

AFT Arrow Model

Title: AFT Arrow Model
Analysis run on: 12/5/2011 6:47:34 AM
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 3.aro

Execution Time= 1.11 seconds
Total Number Of Pressure Iterations= 69
Total Number Of Flow Iterations= 16
Total Number Of Enthalpy Iterations= 16
Number Of Pipes= 111
Number Of Junctions= 111
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= 84,612 lbm/hr
Total Outflow= 84,612 lbm/hr
Total Energy Inflow= 27,984 Btu/s
Total Energy Outflow= 27,984 Btu/s
Total Heat Transferred Into System= 0.000 Btu/s
Maximum Pressure is 139.7 psia at Junction 1 Outlet
Minimum Pressure is 128.1 psia at Junction 137 Inlet
Maximum Static Temperature is 352.8 deg. F at Junction 116 Inlet
Minimum Static Temperature is 350.1 deg. F at Junction 137 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	17,727.5	2,824.1	2,826.5	0.028839	0.028863	0.1187897	139.7	139.6	139.6	139.5
2	Pipe	8 inch	244.000	17,727.5	2,826.8	2,834.9	0.028866	0.028947	0.3978424	139.6	139.2	139.5	139.1
3	Pipe	6 inch	170.000	3,797.0	1,051.1	1,051.5	0.010732	0.010736	0.0575256	139.2	139.1	139.2	139.1
4	Pipe	6 inch	170.000	3,797.0	1,051.5	1,051.9	0.010736	0.010741	0.0575562	139.1	139.0	139.1	139.0
5	Pipe	6 inch	53.000	3,797.0	1,052.0	1,052.1	0.010741	0.010742	0.0179596	139.0	139.0	139.0	139.0
6	Pipe	6 inch	298.000	13,930.3	3,858.7	3,893.6	0.039403	0.039751	1.2430725	139.2	137.9	139.0	137.8
7	Pipe	8 inch	367.000	13,930.3	2,247.8	2,254.0	0.022948	0.023010	0.3793335	137.9	137.5	137.8	137.5
8	Pipe	8 inch	306.000	15,714.0	2,542.9	2,550.3	0.025958	0.026032	0.4006195	137.5	137.1	137.5	137.1
9	Pipe	4 inch	82.000	2,309.0	1,472.3	1,473.2	0.015028	0.015038	0.0857544	137.1	137.0	137.1	137.0
10	Pipe	4 inch	38.000	2,309.0	1,473.3	1,473.7	0.015038	0.015042	0.0397491	137.0	137.0	137.0	137.0
11	Pipe	4 inch	138.000	3,406.0	2,172.1	2,176.9	0.022172	0.022220	0.3048706	137.1	136.8	137.1	136.8
12	Pipe	8 inch	289.000	9,999.0	1,622.5	1,624.3	0.016561	0.016580	0.1584167	137.1	137.0	137.1	136.9
13	Pipe	8 inch	382.000	6,586.0	1,069.8	1,070.6	0.010920	0.010927	0.0944824	137.0	136.9	136.9	136.9
14	Pipe	4 inch	36.000	3,537.0	2,259.8	2,261.2	0.023066	0.023081	0.0856476	136.9	136.8	136.8	136.7
15	Pipe	6 inch	270.000	10,672.0	2,990.8	3,005.6	0.030531	0.030679	0.6760101	137.5	136.8	137.4	136.8
16	Pipe	6 inch	77.000	10,672.0	3,005.6	3,009.8	0.030679	0.030722	0.1933899	136.8	136.6	136.8	136.6
21	Pipe	6 inch	75.000	7,986.0	2,251.9	2,253.6	0.022984	0.023002	0.1074219	136.6	136.5	136.6	136.5
22	Pipe	6 inch	7.000	7,986.0	2,253.8	2,253.9	0.023004	0.023005	0.0100403	136.5	136.5	136.5	136.5
