

## DAFTAR PUSTAKA

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## LAMPIRAN

Lampiran 1 Tabel Properties of miscellaneous material

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**TABLE A-8**

Properties of miscellaneous materials  
(Values are at 300 K unless indicated otherwise)

Material	Density, $\rho$ kg/m <sup>3</sup>	Thermal Conductivity, $k$ W/m · K	Specific Heat, $c_p$ J/kg · K	Material	Density, $\rho$ kg/m <sup>3</sup>	Thermal Conductivity, $k$ W/m · K	Specific Heat, $c_p$ J/kg · K
Asphalt	2115	0.062	920	Ice			
Bakelite	1300	1.4	1465	273 K	920	1.88	2040
Brick, refractory				253 K	922	2.03	1945
Chrome brick				173 K	928	3.49	1460
473 K	3010	2.3	835	Leather, sole	998	0.159	—
823 K	—	2.5	—	Linoleum	535	0.081	—
1173 K	—	2.0	—	1180	0.186	—	
Fire clay, burnt				Mica	2900	0.523	—
1600 K				Paper	930	0.180	1340
773 K	2050	1.0	960	Plastics			
1073 K	—	1.1	—	Plexiglass	1190	0.19	1465
1373 K	—	1.1	—	Teflon			
Fire clay, burnt				300 K	2200	0.35	1050
1725 K				400 K	—	0.45	—
773 K	2325	1.3	960	Lexan	1200	0.19	1260
1073 K	—	1.4	—	Nylon	1145	0.29	—
1373 K	—	1.4	—	Polypropylene	910	0.12	1925
Fire clay brick				Polyester	1395	0.15	1170
478 K	2645	1.0	960	PVC, vinyl	1470	0.1	840
922 K	—	1.5	—	Porcelain	2300	1.5	—
1478 K	—	1.8	—	Rubber, natural	1150	0.28	—
Magnesite				Rubber, vulcanized			
478 K	—	3.8	1130	Soft	1100	0.13	2010
922 K	—	2.8	—	Hard	1190	0.16	—
1478 K	—	1.9	—	Sand	1515	0.2–1.0	800
Chicken meat, white (74.4% water content)				Snow, fresh	100	0.60	—
198 K	—	1.60	—	Snow, 273 K	500	2.2	—
233 K	—	1.49	—	Soil, dry	1500	1.0	1900
253 K	—	1.35	—	Soil, wet	1900	2.0	2200
273 K	—	0.48	—	Sugar	1600	0.58	—
293 K	—	0.49	—	Tissue, human			
Clay, dry	1550	0.930	—	Skin	—	0.37	—
Clay, wet	1495	1.675	—	Fat layer	—	0.2	—
Coal, anthracite	1350	0.26	1260	Muscle	—	0.41	—
Concrete (stone mix)	2300	1.4	880	Vaseline	—	0.17	—
Cork	86	0.048	2030	Wood, cross-grain			
Cotton	80	0.06	1300	Balsa	140	0.055	—
Fat	—	0.17	—	Fir	415	0.11	2720
Glass				Oak	545	0.17	2385
Window	2800	0.7	750	White pine	435	0.11	—
Pyrex	2225	1–1.4	835	Yellow pine	640	0.15	2805
Crown	2500	1.05	—	Wood, radial			
Lead	3400	0.85	—	Oak	545	0.19	2385
				Fir	420	0.14	2720
				Wool, ship	145	0.05	—

Source: Compiled from various sources.

## Lampiran 2 Tabel Properties of insulating material

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<b>TABLE A-6</b>					
Properties of insulating materials (at a mean temperature of 24°C)					
Material	Thickness, <i>L</i> mm	Density, $\rho$ kg/m <sup>3</sup>	Thermal Conductivity, $k$ W/m · K	Specific Heat, $c_p$ kJ/kg · K	<i>R</i> -value (for listed thickness, <i>L</i> /k), K · m <sup>2</sup> /W
<b>Blanket and Batt</b>					
Mineral fiber (fibrous form processed from rock, slag, or glass)	50 to 70 mm	4.8–32	—	0.71–0.96	1.23
	75 to 90 mm	4.8–32	—	0.71–0.96	1.94
	135 to 165 mm	4.8–32	—	0.71–0.96	3.32
<b>Board and Slab</b>					
Cellular glass		136	0.055	1.0	—
Glass fiber (organic bonded)		64–144	0.036	0.96	—
Expanded polystyrene (molded beads)		16	0.040	1.2	—
Expanded polyurethane ( <i>R</i> -11 expanded)		24	0.023	1.6	—
Expanded perlite (organic bonded)		16	0.052	1.26	—
Expanded rubber (rigid)		72	0.032	1.68	—
Mineral fiber with resin binder		240	0.042	0.71	—
Cork		120	0.039	1.80	—
<b>Sprayed or Formed in Place</b>					
Polyurethane foam		24–40	0.023–0.026	—	—
Glass fiber		56–72	0.038–0.039	—	—
Urethane, two-part mixture (rigid foam)		70	0.026	1.045	—
Mineral wool granules with asbestos/ inorganic binders (sprayed)		190	0.046	—	—
<b>Loose Fill</b>					
Mineral fiber (rock, slag, or glass)	~75 to 125 mm	9.6–32	—	0.71	1.94
	~165 to 222 mm	9.6–32	—	0.71	3.35
	~191 to 254 mm	—	—	0.71	3.87
	~185 mm	—	—	0.71	5.28
Silica aerogel		122	0.025	—	—
Vermiculite (expanded)		122	0.068	—	—
Perlite, expanded		32–66	0.039–0.045	1.09	—
Sawdust or shavings		128–240	0.065	1.38	—
Cellulosic insulation (milled paper or wood pulp)		37–51	0.039–0.046	—	—
<b>Roof Insulation</b>					
Cellular glass	—	144	0.058	1.0	—
Preformed, for use above deck	13 mm	—	—	1.0	0.24
	25 mm	—	—	2.1	0.49
	50 mm	—	—	3.9	0.93
<b>Reflective Insulation</b>					
Silica powder (evacuated)		160	0.0017	—	—
Aluminum foil separating fluffy glass mats; 10–12 layers (evacuated); for cryogenic applications (150 K)		40	0.00016	—	—
Aluminum foil and glass paper laminate; 75–150 layers (evacuated); for cryogenic applications (150 K)		120	0.000017	—	—

## Lampiran 3 Tabel Properties of air at 1 atm pressure

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TABLE A-15

Properties of air at 1 atm pressure

Temp. $T, ^\circ\text{C}$	Density $\rho, \text{kg/m}^3$	Specific Heat $c_p, \text{J/kg} \cdot \text{K}$	Thermal Conductivity $k, \text{W/m} \cdot \text{K}$	Thermal Diffusivity $\alpha, \text{m}^2/\text{s}^2$	Dynamic Viscosity $\mu, \text{kg/m} \cdot \text{s}$	Kinematic Viscosity $\nu, \text{m}^2/\text{s}$	Prandtl Number Pr
-150	2.866	983	0.01171	$4.158 \times 10^{-6}$	$8.636 \times 10^{-6}$	$3.013 \times 10^{-6}$	0.7246
-100	2.038	966	0.01582	$8.036 \times 10^{-6}$	$1.189 \times 10^{-5}$	$5.837 \times 10^{-6}$	0.7263
-50	1.582	999	0.01979	$1.252 \times 10^{-5}$	$1.474 \times 10^{-5}$	$9.319 \times 10^{-6}$	0.7440
-40	1.514	1002	0.02057	$1.356 \times 10^{-5}$	$1.527 \times 10^{-5}$	$1.008 \times 10^{-5}$	0.7436
-30	1.451	1004	0.02134	$1.465 \times 10^{-5}$	$1.579 \times 10^{-5}$	$1.087 \times 10^{-5}$	0.7425
-20	1.394	1005	0.02211	$1.578 \times 10^{-5}$	$1.630 \times 10^{-5}$	$1.169 \times 10^{-5}$	0.7408
-10	1.341	1006	0.02288	$1.696 \times 10^{-5}$	$1.680 \times 10^{-5}$	$1.252 \times 10^{-5}$	0.7387
0	1.292	1006	0.02364	$1.818 \times 10^{-5}$	$1.729 \times 10^{-5}$	$1.338 \times 10^{-5}$	0.7362
5	1.269	1006	0.02401	$1.880 \times 10^{-5}$	$1.754 \times 10^{-5}$	$1.382 \times 10^{-5}$	0.7350
10	1.246	1006	0.02439	$1.944 \times 10^{-5}$	$1.778 \times 10^{-5}$	$1.426 \times 10^{-5}$	0.7336
15	1.225	1007	0.02476	$2.009 \times 10^{-5}$	$1.802 \times 10^{-5}$	$1.470 \times 10^{-5}$	0.7323
20	1.204	1007	0.02514	$2.074 \times 10^{-5}$	$1.825 \times 10^{-5}$	$1.516 \times 10^{-5}$	0.7309
25	1.184	1007	0.02551	$2.141 \times 10^{-5}$	$1.849 \times 10^{-5}$	$1.562 \times 10^{-5}$	0.7296
30	1.164	1007	0.02588	$2.208 \times 10^{-5}$	$1.872 \times 10^{-5}$	$1.608 \times 10^{-5}$	0.7282
35	1.145	1007	0.02625	$2.277 \times 10^{-5}$	$1.895 \times 10^{-5}$	$1.655 \times 10^{-5}$	0.7268
40	1.127	1007	0.02662	$2.346 \times 10^{-5}$	$1.918 \times 10^{-5}$	$1.702 \times 10^{-5}$	0.7255
45	1.109	1007	0.02699	$2.416 \times 10^{-5}$	$1.941 \times 10^{-5}$	$1.750 \times 10^{-5}$	0.7241
50	1.092	1007	0.02735	$2.487 \times 10^{-5}$	$1.963 \times 10^{-5}$	$1.798 \times 10^{-5}$	0.7228
60	1.059	1007	0.02808	$2.632 \times 10^{-5}$	$2.008 \times 10^{-5}$	$1.896 \times 10^{-5}$	0.7202
70	1.028	1007	0.02881	$2.780 \times 10^{-5}$	$2.052 \times 10^{-5}$	$1.995 \times 10^{-5}$	0.7177
80	0.9994	1008	0.02953	$2.931 \times 10^{-5}$	$2.096 \times 10^{-5}$	$2.097 \times 10^{-5}$	0.7154
90	0.9718	1008	0.03024	$3.086 \times 10^{-5}$	$2.139 \times 10^{-5}$	$2.201 \times 10^{-5}$	0.7132
100	0.9458	1009	0.03095	$3.243 \times 10^{-5}$	$2.181 \times 10^{-5}$	$2.306 \times 10^{-5}$	0.7111
120	0.8977	1011	0.03235	$3.565 \times 10^{-5}$	$2.264 \times 10^{-5}$	$2.522 \times 10^{-5}$	0.7073
140	0.8542	1013	0.03374	$3.898 \times 10^{-5}$	$2.345 \times 10^{-5}$	$2.745 \times 10^{-5}$	0.7041
160	0.8148	1016	0.03511	$4.241 \times 10^{-5}$	$2.420 \times 10^{-5}$	$2.975 \times 10^{-5}$	0.7014
180	0.7788	1019	0.03646	$4.593 \times 10^{-5}$	$2.504 \times 10^{-5}$	$3.212 \times 10^{-5}$	0.6992
200	0.7459	1023	0.03779	$4.954 \times 10^{-5}$	$2.577 \times 10^{-5}$	$3.455 \times 10^{-5}$	0.6974
250	0.6746	1033	0.04104	$5.890 \times 10^{-5}$	$2.760 \times 10^{-5}$	$4.091 \times 10^{-5}$	0.6946
300	0.6158	1044	0.04418	$6.871 \times 10^{-5}$	$2.934 \times 10^{-5}$	$4.765 \times 10^{-5}$	0.6935
350	0.5664	1056	0.04721	$7.892 \times 10^{-5}$	$3.101 \times 10^{-5}$	$5.475 \times 10^{-5}$	0.6937
400	0.5243	1069	0.05015	$8.951 \times 10^{-5}$	$3.261 \times 10^{-5}$	$6.219 \times 10^{-5}$	0.6948
450	0.4880	1081	0.05298	$1.004 \times 10^{-4}$	$3.415 \times 10^{-5}$	$6.997 \times 10^{-5}$	0.6965
500	0.4565	1093	0.05572	$1.117 \times 10^{-4}$	$3.563 \times 10^{-5}$	$7.806 \times 10^{-5}$	0.6986
600	0.4042	1115	0.06093	$1.352 \times 10^{-4}$	$3.846 \times 10^{-5}$	$9.515 \times 10^{-5}$	0.7037
700	0.3627	1135	0.06581	$1.598 \times 10^{-4}$	$4.111 \times 10^{-5}$	$1.133 \times 10^{-4}$	0.7092
800	0.3289	1153	0.07037	$1.855 \times 10^{-4}$	$4.362 \times 10^{-5}$	$1.326 \times 10^{-4}$	0.7149
900	0.3008	1169	0.07465	$2.122 \times 10^{-4}$	$4.600 \times 10^{-5}$	$1.529 \times 10^{-4}$	0.7206
1000	0.2772	1184	0.07868	$2.398 \times 10^{-4}$	$4.826 \times 10^{-5}$	$1.741 \times 10^{-4}$	0.7260
1500	0.1990	1234	0.09599	$3.908 \times 10^{-4}$	$5.817 \times 10^{-5}$	$2.922 \times 10^{-4}$	0.7478
2000	0.1553	1264	0.11113	$5.664 \times 10^{-4}$	$6.630 \times 10^{-5}$	$4.270 \times 10^{-4}$	0.7539

Note: For ideal gases, the properties  $c_p$ ,  $k$ ,  $\mu$ , and Pr are independent of pressure. The properties  $\rho$ ,  $\nu$ , and  $\alpha$  at a pressure  $P$  (in atm) other than 1 atm are determined by multiplying the values of  $\rho$  at the given temperature by  $P$  and by dividing  $\nu$  and  $\alpha$  by  $P$ .

