



Shellside Incremental Monitor

Released to the following HTRI Member Company:

Rating - Horizontal Multipass Flow TEMA BEM Shell With Single-Segmental Baffles

Shellside Flow Region	1	54095 kg/hr					
Point number	(--)	1	2	3	4	5	6
Shell pass	(--)	1	1	1	1	1	1
Length from tube inlet	(mm)	5991.2	5610.2	5043.1	4670.8	4298.6	3926.3
Mass fraction vapor	(--)	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Bulk temperature	(C)	160.00	141.24	114.50	99.48	86.44	75.74
Skin temperature	(C)		60.31	57.20	55.10	52.33	49.42
MTD	(C)		102.1	76.1	61.4	48.0	37.7
Superheat for Onset of Nucleate Boiling	(C)						
Delta MTD correction	(--)		0.9976	0.9930	0.9886	0.9820	0.9743
Pressure	(kgf/cm2G)	3.670	3.634	3.578	3.512	3.448	3.385
Pressure drop	(kgf/cm2)	0.025	0.046	0.067	0.065	0.063	0.062
Friction loss	(kgf/cm2)		0.046	0.067	0.065	0.063	0.062
Static head loss	(kgf/cm2)		0.000	0.000	0.000	0.000	0.000
Momentum loss	(kgf/cm2)		0.000	0.000	0.000	0.000	0.000
Crossflow velocity	(m/s)		12.16	19.74	19.27	18.83	18.55
Longitudinal velocity	(m/s)		14.28	16.14	15.75	15.40	15.16
Shear stress at tube wall							
Crossflow	(Pa)		0.00	9.59	9.26	8.95	8.75
Longitudinal flow	(Pa)		1.82e-2	1.82e-2	1.82e-2	1.82e-2	1.82e-2
Area	(m2)		27.362	13.368	13.368	13.368	13.368
Cumulative area	(m2)		27.362	40.730	54.097	67.465	80.832
Duty	(MM kcal/hr)		0.5048	0.2119	0.1889	0.1582	0.1261
Cumulative duty	(MM kcal/hr)		0.5048	0.7168	0.9057	1.0639	1.1900
Heat flux	(kcal/hr m2)		18450	15853	14135	11836	9432.1
Calculated heat flux	(kcal/hr m2)		20822	17800	15797	13143	10397
Critical heat flux	(kcal/hr m2)						
Overall U	(kcal/m2-hr-C)		204.22	235.16	259.77	278.09	282.71
Shellside h	(kcal/m2-hr-C)		261.32	314.60	361.27	397.74	407.51
Sensible liquid h	(kcal/m2-hr-C)		0.00	0.00	0.00	0.00	0.00
Sensible vapor h	(kcal/m2-hr-C)		261.32	295.77	291.63	287.78	284.76
Condensate film h	(kcal/m2-hr-C)		340.32	1015.1	2360.4	4983.0	9041.2
Vapor phase h	(kcal/m2-hr-C)		331.25	443.46	437.95	432.57	428.25
Nucleate boiling h	(kcal/m2-hr-C)		0.00	0.00	0.00	0.00	0.00
Conv. boiling h	(kcal/m2-hr-C)		0.00	0.00	0.00	0.00	0.00
Film boiling h	(kcal/m2-hr-C)		0.00	0.00	0.00	0.00	0.00
Boiling thin film h	(kcal/m2-hr-C)		0.00	0.00	0.00	0.00	0.00
Natural convective h	(kcal/m2-hr-C)		0.00	0.00	0.00	0.00	0.00
Local Reynolds	(--)	32123	47369	58407	60055	61685	63019
Vapor Reynolds	(--)	32123	47369	58407	60055	61685	63019
Liquid Reynolds	(--)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vapor Prandtl	(--)	0.7564	0.7568	0.7579	0.7585	0.7591	0.7594
Liquid Prandtl	(--)	3.0569	0.0000	0.0000	0.0000	0.0000	0.0000
Flow regime param.	(--)		0.0000	0.0000	0.0000	0.0000	0.0000
Condensate regime	(--)		Sens Gas	Sens Gas	Sens Gas	Sens Gas	Sens Gas
Boiling regime	(--)						
Boiling mechanism	(--)						



