

University of Idaho Department of Chemical Engineering
 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:45:58

Input File Name: g4.dat

Start Iteration Loop
 Flow = 5.000 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 95.00
 T Out Guess = 71.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density= 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	52.2 126.0	27.9 82.3	73483.	36465. 6422.	9861. 1737.	6714. 1183.
	Dittus-Boelter T film Pr.33 = 6452. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 6422.					
	Nusselt Ent. = 8162.					
	Sieder-Tate = 7095.					
	Sleicher-Rouse = 7071.					
	Petukhov-Popov = 7396. T V					
	McAdams T bulk = 6316. 78.6 34.55					
	McAdams T film = 7198. 102.3					
2	54.7 130.5	31.9 89.4	78466.	37654. 6632.	10005. 1762.	6843. 1205.
	Dittus-Boelter T film Pr.33 = 6654. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 6632.					
	Nusselt Ent. = 8417.					
	Sieder-Tate = 7346.					
	Sleicher-Rouse = 7347.					
	Petukhov-Popov = 7620. T V					
	McAdams T bulk = 6584. 85.8 34.55					
	McAdams T film = 7416. 108.2					
3	57.2 134.9	35.7 96.3	83763.	38858. 6844.	10153. 1788.	6973. 1228.
	Dittus-Boelter T film Pr.33 = 6858. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 6844.					
	Nusselt Ent. = 8675.					
	Sieder-Tate = 7600.					

			Sleicher-Rouse =	7623.		
			Petukhov-Popov =	7843.	T	V
			McAdams T bulk =	6845.	92.8	34.55
			McAdams T film =	7629.	113.9	
4	59.6	39.5	89369.	40072.	10304.	7104.
	139.4	103.0		7057.	1815.	1251.
			Dittus-Boelter T film Pr.33 =	7063.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	7057.		
			Nusselt Ent. =	8935.		
			Sieder-Tate =	7856.		
			Sleicher-Rouse =	7899.		
			Petukhov-Popov =	8062.	T	V
			McAdams T bulk =	7099.	99.7	34.55
			McAdams T film =	7839.	119.5	
5	62.1	43.1	95277.	41293.	10457.	7235.
	143.7	109.6		7272.	1842.	1274.
			Dittus-Boelter T film Pr.33 =	7270.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	7272.		
			Nusselt Ent. =	9197.		
			Sieder-Tate =	8114.		
			Sleicher-Rouse =	8173.		
			Petukhov-Popov =	8278.	T	V
			McAdams T bulk =	7347.	106.3	34.56
			McAdams T film =	8044.	125.0	
6	64.4	46.6	101475.	42516.	10614.	7368.
	148.0	115.9		7488.	1869.	1298.
			Dittus-Boelter T film Pr.33 =	7477.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	7488.		
			Nusselt Ent. =	9459.		
			Sieder-Tate =	8372.		
			Sleicher-Rouse =	8444.		
			Petukhov-Popov =	8489.	T	V
			McAdams T bulk =	7588.	112.8	34.56
			McAdams T film =	8244.	130.4	

Flow Rate = 5.000 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 46.6 Degrees C 115.9 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	52.2	126.0	27.9	82.3
23.333	54.7	130.5	31.9	89.4
35.000	57.2	134.9	35.7	96.3
46.667	59.6	139.4	39.5	103.0
58.333	62.1	143.7	43.1	109.6
70.000	64.4	148.0	46.6	115.9

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 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:46:16

Input from KEYBOARD for Case Number: 2

Start Iteration Loop
 Flow = 3.000 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 53.00
 T Out Guess = 30.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density= 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	62.1 143.7	29.9 85.9	44790.	24416. 4300.	10457. 1842.	6096. 1074.
	Dittus-Boelter T film Pr.33 = 4523. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 4300.					
	Nusselt Ent. = 5722.					
	Sieder-Tate = 4870.					
	Sleicher-Rouse = 4635.					
	Petukhov-Popov = 4835. T V					
	McAdams T bulk = 4240. 80.4 20.72					
	McAdams T film = 5022. 112.1					
2	65.1 149.1	35.8 96.4	49438.	25615. 4511.	10656. 1877.	6277. 1106.
	Dittus-Boelter T film Pr.33 = 4718. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 4511.					
	Nusselt Ent. = 5969.					
	Sieder-Tate = 5118.					
	Sleicher-Rouse = 4909.					
	Petukhov-Popov = 5057. T V					
	McAdams T bulk = 4505. 91.1 20.72					
	McAdams T film = 5222. 120.1					
3	68.0 154.5	41.4 106.5	54511.	26832. 4726.	10865. 1913.	6461. 1138.
	Dittus-Boelter T film Pr.33 = 4915. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 4726.					
	Nusselt Ent. = 6218.					
	Sieder-Tate = 5370.					

