UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2002/2003

Februari / Mac 2003

JNK 504/3 – Penyejukan & Penyaman Udara

Masa : 3 jam

ARAHAN KEPADA CALON :

Sila pastikan bahawa kertas soalan ini mengandungi **SEPULUH (10)** mukasurat dan **TUJUH (7)** soalan yang bercetak serta **SEPULUH (10)** halaman lampiran sebelum anda memulakan peperiksaan.

Sila jawab **LIMA (5)** soalan sahaja dan tidak melebihi dari **TIGA (3)** soalan dari setiap bahagian.

Lampiran :

1. Jadual stim akan dibekalkan oleh Jabatan Pendaftar [10 mukasurat]

Setiap soalan mestilah dimulakan pada mukasurat yang baru.

KETUA PENGAWAS : Sila pungut :

(a) **KESELURUHAN** kertas soalan ini (tanpa diceraikan mana-mana muka surat) dan mana-mana kertas soalan peperiksaan ini yang berlebihan untuk dikembalikan kepada Bahagian Peperiksaan, Jabatan Pendaftar, USM.

Peringatan :

1. Sila pastikan bahawa anda telah menulis angka giliran dengan betul

BAHAGIAN A

S1. **[a]** **Lakarkan kitar mampatan wap praktikal pada gambarjah p-h dan T-s. Labelkan setiap titik pada gambarjah-gambarajah berkenaan dan tunjukkan lokasi perbandingan pada garisan dan gambarajah blok sistem penyejukan. Pada gambarajah p-h tunjukkan kesan penyejukan, haba pemampatan dan haba pembuangan. Apakah hubungan arithmatik ketiga-tiga parameter ini ?**

Sketch a practical vapour compression cycle on p-h and T-s diagrams. Label each point on the diagrams and show the comparable location on a line and block diagram of the refrigeration system. On the p-h diagram show the refrigerating effect, heat of compression and heat of rejection. What is their arithmetic relationship?

(50 markah)

[b] **Bagaimanakah aliran isipadu per kilowatt penyejukan dan pekali prestasi bagi pemampat unggul berubah dengan suhu sejatan yang beroperasi pada suhu pemeluwapan malar ?**

How does volume flow per kilowatt of refrigeration and coefficient of performance for an ideal compressor vary with evaporating temperature operating under constant condensing temperature?

(50 markah)

atau
or

[c] **Dengan bantuan gambarajah, terangkan bagaimana air disejukkan di dalam menara penyejuk ?**

With the aid of a diagram, describe how water is cooled in a cooling tower?

(50 markah)

S2. **[a]** **Apakah peranan peranti kawalan aliran ? Namakan jenis-jenis peranti kawalan aliran.**

What are the purposes of flow control device? Name the types of flow control device

(35 markah)

[b] **Dengan bantuan lakaran terangkan fungsi-fungsi dan penggunaan penumpuk sedutan. Mengapakah pentingnya menggunakan tiub kapilari sebagai peranti pengembangan ?**

With the aid of a sketch explain the functions and applications of suction accumulator. Why is it important in systems using capillary tube as the expansion device?

(35 markah)

[c] **Terangkan kebaikan dan keburukan ammonia yang digunakan sebagai bahan penyejuk.**

Describe desirable and undesirable features of ammonia for use as a refrigerant.

(30 markah)

atau

or

[d] **Apabila mempertimbangkan sistem penyejukan sebagai penyamanan udara di dalam kapal terbang penumpang dan kapal selam apakah faktor-faktor utama yang perlu dipertimbangkan ? Sistem-sistem apakah yang anda syorkan berdasarkan kepada pertimbangan–pertimbangan tersebut ?**

In considering refrigerating systems for air conditioning a passenger aircraft and a submarine what are the most important factors that need to be considered? Which systems would you then recommend based on those considerations?

(30 markah)

S3. **Satu sistem ammonia dua peringkat menggunakan penyingkiran gas kilat dan penyejukantara beroperasi pada kitar yang ditunjukkan dalam Rajah S3. Suhu pemeluwapan ialah 35°C. Suhu tepu bagi penyejat suhu-antara ialah 0°C dan kapasiti ialah 90 kW. Suhu tepu bagi penyejat suhu-rendah ialah –40°C dan kapasiti ialah 170 kW penyejukan.**

Lukiskan kitar pada gambarajah p-h.

A two-stage ammonia system using flash gas removal and intercooling operates on the cycle shown in Figure Q3. The condensing temperature is 35°C. The saturation temperature of the intermediate - temperature evaporator is 0°C, and its capacity is 90 kW. The saturation temperature of the low- temperature evaporator is - 40°C, and its capacity is 170 kW of refrigeration.

Draw the cycle on a p-h diagram.

(20 markah)

[a] **Apakah kadar pemampatan bahan penyejuk oleh pemampat peringkat tinggi ?**

What is the rate of refrigerant compressed by the high stage compressor?

(30 markah)