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Shellside Flow Region		1					
Point number	(--)	7	8	9	10	11	12
Shell pass	(--)	1	1	1	1	1	1
Length from tube inlet	(mm)	3554.0	3181.7	2809.5	2437.2	2064.9	1692.7
Mass fraction vapor	(--)	1.0000	1.0000	0.9983	0.9960	0.9940	0.9924
Bulk temperature	(C)	67.31	60.30	56.83	54.70	52.73	50.95
Skin temperature	(C)	46.84	45.47	47.55	46.11	44.74	43.77
MTD	(C)	29.0	23.0	18.8	16.9	14.8	13.3
Superheat for Onset of Nucleate Boiling	(C)						
Delta MTD correction	(--)	0.9619	0.9583	0.9831	0.9790	0.9712	0.9662
Pressure	(kgf/cm2G)	3.323	3.262	3.201	3.140	3.078	3.015
Pressure drop	(kgf/cm2)	0.061	0.061	0.061	0.062	0.063	0.063
Friction loss	(kgf/cm2)	0.061	0.061	0.061	0.062	0.063	0.063
Static head loss	(kgf/cm2)	0.000	0.000	0.000	0.000	0.000	0.000
Momentum loss	(kgf/cm2)	0.000	-3.1e-7	1.12e-5	2.43e-5	4.67e-5	6.24e-5
Crossflow velocity	(m/s)	18.33	18.26	18.24	18.36	18.45	18.62
Longitudinal velocity	(m/s)	14.99	14.91	14.91	15.00	15.08	15.21
Shear stress at tube wall							
Crossflow	(Pa)	8.58	8.50	0.00	0.00	0.00	0.00
Longitudinal flow	(Pa)	1.83e-2	1.83e-2	0.00	0.00	0.00	0.00
Area	(m2)	13.368	13.368	13.368	13.368	13.368	13.368
Cumulative area	(m2)	94.200	107.57	120.94	134.30	147.67	161.04
Duty	(MM kcal/hr)	0.0975	0.0878	0.1081	0.0931	0.0787	0.0687
Cumulative duty	(MM kcal/hr)	1.2875	1.3753	1.4834	1.5765	1.6552	1.7239
Heat flux	(kcal/hr m2)	7291.4	6571.8	8084.9	6966.9	5886.6	5137.6
Calculated heat flux	(kcal/hr m2)	7940.5	7030.7	8954.9	7669.7	6417.0	5562.9
Critical heat flux	(kcal/hr m2)						
Overall U	(kcal/m2-hr-C)	285.15	308.83	477.95	456.36	434.68	422.05
Shellside h	(kcal/m2-hr-C)	412.61	465.59	984.35	897.00	817.96	774.14
Sensible liquid h	(kcal/m2-hr-C)	0.00	0.00	0.00	0.00	0.00	0.00
Sensible vapor h	(kcal/m2-hr-C)	282.17	280.51	279.41	278.22	276.94	276.07
Condensate film h	(kcal/m2-hr-C)	14938	23858	33582	26541	23484	22168
Vapor phase h	(kcal/m2-hr-C)	424.58	475.19	1014.7	929.54	849.04	803.97
Nucleate boiling h	(kcal/m2-hr-C)	0.00	0.00	0.00	0.00	0.00	0.00
Conv. boiling h	(kcal/m2-hr-C)	0.00	0.00	0.00	0.00	0.00	0.00
Film boiling h	(kcal/m2-hr-C)	0.00	0.00	0.00	0.00	0.00	0.00
Boiling thin film h	(kcal/m2-hr-C)	0.00	0.00	0.00	0.00	0.00	0.00
Natural convective h	(kcal/m2-hr-C)	0.00	0.00	0.00	0.00	0.00	0.00
Local Reynolds	(--)	64224	64584	54123	47127	41836	39143
Vapor Reynolds	(--)	64224	65105	65476	65485	65516	65568
Liquid Reynolds	(--)	0.0000	0.1113	4.8630	10.095	15.250	18.147
Vapor Prandtl	(--)	0.7597	0.7599	0.7598	0.7597	0.7595	0.7594
Liquid Prandtl	(--)	0.0000	0.7929	3.2480	3.3602	3.4925	3.5926
Flow regime param.	(--)	0.0000	0.0012	0.0134	0.0200	0.0250	0.0276
Condensate regime	(--)	Sens Gas	Sens Gas	Ann-Mist	Ann-Mist	Ann-Mist	Ann-Mist
Boiling regime	(--)						
Boiling mechanism	(--)						



