



LAMPIRAN A

- ❖ Tabel A-1 Hasil Pengujian Refrigeran R-134a Isian Massa 300 gram
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TABEL A-1 HASIL PENGUJIAN ISIAN MASSA REFERIGERAN 300 gram

No	Kecepatan Blower	Evaporator			Kompresor			Kondensor			Katup Ekspansi			Ve	Vc	Tin
		P1	T1	H1	P2	T2	H2	P3	T3	H3	P4	T4	H4			
1	Low	0	33,2	262,82	110	33,9	268,807	120	32,9	96,9888	0	31,7	80,8978	1,8 m/s	220	32,4
2		0	25,9		110	38,8		120	34,5		0	24,8				31,3
3		0	27,5		110	42,4		120	33,9		0	20,7				30,5
4		0	28,1		110	44,5		120	33,8		0	18,8				30,1
5		0	28,5		110	46,7		120	33,8		0	16,9				28,9
	Rata-rata	0	28,64		110	41,26		120	33,78		0	22,58				30,64
1	Medium	0	33,1	262,4898	105	33,9	269,3662	115	32,4	96,7844	0	32,4	79,5442	3,6 m/s	220	32,4
2		0	25,9		105	40,2		115	34,3		0	23,8				31,8
3		0	26,4		105	44,1		115	33,9		0	19,3				29,8
4		0	27		105	46,2		115	33,8		0	17,3				29,2
5		0	27,5		105	48,2		115	33,8		0	15,3				28,7
	Rata-rata	0	27,98		105	42,52		115	33,64		0	21,62				30,38
1	High	0	33,4	262,2348	100	33,9	269,6446	110	32,1	95,996	0	27,3	72,6926	4,8 m/s	220	32,4
2		0	25,7		100	40,5		110	33,9		0	19,5				31,2
3		0	25,3		100	44,2		110	33,3		0	15,6				29,5
4		0	26,1		100	47,6		110	33,1		0	11,7				28,2
5		0	26,9		100	49,6		110	33,1		0	9,5				26,3
	Rata-rata	0	27,48		100	43,16		110	33,1		0	16,72				29,52

TABEL A-2 HASIL PENGUJIAN ISIAN MASSA REFERIGERAN 400 gram

No	Kecepatan Blower	Evaporator			Kompresor			Kondensor			Katup Ekspansi			Ve	Vc	Tin
		P1	T1	H1	P2	T2	H2	P3	T3	H3	P4	T4	H4			
1	Low	0	33,9	262,296	110	33,9	269,1661	125	33	96,6968	0	32	77,6548	2,4 m/s	220	32,4
2		0	26,6		110	40		125	34,5		0	23,4				31,9
3		0	26,1		110	42,8		125	33,9		0	19,2				29,7
4		0	25,9		110	45,3		125	33,3		0	14,3				27,6
5		0	25,5		110	48,3		125	33,2		0	12,5				25,6
	Rata-rata	0	27,6		110	42,06		125	33,58		0	20,28				29,44
1	Medium	5	33	261,99	115	33,9	269,8534	125	31,6	95,85	5	31,2	75,05985	4,2 m/s	220	32,4
2		5	26,3		115	40,9		125	33,9		5	19,2				30,9
3		5	25,7		115	44,8		125	33,3		5	14,9				29,6
4		5	25,1		115	48,3		125	33,1		5	14,3				27,8
5		5	24,9		115	50,3		125	33,1		5	12,5				25,5
	Rata-rata	5	27		115	43,64		125	33		5	18,42				29,24
1	High	5	32,6	261,6534	115	33,9	270,5611	125	31,1	95,0324	5	27,4	71,9685	5,8 m/s	220	32,4
2		5	25,3		115	42,2		125	33,3		5	18,2				29,8
3		5	25		115	47		125	32,8		5	14,9				27,3
4		5	24,7		115	50,7		125	32,6		5	11,3				26,4
5		5	24,1		115	52,8		125	32,4		5	9,2				24,2
	Rata-rata	5	26,34		115	45,32		125	32,44		5	16,2				28,02

TABEL A-3 HASIL PENGUJIAN ISIAN MASSA REFERIGERAN 500 gram

No	Kecepatan Blower	Evaporator			Kompresor			Kondensor			Katup Ekspansi			Ve	Vc	Tin
		P1	T1	H1	P2	T2	H2	P3	T3	H3	P4	T4	H4			
1	Low	5	29,9	260,2515	125	33,9	270,9953	135	30,6	95,2368	5	30,7	74,7535	2,6 m/s	220	32,4
2		5	22,2		125	42,7		135	33,2		5	22,8				29,5
3		5	22,2		125	48,4		135	33,3		5	15,9				27,5
4		5	22,2		125	52,4		135	32,9		5	11				25,5
5		5	21,6		125	54,4		135	32,9		5	10,6				23,5
	Rata-rata	5	23,62		125	46,36		135	32,58		5	18,2				27,68
1	Medium	7	32	260,3978	125	33,9	271,4713	135	30,7	95,0032	7	26,4	72,10775	4,8 m/s	220	32,4
2		7	22,4		125	44,7		135	32,7		7	18,7				29,2
3		7	22,6		125	50,3		135	32,9		7	14,6				27
4		7	22,3		125	52,5		135	32,9		7	12,6				25,1
5		7	20,2		125	56,1		135	32,9		7	9,2				23
	Rata-rata	7	23,9		125	47,5		135	32,42		7	16,3				27,34
1	High	7	31,8	259,9693	125	33,9	271,6717	135	31,2	95,3536	7	29,7	70,11965	7,4 m/s	220	32,4
2		7	22,4		125	45,4		135	33,6		7	16,4				29,2
3		7	21,5		125	50,2		135	33		7	11,2				25,4
4		7	20,1		125	54,1		135	32,7		7	9,1				23,4
5		7	19,6		125	56,3		135	32,8		7	7,9				21,4
	Rata-rata	7	23,08		125	47,98		135	32,66		7	14,86				26,36

