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ภาคผนวก ก.

ตารางแสดงผลการทดลอง

ตาราง ก.1 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง

สารทำความเย็น :CFC−12

อุณหภูมิการกลั่นตัว :33 C

NO.	Qw	Pressure (KPa)					T EMPERATURE (C)				COOLING WATER (C)		FLOW RATE (Kg/s)	
	(WATT)	P1	P2	P3	P4	P5	T1	T2	T3	T4	Twi	Two	WATER	REFRIG
		DEL.	LIQ.	EXP.	SUCT.	CAL.	DEL.	LIQ.	EXP.	SUCT.	IN	OUT		E−03
1	815	810	803	225	220	250	61.1	32.5	−8.8	−10.0	30.6	32.6	0.140	7.46
2	850	810	803	225	220	260	66.1	32.6	−8.8	−1.1	30.8	32.7	0.141	7.46
3	900	810	803	225	220	330	73.0	32.4	−8.8	8.1	30.7	32.6	0.144	7.33
4	950	810	803	225	220	520	78.9	32.3	−8.8	20.0	30.6	32.7	0.136	7.18
5	1000	810	803	227	223	690	83.8	32.6	−8.8	27.2	30.6	32.8	0.140	7.23
6	1030	810	803	227	223	760	85.5	32.5	−8.8	30.8	30.5	32.7	0.136	7.23

NO.	ENTHAIPY (Kj/Kg)				SPECIFIC HEAT(Kj/Kg)				POWER (WATT)			AVE TEMP (C)		HEAT
	H2 = H3	H4	H1	H1 '	EVAP	COMP	ISEN	COND	EVAP	COMP	COND	AMB	CALORI	GAIN
				S1 = S4	H4−H2	H1−H4	H1'−H4	H1−H2						(WATT)
1	231.6	347.2	385.2	371.6	115.6	38.6	24.4	153.6	864.1	284	1148.1	33.6	−6	49.1
2	231.8	352.6	388.8	376.5	120.8	36.2	23.9	157.0	902.9	270.6	1173.5	33.5	−5	52.9
3	231.4	358.4	393.9	383.6	127.0	35.5	25.2	162.5	933.3	260.9	1194.1	33.5	2.2	33.3
4	231.2	365.9	398.1	391.7	134.7	32.2	25.8	166.9	969.4	231.7	1201.2	33.6	17.5	19.4
5	231.8	370.6	401.7	397.4	138.8	31.1	26.8	169.9	1005.9	225.4	1231.3	33.1	27.6	5.9
6	231.5	373.6	402.9	399.6	142.1	29.3	26.0	171.4	1029.9	212.4	1242.2	32.5	31.1	0

ตาราง ก.1 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่องทำความเย็น

สารทำความเย็น ;CFC – 12

อุณหภูมิการกลั่นตัว ;33 C

NO.	Va (L/s)	VOL EFF (Va/Vd)	ISEN EFF	U (WATT/ c)	UA (WATT/ c)	n POLYT COMP	COP (OVERALL)	COP (ACTUAL)	COP (ISEN COMP)	WEIGHT (Kg)	Wmotor (WATT)
1	0.565	62.1	64.0	1.24	0.02295	1.184	2.01	3.04	4.74	0.970	430.2
2	0.596	65.5	66.0	1.38	0.02595	1.169	2.11	3.34	5.05	0.965	428.0
3	0.605	66.5	71.0	1.07	0.02470	1.159	2.19	3.58	5.04	0.960	425.8
4	0.623	68.5	81.0	1.21	0.02449	1.141	2.29	4.18	5.22	0.955	423.5
5	0.647	71.1	86.2	1.08	0.02442	1.134	2.39	4.46	5.18	0.950	421.3
6	0.656	72.1	88.7	0	0.02423	1.128	2.44	4.85	5.47	0.950	421.3

ตาราง ก.2 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง

สารทำความเย็น :CFC – 12

อุณหภูมิการกลั่นตัว :35 C

NO.	Qw	Pressure (KPa)					T EMPERATURE (C)				COOLING WATER (C)		FLOW RATE (Kg/s)	
	(WATT)	P1	P2	P3	P4	P5	T1	T2	T3	T4	Twi	Two	WATER	REFRIG
		DEL.	LIQ.	EXP.	SUCT.	CAL	DEL.	LIQ.	EXP.	SUCT.	IN	OUT		E--03
1	815	859	845	230	224	250	62.8	34.2	–8.0	–9.4	32.2	34.6	0.120	7.51
2	850	859	845	230	224	260	67.5	34.1	–8.0	–1.7	31.9	34.6	0.106	7.51
3	900	859	845	231	227	320	73.8	34.6	–7.8	8.6	32.0	34.6	0.111	7.48
4	950	859	845	231	227	520	80.0	34.4	–7.8	19.2	32.0	34.6	0.110	7.31
5	1000	859	845	231	227	680	84.6	34.2	–7.8	26.6	32.1	34.6	0.120	7.31
6	1030	859	845	231	227	750	86.2	34.5	–7.8	30.0	32.2	34.6	0.130	7.35

NO.	ENTHAIPY (Kj/Kg)				SPECIFIC HEAT(Kj/Kg)				POWER (WATT)			AVE TEMP (C)		HEAT
	H2 = H3	H4	H1	H1 '	EVAP	COMP	ISEN	COND	EVAP	COMP	COND	AMB	CALORI	GAIN
				S1 = S4	H4–H2	H1–H4	H1'–H4	H1–H2						(WATT)
1	232.6	347.6	386.1	373.2	115.0	38.8	24.0	153.5	865.4	289.7	1,155.1	33.3	–5.0	50.4
2	232.9	352.6	389.6	377.1	119.7	37.0	24.5	156.7	900.8	278.4	1,179.2	32.9	–5.0	50.8
3	232.5	358.6	394.0	384.0	126.1	35.4	25.4	161.5	945.8	265.5	1,211.3	33.0	1.5	45.8
4	232.9	365.3	398.4	392.2	132.4	33.1	26.9	165.5	969.6	242.4	1,212.0	33.3	17.0	19.6
5	232.7	370.1	401.8	397.7	137.4	31.7	27.6	169.1	1006.2	232.1	1,238.4	33.0	27.2	6.2
6	232.8	372.2	402.9	400.0	139.4	30.7	27.8	170.1	1026.1	226.0	1,252.1	32.2	30.5	–3.9

ตาราง ก.2 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง

สารทำความเย็น :CFC−12

อุณหภูมิการกลั่นตัว :35 C

NO.	Va (L/s)	VOL EFF (Va/Vd)	ISEN EFF	U (WATT/ c)	UA (WATT/ c)	n POLYT COMP	COP			WEIGHT (Kg)	Wmotor (WATT)
							COP (OVERALL)	COP (ACTUAL)	COP (ISEN COMP)		
1	0.559	66.4	64.0	1.190	0.02255	1.180	1.98	2.99	4.49	0.985	437
2	0.584	64.2	66.2	1.340	0.02275	1.169	2.07	3.24	4.89	0.980	435
3	0.602	66.2	71.8	1.450	0.02361	1.157	2.19	3.56	4.96	0.975	432
4	0.615	67.6	81.3	1.200	0.02321	1.142	2.25	4.00	4.92	0.970	430
5	0.635	69.8	87.1	0.010	0.02326	1.133	2.36	4.33	4.98	0.960	426
6	0.646	71.0	90.6	−2.160	0.02318	1.129	2.41	4.54	5.01	0.960	426

ตาราง ก.3 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง

สารทำความเย็น ;HFC – 134a

อุณหภูมิการกลั่นตัว :33 C

NO.	Qw	Pressure (KPa)					T EMPERATURE (C)				COOLING WATER (C)		FLOW RATE (Kg/s)	
	(WATT)	P1	P2	P3	P4	P5	T1	T2	T3	T4	Twi	Two	WATER	REFRIG
		DEL.	LIQ	EXP	SUCT.	CAL.	DEL.	LIQ.	EXP.	SUCT.	IN	OUT		E – 03
1	930	841	831	228	230	270	56.9	32.4	– 6.6	– 5.5	29.8	32.1	0.130	6.55
2	950	841	831	228	230	280	61.6	32.6	– 6.6	1.1	30.0	32.1	0.146	6.55
3	1000	841	831	230	230	320	63.8	32.8	– 6.3	5.6	30.2	32.0	0.173	6.49
4	1050	841	831	230	230	400	67.7	32.6	– 6.3	13.3	29.8	32.0	0.150	6.49
5	1100	841	831	230	230	520	71.1	32.6	– 6.3	19.3	30.0	31.9	0.171	6.49
6	1150	841	831	230	230	740	78.3	32.6	– 6.3	29.4	29.8	31.8	0.174	6.45

NO.	ENTHAIPY (Kj/Kg)				SPECIFIC HEAT(Kg/Kj)				POWER (WATT)			AVE TEMP (C)		HEAT
	H2 = H3	H4	H1	H1 '	EVAP	COMP	ISEN	COND	EVAP	COMP	COND	AMB.	CALORI	GAIN
				S1 = S4	H4 – H2	H1 – H4	H1 ' – H4	H1 – H2						(WATT)
1	145.2	295.0	341.0	323.3	149.8	46.0	28.3	195.8	983.5	302.0	1285.6	31.1	– 3.0	53.5
2	145.5	300.8	345.0	329.6	155.3	44.2	28.8	199.5	1019.6	390.2	1309.8	32.7	– 2.1	69.6
3	145.8	304.9	348.0	333.8	159.1	43.1	28.9	202.2	1034.6	280.3	1314.8	31.6	– 3.5	34.6
4	145.5	311.6	351.9	342.0	166.1	40.3	30.4	206.4	1080.1	262.1	1342.1	33.3	8.3	30.1
5	145.7	317.0	355.2	348.0	171.3	38.2	31.0	209.5	1113.9	248.4	1362.3	32.7	17.5	13.9
6	145.8	325.7	362.6	358.3	179.9	36.9	32.6	216.8	1156.2	237.1	1393.3	32.7	29.7	6.2

ตาราง ก.3 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง

สารทำความเย็น ;HFC−134a

อุณหภูมิการกลั่นตัว :33 C

NO.	Va (L/s)	VOL EFF (Va/Vd)	ISEN EFF	U (WATT/ c)	UA (WATT/ c)	n POLYT COMP	COP			WEIGHT (Kg)	Wmotor (WATT)
							COP (OVERALL)	COP ACTUAL)	COP (ISEN COMP)		
1	0.578	63.5	61.5	1.570	0.02384	1.158	2.17	3.26	5.29	1.020	452
2	0.596	65.5	65.2	1.980	0.02382	1.151	2.25	3.51	5.39	1.020	452
3	0.602	66.2	67.1	1.160	0.02370	1.143	2.31	3.69	5.51	1.010	448
4	0.620	68.6	75.4	1.200	0.02359	1.134	2.34	4.12	5.46	1.010	448
5	0.638	69.4	81.2	0.900	0.02378	1.124	2.50	4.48	5.53	1.005	446
6	0.659	72.3	88.3	1.980	0.02335	1.115	2.61	4.88	5.52	1.000	444

ตาราง ก.4 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง

สารทำความเย็น :HFC – 134a

อุณหภูมิการกลั่นตัว :35 C

NO.	Qw	Pressure (KPa)					T EMPERATURE (C)				COOLING WATER (C)		FLOW RATE (Kg/s)	
	(WATT)	P1	P2	P3	P4	P5	T1	T2	T3	T4	Twi	Two	WATER	REFRIG
		DEL.	LIQ.	EXP.	SUCT.	CAL.	DEL.	LIQ.	EXP.	SUCT.	IN	OUT		E – 03
1	930	897	883	234	232	270	57.8	34.1	– 6.1	– 6.1	30.5	34.4	0.080	6.65
2	950	897	883	234	232	280	62.8	34	– 6.1	0.5	30.6	34.3	0.082	6.55
3	1000	897	883	234	232	340	65.2	34.1	– 6.1	4.4	30.6	34.5	0.082	6.55
4	1050	897	883	236	232	380	69.4	34	– 5.8	13.6	30.7	34.2	0.094	6.53
5	1100	897	883	238	234	510	71.9	34	– 5.8	18.8	30.8	34.0	0.100	6.55
6	1150	897	883	238	234	620	79.1	34.1	– 5.8	28.3	30.8	33.9	0.108	6.5

NO.	ENTHAIPY (Kj/Kg)				SPECIFIC HEAT(Kj/Kg)				POWER (WATT)			AVE TEMP (C)		HEAT
	H2 = H3	H4	H1	H1 '	EVAP	COMP	ISEN	COND	EVAP	COMP	COND	AMB	CALORI	GAIN
				S1 = S4	H4 – H2	H1 – H4	H1 ' – H4	H1 – H2						(WATT)
1	147.5	294.4	340.0	323.7	146.9	45.6	29.3	192.5	979.3	304.0	1,283.3	31.6	– 3.0	49.3
2	147.4	300.3	345.9	329.8	152.9	45.6	29.5	198.5	1,003.9	299.4	1,303.3	32.7	– 2.2	63.9
3	147.4	303.7	348.5	333.7	156.3	44.8	30.0	201.1	1,026.2	294.1	1,320.4	32.2	3.0	26.2
4	147.7	311.7	352.6	344.0	164.0	40.9	32.3	204.9	1,072.6	267.5	1,340.1	32.7	7.0	22.6
5	147.5	316.3	358.3	348.2	168.8	39.0	32.9	207.8	1,108.3	256.1	1,364.3	33.3	9.5	8.3
6	147.6	324.6	362.5	357.5	177.0	37.9	32.9	214.9	1,153.2	246.9	1,400.1	33.3	29.1	3.2

ตาราง ก.4 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง

สารทำความเย็น :HFC – 134a

อุณหภูมิการกลั่นตัว :35 C

NO.	Va (L/s)	VOL EFF (Va/Vd)	ISEN EFF	U (WATT/ c)	UA (WATT/ c)	n POLYT COMP	COP			WEIGHT (Kg)	Wmotor (WATT)
							COP (OVERALL)	COP (ACTUAL)	COP (ISEN COMP)		
1	0.582	64	64.3	1.42	0.02194	1.159	2.13	3.22	5.01	1.035	459
2	0.587	64.5	64.7	1.51	0.02342	1.152	2.2	3.35	5.18	1.03	456.8
3	0.594	65.3	67	0.9	0.02257	1.147	2.27	3.49	5.21	1.02	452.4
4	0.622	68.4	79	0.88	0.02260	1.132	2.37	4.01	5.28	1.02	452.4
5	0.639	70.2	81.8	0.36	0.02297	1.124	2.46	4.33	5.29	1.015	450.2
6	0.659	72.4	86.8	0.76	0.02284	1.116	2.57	4.67	5.38	1.01	447.9

ตาราง ก.5 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง เมื่อลดตัวปรับความดัน 1/4 รอบ

สารทำความเย็น ;HFC−134a

อุณหภูมิการกลั่นตัว :33 C (DECEASE 90 DEGREE)

NO.	Qw	Pressure (KPa)					T EMPERATURE (C)				COOLING WATER (C)		FLOW RATE (Kg/s)	
	(WATT)	P1 DEL.	P2 LIQ.	P3 EXP.	P4 SUCT.	P5 CAL.	T1 DEL.	T2 LIQ.	T3 EXP.	T4 SUCT.	Twi IN	Two OUT	WATER	REFRIG E−03
1	850	841	831	217	214	260	58.8	32.1	−8.1	−5.5	29.8	32.4	0.11	5.97
2	900	841	831	217	214	310	63.8	32.2	−8.1	3.8	29.7	32.4	0.11	5.97
3	950	841	831	221	214	370	67.7	31.7	−8.1	12.2	30	32.3	0.123	5.88
4	1000	841	831	221	214	520	71.6	32.1	−8.1	18.8	30.3	32.3	0.15	5.87
5	1050	841	831	221	218	690	76.6	32.3	−8.1	27.2	29.2	32.4	0.098	5.87
6	1070	841	831	221	218	780	80	32.3	−8.1	32.7	29.2	32.5	0.095	5.79

NO.	ENTHAIPY (Kj/Kg)				SPECIFIC HEAT(Kj/Kg)				POWER (WATT)			AVE TEMP (C)		HEAT
	H2 = H3	H4	H1	H1 ' S1 = S4	EVAP H4−H2	COMP H1−H4	ISEN H1'−H4	COND H1−H2	EVAP	COMP	COND	AMB	CALORI	GAIN (WATT)
1	144.7	296	342.8	325.1	151.3	46.8	29.1	198.1	905.5	280.1	1185.6	31.1	−4.5	55.5
2	145.1	303.6	347.9	334.1	158.5	44.3	30.5	202.8	948.6	265.1	1213.7	31.1	0.1	48.6
3	145.1	310.9	352	341.6	165.8	41.1	30.7	206.9	977.6	242.3	12220	31.1	6.1	27.6
4	144.7	316.8	355.9	349	172.1	39.1	32.2	211.2	1012.6	230.1	1242.7	31.6	17.5	12.6
5	145.1	323.9	361	357.6	178.8	37.1	33.7	215.9	1052	218.3	1270.3	31.1	27.6	2
6	145.1	329.1	364.4	363.3	184	35.5	34.2	219.3	1068.7	205	1273.7	31.1	31.8	1.3

ตาราง ก.5 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง เมื่อลดตัวปรับความดัน 1/4 รอบ

สารทำความเย็น :HFC – 134a

อุณหภูมิการกลั่นตัว :33 C (DECEASE 90 DEGREE)

NO.	Va (L/s)	VOL EFF (Va/Vd)	ISEN EFF	U (WATT/ c)	UA (WATT/ c)	n POLYT COMP	COP			WEIGHT (Kg)	W motor (watt)
							COP (OVERALL)	COP (ACTUAL)	COP (ISEN COMP)		
1	0.56	61.5	62.2	1.557	0.0237	1.158	2.06	3.23	5.2	0.99	439.1
2	0.589	64.7	68.8	1.566	0.02347	1.143	2.16	3.58	5.2	0.99	439.1
3	0.598	65.7	74.7	1.1	0.02394	1.13	2.25	4.03	5.4	0.98	434.6
4	0.613	67.4	82.4	0.89	0.02428	1.121	2.34	4.4	5.34	0.975	432.4
5	0.635	69.8	90.8	0.59	0.02317	1.111	2.45	4.82	5.31	0.97	430.2
6	0.639	70.2	96.9	1.67	0.02353	1.105	2.48	5.21	5.38	0.97	430.2

ตาราง ก.6 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง เมื่อลดตัวปรับความดัน 1/4 รอบ

สารทำความเย็น :HFC−134a

อุณหภูมิการกลั่นตัว :35 C (DECEASE 90 DEGREE)

NO.	Qw	Pressure (KPa)					T EMPERATURE (C)				COOLING WATER (C)		FLOW RATE (Kg/s)	
	(WATT)	P1 DEL.	P2 LIQ.	P3 EXP.	P4 SUCT.	P5 CAL.	T1 DEL.	T2 LIQ.	T3 EXP.	T4 SUCT.	Twi IN	Two OUT	WATER	REFRIG E−03
1	850	896	883	223	220	270	60	33.6	−7.7	−5	29.7	34.4	0.061	6.02
2	900	896	883	223	220	230	64.7	33.5	−7.7	4.4	29.6	34.6	0.059	6.02
3	950	896	883	224	220	380	69.4	33.6	−7.7	12.2	30.2	34.6	0.066	5.96
4	1000	896	883	224	220	480	71.6	33.4	−7.7	17.7	30.3	34.4	0.078	5.96
5	1050	896	883	224	220	700	77.7	33.4	−7.7	27.2	29.2	34.6	0.059	5.92
6	1070	896	883	226	220	780	81.1	33.4	−7.7	32.2	29.2	34.7	0.057	5.87

NO.	ENTHAIPY (KJ/Kg)				SPECIFIC HEAT(Kj/Kg)				POWER (WATT)			AVE TEMP (C)		HEAT
	H2 = H3	H4	H1	H1 ' S1 = S4	EVAP H4−H2	COMP H1−H4	ISEN H1'−H4	COND H1−H2	EVAP	COMP	COND	AMB	CALORI	GAIN (WATT)
1	147	296	342.9	324.9	149	46.9	28.9	195.9	889.3	283.1	1182.3	31.6	−3.8	49.3
2	146.9	304	347.9	335.3	157.1	43.9	31.3	201	948.2	265	1213.1	31.6	1.1	48.2
3	147	310.8	352.6	343	163.8	41.8	32.2	205.6	978.3	249.6	1227.9	32.2	8.1	28.3
4	146.6	315.6	354.9	348.8	169	39.3	33.2	208.3	1009.3	234.7	1244	32.2	14.5	9.3
5	146.6	323.8	361.3	358.7	177.2	37.5	34.9	214.7	1051.6	222.5	1274.1	31.1	27.8	1.6
6	146.6	328.3	364.6	363.5	181.7	36.3	35.2	218	1069.1	213.6	1282.7	31.1	32.7	0.9

