APPENDICES

APPENDIX I

TEST DATA

TABLE 3.1 Test Data of Experiment 3.1

"Freon-12" plant by varying the suction pressure
at delivery pressure = 140 psi., suction gas temperature = 85 F
motor speed = 1410 rpm., compressor speed = 670 rpm.

Test No.	1	2	3	4	5	6	7	8
Ambient air F	87.8	89.6	87.8	87.5	89.6	89.2	85.4	90.0
Comp. motor load lb.	2.12	2.20	2.30	2.40	2.49	2.57	2.62	2.68
Suction gage - psi.	10.1	12.0	14.65	17.7	21.0	24.1	26.0	30.0
- F	2.0	5.34	10.0	15.0	20.0	24.2	26.7	32.0
Liquid gage - psi.	138.0	138.0	138.0	138.0	137.5	137.5	137.5	137.0
- F	110.8	110.8	110.8	110.8	110.5	110.5	110.5	110.3
Expansion gage - psi.	11.2	13.2	15.8	19.3	23.0	26.3	28.2	32.5
- F	3.9	7.6	12.0	17.4	22.8	27.2	29.7	34.9
Condenser cooling water								
- in F	88.4	90.2	88.9	89.2	90.6	90.0	87.1	89.0
- out F	107.2	106.5	104.9	103.8	102.2	101.1	101.0	99.3
- rise F	18.8	16.3	16.0	14.6	11.6	11.1	13.9	10.3
- flow lb/hr	199.0	248.0	284.5	354.2	513.0	593.5	502.8	780.0
Liquid refrigerant temp.								
-at condenser F	94.4	94.6	93.9	94.1	94.1	93.8	91.8	92.8
-at expansion F	91.8	93.4	91.6	92.2	93.2	92.8	90.9	92.2
Vapor refrigerant temp.								
-at suction F	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
-at delivery F	210.0	206.2	201.0	196.0	193.0	187.0	182.0	180.0
Calorimeter								
- gage psi.	92.0	91.2	92.3	92.2	92.2	92.5	94.2	92.2
- gage F	85.14	84.64	85.37	85.27	85.27	85.46	86.7	85.27
- watts input	850	925	1070	1250	1410	1620	1785	1960
Flowmeter lb/hr								
- cond. water	190	240	280	350	500	580	490	760
- refrigerant	50	56	63	73	83	93	100	114

TABLE 3.2 Test Data of Experiment 3.2

"Freon-12" plant by varying the suction gas temperature

at delivery pressure = 140 psi., suction pressure = 21 psi.

motor speed = 1410 rpm., compressor speed = 670 rpm.

Test No.	1	2	3	4	5	6	7	8	9
Ambient air F	91.8	92.2	86.7	88.2	86.9	87.0	88.4	82.8	88.2
Compressor motor									
- load lb.	2.58	2.58	2.58	2.60	2.55	2.55	2.55	2.55	2.56
Condenser cooling water									
- in F	90.7	90.3	87.6	88.9	88.5	88.5	88.9	86.2	88.5
- out F	103.3	103.0	103.3	106.1	102.0	102.4	102.4	102.9	101.5
- rise F	12.6	12.7	15.7	17.2	13.5	13.9	13.5	16.7	13.0
- flow lb/hr	472	470	384	348	445	433	450.5	362.2	465
Liquid refrigerant temperature									
- at cond. F	95.3	95.0	92.6	92.8	93.2	92.8	93.4	91.8	92.8
- at exp. F	94.2	93.8	91.4	91.5	91.8	91.4	92.3	89.8	91.4
Vapor refrigerant temperature									
- at suct. F	34.3	39.9	44.0	46.5	50.2	56.2	61.2	67.0	76.2
- at del. F	154.8	160.3	163.4	164.0	166.0	169.5	174.0	178.0	183.0
Calorimeter									
- gage psi.	29.3	30.0	33.7	36.0	40.2	49.2	54.5	65.0	78.3
- gage F	31.4	32.0	36.5	39.0	43.5	52.3	57.0	66.0	70.0
- watts input	1210	1260	1295	1315	1350	1372	1400	1440	1470
Flowmeter lb/hr									
- cond. water	462	460	380	340	440	425	440	360	453
- refrigerant	88.5	88.5	87.5	88.0	89.0	88.5	88.5	88.0	88.5

TABLE 4.1 Test Data of Experiment 4.1

"Freon-22" plant by varying the suction pressure
at delivery pressure = 200 psi., suction gas temperature = 85 F
motor speed = 1410 rpm., compressor speed = 670 rpm.

Test No.	1	2	3	4	5	6	7
Ambient air F	86.7	86.9	87.4	86.0	86.0	85.6	83.4
Compressor motor load lb.	2.98	3.13	3.23	3.34	3.41	3.51	3.60
Suction gage - psi.	24.8	28.0	31.0	34.1	37.0	40.3	43.3
- F	0.95	4.6	8.0	11.2	14.16	17.26	20.0
Liquid gage - psi.	200	200	200	200	200	200	200
- F	100.7	100.7	100.7	100.7	100.7	100.7	100.7
Expansion gage - psi.	26.0	29.7	32.6	35.8	39.0	42.0	45.0
- F	2.32	6.75	9.65	12.92	16.03	18.83	21.53
Condenser cooling water							
- in F	86.5	86.7	87.2	87.0	86.6	86.4	84.0
- out F	100.9	100.8	100.8	100.8	100.3	100.0	99.7
- rise F	14.4	14.1	13.6	13.8	13.7	13.6	15.7
- flow lb/hr	389.5	440.0	502.5	535.0	583.0	626.0	584.0
Liquid refrigerant temperature							
- at condenser F	99.2	99.5	99.6	100.0	100.0	99.8	99.5
- at expansion F	96.8	97.3	97.5	98.0	98.0	98.0	97.5
Vapor refrigerant temperature							
- at suction F	85.0	85.0	85.0	85.0	85.0	85.0	85.0
- at delivery F	236.5	232.0	228.5	225.5	220.5	215.0	210.0
Calorimeter							
- gage psi.	92.0	92.5	93.5	93.5	94.0	94.5	94.5
- gage F	85.4	85.8	86.2	86.2	86.6	87.0	87.0
- watts input	1290	1465	1620	1780	1930	2120	2350
Flowmeter lb/hr							
- cond. water	380	425	495	520	570	610	570
- refrigerant	59	67	73	80	87	94.5	102.5

TABLE 4.2 Test Data of Experiment 4.2

"Freon-22" plant by varying the suction gas temperature at delivery pressure = 200 psi., suction pressure = 43.3 psi. motor speed = 1410 rpm., compressor speed = 670 rpm.

Test No.	1	2	3	4	5	6	7
Ambient air F	84.6	83.3	85.6	86.3	88.2	88.4	85.3
Compressor motor load lb.	3.55	3.56	3.56	3.56	3.55	3.55	3.57
Condenser cooling water							
- in F	86.3	86.1	88.2	88.7	89.0	89.4	86.2
- out F	99.2	99.5	98.8	99.0	98.8	99.0	99.5
-rise F	12.9	13.4	10.6	10.3	9.8	9.6	13.3
- flow lb/hr	712	697	876	912	943	987	684
Liquid refrigerant temperature							
- at condenser F	99.0	99.0	99.5	100.0	99.8	99.8	99.5
- at expansion F	97.5	97.5	97.9	98.2	98.2	98.2	97.9
Vapor refrigerant temperature							
- at suction F	37.0	45.2	51.7	59.5	64.8	71.2	76.0
- at delivery F	179	183	187	194	198.5	203	206
Calorimeter - watts input	2090	2130	2140	2190	2205	2240	2250
- gage psi.	31.7	38.4	45.5	46.8	62.0	71.5	79.0
- gage F	33.5	41.5	48.5	57.5	63.5	71.0	76.5
Flowmeter lb/hr							
-cond. water	700	680	853	890	915	960	670
- refrigerant	108	107	107	106.5	106	105	103

TABLE 5.1 Test Data of Experiment 5.1

Various compositions of "Freon-12" and "Freon-22"
suction gas temperature = 85 F, expansion temperature = 15 F,
liquid temperature at condenser outlet = 95.4 F,
motor speed = 1410 rpm, compressor speed = 670 rpm

Test No.	1	2	3	4	5	6	7	8	9	10	11
"Freon-12" charged, gm.	0	260	550	742	1010	1750	1300	1800	2600	2540	3290
"Freon-22" charged, gm.	1950	2300	1920	1492	1295	1700	870	810	650	280	0
Ambient air, F	86.4	88.2	86.0	88.2	87.0	91.4	88.2	84.2	87.2	87.8	86.0
Compressor motor load, lb.	3.27	3.22	3.17	3.11	3.06	2.98	2.89	2.78	2.59	2.41	2.18
Suction gage pressure, psi.	36.1	36.0	35.1	34.3	33.6	32.4	30.6	28.0	24.8	21.3	17.0
Expansion gage pressure, psi.	37.5	37.5	37.1	36.1	35.0	33.8	32.0	29.8	26.3	22.9	18.3
Liquid gage pressure, psi.	184.0	183.0	180.0	176.0	171.5	170.5	161.0	152.0	141.0	127.0	109.5
Delivery gage pressure, psi.	185.0	185.0	181.5	178.0	173.5	172.5	162.5	154.0	143.0	129.0	111.0
Condenser cooling water,											
-in, F	84.3	86.1	85.3	84.9	85.0	88.0	87.0	82.4	84.6	86.0	87.2
-out, F	94.1	93.9	93.9	93.9	93.7	94.4	93.4	94.7	94.4	94.3	95.4
-rise, F	9.8	7.8	8.6	9.0	8.7	6.4	6.4	12.3	9.8	8.3	8.2
-flow, lb/hr	857	1091	939	880	899	1210	1140	560	660	713	611
Liquid temp. at expansion, F	93.0	93.6	93.4	93.6	93.4	94.3	93.6	92.6	93.2	93.3	92.8
Vapor temp. at delivery, F	211	209	206	205.5	204	204	199	194	194	190	187
Calorimeter watts input, watt	1970	1940	1920	1870	1825	1790	1740	1685	1520	1380	1265