TABEL A-4 HASIL PENGUJIAN ISIAN MASSA REFERIGERAN 600 gram

No	Kecepatan Blower	Evaporator			Kompresor			Kondensor			Katup Ekspansi			Ve	Vc	Tin
		P1	T1	H1	P2	T2	H2	P3	T3	H3	P4	T4	H4			
1	Low	7	30,6	259,4886	130	33,9	271,2375	145	31,9	97,31	7	28	71,60735	3,2 m/s	220	32,4
2		7	21,1		130	43,1		145	35,4		7	18,6				28,8
3		7	21,5		130	49,1		145	34,8		7	14,2				26,6
4		7	20,9		130	53,2		145	34,2		7	10,6				24,6
5		7	16,7		130	55,4		145	33,7		7	8,3				22,5
	Rata-rata	7	22,16		130	46,94		145	34		7	15,94				26,98
1	Medium	10	30,9	258,8407	135	33,9	271,6633	150	30,2	95,0908	10	29,6	68,96255	5,4 m/s	220	32,4
2		10	19,3		135	45,8		150	32,8		10	14,9				28,3
3		10	19,1		135	50,4		150	33,2		10	10,7				26,1
4		10	18,6		135	54,6		150	33		10	8,4				24
5		10	16,7		135	55,1		150	33,2		10	6,5				22
	Rata-rata	10	20,92		135	47,96		150	32,48		10	14,02				26,56
1	High	12	29,7	258,7153	150	33,9	273,2688	165	29,4	94,8864	12	24,1	66,59325	8,2 m/s	220	32,4
2		12	19,9		150	48,8		165	32,2		12	13,7				28,3
3		12	20,2		150	55,7		165	32,8		12	9,6				26,1
4		12	19,8		150	60		165	33,4		12	7,6				24,2
5		12	13,8		150	62		165	33,9		12	6,5				21,9
	Rata-rata	12	20,68		150	52,08		165	32,34		12	12,3				26,58

TABEL A-5 HASIL RATA-RATA PENGUJIAN REFRIGERAN R-134a

Kecepatan Blower	Massa Gram	Evaporator			Kompresor			Kondensor			Katup Ekspansi			Ve m/s	Vc Volt	Tin ° C
		P1 Psia	T1 ° C	H1 Kj/Kg	P2 Psia	T2 ° C	H2 Kj/Kg	P3 Psia	T3 ° C	H3 Kj/Kg	P4 Psia	T4 ° C	H4 Kj/Kg			
Low	300	0	28,64	262,82	110	41,26	268,807	120	33,78	96,9888	0	22,58	80,8978	1,8	220	30,64
	400	0	27,6	262,296	110	42,06	269,1661	125	33,58	96,6968	0	20,28	77,6548	2,4	220	29,44
	500	5	23,62	260,2515	125	46,36	270,9953	135	32,58	95,2368	5	18,2	74,7535	2,6	220	27,68
	600	7	22,16	259,4886	130	46,94	271,2375	145	34	97,31	7	15,94	71,60735	3,2	220	26,98
Medium	300	0	27,98	262,4898	105	42,52	269,3662	115	33,64	96,7844	0	21,62	79,5442	3,6	220	30,38
	400	5	27	261,99	115	43,64	269,8534	125	33	95,85	5	18,42	75,05985	4,2	220	29,24
	500	7	23,9	260,3978	125	47,5	271,4713	135	32,42	95,0032	7	16,3	72,10775	4,8	220	27,34
	600	10	20,92	258,8407	135	47,96	271,6633	150	32,48	95,0908	10	14,02	68,96255	5,4	220	26,56
High	300	0	27,48	262,2348	100	43,16	269,6446	110	33,1	95,996	0	16,72	72,6926	4,8	220	29,52
	400	5	26,34	261,6534	115	45,32	270,5611	125	32,44	95,0324	5	16,2	71,9685	5,8	220	28,02
	500	7	23,08	259,9693	125	47,98	271,6717	135	32,66	95,3536	7	14,86	70,11965	7,4	220	26,36
	600	12	20,68	258,7153	150	52,08	273,2688	165	32,34	94,8864	12	12,3	66,59325	8,2	220	26,58

TABEL A-6 PERHITUNGAN M_{ref} REFRIGERAN R-134a**LOW COOL**

Massa Gram	Ve m/s	A m ²	ρ udara Kg/m ³	M udara Kg/det	CP udara KJ/kg ⁰ C	ΔT ⁰ C	Q ref evap K _{watt}	Q udara evap K _{watt}	ΔH KJ/kg	M _{ref} Kg/det	RE kJ/kg
300	1,8	0,02276	1,163801	0,0476786	1,005905	8,06	0,0932429	0,3865587	181,9222	0,0005125	181,9222
400	2,4	0,02276	1,168107	0,0638067	1,005871	9,16	0,1141877	0,5879006	184,6412	0,0006184	184,6412
500	2,6	0,02276	1,174422	0,0694976	1,005755	9,48	0,2736366	0,6626288	185,4980	0,0014751	185,4980
600	3,2	0,02276	1,176934	0,0857185	1,005709	11,04	0,3980328	0,9517344	187,8813	0,0021185	187,8813

MEDIUM COOL

Massa Gram	Ve m/s	A m ²	ρ udara Kg/m ³	M udara Kg/det	CP udara KJ/kg ⁰ C	ΔT ⁰ C	Q ref evap K _{watt}	Q udara evap K _{watt}	ΔH KJ/kg	M _{ref} Kg/det	RE kJ/kg
300	3,6	0,02276	1,164734	0,0954336	1,005933	8,76	0,2233133	0,8409587	182,9456	0,0012207	182,9456
400	4,2	0,02276	1,168825	0,1117303	1,005858	10,82	0,2418134	1,2160039	186,9302	0,0012936	186,93015
500	4,8	0,02276	1,175642	0,1284365	1,005732	11,04	0,4257802	1,426067	188,2901	0,0022613	188,29005
600	5,4	0,02276	1,178765	0,1448749	1,005698	12,54	0,7826344	1,8270834	189,8782	0,0041218	189,87815

