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LAMPIRAN



Lampiran 1 Tabel hasil pengamatan pengujian turbin air arus atas

No.	pembukaan	Beban (kg)	Sudutan (rpm)	Temp. air (C)	Volume (m3)	Waktu (s)
1	60 %	0	100	27	0.00694595	7.41
2		0.1	92	27	0.00694595	7.41
3		0.2	81	27	0.00694595	7.41
4		0.3	75	27	0.00694595	7.41
5		0.4	67	27	0.00694595	7.41
6		0.5	60	27	0.00694595	7.41
7		0.6	52	27	0.00694595	7.41
8		0.7	44	27	0.00694595	7.41
9		0.8	35	27	0.00694595	7.41
10		0.9	27	27	0.00694595	7.41
11		1	18	27	0.00694595	7.41
12		1.1	9	27	0.00694595	7.41
13		1.2	0	27	0.00694595	7.41
14	70 %	0	110	27	0.00694595	7.41
15		0.1	105	27	0.00694595	7.41
16		0.2	91	27	0.00694595	7.41
17		0.3	83	27	0.00694595	7.41
18		0.4	78	27	0.00694595	7.41
19		0.5	74	27	0.00694595	7.41
20		0.6	68	27	0.00694595	7.41
21		0.7	60	27	0.00694595	7.41
22		0.8	51	27	0.00694595	7.41
23		0.9	39	27	0.00694595	7.41
24		1	29	27	0.00694595	7.41
25		1.1	20	27	0.00694595	7.41
26		1.2	11	27	0.00694595	7.41
	80 %	0	121	27	0.00694595	7.41
		0.1	115	27	0.00694595	7.41
		0.2	109	27	0.00694595	7.41



30		0.3	103	27	0.00694595	7.41
31		0.4	97	27	0.00694595	7.41
32		0.5	94	27	0.00694595	7.41
33		0.6	88	27	0.00694595	7.41
34		0.7	81	27	0.00694595	7.41
35		0.8	73	27	0.00694595	7.41
36		0.9	62	27	0.00694595	7.41
37		1	53	27	0.00694595	7.41
38		1.1	40	27	0.00694595	7.41
39		1.2	30	27	0.00694595	7.41
40	90 %	0	133	27	0.00694595	7.41
41		0.1	125	27	0.00694595	7.41
42		0.2	120	27	0.00694595	7.41
43		0.3	115	27	0.00694595	7.41
44		0.4	111	27	0.00694595	7.41
45		0.5	105	27	0.00694595	7.41
46		0.6	102	27	0.00694595	7.41
47		0.7	95	27	0.00694595	7.41
48		0.8	90	27	0.00694595	7.41
49		0.9	82	27	0.00694595	7.41
50		1	73	27	0.00694595	7.41
51		1.1	62	27	0.00694595	7.41
52		1.2	49	27	0.00694595	7.41
53		100 %	0	138	27	0.00694595
54	0.1		134	27	0.00694595	7.41
55	0.2		129	27	0.00694595	7.41
56	0.3		126	27	0.00694595	7.41
57	0.4		122	27	0.00694595	7.41
58	0.5		118	27	0.00694595	7.41
59	0.6		115	27	0.00694595	7.41
60	0.7		111	27	0.00694595	7.41
61	0.8		107	27	0.00694595	7.41
62	0.9	100	27	0.00694595	7.41	



63		1	92	27	0.00694595	7.41
64		1.1	83	27	0.00694595	7.41
65		1.2	68	27	0.00694595	7.41



Lampiran 2 Tabel hasil perhitungan secara eksperimen pengujian turbin air arus atas