APPENDIX II

SAMPLE OF CALCULATION

From Test No.3 of Table 3.1 in Appendix I

Ambient air temperature.....	87.8	F
Compressor motor load in pan	2.30	lb.
Motor speed	1410	rpm.
Compressor speed	670	rpm.
Suction gage pressure	14.65	psi.
Suction gas temperature	85	F
Delivery gage pressure	140	psi.
Delivery gas temperature	201	F
Liquid temperature at condenser outlet ..	93.9	F
Liquid temperature before expansion	91.6	F
Rise of condenser water temperature	16	F
Flow of condenser water by measurement ..	284.5	lb/hr
Calorimeter gage temperature	85.37	F
Calorimeter heater load	1070	watts

1. CALCULATION OF REFRIGERATION CAPACITY.

From manufacturer's instruction book

Calorimeter heat leakage rate	=	1	Btu/hr-F
Calorimeter heat gain	=	1(87.8-85.37)	Btu/hr
	=	2.43	Btu/hr
Electrical heat gain (input)	=	3.414 x 1070	Btu/hr
	=	3657	Btu/hr
Refrigeration capacity	=	3657 + 2.43	Btu/hr
	=	3659.43	Btu/hr

2. CALCULATION OF REFRIGERATING EFFECT

Enthalpy of vapor at suction = 89.515 Btu/lb

Enthalpy of liquid before expansion

= 29.1 Btu/lb

Refrigerating effect = 89.515 - 29.1 Btu/lb

= 60.415 Btu/lb

3. CALCULATION OF EVAPORATOR REFRIGERANT MASS FLOW

Refrigeration capacity = 3659.43 Btu/hr

Refrigerating effect = 60.415 Btu/lb

Evaporator refrigerant mass flow

$$= \frac{3659.43}{60.415} \text{ lb/hr}$$

= 60.6 lb/hr

4. CALCULATION OF CONDENSER REFRIGERANT MASS FLOW

Enthalpy of vapor at delivery = 104.233 Btu/lb

Enthalpy of liquid at condenser outlet

= 29.66 Btu/lb

Specific heat rejection = 104.233 - 29.66 Btu/lb

= 74.573 Btu/lb

Condenser duty = 284.5 x 16 Btu/hr

= 4550 Btu/hr

Condenser refrigerant mass flow

$$= \frac{4550}{74.573} \text{ lb/hr}$$

= 61 lb/hr

5. CALCULATION OF COEFFICIENT OF PERFORMANCE.

Refrigerating effect = 60.415 Btu/lb

Heat of compression = 104.233-89.515 Btu/lb

= 14.718 Btu/lb

Coefficient of performance = $\frac{60.415}{14.718}$ = 4.11

6. CALCULATION OF DYNAMOMETER BRAKE HORSEPOWER.

Dynamometer bhp = $\frac{\text{motor speed x wt.in pan x } 2\pi}{33000}$

= $\frac{1410 \times 2.30 \times 2\pi}{33000}$ = 0.615 hp.

7. CALCULATION OF VOLUMETRIC EFFICIENCY.

Swept volume = $\frac{\pi D^2 \times L \times N \times n}{4 \times 1728}$

= $\frac{\pi(1.625)^2 \times (1.5) \times 670 \times 2}{4 \times 1728}$

= 2.42 cuft/min

Specific volume at suction 1.6 cuft/lb

Volumetric efficiency = $\frac{m v_s}{v_p}$

= $\frac{60.6 \times 1.6 \times 100}{2.42 \times 60}$ = 66.8 %

From Test No. 8 of Table 5.1 in Appendix I

"Freon-12" charged	1800	gm
"Freon-22" charged	810	gm
Compressor motor load in pan	2.78	lb
Motor speed	1410	rpm
Suction gage pressure	28.0	psi
Suction gas temperature	85	F
Liquid temperature at expansion	92.6	F
Calorimeter heater load	1685	watts

1. CALCULATION OF MASS FRACTION

For "Freon-12"

Total refrigerant charged = 1800 + 810 gm

= 2610 gm

"Freon-12" mass fraction, x_{12} = 1800 / 2610

= 0.69

2. CALCULATION OF MOLE FRACTION

Molecular weight of "F-12", M_{12} = 121 gm/gm-mole

Molecular weight of "F-22", M_{22} = 86.5 gm/gm-mole

$$\text{"Freon-12" mole fraction} = \frac{x_{12}/M_{12}}{x_{12}/M_{12} + x_{22}/M_{22}}$$

$$= \frac{0.69/121}{0.69/121 + 0.31/86.5}$$

= 0.615

"Freon-22" mole fraction = 1 - 0.615

= 0.385

3. CALCULATION OF PARTIAL PRESSURE

Ideal total suction pressure	= 0.615x17.0 + 0.385x36.1	
	= 24.36	psi
Actual total suction pressure	= 28	psi
Deviation	= 28 - 24.36	psi
	= 3.64	psi
"F-12" partial suction pressure	= 0.615x17.0 + 3.64/2	psi
	= 12.3	psi
"F-22" partial suction pressure	= 28 - 12.3	psi
	= 15.7	psi

4. CALCULATION OF OVERALL COP

Dynamometer bhp	= 0.745	hp
Equivalent heat supplied	= 0.745 x 2544	Btu/hr
	= 1897	Btu/hr
Refrigeration capacity	= 5750	Btu/hr
Overall COP	= 5750 / 1897	
	= 3.035	

5. CALCULATION OF REFRIGERATION CAPACITY DEVIATION

Refri. cap. proportional to mass fraction	= 0.69x4320 + 0.31x6725	
	= 5066	Btu/hr
Refri. cap. deviation	= 5750 - 5066	Btu/hr
	= 684	Btu/hr

APPENDIX III

RESULTS OF EXPERIMENTS

TABLE 3.3 RESULT OF EXPERIMENT 3.1

(at delivery pressure = 140 psi. suction gas temperature = 85 F)

Test No.	1	2	3	4	5	6	7	8
Suction pressure psi.	10.1	12	14.65	17.7	21.0	24.1	26.0	30.0
Refrigeration capacity Btu/hr	2905.66	3160	3659.43	4272.53	4819.33	5535.74	6102	6696.73
Refrigerating effect Btu/lb	60.57	60.015	60.415	60.143	59.757	59.71	60.089	59.596
Evaporator refrigerant mass flow lb/hr	48.0	52.7	60.6	71.0	80.7	92.7	101.5	112.2
Condenser refrigerant mass flow lb/hr	49.2	53.6	61.0	70.2	81.4	91.75	97.5	113.0
Coefficient of performance	3.76	3.86	4.11	4.31	4.41	4.73	5.07	5.11
Dynamometer bhp hp	0.569	0.591	0.615	0.645	0.666	0.69	0.704	0.72
Volumetric efficiency %	63.0	63.5	66.8	70.0	72.4	76.0	78.7	80.0

TABLE 3.4 RESULT OF EXPERIMENT 3.2

(at delivery pressure = 140 psi. suction pressure = 21 psi.)

Test No.	1	2	3	4	5	6	7	8	9
Suction gas temperature F	34.3	39.9	44.0	46.5	50.2	56.2	61.2	67.0	76.2
Refrigeration capacity Btu/hr	4190.4	4360.2	4470.2	4542.2	4650.4	4715.0	4811.4	4933.8	5034.2
Refrigerating effect Btu/lb	51.825	52.763	53.952	54.040	54.900	55.857	56.361	57.821	58.843
Evaporator refrigerant mass flow lb/hr	80.9	82.7	83.0	83.5	84.7	84.5	85.5	85.2	85.5
Condenser refrigerant mass flow lb/hr	90.2	89.5	89.0	88.0	88.1	87.5	87.3	88.5	84.7
Coefficient of performance	3.60	3.69	3.81	3.90	4.05	4.15	4.16	4.34	4.59
Dynamometer bhp hp	0.692	0.692	0.692	0.697	0.685	0.685	0.685	0.685	0.686
Volumetric efficiency %	64.5	67.0	68.0	68.7	70.4	71.2	73.0	73.7	74.8

TABLE 4.3 RESULT OF EXPERIMENT 4.1

(at delivery pressure = 200 psi. suction gas temperature = 85 F)

Test No.	1	2	3	4	5	6	7
Suction pressure psi	24.8	28.0	31.0	34.1	37.0	40.3	43.3
Refrigeration capacity Btu/hr	4404	5002	5527	6077	6592	7240	8025
Refrigerating effect Btu/lb	77.73	77.45	77.30	77.02	76.93	77.02	76.90
Evaporator refrigerant mass flow lb/hr	56.7	64.7	71.5	78.9	85.7	94.0	104.2
Condenser refrigerant mass flow lb/hr	57.5	64.2	71.2	77.5	84.6	91.0	99.0
Coefficient of performance	3.76	3.88	3.99	4.07	4.26	4.48	4.71
Dynamometer bhp hp	0.80	0.84	0.867	0.897	0.915	0.942	0.966
Volumetric efficiency %	64.7	66.5	71.5	74.4	75.8	77.2	79.7

TABLE 4.4 RESULT OF EXPERIMENT 4.2

(at delivery pressure = 200 psi. suction pressure = 43.3 psi.)