[b] **Kirakan kuasa diperlukan oleh pemampat-pemampat.**

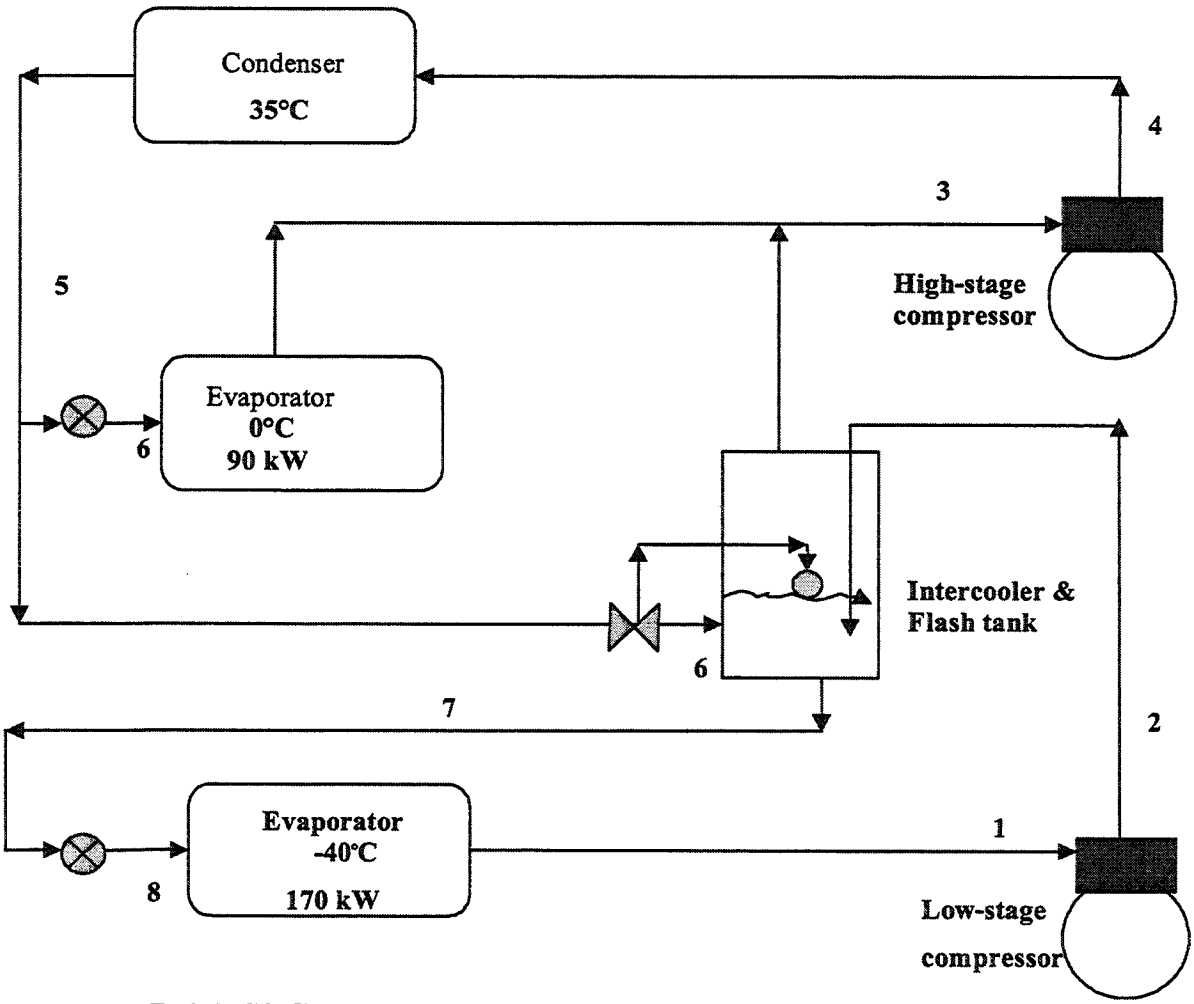
Calculate the power required by the compressors.

(30 markah)

[c] Kirakan pekali prestasi.

Calculate the coefficient of performance

(20 markah)



Rajah S3 Gambarajah skima bagi sistem pelabagai tekanan
Figure Q3 Schematic diagram of the multipressure system

S4. [a] Apakah tujuan penggunaan penukar haba di dalam sistem penyejukan penyerapan wap ?

What is the purpose of using a heat exchanger in a vapour absorption refrigeration system?

(20 markah)

[b] **Sistem penyerapan air lithium-bromida dengan penukar haba seperti yang ditunjukkan pada Rajah S4 beroperasi pada suhu-suhu berikut :**

Penjana	**100°C**
Pemeluwap	**36°C**
Penyejat	**10°C dan**
Penyerap	**28°C**

Suhu larutan pada masukan kepada penjana ialah 50°C. Kadar alir jisim yang dihantar oleh pam larutan ialah 0.55 kg/s.

In a lithium-bromide water absorption system with a heat exchanger as shown in Figure Q4 operates at the following temperatures:

Generator	*100^0C*
Condenser	*36^0C*
Evaporator	*10^0C and*
Absorber	*28^0C.*

The solution temperature at entry to generator is 50C. The mass rate flow delivered by the solution pump is 0.55 kg/s.

(i) **Kirakan pemindahan haba dari atau ke penjana, penyejat, pemeluwap dan penyerap, dan**

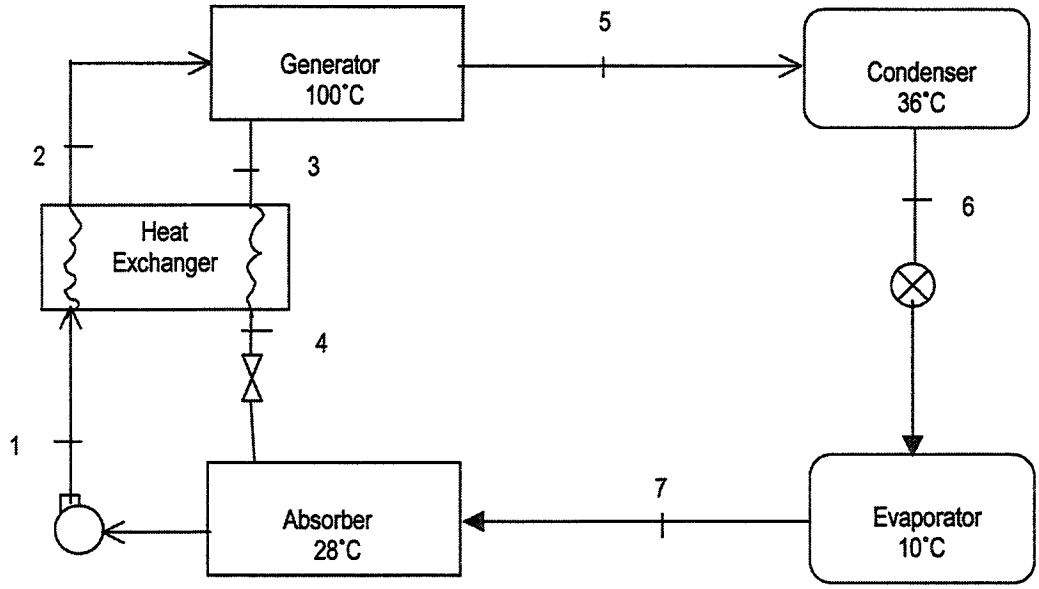
Calculate the heat transfer to or from the generator, condenser, evaporator and absorber, and

(60 markah)

(ii) **Kirakan pekali prestasi bagi kitar.**

Calculate the coefficient of performance of the cycle.

(20 markah)



Rajah S4 Gambarajah skima bagi kitar penyejukan penyerapan
FigureQ4 Schematic diagram of the absorption refrigeration cycle

BAHAGIAN B

S5. [a] Apakah Unit Pengendali Udara (AHU)? Apakah komponen-komponen utamanya ?

What is an Air Handling Unit (AHU)? What are its main components?

(25 markah)

[b] Apakah jenis sistem penyamanan udara yang disyorkan bagi pejabat pelbagai tingkat di Pulau Pinang ? Lukiskan gambarajah skima bagi sistem dan labelkan komponen-komponen utama.

What type of air conditioning system would you recommend for a multi storey office building in Penang? Draw a schematic diagram of the system and label the main components.

(50 markah)

[c] Apakah punca-punca pencemaran udara tertutup ?

What are the causes of indoor air pollution?