			Sleicher-Rouse =	5182.		
			Petukhov-Popov =	5275.	T	V
			McAdams T bulk =	4760.	101.4	20.72
			McAdams T film =	5416.	128.0	
4	71.0	46.8	59998.	28058.	11082.	6647.
	159.8	116.2		4942.	1952.	1171.
			Dittus-Boelter T film Pr.33 =	5113.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	4942.		
			Nusselt Ent. =	6469.		
			Sieder-Tate =	5623.		
			Sleicher-Rouse =	5450.		
			Petukhov-Popov =	5489.	T	V
			McAdams T bulk =	5005.	111.3	20.72
			McAdams T film =	5605.	135.6	
5	73.9	51.9	65865.	29284.	11310.	6833.
	165.1	125.4		5157.	1992.	1203.
			Dittus-Boelter T film Pr.33 =	5310.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	5157.		
			Nusselt Ent. =	6717.		
			Sieder-Tate =	5875.		
			Sleicher-Rouse =	5713.		
			Petukhov-Popov =	5696.	T	V
			McAdams T bulk =	5239.	120.8	20.72
			McAdams T film =	5787.	142.9	
6	76.8	56.8	72061.	30498.	11547.	7021.
	170.2	134.2		5371.	2034.	1237.
			Dittus-Boelter T film Pr.33 =	5503.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	5371.		
			Nusselt Ent. =	6961.		
			Sieder-Tate =	6125.		
			Sleicher-Rouse =	5965.		
			Petukhov-Popov =	5893.	T	V
			McAdams T bulk =	5462.	129.8	20.73
			McAdams T film =	5963.	150.0	

Flow Rate = 3.000 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 56.8 Degrees C 134.2 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	62.1	143.7	29.9	85.9
23.333	65.1	149.1	35.8	96.4
35.000	68.0	154.5	41.4	106.5
46.667	71.0	159.8	46.8	116.2
58.333	73.9	165.1	51.9	125.4
70.000	76.8	170.2	56.8	134.2

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 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:47:17

Input from KEYBOARD for Case Number: 3

Start Iteration Loop
 Flow = 2.500 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 65.00
 T Out Guess = 33.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density= 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	65.9 150.6	30.8 87.5	37581.	21172. 3729.	10711. 1886.	5832. 1027.
				Dittus-Boelter T film Pr.33 = 3992. BTU/Ft2 F		
				Dittus-Boelter T bulk Pr.4 = 3729.		
				Nusselt Ent. = 5050.		
				Sieder-Tate = 4262.		
				Sleicher-Rouse = 3994.		
				Petukhov-Popov = 4160. T V		
				McAdams T bulk = 3680. 81.2 17.26		
				McAdams T film = 4422. 115.9		
2	69.0 156.2	37.4 99.4	42077.	22362. 3938.	10933. 1925.	6035. 1063.
				Dittus-Boelter T film Pr.33 = 4182. BTU/Ft2 F		
				Dittus-Boelter T bulk Pr.4 = 3938.		
				Nusselt Ent. = 5291.		
				Sieder-Tate = 4507.		
				Sleicher-Rouse = 4263.		
				Petukhov-Popov = 4379. T V		
				McAdams T bulk = 3941. 93.4 17.26		
				McAdams T film = 4613. 124.8		
3	72.1 161.8	43.8 110.8	47042.	23571. 4151.	11167. 1967.	6241. 1099.
				Dittus-Boelter T film Pr.33 = 4374. BTU/Ft2 F		
				Dittus-Boelter T bulk Pr.4 = 4151.		
				Nusselt Ent. = 5533.		
				Sieder-Tate = 4755.		