Test No.	1	2	3	4	5	6	7
Suction gas temperature F	37.0	45.2	51.7	59.5	64.8	71.2	76.0
Refrigeration capacity Btu/hr	7186	7312	7337	7500	7555	7665	7724
Refrigerating effect Btu/lb	69.55	70.76	71.63	72.70	73.52	74.48	75.36
Evaporator refrigerant mass flow lb/hr	103.2	103.3	102.5	103.3	102.8	103.0	102.6
Condenser refrigerant mass flow lb/hr	105.7	106.4	105.0	105.0	102.2	104.0	99.3
Coefficient of performance	3.88	4.05	4.17	4.20	4.24	4.32	4.43
Dynamometer bhp hp	0.952	0.955	0.955	0.955	0.952	0.952	0.957
Volumetric efficiency %	70.6	72.3	73.7	74.5	75.15	76.3	76.8

TABLE 5.2 RESULT OF EXPERIMENT 5.1

Various compositions of "Freon-12" and "Freon-22"

suction gas temperature = 85 F, expansion temperature = 15 F

liquid temperature at condenser outlet = 95.4 F

Test No.	1	2	3	4	5	6	7	8	9	10	11
"R-12" mass fraction	0	0.1015	0.223	0.332	0.438	0.507	0.600	0.690	0.800	0.900	1.000
"R-22" mass fraction	1.000	0.8985	0.777	0.668	0.562	0.493	0.400	0.310	0.200	0.100	0
"R-12" mole fraction	0	0.0736	0.170	0.262	0.354	0.424	0.517	0.615	0.741	0.865	1.000
"R-22" mole fraction	1.000	0.9264	0.830	0.738	0.646	0.576	0.483	0.385	0.259	0.135	0
"R-12" partial suct.press.psi	0	1.9	4.0	6.0	8.1	9.6	11.0	12.3	14.0	15.5	17.0
"R-22" partial suct.press.psi	36.1	34.1	31.1	28.3	25.5	22.8	19.6	15.7	10.8	5.8	0
Refri. capacity, Btu/hr	6725	6622	6551	6385	6235	6110	5943	5750	5190	4713	4320
Refri. effect, Btu/lb	78.67	76.68	74.61	73.22	70.71	69.05	67.69	66.28	63.88	61.90	60.11
Dynamometer bhp, hp	0.878	0.864	0.850	0.835	0.820	0.800	0.775	0.745	0.695	0.647	0.585
Ht. equivalent supplied, Btu/hr	2235	2200	2163	2125	2087	2038	1973	1897	1770	1648	1490
Overall COP	3.01	3.01	3.025	3.00	3.00	3.00	3.01	3.035	2.93	2.86	2.90
Refri. capacity proportional to mass fraction, Btu/hr	6725	6480	6190	5928	5671	5507	5283	5066	4801	4560	4320
Refri.capacity deviations	0	138	361	457	564	603	660	684	389	153	0
Dynamometer bhp proportional to mass fraction, hp	0.878	0.848	0.813	0.781	0.750	0.729	0.702	0.676	0.644	0.614	0.585
Dynamometer bhp deviations	0	0.016	0.037	0.054	0.068	0.071	0.073	0.069	0.051	0.033	0

TABLE 5.3 RESULT OF EXPERIMENT 5.1

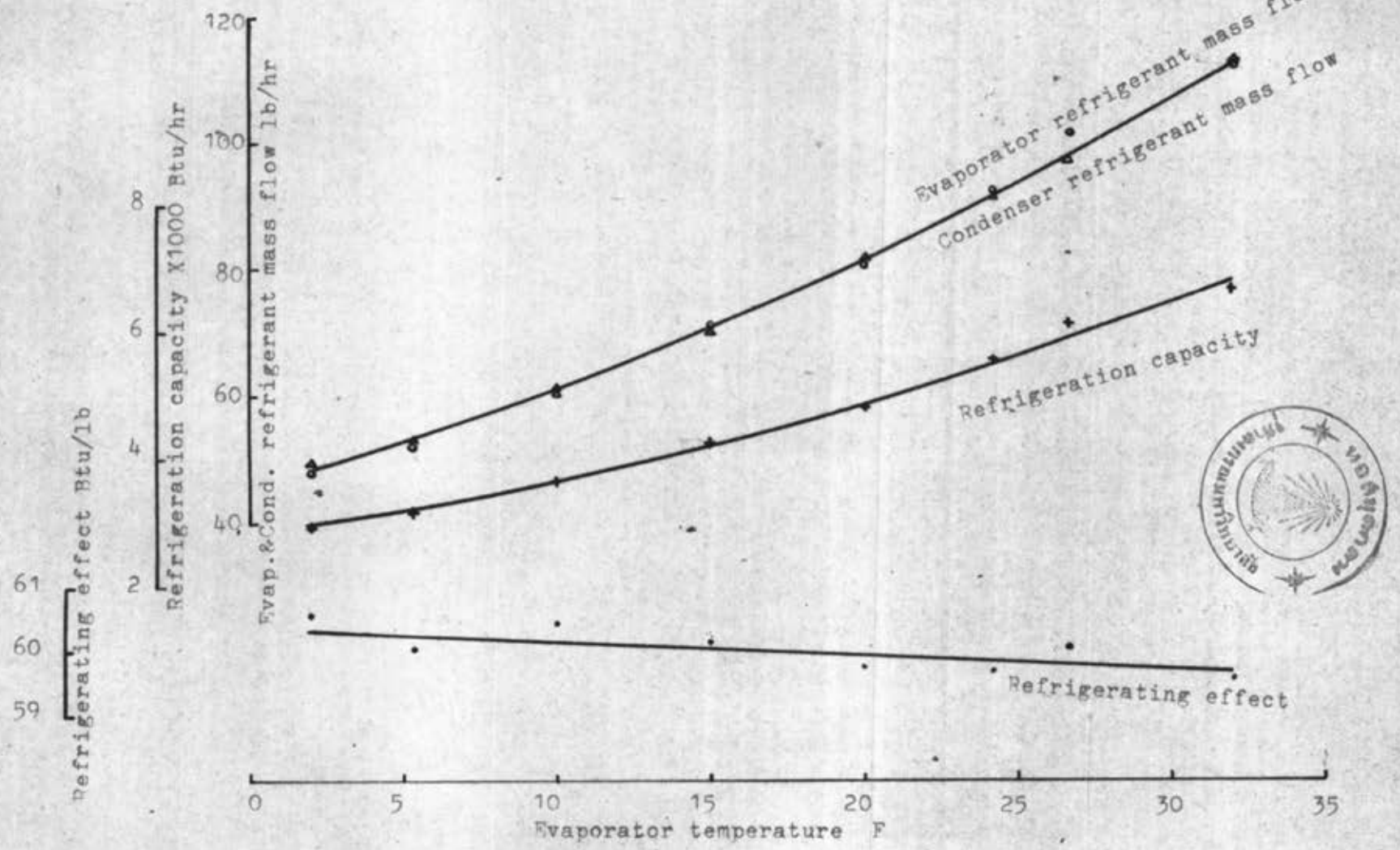
Comparative Chart of Performances of "R-12", "R-22" and Mixed "Freon"* (1 hp compressor calorimeter test) at suction gas temperature = 85 F, expansion temperature = 15 F liquid temperature at condenser outlet = 95.4 F

Refrigerant	R-12	R-22	*
Suction pressure, psi	17.0	36.1	28.0
Delivery pressure, psi	111	185	154
Refrigeration capacity, Btu/hr	4320	6725	5750
Dynamometer bhp, hp	0.585	0.878	0.745
Overall COP	2.90	3.01	3.035
Delivery gas temperature, F	187	211	194
Hp / ton of refrigeration	1.627	1.567	1.553

* Mixed "R-12" and "R-22" in 69:31 % by weight.