ตาราง ก.6 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง เมื่อลดตัวปรับความดัน 1/4 รอบ

สารทำความเย็น :HFC – 134a

อุณหภูมิการกลั่นตัว :35 C (DECEASE 90 DEGREE)

NO.	Va (L/s)	VOL EFF (Va/Vd)	ISEN EFF	U (WATT/ c)	UA (WATT/ c)	n POLYT COMP	COP			WEIGHT (Kg)	W motor (watt)
							COP (OVERALL)	COP (ACTUAL)	COP (ISEN COMP)		
1	0.557	61.2	61.6	1.38	0.02034	1.155	2.01	3.18	5.16	1.01	447.9
2	0.582	64	71.3	1.57	0.02181	1.14	2.13	3.58	5.02	1.005	445.7
3	0.597	65.6	77	1.17	0.02304	1.13	2.21	3.92	5.09	1.00	443.5
4	0.611	67.1	84.5	0.52	0.02117	1.121	2.29	4.3	5.09	0.995	441.3
5	0.631	69.3	93.1	0.49	0.02145	1.111	2.36	4.73	5.08	0.995	441.3
6	0.638	70.1	97	0.54	0.02222	1.106	2.43	5.01	5.16	0.99	439.1

ตาราง ก.7 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง เมื่อลดตัวปรับความดัน 1/2 รอบ

สารทำความเย็น :HFC−134a

อุณหภูมิการกลั่นตัว :33 C (DECEASE 180 DEGREE)

NO.	Qw	Pressure (KPa)					T EMPERATURE (C)				COOLING WATER (C)		FLOW RATE (Kg/s)	
	(WATT)	P1	P2	P3	P4	P5	T1	T2	T3	T4	Twi	Two	WATER	REFRIG
		DEL.	LIQ.	EXP.	SUCT.	CAL.	DEL.	LIQ.	EXP	SUCT.	IN	OUT		E−03
1	780	841	831	207	204	255	59.4	32	−9.16	−7.7	29.3	32.6	0.082	5.59
2	800	841	831	207	204	250	63.3	32	−9.16	−4.4	28.4	32.9	0.064	5.59
3	850	841	831	208	205	250	67.2	31.9	−9.4	3.8	28.4	32.8	0.065	5.56
4	900	841	831	208	206	360	69.4	32.3	−9.4	11.1	29.2	32.7	0.086	5.56
5	950	841	831	208	206	540	73.3	32.3	−9.4	20.5	29.2	32.7	0.088	5.54
6	1000	841	831	208	206	640	78.8	31.9	−9.4	28.6	28.8	32.7	0.076	5.54

NO.	ENTHAIPY (KJ/Kg)				SPECIFIC HEAT(KJ/Kg)				POWER (WATT)			AVE TEMP (C)		HEAT
	H2 = H3	H4	H1	H1 '	EVAP	COMP	ISEN	COND	EVAP	COMP	COND	AMB	CALORI	GAIN
				S1 = S4	H4−H2	H1−H4	H1'−H4	H1−H2						(WATT)
1	144.6	294	343.4	323.4	149.4	49.4	29.4	198.8	835.7	276.3	1112	31.1	−6	55.7
2	144.6	296.9	347.4	327.4	152.3	50.5	30.5	202.8	851.9	282.5	1134.3	30.2	−5.7	51.9
3	144.6	303.8	351.4	335	159.2	47.6	31.2	206.8	884.4	264.4	1148.9	31.1	−5.2	34.4
4	144.8	310.1	353.6	342.5	165.3	43.5	32.4	208.8	918.3	241.7	1160	31.1	4.8	18.3
5	144.6	318.3	357.6	352.3	173.5	39.3	34	212.8	961.7	217.8	1179.5	31.5	18.7	11.7
6	144.6	325.4	363.1	360.3	180.8	37.7	34.9	218.5	999.9	208.5	1208.4	31.2	29.2	−0.1

ตาราง ก.7 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง เมื่อลดตัวปรับความดัน 1/2 รอบ

สารทำความเย็น :HFC – 134a

อุณหภูมิการกลั่นตัว ;33 C (DECEASE 180 DEGREE)

NO.	Va (L/s)	VOL EFF (Va/Vd)	ISEN EFF	U (WATT/ c)	UA (WATT/ c)	n POLYT COMP	COP			WEIGHT (Kg)	W motor (watt)
							COP (OVERALL)	COP (ACTUAL)	COP (ISEN COMP)		
1	0.55	60.4	59.5	1.5	0.02282	1.16	1.94	3.02	5.08	0.97	430.2
2	0.559	61.4	60.4	1.451	0.02261	1.159	1.99	3.02	4.99	0.965	428
3	0.582	64	65.5	0.977	0.02247	1.146	2.08	3.34	5.1	0.96	425.8
4	0.600	65.9	74.5	0.68	0.02221	1.132	2.17	3.8	5.1	0.955	423.5
5	0.621	68.2	86.5	0.914	0.02239	1.118	2.27	4.41	5.1	0.955	423.5
6	0.641	70.4	92.6	0	0.02832	1.11	2.37	4.8	5.18	0.95	421.3

ตาราง ก.8 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง เมื่อลดตัวปรับความดัน 1/2 รอบ

สารทำความเย็น ;HFC−134a

อุณหภูมิการกลั่นตัว ;35 C (DECEASE 180 DEGREE)

NO.	Ow	Pressure (KPa)					T EMPERATURE (C)				COOLING WATER (C)		FLOW RATE (Kg/s)	
	(WATT)	P1	P2	P3	P4	P5	T1	T2	T3	T4	Twi	Two	WATER	REFRIG
		DEL.	LIQ.	EXP.	SUCT.	CAL.	DEL.	LIQ.	EXP.	SUCT.	IN	OUT		E−03
1	780	897	883	212	207	250	60.5	33.6	−8.1	−8.8	29.4	34.8	0.05	5.67
2	800	897	883	212	207	250	64.1	33.5	−8.1	−4.4	28.6	34.9	0.044	5.67
3	850	897	883	212	207	270	68.3	33.5	−8.1	3.6	28.5	35.1	0.044	5.64
4	900	897	883	212	209	370	70.8	33.5	−8.1	11.6	29.1	35.1	0.048	5.64
5	950	897	883	212	209	550	74.4	33.5	−8.1	21.1	29.1	35	0.05	5.61
6	1000	897	883	212	209	760	80.5	33.6	−8.1	29.4	29	35.1	0.05	5.59

NO	ENTHAIPY (Kj/Kg)				SPECIFIC HEAT(Kj/Kg)				POWER (WATT)			AVE TEMP (C)		HEAT
	H2 = H3	H4	H1	H1 '	EVAP	COMP	ISEN	COND	EVAP	COMP	COND	AMB	CALORI	GAIN
				S1 = S4	H4−H2	H1−H4	H1'−H4	H1−H2						(WATT)
1	146.9	292.8	343.5	324	145.9	50.7	31.2	196.6	827.1	287.4	1114.6	31.5	−5.2	47.1
2	146.9	296.8	347.1	328.4	149.9	50.3	31.6	200.2	849.8	285.2	1135	31.1	−5.2	49.8
3	146.9	303.7	351.6	336.9	156.8	47.9	33.2	204.7	885	270.3	1155.3	30.5	−3.5	35
4	146.9	310.8	354.1	344.9	163.9	43.3	34.1	207.2	925	244.4	1169.4	31.1	6	25
5	146.9	318.8	357.8	354.5	171.9	39	35.7	210.9	963.7	218.6	1182.3	31.1	19.2	13.7
6	147	326.1	364.1	362.9	179.1	38	36.8	217.1	1,001.8	212.6	1214.3	31.1	31.1	1.8

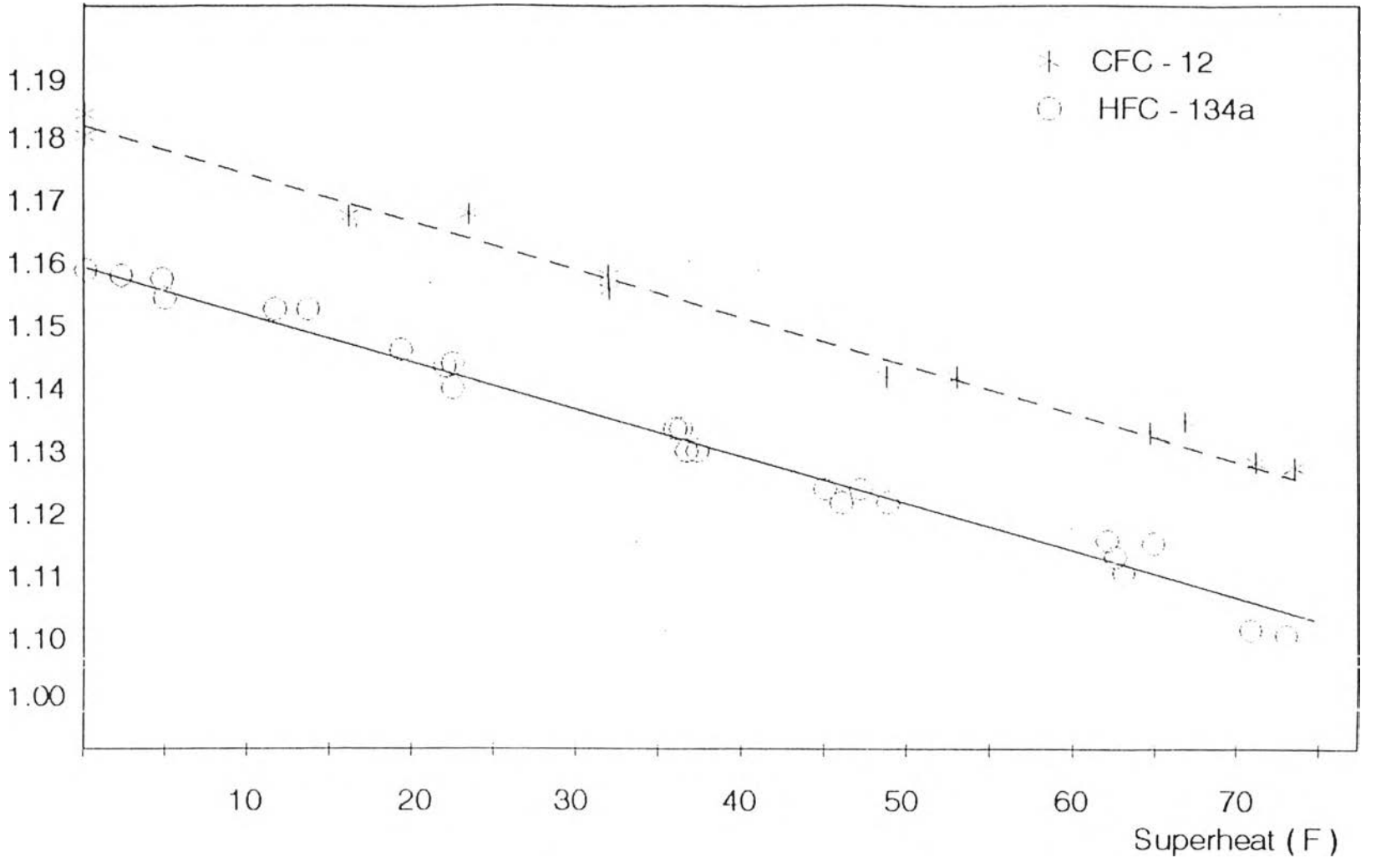
ตาราง ก.8 แสดงผลการทดลองและค่าจากการคำนวณของการทดสอบเครื่อง เมื่อลดตัวปรับความดัน 1/2 รอบ

สารทำความเย็น ;HFC – 134a

อุณหภูมิการกลั่นตัว ;35 C (DECEASE 180 DEGREE)

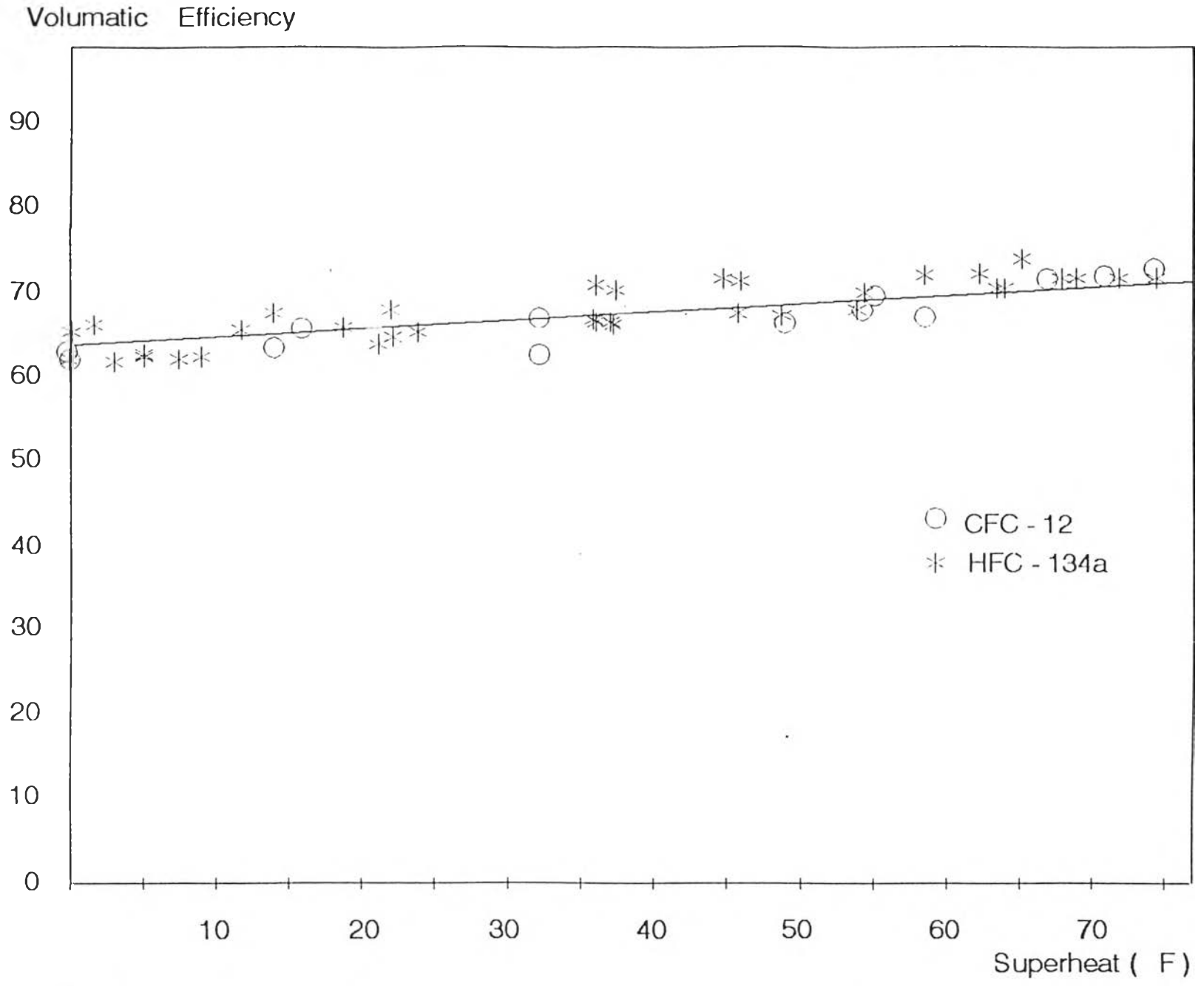
NO.	Va (L/s)	VOL EFF (Va/Vd)	ISEN EFF	U (WATT/ c)	UA (WATT/ c)	n POLYT COMP	COP			WEIGHT (Kg)	W motor (watt)
							COP (OVERALL)	COP (ACTUAL)	COP (ISEN COMP.)		
1	0.549	60.3	61.5	1.27	0.0263	1.164	1.9	2.88	4.68	0.98	434.6
2	0.556	61.1	62.8	1.37	0.02479	1.16	1.96	2.98	4.74	0.98	434.6
3	0.578	63.5	69.3	1.03	0.02156	1.144	2.05	3.27	4.72	0.975	432.4
4	0.599	65.8	78.8	0.99	0.02218	1.13	2.14	3.79	4.81	0.975	432.4
5	0.623	68.5	91.5	1.14	0.02209	1.114	2.24	4.41	4.82	0.97	430.2
6	0.64	70.4	96.8	0	0.02206	1.107	2.35	4.71	4.87	0.96	425.8

n (Polytropic exponent)



po17

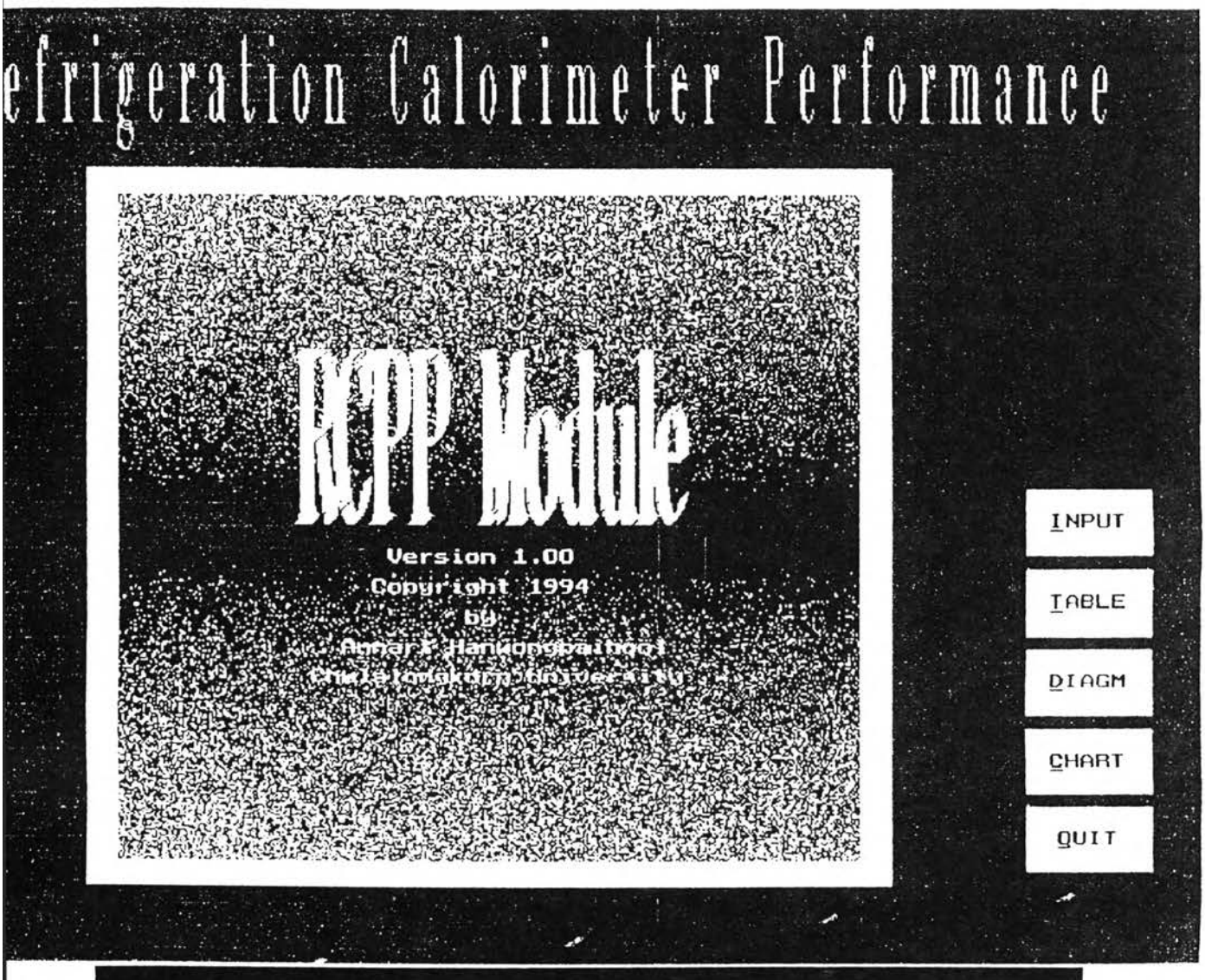
กราฟที่ ก 1 แสดงค่าโพลิโทรปิค เอกซ์โพเนนท์ของการอัดกับปริมาณอุณหภูมิองศาไอร้อนขวดยิ่ง