(25 markah)

S6. **Satu sistem penyamanan udara bagi bangunan pejabat kecil hendak direkabentuk. Rekabentuk adalah berasaskan kepada maklumat-maklumat berikut :**

Keadaan rekabentuk diluar	**35°C DB, 28 °C WB**
Keadaan rekabentuk di dalam	**26 °C DB, 50% RH**
Gandaan haba deria bagi bilik	**45 kW**
Gandaan haba lakuran bagi bilik	**9kW**
Udara luar bagi memenuhi keperluan pengudaraan	**0.95 m^3/s**

Satu gegelung pengembangan terus Freon 134a dengan faktor pirau 0.2 akan digunakan. Analisa masalah pada carta psikometri dan tentukan :

A summer air conditioning system for a small office building is to be designed. The design would be based on the following information:

Outside design conditions	*35°C DB, 28°C WB*
Inside design conditions	*26°C DB, 50% RH*
Room sensible heat gain	*45 kW*
Room latent heat gain	*9 kW*
Outside air to meet ventilation requirement	*0.95 m^3/s*

A direct-expansion Freon 134a coil with a by-pass factor of 0.2 will be used. Analyse the problem on a psychrometric chart and determine the following:

[a] **faktor-haba deria.**

sensible-heat factor.

(15 markah)

[b] **titik embun bagi perkakas bilik.**

the room apparatus dew point

(20 markah)

[c] **suhu udara yang meninggalkan gegelung.**

temperature of air leaving coil

(20 markah)

[d] **kuantiti udara keseluruhan yang diperlukan dalam meter padu per saat.**

total air quantity required in cubic metre per second.

(15 markah)

[e] **suhu bagi udara campuran yang memasuki gegelung.**

temperature of mixed air entering coil

(15 markah)

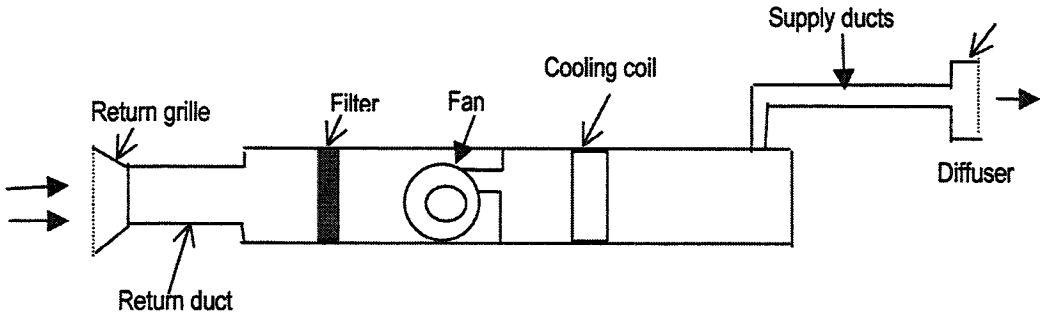
[f] **titik embun perkakas gegelung.**

coil apparatus dew point

(15 markah)

S7. [a] **Tunjukkan profil tekanan jumlah melawan jarak bagi sistem pengagihan udara yang ditunjukkan dalam Rajah S7[a] di bawah. Kehilangan tekanan bagi setiap elemen disenaraikan dalam Jadual S7[a] di bawah.**

Show the total pressure profile against distance of the air distribution system shown in Fig Q7[a] below. Pressure losses at each of the elements have been listed in Table Q7[a] below.



Rajah S7[a] Paparan skima bagi sistem pengagihan udara
Fig Q7[a] Schematic layout of the air distribution system

Elemen *Element*	**Jerejak balikan** *Return Grille*	**Salur balikan** *Return Duct*	**Penuras** *Filter*	**Gegelung penyejuk** *Cooling Coils*	**Salur pembekal** *Supply ducts*	**Peresap** *Diffusers*	**Tekanan jumlah kipas** *Fan total Pressure (Pa)*
Kehilangan tekanan keseluruhan *Total pressure Loss (Pa)*	10	20	20	60	35	8	153

Jadual S7[a] Kehilangan tekanan pada elemen berbeza
Table Q7[a] Pressure losses at different elements

(20 markah)

[b] **Satu pakej penyamanan udara menyejukkan empat bilik di dalam sebuah pangsapuri. Paparan skima bagi sistem salur dan kadar alir isipadu ke setiap bilik ditunjukkan dalam Rajah S7[b]. Panjang bagi bahagian-bahagian salur disenaraikan dalam Jadual S7[b].**

A packaged air conditioner serves four rooms in an apartment. The schematic layout of the duct system and the volume flow rate to each room is shown in Figure Q7[b]. The length of the duct sections are listed in Table Q7[b].

(i) **Kirakan saiz bagi sistem salur menggunakan kaedah sama geseran. Salur mestilah dibina dari bahagian-bahagian bulat piawai dengan diameter dalam pertambahan 25 mm. Halaju udara pada bahagian pertama mestilah tidak melebihi 8 m/s.**

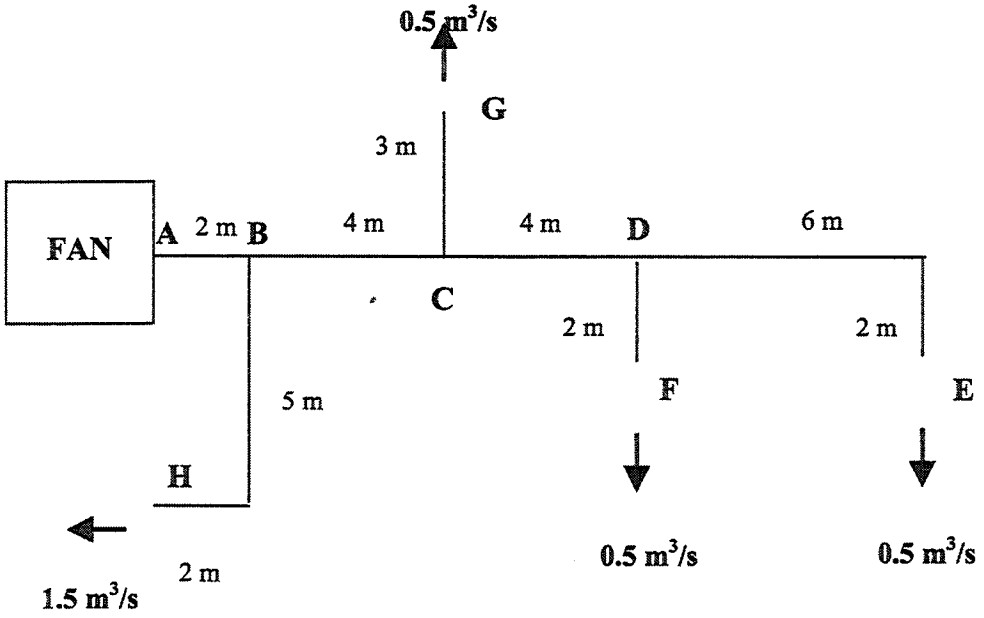
Size the duct system using equal friction method. The duct shall be of standard round sections with diameters in increments of 25 mm. The air velocity in the first section is not to exceed 8 m/s.