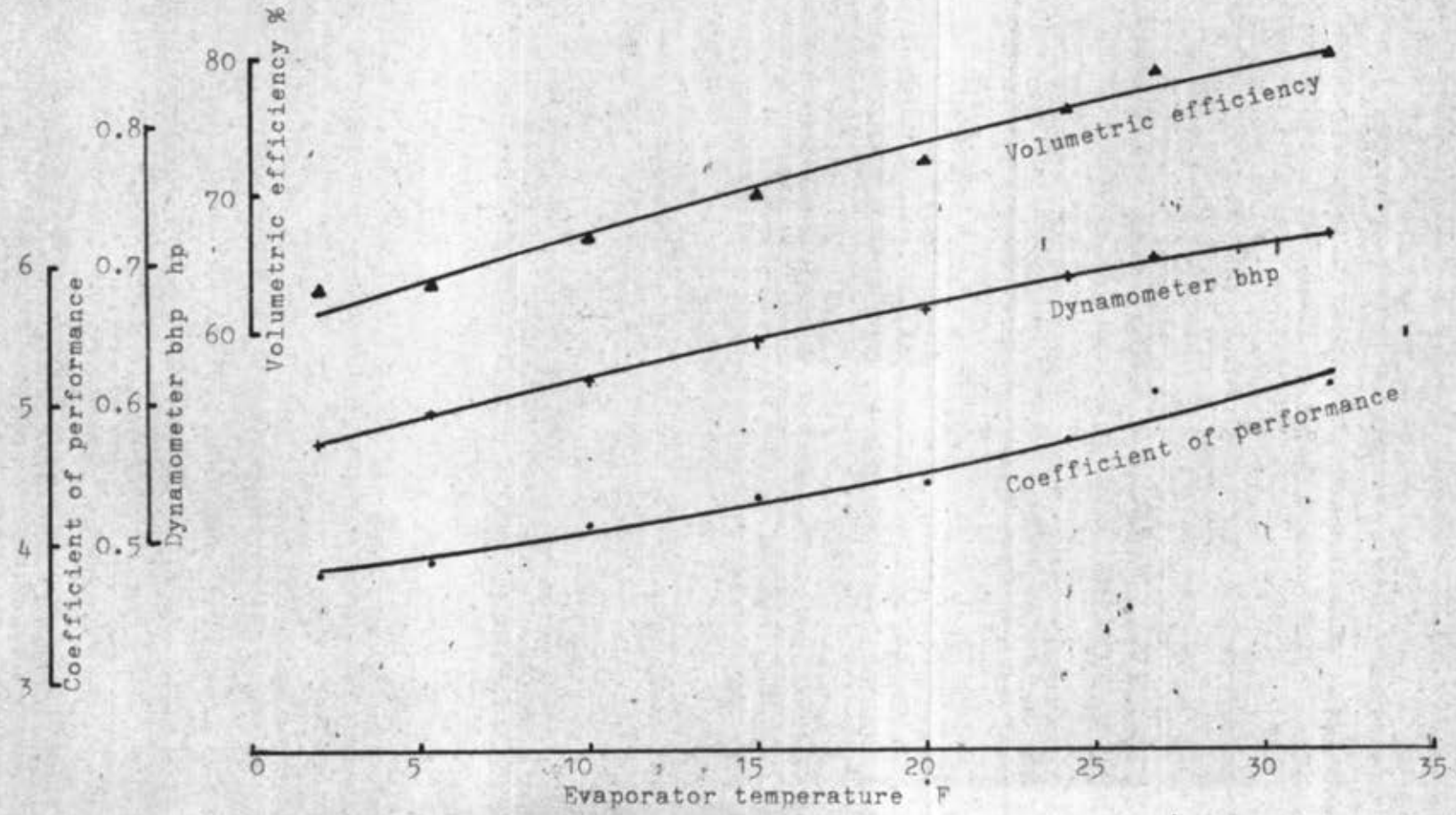
GRAPH 1 RESULTS CURVES OF EXPERIMENT 3.1

(at delivery pressure = 140 psi., suction gas temperature = 85°F)



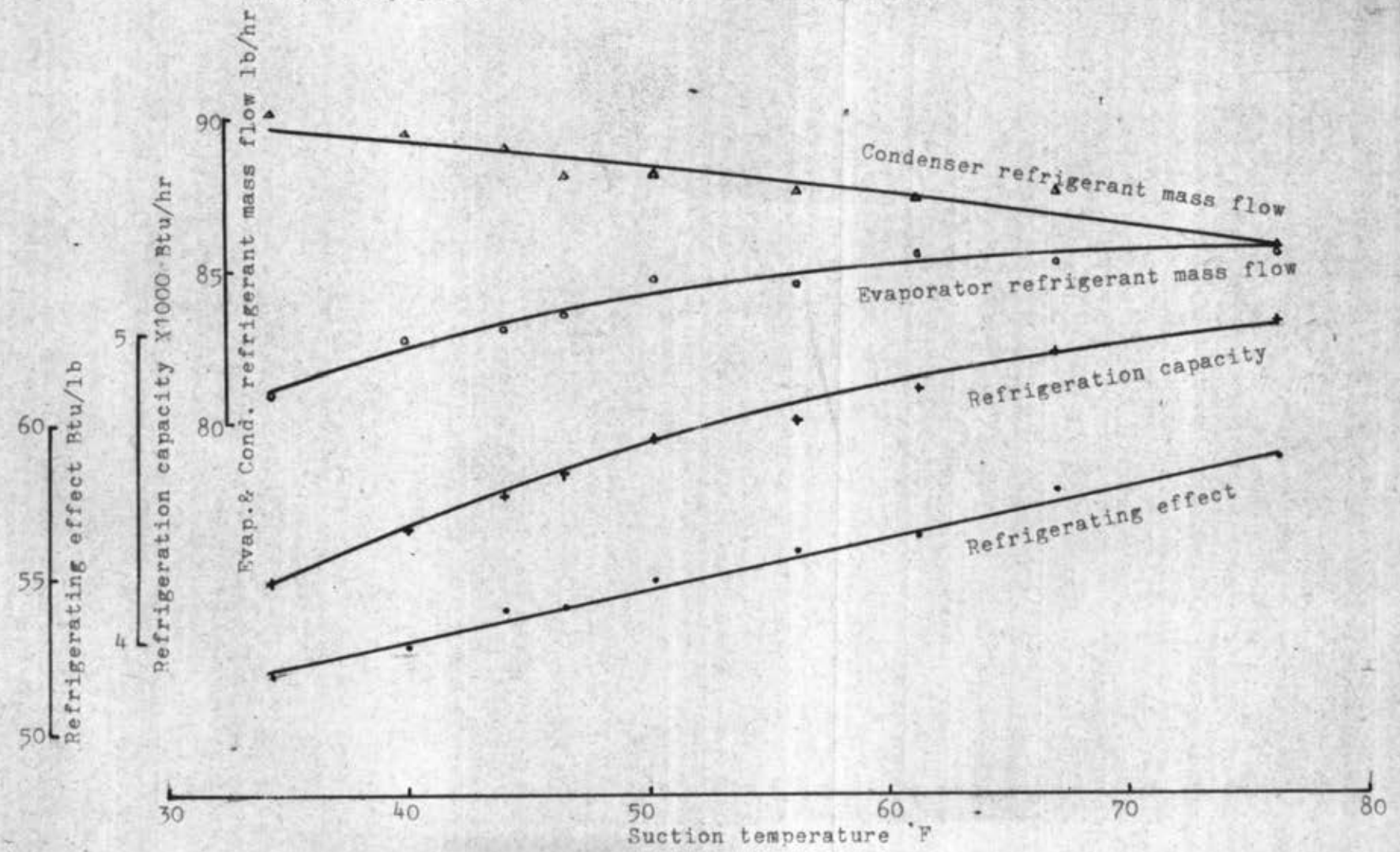
GRAPH 2 RESULT CURVES OF EXPERIMENT 3.1

(at delivery pressure = 140 psi., suction gas temperature = 85°F)



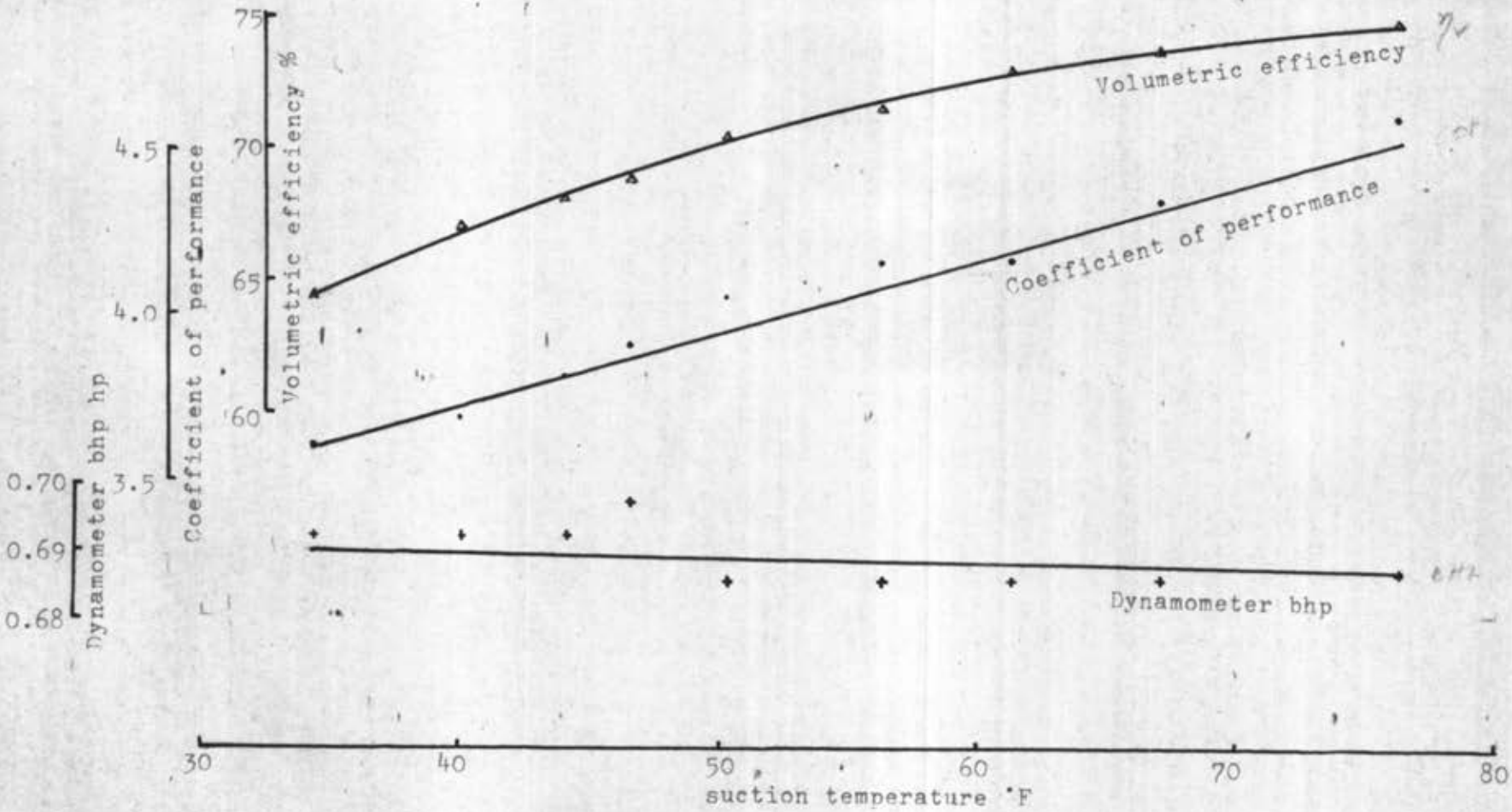
GRAPH 3 RESULT CURVES OF EXPERIMENT 3.2

(at delivery pressure = 140 psi., suction pressure = 21 psi.)