Source: Data generated from the EES software developed by S. A. Klein and F. L. Alvarado. Original sources: Keenan, Chao, Keyes, Gas Tables, Wiley, 198; and Thermophysical Properties of Matter, Vol. 3: Thermal Conductivity, Y. S. Touloukian, P. E. Liley, S. C. Saxena, Vol. 11: Viscosity, Y. S. Touloukian, S. C. Saxena, and P. Hestermans, IFI/Plenum, NY, 1970, ISBN 0-306067020-8.

Lampiran 4 Tabel *Properties of saturated water*854  
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TABLE A-9

Properties of saturated water

Temp. <i>T</i> , °C	Saturation Pressure <i>P</i> <sub>sat</sub> , kPa	Density $\rho$ , kg/m <sup>3</sup>		Enthalpy of Vaporization <i>h</i> <sub>g</sub> , kJ/kg	Specific Heat <i>c</i> <sub>p</sub> , J/kg · K		Thermal Conductivity <i>k</i> , W/m · K		Dynamic Viscosity $\mu$ , kg/m · s		Prandtl Number Pr		Volume Expansion Coefficient $\beta$ , 1/K
		Liquid	Vapor		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	
0.01	0.6113	999.8	0.0048	2501	4217	1854	0.561	0.0171	1.792 × 10 <sup>-3</sup>	0.922 × 10 <sup>-5</sup>	13.5	1.00	-0.068 × 10 <sup>-3</sup>
5	0.8721	999.9	0.0068	2490	4205	1857	0.571	0.0173	1.519 × 10 <sup>-3</sup>	0.934 × 10 <sup>-5</sup>	11.2	1.00	0.015 × 10 <sup>-3</sup>
10	1.2276	999.7	0.0094	2478	4194	1862	0.580	0.0176	1.307 × 10 <sup>-3</sup>	0.946 × 10 <sup>-5</sup>	9.45	1.00	0.733 × 10 <sup>-3</sup>
15	1.7051	999.1	0.0128	2466	4185	1863	0.589	0.0179	1.138 × 10 <sup>-3</sup>	0.959 × 10 <sup>-5</sup>	8.09	1.00	0.138 × 10 <sup>-3</sup>
20	2.339	998.0	0.0173	2454	4182	1867	0.598	0.0182	1.002 × 10 <sup>-3</sup>	0.973 × 10 <sup>-5</sup>	7.01	1.00	0.195 × 10 <sup>-3</sup>
25	3.169	997.0	0.0231	2442	4180	1870	0.607	0.0186	0.891 × 10 <sup>-3</sup>	0.987 × 10 <sup>-5</sup>	6.14	1.00	0.247 × 10 <sup>-3</sup>
30	4.246	996.0	0.0304	2431	4178	1875	0.615	0.0189	0.798 × 10 <sup>-3</sup>	1.001 × 10 <sup>-5</sup>	5.42	1.00	0.294 × 10 <sup>-3</sup>
35	5.628	994.0	0.0397	2419	4178	1880	0.623	0.0192	0.720 × 10 <sup>-3</sup>	1.016 × 10 <sup>-5</sup>	4.83	1.00	0.337 × 10 <sup>-3</sup>
40	7.384	992.1	0.0512	2407	4179	1885	0.631	0.0196	0.653 × 10 <sup>-3</sup>	1.031 × 10 <sup>-5</sup>	4.32	1.00	0.377 × 10 <sup>-3</sup>
45	9.593	990.1	0.0655	2395	4180	1892	0.637	0.0200	0.596 × 10 <sup>-3</sup>	1.046 × 10 <sup>-5</sup>	3.91	1.00	0.415 × 10 <sup>-3</sup>
50	12.35	988.1	0.0831	2383	4181	1900	0.644	0.0204	0.547 × 10 <sup>-3</sup>	1.062 × 10 <sup>-5</sup>	3.55	1.00	0.451 × 10 <sup>-3</sup>
55	15.76	985.2	0.1045	2371	4183	1908	0.649	0.0208	0.504 × 10 <sup>-3</sup>	1.077 × 10 <sup>-5</sup>	3.25	1.00	0.484 × 10 <sup>-3</sup>
60	19.94	983.3	0.1304	2359	4185	1916	0.654	0.0212	0.467 × 10 <sup>-3</sup>	1.093 × 10 <sup>-5</sup>	2.99	1.00	0.517 × 10 <sup>-3</sup>
65	25.03	980.4	0.1614	2346	4187	1926	0.659	0.0216	0.433 × 10 <sup>-3</sup>	1.110 × 10 <sup>-5</sup>	2.75	1.00	0.548 × 10 <sup>-3</sup>
70	31.19	977.5	0.1983	2334	4190	1936	0.663	0.0221	0.404 × 10 <sup>-3</sup>	1.126 × 10 <sup>-5</sup>	2.55	1.00	0.578 × 10 <sup>-3</sup>
75	38.58	974.7	0.2421	2321	4193	1948	0.667	0.0225	0.378 × 10 <sup>-3</sup>	1.142 × 10 <sup>-5</sup>	2.38	1.00	0.607 × 10 <sup>-3</sup>
80	47.39	971.8	0.2935	2309	4197	1962	0.670	0.0230	0.355 × 10 <sup>-3</sup>	1.159 × 10 <sup>-5</sup>	2.22	1.00	0.653 × 10 <sup>-3</sup>
85	57.83	968.1	0.3536	2296	4201	1977	0.673	0.0235	0.333 × 10 <sup>-3</sup>	1.176 × 10 <sup>-5</sup>	2.08	1.00	0.670 × 10 <sup>-3</sup>
90	70.14	965.3	0.4235	2283	4206	1993	0.675	0.0240	0.315 × 10 <sup>-3</sup>	1.193 × 10 <sup>-5</sup>	1.96	1.00	0.702 × 10 <sup>-3</sup>
95	84.55	961.5	0.5045	2270	4212	2010	0.677	0.0246	0.297 × 10 <sup>-3</sup>	1.210 × 10 <sup>-5</sup>	1.85	1.00	0.716 × 10 <sup>-3</sup>
100	101.33	957.9	0.5978	2257	4217	2029	0.679	0.0251	0.282 × 10 <sup>-3</sup>	1.227 × 10 <sup>-5</sup>	1.75	1.00	0.750 × 10 <sup>-3</sup>
110	143.27	950.6	0.8263	2230	4229	2071	0.682	0.0262	0.255 × 10 <sup>-3</sup>	1.261 × 10 <sup>-5</sup>	1.58	1.00	0.798 × 10 <sup>-3</sup>
120	198.53	943.4	1.121	2203	4244	2120	0.683	0.0275	0.232 × 10 <sup>-3</sup>	1.296 × 10 <sup>-5</sup>	1.44	1.00	0.858 × 10 <sup>-3</sup>
130	270.1	934.6	1.496	2174	4263	2177	0.684	0.0288	0.213 × 10 <sup>-3</sup>	1.330 × 10 <sup>-5</sup>	1.33	1.01	0.913 × 10 <sup>-3</sup>
140	361.3	921.7	1.965	2145	4286	2244	0.683	0.0301	0.197 × 10 <sup>-3</sup>	1.365 × 10 <sup>-5</sup>	1.24	1.02	0.970 × 10 <sup>-3</sup>
150	475.8	916.6	2.546	2114	4311	2314	0.682	0.0316	0.183 × 10 <sup>-3</sup>	1.399 × 10 <sup>-5</sup>	1.16	1.02	1.025 × 10 <sup>-3</sup>
160	617.8	907.4	3.256	2083	4340	2420	0.680	0.0331	0.170 × 10 <sup>-3</sup>	1.434 × 10 <sup>-5</sup>	1.09	1.05	1.145 × 10 <sup>-3</sup>
170	791.7	897.7	4.119	2050	4370	2490	0.677	0.0347	0.160 × 10 <sup>-3</sup>	1.468 × 10 <sup>-5</sup>	1.03	1.05	1.178 × 10 <sup>-3</sup>
180	1,002.1	887.3	5.153	2015	4410	2590	0.673	0.0364	0.150 × 10 <sup>-3</sup>	1.502 × 10 <sup>-5</sup>	0.983	1.07	1.210 × 10 <sup>-3</sup>
190	1,254.4	876.4	6.388	1979	4460	2710	0.669	0.0382	0.142 × 10 <sup>-3</sup>	1.537 × 10 <sup>-5</sup>	0.947	1.09	1.280 × 10 <sup>-3</sup>
200	1,553.8	864.3	7.852	1941	4500	2840	0.663	0.0401	0.134 × 10 <sup>-3</sup>	1.571 × 10 <sup>-5</sup>	0.910	1.11	1.350 × 10 <sup>-3</sup>
220	2,318	840.3	11.60	1859	4610	3110	0.650	0.0442	0.122 × 10 <sup>-3</sup>	1.641 × 10 <sup>-5</sup>	0.865	1.15	1.520 × 10 <sup>-3</sup>
240	3,344	813.7	16.73	1767	4760	3520	0.632	0.0487	0.111 × 10 <sup>-3</sup>	1.712 × 10 <sup>-5</sup>	0.836	1.24	1.720 × 10 <sup>-3</sup>
260	4,688	783.7	23.69	1663	4970	4070	0.609	0.0540	0.102 × 10 <sup>-3</sup>	1.788 × 10 <sup>-5</sup>	0.832	1.35	2.000 × 10 <sup>-3</sup>
280	6,412	750.8	33.15	1544	5280	4835	0.581	0.0605	0.094 × 10 <sup>-3</sup>	1.870 × 10 <sup>-5</sup>	0.854	1.49	2.380 × 10 <sup>-3</sup>
300	8,581	713.8	46.15	1405	5750	5980	0.548	0.0695	0.086 × 10 <sup>-3</sup>	1.965 × 10 <sup>-5</sup>	0.902	1.69	2.950 × 10 <sup>-3</sup>
320	11,274	667.1	64.57	1239	6540	7900	0.509	0.0836	0.078 × 10 <sup>-3</sup>	2.084 × 10 <sup>-5</sup>	1.00	1.97	
340	14,586	610.5	92.62	1028	8240	11,870	0.469	0.110	0.070 × 10 <sup>-3</sup>	2.255 × 10 <sup>-5</sup>	1.23	2.43	
360	18,651	528.3	144.0	720	14,690	25,800	0.427	0.178	0.060 × 10 <sup>-3</sup>	2.571 × 10 <sup>-5</sup>	2.06	3.73	
374.14	22,090	317.0	317.0	0	—	—	—	—	0.043 × 10 <sup>-3</sup>	4.313 × 10 <sup>-5</sup>			

Note 1: Kinematic viscosity  $\nu$  and thermal diffusivity  $\alpha$  can be calculated from their definitions,  $\nu = \mu/\rho$  and  $\alpha = k/\rho c_p = \nu/\text{Pr}$ . The temperatures 0.01°C, 100°C, and 374.14°C are the triple-, boiling-, and critical-point temperatures of water, respectively. The properties listed above (except the vapor density) can be used at any pressure with negligible error except at temperatures near the critical-point value.

Note 2: The unit kJ/kg · °C for specific heat is equivalent to kJ/kg · K, and the unit W/m · °C for thermal conductivity is equivalent to W/m · K.

Source: Viscosity and thermal conductivity data are from J. V. Sengers and J. T. R. Watson, *Journal of Physical and Chemical Reference Data* 15 (1986), pp. 1291–1322. Other data are obtained from various sources or calculated.