(65 markah)

(ii) **Anggarkan tekanan statik di dalam indeks larian bagi rangkaian salur. Terdapat jatuhan tekanan 25 kPa pada setiap keluaran pada E,F,G dan H. Di dalam pengiraan, pertimbangkan kerintangan yang disebabkan oleh penyambungan sebagai satu per empat panjang salur.**

Estimate the static pressure in the index run of the duct network. There is a pressure drop of 25 Pa at each of the outlet grilles at E, F, G and H. In the calculation, consider the resistance due to the fittings as one fourth that of the duct length

(15 markah)



Rajah S7[b] Paparan skima salur bagi sistem salur
Figure Q7b Schematic layout of duct of the duct system

Bahagian *Section*	**AB**	**BC**	**CD**	**DE**	**BH**	**CG**	**DF**
Panjang (m) *Length (m)*	2	4	4	8	7	3	2

Jadual S7[b] Panjang bagi bahagian salur
Table Q7[b] Length of Duct Sections

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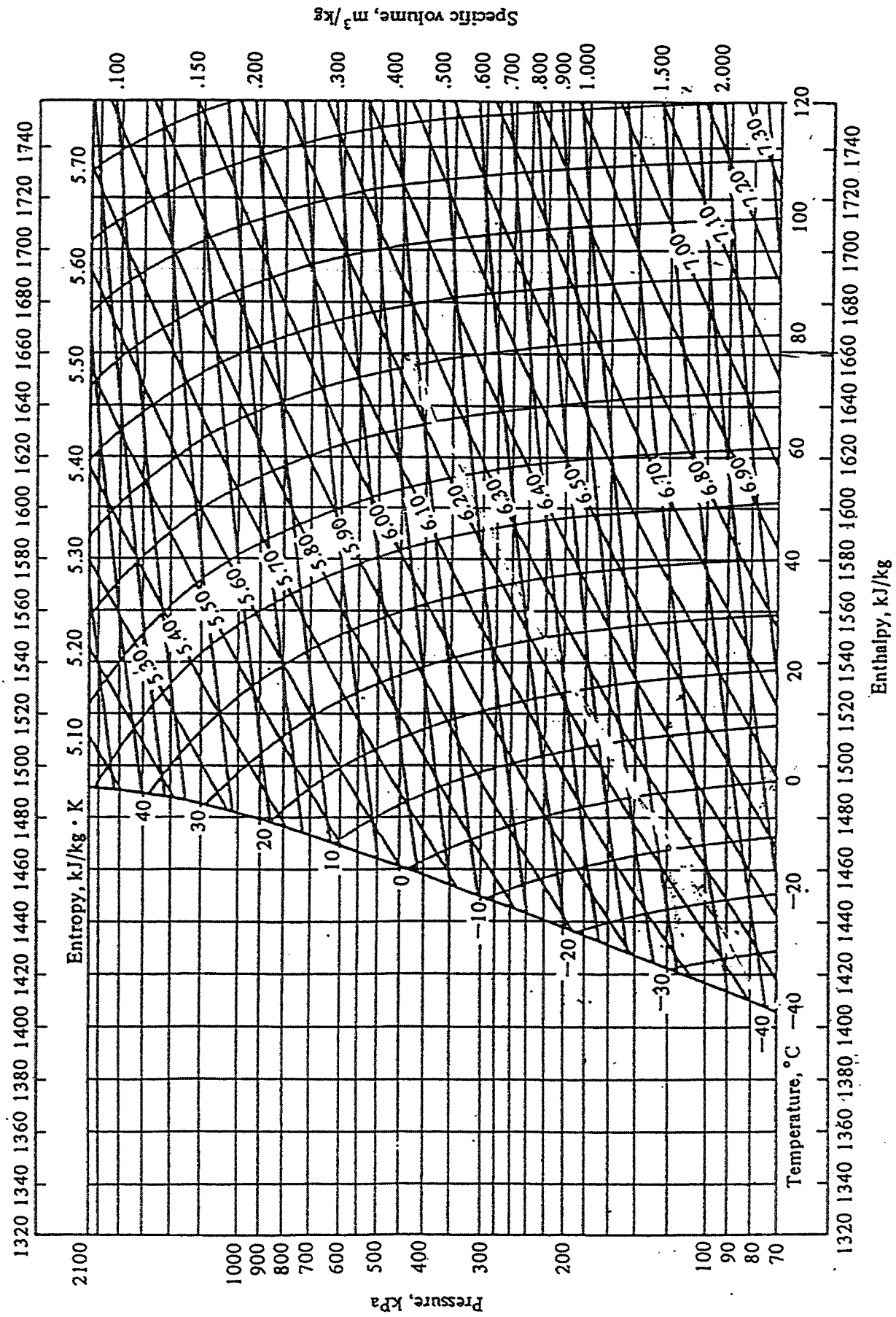
LAMPIRAN

Pressure-enthalpy diagram of superheated ammonia vapor



Pressure-enthalpy diagram of superheated ammonia vapor.

Table-A-3 Ammonia : Properties of liquid and saturated vapor[3]