HIGH COOL

Massa Gram	Ve m/s	A m ²	ρ udara Kg/m ³	M udara Kg/det	CP udara KJ/kg ⁰ C	ΔT ⁰ C	Q ref evap K _{watt}	Q udara evap K _{watt}	ΔH KJ/kg	M _{ref} Kg/det	RE kJ/kg
300	4,8	0,02276	1,16782	0,127582	1,005876	12,8	0,2496216	1,6426454	189,5422	0,001317	189,5422
400	5,8	0,02276	1,173202	0,154872	1,005777	11,82	0,2501446	1,8411629	189,6849	0,0013187	189,6849
500	7,4	0,02276	1,179707	0,198691	1,005696	11,5	0,6267157	2,2979612	189,8497	0,0033011	189,84965
600	8,2	0,02276	1,178671	0,2199777	1,005698	14,28	1,2349706	3,159181	192,1221	0,0064281	192,1221

TABEL A-7 PERHITUNGAN SISI UDARA PANAS DAN DINGIN REFRIGERAN R-134a

SISI UDARA PANAS POSISI LOW

Massa	V	A	ρ	CPh
300	1,8	0,02276	1,163801	1,005905
400	2,4	0,02276	1,168107	1,005871
500	2,6	0,02276	1,174422	1,005755
600	3,2	0,02276	1,176934	1,005709

SISI UDARA DINGIN POSISI LOW

Massa	V	A	ρ	CPc
300	1,8	0,02276	1,197503	1,005666
400	2,4	0,02276	1,208332	1,005647
500	2,6	0,02276	1,218124	1,005631
600	3,2	0,02276	1,228764	1,005613

SISI UDARA PANAS POSISI MEDIUM

Massa	V	A	ρ	CPh
300	3,6	0,02276	1,164734	1,005933
400	4,2	0,02276	1,168825	1,005858
500	4,8	0,02276	1,175642	1,005732
600	5,4	0,02276	1,178765	1,005698

SISI UDARA DINGIN POSISI MEDIUM

Massa	V	A	ρ	CPc
300	3,6	0,02276	1,202023	1,005658
400	4,2	0,02276	1,217088	1,005633
500	4,8	0,02276	1,227069	1,005616
600	5,4	0,02276	1,237804	1,005597

SISI UDARA PANAS POSISI HIGH

Massa	V	A	ρ	CPh
300	4,8	0,02276	1,16782	1,005876
400	5,8	0,02276	1,173202	1,005777
500	7,4	0,02276	1,179707	1,005696
600	8,2	0,02276	1,178671	1,005698

SISI UDARA DINGIN POSISI HIGH

Massa	V	A	ρ	CPc
300	4,8	0,02276	1,225092	1,005619
400	5,8	0,02276	1,22754	1,005615
500	7,4	0,02276	1,233849	1,005604
600	8,2	0,02276	1,245901	1,005584

TABEL A-8 PERHITUNGAN NILAI EFEKTIFITAS REFRIGERAN R-134a**LOW COOL**

Massa	Th masuk	Th keluar	Tc masuk	Ch	Cc	Q	Q max	ε
300	303,79	301,79	295,73	0,0479601	0,0493373	0,0959203	0,3976584	0,2412128
400	302,59	300,75	293,43	0,0641813	0,0663767	0,1180936	0,6080101	0,1942296
500	300,83	296,77	291,35	0,0698976	0,0724896	0,2837841	0,6872015	0,4129561
600	300,13	295,31	289,09	0,0862078	0,0899957	0,4155217	0,9935522	0,4182183

MEDIUM COOL

Massa	Th masuk	Th keluar	Tc masuk	Ch	Cc	Q	Q max	ε
300	303,53	301,13	294,77	0,0959999	0,0990462	0,2303996	0,8676448	0,2655461
400	302,39	300,15	291,57	0,1123848	0,1169992	0,251742	1,2659318	0,1988591
500	300,49	297,05	289,45	0,1291727	0,1348077	0,4443542	1,4882769	0,2985696
600	299,71	294,07	287,17	0,1457004	0,1529825	0,8217504	1,9184011	0,4283517

HIGH COOL

Massa	Th masuk	Th keluar	Tc masuk	Ch	Cc	Q	Q max	ε
300	302,67	300,63	289,87	0,1283317	0,1345909	0,2617966	1,7227634	0,1519632
400	301,17	299,49	289,35	0,1557667	0,162955	0,2616881	1,9261279	0,1358623
500	299,51	296,23	288,01	0,1998227	0,2089744	0,6554185	2,403205	0,2727268
600	299,73	293,83	285,45	0,2212312	0,2338234	1,3052638	3,3389984	0,3909148

TABEL A-9 PERHITUNGAN COP REFRIGERAN R-134a**LOW COOL**

Massa gram	M ref Kg/det	We KJ/kg	P komp K watt	h2 - h3 KJ/Kg	Qc K watt	RE KJ/kg	Qe K watt	COP
300	0,0005125	5,987	0,0030686	171,8182	0,0880642	181,9222	0,0932429	30,386203
400	0,0006184	6,8701	0,0042487	172,4693	0,1066602	184,6412	0,1141877	26,876057
500	0,0014751	10,7438	0,0158487	175,7585	0,2592695	185,498	0,2736366	17,265586
600	0,0021185	11,7489	0,0248904	173,9275	0,3684713	187,88125	0,3980328	15,991391