Lampiran 5 Tabel pengambilan data Pelat kolektor standar

Plat Kolektor Standar (Data 1)								
t	IN (T <sub>fi</sub> )C	OUT (T <sub>fo</sub> )C	Plat datar (T <sub>P</sub> )C	Kaca Dalam (T <sub>c-dalam</sub> )C	Kaca Luar (T <sub>c-Luar</sub> )C	Tanki (T.Tangki)C	Ling (T <sub>a</sub> )C	Ilum (I) Kw
0	27,20	27,10	26,90	26,80	26,10	26,90	26,03	0,000
5	27,37	29,00	41,62	45,90	46,96	29,88	26,52	1,006
10	27,78	29,83	43,08	55,30	56,98	30,46	27,11	1,036
15	28,19	30,36	43,98	60,22	61,60	30,94	27,36	1,039
20	28,64	30,87	44,74	63,26	64,18	31,44	27,53	1,044
25	29,02	31,31	45,34	65,30	65,56	31,86	27,70	1,048
30	29,44	31,74	45,86	66,36	66,70	32,28	27,85	1,026
35	29,80	32,11	46,30	67,24	67,08	32,66	27,98	1,020
40	30,18	32,51	46,74	67,68	67,68	33,04	28,05	1,022
45	30,55	32,88	47,08	68,08	68,36	33,32	28,15	1,023
50	30,91	33,25	47,54	68,32	68,18	33,62	28,24	1,025
55	31,26	33,62	47,96	68,66	68,74	33,96	28,18	1,026
60	31,54	33,91	48,32	68,80	68,74	34,14	28,29	1,026
65	31,86	34,23	48,58	69,16	68,58	34,40	28,33	1,024
70	32,15	34,52	48,90	69,20	68,94	34,64	28,30	1,025
75	32,43	34,79	49,12	69,56	69,16	34,82	28,33	1,023
80	32,72	35,09	49,42	69,50	69,06	35,14	28,30	1,024
85	32,98	35,34	49,76	69,80	69,36	35,36	28,29	1,022
90	33,24	35,60	50,00	69,78	69,48	35,60	28,33	1,025
95	33,49	35,86	50,26	70,02	69,48	35,80	28,35	1,024
100	33,74	36,10	50,60	69,98	69,46	36,08	28,38	1,026
105	33,98	36,35	50,82	70,14	70,08	36,26	28,34	1,030
110	34,17	36,55	51,02	70,12	69,88	36,48	28,35	1,029
115	34,41	36,77	51,20	70,42	69,70	36,66	28,38	1,025
120	34,59	36,96	51,46	70,60	69,84	36,86	28,44	1,021
125	34,73	37,12	51,54	70,64	70,10	37,00	28,51	1,020
130	34,93	37,30	51,76	70,74	69,98	37,24	28,51	1,019
135	35,06	37,44	51,84	70,74	69,96	37,38	28,39	1,016
140	35,24	37,58	52,02	70,84	69,92	37,60	28,35	1,016
145	35,42	37,75	52,24	70,92	70,04	37,80	28,41	1,020
150	35,56	37,89	52,38	71,20	70,32	37,98	28,52	1,020
155	35,72	38,04	52,50	71,18	70,30	38,08	28,54	1,015
160	35,91	38,22	52,64	71,28	70,30	38,24	28,46	1,013
165	36,01	38,33	52,74	71,36	70,10	38,44	28,53	1,017
170	36,14	38,46	52,88	71,32	70,24	38,52	28,50	1,014
175	36,28	38,60	52,98	71,48	70,28	38,70	28,40	1,015

180	36,41	38,71	53,12	71,54	70,44	38,88	28,50	1,015
185	36,34	36,87	38,44	52,48	52,02	36,56	28,43	0
190	36,03	36,17	37,04	43,48	42,82	36,10	28,50	0
195	35,73	35,78	36,22	39,28	38,50	35,68	28,54	0
200	35,42	35,42	35,58	36,76	35,92	35,30	28,45	0
205	35,11	35,07	35,06	35,26	34,38	35,00	28,39	0
210	34,83	34,76	34,56	34,26	33,34	34,64	28,32	0
215	34,52	34,44	34,20	33,56	32,58	34,30	28,24	0
220	34,27	34,15	33,82	33,04	32,06	34,04	28,22	0
225	33,98	33,86	33,46	32,64	31,56	33,74	28,27	0
230	33,69	33,58	33,14	32,24	31,12	33,42	28,14	0
235	33,47	33,33	32,88	31,96	30,84	33,18	28,18	0
240	33,23	33,10	32,62	31,70	30,56	32,94	28,54	0



Plat Kolektor Standar (Data 2)								
t	IN (T <sub>fi</sub> )C	OUT (T <sub>fo</sub> )C	Plat datar (T <sub>P</sub> )C	Kaca Dalam (T <sub>c-dalam</sub> )C	Kaca Luar (T <sub>c-Luar</sub> )C	Tanki (T.Tangki)C	Ling (T <sub>a</sub> )C	Ilum (I) K <sub>w</sub>
0	27,15	27,10	26,50	26,60	26,60	27,10	26,50	0,000
5	27,32	28,90	43,16	47,92	48,40	27,14	26,91	0,993
10	27,73	29,74	44,74	59,46	60,82	27,52	27,23	1,011
15	28,15	30,28	45,78	65,02	66,14	27,90	27,54	1,012
20	28,57	30,78	46,54	67,98	69,02	28,32	27,89	1,023
25	28,99	31,25	47,20	69,78	70,46	28,76	28,09	1,029
30	29,41	31,68	47,78	70,96	71,40	29,26	28,26	1,030
35	29,81	32,10	48,20	71,68	72,12	29,62	28,51	1,029
40	30,20	32,51	48,70	72,34	72,28	30,12	28,62	1,030
45	30,58	32,91	49,14	72,78	72,62	30,50	28,79	1,022
50	30,94	33,26	49,46	73,14	72,96	30,90	28,94	1,018
55	31,29	33,62	49,78	73,46	72,98	31,30	29,06	1,016
60	31,59	33,94	50,14	73,72	73,36	31,68	29,19	1,017
65	31,96	34,31	50,48	74,02	73,40	32,00	29,33	1,020
70	32,28	34,62	50,78	74,26	73,70	32,36	29,41	1,020
75	32,60	34,96	51,10	74,38	73,54	32,72	29,56	1,021
80	32,90	35,26	51,38	74,44	73,80	33,04	29,65	1,022
85	33,18	35,55	51,68	74,60	73,98	33,32	29,73	1,021
90	33,47	35,84	51,96	74,84	74,44	33,68	29,74	1,023
95	33,71	36,08	52,18	74,84	74,58	33,96	29,84	1,048
100	33,96	36,32	52,46	74,90	74,56	34,26	29,91	1,055
105	34,20	36,58	52,66	74,82	74,60	34,46	30,01	1,053
110	34,44	36,79	52,86	74,82	74,66	34,74	29,98	1,048
115	34,66	37,03	53,12	74,92	74,54	34,98	29,93	1,045
120	34,84	37,21	53,10	74,88	74,62	35,08	29,99	1,044
125	35,04	37,41	53,26	74,82	74,52	35,34	30,01	1,042
130	35,24	37,55	53,44	74,86	74,32	35,56	30,06	1,042
135	35,45	37,76	53,62	74,86	74,40	35,72	30,04	1,042
140	35,63	37,95	53,82	74,92	74,44	35,98	30,06	1,042
145	35,84	38,14	53,96	74,96	74,72	36,22	30,12	1,042
150	36,00	38,29	54,12	74,96	74,60	36,32	30,12	1,047
155	36,16	38,47	54,28	75,06	74,66	36,50	30,13	1,015
160	36,33	38,63	54,44	75,24	74,82	36,68	30,10	1,019
165	36,49	38,79	54,60	75,38	74,86	36,86	30,12	1,017
170	36,67	38,98	54,78	75,62	74,68	37,06	30,13	1,014
175	36,72	39,02	54,84	75,34	74,90	37,28	29,42	1,015
180	36,87	39,18	54,94	75,34	75,36	37,36	29,63	1,015

185	36,87	37,41	39,14	55,42	54,74	37,36	29,89	0
190	36,64	36,80	37,58	44,48	43,82	36,96	29,98	0
195	36,35	36,42	36,78	39,74	39,02	36,70	30,00	0
200	36,07	36,09	36,12	37,04	36,34	36,38	30,02	0
205	35,80	35,76	35,66	35,38	34,76	36,06	30,04	0
210	35,52	35,47	35,22	34,32	33,74	35,78	29,97	0
215	35,24	35,18	34,84	33,48	32,94	35,46	29,95	0
220	35,01	34,91	34,48	32,98	32,40	35,24	29,89	0
225	34,74	34,64	34,18	32,48	31,94	34,96	29,83	0
230	34,50	34,40	33,90	32,08	31,62	34,66	29,82	0
235	34,28	34,15	33,60	31,80	31,36	34,44	29,78	0
240	34,07	33,96	33,40	31,58	31,18	34,22	29,80	0

Plat Kolektor Standar (Data 3)								
t	IN (T <sub>fi</sub> )C	OUT (T <sub>fo</sub> )C	Plat datar (T <sub>P</sub> )C	Kaca Dalam (T <sub>c- dalam</sub> )C	Kaca Luar (T <sub>c- Luar</sub> )C	Tanki (T.Tangki)C	Ling (T <sub>a</sub> )C	Ilum (I) K <sub>w</sub>
0	27,20	27,00	26,00	26,10	25,70	27,00	26,67	0,000
5	27,35	28,97	42,64	48,52	47,28	27,24	26,90	0,996
10	27,68	29,73	44,62	59,92	59,14	27,62	27,24	1,022
15	28,01	30,17	45,88	65,20	65,00	28,00	27,51	1,030
20	28,39	30,63	46,72	68,04	67,68	28,32	27,79	1,031
25	28,78	31,07	47,44	69,68	68,92	28,74	27,80	1,020
30	29,18	31,48	48,02	70,58	70,14	29,14	27,76	1,021
35	29,57	31,88	48,50	71,44	71,08	29,42	28,13	1,021
40	29,94	32,29	49,00	72,10	71,42	29,74	28,43	1,021
45	30,33	32,68	49,48	72,62	71,92	30,24	28,66	1,019
50	30,70	33,05	49,88	73,02	72,26	30,64	28,89	1,020
55	31,08	33,45	50,32	73,32	72,46	31,10	29,08	1,021
60	31,38	33,75	50,66	73,52	72,96	31,44	29,21	1,018
65	31,74	34,12	51,04	73,76	72,78	31,76	29,36	1,017
70	32,05	34,44	51,40	74,10	73,26	32,10	29,50	1,016
75	32,37	34,75	51,72	74,30	73,48	32,48	29,58	1,015
80	32,68	35,07	52,08	74,46	73,14	32,78	29,20	1,014
85	32,96	35,34	52,36	74,34	73,20	33,10	29,19	1,013
90	33,25	35,64	52,68	74,58	73,44	33,38	29,44	1,012
95	33,50	35,88	53,02	74,68	73,46	33,68	29,74	1,011
100	33,75	36,13	53,36	74,68	73,16	33,94	29,30	1,014
105	34,03	36,42	53,64	74,68	73,90	34,26	29,37	1,013
110	34,24	36,62	53,78	74,84	73,90	34,66	29,72	1,013
115	34,49	36,87	53,98	75,16	73,60	34,74	29,77	1,013
120	34,75	37,13	54,18	75,10	73,64	35,02	29,32	1,011
125	34,88	37,26	54,34	75,24	73,66	35,40	29,59	1,013
130	35,11	37,50	54,58	75,42	73,86	35,42	29,68	1,012
135	35,32	37,68	54,82	75,24	73,68	35,68	29,33	1,010
140	35,45	37,80	54,94	75,36	73,94	35,90	29,62	1,011
145	35,66	38,01	55,10	75,64	73,96	35,98	29,71	1,010
150	35,82	38,19	55,34	75,54	73,84	36,22	29,37	1,010
155	35,97	38,31	55,48	75,68	73,92	36,46	29,69	1,017
160	36,16	38,52	55,64	75,76	73,80	36,52	29,53	1,019
165	36,25	38,60	55,76	75,72	73,94	36,78	29,51	1,018
170	36,43	38,77	55,98	75,96	74,04	36,82	29,79	1,017
175	36,56	38,90	56,14	75,82	73,82	37,10	29,36	1,017
180	36,72	39,06	56,26	75,92	74,26	37,18	29,67	1,019
185	36,72	37,26	38,98	54,80	54,86	37,12	29,64	0
190	36,37	36,54	37,42	44,16	43,94	36,88	29,39	0

195	36,10	36,17	36,48	39,32	38,94	36,44	29,67	0
200	35,85	35,85	35,76	36,74	36,30	36,12	29,85	0
205	35,55	35,52	35,24	35,18	34,72	35,84	29,89	0
210	35,27	35,22	34,88	34,14	33,62	35,52	29,33	0
215	35,01	34,93	34,40	33,20	32,78	35,24	29,52	0
220	34,76	34,66	34,02	32,68	32,28	34,98	29,72	0
225	34,48	34,39	33,74	32,20	31,84	34,66	29,77	0
230	34,27	34,14	33,48	31,86	31,50	34,44	29,89	0
235	34,04	33,93	33,24	31,62	31,28	34,14	29,90	0
240	33,85	33,71	32,98	31,38	31,04	33,92	29,47	0