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		Enthalpy, kJ/kg		Entropy, kJ/kg · K		Specific volume, L/kg	
t, °C	P, kPa	h_f	h_g	s_f	s_g	v_f	v_g
-60	21.99	-69.5330	1373.19	-0.10909	6.6592	1.4010	4685.08
-55	30.29	-47.5062	1382.01	-0.00717	6.5454	1.4126	3474.22
-50	41.03	-25.4342	1390.64	0.09264	6.4382	1.4245	2616.51
-45	54.74	-3.3020	1399.07	0.19049	6.3369	1.4367	1998.91
-40	72.01	18.9024	1407.26	0.28651	6.2410	1.4493	1547.36
-35	93.49	41.1883	1415.20	0.38082	6.1501	1.4623	1212.49
-30	119.90	63.5629	1422.86	0.47351	6.0636	1.4757	960.867
-28	132.02	72.5387	1425.84	0.51015	6.0302	1.4811	878.100
-26	145.11	81.5300	1428.76	0.54655	5.9974	1.4867	803.761
-24	159.22	90.5370	1431.64	0.58272	5.9652	1.4923	736.868
-22	174.41	99.5600	1434.46	0.61865	5.9336	1.4980	676.570
-20	190.74	108.599	1437.23	0.65436	5.9025	1.5037	622.122
-18	208.26	117.656	1439.94	0.68984	5.8720	1.5096	572.875
-16	227.04	126.729	1442.60	0.72511	5.8420	1.5155	528.257
-14	247.14	135.820	1445.20	0.76016	5.8125	1.5215	487.769
-12	268.63	144.929	1447.74	0.79501	5.7835	1.5276	450.971
-10	291.57	154.056	1450.22	0.82965	5.7550	1.5338	417.477
-9	303.60	158.628	1451.44	0.84690	5.7409	1.5369	401.860
-8	316.02	163.204	1452.64	0.86410	5.7269	1.5400	386.944
-7	328.84	167.785	1453.83	0.88125	5.7131	1.5432	372.692
-6	342.07	172.371	1455.00	0.89835	5.6993	1.5464	359.071
-5	355.71	176.962	1456.15	0.91541	5.6856	1.5496	346.046
-4	369.77	181.559	1457.29	0.93242	5.6721	1.5528	333.589
-3	384.26	186.161	1458.42	0.94938	5.6586	1.5561	321.670
-2	399.20	190.768	1459.53	0.96630	5.6453	1.5594	310.263
-1	414.58	195.381	1460.62	0.98317	5.6320	1.5627	299.340
0	430.43	200.000	1461.70	1.00000	5.6189	1.5660	288.880
1	446.74	204.625	1462.76	1.01679	5.6058	1.5694	278.858
2	463.53	209.256	1463.80	1.03354	5.5929	1.5727	269.253
3	480.81	213.892	1464.83	1.05024	5.5800	1.5762	260.046
4	498.59	218.535	1465.84	1.06691	5.5672	1.5796	251.216
5	516.87	223.185	1466.84	1.08353	5.5545	1.5831	242.745
6	535.67	227.841	1467.82	1.10012	5.5419	1.5866	234.618
7	555.00	232.503	1468.78	1.11667	5.5294	1.5901	226.817
8	574.87	237.172	1469.72	1.13317	5.5170	1.5936	219.326
9	595.28	241.848	1470.64	1.14964	5.5046	1.5972	212.132
10	616.25	246.531	1471.57	1.16607	5.4924	1.6008	205.221
11	637.78	251.221	1472.46	1.18246	5.4802	1.6045	198.580
12	659.89	255.918	1473.34	1.19882	5.4681	1.6081	192.196
13	682.59	260.622	1474.20	1.21515	5.4561	1.6118	186.058
14	705.88	265.334	1475.05	1.23144	5.4441	1.6156	180.154
15	729.79	270.053	1475.88	1.24769	5.4322	1.6193	174.475
16	754.31	274.779	1476.69	1.26391	5.4204	1.6231	169.009
17	779.46	279.513	1477.48	1.28010	1.4087	1.6269	163.748
18	805.25	284.255	1478.25	1.29626	5.3971	1.6308	158.683
19	831.69	289.005	1479.01	1.31238	5.3855	1.6347	153.804
20	858.79	293.762	1479.75	1.32847	5.3740	1.6386	149.106

Table-A-3 (continued)

Table A-3 (continued)

		Enthalpy, kJ/kg		Entropy, kJ/kg · K		Specific volume, L/kg	
t, °C	P, kPa	h_f	h_g	s_f	s_g	v_f	v_g
21	886.57	298.527	1480.48	1.34452	5.3626	1.6426	144.578
22	915.03	303.300	1481.18	1.36055	5.3512	1.6466	140.214
23	944.18	308.081	1481.87	1.37654	5.3399	1.6507	136.006
24	974.03	312.870	1482.53	1.39250	5.3286	1.6547	131.950
25	1004.6	317.667	1483.18	1.40843	5.3175	1.6588	128.037
26	1035.9	322.471	1483.81	1.42433	5.3063	1.6630	124.261
27	1068.0	327.284	1484.42	1.44020	5.2953	1.6672	120.619
28	1100.7	332.104	1485.01	1.45604	5.2843	1.6714	117.103
29	1134.3	336.933	1485.59	1.47185	5.2733	1.6757	113.708
30	1168.6	341.769	1486.14	1.48762	5.2624	1.6800	110.430
31	1203.7	346.614	1486.67	1.50337	5.2516	1.6844	107.263
32	1239.6	351.466	1487.18	1.51908	5.2408	1.6888	104.205
33	1276.3	356.326	1487.66	1.53477	5.2300	1.6932	101.248
34	1313.9	361.195	1488.13	1.55042	5.2193	1.6977	98.3913
35	1352.2	366.072	1488.57	1.56605	5.2086	1.7023	95.6290
36	1391.5	370.957	1488.99	1.58165	5.1980	1.7069	92.9579
37	1431.5	375.851	1489.39	1.59722	5.1874	1.7115	90.3743
38	1472.4	380.754	1489.76	1.61276	5.1768	1.7162	87.8748
39	1514.3	385.666	1490.10	1.62828	5.1663	1.7209	85.4561
40	1557.0	390.587	1490.42	1.64377	5.1558	1.7257	83.1150
41	1600.6	395.519	1490.71	1.65924	5.1453	1.7305	80.8484
42	1645.1	400.462	1490.98	1.67470	5.1349	1.7354	78.6536
43	1690.6	405.416	1491.21	1.69013	5.1244	1.7404	76.5276
44	1737.0	410.382	1491.41	1.70554	5.1140	1.7454	74.4678
45	1784.3	415.362	1491.58	1.72095	5.1036	1.7504	72.4716
46	1832.6	420.358	1491.72	1.73635	5.0932	1.7555	70.5365
47	1881.9	425.369	1491.83	1.75174	5.0827	1.7607	68.6602
48	1932.2	430.399	1491.88	1.76714	5.0723	1.7659	66.8403
49	1983.5	435.450	1491.91	1.78255	5.0618	1.7712	65.0746
50	2035.9	440.523	1491.89	1.79798	5.0514	1.7766	63.3608
51	2089.2	445.623	1491.83	1.81343	5.0409	1.7820	61.6971
52	2143.6	450.751	1491.73	1.82891	5.0303	1.7875	60.0813
53	2199.1	455.913	1491.58	1.84445	5.0198	1.7931	58.5114
54	2255.6	461.112	1491.38	1.86004	5.0092	1.7987	56.9855
55	2313.2	466.353	1491.12	1.87571	4.9985	1.8044	55.5019