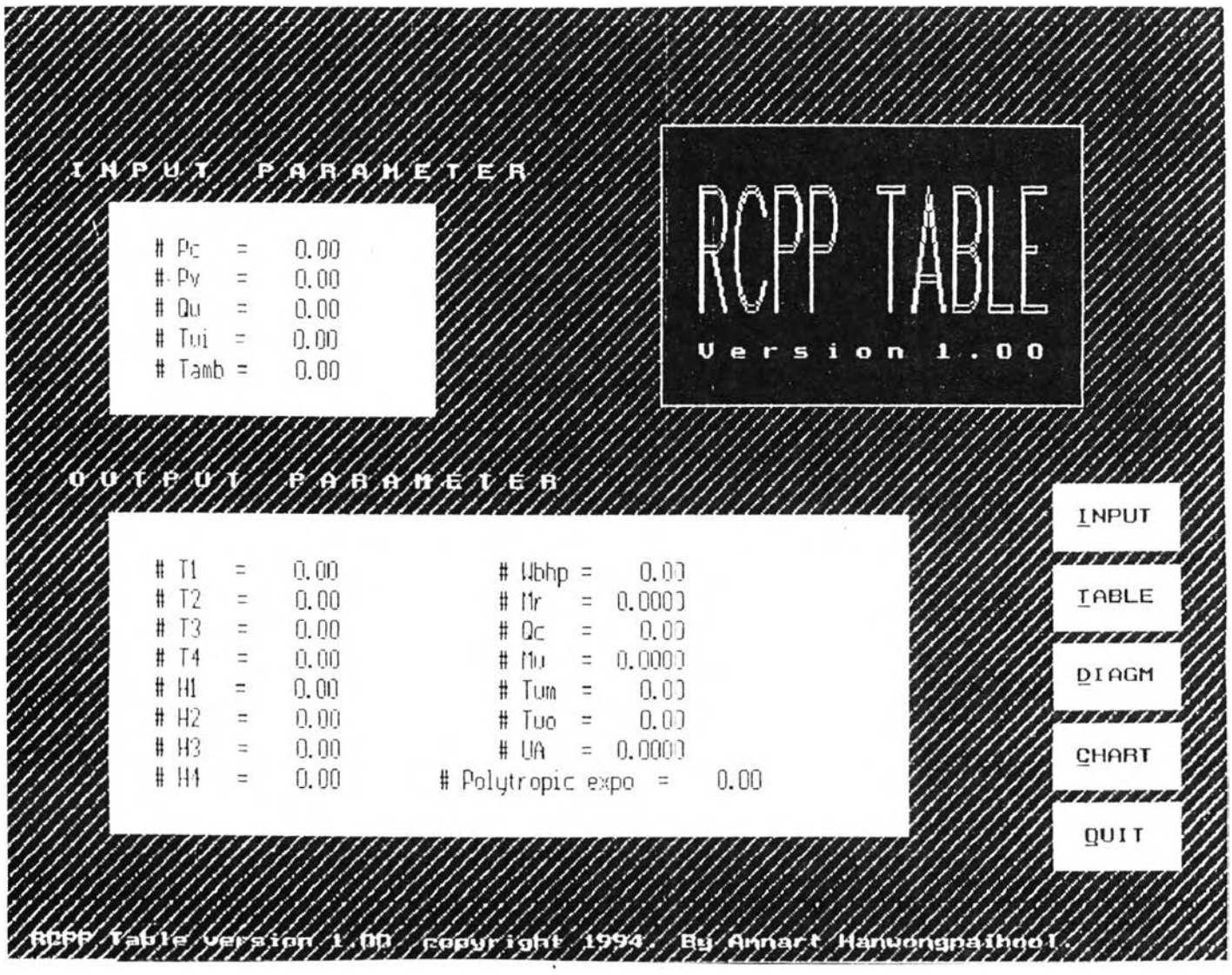
กราฟที่ ก 2 แสดงค่าประสิทธิภาพเชิงปริมาตรของคอมเพรสเซอร์กับปริมาณองศาไอร้อนยวดยิ่ง

ภาคผนวก ข

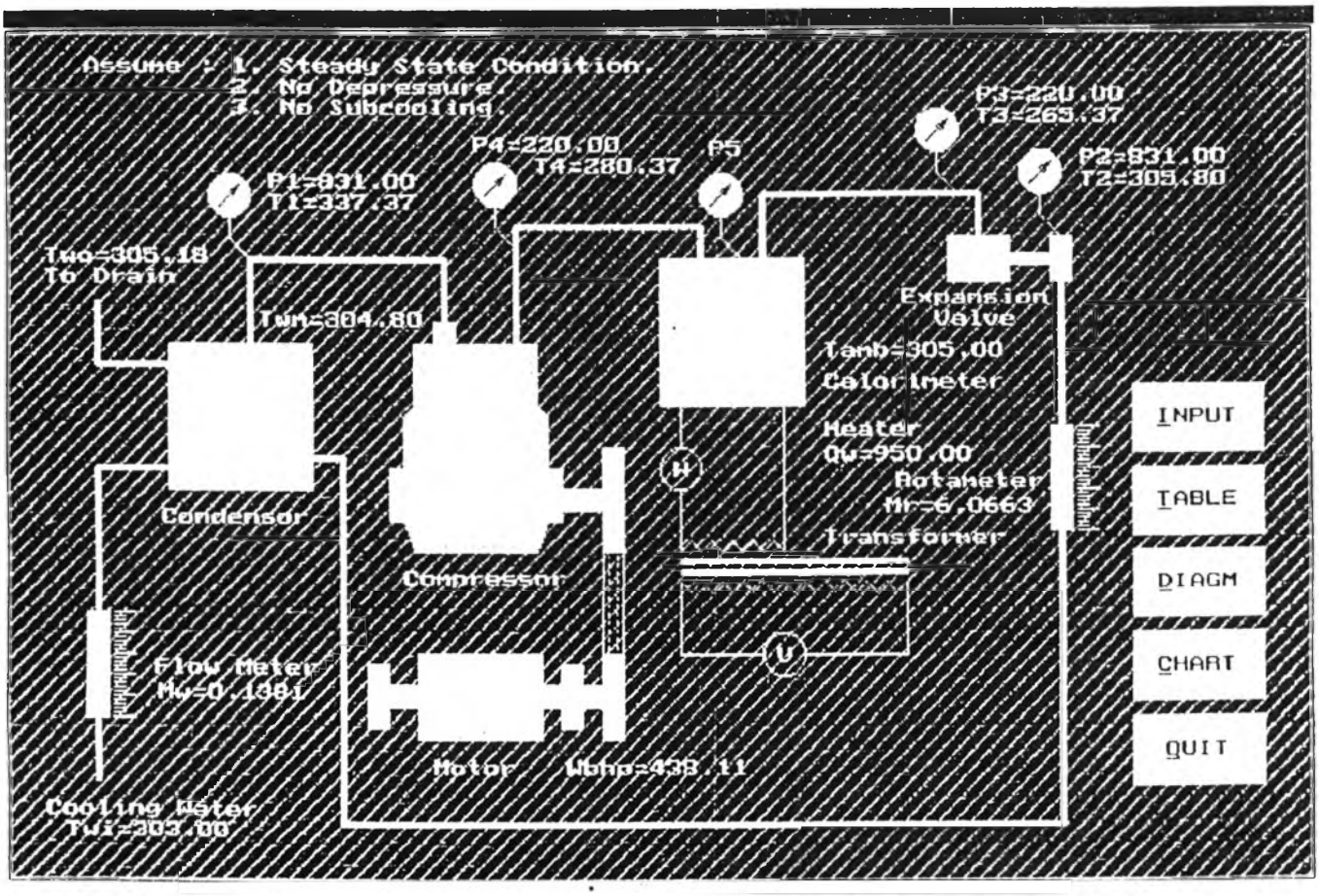
โปรแกรมคอมพิวเตอร์

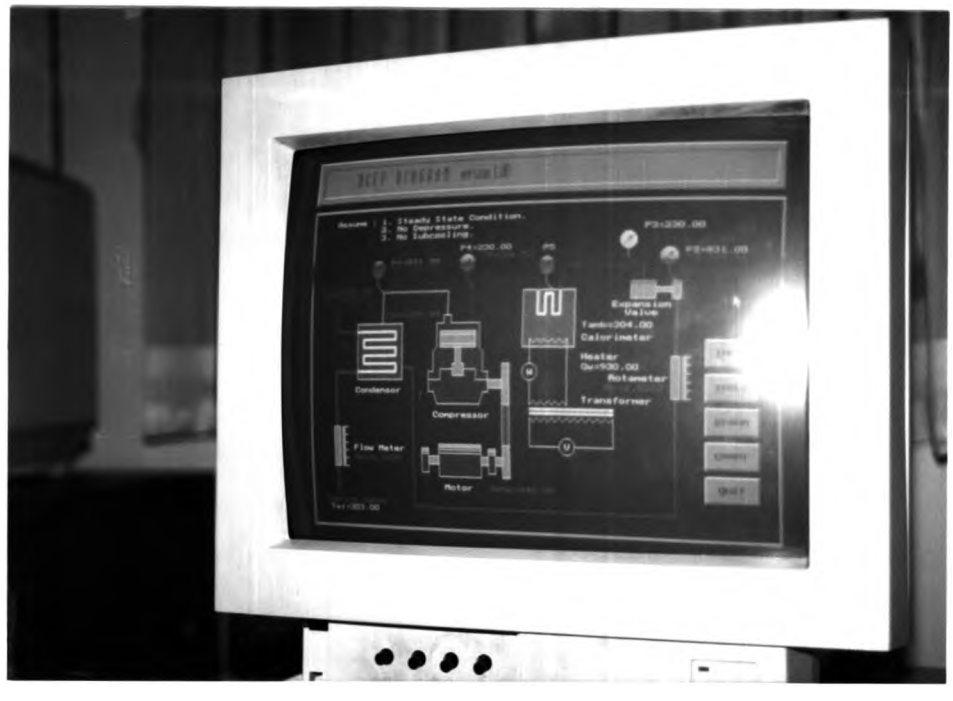


รูปที่ ข.1 แสดงหน้าจอ INTRODUCTION หลังเรียกใช้โปรแกรม "RCPP "