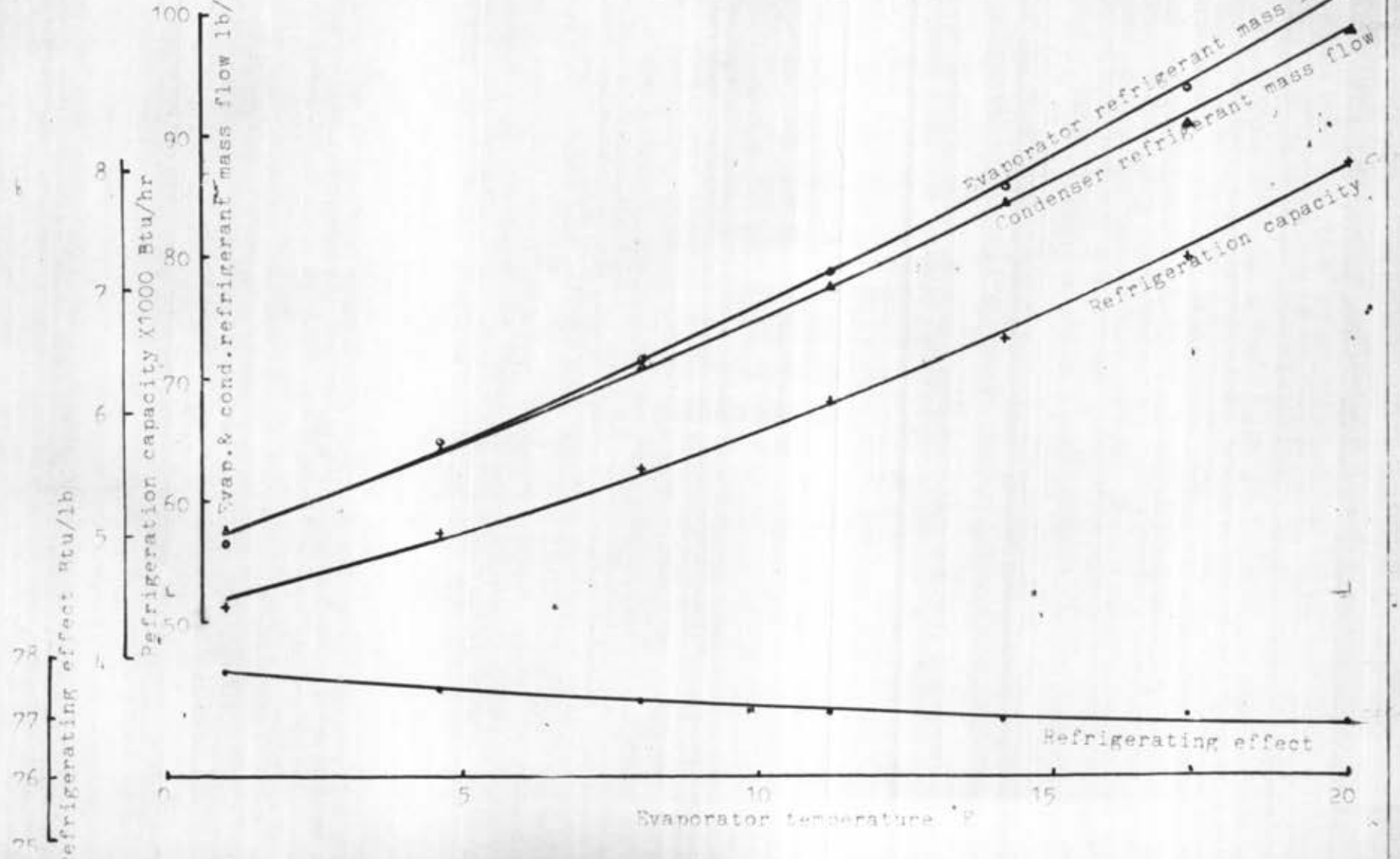
GRAPH 4 RESULT CURVES OF EXPERIMENT 3.2

(at delivery pressure = 140 psi., suction pressure = 21 psi.).



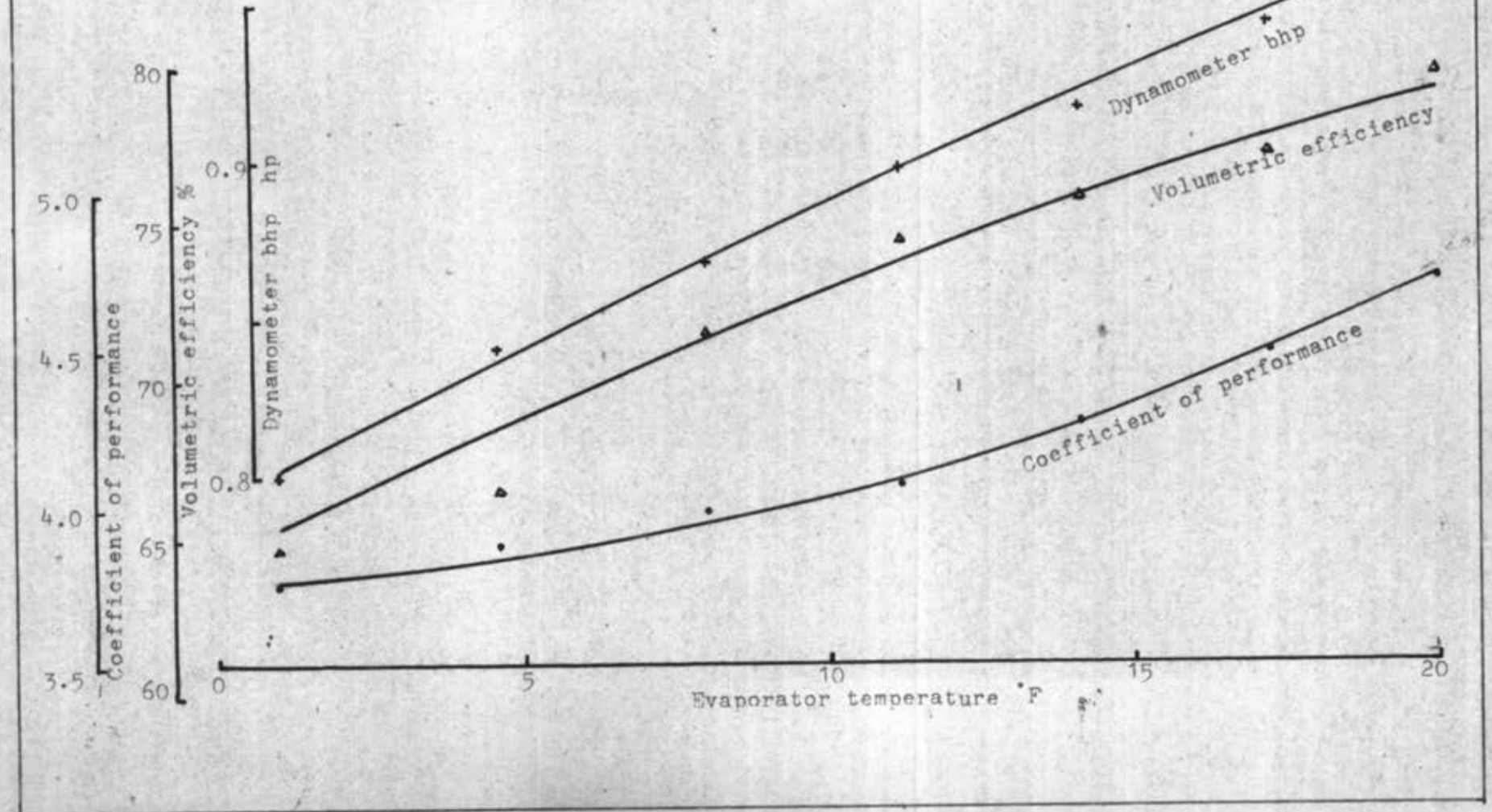
GRAPH 5 RESULT CURVES OF EXPERIMENT 4.1

(at delivery pressure = 200 psi., suction gas temperature = 85 F)