Lampiran 6 Tabel pengambilan data Pelat kolektor dengan ketebalan Al foam

<b>Plat Kolektor Al Foam (Data 1)</b>									
<b>t</b>	<b>IN</b>	<b>OUT</b>	<b>Plat datar</b>	<b>Material</b>	<b>Kaca Dalam</b>	<b>Kaca Luar</b>	<b>Tanki</b>	<b>Ling</b>	<b>Ilum</b>
	<b>(Tfi)C</b>	<b>(Tfo)C</b>	<b>(TP1)C</b>	<b>Al Foam</b>	<b>(Tc-dalam)C</b>	<b>(Tc-Luar)C</b>	<b>(T.Tangki)C</b>	<b>(Ta)C</b>	<b>(I) Kw</b>
0	27,15	27,00	26,50	26,80	26,10	26,10	26,90	26,71	0,000
5	27,32	28,70	38,24	32,54	48,34	47,82	27,04	26,88	1,016
10	27,67	29,54	41,22	35,28	60,04	59,76	27,38	27,17	1,027
15	28,04	30,18	42,84	36,62	65,30	65,28	27,72	27,56	1,015
20	28,52	30,76	44,02	37,60	68,24	68,38	28,18	27,99	1,020
25	28,95	31,22	44,66	38,34	69,54	69,44	28,64	28,13	1,016
30	29,36	31,64	45,30	38,90	70,28	70,54	29,08	28,26	1,020
35	29,74	32,06	45,84	39,34	70,66	70,94	29,50	28,45	1,021
40	30,11	32,47	46,28	39,78	71,00	70,90	29,88	28,49	1,020
45	30,46	32,80	46,72	40,20	71,32	71,14	30,30	28,54	1,019
50	30,84	33,17	47,16	40,54	71,70	71,42	30,68	28,52	1,016
55	31,16	33,52	47,54	40,92	71,94	71,56	31,12	28,56	1,015
60	31,46	33,82	47,74	41,10	72,02	71,48	31,32	28,71	0,995
65	31,73	34,10	48,00	41,44	72,00	71,34	31,72	28,74	1,012
70	32,07	34,43	48,34	41,74	71,98	71,50	32,02	28,85	1,012
75	32,41	34,76	48,72	42,00	72,32	71,80	32,36	29,14	1,010
80	32,62	35,01	49,00	42,26	72,44	71,68	32,68	29,11	1,010
85	32,86	35,24	49,32	42,58	72,56	71,96	32,92	29,09	1,009
90	33,15	35,53	49,60	42,86	72,64	71,76	33,20	29,11	1,010
95	33,32	35,69	49,82	43,00	72,74	71,80	33,60	29,15	1,009
100	33,54	35,91	50,04	43,18	72,78	72,14	33,74	29,19	1,008
105	33,77	36,13	50,30	43,38	72,90	72,02	34,02	29,18	1,009
110	33,99	36,36	50,54	43,66	73,06	72,00	34,24	29,14	1,009
115	34,18	36,55	50,74	43,74	73,16	72,02	34,38	29,25	1,009
120	34,40	36,77	50,94	44,02	73,34	72,26	34,68	29,20	1,007
125	34,59	36,97	51,20	44,20	73,48	72,10	34,88	29,19	1,009
130	34,75	37,13	51,40	44,34	73,56	72,18	34,96	29,24	1,009
135	34,96	37,33	51,52	44,52	73,58	72,36	35,14	29,34	1,009
140	35,14	37,53	51,76	44,72	73,74	72,36	35,44	29,26	1,009
145	35,27	37,65	51,92	44,86	73,90	72,46	35,58	29,27	1,010
150	35,42	37,78	52,08	45,00	73,98	72,62	35,76	29,27	1,010
155	35,55	37,91	52,22	45,10	73,96	72,44	35,86	29,30	1,010
160	35,60	37,94	52,38	45,18	74,04	72,56	36,04	29,32	1,010

165	35,75	38,13	52,50	45,28	74,12	72,64	36,22	29,29	1,009
170	35,93	38,29	52,64	45,42	74,30	72,72	36,36	29,31	1,009
175	36,06	38,41	52,84	45,62	74,32	72,76	36,44	29,32	1,010
180	36,20	38,54	52,92	45,72	74,32	72,80	36,58	29,32	1,010
185	36,13	36,99	40,14	40,10	53,14	52,96	36,60	29,31	0
190	35,87	36,24	37,64	37,78	43,06	42,50	36,24	29,20	0
195	35,59	35,75	36,30	36,64	38,42	37,80	36,00	29,07	0
200	35,36	35,43	35,52	35,86	35,94	35,28	35,66	29,22	0
205	35,02	35,03	34,92	35,34	34,36	33,74	35,34	29,08	0
210	34,73	34,68	34,44	34,94	33,40	32,72	35,10	28,97	0
215	34,46	34,40	34,08	34,52	32,64	31,98	34,72	28,97	0
220	34,20	34,13	33,74	34,22	32,18	31,48	34,42	29,08	0
225	33,89	33,80	33,46	33,88	31,74	31,04	34,18	28,92	0
230	33,66	33,57	33,10	33,56	31,34	30,74	33,84	28,99	0
235	33,41	33,31	32,86	33,26	31,06	30,50	33,60	29,01	0
240	33,14	33,02	32,56	33,08	30,82	30,30	33,38	28,79	0

Plat Kolektor Al Foam (Data 2)									
t	IN (T <sub>fi</sub> )C	OUT (T <sub>fo</sub> )C	Plat datar (TP1)C	Material Al Foam	Kaca Dalam (T <sub>c-dalam</sub> )C	Kaca Luar (T <sub>c-Luar</sub> )C	Tanki (T.Tangki)C	Ling (T <sub>a</sub> )C	Hum (I) K <sub>w</sub>
0	27,10	27,00	26,20	26,50	26,30	26,30	26,90	26,71	0,000
5	27,22	28,34	40,78	32,88	49,08	47,50	27,06	26,94	1,029
10	27,51	29,28	43,46	35,24	59,72	59,22	27,30	27,12	1,026
15	27,89	29,91	44,94	36,56	64,56	64,48	27,64	27,45	1,031
20	28,28	30,44	45,84	37,38	67,06	67,22	28,04	27,83	1,027
25	28,72	30,96	46,58	38,02	68,56	68,88	28,46	28,19	1,028
30	29,12	31,41	47,20	38,58	69,82	70,08	28,80	28,48	1,042
35	29,52	31,83	47,74	39,08	70,78	71,02	29,30	28,71	1,017
40	29,90	32,24	48,14	39,44	71,52	71,56	29,68	28,92	1,013
45	30,29	32,64	48,58	39,94	72,08	71,96	30,14	29,13	1,010
50	30,67	33,04	48,98	40,36	72,40	72,30	30,56	29,28	1,012
55	31,08	33,46	49,48	40,84	72,80	72,78	30,98	29,47	1,014
60	31,40	33,79	49,80	41,22	73,12	72,86	31,36	29,64	1,014
65	31,72	34,13	50,14	41,56	73,30	72,88	31,78	29,39	1,010
70	32,01	34,43	50,38	41,84	73,36	72,94	32,18	29,24	1,008
75	32,35	34,75	50,68	42,12	73,46	72,90	32,48	29,43	1,008
80	32,67	35,07	50,94	42,44	73,58	73,06	32,80	29,57	1,009
85	32,96	35,36	51,26	42,74	73,78	73,32	33,10	29,70	1,009
90	33,20	35,61	51,42	43,06	73,78	72,88	33,48	29,38	1,009
95	33,52	35,93	51,72	43,28	73,82	73,44	33,66	29,65	1,012
100	33,75	36,17	52,00	43,58	73,98	73,30	34,02	29,51	1,012
105	34,03	36,44	52,18	43,76	74,06	73,58	34,20	29,63	1,010
110	34,25	36,67	52,42	44,02	74,18	73,34	34,48	29,60	1,009
115	34,48	36,88	52,66	44,24	74,28	73,50	34,74	29,52	1,012
120	34,74	37,15	52,86	44,44	74,38	73,58	34,98	29,84	1,011
125	34,90	37,32	53,10	44,70	74,52	73,66	35,34	29,45	1,012
130	35,16	37,56	53,26	44,86	74,62	73,74	35,44	29,90	1,011
135	35,32	37,72	53,46	45,10	74,80	73,66	35,66	29,62	1,012
140	35,52	37,90	53,64	45,24	74,84	73,78	35,88	29,68	1,012
145	35,66	38,05	53,78	45,40	74,86	74,02	36,04	29,59	1,013
150	35,86	38,25	53,94	45,54	75,08	74,08	36,24	29,62	1,011
155	36,02	38,41	54,04	45,72	75,16	74,20	36,36	29,67	1,017
160	36,15	38,55	54,26	45,86	75,28	74,06	36,62	29,53	1,014
165	36,34	38,72	54,40	45,98	75,26	74,22	36,72	29,75	1,015
170	36,44	38,85	54,56	46,18	75,34	74,04	37,00	29,52	1,015
175	36,59	38,99	54,70	46,24	75,42	74,34	37,04	29,74	1,013



180	36,72	39,12	54,82	46,46	75,48	74,12	37,28	29,52	1,017
185	36,99	37,91	40,98	40,86	54,06	54,28	37,28	30,03	0
190	36,82	37,18	38,40	38,62	43,92	43,44	37,04	30,06	0
195	36,53	36,68	37,08	37,34	39,20	38,48	36,62	29,99	0
200	36,27	36,32	36,20	36,64	36,64	35,90	36,38	29,71	0
205	36,00	35,99	35,60	36,08	34,98	34,24	36,04	29,65	0
210	35,72	35,67	35,14	35,66	33,92	33,18	35,76	29,63	0
215	35,44	35,36	34,78	35,24	33,16	32,48	35,42	29,65	0
220	35,18	35,09	34,32	34,88	32,62	31,86	35,12	29,46	0
225	34,90	34,80	34,10	34,62	32,24	31,48	34,92	29,44	0
230	34,65	34,53	33,78	34,32	31,86	31,16	34,60	29,30	0
235	34,42	34,31	33,50	34,04	31,62	30,94	34,36	29,31	0
240	34,17	34,05	33,30	33,78	31,42	30,78	34,14	29,54	0

Plat Kolektor Al Foam (Data 3)									
t	IN (T <sub>fi</sub> )C	OUT (T <sub>fo</sub> )C	Plat datar (TP1)C	Material  Al Foam	Kaca Dalam (T <sub>c- dalam</sub> )C	Kaca Luar (T <sub>c- Luar</sub> )C	Tanki  (T.Tangki)C	Ling  (T <sub>a</sub> )C	Ilum  (I) K <sub>w</sub>
0	27,10	27,00	25,90	26,30	26,00	26,00	25,40	26,96	0,000
5	27,22	28,34	38,92	32,68	49,02	46,86	25,48	26,97	1,029
10	27,51	29,28	41,50	35,18	60,48	59,42	25,96	27,15	1,026
15	27,89	29,91	42,96	36,52	65,78	65,00	26,44	27,52	1,031
20	28,32	30,56	43,90	37,30	68,66	67,84	26,98	27,97	1,014
25	28,79	31,11	44,62	38,00	70,40	69,24	27,48	28,22	1,018
30	29,21	31,57	45,28	38,68	71,66	70,28	28,00	28,45	1,016
35	29,65	32,03	45,84	39,16	72,42	71,20	28,46	28,62	1,012
40	30,02	32,47	46,24	39,64	72,90	71,70	29,06	28,78	1,014
45	30,44	32,85	46,68	40,08	73,36	72,10	29,48	28,96	1,011
50	30,82	33,26	47,08	40,52	73,86	72,14	29,88	29,10	1,014
55	31,21	33,61	47,30	40,84	73,52	72,42	30,40	29,28	0,988
60	31,54	33,95	47,50	41,14	73,30	72,26	30,88	29,40	0,984
65	31,91	34,30	47,84	41,58	73,16	72,24	31,26	29,50	1,012
70	32,25	34,64	48,20	41,96	73,02	72,40	31,60	29,60	1,012
75	32,59	34,98	48,56	42,32	73,28	72,74	31,94	29,73	1,010
80	32,86	35,25	48,86	42,62	73,36	72,52	32,34	29,50	1,010
85	33,12	35,53	49,12	42,96	73,28	72,64	32,68	29,25	1,010
90	33,45	35,84	49,30	43,10	73,38	72,72	33,12	29,54	1,005
95	33,74	36,13	49,62	43,40	73,60	73,02	33,40	29,70	1,005
100	33,97	36,38	49,86	43,70	73,62	72,76	33,68	29,41	1,008
105	34,18	36,63	50,08	44,00	73,26	72,86	33,98	29,30	1,007
110	34,46	36,88	50,30	44,16	73,10	73,12	34,32	29,63	1,007
115	34,71	37,18	50,54	44,42	73,30	73,02	34,58	29,78	1,007
120	34,87	37,37	50,80	44,72	73,30	72,78	34,90	29,35	1,007
125	35,10	37,57	50,92	44,84	73,16	73,24	35,16	29,56	1,011
130	35,31	37,76	51,14	45,00	73,36	73,32	35,46	29,81	1,017
135	35,49	37,93	51,36	45,30	73,44	73,20	35,62	29,43	1,015
140	35,65	38,11	51,50	45,42	73,42	73,42	35,92	29,52	1,016
145	35,90	38,33	51,64	45,54	73,44	73,70	36,16	29,82	1,015
150	36,03	38,51	51,84	45,76	73,54	73,46	36,38	29,57	1,014
155	36,20	38,60	52,00	45,88	73,40	73,56	36,54	29,50	1,017
160	36,44	38,81	52,10	46,02	73,46	73,78	36,74	29,83	1,014
165	36,59	38,97	52,22	46,16	73,54	73,52	36,94	29,67	1,015
170	36,73	39,09	52,40	46,38	73,50	73,58	37,16	29,58	1,015

