

SULIT



**KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI**

**BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI**

JABATAN KEJURUTERAAN AWAM

PEPERIKSAAN AKHIR

SESI I : 2025/2026

DCB40153 : AIR CONDITIONING SYSTEM TECHNOLOGY

TARIKH : 25 NOVEMBER 2025

MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)

Kertas ini mengandungi **LIMA BELAS (15)** halaman bercetak.

Bahagian A: Struktur (2 soalan)

Bahagian B: Struktur (4 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

SECTION A: 50 MARKS**BAHAGIAN A: 50 MARKAH****INSTRUCTION:**

This section consists of **TWO (2)** subjective questions. Answer **ALL** questions.

ARAHAN:

*Bahagian ini mengandungi **DUA (2)** soalan subjektif. Jawab **SEMUA** soalan.*

QUESTION 1**SOALAN 1**

- CLO2 (a) Differentiate between sensible heat and latent heat in terms of phase change, temperature change and appropriate examples.

Bezakan antara haba deria dan haba pendam dari segi perubahan fasa, perubahan suhu dan contoh yang sesuai.

[5 marks]

[5 markah]

- CLO2 (b) A fan rotates at a speed of 2000 rpm to move 2222 m³/hr of air and produces a pressure of 1322 Pa using a power of 5.4 hp. If the fan speed is increased to 2300 rpm, calculate the final air volume flow rate, final pressure and final power of the fan.

Sebuah kipas berputar pada kelajuan 2000 rpm untuk menggerakkan 2222 m³/jam udara dan menghasilkan tekanan 1322 Pa menggunakan kuasa 5.4 hp. Jika kelajuan kipas dinaikkan kepada 2300 rpm, kira kadar alir isipadu udara akhir, tekanan akhir dan kuasa akhir kipas.

[12 marks]

[12 markah]

CLO2

- (c) In an Air Handling Unit (AHU), the blower, which is essentially a fan, functions to actively move and distribute conditioned air throughout the building by pushing it through the supply ducts, ensuring proper air circulation throughout space. Illustrate with a labelled diagram a centrifugal fan commonly used in an AHU.

Dalam Unit Pengendalian Udara (UPU), penghembus, yang pada dasarnya adalah kipas, berfungsi untuk menggerakkan dan mengedarkan udara berhawa dingin secara aktif ke seluruh bangunan dengan menolaknya melalui sesalur bekalan, memastikan peredaran udara yang betul ke seluruh ruang. Ilustrasikan dengan gambar rajah berlabel tentang sebuah kipas empar yang biasa digunakan dalam sebuah UPU.

[8 marks]

[8 markah]

QUESTION 2**SOALAN 2**

An old lecture hall measuring 24 m × 18 m × 6 m has been renovated to accommodate new lecture equipment and a more environmentally friendly air conditioning system. This lecture hall will be used every working day from 0800 am to 1700 pm. The cumulative external load is 50200 watts. The following is the data for this lecture hall.

Sebuah dewan kuliah yang lama dengan ukuran 24 m × 18 m × 6 m telah diubahsuai bagi menempatkan kelengkapan kuliah yang baharu dan sistem penyamanan udara yang lebih mesra alam. Dewan kuliah ini akan digunakan pada setiap hari bekerja bermula dari jam 0800 pagi hingga 1700 petang. Beban luaran terkumpul ialah 50200 watt. Berikut adalah data bagi dewan kuliah ini.

Building data (*Data bangunan*):

Student/Lecturer 252 persons, Table 1: Seated, very light work, Table 37: hours in space (8h)

Pelajar/Pensyarah 252 orang, Jadual 1: Duduk, kerja sangat ringan, Jadual 37: jam di dalam ruang (8h)

Lighting 84 units fluorescent lamp, lamp wattage 36 W each, ballast factor 1.2, Table 38: Zone Type A, hours light on (8h)

Pencahayaan 84 unit lampu kalimantang, kuasa lampu 36 W setiap satu, faktor ballast 1.2, Jadual 38: Zon Jenis A, jam lampu menyala (8h)

Laptop 2 units (100 watts each)

Komputer riba 2 unit (100 watt setiap satu)

LCD Projector 1 unit (150 watts)

Projektor LCD 1 unit (150 watt)

Audio system 1 unit (300 watts)

Sistem audio 1 unit (300 watt)

Statement A2 / *Penyataan A2*

- CLO2 (a) To ensure that the new air conditioning system in the lecture hall operates properly, a certain amount of sensible and latent heat loads need to be accurately considered so that students and lecturers receive optimal comfort throughout the lecture. Identify **FIVE (5)** factors that affect the sensible heat load.

*Bagi memastikan sistem penyamanan udara baharu di dewan kuliah tersebut beroperasi dengan baik, sejumlah beban haba deria dan haba pendam perlu diambilkira dengan tepat supaya pelajar dan pensyarah mendapat keselesaan yang optimum sepanjang kuliah berlangsung. Kenalpasti **LIMA (5)** faktor yang memberi kesan kepada beban haba deria.*

[5 marks]

[5 markah]

- CLO2 (b) Based on Statement A2 and Appendix 1, calculate the internal load for people and lighting using ASHRAE standard formula.

Berdasarkan Penyataan A2 dan Lampiran 1, kirakan beban dalaman untuk orang dan pencahayaan menggunakan formula piawai ASHRAE.

[12 marks]

[12 markah]

- CLO2 (c) Based on Statement A2, Appendix 1 and answers from Question A2(b), determine the appropriate type of air conditioning system by referring to Table A2 (Appendix 2) and ASHRAE standard formula.