23	Pipe	6 inch	36.000	7,986.0	2,254.1	2,255.0	0.023007	0.023015	0.0516052	136.5	136.5	136.5	136.4
24	Pipe	6 inch	92.000	7,986.0	2,255.1	2,257.3	0.023017	0.023039	0.1319733	136.4	136.3	136.4	136.3
25	Pipe	6 inch	220.000	7,986.0	2,257.4	2,262.7	0.023040	0.023093	0.3161316	136.3	136.0	136.3	135.9
26	Pipe	3 inch	130.000	2,515.0	2,785.1	2,798.4	0.028425	0.028557	0.6443939	136.0	135.3	135.9	135.3
27	Pipe	3 inch	35.000	2,515.0	2,798.6	2,802.2	0.028559	0.028595	0.1740265	135.3	135.2	135.3	135.1
28	Pipe	6 inch	139.000	3,836.0	1,086.6	1,087.0	0.011090	0.011094	0.0490723	136.0	135.9	136.0	135.9
29	Pipe	3 inch	47.000	3,836.0	4,252.3	4,269.0	0.043401	0.043568	0.5312195	135.9	135.4	135.8	135.2
30	Pipe	3 inch	14.000	3,836.0	4,270.2	4,275.2	0.043581	0.043631	0.1586761	135.4	135.2	135.2	135.0
31	Pipe	3 inch	59.000	3,836.0	4,276.5	4,297.9	0.043644	0.043857	0.6710052	135.2	134.5	135.0	134.3
32	Pipe	3 inch	55.000	3,836.0	4,299.2	4,319.4	0.043870	0.044072	0.6287231	134.4	133.8	134.3	133.7
33	Pipe	3 inch	15.000	3,836.0	4,320.7	4,326.3	0.044085	0.044141	0.1720428	133.8	133.6	133.6	133.4
34	Pipe	6 inch	46.000	3,836.0	1,087.0	1,087.2	0.011094	0.011095	0.0162354	135.9	135.9	135.9	135.9
38	Pipe	6 inch	40.000	1,635.0	463.1	463.1	0.004727	0.004727	0.0028534	136.0	136.0	136.0	136.0
39	Pipe	6 inch	36.000	1,635.0	463.1	463.2	0.004727	0.004727	0.0025635	136.0	136.0	136.0	136.0
40	Pipe	6 inch	79.000	1,635.0	463.2	463.2	0.004727	0.004727	0.0056458	136.0	136.0	136.0	136.0
41	Pipe	6 inch	43.000	677.0	191.8	191.8	0.001957	0.001957	0.0006104	136.0	136.0	136.0	136.0
50	Pipe	8 inch	30.000	12,456.5	2,015.2	2,015.5	0.020571	0.020574	0.0250092	137.5	137.5	137.5	137.5
51	Pipe	8 inch	101.000	12,456.5	2,013.9	2,015.2	0.020558	0.020571	0.0841827	137.6	137.5	137.6	137.5

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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	12,456.5	2,013.6	2,013.8	0.020555	0.020557	0.0174866	137.6	137.6	137.6	137.6
53	Pipe	8 inch	63.000	15,388.5	2,486.4	2,487.8	0.025382	0.025396	0.0789795	137.7	137.6	137.7	137.6
57	Pipe	8 inch	300.000	15,388.5	2,479.6	2,486.4	0.025314	0.025382	0.3754883	138.1	137.7	138.0	137.7
58	Pipe	8 inch	5.000	2,932.0	473.9	473.9	0.004837	0.004837	0.0002747	137.6	137.6	137.6	137.6
59	Pipe	8 inch	153.000	20,336.4	3,269.8	3,277.6	0.033385	0.033462	0.3285980	138.4	138.1	138.3	138.0
60	j99	10 inch	230.000	38,223.8	3,885.2	3,900.0	0.039671	0.039820	0.5282898	139.0	138.4	138.8	138.3
61	Pipe	4 inch	92.000	5,716.0	3,598.4	3,612.7	0.036742	0.036885	0.5491638	139.0	138.4	138.8	138.3