MEDIUM COOL

Massa gram	M ref Kg/det	We KJ/kg	P komp K watt	h2 - h3 KJ/Kg	Qc K watt	RE KJ/kg	Qe K watt	COP
300	0,0012207	6,8764	0,0083937	172,5818	0,2106627	182,9456	0,2233133	26,604851
400	0,0012936	7,8634	0,0101721	174,0034	0,2250913	186,93015	0,2418134	23,772179
500	0,0022613	11,0735	0,0250405	176,4681	0,3990473	188,29005	0,4257802	17,003662
600	0,0041218	12,8226	0,0528518	176,5725	0,7277915	189,87815	0,7826344	14,808085

HIGH COOL

Massa gram	M ref Kg/det	We KJ/kg	P komp K watt	h2 - h3 KJ/Kg	Qc K watt	RE KJ/kg	Qe K watt	COP
300	0,001317	7,4098	0,0097585	173,6486	0,2286902	189,5422	0,2496216	25,579935
400	0,0013187	8,9077	0,0117469	175,5287	0,2314763	189,6849	0,2501446	21,294487
500	0,0033011	11,7024	0,038631	176,3181	0,5820465	189,8497	0,6267157	16,223138
600	0,0064281	14,5535	0,0935507	178,3824	1,1466514	192,1221	1,2349706	13,201089



LAMPIRAN B

- ❖ Tabel B-1 Properties Of Air At Atmospheric Pressure
- ❖ Tabel B-2 Properties Of Saturated Refrigerant 134a (Liquid-Vapor)
Temperature Table
- ❖ Tabel B-3 Properties Of Saturated Refrigerant 134a (Liquid-Vapor)
Pressure Table
- ❖ Tabel B-4 Properties Of Superheated Refrigerant R-134a Vapor

TABEL B-1 PROPERTIES OF AIR AT ATMOSPHERIC PRESSURE

The values of μ , k , c_p , and Pr are not strongly pressure-dependent and may be used over a fairly wide range of pressures							
T, K	ρ kg/m ³	c_p kJ/kg · °C	$\mu \times 10^5$ kg/m · s	$\nu \times 10^6$ m ² /s	k W/m · °C	$\alpha \times 10^4$ m ² /s	Pr
100	3.6010	1.0266	0.6924	1.923	0.009246	0.02501	0.770
150	2.3675	1.0099	1.0283	4.343	0.013735	0.05745	0.753
200	1.7684	1.0061	1.3289	7.490	0.01809	0.10165	0.739
250	1.4128	1.0053	1.5990	11.31	0.02227	0.15675	0.722
300	1.1774	1.0057	1.8462	15.69	0.02624	0.22160	0.708
350	0.9980	1.0090	2.075	20.76	0.03003	0.2983	0.697
400	0.8826	1.0140	2.286	25.90	0.03365	0.3760	0.689
450	0.7833	1.0207	2.484	31.71	0.03707	0.4222	0.683
500	0.7048	1.0295	2.671	37.90	0.04038	0.5564	0.680
550	0.6423	1.0392	2.848	44.34	0.04360	0.6532	0.680
600	0.5879	1.0551	3.018	51.34	0.04659	0.7512	0.680
650	0.5430	1.0635	3.177	58.51	0.04953	0.8578	0.682
700	0.5030	1.0752	3.332	66.25	0.05230	0.9672	0.684
750	0.4709	1.0856	3.481	73.91	0.05509	1.0774	0.686
800	0.4405	1.0978	3.625	82.29	0.05779	1.1951	0.689
850	0.4149	1.1095	3.765	90.75	0.06028	1.3097	0.692
900	0.3925	1.1212	3.899	99.3	0.06279	1.4271	0.696
950	0.3716	1.1321	4.023	108.2	0.06525	1.5510	0.699
1000	0.3524	1.1417	4.152	117.8	0.06752	1.6779	0.702
1100	0.3204	1.160	4.44	138.6	0.0732	1.969	0.704
1200	0.2947	1.179	4.69	159.1	0.0782	2.251	0.707
1300	0.2707	1.197	4.93	182.1	0.0837	2.583	0.705
1400	0.2515	1.214	5.17	205.5	0.0891	2.920	0.705
1500	0.2355	1.230	5.40	229.1	0.0946	3.262	0.705
1600	0.2211	1.248	5.63	254.5	0.100	3.609	0.705
1700	0.2082	1.267	5.85	280.5	0.105	3.977	0.705
1800	0.1970	1.287	6.07	308.1	0.111	4.379	0.704
1900	0.1858	1.309	6.29	338.5	0.117	4.811	0.704
2000	0.1762	1.338	6.50	369.0	0.124	5.260	0.702
2100	0.1682	1.372	6.72	399.6	0.131	5.715	0.700
2200	0.1602	1.419	6.93	432.6	0.139	6.120	0.707
2300	0.1538	1.482	7.14	464.0	0.149	6.540	0.710
2400	0.1458	1.574	7.35	504.0	0.161	7.020	0.718
2500	0.1394	1.688	7.57	543.5	0.175	7.441	0.730