Table-A-1 Water : Properties of liquid and saturated vapor

Table A-1 Water: properties of liquid and saturated vapor

	Saturation pressure,	Specific volume, m^3/kg		Enthalpy, kJ/kg		Entropy, kJ/kg - K	
t, °C	kPa	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor
0	0.6108	0.0010002	206.3	-0.04	2501.6	-0.0002	9.1577
2	0.7055	0.0010001	179.9	8.39	2505.2	0.0306	9.1047
4	0.8129	0.0010000	157.3	16.80	2508.9	0.0611	9.0526
6	0.9345	0.0010000	137.8	25.21	2512.6	0.0913	9.0015
8	1.0720	0.0010001	121.0	33.60	2516.2	0.1213	8.9513
10	1.2270	0.0010003	106.4	41.99	2519.9	0.1510	8.9020
12	1.4014	0.0010004	93.84	50.38	2523.6	0.1805	8.8536
14	1.5973	0.0010007	82.90	58.75	2527.2	0.2098	8.8060
16	1.8168	0.0010010	73.38	67.13	2530.9	0.2388	8.7593
18	2.062	0.0010013	65.09	75.50	2534.5	0.2677	8.7135
20	2.337	0.0010017	57.84	83.86	2538.2	0.2963	8.6684
22	2.642	0.0010022	51.49	92.23	2541.8	0.3247	8.6241
24	2.982	0.0010026	45.93	100.59	2545.5	0.3530	8.5806
26	3.360	0.0010032	41.03	108.95	2549.1	0.3810	8.5379
28	3.778	0.0010037	36.73	117.31	2552.7	0.4088	8.4959
30	4.241	0.0010043	32.93	125.66	2556.4	0.4365	8.4546
32	4.753	0.0010049	29.57	134.02	2560.0	0.4640	8.4140
34	5.318	0.0010056	26.60	142.38	2563.6	0.4913	8.3740
36	5.940	0.0010063	23.97	150.74	2567.2	0.5184	8.3348
38	6.624	0.0010070	21.63	159.10	2570.8	0.5452	8.2962
40	7.375	0.0010078	19.55	167.45	2574.4	0.5721	8.2583
42	8.198	0.0010086	17.69	175.31	2577.9	0.5987	8.2209
44	9.100	0.0010094	16.04	184.17	2581.5	0.6252	8.1842
46	10.086	0.0010103	14.56	192.53	2585.1	0.6514	8.1481

Table-A-1 (continued)

Table A-1 (continued)

t, °C	Saturation pressure, kPa	Specific volume, m^3/kg		Enthalpy, kJ/kg		Entropy, kJ/kg · K	
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor
48	11.162	0.0010112	13.23	200.89	2588.6	0.6776	8.1125
50	12.335	0.0010121	12.05	209.26	2592.2	0.7035	8.0776
52	13.613	0.0010131	10.98	217.62	2595.7	0.7293	8.0432
54	15.002	0.0010140	10.02	225.98	2599.2	0.7550	8.0093
56	16.511	0.0010150	9.159	234.35	2602.7	0.7804	7.9759
58	18.147	0.0010161	8.381	242.72	2606.2	0.8058	7.9431
60	19.920	0.0010171	7.679	251.09	2609.7	0.8310	7.9108
62	21.84	0.0010182	7.044	259.46	2613.2	0.8560	7.8790
64	23.91	0.0010193	6.469	267.84	2616.6	0.8809	7.8477
66	26.15	0.0010205	5.948	276.21	2620.1	0.9057	7.8168
68	28.56	0.0010217	5.476	284.59	2623.5	0.9303	7.7864
70	31.16	0.0010228	5.046	292.97	2626.9	0.9548	7.7565
72	33.96	0.0010241	4.646	301.35	2630.3	0.9792	7.7270
74	36.96	0.0010253	4.300	309.74	2633.7	1.0034	7.6979
76	40.19	0.0010266	3.976	318.13	2637.1	1.0275	7.6693
78	43.65	0.0010279	3.680	326.52	2640.4	1.0514	7.6410
80	47.36	0.0010292	3.409	334.92	2643.8	1.0753	7.6132
82	51.33	0.0010305	3.162	343.31	2647.1	1.0990	7.5850
84	55.57	0.0010319	2.935	351.71	2650.4	1.1225	7.5588
86	60.11	0.0010333	2.727	360.12	2653.6	1.1460	7.5321
88	64.95	0.0010347	2.536	368.53	2656.9	1.1693	7.5058
90	70.11	0.0010361	2.361	376.94	2660.1	1.1925	7.4799
92	75.61	0.0010376	2.200	385.36	2663.4	1.2156	7.4543
94	81.46	0.0010391	2.052	393.78	2666.6	1.2386	7.4291
96	87.69	0.0010406	1.915	402.20	2669.7	1.2615	7.4042
98	94.30	0.0010421	1.789	410.63	2672.9	1.2842	7.3796
100	101.33	0.0010437	1.673	419.06	2676.0	1.3069	7.3554
102	108.78	0.0010453	1.566	427.50	2679.1	1.3294	7.3315
104	116.68	0.0010469	1.466	435.95	2682.2	1.3518	7.3078
106	125.04	0.0010485	1.374	444.40	2685.3	1.3742	7.2845
108	133.90	0.0010502	1.289	452.85	2688.3	1.3964	7.2615
110	143.26	0.0010519	1.210	461.32	2691.3	1.4185	7.2388
112	153.16	0.0010536	1.137	469.78	2694.3	1.4405	7.2164
114	163.62	0.0010553	1.069	478.26	2697.2	1.4624	7.1942
116	174.65	0.0010571	1.005	486.74	2700.2	1.4842	7.1723
118	186.28	0.0010588	0.9463	495.23	2703.1	1.5060	7.1507
120	198.54	0.0010606	0.8915	503.72	2706.0	1.5276	7.1293

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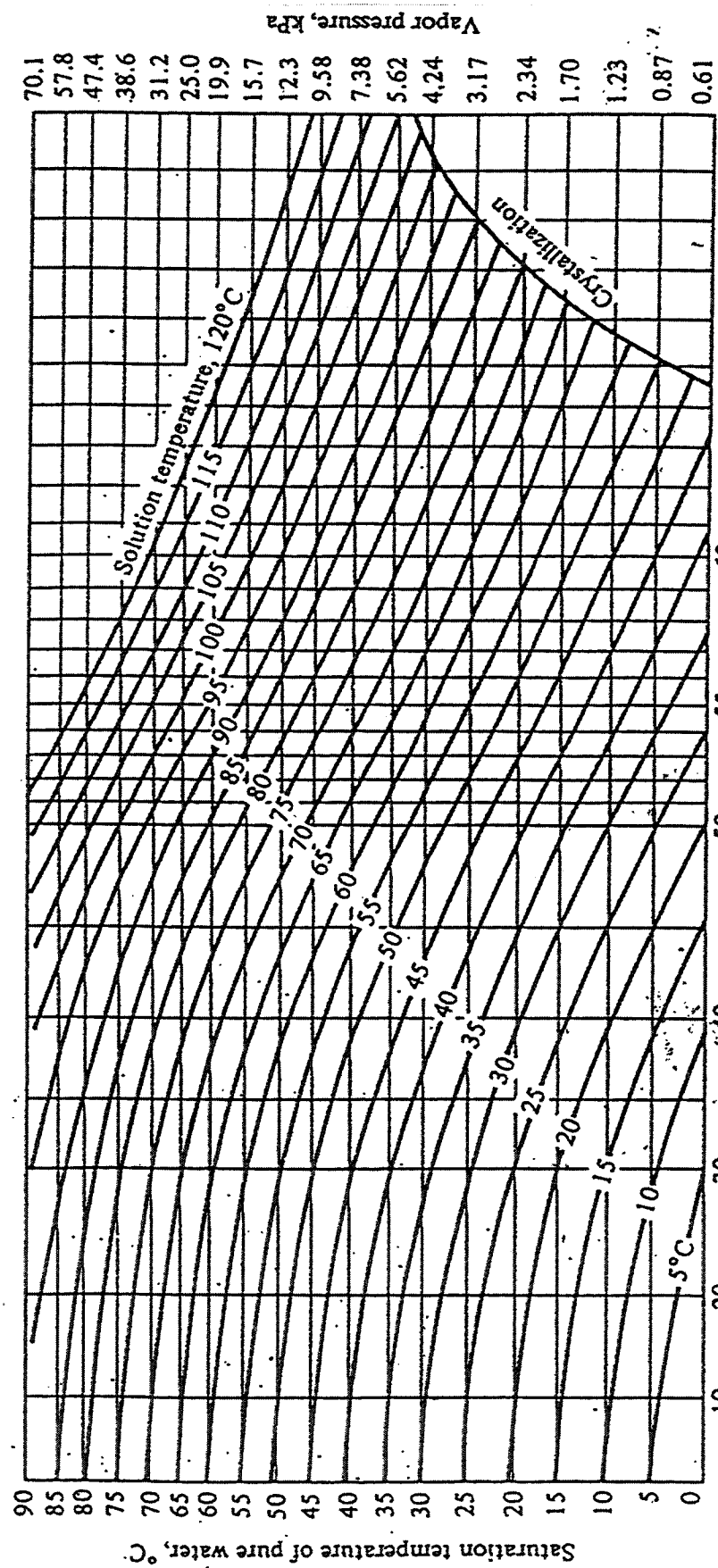
Temperature-pressure-concentration-diagram of saturated LiBr-water solution developed from data in Ref.1.