Pembukaan	Beban (kg)	Q (m ³ /s)	v (m/s)	Pair (watt)	τ (Nm)	ω (rad/s)	Pturbin (watt)	η
60 %	0	0,00057	1,8447	9,2378	0	10,467	0	0
	0.1	0,00057	1,8447	9,2378	0,0441	9,106	0,402	4,35
	0.2	0,00057	1,8447	9,2378	0,0883	8,478	0,749	8,10
	0.3	0,00057	1,8447	9,2378	0,1324	7,850	1,040	11,25
	0.4	0,00057	1,8447	9,2378	0,1766	7,013	1,238	13,40
	0.5	0,00057	1,8447	9,2378	0,2207	6,280	1,386	15,01
	0.6	0,00057	1,8447	9,2378	0,2649	5,443	1,442	15,61
	0.7	0,00057	1,8447	9,2378	0,3090	4,605	1,423	15,41
	0.8	0,00057	1,8447	9,2378	0,3532	3,663	1,294	14,00
	0.9	0,00057	1,8447	9,2378	0,3973	2,826	1,123	12,15
	1	0,00057	1,8447	9,2378	0,4415	1,884	0,832	9,00
	1.1	0,00057	1,8447	9,2378	0,4856	0,942	0,457	4,95
1.2	0,00057	1,8447	9,2378	0,5297	0,000	0,000	0	
70 %	0	0,00061	1,9651	9,8407	0	11,513	0	8.1065
	0.1	0,00061	1,9651	9,8407	0,0441	10,362	0,457	4,65
	0.2	0,00061	1,9651	9,8407	0,0883	9,525	0,841	8,55
	0.3	0,00061	1,9651	9,8407	0,1324	8,687	1,151	11,69
	0.4	0,00061	1,9651	9,8407	0,1766	8,164	1,442	14,65
	0.5	0,00061	1,9651	9,8407	0,2207	7,745	1,710	17,37
	0.6	0,00061	1,9651	9,8407	0,2649	7,117	1,885	19,16
	0.7	0,00061	1,9651	9,8407	0,3090	6,280	1,941	19,72
	0.8	0,00061	1,9651	9,8407	0,3532	5,338	1,885	19,16
	0.9	0,00061	1,9651	9,8407	0,3973	4,082	1,622	16,48
	1	0,00061	1,9651	9,8407	0,4415	3,035	1,340	13,62
	1.1	0,00061	1,9651	9,8407	0,4856	2,093	1,017	10,33
1.2	0,00061	1,9651	9,8407	0,52974	1,151	0,610	26.9992	
6	0	0,00073	2,35	11,7685	0,0000	12,665	0	0
	0.1	0,00073	2,35	11,7685	0,0441	12,037	0,531	4,52
	0.2	0,00073	2,35	11,7685	0,0883	11,513	1,017	8,64