**TABEL B-2 PROPERTIES OF SATURATED REFRIGERANT 134a
(LIQUID-VAPOR) : TEMPERATURE TABLE**

Temp. °C	Press. bar	Specific Volume m ³ /kg		Internal Energy kJ/kg		Enthalpy kJ/kg			Entropy kJ/kg · K		Temp. °C
		Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Sat. Liquid u_f	Sat. Vapor u_g	Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Sat. Liquid s_f	Sat. Vapor s_g	
-40	0.5164	0.7055	0.3569	-0.04	204.45	0.00	222.88	222.88	0.0000	0.9560	-40
-36	0.6332	0.7113	0.2947	4.68	206.73	4.73	220.67	225.40	0.0201	0.9506	-36
-32	0.7704	0.7172	0.2451	9.47	209.01	9.52	218.37	227.90	0.0401	0.9456	-32
-28	0.9305	0.7233	0.2052	14.31	211.29	14.37	216.01	230.38	0.0600	0.9411	-28
-26	1.0199	0.7265	0.1882	16.75	212.43	16.82	214.80	231.62	0.0699	0.9390	-26
-24	1.1160	0.7296	0.1728	19.21	213.57	19.29	213.57	232.85	0.0798	0.9370	-24
-22	1.2192	0.7328	0.1590	21.68	214.70	21.77	212.32	234.08	0.0897	0.9351	-22
-20	1.3299	0.7361	0.1464	24.17	215.84	24.26	211.05	235.31	0.0996	0.9332	-20
-18	1.4483	0.7395	0.1350	26.67	216.97	26.77	209.76	236.53	0.1094	0.9315	-18
-16	1.5748	0.7428	0.1247	29.18	218.10	29.30	208.45	237.74	0.1192	0.9298	-16
-12	1.8540	0.7498	0.1068	34.25	220.36	34.39	205.77	240.15	0.1388	0.9267	-12
-8	2.1704	0.7569	0.0919	39.38	222.60	39.54	203.00	242.54	0.1583	0.9239	-8
-4	2.5274	0.7644	0.0794	44.56	224.84	44.75	200.15	244.90	0.1777	0.9213	-4
0	2.9282	0.7721	0.0689	49.79	227.06	50.02	197.21	247.23	0.1970	0.9190	0
4	3.3765	0.7801	0.0600	55.08	229.27	55.35	194.19	249.53	0.2162	0.9169	4
8	3.8756	0.7884	0.0525	60.43	231.46	60.73	191.07	251.80	0.2354	0.9150	8
12	4.4294	0.7971	0.0460	65.83	233.63	66.18	187.85	254.03	0.2545	0.9132	12
16	5.0416	0.8062	0.0405	71.29	235.78	71.69	184.52	256.22	0.2735	0.9116	16
20	5.7160	0.8157	0.0358	76.80	237.91	77.26	181.09	258.36	0.2924	0.9102	20
24	6.4566	0.8257	0.0317	82.37	240.01	82.90	177.55	260.45	0.3113	0.9089	24
26	6.8530	0.8309	0.0298	85.18	241.05	85.75	175.73	261.48	0.3208	0.9082	26
28	7.2675	0.8362	0.0281	88.00	242.08	88.61	173.89	262.50	0.3302	0.9076	28
30	7.7006	0.8417	0.0265	90.84	243.10	91.49	172.00	263.50	0.3396	0.9070	30
32	8.1528	0.8473	0.0250	93.70	244.12	94.39	170.09	264.48	0.3490	0.9064	32
34	8.6247	0.8530	0.0236	96.58	245.12	97.31	168.14	265.45	0.3584	0.9058	34
36	9.1168	0.8590	0.0223	99.47	246.11	100.25	166.15	266.40	0.3678	0.9053	36
38	9.6298	0.8651	0.0210	102.38	247.09	103.21	164.12	267.33	0.3772	0.9047	38
40	10.164	0.8714	0.0199	105.30	248.06	106.19	162.05	268.24	0.3866	0.9041	40
42	10.720	0.8780	0.0188	108.25	249.02	109.19	159.94	269.14	0.3960	0.9035	42
44	11.299	0.8847	0.0177	111.22	249.96	112.22	157.79	270.01	0.4054	0.9030	44
48	12.526	0.8989	0.0159	117.22	251.79	118.35	153.33	271.68	0.4243	0.9017	48
52	13.851	0.9142	0.0142	123.31	253.55	124.58	148.66	273.24	0.4432	0.9004	52
56	15.278	0.9308	0.0127	129.51	255.23	130.93	143.75	274.68	0.4622	0.8990	56
60	16.813	0.9488	0.0114	135.82	256.81	137.42	138.57	275.99	0.4814	0.8973	60
70	21.162	1.0027	0.0086	152.22	260.15	154.34	124.08	278.43	0.5302	0.8918	70
80	26.324	1.0766	0.0064	169.88	262.14	172.71	106.41	279.12	0.5814	0.8827	80
90	32.435	1.1949	0.0046	189.82	261.34	193.69	82.63	276.32	0.6380	0.8655	90
100	39.742	1.5443	0.0027	218.60	248.49	224.74	34.40	259.13	0.7196	0.8117	100