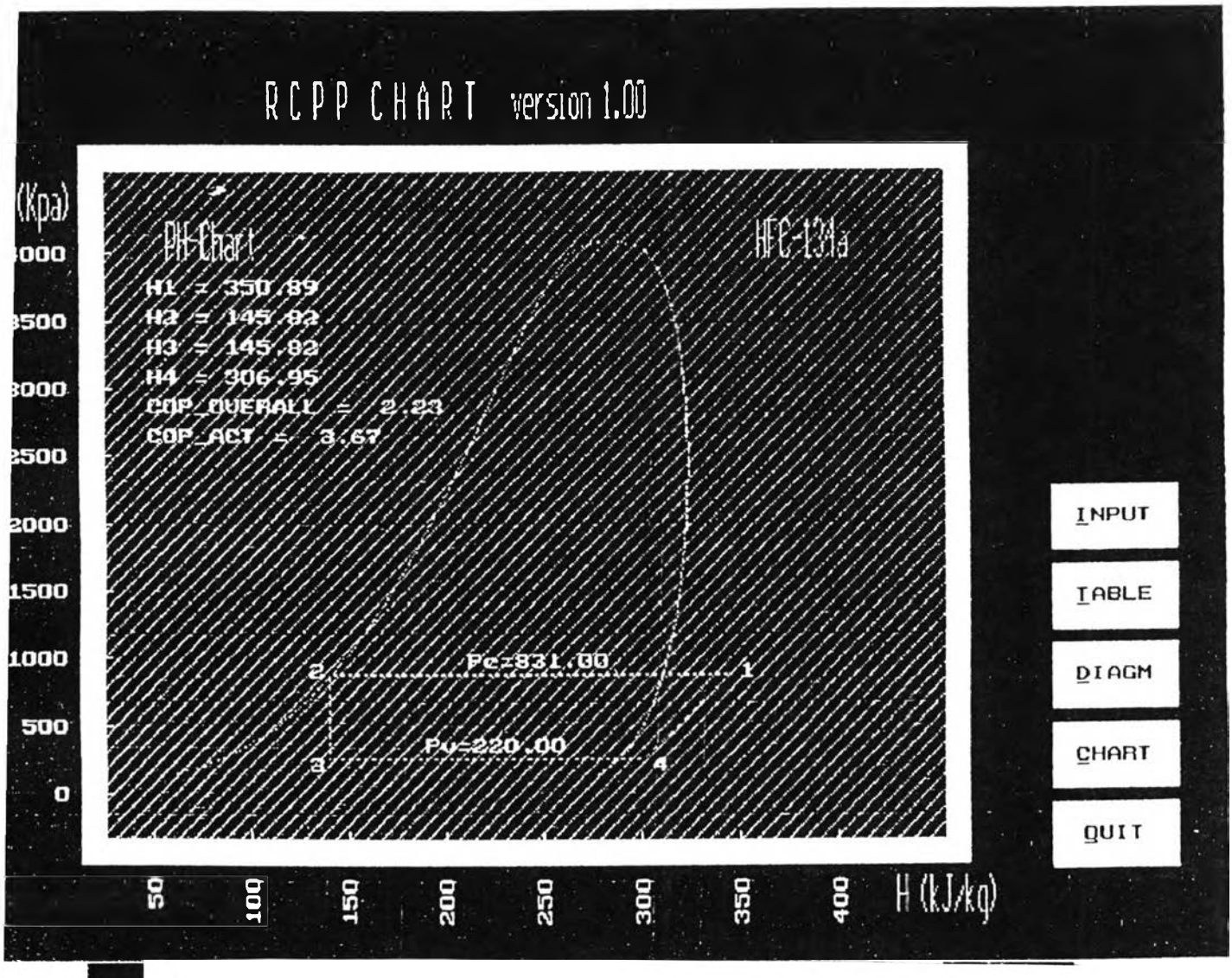


รูปที่ ข.2 แสดง OUTPUT ในรูปของ TABLE





รูปที่ ข.3 แสดง OUTPUT ในรูปของ DIAGRAM



รูปที่ ข.4 แสดง OUTPUT ในรูปของ P-h CHART


```
#include <iostream.h>
#include <stdio.h>
#include <stdarg.h>
#include <graphics.h>
#include <stdlib.h>
#include <conio.h>
#include <dir.h>
#include "mous.h"
#include "window.h"

// The declaration should be defined in file which has *.h extension.
#define QUIT       1
#define CHART      2
#define DIAGM      3
#define TABLE      4
#define INPUT      5
#define MENU       6
float Tv,Tc,T1,T2,T3,T4;
float H1,H2,H3,H4,H11;
float V1,V2,V4;
float density4,density2,censity1;
float Work,Mr_A,Mr_B;
float Ql,Qs,Qc,Mw,Two,Twm,lm,ua;
float COP_ACT,COP_OVERALL,Polytropic;

void main(void)
{
  int gdriver = VGA, gmode = VGAHI, errorcode;
  int gprintf(int *xloc,int *yloc,char *fmt,...);
  int Calculate(float Pc,float Pv,float Qw,float Twi,float Tamb,float Zeta_S);
  int PH_chart(float Pc,float Pv);
  void background(int xtop,int ytop,int xbot,int ybot);
  void clear_type(void);
  void screen(void);
  void clear_screen(void);
  void Diagram(void);
  int xlocate,ylocate;
  float buf=0;
  float Pc=0,Pv=0,Qw=0,Twi=0,Tamb=0,Zeta_S=0;
  float bufPc=0,bufPv=0,bufQw=0,bufTwi=0,bufTamb=0;

  char s[81];
  EvntMsg evntmsg;

  initgraph(&gdriver, &gmode, "");
  if ( (errorcode = graphresult()) != grOk)
  {
    cout << "Graphics not initialized: " << errorcode << '\n';
    getch();
  }
  else
  {
  //Windw wndw1(0,0,510,480,TRUE,FALSE);
  Windw Caphead(0,0,getmaxx(),60,TRUE,FALSE);
  Windw Output(100,200,250,350,TRUE,FALSE);
  CapWindw CapOutput(55,100,200,60,FALSE,FALSE,'');
  CapWindw head(20,10,590,40,FALSE,FALSE,"");
  CapWindw xhead(70,75,410,40,FALSE,FALSE,"");
  CapWindw rhead(70,245,410,40,FALSE,FALSE,"");
  //rectangle(0,0,getmaxx(),getmaxy());
  //setfillstyle(3,BLUE);
  //floodfill(1,1,WHITE);
  settextstyle(TRIPLEX_FONT,0,1);
  //setfillstyle(SOLID_FILL,BLUE);
  //Windw chart(85,90,380,300,TRUE,FALSE);
```

```
  //Window wndw2(70,80,410,150,TRUE,FALSE);
  //wndw2.DrawWindow();
  //Window wndw3(70,250,410,150,TRUE,FALSE);
  //wndw3.DrawWindow();
  //setfillstyle(SOLID_FILL,CYAN);
  setusercharsize(1,2,2,1);
  outtextxy(10,0,"R e f r i g e r a t i o n  C a l o r i m e t o r  P e r f o r m
  settextstyle(0,0,1);
  mouse.SetLimits(0,getmaxx()-5,0,getmaxy()-5);
  Button push1(550,400,"^QUIT");
  Button push2(550,360,"^CHART");
  Button push3(550,320,"^DIAGM");
  Button push4(550,280,"^TABLE");
  Button push5(550,240,"^INPUT");
  push1.DrawWindow();
  push2.DrawWindow();
  push3.DrawWindow();
  push4.DrawWindow();
  push5.DrawWindow();
  screen();
  mouse.ShowMouse();

LOOP:  int button=0;
  while(!button)
  {
  GetEvent(evntmsg);
  if(push1.Clicked(evntmsg))
     button = QUIT;
  if(push2.Clicked(evntmsg))
     button = CHART;
  if(push3.Clicked(evntmsg))
     button = DIAGM;
  if(push4.Clicked(evntmsg))
     button = TABLE;
  if(push5.Clicked(evntmsg))
     button = INPUT;
  }
  mouse.HideMouse();
  switch(button)
  {
  case QUIT   : closegraph();
                textbackground(BLACK);
                textcolor(LIGHTBLUE);
                clrscr();
                printf("\n");
                printf("\t================ PROCESS END ================\n");
                printf("\t         RCPP Package (version 1.00)         \n");
                printf("\t               Copyright 1994                \n");
                printf("\t                    by                       \n");
                printf("\t          Amnart Hanwongpaibool              \n");
                printf("\t        Chulalongkorn University             \n");
                printf("\t=============================================\n");
                textcolor(LIGHTGRAY);
                window(1,10,80,25);
                clrscr();
                exit(0);

  case DIAGM  : cleardevice();
                Caphead.DrawWindow();
                Diagram();
                push1.DrawWindow();
                push2.DrawWindow();
                push3.DrawWindow();
                push4.DrawWindow();
                push5.DrawWindow();
                setcolor(YELLOW);
```

```
                outtextxy(345,125,"P5");
                xlocate = 130; ylocate = 140;
                gprintf(&xlocate,&ylocate,"P1=%6.2f",Pc);
                xlocate = 230; ylocate = 123;
                gprintf(&xlocate,&ylocate,"P4=%6.2f",Pv);
                xlocate = 475; ylocate = 100;
                gprintf(&xlocate,&ylocate,"P3=%6.2f",Pv);
                xlocate = 525; ylocate = 130;
                gprintf(&xlocate,&ylocate,"P2=%6.2f",Pc);
                xlocate = 30;  ylocate = 450;
                gprintf(&xlocate,&ylocate,"Twi=%6.2f",Twi);
                xlocate = 400; ylocate = 270;
                gprintf(&xlocate,&ylocate,"Qw=%6.2f",Qw);
                xlocate = 400; ylocate = 220;
                gprintf(&xlocate,&ylocate,"Tamb=%6.2f",Tamb);
                setcolor(GREEN);
                xlocate = 20;  ylocate = 175;
                gprintf(&xlocate,&ylocate,"Two=%6.2f",Two);
                xlocate = 75;  ylocate = 385;
                gprintf(&xlocate,&ylocate,"Mw=%6.4f",Mw);
                xlocate = 130, ylocate = 150;
                gprintf(&xlocate,&ylocate,"T1=%6.2f",T1);
                xlocate = 525, ylocate = 140;
                gprintf(&xlocate,&ylocate,"T2=%6.2f",T2);
                xlocate = 475; ylocate = 110;
                gprintf(&xlocate,&ylocate,"T3=%6.2f",T3);
                xlocate = 260; ylocate = 133;
                gprintf(&xlocate,&ylocate,"T4=%6.2f",T4);
                xlocate = 275; ylocate = 420;
                gprintf(&xlocate,&ylocate,"Wbhp=%6.2f",Work);
                xlocate = 125;  ylocate = 205;
                gprintf(&xlocate,&ylocate,"Twm=%6.2f",Twm);
                xlocate = 430;  ylocate = 295;
                gprintf(&xlocate,&ylocate,"Mr=%6.4f",Mr_B);
                setcolor(WHITE);
                break;

case CHART   : cleardevice();
                push1.DrawWindow();
                push2.DrawWindow();
                push3.DrawWindow();
                push4.DrawWindow();
                push5.DrawWindow();
                PH_chart(Pc,Pv);
                break;

case TABLE :  cleardevice();
                setcolor(WHITE);
                rectangle(0,0,getmaxx(),getmaxy());
                setfillstyle(3,BLUE);
                floodfill(1,1,WHITE);
                setviewport(350,60,565,200,1);
                clearviewport();
                setviewport(0,0,getmaxx(),getmaxy(),1);
                rectangle(350,60,565,200);
                setcolor(LIGHTGRAY);
                outtextxy(370,170,"V e r s i o n  1 . 0 0");
                setcolor(YELLOW);
                settextstyle(3,0,1);
                setusercharsize(1,1,3,1);
                outtextxy(370,70,"RCPP TABLE");
                settextstyle(0,0,1);
                setcolor(RED);
                outtextxy(30,465,"RCPP Table version 1.00  copyright 1994.");
                outtextxy(345,465,"  By Amnart Hanwongpaibool.");
                setusercharsize(1,1,3,2);
```

```
                setcolor(LIGHTBLUE);
                outtextxy(50,80,"I N P U T   P A R A M E T E R");
                outtextxy(50,235,"O U T P U T   P A R A M E T E R");
                Windw Intable(70,100,165,105,TRUE,FALSE);
                Intable DrawWindow();
                settextstyle(2,0,1);
                setusercharsize(1,1,3,2);
                setcolor(BLACK);
                xlocate = 75; ylocate = 115;
                gprintf(&xlocate,&ylocate,"   # Pc   = %7.2f",Pc);
                xlocate = 75; ylocate = 130;
                gprintf(&xlocate,&ylocate,"   # Pv   = %7.2f",Pv);
                xlocate = 75; ylocate = 145;
                gprintf(&xlocate,&ylocate,"   # Qw   = %7.2f",Qw);
                xlocate = 75; ylocate = 160;
                gprintf(&xlocate,&ylocate,"   # Twi  = %7.2f",Twi);
                xlocate = 75, ylocate = 175;
                gprintf(&xlocate,&ylocate,"   # Tamb = %7.2f",Tamb);
                Windw Outtable(70,255,405,160,TRUE,FALSE);
                Outtable.DrawWindow();
                setcolor(BLACK);
                xlocate = 75; ylocate = 275;
                gprintf(&xlocate,&ylocate,"   # T1   = %7.2f",T1);
                xlocate = 75; ylocate = 290;
                gprintf(&xlocate,&ylocate,"   # T2   = %7.2f",T2);
                xlocate = 75; ylocate = 305;
                gprintf(&xlocate,&ylocate,"   # T3   = %7.2f",T3);
                xlocate = 75; ylocate = 320;
                gprintf(&xlocate,&ylocate,"   # T4   = %7.2f",T4);
                xlocate = 75, ylocate = 335;
                gprintf(&xlocate,&ylocate,"   # H1   = %7.2f",H1);
                xlocate = 75; ylocate = 350;
                gprintf(&xlocate,&ylocate,"   # H2   = %7.2f",H2);
                xlocate = 75; ylocate = 365;
                gprintf(&xlocate,&ylocate,"   # H3   = %7.2f",H3);
                xlocate = 75; ylocate = 380;
                gprintf(&xlocate,&ylocate,"   # H4   = %7.2f",H4);
                xlocate = 250; ylocate = 275;
                gprintf(&xlocate,&ylocate,"   # Wbhp = %7.2f",Work);
                xlocate = 250, ylocate = 290;
                gprintf(&xlocate,&ylocate,"   # Mr   = %7.4f",Mr_B);
                xlocate = 250; ylocate = 305;
                gprintf(&xlocate,&ylocate,"   # Qc   = %7.2f",Qc);
                xlocate = 250; ylocate = 320;
                gprintf(&xlocate,&ylocate,"   # Mw   = %7.4f",Mw);
                xlocate = 250; ylocate = 335;
                gprintf(&xlocate,&ylocate,"   # Twm  = %7.2f",Twm);
                xlocate = 250; ylocate = 350;
                gprintf(&xlocate,&ylocate,"   # Two  = %7.2f",Two);
                xlocate = 250, ylocate = 365;
                gprintf(&xlocate,&ylocate,"   # UA   = %7.4f",ua);
                xlocate = 220, ylocate = 380;
                gprintf(&xlocate,&ylocate,"   # Polytropic expo  = %7.2f",Polytropic);
                settextstyle(0,0,1);
                setcolor(WHITE);
                push1.DrawWindow();
                push2.DrawWindow();
                push3.DrawWindow();
                push4.DrawWindow();
                push5.DrawWindow();
                break;

case INPUT   : InputWindw *InputPc = new InputWindw("Input Parameter",
                                "Please Enter Pc :","( Pc Range = 110-2000 )");
                InputWindw *InputPv = new InputWindw("Input Parameter",
                                "Please Enter Pv :","( Pv Range = 110-2000 )");
```

```
InputWindw *InputQw = new InputWindw("Input Parameter",
                      "Please Enter Qw :","( Qw Range = 100-2000 )");
InputWindw *InputTwi = new InputWindw("Input Parameter",
                      "Please Enter Twi :","( Twi Range = 100-400 )");
InputWindw *InputTamb = new InputWindw("Input Parameter",
                      "Please Enter Tamb :","( Tamb Range = 100-400 )

InputPc->DrawWindow();
mouse.ShowMouse();
InputPc->RunWindow();
if(InputPc->GetButton() == OK)
{
   InputPc->GetInput(s);
   mouse.HideMouse();
   delete InputPc;
}
else
{
   mouse.HideMouse();
   delete InputPc;
   break;
}
buf = atof(s);
if(buf<110||buf>2000)
{
   OKWindw *error = new OKWindw("Error Message",
                    "Invalid Parameter",
                    "Pc...Out of Range");
   error->DrawWindow();
   mouse.ShowMouse();
   error->RunWindow();
   mouse.HideMouse();
   delete error;
   break;
}
bufPc = atof(s);
InputPv->DrawWindow();
mouse.ShowMouse();
InputPv->RunWindow();
if(InputPv->GetButton() == OK)
{
   InputPv->GetInput(s);
   mouse.HideMouse();
   delete InputPv;
}
else
{
   mouse.HideMouse();
   delete InputPv;
   break;
}
buf = atof(s);
if(buf<110||buf>2000||buf>bufPc)
{
   OKWindw *error = new OKWindw("Error Message",
                    "Invalid Parameter",
                    "Pv...Out of Range");
   error->DrawWindow();
   mouse.ShowMouse();
   error->RunWindow();
   mouse.HideMouse();
   delete error;
   break;
}
bufPv = atof(s);
InputQw->DrawWindow();
```

```
mouse.ShowMouse();
InputQw->RunWindow();
if(InputQw->GetButton() == OK)
{
   InputQw->GetInput(s);
   mouse.HideMouse();
   delete InputQw;
}
else
{
   mouse.HideMouse();
   delete InputQw;
   break;
}
buf = atof(s);
if(buf<100||buf>2000)
{
   OKWindw *error = new OKWindw("Error Message",
                     "Invalid Parameter",
                     "Qw...Out of Range");
   error->DrawWindow();
   mouse.ShowMouse();
   error->RunWindow();
   mouse.HideMouse();
   delete error;
   break;
}
bufQw = atof(s);
InputTwi->DrawWindow();
mouse.ShowMouse();
InputTwi->RunWindow();
if(InputTwi->GetButton() == OK)
{
   InputTwi->GetInput(s);
   mouse.HideMouse();
   delete InputTwi;
}
else
{
   mouse.HideMouse();
   delete InputTwi;
   break;
}
buf = atof(s);
if(buf<100||buf>400)
{
   OKWindw *error = new OKWindw("Error Message",
                     "Invalid Parameter",
                     "Twi...Out of Range");
   error->DrawWindow();
   mouse.ShowMouse();
   error->RunWindow();
   mouse.HideMouse();
   delete error;
   break;
}
bufTwi = atof(s);
InputTamb->DrawWindow();
mouse.ShowMouse();
InputTamb->RunWindow();
if(InputTamb->GetButton() == OK)
{
   InputTamb->GetInput(s);
   mouse.HideMouse();
   delete InputTamb;
}
```

```
                else
                {
                   mouse.Hidehouse();
                   delete InputTamb;
                   break;
                }
                buf = atof(s);
                if(buf<100||buf>400)
                {
                   OKWindw *error = new OKWindw("Error Message",
                                    "Invalid Parameter",
                                    "Tamb...Out of Range");
                   error->DrawWindow();
                   mouse.ShowMouse();
                   error->RunWindow();
                   mouse.HideMouse();
                   delete error;
                   break;
                }
                bufTamb = atof(s);

                Windw *Wait = new Windw(280,200,80,80,TRUE,FALSE);
                Wait->DrawWindow();
                outtextxy(290,240," Wait !");
                Pc=bufPc;
                Pv=bufPv;
                Qw=bufQw;
                Twi=bufTwi;
                Tamb=bufTamb;
                Calculate(Pc,Pv,Qw,Twi,Tamb,Zeta_S);
                delete Wait;
                break;
  }
  mouse.ShowMouse();
  goto LOOP;
  } // else loop
}



void clear_type(void)
{
   setfillstyle(SOLID_FILL,BLUE);
   bar(12,53,529,466);
}

void background(int xtop,int ytop,int xbot,int ybot)
{
   int i,j;
   unsigned int k;
   float l;
   for(k=ybot-ytop;k>ytop;k--)
   {
      j = 2.1*k-(xbot-xtop);
      for(l=xtop; l<j; l++)
      {
         i = random(xbot-xtop);
         putpixel(i,k,LIGHTBLUE);
         putpixel(i,ybot-ytop-k,LIGHTBLUE);
      }
   }
   setcolor(WHITE);
   rectangle(xtop,ytop,xbot-10,ybot);
}

void screen(void)
```

```
{
  Windw chart(70,80,410,360,TRUE,FALSE);
  chart.DrawWindow();
  setviewport(85,92,465,428,1);
  clearviewport();
  background(0,0,390,336);
  setviewport(0,0,getmaxx(),getmaxy(),1);
  settextstyle(TRIPLEX_FONT,HORIZ_DIR,0);
  setusercharsize(1,1,2,1);
/*  setcolor(RED);
  line(165,410,395,410);
  line(165,415,395,415);
  line(165,420,395,420);
  line(165,425,395,425);
  line(165,430,395,430);
  line(165,435,395,435);
  line(165,440,395,440);
  line(165,445,395,445);
  line(165,450,395,450);
  setcolor(LIGHTGRAY);
  outtextxy(173,388,"   Phoenix");
  outtextxy(172,389,"   Phoenix");
  setcolor(WHITE);
  outtextxy(170,390,"   Phoenix");*/
  setusercharsize(1,1,4,1);
  setcolor(RED);
  outtextxy(161,144," RCPP Module ");
  outtextxy(162,143," RCPP Module ");
  outtextxy(163,142," RCPP Module ");
  outtextxy(164,141," RCPP Module ");
  setcolor(LIGHTRED);
  outtextxy(160,145," RCPP Module ");
  setcolor(LIGHTRED);
  settextstyle(0,0,1);
  outtextxy(160,270,"        Version 1.00      ");
  outtextxy(160,285,"       Copyright 1994     ");
  outtextxy(160,300,"             by           ");
  outtextxy(160,315,"     Amnart Hanwongpaibool");
  outtextxy(160,330,"   Chulalongkorn University");
  setcolor(WHITE);
  //outtextxy(220,452," G  r  o  u  p");
}

int gprintf(int *xloc,int *yloc,char *fmt,...)
{
   va_list argptr;
   char str[140];
   int cnt;
   va_start(argptr,fmt);
   cnt = vsprintf(str,fmt,argptr);
   outtextxy(*xloc,*yloc,str);
   *yloc += textheight("H") +2;
   va_end(argptr);
   return (cnt);
}
```

```
#include <stdio.h>
#include <conio.h>
#include <stdlib.h>
#include <graphics.h>

#define FLOW 0
#define ROTA 1
void Diagram(void)
{
   void Compressor(int x,int y);
   void Condensor(int x,int y);
   void Gage(int x,int y,int color);
   void Motor(int x,int y);
   void Calorimeter(int x,int y);
   void Meter(int x,int y,int type);
   void Expansion_Valve(int x,int y);
   setcolor(WHITE);
   rectangle(0,70,getmaxx(),getmaxy());
   rectangle(2,72,getmaxx()-2,getmaxy()-2);
   settextstyle(2,0,1);
   setusercharsize(1,1,3,1);
   setcolor(MAGENTA);
   outtextxy(50,13,"   R C C P   D I A G R A M   version 1.00");
   outtextxy(51,13,"   R C C P   D I A G R A M   version 1.00");
   settextstyle(0,0,1);
   setcolor(WHITE);
   setfillstyle(3,BLUE);
   floodfill(3,74,WHITE);
   outtextxy(40,85,"Assume : 1. Steady State Condition.");
   outtextxy(40,95,"         2. No Depressure.");
   outtextxy(40,105,"         3. No Subcooling.");


   Compressor(200,220);
   Condensor(80,220);
   Gage(505,160,YELLOW); // POINT 2
   Gage(455,140,YELLOW); // POINT 3
   Gage(350,170,YELLOW); // POINT 5
   Gage(240,165,YELLOW); // POINT 4
   Gage(110,170,YELLOW); // POINT 1
   Motor(202,370);
   Calorimeter(320,180);
   Meter(40,350,FLOW);
   Meter(510,260,ROTA);
   Expansion_Valve(460,170);
   line(292,320,292,370);
   line(302,320,302,370);
   setlinestyle(1,0,1);
   line(295,320,295,370);
   line(299,320,299,370);
   setlinestyle(0,0,3);
   // HOT LINE FROM CONDENSOR TO ROTAMETER
   setcolor(RED);
   moveto(151,275);
   lineto(165,275);
   lineto(165,450);
   lineto(515,450);
   lineto(515,311);
   // HOT LINE FROM ROTAMETER TO EXPANSION VALVE
   setcolor(RED);
   moveto(515,259);
   lineto(515,192);
   // SUPER COOL LINE FROM EXPANSION VALVE TO CALORIMETER
   setcolor(LIGHTBLUE);
```

```
    moveto(475,169);
    lineto(475,150);
    lineto(370,150);
    lineto(370,180);
    // COOL LINE FROM CALORIMETER TO COMPRESSOR
    setcolor(BLUE);
    moveto(340,180);
    lineto(340,165);
    lineto(250,165);
    lineto(250,219);
    // SUPER HOT LINE FROM COMPRESSOR TO CONDENSOR
    setcolor(LIGHTRED);
    moveto(215,209);
    lineto(215,180);
    lineto(120,180);
    lineto(120,219);
    // COOL WATER FROM CONDENSOR TO FLOW METER
    setcolor(LIGHTBLUE);
    moveto(79,280);
    lineto(45,280);
    lineto(45,349);
    moveto(45,401);
    lineto(45,430);
    outtextxy(20,440,"Cooling Water");
    // DRAIN WATER
    setcolor(RED);
    moveto(79,230);
    lineto(45,230);
    lineto(45,200);
    outtextxy(20,185,"To Drain");
    setlinestyle(0,0,1);
    setcolor(WHITE);
}

void Compressor(int x,int y)
{
    setcolor(WHITE);
    moveto(x,y);
    lineto(x+10,y);
    lineto(x+10,y-10);
    lineto(x+20,y-10);
    lineto(x+20,y);
    lineto(x+60,y);
    lineto(x+60,y+30);
    lineto(x+65,y+35);
    lineto(x+65,y+60);
    lineto(x+72,y+60);
    lineto(x+72,y+85);
    lineto(x+65,y+85);
    lineto(x+60,y+100);
    lineto(x,y+100);
    lineto(x-5,y+85);
    lineto(x-12,y+85);
    lineto(x-12,y+60);
    lineto(x-5,y+60);
    lineto(x-5,y+35);
    lineto(x,y+30);
    lineto(x,y);
    setfillstyle(SOLID_FILL,BLUE);
    floodfill(x+1,y+1,WHITE);
    outtextxy(x-5,y+110,"Compressor");
    rectangle(x+5,y+10,x+55,y+30);
    setfillstyle(SOLID_FILL,LIGHTGRAY);
    floodfill(x+6,y+11,WHITE);
    line(x+5,y+14,x+55,y+14);
    line(x+5,y+26,x+55,y+26);
```

```
    moveto(x+34,y+30);
    lineto(x+34,y+50);
    lineto(x+38,y+50);
    lineto(x+38,y+65);
    lineto(x+22,y+65);
    lineto(x+22,y+50);
    lineto(x+26,y+50);
    lineto(x+26,y+30);
    floodfill(x+33,y+31,WHITE);
    moveto(x+38,y+57);
    lineto(x+55,y+57);
    lineto(x+55,y+70);
    lineto(x+72,y+70);
    moveto(x+22,y+57);
    lineto(x+5,y+57);
    lineto(x+5,y+70);
    lineto(x-12,y+70);
    line(x+72,y+70,x+92,y+70);
    line(x+72,y+80,x+92,y+80);
    rectangle(x+92,y+50,x+102,y+100);
    setfillstyle(SOLID_FILL,LIGHTGRAY);
    floodfill(x+93,y+61,WHITE);
    //line(x+92,y+50,x+102,y+100);
    //line(x+92,y+100,x+102,y+50);
    setfillstyle(SOLID_FILL,LIGHTGRAY);
    floodfill(x+73,y+71,WHITE);
}

void Condensor(int x,int y)
{
    rectangle(x,y,x+70,y+70);
    setfillstyle(SOLID_FILL,RED);
    floodfill(x+1,y+1,WHITE);
    moveto(x,y+10);
    setlinestyle(0,0,3);
    lineto(x+60,y+10);
    lineto(x+60,y+20);
    lineto(x+10,y+20);
    lineto(x+10,y+30);
    lineto(x+60,y+30);
    lineto(x+60,y+40);
    lineto(x+10,y+40);
    lineto(x+10,y+50);
    lineto(x+60,y+50);
    lineto(x+60,y+60);
    lineto(x,y+60);
    setlinestyle(0,0,1);
    outtextxy(x-3,y+80,"Condensor");
}

// FIX POINT : X+10,Y+10
void Gage(int x,int y,int color)
{
    circle(x,y-20,10);
    setfillstyle(SOLID_FILL,color);
    floodfill(x,y-20,WHITE);
    line(x,y-10,x,y);
    line(x,y,x+10,y+10);
    setcolor(BLACK);
    line(x-5,y-15,x+5,y-25);
    moveto(x+5,y-25);
    lineto(x,y-22);
    moveto(x+5,y-25);
    lineto(x+2,y-20);
    setcolor(WHITE);
}
```

```
void Motor(int x,int y)
{
   rectangle(x,y,x+60,y+40);
   setfillstyle(SOLID_FILL,BLUE);
   floodfill(x+1,y+1,WHITE);
   line(x,y+2,x+60,y+2);
   line(x,y+4,x+60,y+4);
   line(x,y+7,x+60,y+7);
   line(x,y+11,x+60,y+11);
   outtextxy(x,y+50," Motor");
   moveto(x,y+15);
   line(x,y+15,x-15,y+15);
   line(x,y+25,x-15,y+25);
   rectangle(x-25,y+5,x-15,y+35);
   setfillstyle(SOLID_FILL,BLUE);
   floodfill(x-16,y+16,WHITE);
   line(x-25,y+7,x-15,y+7);
   line(x-25,y+9,x-15,y+9);
   line(x-25,y+12,x-15,y+12);
   setfillstyle(SOLID_FILL,LIGHTGRAY);
   floodfill(x-1,y+16,WHITE);
   moveto(x+90,y+15);
   lineto(x+80,y+15);
   lineto(x+80,y+5);
   lineto(x+70,y+5);
   lineto(x+70,y+35);
   lineto(x+80,y+35);
   lineto(x+80,y+25);
   lineto(x+90,y+25);
   line(x+60,y+25,x+70,y+25);
   line(x+60,y+15,x+70,y+15);
   rectangle(x+70,y+5,x+80,y+35);
   setfillstyle(SOLID_FILL,BLUE);
   floodfill(x+71,y+16,WHITE);
   line(x+70,y+7,x+80,y+7);
   line(x+70,y+9,x+80,y+9);
   line(x+70,y+12,x+80,y+12);
   rectangle(x+90,y,x+100,y+40);
   setfillstyle(SOLID_FILL,LIGHTGRAY);
   floodfill(x+91,y+20,WHITE);
   setfillstyle(SOLID_FILL,LIGHTGRAY);
   floodfill(x+65,y+20,WHITE);
   floodfill(x+87,y+20,WHITE);
}

void Calorimeter(int x,int y)
{
   void Zzax(int x,int y,int zz,int type);
   rectangle(x,y,x+70,y+70);
   setfillstyle(SOLID_FILL,RED);
   floodfill(x+1,y+1,WHITE);

   moveto(x+20,y-15);
   setlinestyle(0,0,3);
   lineto(x+20,y+30);
   lineto(x+30,y+30);
   lineto(x+30,y+5);
   lineto(x+40,y+5);
   lineto(x+40,y+30);
   lineto(x+50,y+30);
   lineto(x+50,y-15);
   setlinestyle(0,0,1);
   moveto(x+10,y+90);
   lineto(x+10,y+60);
   lineto(x+15,y+65);
```

```
    lineto(x+20,y+60);
    lineto(x+25,y+65);
    lineto(x+30,y+60);
    lineto(x+35,y+65);
    lineto(x+40,y+60);
    lineto(x+45,y+65);
    lineto(x+50,y+60);
    lineto(x+55,y+65);
    lineto(x+50,y+60);
    lineto(x+55,y+65);
    lineto(x+60,y+60);
    lineto(x+60,y+140);
    outtextxy(x+80,y+55,"Calorimeter");
    outtextxy(x+80,y+78,"Heater");
    outtextxy(x+7,y+97,"W");