	0.3	0,00073	2,35	11,7685	0,1324	10,781	1,428	12,13
	0.4	0,00073	2,35	11,7685	0,1766	10,153	1,793	15,23
	0.5	0,00073	2,35	11,7685	0,2207	9,525	2,102	17,86
	0.6	0,00073	2,35	11,7685	0,2649	9,211	2,440	20,73
	0.7	0,00073	2,35	11,7685	0,3090	8,478	2,620	22,26
	0.8	0,00073	2,35	11,7685	0,3532	7,641	2,698	22,93
	0.9	0,00073	2,35	11,7685	0,3973	6,489	2,578	21,91
	1	0,00073	2,35	11,7685	0,4415	5,547	2,449	20,81
	1.1	0,00073	2,35	11,7685	0,4856	4,187	2,033	17,28
	1.2	0,00073	2,35	11,7685	0,5297	3,140	1,663	14,13
90 %	0	0,00081	2,6201	13,1209	0	13,921	0	0
	0.1	0,00081	2,6201	13,1209	0,0441	13,293	0,587	4,47
	0.2	0,00081	2,6201	13,1209	0,0883	12,560	1,109	8,45
	0.3	0,00081	2,6201	13,1209	0,1324	12,037	1,594	12,15
	0.4	0,00081	2,6201	13,1209	0,1766	11,618	2,052	15,64
	0.5	0,00081	2,6201	13,1209	0,2207	10,990	2,426	18,49
	0.6	0,00081	2,6201	13,1209	0,2649	10,676	2,828	21,55
	0.7	0,00081	2,6201	13,1209	0,3090	10,153	3,137	23,91
	0.8	0,00081	2,6201	13,1209	0,3532	9,420	3,327	25,35
	0.9	0,00081	2,6201	13,1209	0,3973	8,583	3,410	25,99
	1	0,00081	2,6201	13,1209	0,4415	7,641	3,373	25,71
	1.1	0,00081	2,6201	13,1209	0,4856	6,489	3,151	24,02
	1.2	0,00081	2,6201	13,1209	0,5739	5,129	2,717	20,71
100 %	0	0,0009	2,9077	14,5612	0	14,444	0,610	0
	0.1	0,0009	2,9077	14,5612	0,0441	13,816	1,192	4,19
	0.2	0,0009	2,9077	14,5612	0,0883	13,502	1,747	8,19
	0.3	0,0009	2,9077	14,5612	0,1324	13,188	2,255	11,99
	0.4	0,0009	2,9077	14,5612	0,1766	12,769	2,726	15,48
	0.5	0,0009	2,9077	14,5612	0,2207	12,351	3,188	18,72
	0.6	0,0009	2,9077	14,5612	0,2649	12,037	3,590	21,89
	0.7	0,0009	2,9077	14,5612	0,3090	11,618	3,955	24,66
	0.8	0,0009	2,9077	14,5612	0,3532	11,199	4,158	27,16
	0.9	0,0009	2,9077	14,5612	0,3973	10,467	4,251	28,56



	1	0,0009	2,9077	14,5612	0,4415	9,629	4,219	29,19
	1.1	0,0009	2,9077	14,5612	0,4856	8,687	3,770	28,97
	1.2	0,0009	2,9077	14,5612	0,5739	7,117	0,610	25,89



Lampiran 3 Tabel hasil perhitungan teori pengujian turbin air arus atas

Pembukaan	V_{in}	$V_{berguna}$	V_{out}
60 %	1,845	1,779	0,065
	1,845	1,548	0,297
	1,845	1,441	0,403
	1,845	1,335	0,510
	1,845	1,192	0,653
	1,845	1,068	0,777
	1,845	0,925	0,919
	1,845	0,783	1,062
	1,845	0,623	1,222
	1,845	0,480	1,364
	1,845	0,320	1,524
	1,845	0,160	1,685
	1,845	0	1,845
70 %	1,965	1,957	0,008
	1,965	1,762	0,204
	1,965	1,619	0,346
	1,965	1,477	0,488
	1,965	1,388	0,577
	1,965	1,317	0,648
	1,965	1,210	0,755
	1,965	1,068	0,897
	1,965	0,907	1,058
	1,965	0,694	1,271
	1,965	0,516	1,449
	1,965	0,356	1,609
%	2,350	2,153	0,197
	2,350	2,046	0,304
	2,350	1,957	0,393



	2,350	1,833	0,517
	2,350	1,726	0,624
	2,350	1,619	0,731
	2,350	1,566	0,784
	2,350	1,441	0,909
	2,350	1,299	1,051
	2,350	1,103	1,247
	2,350	0,943	1,407
	2,350	0,712	1,638
	2,350	0,534	1,816
90 %	2,620	2,367	0,254
	2,620	2,260	0,360
	2,620	2,135	0,485
	2,620	2,046	0,574
	2,620	1,975	0,645
	2,620	1,868	0,752
	2,620	1,815	0,805
	2,620	1,726	0,894
	2,620	1,601	1,019
	2,620	1,459	1,161
	2,620	1,299	1,321
	2,620	1,103	1,517
	2,620	0,872	1,748
100 %	2,908	2,455	0,452
	2,908	2,349	0,559
	2,908	2,295	0,612
	2,908	2,242	0,666
	2,908	2,171	0,737
	2,908	2,100	0,808
	2,908	2,046	0,861
	2,908	1,975	0,933