175	36,90	39,27	52,54	46,44	73,48	73,90	37,30	29,88	1,013
180	37,05	39,44	52,64	46,62	73,44	73,64	37,46	29,68	1,017
185	36,94	37,81	41,06	41,08	53,08	54,10	37,48	29,49	0
190	36,76	37,15	38,58	38,72	43,86	43,58	37,28	29,70	0
195	36,51	36,70	37,30	37,62	39,52	38,82	37,02	29,84	0
200	36,24	36,31	36,46	36,84	37,00	36,24	36,72	29,97	0
205	35,97	35,98	35,90	36,34	35,48	34,74	36,38	29,98	0
210	35,70	35,67	35,48	35,92	34,48	33,78	36,12	29,99	0
215	35,37	35,33	35,14	35,64	33,72	33,02	35,82	29,47	0
220	35,10	35,03	34,80	35,36	33,16	32,48	35,52	29,13	0
225	34,84	34,76	34,44	34,88	32,58	31,92	35,28	29,42	0
230	34,61	34,51	34,12	34,54	32,20	31,54	34,94	29,60	0
235	34,40	34,31	33,86	34,28	32,00	31,30	34,64	29,73	0
240	34,19	34,08	33,60	34,02	31,70	31,10	34,38	29,70	0

Lampiran 7 Tabel pengambilan data Pelat kolektor dengan ketebalan Al foam PCM

Plat Kolektor Al Foam PCM (Data 1)									
t	IN (Tfi)C	OUT (Tfo)C	Plat datar (TP)C	Material Al foam PCM	Kaca Dalam (Tc- dalam)C	Kaca Luar (Tc- Luar)C	Tanki (T.Tangki)C	Ling (Ta)C	Ilum (I) Kw
0	27,20	27,10	26,70	26,80	27,10	27,20	27,20	26,95	0,000
5	27,37	28,57	40,62	27,44	45,70	46,72	27,34	26,95	0,964
10	27,61	29,41	42,90	29,18	55,68	57,46	27,54	27,43	0,996
15	27,90	29,95	44,22	31,04	60,36	62,08	27,90	27,69	0,994
20	28,22	30,43	45,06	32,68	62,88	65,14	28,26	27,76	0,992
25	28,56	30,86	45,74	33,94	64,34	66,60	28,72	27,72	0,995
30	28,89	31,25	46,26	34,90	65,30	67,16	29,04	27,66	0,994
35	29,21	31,57	46,62	35,66	65,78	68,10	29,42	28,03	0,993
40	29,50	31,88	46,84	36,24	66,08	68,42	29,74	28,38	0,987
45	29,79	32,18	47,14	36,86	66,18	67,88	30,10	28,32	0,983
50	30,07	32,48	47,42	37,30	66,40	68,00	30,40	28,60	0,992
55	30,34	32,75	47,70	37,76	66,58	68,28	30,72	28,84	0,993
60	30,58	33,00	47,94	38,16	66,60	68,40	30,96	28,73	1,001
65	30,86	33,28	48,14	38,54	66,70	68,46	31,22	28,95	1,000
70	31,13	33,55	48,40	38,84	67,08	68,30	31,50	28,82	1,000
75	31,34	33,78	48,58	39,12	67,14	68,58	31,76	28,99	1,000
80	31,58	34,03	48,84	39,44	67,10	68,98	32,02	28,80	1,000
85	31,85	34,31	48,98	39,66	67,52	68,74	32,24	29,05	0,996
90	32,18	34,63	49,26	39,96	68,16	68,98	32,48	28,97	1,000
95	32,48	34,93	49,62	40,30	68,68	69,24	32,84	29,26	1,002
100	32,77	35,25	50,06	40,54	69,38	69,86	33,00	29,45	1,006
105	32,98	35,48	50,32	40,90	69,56	70,30	33,28	29,56	1,003
110	33,24	35,76	50,60	41,20	69,82	70,52	33,50	29,69	1,006
115	33,52	36,03	50,80	41,48	70,04	70,72	33,82	29,85	1,006
120	33,73	36,25	51,04	41,80	70,20	70,76	34,08	29,82	1,006
125	33,99	36,49	51,32	42,12	70,34	71,34	34,40	30,03	1,007
130	34,28	36,78	51,58	42,42	70,48	70,90	34,66	29,95	1,005
135	34,48	36,99	51,76	42,74	70,72	71,26	34,94	29,94	1,005
140	34,68	37,21	51,96	43,04	70,80	71,38	35,14	29,97	1,005
145	34,89	37,46	52,18	43,32	70,94	71,44	35,32	30,05	1,008
150	35,10	37,60	52,36	43,62	71,14	71,60	35,58	30,11	1,005
155	35,26	37,78	52,52	43,96	71,10	71,38	35,78	29,98	1,005
160	35,41	37,93	52,62	44,26	71,20	71,50	35,96	29,86	1,005
165	35,59	38,09	52,80	44,54	71,22	71,48	36,12	29,98	1,005
170	35,76	38,28	52,86	44,80	71,10	71,38	36,28	30,13	1,005
175	35,95	38,40	52,80	45,02	70,82	70,94	36,34	30,01	1,006

180	36,05	38,53	52,82	45,28	70,62	70,82	36,62	30,19	1,005
185	36,05	37,22	40,96	45,18	53,14	53,30	36,56	30,17	0
190	35,87	36,49	38,82	44,44	43,70	44,30	36,32	30,02	0
195	35,61	36,05	37,70	43,54	39,30	39,96	36,02	29,96	0
200	35,35	35,69	36,96	42,80	36,74	37,30	35,82	29,88	0
205	35,11	35,34	36,32	42,12	35,22	35,54	35,50	29,82	0
210	34,84	35,03	35,80	41,46	34,24	34,36	35,24	29,71	0
215	34,59	34,73	35,30	40,74	33,52	33,48	34,94	29,66	0
220	34,35	34,44	34,84	39,96	32,94	32,82	34,68	29,70	0
225	34,07	34,15	34,42	39,26	32,50	32,28	34,40	29,65	0
230	33,84	33,88	34,08	38,50	32,18	31,90	34,14	29,59	0
235	33,61	33,63	33,76	37,82	31,96	31,54	33,86	29,52	0
240	33,43	33,43	33,46	37,10	31,64	31,26	33,64	29,21	0

Plat Kolektor Al Foam PCM (Data 2)									
t	IN (T <sub>fi</sub> )C	OUT (T <sub>fo</sub> )C	Plat datar (T <sub>P1</sub> )C	Material Al foam PCM	Kaca Dalam (T <sub>c- dalam</sub> )C	Kaca Luar (T <sub>c- Luar</sub> )C	Tanki (T.Tangki)C	Ling (T <sub>a</sub> )C	Ilum (I) K <sub>w</sub>
0	27,20	27,10	26,50	25,00	26,70	26,60	27,10	26,95	0,000
5	27,42	28,62	38,14	25,74	46,70	45,94	27,32	26,95	0,987
10	27,67	29,47	40,68	27,82	56,66	56,60	27,62	27,43	0,996
15	27,99	30,03	42,06	30,10	61,36	61,46	27,98	27,69	0,994
20	28,32	30,53	43,00	31,88	64,14	64,30	28,32	27,76	0,992
25	28,71	31,01	43,72	33,28	65,86	65,92	28,68	27,72	0,995
30	29,08	31,43	44,32	34,34	67,06	66,88	29,04	27,66	0,994
35	29,37	31,73	44,84	35,26	67,84	67,86	29,42	28,03	0,993
40	29,70	32,08	45,28	36,00	68,40	68,32	29,82	28,38	1,022
45	29,99	32,38	45,70	36,66	68,88	68,82	30,28	28,32	1,025
50	30,27	32,68	46,08	37,26	69,38	69,18	30,66	28,60	1,023
55	30,54	32,95	46,50	37,80	69,70	69,34	31,10	28,84	1,021
60	30,78	33,21	46,80	38,26	70,04	69,48	31,36	28,73	1,021
65	31,06	33,49	47,12	38,74	70,22	69,84	31,66	28,95	1,021
70	31,33	33,76	47,42	39,16	70,56	69,96	32,04	28,82	1,021
75	31,54	33,97	47,66	39,52	70,76	70,14	32,32	28,99	1,020
80	31,77	34,21	48,00	39,96	71,06	70,28	32,64	28,80	1,020
85	32,03	34,47	48,16	40,32	71,12	70,26	33,02	29,05	1,008
90	32,38	34,83	48,38	40,70	71,16	70,24	33,28	28,97	1,011
95	32,68	35,14	48,66	41,02	71,24	70,38	33,56	29,26	1,019
100	32,98	35,45	48,92	41,36	71,40	70,36	33,84	29,45	1,016
105	33,18	35,66	49,10	41,68	71,50	70,26	34,14	29,56	1,017
110	33,44	35,94	49,40	42,08	71,56	70,10	34,42	29,69	1,021
115	33,72	36,22	49,60	42,46	71,54	70,52	34,72	29,85	1,020
120	33,93	36,44	49,76	42,64	71,62	70,42	34,84	29,82	1,018
125	34,18	36,69	49,86	42,90	71,74	70,62	35,08	30,03	1,017
130	34,45	36,97	50,18	43,18	71,90	70,52	35,40	29,95	1,005
135	34,68	37,20	50,40	43,64	71,84	70,74	35,68	29,94	1,005
140	34,87	37,39	50,60	43,84	71,98	70,66	35,76	29,97	1,005
145	35,07	37,60	50,64	44,10	72,08	70,76	35,92	30,05	1,008
150	35,27	37,80	50,86	44,40	72,34	70,78	36,14	30,11	1,005
155	35,47	38,00	51,08	44,82	72,08	70,56	36,40	29,98	1,005
160	35,61	38,13	51,18	45,00	72,10	70,80	36,44	29,86	1,005
165	35,78	38,30	51,26	45,20	72,36	70,88	36,54	29,98	1,005
170	35,94	38,46	51,44	45,44	72,66	70,74	36,74	30,13	1,005
175	36,09	38,61	51,66	45,78	72,46	70,72	37,04	30,01	1,006

180	36,24	38,76	51,74	45,90	72,40	71,04	37,08	30,19	1,005
185	36,17	37,34	41,36	45,66	52,54	52,30	37,10	30,17	0
190	35,97	36,60	39,40	44,78	43,96	43,08	36,86	30,02	0
195	35,68	36,12	38,30	43,84	39,76	38,64	36,70	29,96	0
200	35,39	35,72	37,50	42,96	37,12	36,14	36,30	29,88	0
205	35,13	35,36	36,86	42,26	35,64	34,64	35,98	29,82	0
210	34,87	35,07	36,34	41,56	34,64	33,74	35,70	29,71	0
215	34,62	34,76	35,90	40,92	34,04	33,06	35,42	29,66	0
220	34,37	34,45	35,46	40,26	33,60	32,62	35,22	29,70	0
225	34,12	34,20	35,10	39,58	33,20	32,20	34,96	29,65	0
230	33,87	33,92	34,74	38,86	32,86	31,84	34,70	29,59	0
235	33,63	33,65	34,42	38,22	32,50	31,56	34,44	29,52	0
240	33,44	33,45	34,08	37,56	32,28	31,34	34,28	29,21	0