**TABEL B-3 PROPERTIES OF SATURATED REFRIGERANT 134a
(LIQUID-VAPOR) : PRESSURE TABLE**

Press. bar	Temp. °C	Specific Volume m ³ /kg		Internal Energy kJ/kg		Enthalpy kJ/kg			Entropy kJ/kg · K		Press. bar
		Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Sat. Liquid u_f	Sat. Vapor u_g	Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Sat. Liquid s_f	Sat. Vapor s_g	
0.6	-37.07	0.7097	0.3100	3.41	206.12	3.46	221.27	224.72	0.0147	0.9520	0.6
0.8	-31.21	0.7184	0.2366	10.41	209.46	10.47	217.92	228.39	0.0440	0.9447	0.8
1.0	-26.43	0.7258	0.1917	16.22	212.18	16.29	215.06	231.35	0.0678	0.9395	1.0
1.2	-22.36	0.7323	0.1614	21.23	214.50	21.32	212.54	233.86	0.0879	0.9354	1.2
1.4	-18.80	0.7381	0.1395	25.66	216.52	25.77	210.27	236.04	0.1055	0.9322	1.4
1.6	-15.62	0.7435	0.1229	29.66	218.32	29.78	208.19	237.97	0.1211	0.9295	1.6
1.8	-12.73	0.7485	0.1098	33.31	219.94	33.45	206.26	239.71	0.1352	0.9273	1.8
2.0	-10.09	0.7532	0.0993	36.69	221.43	36.84	204.46	241.30	0.1481	0.9253	2.0
2.4	-5.37	0.7618	0.0834	42.77	224.07	42.95	201.14	244.09	0.1710	0.9222	2.4
2.8	-1.23	0.7697	0.0719	48.18	226.38	48.39	198.13	246.52	0.1911	0.9197	2.8
3.2	2.48	0.7770	0.0632	53.06	228.43	53.31	195.35	248.66	0.2089	0.9177	3.2
3.6	5.84	0.7839	0.0564	57.54	230.28	57.82	192.76	250.58	0.2251	0.9160	3.6
4.0	8.93	0.7904	0.0509	61.69	231.97	62.00	190.32	252.32	0.2399	0.9145	4.0
5.0	15.74	0.8056	0.0409	70.93	235.64	71.33	184.74	256.07	0.2723	0.9117	5.0
6.0	21.58	0.8196	0.0341	78.99	238.74	79.48	179.71	259.19	0.2999	0.9097	6.0
7.0	26.72	0.8328	0.0292	86.19	241.42	86.78	175.07	261.85	0.3242	0.9080	7.0
8.0	31.33	0.8454	0.0255	92.75	243.78	93.42	170.73	264.15	0.3459	0.9066	8.0
9.0	35.53	0.8576	0.0226	98.79	245.88	99.56	166.62	266.18	0.3656	0.9054	9.0
10.0	39.39	0.8695	0.0202	104.42	247.77	105.29	162.68	267.97	0.3838	0.9043	10.0
12.0	46.32	0.8928	0.0166	114.69	251.03	115.76	155.23	270.99	0.4164	0.9023	12.0
14.0	52.43	0.9159	0.0140	123.98	253.74	125.26	148.14	273.40	0.4453	0.9003	14.0
16.0	57.92	0.9392	0.0121	132.52	256.00	134.02	141.31	275.33	0.4714	0.8982	16.0
18.0	62.91	0.9631	0.0105	140.49	257.88	142.22	134.60	276.83	0.4954	0.8959	18.0
20.0	67.49	0.9878	0.0093	148.02	259.41	149.99	127.95	277.94	0.5178	0.8934	20.0
25.0	77.59	1.0562	0.0069	165.48	261.84	168.12	111.06	279.17	0.5687	0.8854	25.0
30.0	86.22	1.1416	0.0053	181.88	262.16	185.30	92.71	278.01	0.6156	0.8735	30.0

**TABEL B-4 PROPERTIES OF SUPERHEATED REFRIGERANT R-134a
VAPOR**

T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg · K	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg · K
$p = 0.6 \text{ bar} = 0.06 \text{ MPa}$ ($T_{\text{sat}} = -37.07^\circ\text{C}$)					$p = 1.0 \text{ bar} = 0.10 \text{ MPa}$ ($T_{\text{sat}} = -26.43^\circ\text{C}$)			
Sat.	0.31003	206.12	224.72	0.9520	0.19170	212.18	231.35	0.9395
-20	0.33536	217.86	237.98	1.0062	0.19770	216.77	236.54	0.9602
-10	0.34992	224.97	245.96	1.0371	0.20686	224.01	244.70	0.9918
0	0.36433	232.24	254.10	1.0675	0.21587	231.41	252.99	1.0227
10	0.37861	239.69	262.41	1.0973	0.22473	238.96	261.43	1.0531
20	0.39279	247.32	270.89	1.1267	0.23349	246.67	270.02	1.0829
30	0.40688	255.12	279.53	1.1557	0.24216	254.54	278.76	1.1122
40	0.42091	263.10	288.35	1.1844	0.25076	262.58	287.66	1.1411
50	0.43487	271.25	297.34	1.2126	0.25930	270.79	296.72	1.1696
60	0.44879	279.58	306.51	1.2405	0.26779	279.16	305.94	1.1977
70	0.46266	288.08	315.84	1.2681	0.27623	287.70	315.32	1.2254
80	0.47650	296.75	325.34	1.2954	0.28464	296.40	324.87	1.2528
90	0.49031	305.58	335.00	1.3224	0.29302	305.27	334.57	1.2799

$p = 1.4 \text{ bar} = 0.14 \text{ MPa}$ ($T_{\text{sat}} = -18.80^\circ\text{C}$)					$p = 1.8 \text{ bar} = 0.18 \text{ MPa}$ ($T_{\text{sat}} = -12.73^\circ\text{C}$)			
Sat.	0.13945	216.52	236.04	0.9322	0.10983	219.94	239.71	0.9273
-10	0.14549	223.03	243.40	0.9606	0.11135	222.02	242.06	0.9362
0	0.15219	230.55	251.86	0.9922	0.11678	229.67	250.69	0.9684
10	0.15875	238.21	260.43	1.0230	0.12207	237.44	259.41	0.9998
20	0.16520	246.01	269.13	1.0532	0.12723	245.33	268.23	1.0304
30	0.17155	253.96	277.97	1.0828	0.13230	253.36	277.17	1.0604
40	0.17783	262.06	286.96	1.1120	0.13730	261.53	286.24	1.0898
50	0.18404	270.32	296.09	1.1407	0.14222	269.85	295.45	1.1187
60	0.19020	278.74	305.37	1.1690	0.14710	278.31	304.79	1.1472
70	0.19633	287.32	314.80	1.1969	0.15193	286.93	314.28	1.1753
80	0.20241	296.06	324.39	1.2244	0.15672	295.71	323.92	1.2030
90	0.20846	304.95	334.14	1.2516	0.16148	304.63	333.70	1.2303
100	0.21449	314.01	344.04	1.2785	0.16622	313.72	343.63	1.2573