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Shellside Flow Region		1			
Point number	(--)	13	14	15	16
Shell pass	(--)	1	1	1	1
Length from tube inlet	(mm)	1320.4	948.13	381.00	0.000
Mass fraction vapor	(--)	0.9910	0.9899	0.9885	0.9878
Bulk temperature	(C)	49.32	47.86	46.12	45.00
Skin temperature	(C)	42.74	42.04	40.90	
MTD	(C)	11.5	10.3	8.2	
Superheat for Onset of Nucleate Boiling	(C)				
Delta MTD correction	(--)	0.9525	0.9456	0.9198	
Pressure	(kgf/cm2G)	2.951	2.886	2.835	2.791
Pressure drop	(kgf/cm2)	0.064	0.065	0.038	0.012
Friction loss	(kgf/cm2)	0.064	0.065	0.038	
Static head loss	(kgf/cm2)	0.000	0.000	0.000	
Momentum loss	(kgf/cm2)	8.72e-5	1.03e-4	6.10e-6	
Crossflow velocity	(m/s)	18.76	18.99	11.11	
Longitudinal velocity	(m/s)	15.34	15.51	13.06	
Shear stress at tube wall					
Crossflow	(Pa)	0.00	0.00	0.00	
Longitudinal flow	(Pa)	0.00	0.00	0.00	
Area	(m2)	13.368	13.368	27.362	
Cumulative area	(m2)	174.41	187.77	215.13	
Duty	(MM kcal/hr)	0.0579	0.0509	0.0791	
Cumulative duty	(MM kcal/hr)	1.7818	1.8327	1.9118	
Heat flux	(kcal/hr m2)	4330.4	3811.3	2890.8	
Calculated heat flux	(kcal/hr m2)	4612.8	4020.3	2965.7	
Critical heat flux	(kcal/hr m2)				
Overall U	(kcal/m2-hr-C)	403.82	393.69	369.90	
Shellside h	(kcal/m2-hr-C)	716.15	684.61	615.11	
Sensible liquid h	(kcal/m2-hr-C)	0.00	0.00	0.00	
Sensible vapor h	(kcal/m2-hr-C)	275.05	274.41	235.43	
Condensate film h	(kcal/m2-hr-C)	20942	20374	16069	
Vapor phase h	(kcal/m2-hr-C)	743.54	710.57	640.87	
Nucleate boiling h	(kcal/m2-hr-C)	0.00	0.00	0.00	
Conv. boiling h	(kcal/m2-hr-C)	0.00	0.00	0.00	
Film boiling h	(kcal/m2-hr-C)	0.00	0.00	0.00	
Boiling thin film h	(kcal/m2-hr-C)	0.00	0.00	0.00	
Natural convective h	(kcal/m2-hr-C)	0.00	0.00	0.00	
Local Reynolds	(--)	36307	34886	27456	18801
Vapor Reynolds	(--)	65635	65701	55867	39258
Liquid Reynolds	(--)	21.358	22.914	21.962	15.974
Vapor Prandtl	(--)	0.7593	0.7592	0.7591	0.7594
Liquid Prandtl	(--)	3.7194	3.8044	3.9668	4.0259
Flow regime param.	(--)	0.0302	0.0315	0.0533	
Condensate regime	(--)	Ann-Mist	Ann-Mist	Ann-Mist	
Boiling regime	(--)				
Boiling mechanism	(--)				