Plat Kolektor Al Foam PCM (Data 3)									
t	IN (T <sub>fi</sub> )C	OUT (T <sub>fo</sub> )C	Plat datar (T <sub>P</sub> )C	Material Al foam PCM	Kaca Dalam (T <sub>c- dalam</sub> )C	Kaca Luar (T <sub>c- Luar</sub> )C	Tanki (T.Tangki)C	Ling (T <sub>a</sub> )C	Ilum (I) Kw
0	27,10	27,00	26,40	26,60	26,50	26,20	27,00	26,22	0,000
5	27,35	28,55	38,28	27,26	45,62	46,30	27,24	26,14	0,979
10	27,60	29,40	40,72	29,06	55,04	56,82	27,46	26,62	0,996
15	27,92	29,96	42,22	31,12	59,66	61,54	27,90	27,01	0,994
20	28,25	30,46	43,12	32,70	61,96	64,22	28,30	27,36	0,992
25	28,64	30,94	43,82	33,94	63,26	65,88	28,64	27,75	0,995
30	29,01	31,36	44,40	34,86	63,48	67,06	28,96	28,12	0,994
35	29,30	31,66	44,92	35,66	63,16	67,60	29,28	28,45	0,993
40	29,63	32,01	45,34	36,32	63,16	68,10	29,72	28,74	1,014
45	29,92	32,31	45,82	36,98	62,94	68,48	30,16	28,93	1,019
50	30,20	32,61	46,20	37,46	62,90	69,00	30,56	29,09	1,014
55	30,47	32,88	46,60	37,94	63,04	69,18	30,92	29,24	1,007
60	30,71	33,14	46,96	38,42	63,12	69,46	31,40	29,38	1,005
65	30,99	33,42	47,34	38,88	62,98	69,84	31,76	29,53	1,010
70	31,26	33,69	47,66	39,28	62,92	69,86	32,18	29,59	1,013
75	31,47	33,90	47,98	39,66	62,94	70,18	32,46	29,69	1,014
80	31,70	34,14	48,24	40,06	62,98	70,28	32,82	29,75	1,014
85	31,96	34,40	48,60	40,52	62,62	70,16	33,16	29,25	1,012
90	32,31	34,76	48,80	40,84	62,42	70,42	33,42	29,29	1,010
95	32,61	35,07	48,98	41,08	62,16	70,24	33,62	29,61	1,005
100	32,91	35,38	49,16	41,40	61,92	70,18	33,80	29,76	1,011
105	33,11	35,59	49,46	41,72	61,64	70,08	34,14	29,53	1,012
110	33,37	35,87	49,68	42,06	61,24	70,56	34,44	29,37	1,016
115	33,65	36,15	49,88	42,30	61,10	70,38	34,46	29,65	1,015
120	33,86	36,37	50,08	42,58	60,94	70,40	34,76	29,82	1,016
125	34,11	36,62	50,38	42,94	54,66	70,54	35,02	29,49	1,015
130	34,38	36,90	50,54	43,14	54,30	70,70	35,16	29,40	1,005
135	34,61	37,13	50,70	43,38	54,40	70,50	35,40	29,76	1,005
140	34,80	37,32	50,90	43,64	54,62	70,60	35,54	29,84	1,005
145	35,00	37,53	51,14	44,08	54,78	70,38	35,92	29,37	1,008
150	35,20	37,73	51,20	44,26	54,84	70,88	36,02	29,67	1,005
155	35,40	37,93	51,42	44,50	55,04	70,74	36,10	29,90	1,005

160	35,54	38,06	51,66	44,86	55,18	70,56	36,28	29,51	1,005
165	35,71	38,23	51,80	45,06	55,32	71,20	36,46	29,49	1,005
170	35,87	38,39	51,92	45,32	55,48	71,32	36,58	29,87	1,005
175	36,02	38,54	52,12	45,54	55,64	70,94	36,76	29,79	1,006
180	36,17	38,69	52,26	45,78	55,70	71,34	37,00	29,50	1,004
185	36,10	37,27	41,28	45,56	44,78	52,08	36,94	29,73	0
190	35,90	36,53	39,24	44,62	41,18	42,80	36,66	29,92	0
195	35,61	36,05	38,12	43,58	39,10	38,58	36,36	29,92	0
200	35,32	35,65	37,46	42,94	37,74	36,26	36,26	29,39	0
205	35,06	35,29	36,74	42,24	36,62	34,66	35,90	29,53	0
210	34,80	35,00	36,24	41,52	35,72	33,64	35,58	29,76	0
215	34,55	34,69	35,78	40,84	34,96	33,04	35,34	29,84	0
220	34,30	34,38	35,40	40,12	34,50	32,70	35,10	29,92	0
225	34,05	34,13	35,02	39,42	34,16	32,28	34,84	30,00	0
230	33,80	33,85	34,66	38,72	33,92	31,94	34,58	30,00	0
235	33,56	33,58	34,34	38,10	33,84	31,76	34,38	29,96	0
240	33,37	33,38	34,02	37,44	33,68	31,46	34,18	29,78	0

Lampiran 8 Tabel hasil perhitungan Pelat kolektor standar

Plat Kolektor Standar (Data 1)								
t	Ut (W/m <sup>2</sup> .K)	Ub (W/m <sup>2</sup> .K)	UI (W/m <sup>2</sup> .K)	Qloss (W/m <sup>2</sup> .K)	S (W/m <sup>2</sup> )	V (m <sup>3</sup> /s)	Qu (Watt)	η (%)
0	4,106	1,95	6,056	3,309	0,00	1,E-05	-4,166	0,00
5	4,832	1,95	6,782	2,887	858,098	1,E-05	67,715	59,48
10	5,203	1,95	7,153	2,746	883,643	1,E-05	85,665	73,73
15	5,351	1,95	7,301	2,702	886,191	1,E-05	90,216	77,42
20	5,441	1,95	7,391	3,269	891,009	1,E-05	93,039	79,41
25	5,494	1,95	7,444	6,513	894,175	1,E-05	95,220	80,98
30	5,528	1,95	7,478	8,529	875,419	1,E-05	95,340	82,83
35	5,551	1,95	7,501	11,291	870,609	1,E-05	95,822	83,70
40	5,568	1,95	7,518	13,016	872,130	1,E-05	96,756	84,37
45	5,584	1,95	7,534	14,918	872,709	1,E-05	96,864	84,41
50	5,590	1,95	7,540	18,044	874,632	1,E-05	97,304	84,60
55	5,604	1,95	7,554	19,733	875,473	1,E-05	97,996	85,12
60	5,611	1,95	7,561	21,189	875,524	1,E-05	98,707	85,74
65	5,621	1,95	7,571	23,366	873,898	1,E-05	98,657	85,85
70	5,626	1,95	7,576	24,997	874,640	1,E-05	98,369	85,53
75	5,637	1,95	7,587	26,991	872,763	1,E-05	97,878	85,28
80	5,636	1,95	7,586	29,194	873,497	1,E-05	98,713	85,94
85	5,648	1,95	7,598	30,401	872,223	1,E-05	98,101	85,53
90	5,650	1,95	7,600	32,265	874,462	1,E-05	98,321	85,50
95	5,656	1,95	7,606	34,459	874,053	1,E-05	98,447	85,65
100	5,657	1,95	7,607	36,159	875,149	1,E-05	98,066	85,22
105	5,665	1,95	7,615	37,641	878,601	1,E-05	98,247	85,04
110	5,665	1,95	7,615	39,308	878,060	1,E-05	98,631	85,42
115	5,672	1,95	7,622	41,005	874,508	1,E-05	97,826	85,07
120	5,678	1,95	7,628	42,370	871,389	1,E-05	98,535	85,99
125	5,683	1,95	7,633	42,678	870,146	1,E-05	98,969	86,49
130	5,685	1,95	7,635	44,540	869,319	1,E-05	98,427	86,10
135	5,685	1,95	7,635	45,585	867,119	1,E-05	98,909	86,74
140	5,688	1,95	7,638	46,879	866,926	1,E-05	97,106	85,18
145	5,692	1,95	7,642	47,988	870,076	1,E-05	97,059	84,83
150	5,701	1,95	7,651	49,029	870,177	1,E-05	96,770	84,57
155	5,701	1,95	7,651	50,216	866,370	1,E-05	96,101	84,36
160	5,703	1,95	7,653	51,989	864,532	1,E-05	95,980	84,43
165	5,706	1,95	7,656	52,511	867,636	1,E-05	96,490	84,57
170	5,706	1,95	7,656	53,630	864,810	1,E-05	96,168	84,57
175	5,710	1,95	7,660	54,763	865,899	1,E-05	96,500	84,75
180	5,714	1,95	7,664	55,361	866,370	1,E-05	95,770	84,07

Plat Kolektor Standar (Data 2)								
t	Ut (W/m <sup>2</sup> .K)	Ub (W/m <sup>2</sup> .K)	U1 (W/m <sup>2</sup> .K)	Qloss (W/m <sup>2</sup> .K)	S (W/m <sup>2</sup> )	V (m <sup>3</sup> /s)	Qu (Watt)	η (%)
0	4,063	1,95	6,013	3,909	0,00	1,E-05	-2,083	0,00
5	4,891	1,95	6,841	2,856	846,917	1,E-05	65,616	54,89
10	5,322	1,95	7,272	3,575	862,648	1,E-05	83,995	71,91
15	5,482	1,95	7,432	4,529	863,575	1,E-05	88,805	75,86
20	5,569	1,95	7,519	5,091	872,632	1,E-05	91,886	78,54
25	5,622	1,95	7,572	6,791	878,130	1,E-05	93,951	80,27
30	5,657	1,95	7,607	8,819	878,577	1,E-05	94,444	80,74
35	5,683	1,95	7,633	9,934	878,261	1,E-05	95,231	82,56
40	5,703	1,95	7,653	12,072	878,655	1,E-05	96,050	83,96
45	5,720	1,95	7,670	13,779	871,729	1,E-05	96,654	84,73
50	5,734	1,95	7,684	15,349	868,779	1,E-05	96,533	85,00
55	5,745	1,95	7,695	17,171	867,227	1,E-05	96,845	85,57
60	5,757	1,95	7,707	18,504	867,664	1,E-05	97,463	86,42
65	5,768	1,95	7,718	20,241	870,555	1,E-05	97,906	86,99
70	5,778	1,95	7,728	22,219	870,385	1,E-05	97,355	86,63
75	5,785	1,95	7,735	23,548	871,512	1,E-05	98,162	87,37
80	5,791	1,95	7,741	25,190	871,783	1,E-05	97,882	86,98
85	5,799	1,95	7,749	26,775	871,265	1,E-05	98,528	87,75
90	5,808	1,95	7,758	28,904	873,172	1,E-05	98,417	88,55
95	5,812	1,95	7,762	30,062	894,028	1,E-05	98,402	85,71
100	5,816	1,95	7,766	31,421	899,889	1,E-05	98,387	85,85
105	5,817	1,95	7,767	32,556	898,530	1,E-05	98,878	86,25
110	5,818	1,95	7,768	34,608	894,360	1,E-05	97,864	85,43
115	5,821	1,95	7,771	36,731	891,835	1,E-05	98,802	86,23
120	5,821	1,95	7,771	37,638	890,631	1,E-05	98,519	86,03
125	5,821	1,95	7,771	39,116	889,480	1,E-05	98,472	86,09
130	5,823	1,95	7,773	40,272	889,488	1,E-05	96,106	83,98
135	5,824	1,95	7,774	42,009	889,434	1,E-05	95,956	83,78
140	5,827	1,95	7,777	43,341	889,465	1,E-05	96,012	83,86
145	5,831	1,95	7,781	44,512	889,503	1,E-05	95,696	83,64
150	5,832	1,95	7,782	45,758	893,642	1,E-05	95,183	83,12
155	5,835	1,95	7,785	46,919	866,370	1,E-05	95,862	83,77
160	5,840	1,95	7,790	48,531	869,505	1,E-05	95,715	83,61
165	5,845	1,95	7,795	49,670	867,636	1,E-05	95,471	83,47
170	5,851	1,95	7,801	51,043	864,810	1,E-05	95,906	83,76
175	5,833	1,95	7,783	56,775	865,899	1,E-05	95,658	83,54
180	5,839	1,95	7,789	56,395	866,370	1,E-05	95,806	83,74