			Sleicher-Rouse =	4532.		
			Petukhov-Popov =	4595.	T	V
			McAdams T bulk =	4191.	105.1	17.26
			McAdams T film =	4798.	133.5	
4	75.2	49.8	52450.	24788.	11414.	6448.
	167.4	121.6		4366.	2010.	1136.
			Dittus-Boelter T film Pr.33 =	4566.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	4366.		
			Nusselt Ent. =	5776.		
			Sieder-Tate =	5003.		
			Sleicher-Rouse =	4794.		
			Petukhov-Popov =	4804.	T	V
			McAdams T bulk =	4429.	116.2	17.27
			McAdams T film =	4977.	141.8	
5	78.3	55.5	58253.	25999.	11676.	6657.
	172.9	131.9		4579.	2056.	1172.
			Dittus-Boelter T film Pr.33 =	4754.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	4579.		
			Nusselt Ent. =	6014.		
			Sieder-Tate =	5249.		
			Sleicher-Rouse =	5049.		
			Petukhov-Popov =	5004.	T	V
			McAdams T bulk =	4655.	126.8	17.27
			McAdams T film =	5149.	149.8	
6	81.2	60.9	64373.	27187.	11952.	6865.
	178.2	141.6		4788.	2105.	1209.
			Dittus-Boelter T film Pr.33 =	4937.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	4788.		
			Nusselt Ent. =	6245.		
			Sieder-Tate =	5490.		
			Sleicher-Rouse =	5291.		
			Petukhov-Popov =	5192.	T	V
			McAdams T bulk =	4869.	136.8	17.27
			McAdams T film =	5313.	157.5	

Flow Rate = 2.500 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 60.9 Degrees C 141.6 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	65.9	150.6	30.8	87.5
23.333	69.0	156.2	37.4	99.4
35.000	72.1	161.8	43.8	110.8
46.667	75.2	167.4	49.8	121.6
58.333	78.3	172.9	55.5	131.9
70.000	81.2	178.2	60.9	141.6

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 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:47:37

Input from KEYBOARD for Case Number: 4

Start Iteration Loop
 Flow = 2.000 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 66.00
 T Out Guess = 33.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density= 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	70.7 159.2	32.0 89.5	30343.	17789. 3133.	11055. 1947.	5482. 965.
	Dittus-Boelter T film Pr.33 = 3429. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 3133.					
	Nusselt Ent. = 4337.					
	Sieder-Tate = 3623.					
	Sleicher-Rouse = 3332.					
	Petukhov-Popov = 3465. T V					
	McAdams T bulk = 3097. 82.3 13.80					
	McAdams T film = 3784. 120.7					
2	73.9 165.0	39.7 103.4	34635.	18959. 3339.	11303. 1991.	5711. 1006.
	Dittus-Boelter T film Pr.33 = 3611. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 3339.					
	Nusselt Ent. = 4568.					
	Sieder-Tate = 3860.					
	Sleicher-Rouse = 3596.					
	Petukhov-Popov = 3679. T V					
	McAdams T bulk = 3351. 96.5 13.81					
	McAdams T film = 3963. 130.7					
3	77.1 170.8	46.9 116.5	39440.	20150. 3549.	11572. 2038.	5944. 1047.
	Dittus-Boelter T film Pr.33 = 3794. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 3549.					
	Nusselt Ent. = 4800.					
	Sieder-Tate = 4101.					

			Sleicher-Rouse =	3857.		
			Petukhov-Popov =	3889.	T	V
			McAdams T bulk =	3592.	109.9	13.81
			McAdams T film =	4136.	140.4	
4	80.3	53.8	44720.	21344.	11863.	6179.
	176.6	128.8		3759.	2089.	1088.
			Dittus-Boelter T film Pr.33 =	3976.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	3759.		
			Nusselt Ent. =	5029.		
			Sieder-Tate =	4341.		
			Sleicher-Rouse =	4111.		
			Petukhov-Popov =	4090.	T	V
			McAdams T bulk =	3820.	122.7	13.81
			McAdams T film =	4302.	149.6	
5	83.5	60.2	50387.	22521.	12176.	6415.
	182.3	140.4		3966.	2144.	1130.
			Dittus-Boelter T film Pr.33 =	4151.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	3966.		
			Nusselt Ent. =	5251.		
			Sieder-Tate =	4576.		
			Sleicher-Rouse =	4353.		
			Petukhov-Popov =	4279.	T	V
			McAdams T bulk =	4034.	134.6	13.81
			McAdams T film =	4460.	158.4	
6	86.6	66.2	56305.	23655.	12514.	6650.
	187.8	151.1		4166.	2204.	1171.
			Dittus-Boelter T film Pr.33 =	4316.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	4166.		
			Nusselt Ent. =	5460.		
			Sieder-Tate =	4800.		
			Sleicher-Rouse =	4579.		
			Petukhov-Popov =	4454.	T	V
			McAdams T bulk =	4233.	145.7	13.81
			McAdams T film =	4610.	166.8	

Flow Rate = 2.000 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 66.2 Degrees C 151.1 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	70.7	159.2	32.0	89.5
23.333	73.9	165.0	39.7	103.4
35.000	77.1	170.8	46.9	116.5
46.667	80.3	176.6	53.8	128.8
58.333	83.5	182.3	60.2	140.4
70.000	86.6	187.8	66.2	151.1