62	Pipe	10 inch	245.000	43,939.7	4,443.6	4,467.2	0.045380	0.045616	0.7363739	139.7	139.0	139.5	138.8
63	Pipe	3 inch	49.000	855.0	929.8	930.0	0.009493	0.009495	0.0301514	138.4	138.4	138.4	138.4
64	Pipe	3 inch	75.000	855.0	930.1	930.4	0.009495	0.009498	0.0461731	138.4	138.4	138.4	138.3
65	Pipe	3 inch	52.000	855.0	930.4	930.6	0.009498	0.009500	0.0320282	138.4	138.3	138.3	138.3
67	Pipe	8 inch	427.000	17,032.0	2,738.1	2,751.0	0.027955	0.028084	0.6499481	138.4	137.8	138.4	137.7
68	Pipe	8 inch	17.000	17,032.0	2,751.0	2,751.5	0.028084	0.028089	0.0259399	137.8	137.8	137.7	137.7
69	Pipe	8 inch	22.000	1,365.0	220.4	220.4	0.002250	0.002250	0.0002899	137.8	137.8	137.8	137.8
70	Pipe	8 inch	350.000	15,667.0	2,530.9	2,539.3	0.025836	0.025920	0.4548645	137.8	137.3	137.7	137.2
71	Pipe	3 inch	131.000	1,182.0	1,298.7	1,300.1	0.013256	0.013270	0.1505127	137.0	136.9	137.0	136.9
72	Pipe	8 inch	213.000	15,667.0	2,539.3	2,544.4	0.025920	0.025972	0.2775421	137.3	137.0	137.2	137.0
73	Pipe	8 inch	210.000	12,785.0	2,076.1	2,078.9	0.021191	0.021219	0.1849365	137.0	136.8	137.0	136.8
79	Pipe	6 inch	210.000	1,990.0	560.2	560.3	0.005718	0.005719	0.0214691	136.8	136.8	136.8	136.8
80	Pipe	3 inch	17.000	995.0	1,094.9	1,095.0	0.011175	0.011176	0.0140991	136.8	136.8	136.8	136.8
81	Pipe	3 inch	23.000	995.0	1,095.0	1,095.2	0.011176	0.011178	0.0190735	136.8	136.8	136.8	136.8
82	Pipe	3 inch	70.000	995.0	1,094.9	1,095.3	0.011175	0.011180	0.0580444	136.8	136.8	136.8	136.7
83	Pipe	3 inch	9.000	995.0	1,095.4	1,095.4	0.011180	0.011181	0.0074768	136.8	136.7	136.7	136.7
84	Pipe	3 inch	8.000	995.0	1,095.4	1,095.5	0.011181	0.011181	0.0066376	136.7	136.7	136.7	136.7
85	Pipe	3 inch	9.000	995.0	1,095.5	1,095.6	0.011181	0.011182	0.0074615	136.7	136.7	136.7	136.7
86	Pipe	3 inch	80.000	995.0	1,095.6	1,096.1	0.011182	0.011188	0.0663757	136.7	136.7	136.7	136.6
87	Pipe	8 inch	372.000	9,241.0	1,502.5	1,504.4	0.015336	0.015355	0.1756897	136.8	136.7	136.8	136.6
88	Pipe	3 inch	29.000	1,020.0	1,123.7	1,123.9	0.011469	0.011471	0.0252228	136.7	136.6	136.7	136.6
89	Pipe	6 inch	400.000	4,331.0	1,220.9	1,222.5	0.012461	0.012477	0.1770782	136.7	136.5	136.6	136.5
90	Pipe	3 inch	48.000	1,020.0	1,125.1	1,125.5	0.011483	0.011487	0.0418243	136.5	136.4	136.5	136.4
91	Pipe	3 inch	93.000	2,031.0	2,241.1	2,246.1	0.022874	0.022924	0.3032379	136.5	136.2	136.4	136.1
92	Pipe	6 inch	243.000	2,031.0	573.2	573.3	0.005851	0.005852	0.0258789	136.5	136.5	136.5	136.5
93	Pipe	3 inch	12.000	1,020.0	1,127.8	1,127.9	0.011510	0.011511	0.0104828	136.2	136.1	136.1	136.1