Plat Kolektor Standar (Data 3)								
t	Ut (W/m <sup>2</sup> .K)	Ub (W/m <sup>2</sup> .K)	U <sub>l</sub> (W/m <sup>2</sup> .K)	Q <sub>loss</sub> (W/m <sup>2</sup> .K)	S (W/m <sup>2</sup> )	V (m <sup>3</sup> /s)	Qu (Watt)	η (%)
0	4,049	1,95	5,999	3,151	0,00	1,E-05	-8,332	0,00
5	4,928	1,95	6,878	3,079	849,703	1,E-05	67,670	60,13
10	5,328	1,95	7,278	3,174	871,798	1,E-05	85,590	74,66
15	5,482	1,95	7,432	3,699	879,002	1,E-05	89,996	77,86
20	5,565	1,95	7,515	4,484	879,797	1,E-05	93,342	80,69
25	5,610	1,95	7,560	7,410	869,976	1,E-05	95,550	83,52
30	5,637	1,95	7,587	10,808	870,871	1,E-05	95,792	83,65
35	5,669	1,95	7,619	10,915	870,910	1,E-05	96,483	84,25
40	5,693	1,95	7,643	11,502	870,895	1,E-05	97,647	85,27
45	5,713	1,95	7,663	12,799	869,875	1,E-05	97,924	85,61
50	5,730	1,95	7,680	13,912	870,045	1,E-05	97,808	85,49
55	5,744	1,95	7,694	15,392	870,879	1,E-05	98,356	85,89
60	5,755	1,95	7,705	16,731	868,862	1,E-05	98,652	86,35
65	5,764	1,95	7,714	18,352	867,906	1,E-05	99,028	86,77
70	5,779	1,95	7,729	19,729	866,748	1,E-05	99,429	87,24
75	5,787	1,95	7,737	21,648	865,829	1,E-05	98,842	86,81
80	5,785	1,95	7,735	26,931	864,926	1,E-05	99,216	87,23
85	5,784	1,95	7,734	29,137	864,038	1,E-05	99,003	87,14
90	5,797	1,95	7,747	29,543	863,876	1,E-05	99,256	87,38
95	5,807	1,95	7,757	29,127	862,671	1,E-05	99,070	87,33
100	5,800	1,95	7,750	34,427	864,918	1,E-05	98,811	86,88
105	5,805	1,95	7,755	36,142	864,509	1,E-05	99,152	87,22
110	5,817	1,95	7,767	35,090	864,293	1,E-05	99,049	87,15
115	5,825	1,95	7,775	36,665	864,007	1,E-05	98,932	87,08
120	5,816	1,95	7,766	42,138	862,942	1,E-05	99,023	87,26
125	5,826	1,95	7,776	41,087	864,447	1,E-05	98,836	86,95
130	5,834	1,95	7,784	42,244	863,088	1,E-05	99,152	87,36
135	5,823	1,95	7,773	46,584	862,177	1,E-05	97,914	86,36
140	5,834	1,95	7,784	45,328	862,694	1,E-05	97,585	86,02
145	5,843	1,95	7,793	46,356	861,722	1,E-05	97,584	86,12
150	5,835	1,95	7,785	50,175	861,683	1,E-05	98,193	86,66
155	5,845	1,95	7,795	48,918	868,169	1,E-05	97,431	85,34
160	5,845	1,95	7,795	51,637	869,744	1,E-05	97,991	85,68
165	5,844	1,95	7,794	52,555	868,841	1,E-05	97,535	85,37
170	5,857	1,95	7,807	51,847	867,814	1,E-05	97,022	85,02
175	5,846	1,95	7,796	56,198	867,590	1,E-05	96,949	84,98
180	5,856	1,95	7,806	55,038	867,744	1,E-05	96,930	84,78

Lampiran 9 Tabel hasil perhitungan Pelat kolektor Al Foam

Plat Kolektor Al Foam (Data 1)								
t	Ut (W/m <sup>2</sup> .K)	Ub (W/m <sup>2</sup> .K)	UI (W/m <sup>2</sup> .K)	Qloss (W/m <sup>2</sup> .K)	S (W/m <sup>2</sup> )	V (m <sup>3</sup> /s)	Qu (Watt)	η (%)
0	4,101	1,54	5,641	2,479	0	1,E-05	-6,103	0,00
5	4,967	1,540	6,507	2,863	866,810	1,E-05	57,349	50,24
10	5,318	1,540	6,857	3,415	876,076	1,E-05	78,077	67,77
15	5,468	1,540	7,008	3,353	866,347	1,E-05	89,039	78,16
20	5,557	1,540	7,097	3,744	870,053	1,E-05	93,494	81,72
25	5,595	1,540	7,135	5,853	866,810	1,E-05	94,697	83,08
30	5,622	1,540	7,162	7,833	870,053	1,E-05	95,089	83,11
35	5,638	1,540	7,178	9,252	870,980	1,E-05	96,700	84,43
40	5,649	1,540	7,188	11,653	870,053	1,E-05	98,310	85,93
45	5,660	1,540	7,200	13,851	869,590	1,E-05	97,485	85,25
50	5,672	1,540	7,212	16,761	867,273	1,E-05	97,066	85,11
55	5,681	1,540	7,221	18,757	866,347	1,E-05	97,866	85,91
60	5,686	1,540	7,226	19,899	848,742	1,E-05	97,855	87,68
65	5,687	1,540	7,227	21,596	863,567	1,E-05	98,656	86,88
70	5,691	1,540	7,231	23,304	863,104	1,E-05	98,238	86,56
75	5,708	1,540	7,248	23,710	861,714	1,E-05	97,414	85,97
80	5,711	1,540	7,251	25,421	862,177	1,E-05	99,435	87,70
85	5,716	1,540	7,256	27,352	860,787	1,E-05	99,020	87,48
90	5,719	1,540	7,259	29,349	861,714	1,E-05	98,603	87,02
95	5,724	1,540	7,264	30,289	861,251	1,E-05	98,597	87,06
100	5,728	1,540	7,268	31,656	859,861	1,E-05	98,183	86,84
105	5,732	1,540	7,272	33,376	860,787	1,E-05	98,175	86,73
110	5,736	1,540	7,276	35,313	860,787	1,E-05	98,167	86,73
115	5,741	1,540	7,281	35,909	861,251	1,E-05	98,565	87,03
120	5,747	1,540	7,287	37,927	858,934	1,E-05	98,151	86,90
125	5,751	1,540	7,290	39,371	860,787	1,E-05	98,955	87,42
130	5,755	1,540	7,295	40,178	861,251	1,E-05	98,949	87,37
135	5,759	1,540	7,298	41,053	860,787	1,E-05	98,536	87,05
140	5,762	1,540	7,302	42,927	860,787	1,E-05	99,340	87,76
145	5,767	1,540	7,307	43,885	861,714	1,E-05	98,524	86,95
150	5,771	1,540	7,310	44,976	861,714	1,E-05	98,113	86,59
155	5,771	1,540	7,311	45,691	862,177	1,E-05	98,109	86,53
160	5,774	1,540	7,314	45,928	861,714	1,E-05	97,296	85,86
165	5,777	1,540	7,317	47,300	861,251	1,E-05	98,911	87,34
170	5,782	1,540	7,322	48,480	861,251	1,E-05	98,094	86,62
175	5,784	1,540	7,324	49,423	861,714	1,E-05	97,279	85,85
180	5,785	1,540	7,325	50,385	861,714	1,E-05	97,522	86,06

Plat Kolektor Al Foam (Data 2)								
t	Ut (W/m <sup>2</sup> .K)	Ub (W/m <sup>2</sup> .K)	U1 (W/m <sup>2</sup> .K)	Qloss (W/m <sup>2</sup> .K)	S (W/m <sup>2</sup> )	V (m <sup>3</sup> /s)	Qu (Watt)	η (%)
0	4,057	1,540	5,597	2,188	0	1,E-05	-4,085	0,00
5	4,981	1,540	6,521	1,816	878,383	1,E-05	46,931	40,60
10	5,316	1,540	6,856	2,696	875,265	1,E-05	73,809	64,12
15	5,458	1,540	6,998	3,070	879,296	1,E-05	84,266	72,88
20	5,535	1,540	7,075	3,175	876,608	1,E-05	90,140	78,20
25	5,585	1,540	7,124	3,804	876,871	1,E-05	93,144	80,78
30	5,625	1,540	7,165	4,579	889,048	1,E-05	95,217	81,45
35	5,657	1,540	7,197	5,841	867,860	1,E-05	95,831	83,98
40	5,682	1,540	7,222	7,076	864,671	1,E-05	97,361	85,63
45	5,702	1,540	7,242	8,418	861,567	1,E-05	98,024	86,52
50	5,716	1,540	7,255	10,066	863,451	1,E-05	98,382	86,65
55	5,733	1,540	7,273	11,707	865,590	1,E-05	98,725	86,74
60	5,745	1,540	7,285	12,765	865,370	1,E-05	99,652	87,57
65	5,747	1,540	7,287	16,969	861,482	1,E-05	100,278	88,52
70	5,747	1,540	7,287	20,232	860,432	1,E-05	100,470	88,80
75	5,755	1,540	7,294	21,302	860,200	1,E-05	99,666	88,11
80	5,762	1,540	7,302	22,676	861,258	1,E-05	99,464	87,82
85	5,772	1,540	7,312	23,819	860,934	1,E-05	99,887	88,23
90	5,765	1,540	7,305	27,911	860,702	1,E-05	100,127	88,47
95	5,775	1,540	7,315	28,311	863,636	1,E-05	99,960	88,02
100	5,777	1,540	7,317	31,003	863,899	1,E-05	100,566	88,53
105	5,784	1,540	7,323	32,242	861,822	1,E-05	99,961	88,21
110	5,786	1,540	7,326	34,074	860,841	1,E-05	100,297	88,60
115	5,789	1,540	7,329	36,358	863,907	1,E-05	99,721	87,78
120	5,799	1,540	7,339	35,948	862,996	1,E-05	100,022	88,14
125	5,796	1,540	7,336	39,979	863,204	1,E-05	100,508	88,55
130	5,808	1,540	7,348	38,632	862,656	1,E-05	99,750	87,94
135	5,808	1,540	7,348	41,840	863,775	1,E-05	99,514	87,61
140	5,812	1,540	7,352	42,918	863,405	1,E-05	98,696	86,93
145	5,812	1,540	7,352	44,606	864,656	1,E-05	99,365	87,39
150	5,819	1,540	7,359	45,941	862,965	1,E-05	99,115	87,34
155	5,823	1,540	7,363	46,790	867,459	1,E-05	98,825	86,64
160	5,824	1,540	7,363	48,775	864,810	1,E-05	99,462	87,46
165	5,829	1,540	7,369	48,566	865,968	1,E-05	98,867	86,82
170	5,826	1,540	7,366	51,029	866,370	1,E-05	99,897	87,69
175	5,834	1,540	7,374	50,530	864,270	1,E-05	99,418	87,48
180	5,832	1,540	7,371	53,069	867,567	1,E-05	99,537	87,25



Plat Kolektor Al Foam (Data 3)								
t	Ut (W/m <sup>2</sup> .K)	Ub (W/m <sup>2</sup> .K)	U1 (W/m <sup>2</sup> .K)	Qloss (W/m <sup>2</sup> .K)	S (W/m <sup>2</sup> )	V (m <sup>3</sup> /s)	Qu (Watt)	η (%)
0	4,050	1,54	5,590	0,783	0	1,E-05	-4,166	0,00
5	4,984	1,540	6,523	1,607	878,383	1,E-05	46,649	40,36
10	5,327	1,540	6,867	2,429	875,265	1,E-05	74,041	64,32
15	5,478	1,540	7,018	2,597	879,295	1,E-05	84,186	72,81
20	5,563	1,540	7,103	2,501	864,887	1,E-05	93,077	81,84
25	5,614	1,540	7,154	4,079	868,400	1,E-05	96,806	84,77
30	5,653	1,540	7,193	5,525	866,625	1,E-05	98,204	86,18
35	5,679	1,540	7,219	7,436	863,250	1,E-05	99,103	87,30
40	5,697	1,540	7,237	8,988	865,335	1,E-05	101,585	89,27
45	5,714	1,540	7,254	10,751	862,223	1,E-05	100,155	88,34
50	5,730	1,540	7,270	12,520	864,903	1,E-05	101,471	89,22
55	5,729	1,540	7,269	14,029	842,588	1,E-05	100,043	90,29
60	5,727	1,540	7,267	15,566	839,536	1,E-05	100,114	90,69
65	5,728	1,540	7,268	17,516	863,706	1,E-05	99,186	87,33
70	5,730	1,540	7,270	19,280	863,706	1,E-05	99,090	87,25
75	5,742	1,540	7,282	20,811	862,100	1,E-05	99,244	87,54
80	5,741	1,540	7,280	24,460	861,598	1,E-05	99,317	87,66
85	5,736	1,540	7,276	28,188	862,046	1,E-05	99,971	88,19
90	5,745	1,540	7,285	28,499	857,722	1,E-05	99,377	88,11
95	5,756	1,540	7,296	29,535	857,722	1,E-05	99,201	87,95
100	5,752	1,540	7,292	33,278	859,822	1,E-05	100,106	88,54
105	5,744	1,540	7,284	35,544	859,459	1,E-05	101,841	90,11
110	5,749	1,540	7,289	35,175	859,583	1,E-05	100,585	88,99
115	5,757	1,540	7,297	35,945	859,197	1,E-05	102,651	90,86
120	5,750	1,540	7,290	40,253	858,888	1,E-05	103,724	91,84
125	5,753	1,540	7,293	40,403	862,919	1,E-05	102,553	90,38
130	5,764	1,540	7,304	40,171	867,397	1,E-05	101,465	88,96
135	5,759	1,540	7,299	44,233	866,424	1,E-05	101,376	88,98
140	5,762	1,540	7,302	44,763	866,787	1,E-05	101,950	89,44
145	5,770	1,540	7,310	44,461	865,961	1,E-05	100,862	88,58
150	5,768	1,540	7,308	47,224	865,265	1,E-05	102,766	90,32
155	5,765	1,540	7,305	49,002	867,343	1,E-05	99,439	87,19
160	5,774	1,540	7,314	48,345	864,810	1,E-05	98,518	86,63
165	5,773	1,540	7,313	50,573	865,969	1,E-05	98,679	86,66
170	5,771	1,540	7,311	52,333	866,370	1,E-05	97,843	85,88
175	5,779	1,540	7,318	51,390	864,270	1,E-05	98,500	86,67
180	5,774	1,540	7,313	53,927	867,567	1,E-05	99,081	86,85