University of Idaho Department of Chemical Engineering
 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:47:56

Input from KEYBOARD for Case Number: 5

Start Iteration Loop
 Flow = 1.500 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 72.00
 T Out Guess = 35.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density = 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	76.8 170.3	33.6 92.5	23057.	14220. 2504.	11551. 2034.	4992. 879.
	Dittus-Boelter T film Pr.33 = 2819. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 2504.					
	Nusselt Ent. = 3566.					
	Sieder-Tate = 2937.					
	Sleicher-Rouse = 2647.					
	Petukhov-Popov = 2742. T V					
	McAdams T bulk = 2480. 83.8 10.35					
	McAdams T film = 3095. 127.0					
2	80.0 176.1	42.8 109.0	27049.	15350. 2703.	11838. 2085.	5257. 926.
	Dittus-Boelter T film Pr.33 = 2989. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 2703.					
	Nusselt Ent. = 3781.					
	Sieder-Tate = 3163.					
	Sleicher-Rouse = 2900.					
	Petukhov-Popov = 2947. T V					
	McAdams T bulk = 2722. 100.8 10.35					
	McAdams T film = 3257. 138.4					
3	83.3 182.0	51.4 124.4	31605.	16501. 2906.	12160. 2142.	5525. 973.
	Dittus-Boelter T film Pr.33 = 3158. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 2906.					
	Nusselt Ent. = 3995.					
	Sieder-Tate = 3391.					

			Sleicher-Rouse =	3150.		
			Petukhov-Popov =	3146.	T	V
			McAdams T bulk =	2949.	116.7	10.35
			McAdams T film =	3412.	149.4	
4	86.6	59.3	36648.	17645.	12520.	5795.
	187.9	138.7		3108.	2205.	1021.
			Dittus-Boelter T film Pr.33 =	3321.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	3108.		
			Nusselt Ent. =	4201.		
			Sieder-Tate =	3615.		
			Sleicher-Rouse =	3388.		
			Petukhov-Popov =	3335.	T	V
			McAdams T bulk =	3160.	131.6	10.35
			McAdams T film =	3561.	159.8	
5	89.9	66.6	42019.	18748.	12921.	6063.
	193.8	151.8		3302.	2276.	1068.
			Dittus-Boelter T film Pr.33 =	3474.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	3302.		
			Nusselt Ent. =	4394.		
			Sieder-Tate =	3829.		
			Sleicher-Rouse =	3610.		
			Petukhov-Popov =	3507.	T	V
			McAdams T bulk =	3355.	145.3	10.36
			McAdams T film =	3700.	169.5	
6	93.0	73.2	47479.	19775.	13367.	6325.
	199.4	163.7		3483.	2354.	1114.
			Dittus-Boelter T film Pr.33 =	3610.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	3483.		
			Nusselt Ent. =	4567.		
			Sieder-Tate =	4025.		
			Sleicher-Rouse =	3807.		
			Petukhov-Popov =	3658.	T	V
			McAdams T bulk =	3533.	157.8	10.36
			McAdams T film =	3829.	178.6	

Flow Rate = 1.500 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 73.2 Degrees C 163.7 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	76.8	170.3	33.6	92.5
23.333	80.0	176.1	42.8	109.0
35.000	83.3	182.0	51.4	124.4
46.667	86.6	187.9	59.3	138.7
58.333	89.9	193.8	66.6	151.8
70.000	93.0	199.4	73.2	163.7

University of Idaho Department of Chemical Engineering
 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:48:22

Input from KEYBOARD for Case Number: 6

Start Iteration Loop
 Flow = 1.250 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 78.00
 T Out Guess = 35.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density = 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	80.7 177.2	34.7 94.5	19384.	12342. 2174.	11899. 2096.	4666. 822.
				Dittus-Boelter T film Pr.33 = 2489. BTU/Ft2 F		
				Dittus-Boelter T bulk Pr.4 = 2174.		
				Nusselt Ent. = 3149.		
				Sieder-Tate = 2570.		
				Sleicher-Rouse = 2293.		
				Petukhov-Popov = 2367. T V		
				McAdams T bulk = 2155. 84.7 8.62		
				McAdams T film = 2723. 131.0		
2	83.8 182.9	44.9 112.8	23172.	13439. 2367.	12212. 2151.	4952. 872.
				Dittus-Boelter T film Pr.33 = 2649. BTU/Ft2 F		
				Dittus-Boelter T bulk Pr.4 = 2367.		
				Nusselt Ent. = 3352.		
				Sieder-Tate = 2787.		
				Sleicher-Rouse = 2539.		
				Petukhov-Popov = 2565. T V		
				McAdams T bulk = 2387. 103.7 8.62		
				McAdams T film = 2874. 143.3		
3	87.1 188.8	54.3 129.7	27543.	14554. 2563.	12574. 2215.	5241. 923.
				Dittus-Boelter T film Pr.33 = 2808. BTU/Ft2 F		
				Dittus-Boelter T bulk Pr.4 = 2563.		
				Nusselt Ent. = 3552.		
				Sieder-Tate = 3004.		