$p = 2.0 \text{ bar} = 0.20 \text{ MPa}$ ($T_{\text{sat}} = -10.09^\circ\text{C}$)					$p = 2.4 \text{ bar} = 0.24 \text{ MPa}$ ($T_{\text{sat}} = -5.37^\circ\text{C}$)			
Sat.	0.09933	221.43	241.30	0.9253	0.08343	224.07	244.09	0.9222
-10	0.09938	221.50	241.38	0.9256				
0	0.10438	229.23	250.10	0.9582	0.08574	228.31	248.89	0.9399
10	0.10922	237.05	258.89	0.9898	0.08993	236.26	257.84	0.9721
20	0.11394	244.99	267.78	1.0206	0.09399	244.30	266.85	1.0034
30	0.11856	253.06	276.77	1.0508	0.09794	252.45	275.95	1.0339
40	0.12311	261.26	285.88	1.0804	0.10181	260.72	285.16	1.0637
50	0.12758	269.61	295.12	1.1094	0.10562	269.12	294.47	1.0930
60	0.13201	278.10	304.50	1.1380	0.10937	277.67	303.91	1.1218
70	0.13639	286.74	314.02	1.1661	0.11307	286.35	313.49	1.1501
80	0.14073	295.53	323.68	1.1939	0.11674	295.18	323.19	1.1780
90	0.14504	304.47	333.48	1.2212	0.12037	304.15	333.04	1.2055
100	0.14932	313.57	343.43	1.2483	0.12398	313.27	343.03	1.2326

T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg · K	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg · K
$p = 2.8 \text{ bar} = 0.28 \text{ MPa}$ ($T_{\text{sat}} = -1.23^\circ\text{C}$)					$p = 3.2 \text{ bar} = 0.32 \text{ MPa}$ ($T_{\text{sat}} = 2.48^\circ\text{C}$)			
Sat.	0.07193	226.38	246.52	0.9197	0.06322	228.43	248.66	0.9177
0	0.07240	227.37	247.64	0.9238				
10	0.07613	235.44	256.76	0.9566	0.06576	234.61	255.65	0.9427
20	0.07972	243.59	265.91	0.9883	0.06901	242.87	264.95	0.9749
30	0.08320	251.83	275.12	1.0192	0.07214	251.19	274.28	1.0062
40	0.08660	260.17	284.42	1.0494	0.07518	259.61	283.67	1.0367
50	0.08992	268.64	293.81	1.0789	0.07815	268.14	293.15	1.0665
60	0.09319	277.23	303.32	1.1079	0.08106	276.79	302.72	1.0957
70	0.09641	285.96	312.95	1.1364	0.08392	285.56	312.41	1.1243
80	0.09960	294.82	322.71	1.1644	0.08674	294.46	322.22	1.1525
90	0.10275	303.83	332.60	1.1920	0.08953	303.50	332.15	1.1802
100	0.10587	312.98	342.62	1.2193	0.09229	312.68	342.21	1.2076
110	0.10897	322.27	352.78	1.2461	0.09503	322.00	352.40	1.2345
120	0.11205	331.71	363.08	1.2727	0.09774	331.45	362.73	1.2611

$p = 4.0 \text{ bar} = 0.40 \text{ MPa}$ ($T_{\text{sat}} = 8.93^\circ\text{C}$)					$p = 5.0 \text{ bar} = 0.50 \text{ MPa}$ ($T_{\text{sat}} = 15.74^\circ\text{C}$)			
Sat.	0.05089	231.97	252.32	0.9145	0.04086	235.64	256.07	0.9117
10	0.05119	232.87	253.35	0.9182				
20	0.05397	241.37	262.96	0.9515	0.04188	239.40	260.34	0.9264
30	0.05662	249.89	272.54	0.9837	0.04416	248.20	270.28	0.9597
40	0.05917	258.47	282.14	1.0148	0.04633	256.99	280.16	0.9918
50	0.06164	267.13	291.79	1.0452	0.04842	265.83	290.04	1.0229
60	0.06405	275.89	301.51	1.0748	0.05043	274.73	299.95	1.0531
70	0.06641	284.75	311.32	1.1038	0.05240	283.72	309.92	1.0825
80	0.06873	293.73	321.23	1.1322	0.05432	292.80	319.96	1.1114
90	0.07102	302.84	331.25	1.1602	0.05620	302.00	330.10	1.1397
100	0.07327	312.07	341.38	1.1878	0.05805	311.31	340.33	1.1675
110	0.07550	321.44	351.64	1.2149	0.05988	320.74	350.68	1.1949
120	0.07771	330.94	362.03	1.2417	0.06168	330.30	361.14	1.2218
130	0.07991	340.58	372.54	1.2681	0.06347	339.98	371.72	1.2484
140	0.08208	350.35	383.18	1.2941	0.06524	349.79	382.42	1.2746

$p = 6.0 \text{ bar} = 0.60 \text{ MPa}$ ($T_{\text{sat}} = 21.58^\circ\text{C}$)					$p = 7.0 \text{ bar} = 0.70 \text{ MPa}$ ($T_{\text{sat}} = 26.72^\circ\text{C}$)			
Sat.	0.03408	238.74	259.19	0.9097	0.02918	241.42	261.85	0.9080
30	0.03581	246.41	267.89	0.9388	0.02979	244.51	265.37	0.9197
40	0.03774	255.45	278.09	0.9719	0.03157	253.83	275.93	0.9539
50	0.03958	264.48	288.23	1.0037	0.03324	263.08	286.35	0.9867
60	0.04134	273.54	298.35	1.0346	0.03482	272.31	296.69	1.0182
70	0.04304	282.66	308.48	1.0645	0.03634	281.57	307.01	1.0487
80	0.04469	291.86	318.67	1.0938	0.03781	290.88	317.35	1.0784
90	0.04631	301.14	328.93	1.1225	0.03924	300.27	327.74	1.1074
100	0.04790	310.53	339.27	1.1505	0.04064	309.74	338.19	1.1358
110	0.04946	320.03	349.70	1.1781	0.04201	319.31	348.71	1.1637
120	0.05099	329.64	360.24	1.2053	0.04335	328.98	359.33	1.1910
130	0.05251	339.38	370.88	1.2320	0.04468	338.76	370.04	1.2179
140	0.05402	349.23	381.64	1.2584	0.04599	348.66	380.86	1.2444
150	0.05550	359.21	392.52	1.2844	0.04729	358.68	391.79	1.2706
160	0.05698	369.32	403.51	1.3100	0.04857	368.82	402.82	1.2963