94	Pipe	3 inch	168.000	1,011.0	1,117.9	1,119.1	0.011409	0.011421	0.1443481	136.2	136.0	136.1	136.0
95	Pipe	3 inch	38.000	1,011.0	1,119.1	1,119.4	0.011421	0.011423	0.0326691	136.0	136.0	136.0	136.0
96	Pipe	3 inch	60.000	1,011.0	1,119.4	1,119.8	0.011424	0.011428	0.0515900	136.0	135.9	136.0	135.9
97	Pipe	6 inch	340.000	22,661.0	6,261.6	6,433.4	0.063952	0.065671	3.7167358	139.7	136.0	139.3	135.6
98	Pipe	6 inch	243.000	20,986.0	5,956.1	6,060.4	0.060796	0.061840	2.3335114	136.0	133.6	135.7	133.3
99	Pipe	6 inch	215.000	20,986.0	6,060.4	6,157.4	0.061840	0.062811	2.0993347	133.6	131.5	133.3	131.2

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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)
100	Pipe	6 inch	208.000	12,096.0	3,544.5	3,563.3	0.036151	0.036339	0.6952057	131.5	130.9	131.4	130.7
101	Pipe	6 inch	15.000	5,578.0	1,642.4	1,642.5	0.016748	0.016749	0.0112305	130.9	130.8	130.8	130.8
102	Pipe	6 inch	238.000	6,518.0	1,919.3	1,922.8	0.019571	0.019607	0.2406769	130.9	130.6	130.8	130.6
103	Pipe	4 inch	430.000	2,770.0	1,854.4	1,864.0	0.018909	0.019005	0.6705933	130.6	129.9	130.6	129.9
104	Pipe	3 inch	62.000	958.0	1,060.6	1,061.0	0.010824	0.010828	0.0481567	136.0	135.9	136.0	135.9
105	Pipe	3 inch	79.000	958.0	1,061.0	1,061.5	0.010828	0.010833	0.0613708	135.9	135.9	135.9	135.9
106	Pipe	6 inch	10.000	2,686.0	757.2	757.2	0.007729	0.007729	0.0017853	136.6	136.6	136.6	136.6
108	Pipe	3 inch	90.000	855.0	930.6	931.0	0.009501	0.009504	0.0554199	138.3	138.3	138.3	138.3
109	Pipe	3 inch	50.000	855.0	931.0	931.2	0.009504	0.009506	0.0308075	138.3	138.2	138.3	138.2
110	Pipe	3 inch	50.000	855.0	931.2	931.4	0.009507	0.009509	0.0308228	138.2	138.2	138.2	138.2
111	Pipe	3 inch	30.000	855.0	931.4	931.6	0.009509	0.009510	0.0184937	138.2	138.2	138.2	138.2
112	Pipe	3 inch	1.000	855.0	930.6	930.6	0.009500	0.009500	0.0006104	138.3	138.3	138.3	138.3
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	3,754.1	3,776.3	0.038322	0.038544	0.8038177	137.0	136.2	136.8	136.0
115	Pipe	3 inch	50.000	3,413.0	3,777.2	3,789.7	0.038553	0.038678	0.4487305	136.1	135.7	136.0	135.5
116	Pipe	8 inch	331.000	3,049.0	495.6	495.7	0.005058	0.005059	0.0192871	136.9	136.8	136.9	136.8
117	Pipe	3 inch	15.000	3,049.0	3,356.1	3,358.7	0.034257	0.034284	0.1072845	136.8	136.7	136.7	136.6
118	Pipe	3 inch	30.000	1,675.0	1,854.8	1,855.7	0.018929	0.018938	0.0676270	136.0	135.9	135.9	135.9
119	Pipe	6 inch	214.000	8,890.0	2,604.3	2,612.1	0.026560	0.026638	0.3923340	131.5	131.2	131.5	131.1