			Sleicher-Rouse =	2779.		
			Petukhov-Popov =	2756.	T	V
			McAdams T bulk =	2604.	121.3	8.62
			McAdams T film =	3018.	155.0	
4	90.4	62.9	32389.	15653.	12989.	5531.
	194.7	145.2		2757.	2288.	974.
			Dittus-Boelter T film Pr.33 =	2958.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	2757.		
			Nusselt Ent. =	3742.		
			Sieder-Tate =	3216.		
			Sleicher-Rouse =	3006.		
			Petukhov-Popov =	2934.	T	V
			McAdams T bulk =	2803.	137.5	8.63
			McAdams T film =	3155.	166.1	
5	93.6	70.7	37487.	16693.	13463.	5815.
	200.6	159.2		2940.	2371.	1024.
			Dittus-Boelter T film Pr.33 =	3093.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	2940.		
			Nusselt Ent. =	3913.		
			Sieder-Tate =	3414.		
			Sleicher-Rouse =	3210.		
			Petukhov-Popov =	3093.	T	V
			McAdams T bulk =	2985.	152.2	8.63
			McAdams T film =	3282.	176.4	
6	96.8	77.6	42524.	17630.	14003.	6091.
	206.2	171.7		3105.	2466.	1073.
			Dittus-Boelter T film Pr.33 =	3209.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	3105.		
			Nusselt Ent. =	4059.		
			Sieder-Tate =	3589.		
			Sleicher-Rouse =	3386.		
			Petukhov-Popov =	3227.	T	V
			McAdams T bulk =	3148.	165.4	8.63
			McAdams T film =	3398.	185.8	

Flow Rate = 1.250 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 77.6 Degrees C 171.7 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	80.7	177.2	34.7	94.5
23.333	83.8	182.9	44.9	112.8
35.000	87.1	188.8	54.3	129.7
46.667	90.4	194.7	62.9	145.2
58.333	93.6	200.6	70.7	159.2
70.000	96.8	206.2	77.6	171.7

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 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:48:39

Input from KEYBOARD for Case Number: 7

Start Iteration Loop
 Flow = 1.000 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 85.00
 T Out Guess = 36.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density= 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	85.2 185.3	36.2 97.1	15688.	10381. 1828.	12358. 2177.	4259. 750.
			Dittus-Boelter T film Pr.33 =	2135.	BTU/Ft2 F	
			Dittus-Boelter T bulk Pr.4 =	1828.		
			Nusselt Ent. =	2701.		
			Sieder-Tate =	2181.		
			Sleicher-Rouse =	1931.		
			Petukhov-Popov =	1979.	T V	
			McAdams T bulk =	1815.	86.0 6.89	
			McAdams T film =	2325.	135.7	
2	88.2 190.8	47.6 117.6	19205.	11427. 2013.	12709. 2238.	4567. 804.
			Dittus-Boelter T film Pr.33 =	2283.	BTU/Ft2 F	
			Dittus-Boelter T bulk Pr.4 =	2013.		
			Nusselt Ent. =	2889.		
			Sieder-Tate =	2384.		
			Sleicher-Rouse =	2165.		
			Petukhov-Popov =	2167.	T V	
			McAdams T bulk =	2034.	107.4 6.90	
			McAdams T film =	2462.	149.1	
3	91.4 196.5	58.0 136.4	23323.	12490. 2200.	13130. 2312.	4879. 859.
			Dittus-Boelter T film Pr.33 =	2427.	BTU/Ft2 F	
			Dittus-Boelter T bulk Pr.4 =	2200.		
			Nusselt Ent. =	3071.		
			Sieder-Tate =	2588.		