T °C	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg · K	v m ³ /kg	u kJ/kg	h kJ/kg	s kJ/kg · K
$p = 8.0 \text{ bar} = 0.80 \text{ MPa}$ ($T_{\text{sat}} = 31.33^\circ\text{C}$)					$p = 9.0 \text{ bar} = 0.90 \text{ MPa}$ ($T_{\text{sat}} = 35.53^\circ\text{C}$)			
Sat.	0.02547	243.78	264.15	0.9066	0.02255	245.88	266.18	0.9054
40	0.02691	252.13	273.66	0.9374	0.02325	250.32	271.25	0.9217
50	0.02846	261.62	284.39	0.9711	0.02472	260.09	282.34	0.9566
60	0.02992	271.04	294.98	1.0034	0.02609	269.72	293.21	0.9897
70	0.03131	280.45	305.50	1.0345	0.02738	279.30	303.94	1.0214
80	0.03264	289.89	316.00	1.0647	0.02861	288.87	314.62	1.0521
90	0.03393	299.37	326.52	1.0940	0.02980	298.46	325.28	1.0819
100	0.03519	308.93	337.08	1.1227	0.03095	308.11	335.96	1.1109
110	0.03642	318.57	347.71	1.1508	0.03207	317.82	346.68	1.1392
120	0.03762	328.31	358.40	1.1784	0.03316	327.62	357.47	1.1670
130	0.03881	338.14	369.19	1.2055	0.03423	337.52	368.33	1.1943
140	0.03997	348.09	380.07	1.2321	0.03529	347.51	379.27	1.2211
150	0.04113	358.15	391.05	1.2584	0.03633	357.61	390.31	1.2475
160	0.04227	368.32	402.14	1.2843	0.03736	367.82	401.44	1.2735
170	0.04340	378.61	413.33	1.3098	0.03838	378.14	412.68	1.2992
180	0.04452	389.02	424.63	1.3351	0.03939	388.57	424.02	1.3245
$p = 10.0 \text{ bar} = 1.00 \text{ MPa}$ ($T_{\text{sat}} = 39.39^\circ\text{C}$)					$p = 12.0 \text{ bar} = 1.20 \text{ MPa}$ ($T_{\text{sat}} = 46.32^\circ\text{C}$)			
Sat.	0.02020	247.77	267.97	0.9043	0.01663	251.03	270.99	0.9023
40	0.02029	248.39	268.68	0.9066				
50	0.02171	258.48	280.19	0.9428	0.01712	254.98	275.52	0.9164
60	0.02301	268.35	291.36	0.9768	0.01835	265.42	287.44	0.9527
70	0.02423	278.11	302.34	1.0093	0.01947	275.59	298.96	0.9868
80	0.02538	287.82	313.20	1.0406	0.02051	285.62	310.24	1.0192
90	0.02649	297.53	324.01	1.0707	0.02150	295.59	321.39	1.0503
100	0.02755	307.27	334.82	1.1000	0.02244	305.54	332.47	1.0804
110	0.02858	317.06	345.65	1.1286	0.02335	315.50	343.52	1.1096
120	0.02959	326.93	356.52	1.1567	0.02423	325.51	354.58	1.1381
130	0.03058	336.88	367.46	1.1841	0.02508	335.58	365.68	1.1660
140	0.03154	346.92	378.46	1.2111	0.02592	345.73	376.83	1.1933
150	0.03250	357.06	389.56	1.2376	0.02674	355.95	388.04	1.2201
160	0.03344	367.31	400.74	1.2638	0.02754	366.27	399.33	1.2465
170	0.03436	377.66	412.02	1.2895	0.02834	376.69	410.70	1.2724
180	0.03528	388.12	423.40	1.3149	0.02912	387.21	422.16	1.2980
$p = 14.0 \text{ bar} = 1.40 \text{ MPa}$ ($T_{\text{sat}} = 52.43^\circ\text{C}$)					$p = 16.0 \text{ bar} = 1.60 \text{ MPa}$ ($T_{\text{sat}} = 57.92^\circ\text{C}$)			
Sat.	0.01405	253.74	273.40	0.9003	0.01208	256.00	275.33	0.8982
60	0.01495	262.17	283.10	0.9297	0.01233	258.48	278.20	0.9069
70	0.01603	272.87	295.31	0.9658	0.01340	269.89	291.33	0.9457
80	0.01701	283.29	307.10	0.9997	0.01435	280.78	303.74	0.9813
90	0.01792	293.55	318.63	1.0319	0.01521	291.39	315.72	1.0148
100	0.01878	303.73	330.02	1.0628	0.01601	301.84	327.46	1.0467
110	0.01960	313.88	341.32	1.0927	0.01677	312.20	339.04	1.0773
120	0.02039	324.05	352.59	1.1218	0.01750	322.53	350.53	1.1069
130	0.02115	334.25	363.86	1.1501	0.01820	332.87	361.99	1.1357
140	0.02189	344.50	375.15	1.1777	0.01887	343.24	373.44	1.1638
150	0.02262	354.82	386.49	1.2048	0.01953	353.66	384.91	1.1912
160	0.02333	365.22	397.89	1.2315	0.02017	364.15	396.43	1.2181
170	0.02403	375.71	409.36	1.2576	0.02080	374.71	407.99	1.2445
180	0.02472	386.29	420.90	1.2834	0.02142	385.35	419.62	1.2704
190	0.02541	396.96	432.53	1.3088	0.02203	396.08	431.33	1.2960
200	0.02608	407.73	444.24	1.3338	0.02263	406.90	443.11	1.3212