    circle(x+10,y+100,10);
    moveto(x+10,y+110);
    lineto(x+10,y+135);
    outtextxy(x+80,y+130,"Transformer");
    Zzax(x+10,y+135,11,0);
    setlinestyle(0,0,3);
    line(x+10,y+145,x+120,y+145);
    line(x+10,y+150,x+120,y+150);
    setlinestyle(0,0,1);
    Zzax(x+10,y+160,23,1);
    moveto(x+10,y+160);
    lineto(x+10,y+190);
    lineto(x+50,y+190);
    circle(x+60,y+190,10);
    moveto(x+70,y+190);
    lineto(x+120,y+190);
    lineto(x+120,y+160);
    outtextxy(x+57,y+187,"V");
}

void Zzax(int x,int y,int zz,int type)   //0:up,1:down
{
   int i;
   moveto(x,y);
   x = x-5;
   switch(type)
   {
   case 0 : for(i=0;i<zz;i++)
            {
               x = x+5;
               if(type == 0)
               {
                  lineto(x,y+5);
                  type = 1;
               }
               else
               {
                  lineto(x,y);
                  type = 0;
               }
            }
            break;
   case 1 : type = 0;
            for(i=0;i<zz;i++)
            {
               x = x+5;
               if(type == 0)
               {
                  lineto(x,y-5);
                  type = 1;
               }
```

```
                else
                {
                    lineto(x,y);
                    type = 0;
                }
            }
            break;
    default : break;
    }
    lineto(x,y);
}

void Meter(int x,int y,int type)    // type 0 : flow meter
{                                   // type 1 : rotameter
    int i;
    rectangle(x,y,x+10,y+50);
    setfillstyle(SOLID_FILL,LIGHTGRAY);
    floodfill(x+1,y+1,WHITE);
    for(i=0;i<=25;i++)
    {
        line(x+13,y+i*2,x+18,y+i*2);
        if(i==0||i==5||i==10||i==15||i==20||i==25)
        line(x+13,y+i*2,x+23,y+i*2);
    }
    if(type == 0)
    outtextxy(x+33,y+23,"Flow Meter");
    else outtextxy(x-75,y+23,"Rotameter");
}

void Expansion_Valve(int x,int y)
{
    moveto(x,y);
    lineto(x+30,y);
    lineto(x+30,y+8);
    lineto(x+50,y+8);
    lineto(x+50,y);
    lineto(x+60,y);
    lineto(x+60,y+21);
    lineto(x+50,y+21);
    lineto(x+50,y+13);
    lineto(x+30,y+13);
    lineto(x+30,y+21);
    lineto(x,y+21);
    lineto(x,y);
    setfillstyle(SOLID_FILL,LIGHTGRAY);
    floodfill(x+1,y+1,WHITE);
    outtextxy(x-22,y+25,"Expansion");
    outtextxy(x-22,y+35,"  Valve  ");
}
```

```
#include <iostream.h>
#include <stdio.h>
#include <conio.h>
#include <stdarg.h>
#include <stdlib.h>
#include <dos.h>
#include "window.h"
#include <graphics.h>
#define ORIGIN_X 35
#define ORIGIN_Y 255

int PH_chart(float Pc,float Pv)
{
   int Plot(float p);
   int gprintf(int *xloc,int *yloc,char *fmt,...);
   int i,x,y,p;
   int localx,localy;
   extern float H1,H2,H3,H4;
   extern float COP_ACT,COP_OVERALL;
   Windw boundary(53,68,454,361,TRUE,FALSE);
   boundary.DrawWindow();
   rectangle(65,80,495,417);
   setfillstyle(3,BLUE);
   floodfill(66,81,WHITE);
   settextstyle(2,0,1);
   setusercharsize(1,1,3,1);
   setcolor(YELLOW);
   outtextxy(150,30,"R C P P  C H A R T   version 1.00");
   setcolor(WHITE);
   outtextxy(80,100,"   PH-Chart");
   outtextxy(400,100,"HFC-134a");
   outtextxy(10,80,"P (Kpa)");
   outtextxy(470,430,"H (KJ/kg)");
   settextstyle(0,0,1);
   setcolor(LIGHTRED);
   localx=80; localy=135;
   gprintf(&localx,&localy," H1 = %6.2f",H1);
   localx=80; localy=150;
   gprintf(&localx,&localy," H2 = %6.2f",H2);
   localx=80; localy=165;
   gprintf(&localx,&localy," H3 = %6.2f",H3);
   localx=80; localy=180;
   gprintf(&localx,&localy," H4 = %6.2f",H4);
   localx=80; localy=195;
   gprintf(&localx,&localy," COP_OVERALL =%6.2f",COP_OVERALL);
   localx=80; localy=210;
   gprintf(&localx,&localy," COP_ACT =%6.2f",COP_ACT);
   setcolor(WHITE);
   x=15;
   for(p=0;p<=4000;p+=500)
   {
      y = ORIGIN_Y+(2000-p)*130.0/1900.0;
      gprintf(&x,&y,"%4d  -",p);
   }
   for(p=50;p<=400;p+=50)
      {
      y = ORIGIN_Y+(2300)*130.0/1900.0;
      x = ORIGIN_X+p+10;
      settextstyle(0,1,1);
      gprintf(&x,&y,"%d  -",p);
      }
      settextstyle(0,0,1);
   for(i=110;i<4050;i+=20)
      Plot(i);
   if(H1!=0)
```

```
    setcolor(YELLOW);
    setlinestyle(1,0,1);
    x = ORIGIN_X+(H1)*400/400;
    y = ORIGIN_Y+(2000-Pc)*130/1900;
    outtextxy(x+5,y-5,"1");
    localx=x; localy=y;
    moveto(x,y);
    x = ORIGIN_X+(H2)*400/400;
    y = ORIGIN_Y+(2000-Pc)*130/1900;
    lineto(x,y);
    outtextxy(x-10,y-5,"2");
    localx+=x;
    localx = localx/2 - 30;
    localy = localy-10;
    gprintf(&localx,&localy,"Pc=%6.2f",Pc);
    moveto(x,y);
    x = ORIGIN_X+(H3)*400/400;
    y = ORIGIN_Y+(2000-Pv)*130/1900;
    lineto(x,y);
    outtextxy(x-10,y,"3");
    localx=x; localy=y;
    moveto(x,y);
    x = ORIGIN_X+(H4)*400/400;
    y = ORIGIN_Y+(2000-Pv)*130/1900;
    lineto(x,y);
    outtextxy(x+5,y,"4");
    localx+=x;
    localx = localx/2 - 30;
    localy = localy-10;
    gprintf(&localx,&localy,"Pv=%6.2f",Pv);
    moveto(x,y);
    x = ORIGIN_X+(H1)*400/400;
    y = ORIGIN_Y+(2000-Pc)*130/1900;
    lineto(x,y);
    }
    setlinestyle(0,0,1);
    return 0;
}

// This function returns Enthalpy value
// which retrieve from Table.pth file.
// define dif_value = 0.5    ( With Interpolate )
// Find out : H3=H2,H11,T2,T11,Tv
int Plot(float p)
{
    FILE *fp;
    char ch;
    char buffer[20];
    float min_p,max_p,
          min_t,max_t,
          min_h2,max_h2,
          min_h11,max_h11;
    float H2,H11;
    int x=0,y=0;
    int i,count = 0;
    int countline = 0;
    if(p<106.382) return -99;
    if((fp=fopen("c:\\thermo\\table.pth","r"))==NULL)
    {
       printf("Can't open table file for read\n");
       return -99;
    }
    ch = 'A';
loop :   for(i=0;ch!=':';i++)
         {
```

```
      ch = getc(fp);
      if(ch==EOF)
         {
         printf("Out of Table\n");
         return -99;
         }
      buffer[i] = ch;
   }
buffer[i] = '\0';
max_p = atof(buffer);

if(p<=max_p )
{
 x: ch = 'A';
   count+=1;
   for(i=0;ch!=':';i++)
   {
      ch = getc(fp);
      if(ch==EOF)
         {
         printf("Out of Table\n");
         return -99;
         }
      buffer[i] = ch;
   }
buffer[i] = '\0';
if(count == 1) max_t   = atof(buffer);
if(count == 2) max_h2  = atof(buffer);
if(count == 3) max_h11 = atof(buffer);
if(count<3)  goto x;
}
else
{
   while(ch!='\n'&& ch!=EOF) ch = getc(fp);
   countline+=1;
   goto loop;
}
fclose(fp);
if((fp=fopen("c:\\thermo\\table.pth","r"))==NULL)
{
   printf("Can't open table file for read\n");
   return -99;
}
for(i=1; i<countline; i++)
{
   while(ch!='\n'&& ch!=EOF)
   ch = getc(fp);
   ch = 'A';
}
ch = 'A';
count = 0;
xx: ch = 'A';
   count+=1;
   for(i=0;ch!=':';i++)
   {
      ch = getc(fp);
      if(ch==EOF)
         {
         printf("Out of Table\n");
         return -99;
         }
      buffer[i] = ch;
   }
buffer[i] = '\0';
if(count == 1) min_p   = atof(buffer);
if(count == 2) min_t   = atof(buffer);
```

```
        if(count == 3) min_h2  = atof(buffer);
        if(count == 4) min_h11 = atof(buffer);
        if(count<4)  goto xx;

        H2  = min_h2+((max_h2-min_h2)*(p-min_p)/(max_p-min_p));
        H11 = min_h11+((max_h11-min_h11)*(p-min_p)/(max_p-min_p));
        fclose(fp);
        x = ORIGIN_X+(H2)*400/400;
        y = ORIGIN_Y+(2000-p)*130/1900;
        putpixel(x,y,LIGHTCYAN);
        x = ORIGIN_X+(H11)*400/400;
        y = ORIGIN_Y+(2000-p)*130/1900;
        putpixel(x,y,LIGHTCYAN);
        return 0;
}
```

```
#ifndef _WINDW_H
#define _WINDW_H

#include <string.h>
#include "event.h"

#define TRUE       1
#define FALSE      0
#define OK         1
#define YES        2
#define NO         3
#define CANCEL     4
#define OKALT      0x1c0d
#define CANCELALT  0x011b


// Function prototypes.
void GetEvent(EvntMsg &evntmsg);

class Windw
{
  int *buffer; // Pointer to screen buffer.

protected:
  int wx, wy, ww, wh; // Window coords.
  int border,         // Flag for border.
      buffered;       // Flag for buffer.
  EvntMsg evntmsg;    // Event message.

public:
  Windw(int x, int y, int w, int h, int bdr, int buf);
  virtual ~Windw(void);
  virtual void DrawWindow(void);
  virtual void RunWindow(void);

private:
  void WindwError(char *s);
};

class CapWindw: public Windw
{
protected:
  char label[61];

public:
  CapWindw(int x, int y, int w, int h, int bdr, int buf, char *s);
  virtual void DrawWindow(void);
  void SetCaption(char *s);
private:
  void DrawCapBar(void);
};

class CapTWindw: public CapWindw
{
protected:
  char *line1, *line2;
  int button;

public:
  CapTWindw(char *s1, char *s2, char *s3);
  virtual void DrawWindow(void);
  int GetButton(void) { return button; }
};
```

```
class Button: public Windw
{
  char label[20];
  unsigned hotkey;
  int altkey;

public:
  Button(int x, int y, char *s);
  void DrawWindow(void);
  int Clicked(EvntMsg evntmsg);
  void ClickButton(void);
};

class OKWindw: public CapTWindw
{
  Button *butn;

public:
  OKWindw(char *s1, char *s2, char *s3);
  virtual ~OKWindw(void);
  virtual void DrawWindow(void);
  virtual void RunWindow(void);
};

class YesNoWindw: public CapTWindw
{
protected:
  Button *butn1, *butn2;

public:
  YesNoWindw(char *s1, char *s2, char *s3);
  virtual ~YesNoWindw(void);
  virtual void DrawWindow(void);
  virtual void RunWindow(void);
};

class YesNoCanWindw: public CapTWindw
{
  Button *butn1, *butn2, *butn3;

public:
  YesNoCanWindw(char *s1, char *s2, char *s3);
  virtual ~YesNoCanWindw(void);
  virtual void DrawWindow(void);
  virtual void RunWindow(void);
};

class InputWindw: public CapTWindw
{
  char input[81];
  Button *butn1, *butn2;

public:
  InputWindw(char *s1, char *s2, char *s3);
  virtual ~InputWindw(void);
  void GetInput(char *s) { strcpy(s, input); }
  virtual void DrawWindow(void);
  virtual void RunWindow(void);
private:
  void HandleInput(char k);
};

#endif
```

```
#include <graphics.h>
#include <alloc.h>
#include <iostream.h>
#include <conio.h>
#include <stdlib.h>
#include <dos.h>
#include "mous.h"
#include "windw.h"

unsigned ctrlkeys[] =
  {0x1e01, 0x3002, 0x2e03, 0x2004, 0x1205, 0x2106,
   0x2207, 0x2308, 0x1709, 0x240a, 0x250b, 0x260c,
   0x320d, 0x310e, 0x180f, 0x1910, 0x1011, 0x1312,
   0x1f13, 0x1414, 0x1615, 0x2f16, 0x1117, 0x2d18,
   0x1519, 0x2c1a};

////////////////////////////////////////////////////////
// Implementation of the Windw class
////////////////////////////////////////////////////////
Windw::Windw(int x, int y, int w, int h, int brd, int buf)
{
  wx = x; wy=y; ww=w; wh=h;
  border=brd;
  buffered = buf;
  buffer = NULL;
}

Windw::~Windw(void)
{
  if (buffer != NULL)
  {
    mouse.HideMouse();
    putimage(wx, wy, buffer, COPY_PUT);
    free(buffer);
    mouse.ShowMouse();
  }
}

void Windw::DrawWindow (void)
{
  int size;

  mouse.HideMouse();

  // Save window screen area, if requested.
  if (buffered)
  {
    if ((size = imagesize(wx, wy, wx+ww, wy+wh)) < 0)
      WindwError("Image too large to store.");
    else
    {
      if ((buffer = (int *)malloc(size)) == NULL)
        WindwError("Not enough memory.");
      else getimage(wx, wy, wx+ww, wy+wh, buffer);
    }
  }

  //Draw basic 3D window.
  setcolor(WHITE);
  moveto(wx+ww, wy);
  lineto(wx, wy);
```

```
    lineto(wx, wy+wh);
    moveto(wx+ww-1, wy+1);
    lineto(wx+1, wy+1);
    lineto(wx+1, wy+wh-1);
    setcolor(DARKGRAY);
    moveto(wx+1, wy+wh);
    lineto(wx+ww, wy+wh);
    lineto(wx+ww, wy);
    moveto(wx+2, wy+wh-1);
    lineto(wx+ww-1, wy+wh-1);
    lineto(wx+ww-1, wy+1);
    setfillstyle(SOLID_FILL, LIGHTGRAY);
    bar(wx+2, wy+2, wx+ww-2, wy+wh-2);

      //Draw border, if requested.
    if (border) {
      setcolor(DARKGRAY);
      moveto(wx+ww-10, wy+10);
      lineto(wx+10, wy+10);
      lineto(wx+10, wy+wh-10);
      setcolor(WHITE);
      lineto(wx+ww-10, wy+wh-10);
      lineto(wx+ww-10, wy+10);
    }
    mouse.ShowMouse();
}

void Windw::RunWindow(void)
{
  GetEvent(evntmsg);
}

void Windw::WindwError(char *s)
{
  cout << "ERROR: " << s << '\n';
  cout << "Press any key";
  getch();
  abort();
}

////////////////////////////////////////////////////////
// Implementation of the CapWindw class
////////////////////////////////////////////////////////
CapWindw::CapWindw(int x, int y, int w, int h,
                   int brd, int buf, char *s) :
                 Windw(x, y, w, h, brd, buf)
{
  strcpy(label, s);
}

void CapWindw::DrawWindow(void)
{
  // Draw basic window.
  Windw::DrawWindow();

  // Draw caption bar.
  DrawCapBar();
}

void CapWindw::SetCaption(char *s)
{
  strcpy(label, s);
  DrawCapBar();
}

void CapWindw::DrawCapBar(void)
```

```
  mouse.HideMouse();
  setcolor(WHITE);
  moveto(wx+20, wy+40);
  lineto(wx+20, wy+20);
  lineto(wx+ww-20, wy+20);
  setcolor(BLACK);
  lineto(wx+ww-20, wy+40);
  lineto(wx+20, wy+40);
  setfillstyle(SOLID_FILL, DARKGRAY);
  bar(wx+21, wy+21, wx+ww-21, wy+39);
  setcolor(WHITE);
  int x = (wx+ww/2) - (strlen(label)*4);
  outtextxy(x, wy+27, label);
  mouse.ShowMouse();
}

CapTWindw::CapTWindw(char *s1, char *s2, char *s3) :
        CapWindw(0, 0, 0, 150, FALSE, TRUE, s1)
{
  // Calculate which string is the longest and
  // use that width to calculate the window's width.
  int w = strlen(s1) * 8 + 60;
  if (strlen(s2) > strlen(s3))
    ww = strlen(s2) * 8 + 60;
  else ww = strlen(s3) * 8 + 60;
  if (w > ww) ww = w;

  // Enforce a minimum width.
  if (ww < 230) ww = 230;

  // Calculate the window's x,y coordinates.
  wx = 320 - ww/2;
  wy = 164;

  // Set the window's text.
  line1 = s2;
  line2 = s3;
}

void CapTWindw::DrawWindow(void)
{
  // Draw the captioned window.
  CapWindw::DrawWindow();

  // Position and draw window body text.
  mouse.HideMouse();
  int x = (wx+ww/2) - (strlen(line1)*8)/2;
  setcolor(BLACK);
  if (strlen(line2)==0)
    outtextxy(x, wy+68, line1);
  else
  {
    outtextxy(x, wy+56, line1);
    x = (wx+ww/2) - (strlen(line2)*8)/2;
    outtextxy(x, wy+71, line2);
  }
  mouse.ShowMouse();
}

////////////////////////////////////////////////////////
// Implementation of the OKWindw class
////////////////////////////////////////////////////////
OKWindw::OKWindw(char *s1, char *s2, char *s3) :
        CapTWindw(s1, s2, s3)
{
```

```
  butn = NULL;
}

OKWindw::~OKWindw(void)
{
  if (butn != NULL) delete butn;
}

void OKWindw::DrawWindow(void)
{
  CapTWindw::DrawWindow();
  butn = new Button(wx+ww/2-32, wy+wh-42, "~OK");
  butn->DrawWindow();
}

void OKWindw::RunWindow(void)
{
  button = 0;

  // Loop until a button is chosen.
  while (!button)
  {
    GetEvent(evntmsg);

    // Check for mouse click on button.
    if (butn->Clicked(evntmsg))
      button = OK;

    // Check for a keyboard event.
    else if (evntmsg.type == KEYBD)
    {
      // Convert character code to ASCII,
      // and check for Esc key.
      char k = evntmsg.key & 0x00ff;
      if (k == ESC) button = CANCEL;
    }
  }
}

////////////////////////////////////////////////////////
// Implementation of the YesNoWindw class
////////////////////////////////////////////////////////
YesNoWindw::YesNoWindw(char *s1, char *s2, char *s3) :
            CapTWindw(s1, s2, s3)
{
  butn1 = butn2 = NULL;
}

YesNoWindw::~YesNoWindw(void)
{
  if (butn1 != NULL) delete butn1;
  if (butn2 != NULL) delete butn2;
}

void YesNoWindw::DrawWindow(void)
{
  CapTWindw::DrawWindow();
  butn1 = new Button(wx+ww/2-70, wy+108, "~YES");
  butn1->DrawWindow();
  butn2 = new Button(wx+ww/2+6, wy+108, "~NO");
  butn2->DrawWindow();
}

void YesNoWindw::RunWindow(void)
{
  button = 0;
```

```
  while (!button)
  {
    GetEvent(evntmsg);
    if (butn1->Clicked(evntmsg))
      button = YES;
    else if (butn2->Clicked(evntmsg))
      button = NO;
    else if (evntmsg.type == KEYBD)
    {
      char k = evntmsg.key & 0x00ff;
      if (k == ESC) button = CANCEL;
    }
  }
}

////////////////////////////////////////////////////////
// Implementation of the YesNoCanWindw class
////////////////////////////////////////////////////////
YesNoCanWindw::YesNoCanWindw(char *s1, char *s2, char *s3) :
               CapTWindw(s1, s2, s3)
{
  butn1 = butn2 = butn3 = NULL;
}

YesNoCanWindw::~YesNoCanWindw(void)
{
  if (butn1 != NULL) delete butn1;
  if (butn2 != NULL) delete butn2;
  if (butn3 != NULL) delete butn3;
}

void YesNoCanWindw::DrawWindow(void)
{
  CapTWindw::DrawWindow();
  butn1 = new Button(wx+ww/2-105, wy+wh-42, "~YES");
  butn1->DrawWindow();
  butn2 = new Button(wx+ww/2-32, wy+wh-42, "~NO");
  butn2->DrawWindow();
  butn3 = new Button(wx+ww/2+41, wy+wh-42, "~CANCEL");
  butn3->DrawWindow();
}

void YesNoCanWindw::RunWindow(void)
{
  button = 0;
  while (!button)
  {
    GetEvent(evntmsg);
    if (butn1->Clicked(evntmsg))
      button = YES;
    else if (butn2->Clicked(evntmsg))
      button = NO;
    else if (butn3->Clicked(evntmsg))
      button = CANCEL;
  }
}

////////////////////////////////////////////////////////
// Implementation of the InputWindw class
////////////////////////////////////////////////////////
InputWindw::InputWindw(char *s1, char *s2, char *s3) :
            CapTWindw(s1, s2, s3)
{
  input[0] = 0;
  butn1 = butn2 = NULL;
}
```

```
InputWindw::~InputWindw(void)
{
  if (butn1 != NULL) delete butn1;
  if (butn2 != NULL) delete butn2;
}

void InputWindw::DrawWindow(void)
{
  CaptWindw::DrawWindow();
  butn1 = new Button(wx+ww/2-70, wy+108, "OK");
  butn1->DrawWindow();
  butn2 = new Button(wx+ww/2+6, wy+108, "CANCEL");
  butn2->DrawWindow();
  mouse.HideMouse();
  setfillstyle(SOLID_FILL, BLACK);
  bar(wx+15, wy+85, wx+ww-15, wy+99);
  mouse.ShowMouse();
}

void InputWindw::RunWindow(void)
{
  button = 0;
  while (!button)
  {
    GetEvent(evntmsg);
    if (butn1->Clicked(evntmsg))
      button = OK;
    else if (butn2->Clicked(evntmsg))
      button = CANCEL;
    else if (evntmsg.type == KEYBD)
    {
      char k = evntmsg.key & 0x00ff;
      HandleInput(k);
    }
  }
}

void InputWindw::HandleInput(char k)
{
  int l = strlen(input);
  int w = (ww - 30)/8;
  settextjustify(LEFT_TEXT, TOP_TEXT);

  // Check that an appropriate key was pressed
  // and that the string can hold another character.
  if ((k>31) && (k<127) && (l<80))
  {
    // Add character to string.
    input[l+1] = 0;  input[l] = k;

    // Draw the portion of the string that will
    // fit into the text entry field.
    setcolor(WHITE);
    if (l < w) outtextxy(wx+15, wy+88, input);
    else
    {
      int i = l - w + 1;
      setfillstyle(SOLID_FILL, BLACK);
      bar(wx+15, wy+85, wx+ww-15, wy+99);
      outtextxy(wx+15, wy+88, &input[i]);
    }
  }

  // Check for a Backspace character and that
  // the string has a character to delete.
```

```
  else if ((k==BACKSP) && (i>0))
  {
    // Delete the last character.
    i -= 1;
    input[i] = 0;

    // Draw the portion of the string that
    // will fit in the text entry field.
    setfillstyle(SOLID_FILL, BLACK);
    bar(wx+15, wy+85, wx+ww-15, wy+99);
    setcolor(WHITE);
    if (i < w+1) outtextxy(wx+15, wy+88, input);
    else
    {
      int i = i - w;
      outtextxy(wx+15, wy+88, &input[i]);
    }
  }
}

////////////////////////////////////////////////////////
// Implementation of the Button class
////////////////////////////////////////////////////////
Button::Button(int x, int y, char *s) :
         Windw(x, y, 64, 32, FALSE, FALSE)
{
  strcpy(label, s);
  altkey = 0;
  hotkey = 0;
}

void Button::DrawWindow(void)
{
  int pos = -1;
  char tlabel[20];

  Windw::DrawWindow();
  mouse.HideMouse();

  // Find and remove the ` character and
  // set the appropriate hot key.
  strcpy(tlabel, label);
  for (int i = 0; i<strlen(tlabel); ++i)
  {
    if (tlabel[i] == '`')
    {
      pos = i;
      hotkey = ctrlkeys[tlabel[i+1]-65];
      for (int j=i; j<strlen(tlabel); ++j)
        tlabel[j] = tlabel[j+1];
    }
  }

  if (strcmp(tlabel,"OK")==0) altkey = OKALT;
  else if (strcmp(tlabel, "CANCEL")==0) altkey = CANCELALT;

  // Center and draw text on button.
  int x = (wx+ww/2) - (strlen(tlabel)*4);
  setcolor(BLACK);
  outtextxy(x, wy+12, tlabel);

  // Underline the hot-key character.
  if (pos >= 0)
    line(x+pos*8, wy+20, x+pos*8+6, wy+20);

  mouse.ShowMouse();
```

```
int Button::Clicked(EvntMsg evntmsg)
{
  int mx, my;
  int click = FALSE;

  // Check whether button was selected by the mouse...
  if  ((evntmsg.type == MBUTTON) &&
      (evntmsg.mx>wx) && (evntmsg.mx<wx+ww) &&
      (evntmsg.my>wy) && (evntmsg.my<wy+wh))
  {
    ClickButton();
    click = TRUE;
  }

  // or was selected from the keyboard.
  else if (evntmsg.type == KEYBD)
  {
    if ((evntmsg.key == hotkey) || (evntmsg.key == altkey))
    {
      ClickButton();
      click = TRUE;
    }
  }
  return click;
}

void Button::ClickButton(void)
{
  int *buff;

  mouse.HideMouse();

  // Shift the image on the button down and right
  // to simulate button movement.
  int size = imagesize(wx+2, wy+2, wx+ww-2, wy+wh-2);
  buff = (int *)malloc(size);
  if (buff)
  {
    getimage(wx+2, wy+2, wx+ww-2, wy+wh-2, buff);
    putimage(wx+3, wy+3, buff, COPY_PUT);
    free(buff);
  }

  // Draw the button's borders so the
  // button appears to be depressed.
  setcolor(DARKGRAY);
  moveto(wx+ww, wy);
  lineto(wx, wy); lineto(wx, wy+wh);
  moveto(wx+ww-1, wy+1);
  lineto(wx+1, wy+1); lineto(wx+1, wy+wh-1);
  setcolor(WHITE);
  moveto(wx+1, wy+wh);
  lineto(wx+ww, wy+wh); lineto(wx+ww, wy);
  moveto(wx+2, wy+wh-1);
  lineto(wx+ww-1, wy+wh-1);
  lineto(wx+ww-1, wy+1);

  // Make button beep.
  sound ( 2000 );
  delay ( 100 );
  nosound();

  // Redraw button in unselected form.
  DrawWindow();
```

```
#include <bios.h>
#include "event.h"
#include "mous.h"

// Check for and retrieve key events.
int KeyEvent(void)
{
  // Check for key press.
  int key = bioskey(1);

  // Get key if one is available.
  if (key) key = bioskey(0);

  return key;
}

// Wait for an event. When one is received,
// construct an event message.
void GetEvent(EvntMsg &evntmsg)
{
  while ( ( !mouse.Event() ) && ( !(evntmsg.key = KeyEvent()) ) ) {}
  evntmsg.button = mouse.GetButton();
  if (evntmsg.button)
  {
    evntmsg.type = MBUTTON;
    mouse.GetXY(evntmsg.mx, evntmsg.my);
  }
  else
  {
    evntmsg.type = KEYBD;
    evntmsg.mx = -1;
    evntmsg.my = -1;
  }
}
```

```
#ifndef _EVENT_H
#define _EVENT_H

#define MBUTTON 1
#define KEYBD   2

#define CR     13
#define ESC    27
#define BACKSP 8

typedef struct EvntMsg
{
  int type,     // Event type.
      mx, my,   // Mouse coords.
      button;   // Mouse button pressed.
  unsigned key; // Key pressed.
};

#endif
```

```
// MOUS.CPP: Mouse class implementation.

#include <dos.h>
#include <conio.h>
#include "mous.h"

Mouse mouse;

// Initialize the mouse.
Mouse::Mouse(void)
{
  got_mouse = 0;
  _AX = 0x00;
  geninterrupt(0x33);
  got_mouse = _AX;
  num_buttons = _BX;
}

// Set the mouse's screen coord limits.
void Mouse::SetLimits(int min_Xlimit, int max_Xlimit,
                      int min_Ylimit, int max_Ylimit)
{
  if (!got_mouse) return;
  _AX = 0x07;
  _CX = min_Xlimit;
  _DX = max_Xlimit;
  geninterrupt(0x33);
  _AX = 0x08;
  _CX = min_Ylimit;
  _DX = max_Ylimit;
  geninterrupt(0x33);
}

// Check the status of the mouse's buttons
// and get the mouse's current position.
int Mouse::Event(void)
{
  if (!got_mouse) return 0;
  MouseIntr(0x03);
  button = bx;
  mx = cx;
  my = dx;
  if (button) return 1;
  else return 0;
}

// Wait for mouse button to be released.
void Mouse::ButtonUp(void)
{
  while (button) Event();
}

// Call a mouse function.
void Mouse::MouseIntr(int func)
{
  if (!got_mouse) return;
  _AX = func;
  geninterrupt(0x33);
  ax = _AX;
  bx = _BX;
  cx = _CX;
  dx = _DX;
}
```