				Sleicher-Rouse =	2392.		
				Petukhov-Popov =	2347.	T	V
				McAdams T bulk =	2237.	127.0	6.90
				McAdams T film =	2593.	161.8	
4	94.7	67.4	27874.	13522.	13631.		5188.
	202.4	153.3		2381.	2401.		914.
				Dittus-Boelter T film Pr.33 =	2559.	BTU/Ft2	F
				Dittus-Boelter T bulk Pr.4 =	2381.		
				Nusselt Ent. =	3237.		
				Sieder-Tate =	2783.		
				Sleicher-Rouse =	2601.		
				Petukhov-Popov =	2511.	T	V
				McAdams T bulk =	2420.	144.8	6.90
				McAdams T film =	2716.	173.6	
5	97.9	75.6	32543.	14467.	14219.		5487.
	208.1	168.2		2548.	2504.		966.
				Dittus-Boelter T film Pr.33 =	2672.	BTU/Ft2	F
				Dittus-Boelter T bulk Pr.4 =	2548.		
				Nusselt Ent. =	3380.		
				Sieder-Tate =	2958.		
				Sleicher-Rouse =	2782.		
				Petukhov-Popov =	2651.	T	V
				McAdams T bulk =	2584.	160.7	6.90
				McAdams T film =	2827.	184.4	
6	100.9	82.8	36927.	15274.	14906.		5768.
	213.6	181.1		2690.	2625.		1016.
				Dittus-Boelter T film Pr.33 =	2761.	BTU/Ft2	F
				Dittus-Boelter T bulk Pr.4 =	2690.		
				Nusselt Ent. =	3493.		
				Sieder-Tate =	3105.		
				Sleicher-Rouse =	2927.		
				Petukhov-Popov =	2763.	T	V
				McAdams T bulk =	2727.	174.6	6.90
				McAdams T film =	2927.	194.1	

Flow Rate = 1.000 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 82.8 Degrees C 181.1 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	85.2	185.3	36.2	97.1
23.333	88.2	190.8	47.6	117.6
35.000	91.4	196.5	58.0	136.4
46.667	94.7	202.4	67.4	153.3
58.333	97.9	208.1	75.6	168.2
70.000	100.9	213.6	82.8	181.1

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 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:49: 0

Input from KEYBOARD for Case Number: 8

Start Iteration Loop
 Flow = 0.750 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 88.00
 T Out Guess = 40.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density= 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	90.6 195.0	38.1 100.5	11948.	8307. 1463.	13014. 2292.	3733. 658.
	Dittus-Boelter T film Pr.33 = 1748. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 1463.					
	Nusselt Ent. = 2212.					
	Sieder-Tate = 1761.					
	Sleicher-Rouse = 1556.					
	Petukhov-Popov = 1573. T V					
	McAdams T bulk = 1456. 87.8 5.17					
	McAdams T film = 1893. 141.4					
2	93.4 200.1	51.1 124.0	15107.	9279. 1634.	13421. 2364.	4064. 716.
	Dittus-Boelter T film Pr.33 = 1880. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 1634.					
	Nusselt Ent. = 2378.					
	Sieder-Tate = 1947.					
	Sleicher-Rouse = 1774.					
	Petukhov-Popov = 1747. T V					
	McAdams T bulk = 1656. 112.3 5.17					
	McAdams T film = 2013. 156.2					
3	96.4 205.5	62.8 145.1	18858.	10261. 1807.	13936. 2454.	4398. 774.
	Dittus-Boelter T film Pr.33 = 2004. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 1807.					
	Nusselt Ent. = 2535.					
	Sieder-Tate = 2131.					

				Sleicher-Rouse =	1980.		
				Petukhov-Popov =	1911.	T	V
				McAdams T bulk =	1838.	134.6	5.17
				McAdams T film =	2127.	170.0	
4	99.5	73.1	22941.	11186.	14582.		4722.
	211.1	163.6		1970.	2568.		832.
				Dittus-Boelter T film Pr.33 =	2110.	BTU/Ft2	F
				Dittus-Boelter T bulk Pr.4 =	1970.		
				Nusselt Ent. =	2670.		
				Sieder-Tate =	2301.		
				Sleicher-Rouse =	2161.		
				Petukhov-Popov =	2055.	T	V
				McAdams T bulk =	2000.	154.3	5.17
				McAdams T film =	2231.	182.7	
5	102.5	81.8	26916.	11985.	15373.		5023.
	216.6	179.3		2111.	2707.		885.
				Dittus-Boelter T film Pr.33 =	2194.	BTU/Ft2	F
				Dittus-Boelter T bulk Pr.4 =	2111.		
				Nusselt Ent. =	2775.		
				Sieder-Tate =	2445.		
				Sleicher-Rouse =	2306.		
				Petukhov-Popov =	2170.	T	V
				McAdams T bulk =	2140.	171.4	5.18
				McAdams T film =	2324.	194.0	
6	105.3	89.1	30312.	12606.	16327.		5293.
	221.5	192.4		2220.	2875.		932.
				Dittus-Boelter T film Pr.33 =	2252.	BTU/Ft2	F
				Dittus-Boelter T bulk Pr.4 =	2220.		
				Nusselt Ent. =	2849.		
				Sieder-Tate =	2554.		
				Sleicher-Rouse =	2411.		
				Petukhov-Popov =	2254.	T	V
				McAdams T bulk =	2258.	185.8	5.18
				McAdams T film =	2404.	203.7	