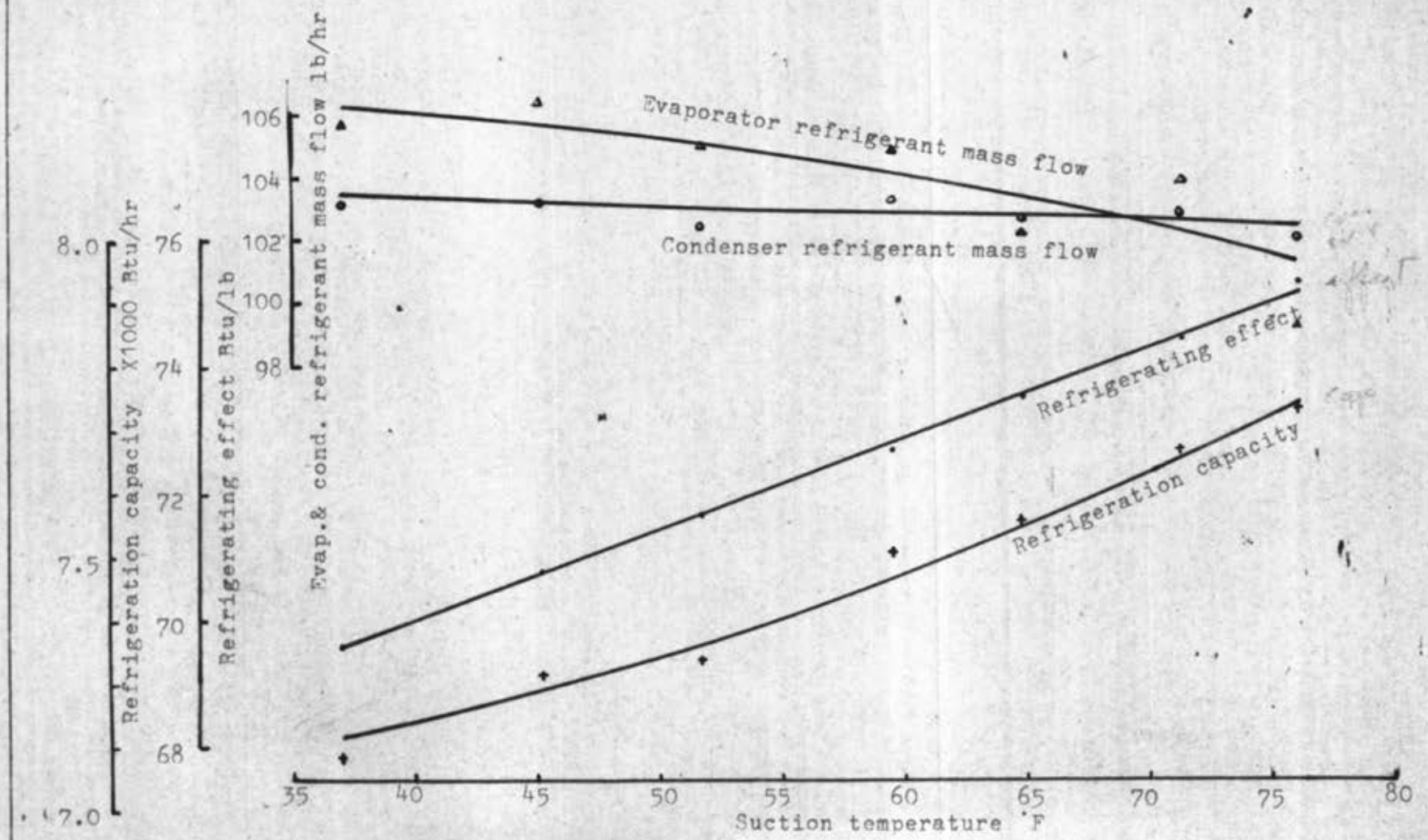
GRAPH 6 RESULT CURVES OF EXPERIMENT 4.1

(at delivery pressure = 200 psi., suction gas temperature = 85°F



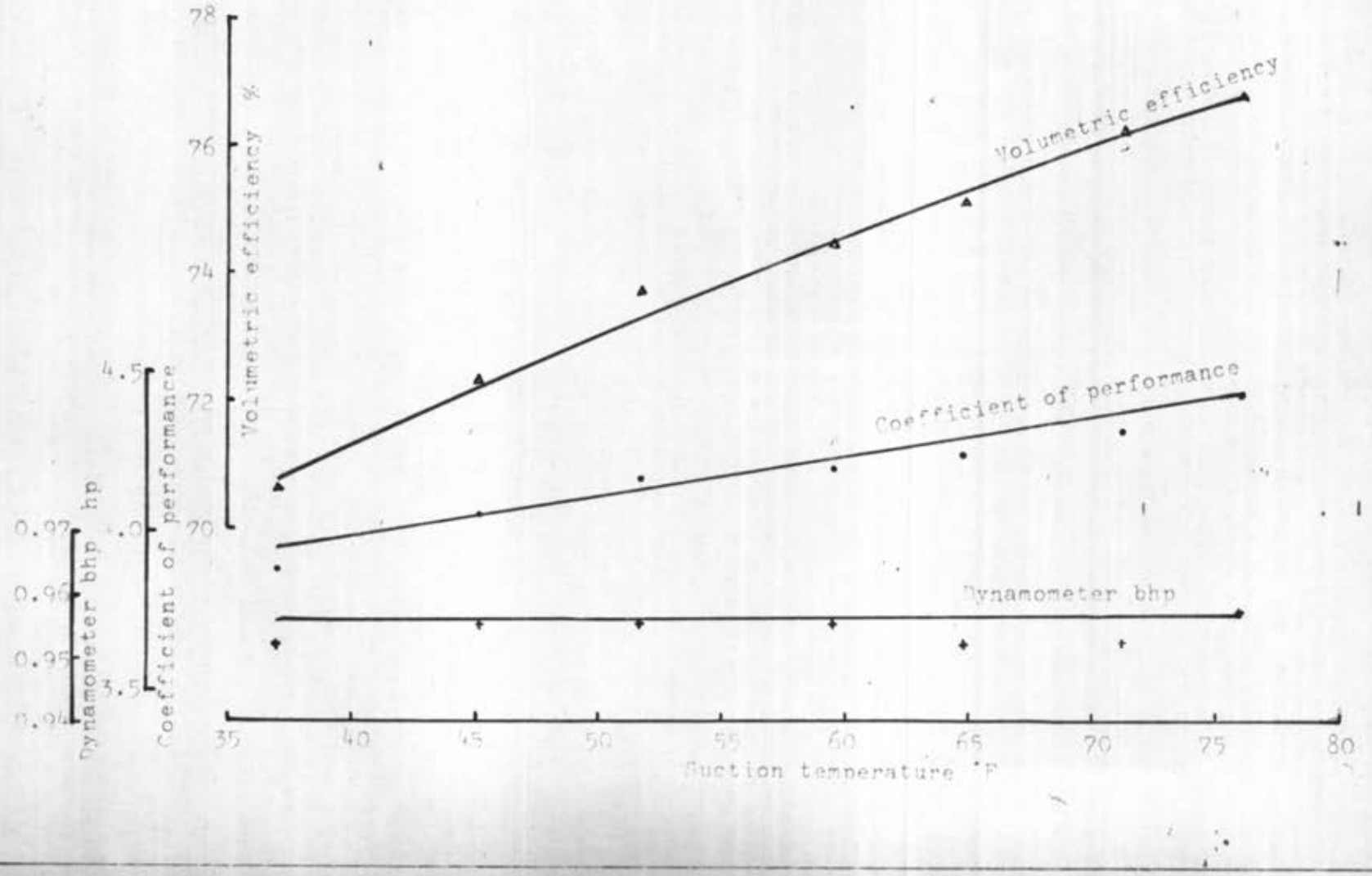
GRAPH 7 RESULT CURVES OF EXPERIMENT 4.2

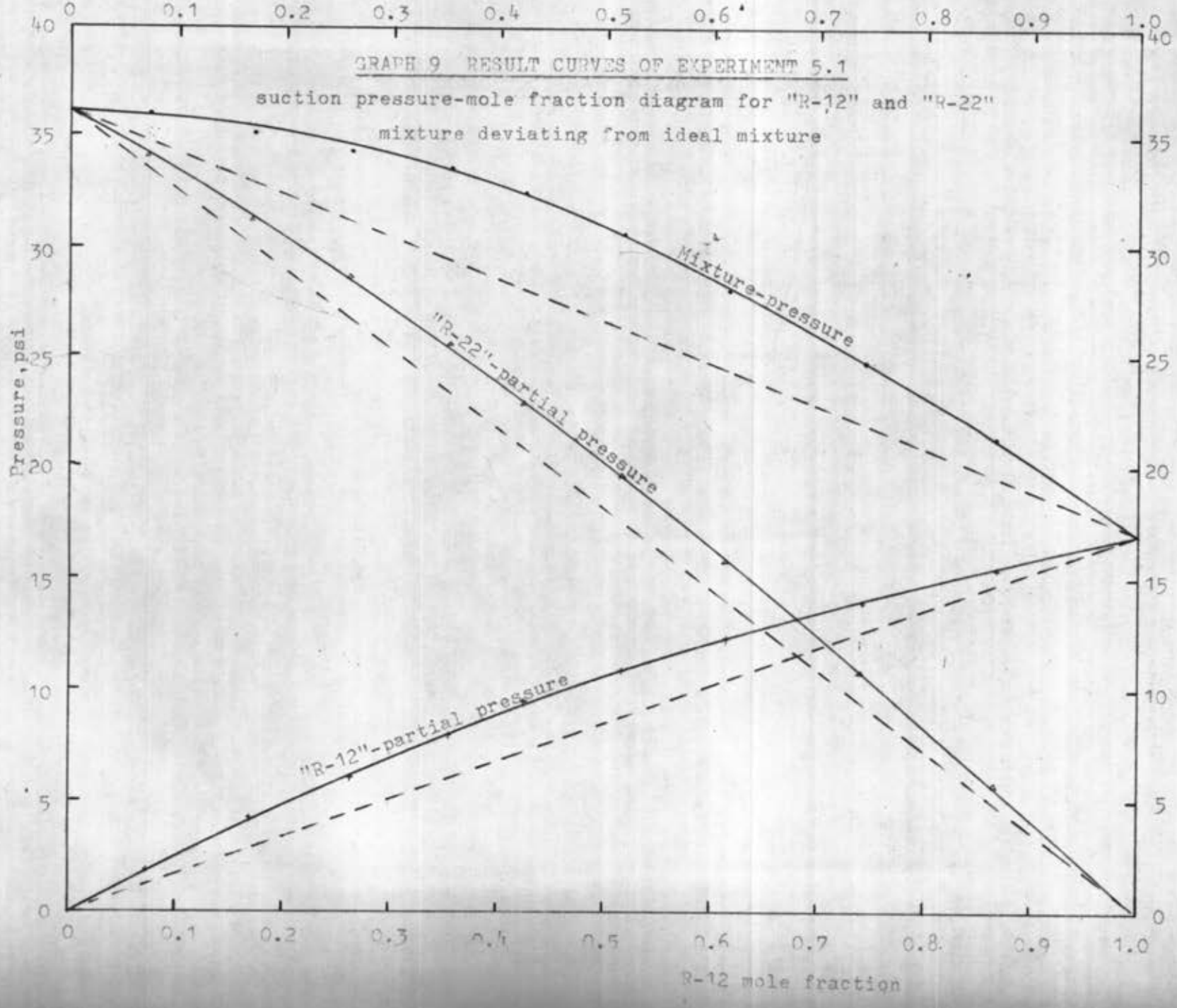
(at delivery pressure = 200 psi., suction pressure = 43.3 psi.)



GRAPH 8 RESULT CURVES OF EXPERIMENT 4.2

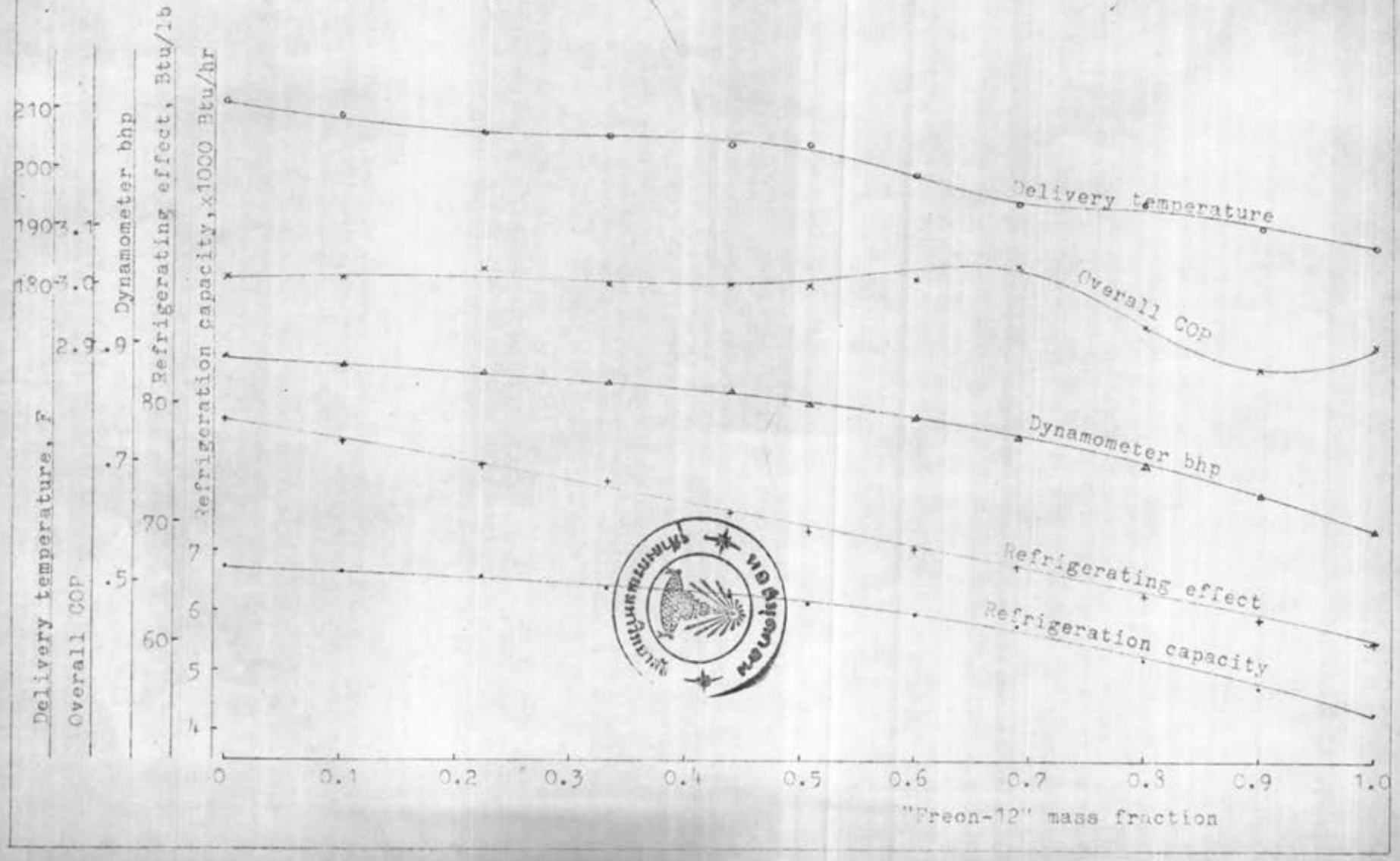