ต้นฉบับ หน้าขาดหาย

```
//    ********************************************
//    ********************************************
//             RCPP Package version 1.00
//    Refrigeration Calorimetor Performance Package
//                copyright 1994
//                  by PHOENIX
//    ********************************************
//    ********************************************

#include <stdio.h>
#include <conio.h>
#include <stdlib.h>
#include <graphics.h>
#include <math.h>

#define Temperature 1
#define Enthalpy_11 2
#define Enthalpy_2  3
// Definition of State_Equation
#define A   24.803398
#define B  -3980.408
#define C  -0.02405332
#define D   0.00002245211
#define E   0.1995548
#define F   374.8473
// Definition of Density
#define R    81.44*pow(10,-3.0)
#define b    0.3455467*pow(10,-3.0)
#define K    5.475
#define A2  -0.1195051
#define A3   0.01447797*pow(10,-3.0)
#define A4  -1.049005*pow(10,-7.0)
#define A5  -6.953904*pow(10,-12.0)
#define B2   0.113759*pow(10,-3.0)
#define B3  -0.8942552*pow(10,-7.0)
#define B5   1.269806*pow(10,-13.0)
#define C2  -3.531592
#define C3   0.6469248*pow(10,-2.0)
#define C5  -2.051369*pow(10,-9.0)
// Definition of Flow Rate Equation
#define U   1.116      // Coefficient of Cylinder's transfer heat
#define Vd  0.91       // Displacement of pistol
// Definition of Enthalpy Equation
#define H0     109.36
#define Tcr    347.25
#define Cp1   -0.5257455*pow(10,-2.0)
#define Cp2    0.329657*pow(10,-2.0)
#define Cp3   -2.017321*pow(10,-6.0)
#define Cp4    0.0
#define Cp5    15.82170

int Calculate(float Pc,float Pv,float Qw,float Twi,float Tamb,float Zeta_S)
{
   float State_Equation(float p);
   float OpenTable(float p,int type);
   float Density(float P,float T);
   float B_Flowrate(float Tv,float Tamb,float Qw,float H3,float H4,float Zeta_S);
   float A_Flowrate(float density,float Zeta_S);
   float T1_superheat(float Pv,float Pc,float Tv,float Zeta_S);
   float Bhp_Work(float Pc,float Pv,float V4,float Zeta_S);
   float Heat_rejection(float Mr,float H1,float H2);
   float Q_liquid(float Mr,float H11,float H2);
   float Q_solid(float Mr,float H1,float H11);
   float Mw_minimum(float T2,float Twi,float Q1);
```

```
float T_WM(float Mw,float Twi,float Ql);
float T_WO(float Mw,float Twm,float Qs);
float Delta_lm(float T1,float T2,float Twm,float Two);
float UA(float Qs,float lm);
float Enthalpy(float P,float v,float T);
float COP_Act(float H1,float H3,float H4);
float COP_Overall(float Qw,float Tamb,float T4,float Wbhp);
// OUTPUT
extern float Tv,Tc,T1,T2,T3,T4;
extern float H1,H2,H3,H4,H11;
extern float V1,V2,V4;
extern float density4,density2,density1;
extern float Work,Mr_A,Mr_B;
extern float Ql,Qs,Qc,Mw,Two,Twm,lm,ua;
extern float COP_ACT,COP_OVERALL,Polytropic;
int Check=0;
char string[80];
T2 = OpenTable(Pc,Temperature);                    // Find out : T2
Tv = OpenTable(Pv,Temperature);                    // Find out : Tv
H11 = OpenTable(Pc,Enthalpy_11);
Tc = T2;
density2 = Density(Pc,T2);       // Find out : Density 2
V2 = 1/density2;                    // Find out : V2
H2 = OpenTable(Pc,Enthalpy_2);
T3 = OpenTable(Pv,Temperature);
H3 = H2;                            // Find out : H3

loop :   T4 = Tv + Zeta_S;                    // Find out : T4
         T1 = T1_superheat(Pv,Pc,Tv,Zeta_S);// Find out : T1
         density4 = Density(Pv,T4);       // Find out : Density 4
         V4 = 1/density4;                    // Find out : V4
         density1 = Density(Pc,T1);
         V1 = 1/density1;
         H1 = Enthalpy(Pc,V1,T1);
         H4 = Enthalpy(Pv,V4,T4);         // Find out : H4
         Mr_B = B_Flowrate(Tv,Tamb,Qw,H3,H4,Zeta_S);      // Find out : Mr_A
         Mr_A = A_Flowrate(density4,Zeta_S);              // Find out : Mr_B
         setcolor(LIGHTGRAY);
         outtextxy(290,240," Wait !");
         setcolor(WHITE);
         outtextxy(290,240," Wait !");
         if((Mr_B-Mr_A)<-10)
         {
            Zeta_S+=3;
            goto loop;
         }
         if((Mr_B-Mr_A)>=0.0001 || (Mr_B-Mr_A)<-10)
         {
            if(fabs(Mr_B-Mr_A)>1) Zeta_S+=15;
            if(fabs(Mr_B-Mr_A)>0.5) Zeta_S+=10;
            if(fabs(Mr_B-Mr_A)>0.2) Zeta_S+=3;
            Zeta_S+=1;
            Check+=1;
            setcolor(LIGHTGRAY);
            outtextxy(290,240," Wait !");
            setcolor(WHITE);
            outtextxy(290,240," Wait !");
            if(Check >=70)
            {
               closegraph();
               printf("CHECK VALUE >= 70.. ERROR IN LINE 115 CAL.CPP.");
               exit(0);
            }
            goto loop;
         }
         Work = Bhp_Work(Pc,Pv,V4,Zeta_S);
```

```
}

// Equation (17)
// This function returns density value.
// define volumn simulate = 0.0001-1.0
// Find out : density.
float Density(float P,float T)
{
   float left,right;
   float Tr;
   float v;
   double expo;
   Tr = T/Tcr;
   expo = exp(-K*Tr);
   left = P;
   for(v=0.005; v<1; v+=0.00001)
   {
      if((v-b)==0) v+=0.00001;
      right = R*T/(v-b) + (A2+B2*T+C2*expo)/pow((v-b),2.0) +
              (A3+B3*T+C3*expo)/pow((v-b),3.0) + A4/pow((v-b),4.0) +
              (A5+B5*T+C5*expo)/pow((v-b),5.0);
      if(fabs(right-left)<=0.5) goto loop;
      if(fabs(right-left)>100) v+=0.001;
   }
   if(fabs(right-left)>0.5)
   {
      closegraph();
      printf("Can't find suitable value\n");
      printf("Module : Density..line 225");
      exit(0);
   }
loop :   return 1/v;
}

// This function returns Enthalpy value
// which retrieve from Table.pth file.
// define dif_value = 0.5    ( No Interpolate )
// Find out : H3=H2,H11,T2,T11,Tv
float OpenTable(float p,int type)
{
   FILE *fp;
   char ch;
   char buffer[20];
   float min_p,max_p,
         min_t,max_t,
         min_h2,max_h2,
         min_h11,max_h11;
   float T,H2,H11;
   int i,count = 0;
   int countline = 0;
   if(p<106.382)
   {
      closegraph();
      printf("Error in OpenTable line 250");
      exit(0);
   }
   if((fp=fopen("c:\\thermo\\table.pth","r"))==NULL)
   {
      closegraph();
      printf("Can't open table file for read\n");
      printf("Check file Table.pth in c:\Thermo> ");
      exit(0);
   }
   ch = 'A';
loop :   for(i=0;ch!=':';i++)
         {
```

```
      ch = getc(fp);
      if(ch==EOF)
         {
         closegraph();
         printf("Out of Table\n");
         exit(0);
         }
      buffer[i] = ch;
   }
buffer[i] = '\0';
max_p = atof(buffer);

if(p<=max_p )
{
 x: ch = 'A';
   count+=1;
   for(i=0;ch!=':';i++)
   {
      ch = getc(fp);
      if(ch==EOF)
         {
         closegraph();
         printf("Out of Table\n");
         exit(0);
         }
      buffer[i] = ch;
   }
buffer[i] = '\0';
if(count == 1) max_t   = atof(buffer);
if(count == 2) max_h2  = atof(buffer);
if(count == 3) max_h11 = atof(buffer);
if(count<3)  goto x;
}
else
{
   while(ch!='\n'&& ch!=EOF) ch = getc(fp);
   countline+=1;
   goto loop;
}
fclose(fp);
if((fp=fopen("c:\\thermo\\table.pth","r"))==NULL)
{
   closegraph();
   printf("Can't open table file for read\n");
   printf("Check file Table.pth in c:\Thermo> ");
   exit(0);
}
for(i=1; i<countline; i++)
{
   while(ch!='\n'&& ch!=EOF)
   ch = getc(fp);
   ch = 'A';
}
ch = 'A';
count = 0;
xx: ch = 'A';
   count+=1;
   for(i=0;ch!=':';i++)
   {
      ch = getc(fp);
      if(ch==EOF)
         {
         closegraph();
         printf("Out of Table\n");
         exit(0);
         }
```