Lampiran 10 Tabel hasil perhitungan Pelat kolektor dengan ketebalan Al foam PCM

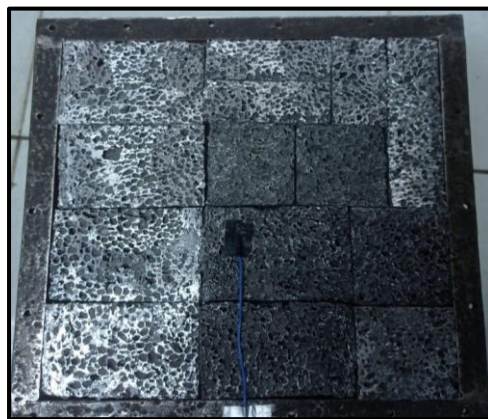
Plat Kolektor Al Foam PCM (Data 1)								
t	Ut (W/m <sup>2</sup> .K)	Ub (W/m <sup>2</sup> .K)	U1 (W/m <sup>2</sup> .K)	Qloss (W/m <sup>2</sup> .K)	S (W/m <sup>2</sup> )	V (m <sup>3</sup> /s)	Qu (Watt)	η (%)
0	4,146	1,516	5,662	5,545	0	1,E-05	-4,16572	0,00
5	5,467	1,516	6,340	8,120	822,805	1,E-05	49,97025	45,53
10	5,472	1,516	6,711	9,637	849,800	1,E-05	74,91838	67,05
15	5,475	1,516	6,846	11,661	848,047	1,E-05	85,23437	76,43
20	5,479	1,516	6,919	13,905	846,495	1,E-05	91,90244	82,57
25	5,482	1,516	6,961	16,143	849,344	1,E-05	95,64266	85,64
30	5,485	1,516	6,988	18,481	848,116	1,E-05	97,9468	87,83
35	5,488	1,516	7,004	20,635	847,421	1,E-05	98,33482	88,25
40	5,498	1,516	7,014	22,363	842,449	1,E-05	98,99414	89,36
45	5,497	1,516	7,013	25,567	839,136	1,E-05	99,36943	90,05
50	5,503	1,516	7,019	27,810	846,325	1,E-05	100,0628	89,91
55	5,509	1,516	7,025	29,674	847,421	1,E-05	100,4995	90,19
60	5,512	1,516	7,028	31,329	854,292	1,E-05	100,7908	89,72
65	5,517	1,516	7,033	32,588	853,019	1,E-05	100,5337	89,63
70	5,528	1,516	7,044	33,729	853,143	1,E-05	100,6794	89,74
75	5,530	1,516	7,047	35,524	852,834	1,E-05	101,3615	90,38
80	5,532	1,516	7,048	37,413	853,629	1,E-05	102,097	90,95
85	5,550	1,516	7,066	35,503	849,684	1,E-05	102,1797	91,45
90	5,578	1,516	7,095	33,310	853,475	1,E-05	101,9239	90,82
95	5,601	1,516	7,117	32,298	855,259	1,E-05	102,1627	90,84
100	5,629	1,516	7,145	31,501	858,579	1,E-05	102,9902	91,22
105	5,636	1,516	7,152	32,933	856,000	1,E-05	103,9959	92,39
110	5,647	1,516	7,163	33,918	858,594	1,E-05	104,7495	92,78
115	5,656	1,516	7,172	34,885	858,108	1,E-05	104,0893	92,25
120	5,662	1,516	7,178	36,120	858,656	1,E-05	104,8517	92,86
125	5,671	1,516	7,187	37,210	859,019	1,E-05	103,8881	91,97
130	5,675	1,516	7,191	38,729	857,120	1,E-05	103,7963	92,09
135	5,684	1,516	7,201	39,712	857,544	1,E-05	104,3283	92,52
140	5,688	1,516	7,204	41,239	857,869	1,E-05	105,0097	93,09
145	5,693	1,516	7,209	42,514	859,972	1,E-05	106,8795	94,51
150	5,699	1,516	7,215	43,947	857,421	1,E-05	103,9194	92,17
155	5,699	1,516	7,215	44,750	857,120	1,E-05	104,4397	92,66
160	5,703	1,516	7,219	45,723	857,544	1,E-05	104,5282	92,70
165	5,704	1,516	7,220	47,099	857,869	1,E-05	104,0958	92,28
170	5,702	1,516	7,218	47,868	857,575	1,E-05	104,5012	92,67
175	5,695	1,516	7,211	48,655	858,085	1,E-05	101,9075	90,31
180	5,690	1,516	7,206	49,497	857,421	1,E-05	102,703	91,09

Plat Kolektor Al Foam PCM (Data 2)								
t	Ut (W/m <sup>2</sup> .K)	Ub (W/m <sup>2</sup> .K)	U1 (W/m <sup>2</sup> .K)	Qloss (W/m <sup>2</sup> .K)	S (W/m <sup>2</sup> )	V (m <sup>3</sup> /s)	Qu (Watt)	η (%)
0	4,100	1,516	5,616	3,269	0	1,E-05	-4,16583	0,00
5	5,516	1,516	6,427	5,264	841,931	1,E-05	49,9712	45,03
10	5,523	1,516	6,734	7,125	849,800	1,E-05	74,91943	67,05
15	5,530	1,516	6,867	8,262	848,047	1,E-05	85,23401	76,43
20	5,537	1,516	6,949	8,654	846,495	1,E-05	91,82415	82,50
25	5,542	1,516	7,001	9,208	849,344	1,E-05	95,63939	85,63
30	5,548	1,516	7,039	9,675	848,116	1,E-05	97,94152	87,82
35	5,552	1,516	7,068	9,628	847,421	1,E-05	98,32649	88,24
40	5,572	1,516	7,088	10,511	872,130	1,E-05	98,98398	86,32
45	5,590	1,516	7,106	11,202	874,717	1,E-05	99,35575	86,38
50	5,608	1,516	7,124	11,883	873,018	1,E-05	100,0445	87,15
55	5,621	1,516	7,137	12,778	870,980	1,E-05	100,4779	87,73
60	5,633	1,516	7,149	13,637	871,380	1,E-05	100,7474	87,92
65	5,643	1,516	7,159	14,557	870,972	1,E-05	100,949	88,14
70	5,654	1,516	7,170	15,893	870,918	1,E-05	100,8807	88,09
75	5,662	1,516	7,178	16,620	870,709	1,E-05	101,1451	88,34
80	5,674	1,516	7,190	17,465	870,455	1,E-05	101,133	88,35
85	5,678	1,516	7,194	18,437	859,892	1,E-05	101,5284	89,79
90	5,682	1,516	7,198	20,400	862,525	1,E-05	101,9498	89,89
95	5,688	1,516	7,204	21,747	869,211	1,E-05	102,27	89,48
100	5,694	1,516	7,210	23,421	867,235	1,E-05	102,5857	89,96
105	5,698	1,516	7,214	24,554	867,621	1,E-05	103,2636	90,51
110	5,693	1,516	7,209	29,262	870,879	1,E-05	103,6092	90,47
115	5,692	1,516	7,208	32,653	869,914	1,E-05	103,6972	90,65
120	5,699	1,516	7,215	32,350	868,787	1,E-05	104,0764	91,10
125	5,707	1,516	7,223	32,523	867,428	1,E-05	104,2863	91,43
130	5,712	1,516	7,228	34,581	857,120	1,E-05	104,5514	92,76
135	5,706	1,516	7,223	38,785	857,544	1,E-05	104,4628	92,64
140	5,715	1,516	7,231	38,265	857,869	1,E-05	104,6317	92,75
145	5,722	1,516	7,238	38,324	859,972	1,E-05	104,9716	92,83
150	5,728	1,516	7,244	40,294	857,421	1,E-05	104,864	93,01
155	5,715	1,516	7,231	44,603	857,120	1,E-05	105,0195	93,18
160	5,722	1,516	7,238	43,593	857,544	1,E-05	104,6803	92,83
165	5,732	1,516	7,248	43,470	857,869	1,E-05	104,5923	92,72
170	5,739	1,516	7,255	44,971	857,575	1,E-05	104,4243	92,60
175	5,728	1,516	7,244	48,887	858,085	1,E-05	104,5056	92,62
180	5,733	1,516	7,249	48,153	857,421	1,E-05	104,4193	92,61

Plat Kolektor Al Foam PCM (Data 3)								
t	Ut (W/m <sup>2</sup> .K)	Ub (W/m <sup>2</sup> .K)	U1 (W/m <sup>2</sup> .K)	Qloss (W/m <sup>2</sup> .K)	S (W/m <sup>2</sup> )	V (m <sup>3</sup> /s)	Qu (Watt)	η (%)
0	4,058	1,516	5,574	4,883	0	1,E-05	-4,166	0,00
5	5,450	1,516	6,387	7,703	835,113	1,E-05	49,14124	44,44
10	5,451	1,516	6,695	6,561	849,800	1,E-05	74,08995	66,30
15	5,452	1,516	6,833	6,221	848,047	1,E-05	84,40499	75,68
20	5,451	1,516	6,904	6,190	846,495	1,E-05	90,9953	81,75
25	5,451	1,516	6,950	6,207	849,344	1,E-05	94,81152	84,89
30	5,452	1,516	6,968	6,204	848,116	1,E-05	97,11291	87,08
35	5,454	1,516	6,970	5,869	847,421	1,E-05	97,49722	87,50
40	5,462	1,516	6,978	6,214	864,911	1,E-05	98,15304	86,31
45	5,464	1,516	6,980	6,918	869,119	1,E-05	98,52443	86,21
50	5,469	1,516	6,985	7,778	865,451	1,E-05	99,21499	87,18
55	5,477	1,516	6,993	8,589	858,795	1,E-05	99,64798	88,24
60	5,483	1,516	7,000	9,355	857,600	1,E-05	99,91774	88,60
65	5,485	1,516	7,001	10,216	861,536	1,E-05	100,119	88,38
70	5,486	1,516	7,002	11,723	864,455	1,E-05	100,0512	88,02
75	5,490	1,516	7,007	12,497	865,320	1,E-05	100,317	88,16
80	5,494	1,516	7,010	13,714	864,926	1,E-05	100,3047	88,19
85	5,477	1,516	6,993	18,977	863,667	1,E-05	100,7016	88,67
90	5,474	1,516	6,990	21,101	861,938	1,E-05	101,1241	89,22
95	5,472	1,516	6,988	20,966	857,274	1,E-05	101,4456	89,99
100	5,469	1,516	6,985	21,974	862,277	1,E-05	101,7594	89,75
105	5,458	1,516	6,974	24,963	863,490	1,E-05	102,4404	90,22
110	5,446	1,516	6,962	27,856	867,250	1,E-05	102,7846	90,13
115	5,447	1,516	6,963	27,819	866,463	1,E-05	102,8712	90,29
120	5,445	1,516	6,961	28,150	866,501	1,E-05	103,2507	90,62
125	5,231	1,516	6,748	31,120	865,829	1,E-05	103,4617	90,87
130	5,214	1,516	6,730	33,514	857,120	1,E-05	103,7289	92,03
135	5,221	1,516	6,737	32,715	857,544	1,E-05	103,6361	91,90
140	5,229	1,516	6,745	33,455	857,869	1,E-05	103,8082	92,02
145	5,225	1,516	6,741	37,954	859,972	1,E-05	104,1504	92,10
150	5,233	1,516	6,749	37,360	857,421	1,E-05	104,0404	92,28
155	5,241	1,516	6,758	37,193	857,120	1,E-05	104,1951	92,45
160	5,237	1,516	6,754	40,724	857,544	1,E-05	103,8562	92,10
165	5,243	1,516	6,759	42,040	857,869	1,E-05	103,7686	91,99
170	5,255	1,516	6,771	40,640	857,575	1,E-05	103,5991	91,87
175	5,257	1,516	6,773	42,212	858,085	1,E-05	103,6797	91,89
180	5,254	1,516	6,770	45,156	856,672	1,E-05	103,5965	91,96

## Lampiran 11 Dokumentasi

## A. Perakitan Kolektor





## B. Pengambilan Data