(at delivery pressure = 200 psi., suction pressure = 43.3 psi.)




GRAPH 9 RESULT CURVES OF EXPERIMENT 5.1
suction pressure-mole fraction diagram for "R-12" and "R-22"
mixture deviating from ideal mixture
Mixture-pressure
"R-22"-partial pressure
"R-12"-partial pressure
Pressure, psi
R-12 mole fraction
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
5
10
15
20
25
30
35
40

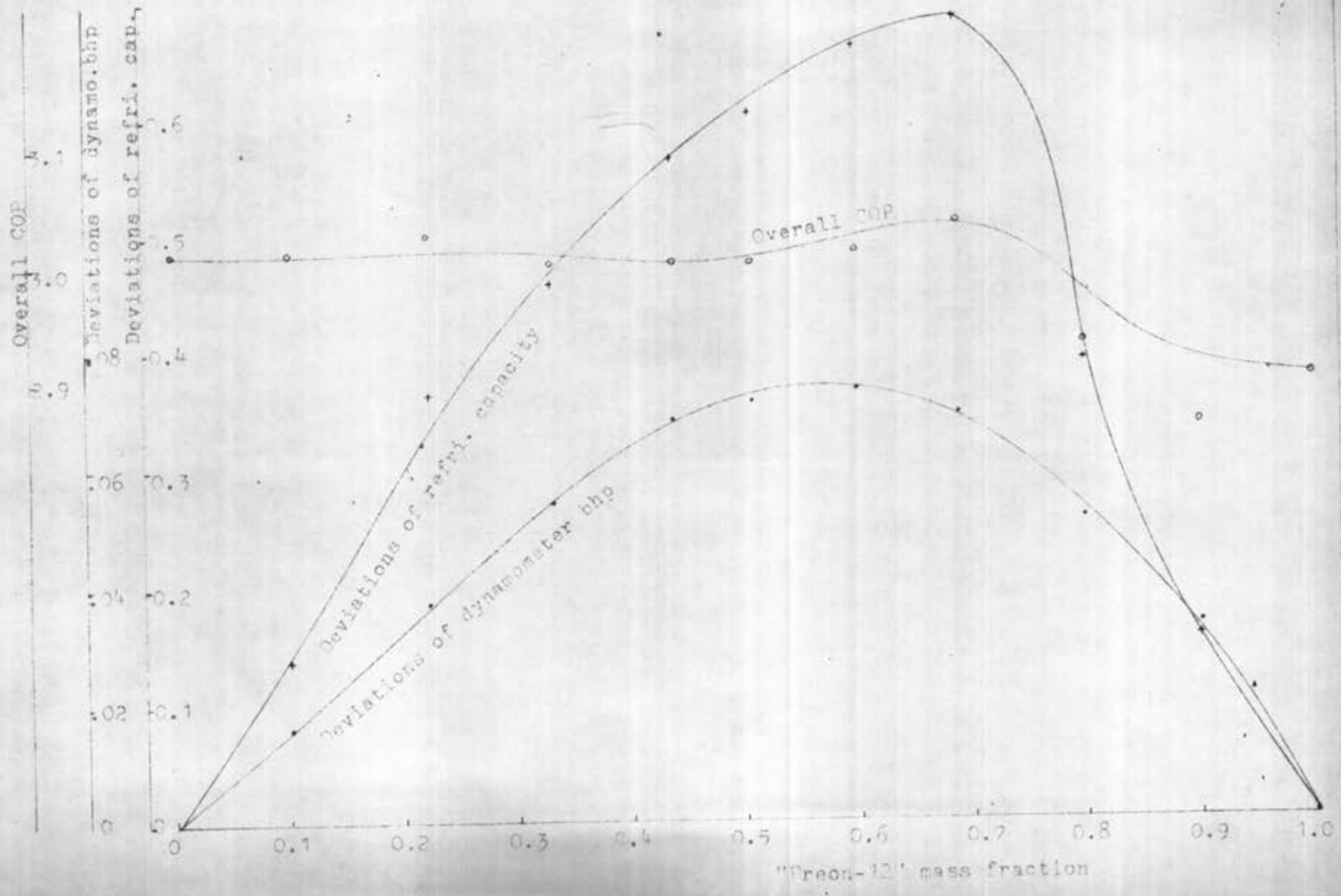
GRAPH 10 RESULT CURVES OF EXPERIMENT 6.1