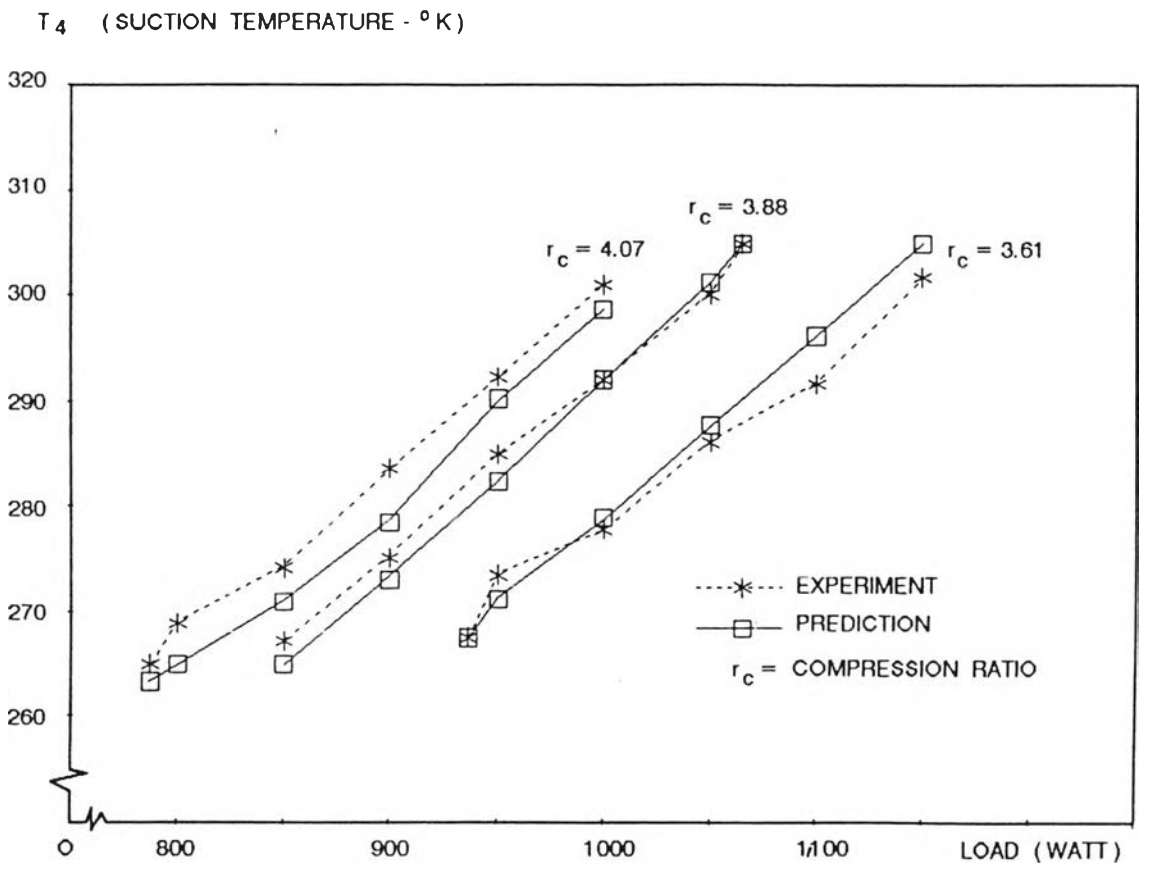
```
            buffer[i] = ch;
        }
        buffer[i] = '\0';
        if(count == 1) min_p   = atof(buffer);
        if(count == 2) min_t   = atof(buffer);
        if(count == 3) min_h2  = atof(buffer);
        if(count == 4) min_h11 = atof(buffer);
        if(count<4)  goto xx;

        T   = min_t+((max_t-min_t)*(p-min_p)/(max_p-min_p));
        H2  = min_h2+((max_h2-min_h2)*(p-min_p)/(max_p-min_p));
        H11 = min_h11+((max_h11-min_h11)*(p-min_p)/(max_p-min_p));
        fclose(fp);
        switch(type)
        {
           case Temperature : return T;
           case Enthalpy_11 : return H11;
           case Enthalpy_2  : return H2;
           default          : return -99;
        }
}

// Equation (7),(8)
// This function returns flow rate which assume "B"
float B_Flowrate(float Tv,float Tamb,float Qw,float H3,float H4,float Zeta_S)
{
   float Qg,B_Mr;
   float T4;
   T4 = Tv + Zeta_S;
   Qg = U*(Tamb-T4);
   B_Mr = (Qw+Qg)/(H4-H3);
   return B_Mr;
}

// Equation (5)
// This function returns flow rate which assume "A"
float A_Flowrate(float density,float Zeta_S)
{
   float A_Mr;
   float Nv_coeffic;
   Nv_coeffic = 2.117*pow(10.0,-3.0)*Zeta_S + 0.63;
   A_Mr = density*Vd*Nv_coeffic;
   return A_Mr;
}

// Equation (1)
// This function returns superheat temperature value at point 1.
float T1_superheat(float Pv,float Pc,float Tv,float Zeta_S)
{
   float T1,T4;
   float polytropic_expo;
   polytropic_expo = -1.45*pow(10.0,-3.0)*Zeta_S + 1.161;
   T4 = Tv + Zeta_S;
   T1 = T4*pow(Pc/Pv,polytropic_expo-1);
   return T1;
}

// This function returns break-horse-power Work.
float Bhp_Work(float Pc,float Pv,float V4,float Zeta_S)
{
   float Work;
   float polytropic_expo;
   float degree;
   polytropic_expo = -1.45*pow(10.0,-3.0)*Zeta_S + 1.161;
   degree = (polytropic_expo-1)/polytropic_expo;
   Work = (polytropic_expo/(polytropic_expo-1))*Pv*1.38*(pow(Pc/Pv,degree)-1);
```

```
   return Work;
}

// This function returns heat-rejection value.
// Find out : Qc
float Heat_rejection(float Mr,float H1,float H2)
{
   float Qc;
   Qc = Mr*(H1-H2);
   return Qc;
}

// ***************** CONDENSOR MODULE ********************

// This function returns Ql value.
// Find out : Ql
float Q_liquid(float Mr,float H11,float H2)
{
   float Ql;
   Ql = Mr*(H11-H2);
   return Ql;
}

// This function returns Qs value.
// Find out : Qs
float Q_solid(float Mr,float H1,float H11)
{
   float Qs;
   Qs = Mr*(H1-H11);
   return Qs;
}

// This function returns the initial value of Mw.
float Mw_minimum(float T2,float Twi,float Ql)
{
   float Mw_min;
   Mw_min = Ql/(4200*(T2-Twi));
   return Mw_min+0.0001;
}

// Equation (12)
// This function returns Twm.
float T_WM(float Mw,float Twi,float Ql)
{
   float Twm;
   Twm = (Ql/(4200*Mw))+Twi;
   return Twm;
}

// Equation (13)
// This function returns Two.
float T_WO(float Mw,float Twm,float Qs)
{
   float Two;
   Two = (Qs/(4200*Mw))+Twm;
   return Two;
}

// Equation (15)
// This function returns Delta_lm.
float Delta_lm(float T1,float T2,float Twm,float Two)
{
   float lm;
   lm = ((T2-Twm)-(T1-Two))/log((T2-Twm)/(T1-Two));
   return lm;
}
```

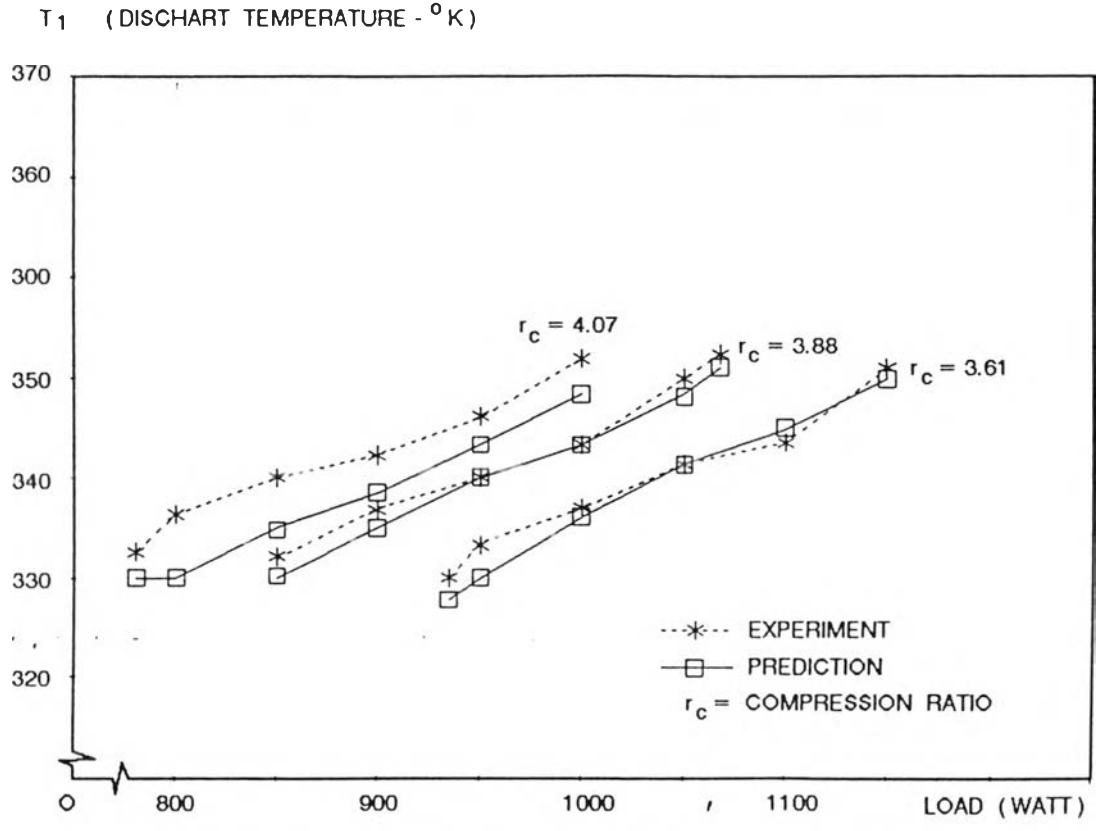
```
// Equation (14)
// This function returns UA
float UA(float Qs,float lm)
{
   float ua;
   ua = Qs/(1000*lm);
   return ua;
}


// Equation (18)
// This functions returns Entralpy value.
// Find out : H11,H4
float Enthalpy(float P,float v,float T)
{
   float H;
   float Tr;
   Tr = T/Tcr;
   H = H0 + (P*v-R*T) + (Cp1*T + Cp2*pow(T,2.0)/2 + Cp3*pow(T,3.0)/3 +
       Cp4*pow(T,4.0)/4 + Cp5*log(T)) + (A2/(v-b) + A3/(2*pow(v-b,3.0))
       + A4/(3*pow(v-b,3.0)) + A5/(4*pow(v-b,5))) + exp(-K*Tr)*(1+K*Tr)*
       (C2/(v-b) + C3/(2*pow(v-b,2.0)) + C5/(4*pow(v-b,4.0)));
   return H;
}

// This function returns COP_act.
float COP_Act(float H1,float H3,float H4)
{
   float cop_act;
   cop_act = (H4-H3)/(H1-H4);
   return cop_act;
}

// This function returns COP_overall.
float COP_Overall(float Qw,float Tamb,float T4,float Wbhp)
{
   float cop_overall,Qg;
   Qg = U*(Tamb-T4);
   cop_overall = (Qw+Qg)/Wbhp;
   return cop_overall;
}
```

ภาคผนวก ค.

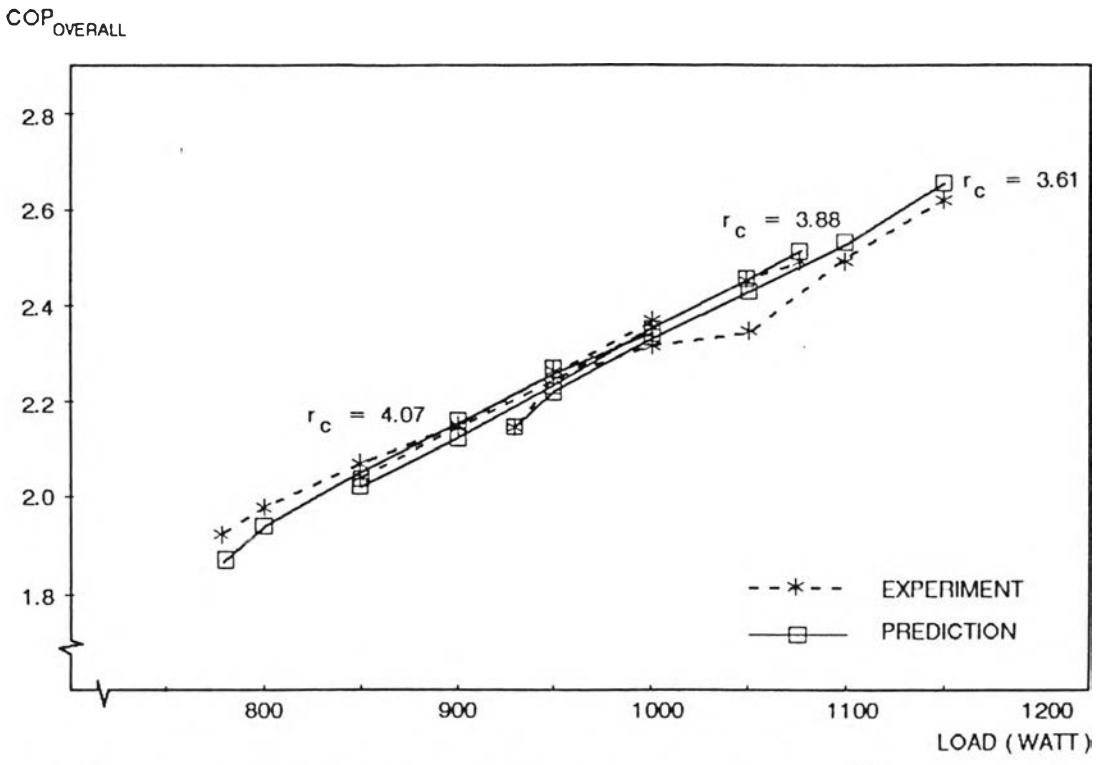
แสดงการเปรียบเทียบผลการทดลอง กับ โปรแกรมคอมพิวเตอร์



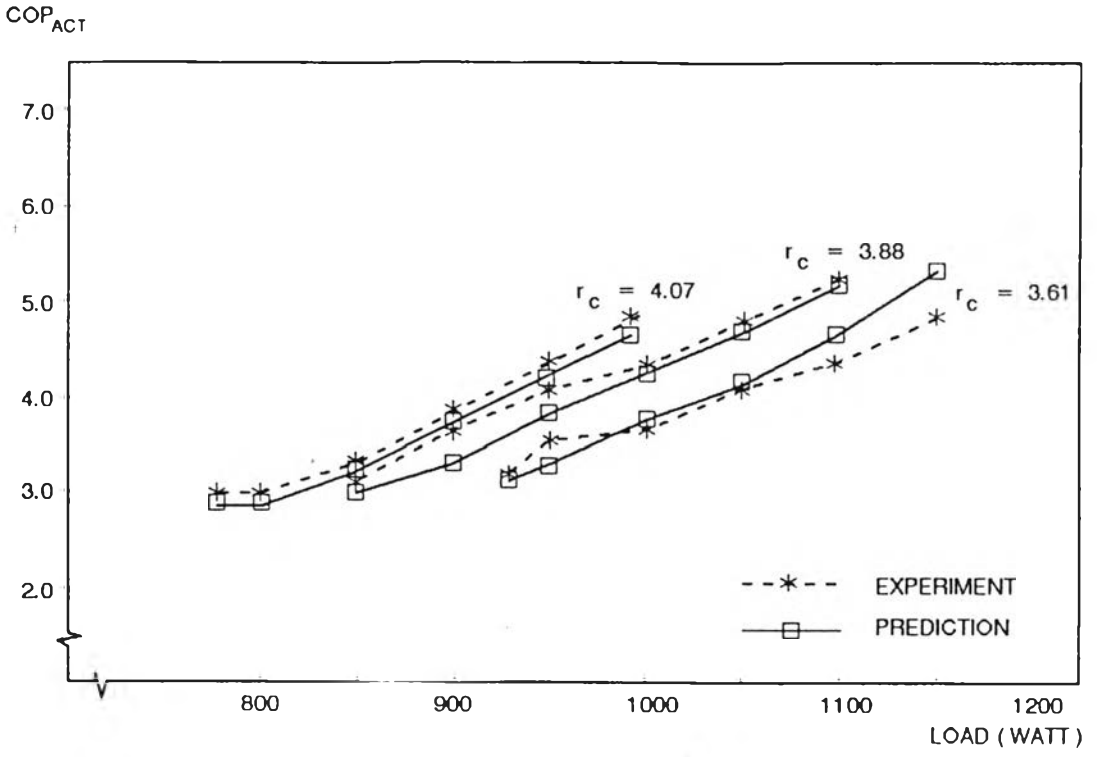
กราฟรูปที่ ค.1 แสดงการเปรียบเทียบค่าอุณหภูมิของสารทำความเย็นก่อนเข้าคอมเพรสเซอร์



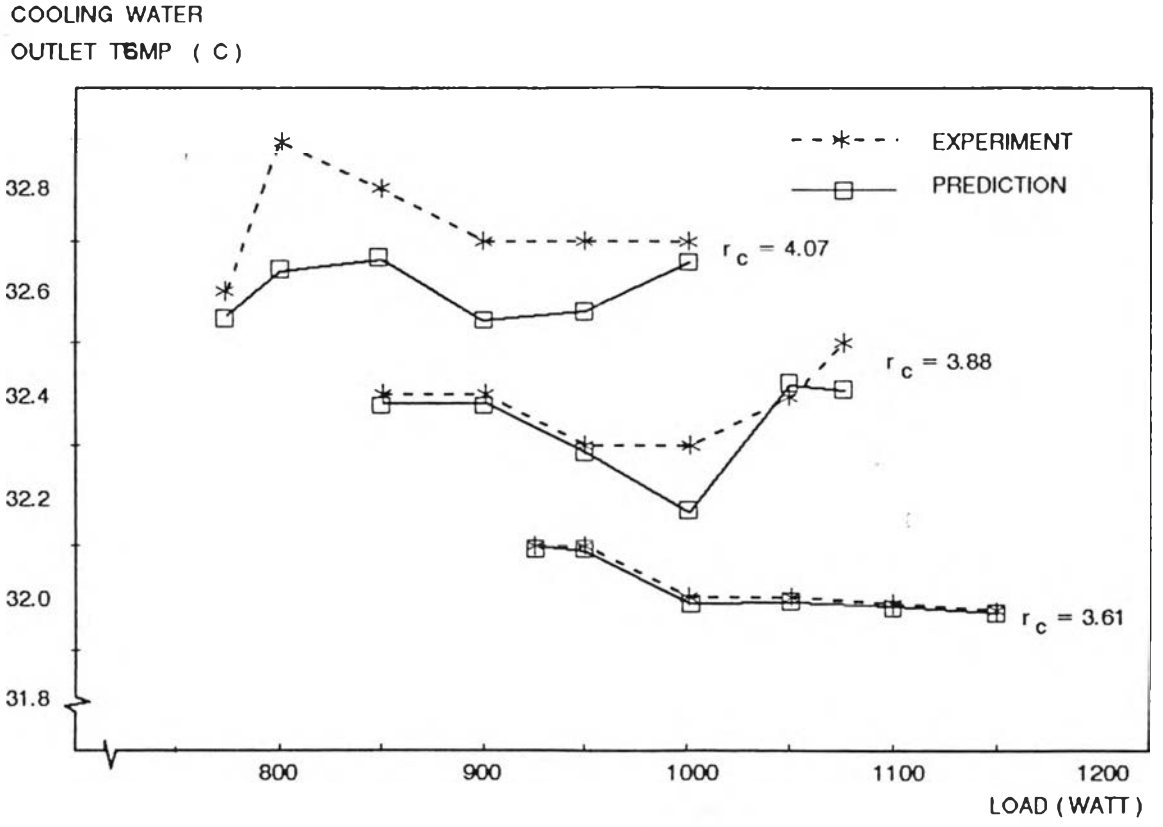
กราฟรูปที่ ค.2 แสดงการเปรียบเทียบค่าอุณหภูมิของสารทำความเย็นด้านขาออกจากคอมเพรสเซอร์