120	Pipe	6 inch	297.000	8,890.0	2,612.1	2,623.0	0.026638	0.026747	0.5464172	131.2	130.6	131.1	130.5
121	Pipe	4 inch	125.000	6,624.0	4,438.2	4,474.7	0.045262	0.045626	1.0619965	130.6	129.5	130.4	129.4
122	Pipe	6 inch	135.000	2,266.0	668.4	668.5	0.006815	0.006816	0.0184174	130.6	130.6	130.6	130.6
123	Pipe	3 inch	293.000	2,266.0	2,613.2	2,638.2	0.026647	0.026897	1.2383575	130.6	129.4	130.5	129.3
125	Pipe	3 inch	264.000	2,266.0	2,638.2	2,661.4	0.026897	0.027129	1.1260223	129.4	128.2	129.3	128.2
126	Pipe	3 inch	18.000	2,266.0	2,661.7	2,663.3	0.027132	0.027148	0.0771484	128.2	128.1	128.2	128.1
127	Pipe	4 inch	109.000	3,748.0	2,509.5	2,515.4	0.025590	0.025649	0.3041992	130.6	130.3	130.6	130.3
128	Pipe	3 inch	70.000	1,700.0	1,868.0	1,870.2	0.019067	0.019089	0.1612244	137.0	136.9	137.0	136.8
129	Pipe	3 inch	165.000	1,554.0	1,712.1	1,716.2	0.017475	0.017515	0.3208618	136.7	136.3	136.6	136.3
130	Pipe	8 inch	307.000	3,890.0	633.2	633.4	0.006463	0.006464	0.0282135	136.7	136.6	136.7	136.6
131	Pipe	6 inch	83.000	3,890.0	1,096.8	1,097.0	0.011194	0.011197	0.0299530	136.6	136.6	136.6	136.6
132	Pipe	3 inch	250.000	1,280.0	1,412.0	1,415.4	0.014411	0.014446	0.3358459	136.5	136.1	136.5	136.1
133	Pipe	3 inch	80.000	1,280.0	1,416.5	1,417.6	0.014456	0.014467	0.1077271	136.1	135.9	136.0	135.9
134	Pipe	3 inch	70.000	1,280.0	1,415.4	1,416.4	0.014446	0.014455	0.0941925	136.1	136.1	136.1	136.0
135	Pipe	3 inch	90.000	1,554.0	1,709.9	1,712.0	0.017452	0.017474	0.1746826	136.8	136.7	136.8	136.6
136	Pipe	4 inch	28.000	4,948.0	3,138.1	3,141.0	0.032037	0.032066	0.1268768	137.9	137.8	137.8	137.7
137	Pipe	4 inch	38.000	4,948.0	3,133.7	3,137.6	0.031993	0.032032	0.1719666	138.1	137.9	138.0	137.8

AFT Arrow Model

Jct	Name	Mass Flow Rate Thru Jct (lbm/hr)
1	Boiler	N/A
2	Bend	17,727.5
3	Pit 9	N/A
4	Bend	3,797.0
5	Bend	3,797.0
6	Williams Fieldhouse	3,797.0
7	PIT 8	13,930.3
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	12,456.5
54	Bend	12,456.5
59	Pit 15	N/A
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	17,032.0
70	Tee or Wye	N/A
71	Wilgus Hall/S6	1,365.0
72	Pit 19	15,667.0
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	20,986.0
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	15,388.5
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	8,890.0
131	Branch	N/A
132	A4	6,624.0
133	Bend	2,266.0
134	Branch	2,266.0
136	Bend	2,266.0
137	AR3/R8/S8	2,266.0
138	R7/S7	3,748.0
139	R5/S5	1,700.0
140	R4/S4	1,554.0
142	S2/R1/S1	3,890.0
144	R3/S3	1,280.0
149	Bend	3,890.0
150		855.0
151	Bend	1,280.0
152	Branch	1,280.0
153	Bend	1,554.0
154	Bend	4,948.0
155	A2	4,948.0