Flow Rate = 0.750 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 89.1 Degrees C 192.4 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	90.6	195.0	38.1	100.5
23.333	93.4	200.1	51.1	124.0
35.000	96.4	205.5	62.8	145.1
46.667	99.5	211.1	73.1	163.6
58.333	102.5	216.6	81.8	179.3
70.000	105.3	221.5	89.1	192.4

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 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:49:23

Input from KEYBOARD for Case Number: 9

Start Iteration Loop
 Flow = 0.600 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 95.00
 T Out Guess = 42.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density= 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	94.3 201.8	39.6 103.3	9677.	6989. 1231.	13576. 2391.	3337. 588.
	Dittus-Boelter T film Pr.33 = 1494. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 1231.					
	Nusselt Ent. = 1890.					
	Sieder-Tate = 1489.					
	Sleicher-Rouse = 1324.					
	Petukhov-Popov = 1319. T V					
	McAdams T bulk = 1227. 89.1 4.13					
	McAdams T film = 1610. 145.5					
2	96.9 206.5	53.9 129.1	12552.	7897. 1391.	14035. 2472.	3678. 648.
	Dittus-Boelter T film Pr.33 = 1612. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 1391.					
	Nusselt Ent. = 2040.					
	Sieder-Tate = 1661.					
	Sleicher-Rouse = 1526.					
	Petukhov-Popov = 1480. T V					
	McAdams T bulk = 1411. 116.2 4.13					
	McAdams T film = 1719. 161.3					
3	99.8 211.6	66.6 151.8	15992.	8807. 1551.	14647. 2580.	4020. 708.
	Dittus-Boelter T film Pr.33 = 1720. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 1551.					
	Nusselt Ent. = 2176.					
	Sieder-Tate = 1829.					

			Sleicher-Rouse =	1714.		
			Petukhov-Popov =	1631.	T	V
			McAdams T bulk =	1577.	140.4	4.14
			McAdams T film =	1820.	176.0	
4	102.8	77.4	19660.	9640.	15438.	4346.
	217.0	171.3		1698.	2719.	765.
			Dittus-Boelter T film Pr.33 =	1808.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	1698.		
			Nusselt Ent. =	2287.		
			Sieder-Tate =	1979.		
			Sleicher-Rouse =	1871.		
			Petukhov-Popov =	1758.	T	V
			McAdams T bulk =	1722.	161.5	4.14
			McAdams T film =	1911.	189.2	
5	105.6	86.3	23023.	10315.	16438.	4636.
	222.0	187.3		1817.	2895.	816.
			Dittus-Boelter T film Pr.33 =	1871.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	1817.		
			Nusselt Ent. =	2366.		
			Sieder-Tate =	2098.		
			Sleicher-Rouse =	1986.		
			Petukhov-Popov =	1854.	T	V
			McAdams T bulk =	1843.	179.3	4.14
			McAdams T film =	1989.	200.6	
6	108.0	93.4	25632.	10793.	17673.	4882.
	226.4	200.1		1901.	3112.	860.
			Dittus-Boelter T film Pr.33 =	1909.	BTU/Ft2	F
			Dittus-Boelter T bulk Pr.4 =	1901.		
			Nusselt Ent. =	2415.		
			Sieder-Tate =	2180.		
			Sleicher-Rouse =	2061.		
			Petukhov-Popov =	1917.	T	V
			McAdams T bulk =	1943.	193.7	4.14
			McAdams T film =	2054.	210.1	

Flow Rate = 0.600 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 93.4 Degrees C 200.1 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	94.3	201.8	39.6	103.3
23.333	96.9	206.5	53.9	129.1
35.000	99.8	211.6	66.6	151.8
46.667	102.8	217.0	77.4	171.3
58.333	105.6	222.0	86.3	187.3
70.000	108.0	226.4	93.4	200.1

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 DOUBLE PIPE HEAT EXCHANGER Prediction Program Rel. 2/8/92
 Ch. E. 434 Laboratory D. C. Drown