Temperature-pressure-concentration diagram of saturated LiBr-water solutions, developed from data in Ref. 1.

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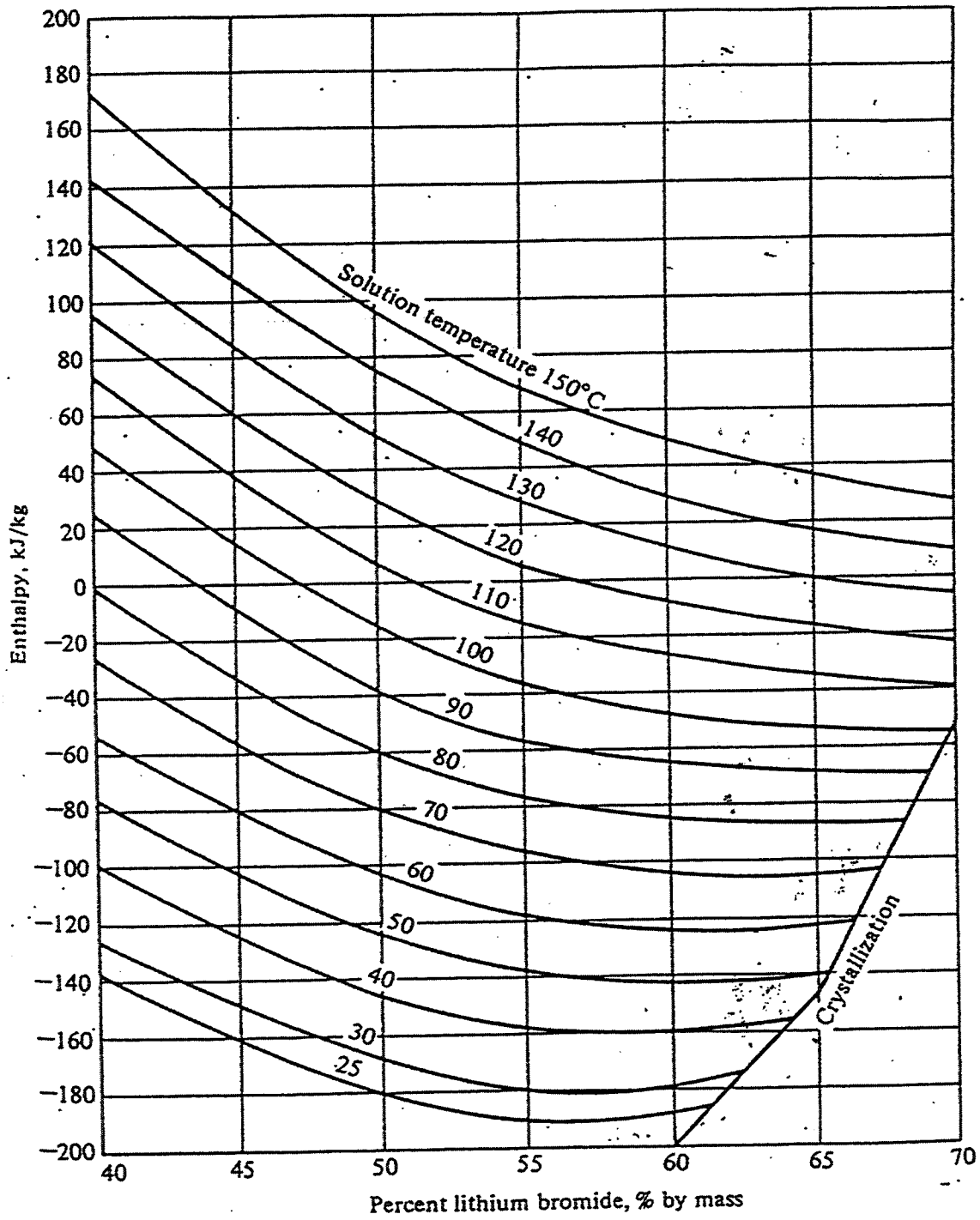
Enthalpy of LiBr-water solutions



Enthalpy of LiBr–water solutions;