	2,908	1,904	1,004
	2,908	1,779	1,128
	2,908	1,637	1,271
	2,908	1,477	1,431
	2,908	1,210	1,698



Lampiran 4 Tabel hasil perhitungan secara teori pengujian turbin air arus atas

Pembukaan	Beban (kg)	Q (m ³ /s)	v (m/s)	Pair (watt)	τ (Nm)	ω (rad/s)	Pturbin (watt)	η
60 %	0	0,00080	2,577	12,907	0	10,467	0	0
	0.1	0,00080	2,577	12,907	0,0441	9,106	0,402	3,11
	0.2	0,00080	2,577	12,907	0,0883	8,478	0,749	5,80
	0.3	0,00080	2,577	12,907	0,1324	7,850	1,040	8,05
	0.4	0,00080	2,577	12,907	0,1766	7,013	1,238	9,59
	0.5	0,00080	2,577	12,907	0,2207	6,280	1,386	10,74
	0.6	0,00080	2,577	12,907	0,2649	5,443	1,442	11,17
	0.7	0,00080	2,577	12,907	0,3090	4,605	1,423	11,03
	0.8	0,00080	2,577	12,907	0,3532	3,663	1,294	10,02
	0.9	0,00080	2,577	12,907	0,3973	2,826	1,123	8,70
	1	0,00080	2,577	12,907	0,4415	1,884	0,832	6,44
	1.1	0,00080	2,577	12,907	0,4856	0,942	0,457	3,54
	1.2	0,00080	2,577	12,907	0,5297	0	0	0
70 %	0	0,00089	2,873	14,389	0	11,513	0	0
	0.1	0,00089	2,873	14,389	0,0441	10,362	0,457	3,18
	0.2	0,00089	2,873	14,389	0,0883	9,525	0,841	5,84
	0.3	0,00089	2,873	14,389	0,1324	8,687	1,151	8,00
	0.4	0,00089	2,873	14,389	0,1766	8,164	1,442	10,02
	0.5	0,00089	2,873	14,389	0,2207	7,745	1,710	11,88
	0.6	0,00089	2,873	14,389	0,2649	7,117	1,885	13,10
	0.7	0,00089	2,873	14,389	0,3090	6,280	1,941	13,49
	0.8	0,00089	2,873	14,389	0,3532	5,338	1,885	13,10
	0.9	0,00089	2,873	14,389	0,3973	4,082	1,622	11,27
	1	0,00089	2,873	14,389	0,4415	3,035	1,340	9,31
	1.1	0,00089	2,873	14,389	0,4856	2,093	1,017	7,06
	1.2	0,00089	2,873	14,389	0,52974	1,151	0,610	4,24
6	0	0,00101	3,271	16,380	0,0000	12,665	0	0
	0.1	0,00101	3,271	16,380	0,0441	12,037	0,531	3,24
	0.2	0,00101	3,271	16,380	0,0883	11,513	1,017	6,21