Date: Jan 29, 2009 Time: 23:49:48

Input from KEYBOARD for Case Number: 10

Start Iteration Loop
 Flow = 0.480 GPM
 Inlet Temperature = 23.89 C

Steam Temperature = 115.22 T Wall Guess = 95.00
 T Out Guess = 42.00

Steam Pressure = 10.00 PSIG + Temperature = 239.391 Deg F
 H Vaporization = 952.59 BTU/LB Density= 0.060629 LB/FT3
 Barometric Pressure = 14.6960 PSIA

Steam Pressure = 10.00 PSIG + Temperature = 115.215 Deg C
 H Vaporization = 2215815. J/Kg Density = 0.9712 Kg/M3
 Fouling - Inside = .0000000 Outside = .0000000
 Temperature Convergence to 0.010 Degrees

N	T Wall C	T Out C	Re No.	H Inside Watts / Sq. Meter	H Outside BTU / Sq. Feet	U
	Units = F	F				
1	97.7 207.9	41.1 106.1	7839.	5881. 1036.	14190. 2499.	2957. 521.
	Dittus-Boelter T film Pr.33 = 1274. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 1036.					
	Nusselt Ent. = 1612.					
	Sieder-Tate = 1257.					
	Sleicher-Rouse = 1130.					
	Petukhov-Popov = 1106. T V					
	McAdams T bulk = 1034. 90.5 3.30					
	McAdams T film = 1368. 149.2					
2	100.1 212.1	56.7 134.1	10433.	6722. 1184.	14709. 2591.	3302. 582.
	Dittus-Boelter T film Pr.33 = 1380. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 1184.					
	Nusselt Ent. = 1745.					
	Sieder-Tate = 1415.					
	Sleicher-Rouse = 1317.					
	Petukhov-Popov = 1256. T V					
	McAdams T bulk = 1202. 120.1 3.31					
	McAdams T film = 1465. 166.1					
3	102.8 217.0	70.2 158.4	13549.	7555. 1331.	15437. 2719.	3646. 642.
	Dittus-Boelter T film Pr.33 = 1472. BTU/Ft2 F					
	Dittus-Boelter T bulk Pr.4 = 1331.					
	Nusselt Ent. = 1862.					
	Sieder-Tate = 1567.					

				Sleicher-Rouse =	1484.		
				Petukhov-Popov =	1393.	T	V
				McAdams T bulk =	1352.	146.2	3.31
				McAdams T film =	1554.	181.6	
4	105.5	81.4	16767.	8288.	16414.		3962.
	221.9	178.6		1460.	2891.		698.
			Dittus-Boelter T film Pr.33 =	1542.	BTU/Ft2	F	
			Dittus-Boelter T bulk Pr.4 =	1460.			
			Nusselt Ent. =	1950.			
			Sieder-Tate =	1697.			
			Sleicher-Rouse =	1616.			
			Petukhov-Popov =	1503.	T	V	
			McAdams T bulk =	1480.	168.5	3.31	
			McAdams T film =	1632.	195.2		
5	108.0	90.3	19502.	8839.	17684.		4230.
	226.5	194.6		1557.	3114.		745.
			Dittus-Boelter T film Pr.33 =	1586.	BTU/Ft2	F	
			Dittus-Boelter T bulk Pr.4 =	1557.			
			Nusselt Ent. =	2007.			
			Sieder-Tate =	1792.			
			Sleicher-Rouse =	1703.			
			Petukhov-Popov =	1580.	T	V	
			McAdams T bulk =	1584.	186.6	3.31	
			McAdams T film =	1698.	206.5		
6	110.2	97.2	21392.	9189.	19269.		4443.
	230.3	207.0		1618.	3394.		782.
			Dittus-Boelter T film Pr.33 =	1610.	BTU/Ft2	F	
			Dittus-Boelter T bulk Pr.4 =	1618.			
			Nusselt Ent. =	2037.			
			Sieder-Tate =	1851.			
			Sleicher-Rouse =	1753.			
			Petukhov-Popov =	1626.	T	V	
			McAdams T bulk =	1666.	200.8	3.31	
			McAdams T film =	1750.	215.5		

Flow Rate = 0.480 GPM Steam Pressure = 10.00 PSIG

Temperature IN = 23.9 Degrees C 75.0 F
 Temperature OUT = 97.2 Degrees C 207.0 F
 Steam Temperature = 115.2 Degrees C 239.4 F

Length Inches	Wall Temp.		Temp. Water Out	
	C	F	C	F
11.667	97.7	207.9	41.1	106.1
23.333	100.1	212.1	56.7	134.1
35.000	102.8	217.0	70.2	158.4
46.667	105.5	221.9	81.4	178.6
58.333	108.0	226.5	90.3	194.6
70.000	110.2	230.3	97.2	207.0