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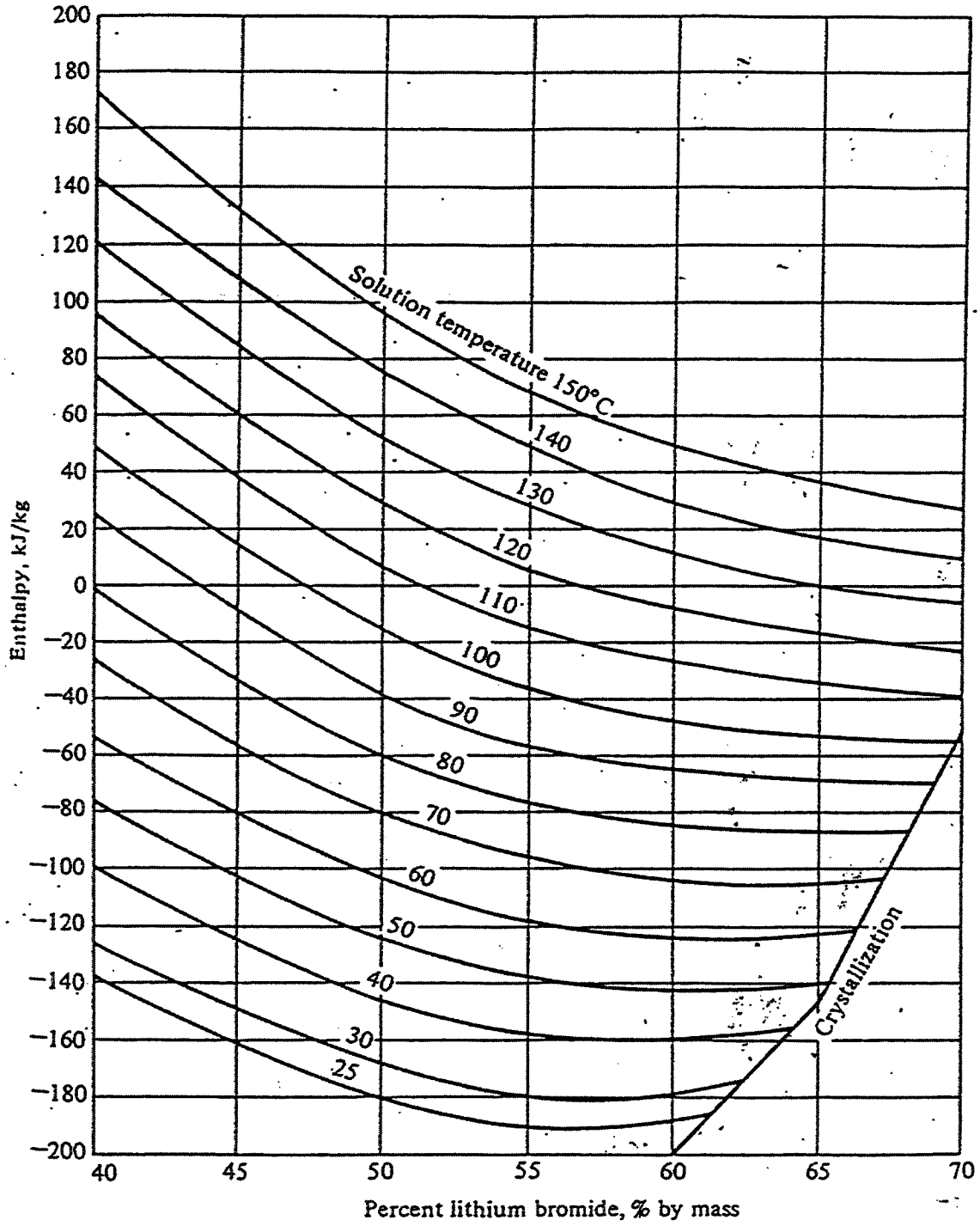
Enthalpy of LiBr-water solutions



Enthalpy of LiBr–water solutions;

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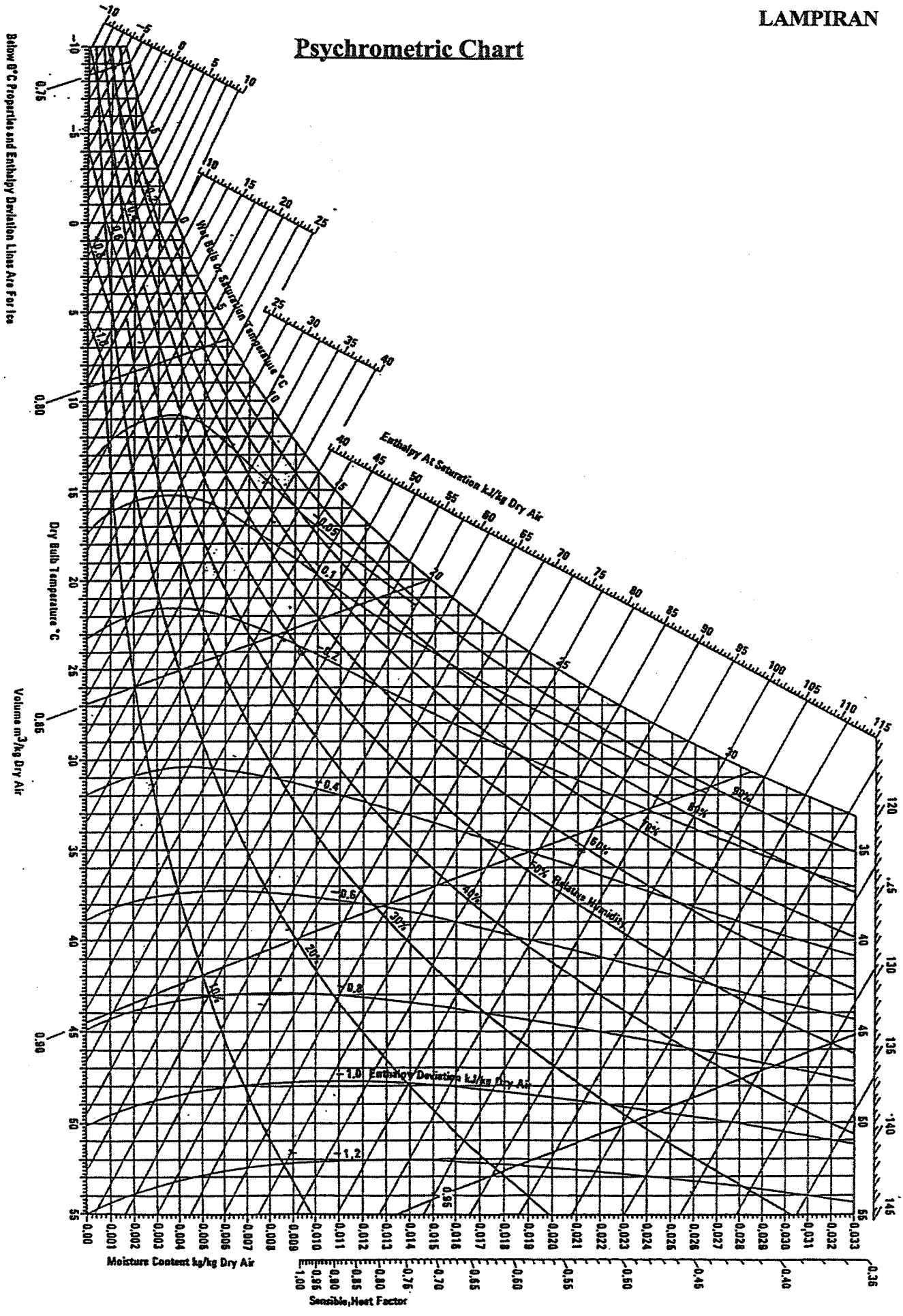
Psychrometric Chart



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Friction Chart for Round Duct ($\rho = 1.20 kg/m^3$ and $\varepsilon = 0.009$ mm)