(suction temp = 85 F, expansion temp = 15 F, liquid temp at condenser = 95.4 F)



GRAPH 11 RESULT CURVES OF EXPERIMENT 5.1

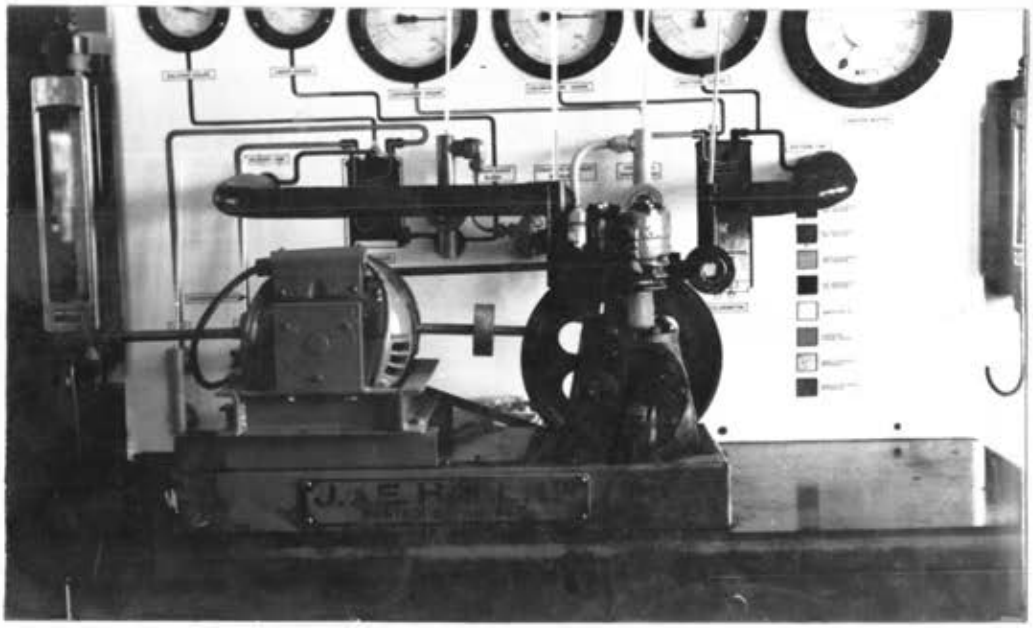
Overall COP, deviations of refrigeration capacity and dynamometer bhp



APPENDIX IV

PHOTOGRAPHIC ILLUSTRATION

PHOTOGRAPH 1 Refrigeration plant.

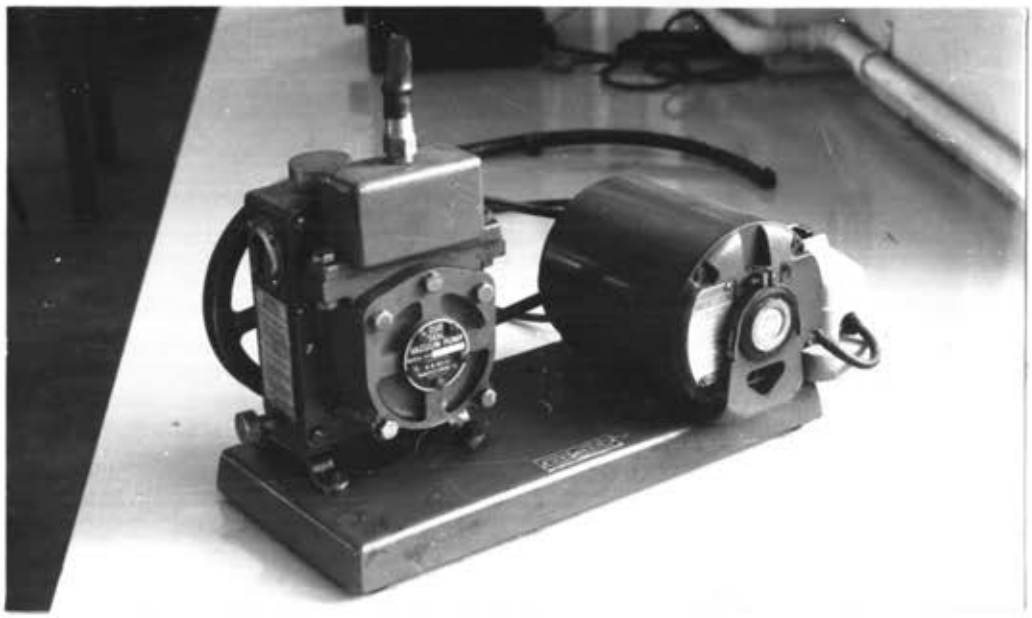


PHOTOGRAPH 2 Compressor and dynamometer.

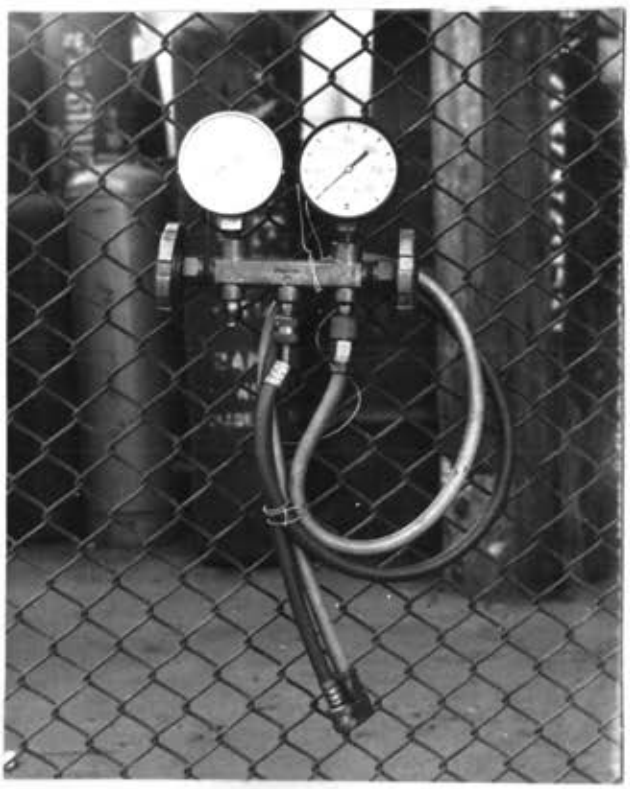
PHOTOGRAPH 3 Condenser.

PHOTOGRAPH 4 Refrigerant liquid flowmeter.

PHOTOGRAPH 5 Control panel.



PHOTOGRAPH 6 High vacuum pump.



PHOTOGRAPH 7 Charging valve.

APPENDIX V

REFERENCES

1. ALTHOUSE, A. D. & TURNQUIST, C. H. "Modern Refrigeration and Air Conditioning", The Goodheart-Willcox Co., Inc., 1960.
2. DODGE, B. F., "Chemical Engineering Thermodynamics", McGraw-Hill Book Company, Inc., 1944.
3. DOSSAT, R. J. "Principles of Refrigeration", John Wiley and Sons, Inc., 1961.
4. DUPONT. "Service Pointers - Your Guide to the Use of Freon Refrigerants in Servicing Refrigeration Systems", E. I. du Pont de Nemours and Co. (Inc.), 1960.
5. GOSNEY, W. B. "Modern Refrigeration", The Journal of The Royal Society for The Encouragement of Arts Manufactures and Commerce, May 1968, p.457.
6. I.C.I. "Data on ARCTON Refrigerants", Imperial Chemical Industries Limited., May, 1963.
7. J. & E. HALL LIMITED. "Instruction Book for Laboratory Demonstration Refrigeration Plant".

8. JORDAN, R. C. & PRIESTER, G. B. "Refrigeration and Air Conditioning", Prentice-Hall, Inc., 1960.

9. KEENAN, J. H. "Thermodynamics", John-Wiley & Sons, Inc., 1957.

10. LAY, J. E. "Thermodynamics", Sir Isaac Pitman & Sons, Ltd., London., 1964.

11. LEE, J. F. & SEARS, F. W. "Thermodynamics", Addison-Wesley Publishing Company, Inc., 1956.

12. NICKERSON & COLLINS CO. "A Practical Discussion of R-12 and R-22", Refrigeration Service and Contracting, Vol. 30, February 1962.

13. SALISBURY, J. K. "Kent's Mechanical Engineers' Handbook - Power Volume", John-Wiley & Sons, Inc., 1950.

14. THRELKELD, J. L. "Thermal Environmental Engineering", Prentice-Hall, Inc., 1962.