	0.3	0,00101	3,271	16,380	0,1324	10,781	1,428	8,72
	0.4	0,00101	3,271	16,380	0,1766	10,153	1,793	10,94
	0.5	0,00101	3,271	16,380	0,2207	9,525	2,102	12,83
	0.6	0,00101	3,271	16,380	0,2649	9,211	2,440	14,89
	0.7	0,00101	3,271	16,380	0,3090	8,478	2,620	15,99
	0.8	0,00101	3,271	16,380	0,3532	7,641	2,698	16,47
	0.9	0,00101	3,271	16,380	0,3973	6,489	2,578	15,74
	1	0,00101	3,271	16,380	0,4415	5,547	2,449	14,95
	1.1	0,00101	3,271	16,380	0,4856	4,187	2,033	12,41
	1.2	0,00101	3,271	16,380	0,5297	3,140	1,663	10,16
90 %	0	0,00117	3,789	18,976	0	13,921	0	0
	0.1	0,00117	3,789	18,976	0,0441	13,293	0,587	3,09
	0.2	0,00117	3,789	18,976	0,0883	12,560	1,109	5,84
	0.3	0,00117	3,789	18,976	0,1324	12,037	1,594	8,40
	0.4	0,00117	3,789	18,976	0,1766	11,618	2,052	10,81
	0.5	0,00117	3,789	18,976	0,2207	10,990	2,426	12,78
	0.6	0,00117	3,789	18,976	0,2649	10,676	2,828	14,90
	0.7	0,00117	3,789	18,976	0,3090	10,153	3,137	16,53
	0.8	0,00117	3,789	18,976	0,3532	9,420	3,327	17,53
	0.9	0,00117	3,789	18,976	0,3973	8,583	3,410	17,97
	1	0,00117	3,789	18,976	0,4415	7,641	3,373	17,78
	1.1	0,00117	3,789	18,976	0,4856	6,489	3,151	16,61
	1.2	0,00117	3,789	18,976	0,5739	5,129	2,717	14,32
100 %	0	0,00132	4,257	21,316	0	14,444	0,610	0
	0.1	0,00132	4,257	21,316	0,0441	13,816	1,192	2,86
	0.2	0,00132	4,257	21,316	0,0883	13,502	1,747	5,59
	0.3	0,00132	4,257	21,316	0,1324	13,188	2,255	8,19
	0.4	0,00132	4,257	21,316	0,1766	12,769	2,726	10,58
	0.5	0,00132	4,257	21,316	0,2207	12,351	3,188	12,79
	0.6	0,00132	4,257	21,316	0,2649	12,037	3,590	14,96
	0.7	0,00132	4,257	21,316	0,3090	11,618	3,955	16,84
	0.8	0,00132	4,257	21,316	0,3532	11,199	4,158	18,55
	0.9	0,00132	4,257	21,316	0,3973	10,467	4,251	19,51



1	0,00132	4,257	21,316	0,4415	9,629	4,219	19,94
1.1	0,00132	4,257	21,316	0,4856	8,687	3,770	19,79
1.2	0,00132	4,257	21,316	0,5739	7,117	0,610	17,69



Lampiran 5 Tabel Densitas Air Berdasarkan Temperatur (Pell & Dunson, 1997)