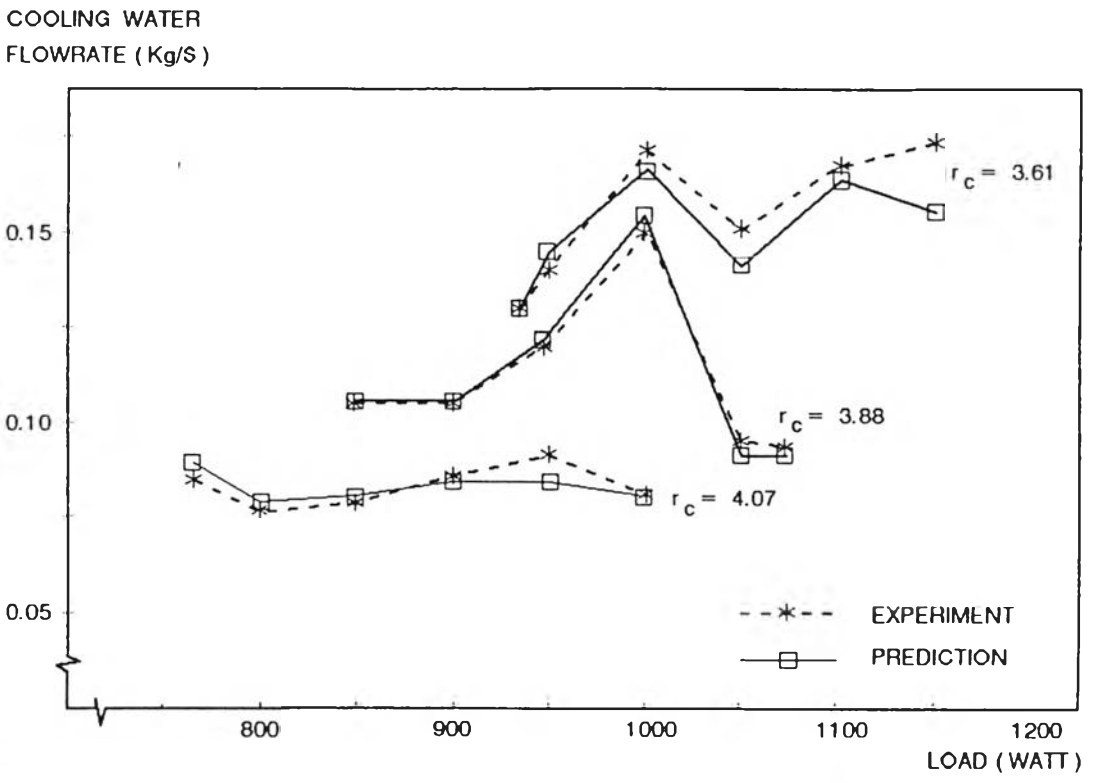
กราฟรูปที่ ค.3 แสดงการเปรียบเทียบค่าสัมประสิทธิ์สมรรถนะรวมของเครื่องทดสอบความเย็น



กราฟรูปที่ ค.4 แสดงการเปรียบเทียบค่าสัมประสิทธิ์สมรรถนะทางปฏิบัติของเครื่องทดสอบความเย็น



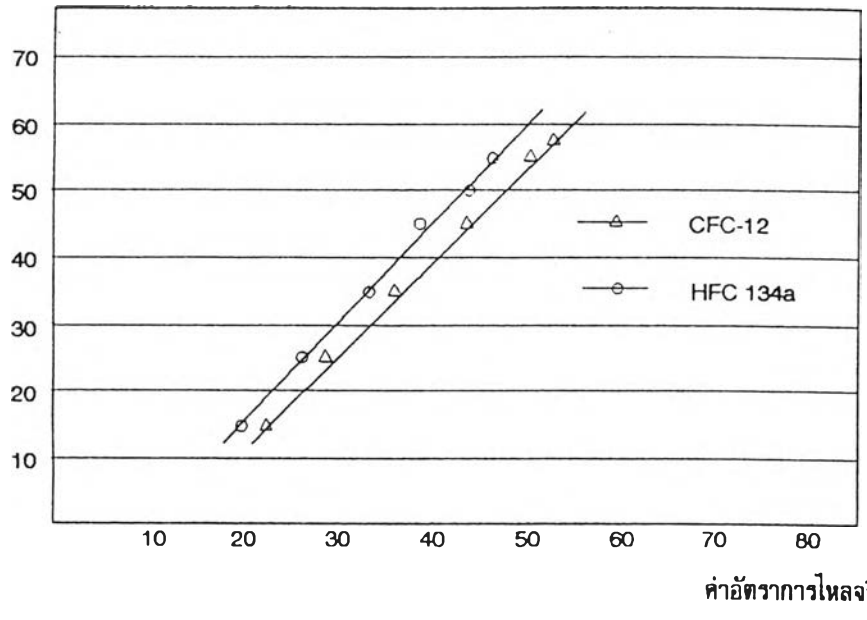
กราฟรูปที่ ค.5 แสดงการเปรียบเทียบอุณหภูมิของน้ำหล่อเย็นขาออกจากคอมเพรสเซอร์

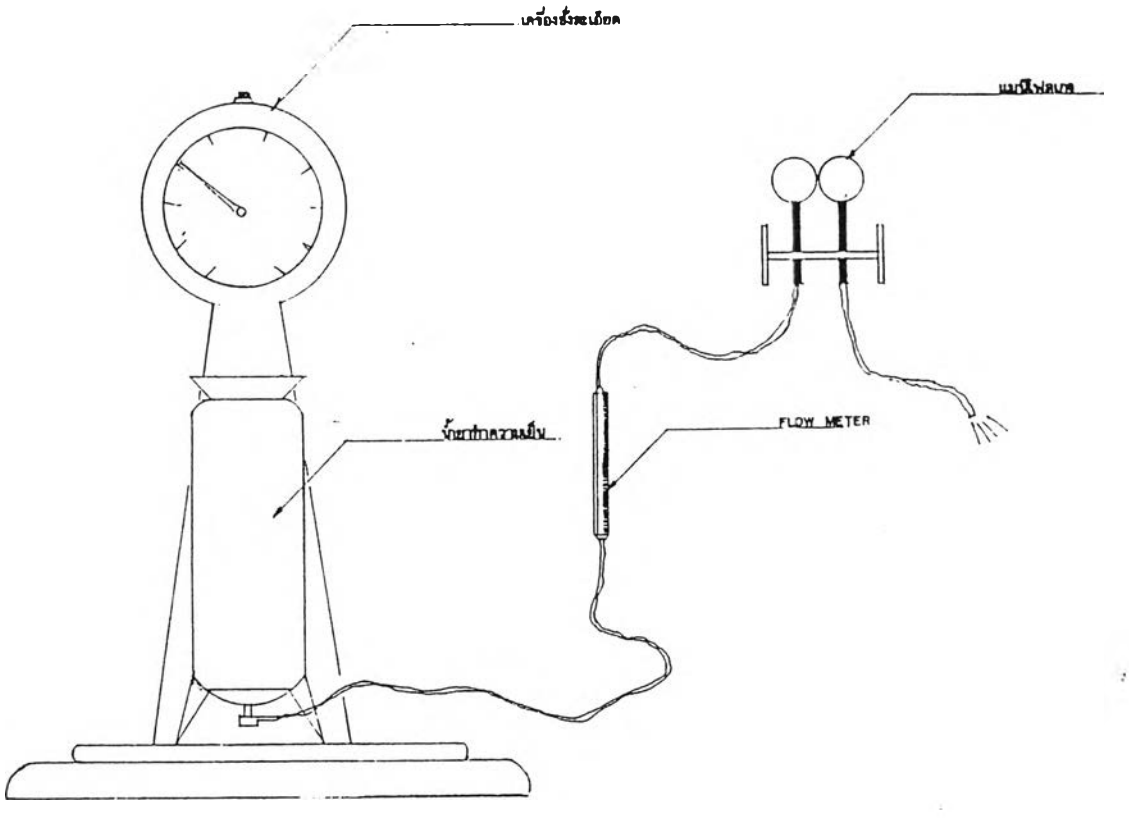


กราฟรูปที่ ค.6 แสดงการเปรียบเทียบค่าอัตราการไหลของน้ำหล่อเย็น

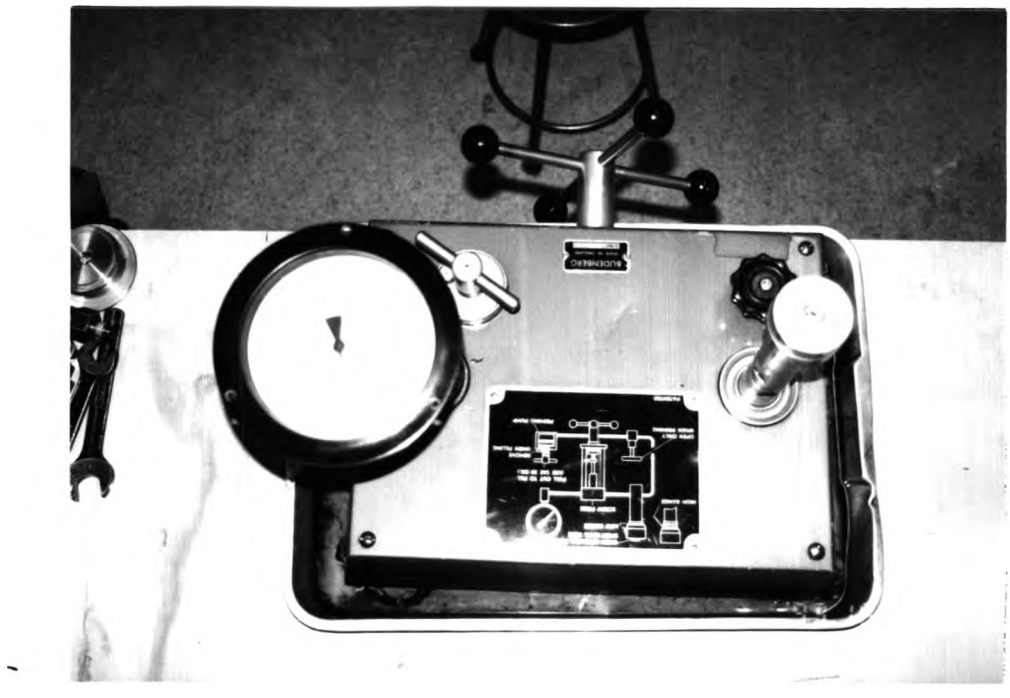
Cooling

ภาคผนวก ง.
การปรับเทียบอุปกรณ์





กราฟรูปที่ ง.1 แสดงการปรับเทียบเครื่องวัดอัตราการไหลของสารทำความเย็น

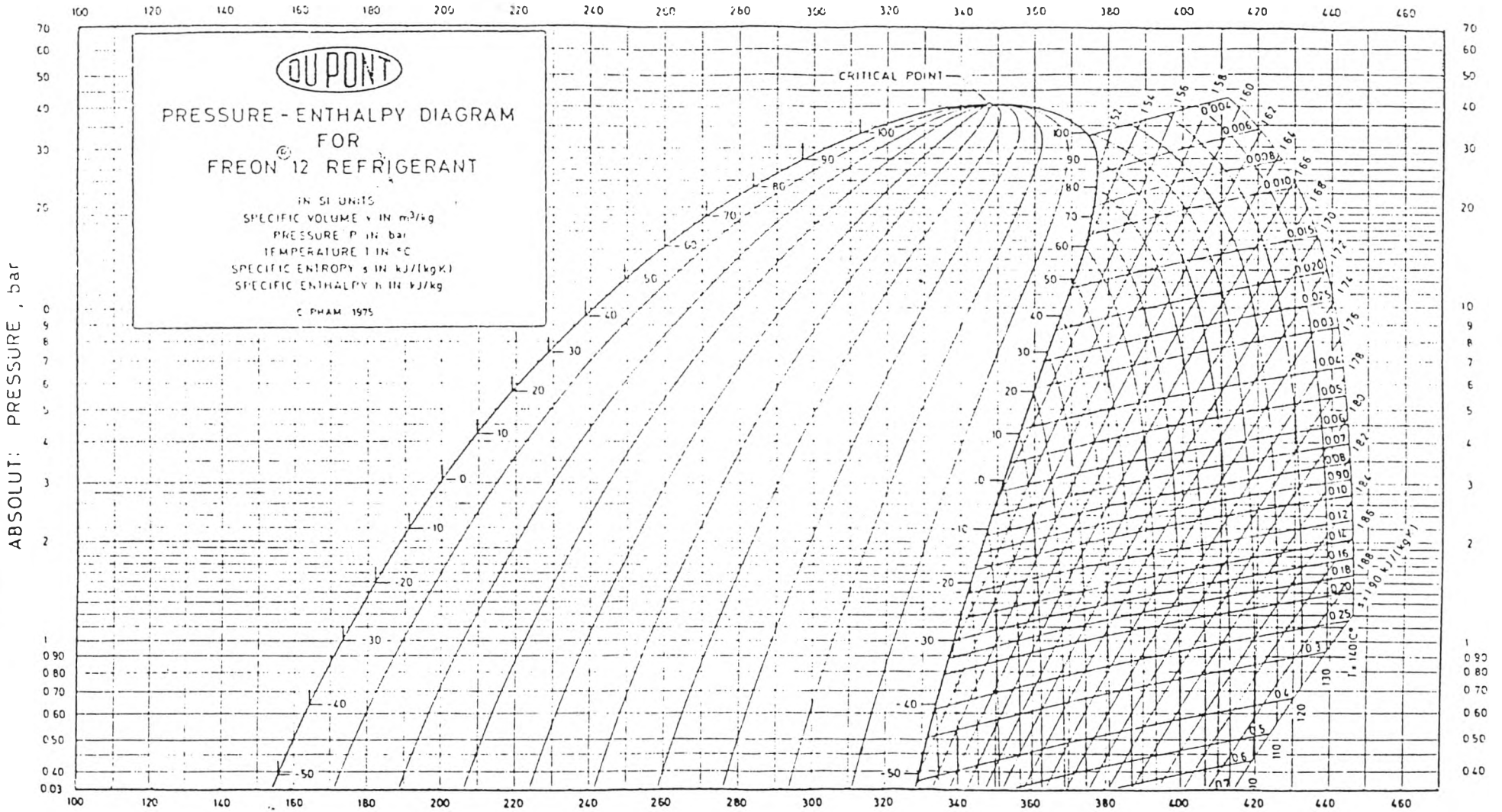


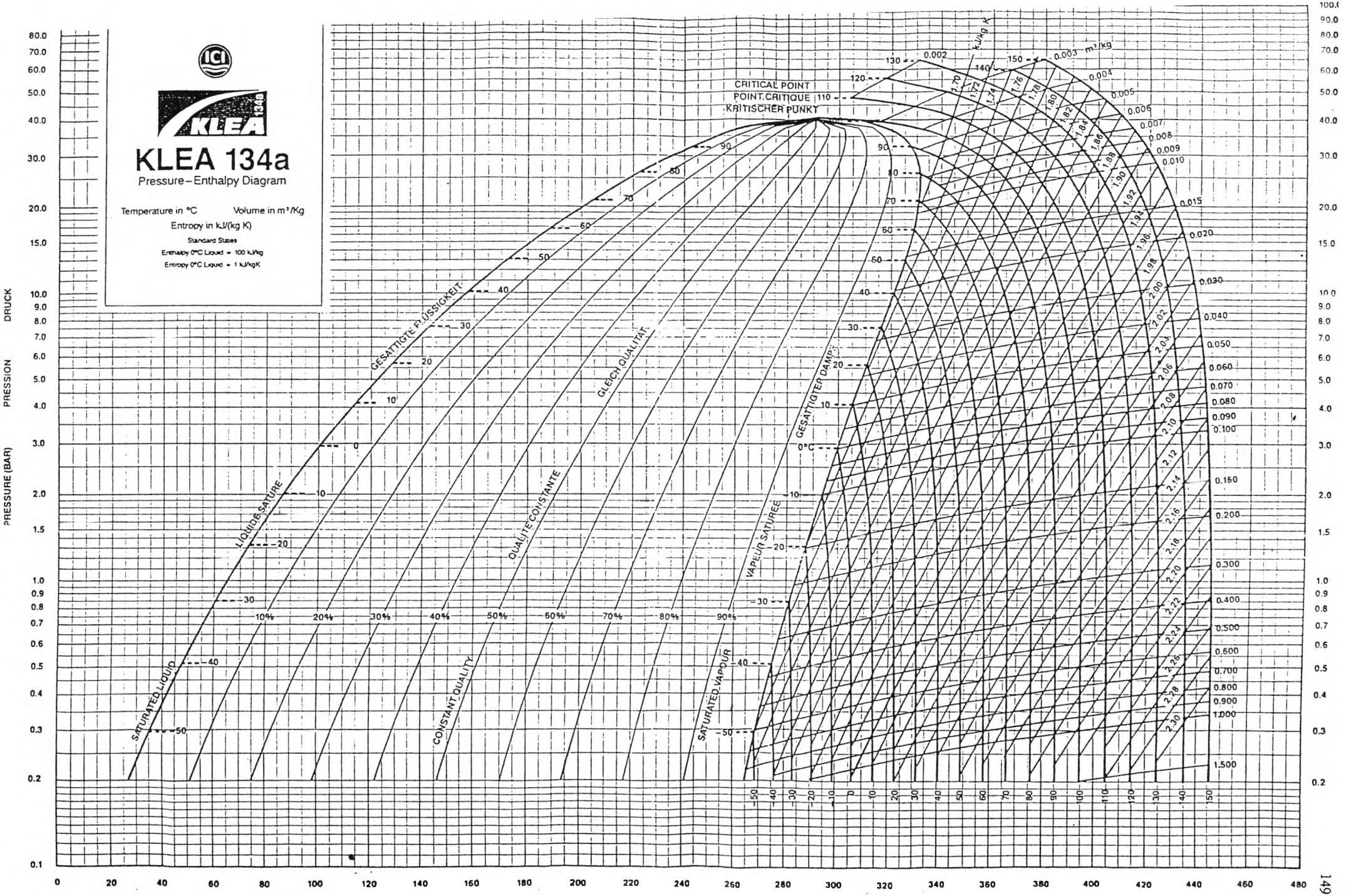
กราฟรูปที่ ง.2 แสดงการปรับเทียบมาตรวัดความดัน

ภาคผนวก จ.

แผนภาพความดัน-เอนทัลปีของสารทำความเย็น

CFC-12 และ HFC-134a


DUPONT
PRESSURE - ENTHALPY DIAGRAM
FOR
FREON® 12 REFRIGERANT
IN SI UNITS
SPECIFIC VOLUME v IN m³/kg
PRESSURE P IN bar
TEMPERATURE T IN °C
SPECIFIC ENTROPY s IN kJ/(kgK)
SPECIFIC ENTHALPY h IN kJ/kg
© PHAM 1975
CRITICAL POINT
ABSOLUTE PRESSURE , bar
SPECIFIC ENTHALPY , kJ/kg


KLEA 134a
Pressure–Enthalpy Diagram
Temperature in °C
Volume in m³/Kg
Entropy in kJ/(kg K)
Standard States
Enthalpy 0°C Liquid = 100 kJ/kg
Entropy 0°C Liquid = 1 kJ/kgK
PRESSURE (BAR)
PRESSION
DRUCK
CRITICAL POINT
POINT CRITIQUE
KRITISCHER PUNKT
SATURATED LIQUID
LIQUIDE SATURE
GESÄTTIGTE FLÜSSIGKEIT
CONSTANT QUALITY
QUALITE CONSTANTE
GLEICH QUALITÄT
SATURATED VAPOUR
VAPEUR SATUREE
GESÄTTIGTER DAMPF
kJ/kg K
m³/kg

ประวัติผู้เขียน

นาย อำนาจ หาญวงศ์ไพบูลย์ เกิดเมื่อวันที่ 20 ธันวาคม 2510 ที่ กรุงเทพฯ จบการศึกษาระดับปริญญาตรีทางด้านวิศวกรรมเครื่องกล ที่จุฬาลงกรณ์มหาวิทยาลัย เมื่อปี 2533 ประวัติการทำงาน เป็นวิศวกรออกแบบงานระบบปรับอากาศ และ ระบบสุขาภิบาล อาทิเช่น อาคารสำนักงานใหญ่ธนาคารไทยพานิชย์ อาคาร ตึกสก.ของโรงพยาบาลจุฬาลงกรณ์ อาคารสีสวนพลาซ่า เชียงใหม่ ฯลฯ ปัจจุบัน ทำงานบริษัทไทยเลดัน จำกัด ในตำแหน่งวิศวกรประสานงานระบบ