64	Ottensman Hall	5,716.0
65	Bend	855.0
66	Bend	855.0
67	Bend	855.0

## AFT Arrow Model

Jct	Name	Mass Flow Rate Thru Jct (lbm/hr)
69	Pit 18	14,052.0
70	Tee or Wye	N/A
71	Wilgus Hall/S6	853.0
72	Pit 19	13,199.0
73	Pit 20	N/A
74	Dobson Hall	1,182.0
75	Pit 21	N/A
81	Branch	N/A
82	Bend	995.0
83	Porter Hall	995.0
84	Bend	995.0
85	Bend	995.0
86	Bend	995.0
87	Bend	995.0
88	Melcher Hall	995.0
89	Pit 23	N/A
90	Morrow Hall	1,020.0
91	Pit 24	N/A
92	Huginin Hall	1,020.0
93	Pit 25	2,031.0
95	Brockert Hall	1,020.0
96	Bend	1,011.0
97	Bend	1,011.0
98	Pickard Hall	1,011.0
99	Pit 26	N/A
100	Pit 27	19,670.0
101	Pit 28	N/A
102	Pit 29	N/A
103	Engineering Hall/A3	5,578.0
104	Pit 30	N/A
105	Southwest Hall	2,770.0
106	Tee or Wye	N/A
107	Bend	958.0
108	Ullrich Hall	958.0
109	Branch	N/A
110	Doudna Hall	2,686.0
112	Bend	855.0
113	Bend	855.0
114	Bend	855.0

## AFT Arrow Model

Jct	Name	Mass Flow Rate Thru Jct (lbm/hr)
115	McGregor	855.0
116	Central Heating/F1	284.0
117	Branch	N/A
118	Pit 5	N/A
120	Tee or Wye	N/A
121	Branch	3,836.0
122	Branch	16,704.9
123	A1	3,413.0
124	Tee or Wye	N/A
125	Bend	3,413.0
126	Tee or Wye	N/A
127	Bend	3,049.0
128	A7	3,049.0
129	AR1	1,675.0
130	Branch	7,574.0
131	Branch	N/A
132	A4	6,624.0
133	Bend	950.0
134	Branch	950.0
136	Bend	950.0
137	AR3	950.0
138	R7/S7	3,748.0
139	R5/S5	1,700.0
140	R4/S4	1,554.0
142	S2	1,422.0
144	R3/S3	1,280.0
149	Bend	1,422.0
150		855.0
151	Bend	1,280.0
152	Branch	1,280.0
153	Bend	1,554.0