TABLE 2-28 Density (kg/m³) of Water from 0 to 100°C^a

t, °C	p, kg/m ³									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	999.830	999.840	999.852	999.869	999.885	999.871	999.877	999.882	999.888	999.893
1	999.808	999.803	999.808	999.813	999.817	999.821	999.825	999.829	999.833	999.836
2	999.640	999.643	999.646	999.649	999.652	999.654	999.656	999.659	999.661	999.662
3	999.064	999.066	999.067	999.068	999.069	999.070	999.071	999.071	999.071	999.072
4	999.072	999.072	999.072	999.071	999.071	999.070	999.069	999.068	999.067	999.065
5	999.064	999.062	999.060	999.058	999.056	999.054	999.051	999.049	999.046	999.043
6	999.040	999.037	999.034	999.030	999.026	999.023	999.019	999.015	999.010	999.006
7	999.001	999.007	999.002	999.007	999.002	999.007	999.002	999.007	999.002	999.007
8	999.048	999.042	999.036	999.030	999.023	999.016	999.009	999.002	999.005	999.008
9	999.781	999.773	999.765	999.758	999.750	999.742	999.734	999.725	999.717	999.708
10	999.600	999.601	999.602	999.602	999.603	999.604	999.604	999.603	999.602	999.601
11	999.605	999.605	999.605	999.605	999.605	999.605	999.605	999.605	999.605	999.605
12	999.497	999.486	999.474	999.462	999.451	999.439	999.426	999.414	999.402	999.389
13	999.377	999.364	999.351	999.338	999.325	999.312	999.299	999.285	999.272	999.258
14	999.244	999.230	999.216	999.202	999.188	999.173	999.159	999.144	999.129	999.114
15	999.069	999.054	999.069	999.054	999.038	999.022	999.007	998.991	998.975	998.958
16	998.043	998.026	998.010	998.004	998.007	998.000	998.003	998.006	998.009	998.012
17	998.775	998.757	998.740	998.722	998.704	998.686	998.668	998.650	998.632	998.614
18	998.525	998.511	998.505	998.500	998.500	998.502	998.502	998.503	998.504	998.505
19	998.405	998.385	998.366	998.346	998.326	998.306	998.286	998.265	998.245	998.224
20	998.204	998.183	998.162	998.141	998.120	998.099	998.078	998.057	998.035	998.014
21	997.092	997.071	997.049	997.027	997.005	997.003	997.000	997.000	997.000	997.000
22	997.770	997.747	997.725	997.702	997.679	997.656	997.632	997.609	997.585	997.562
23	997.538	997.515	997.491	997.467	997.443	997.419	997.394	997.370	997.345	997.321
24	997.296	997.272	997.247	997.222	997.197	997.172	997.146	997.121	997.096	997.070
25	997.045	997.019	996.993	996.967	996.941	996.915	996.889	996.863	996.836	996.810
26	996.793	996.757	996.730	996.703	996.676	996.649	996.622	996.595	996.568	996.540
27	996.513	996.485	996.458	996.430	996.402	996.374	996.346	996.318	996.290	996.262
28	996.233	996.205	996.176	996.148	996.119	996.090	996.061	996.032	996.003	995.974
29	995.945	995.915	995.886	995.856	995.827	995.797	995.767	995.737	995.707	995.677
30	995.647	995.617	995.586	995.556	995.526	995.495	995.464	995.433	995.402	995.372
31	995.341	995.310	995.278	995.247	995.216	995.184	995.153	995.121	995.090	995.058
32	995.026	994.997	994.962	994.930	994.898	994.866	994.833	994.801	994.768	994.735
33	994.703	994.670	994.637	994.604	994.571	994.538	994.505	994.472	994.438	994.405
34	994.371	994.338	994.304	994.270	994.236	994.202	994.168	994.134	994.100	994.066
35	994.032	993.997	993.963	993.928	993.893	993.859	993.824	993.789	993.754	993.719
36	993.664	993.628	993.593	993.558	993.523	993.488	993.453	993.418	993.383	993.348
37	993.228	993.202	993.176	993.150	993.124	993.098	993.072	993.046	993.020	992.994
38	992.965	992.928	992.891	992.854	992.818	992.781	992.744	992.707	992.670	992.633
39	992.594	992.557	992.519	992.481	992.444	992.406	992.368	992.330	992.292	992.254
40	992.215	992.177	992.139	992.100	992.062	992.023	991.985	991.946	991.907	991.868
41	991.830	991.791	991.751	991.712	991.673	991.634	991.594	991.555	991.515	991.476
42	991.436	991.396	991.357	991.317	991.277	991.237	991.197	991.157	991.116	991.076
43	991.036	990.995	990.955	990.914	990.873	990.833	990.792	990.751	990.710	990.669
44	990.628	990.587	990.546	990.504	990.463	990.421	990.380	990.338	990.297	990.255
45	990.213	990.171	990.129	990.087	990.045	990.003	989.961	989.919	989.877	989.834
46	989.732	989.700	989.666	989.632	989.598	989.564	989.530	989.496	989.462	989.428
47	989.363	989.329	989.295	989.261	989.227	989.193	989.159	989.125	989.091	989.057
48	988.928	988.894	988.860	988.826	988.792	988.757	988.723	988.689	988.654	988.620
49	988.485	988.441	988.396	988.352	988.307	988.262	988.217	988.172	988.127	988.082

^aFrom "Water: Density at Atmospheric Pressure and Temperature from 0 to 100°C," *Tables of Standard Handbook Data*, Standard, Moscow, 1978. To conserve space, only a few tables of density values are given. The reader is reminded that density values may be found as the reciprocal of the specific volume values tabulated in the "Thermodynamic Properties; Tables" subsection.