Berdasarkan Penyataan A2, Lampiran 1 dan jawapan daripada Soalan A2(b), tentukan jenis sistem penyamanan udara yang sesuai dengan merujuk Jadual A2 (Lampiran 2) dan formula piawai ASHRAE.

[8 marks]

[8 markah]

SECTION B: 50 MARKS**BAHAGIAN B: 50 MARKAH****INSTRUCTION:**

This section consists of **FOUR (4)** subjective questions. Answer **TWO (2)** questions only.

ARAHAN:

Bahagian ini mengandungi EMPAT (4) soalan subjektif. Jawab DUA (2) soalan sahaja.

QUESTION 1**SOALAN 1**

Broken Stone Construction will build a medium-scale office with a capacity of 25 people at Gerik Residence. The office will be equipped with a summer air conditioning system based on CIBSE standard. The conditions outside the office are 35°C DBT & 27°C WBT while the conditions inside the office are 22°C DBT & 50% RH. The air volume that needs to be supplied into this office is 0.4 m³/min/person.

Broken Stone Construction akan membina sebuah pejabat berskala sederhana dengan kapasiti 25 orang di Gerik Residence. Pejabat tersebut akan disediakan sekali dengan sistem penyamanan udara musim panas berdasarkan piawai CIBSE. Keadaan luar pejabat adalah 35°C SBK & 27°C SBB manakala keadaan dalam pejabat adalah 22°C SBK & 50% KR. Isipadu udara yang perlu dibekalkan ke dalam pejabat ini adalah 0.4 m³/min/orang.

Statement B1 / *Penyataan B1*

CLO1

- (a) As an HVAC engineer from Broken Stone Construction, illustrate with labels the summer air conditioning system.

Sebagai seorang jurutera HVAC daripada Broken Stone Construction, gambarkan dengan label mengenai sistem penyamanan udara musim panas.

[5 marks]

[5 markah]

- CLO1 (b) By using the data from Statement B1 and CIBSE Standard Psychrometric Chart (Appendix 3), determine the specific enthalpy for points 1, 2 and 3 (h_1 , h_2 and h_3).

Dengan menggunakan data dari Pernyataan B1 dan Carta Psikrometrik Standard CIBSE (Lampiran 3), tentukan entalpi tentu bagi titik 1, 2 dan 3 (h_1 , h_2 dan h_3).

[12 marks]

[12 markah]

- CLO1 (c) Based on the data from Statement B1 and answers from Question B1(b), calculate the sensible heat factor for this system.

Berdasarkan data dari Pernyataan B1 dan jawapan dari Soalan B1(b), kirakan faktor haba deria bagi sistem ini.

[8 marks]

[8 markah]

QUESTION 2**SOALAN 2**

Blue Dragon Aircond wins the tender to supply and install air conditioning units for all lecture rooms at Gerik Technology Institute. Lecture rooms that are not air conditioned will be redesigned to accommodate air conditioning units. This lecture room measuring $8.8\text{ m} \times 8.4\text{ m} \times 4\text{ m}$ has walls constructed from plastered hollow brick, tile roof ceiling with fiberglass and concrete floor. It is also completed with 3 sets of double-glazed windows and 2 wooden doors as shown in Figure B2. The size of the glass window is $1.2\text{ m} \times 1.2\text{ m}$ while the size of the door is $1.7\text{ m} \times 2.1\text{ m}$. Each lecture room will be used by 40 students and 1 lecturer from 0800 am to 1700 pm every working day (8h hours in space, 70 watts sensible heat and 45 watts latent heat per person). This lecture room is equipped with 18 LED fluorescent lamps with a power of 18 watts per unit (ballast factor = 1.2, CLF = 0.13). The internal temperature is 27°C while the external temperature is 33°C . Assume solar heat gain through glass windows is 348 watts and heat gain from infiltration and ventilation is 350 watts.

Blue Dragon Aircond memenangi tender membekal dan memasang unit penyaman udara untuk semua bilik kuliah di Institut Teknologi Gerik. Bilik kuliah yang tidak berhawa dingin akan direka bentuk semula untuk menempatkan unit penyaman udara. Bilik kuliah yang berukuran $8.8\text{ m} \times 8.4\text{ m} \times 4\text{ m}$ ini mempunyai dinding yang dibina daripada bata berlubang yang dilepa, siling bumbung jubin dengan gentian kaca dan lantai konkrit. Ia juga dilengkapi dengan 3 set tingkap kaca kembar dan 2 pintu kayu seperti yang ditunjukkan dalam Rajah B2. Saiz tingkap kaca ialah $1.2\text{ m} \times 1.2\text{ m}$ manakala saiz pintu ialah $1.7\text{ m} \times 2.1\text{ m}$. Setiap bilik kuliah akan digunakan oleh 40 pelajar dan 1 pensyarah dari jam 0800 pagi hingga 1700 petang setiap hari bekerja (8h jam di dalam ruang, 70 watt haba deria dan 45 watt haba pendam setiap orang). Bilik kuliah ini dilengkapi dengan 18 lampu pendarfluor LED dengan kuasa 18 watt seunit (faktor ballast = 1.2, CLF = 0.13). Suhu dalaman ialah 27°C manakala suhu luaran ialah 33°C . Andaikan penambahan haba suria melalui tingkap kaca ialah 348 watt dan penambahan haba daripada penyusupan dan pengudaraan ialah 350 watt.

Statement B2 / *Penyataan B2*

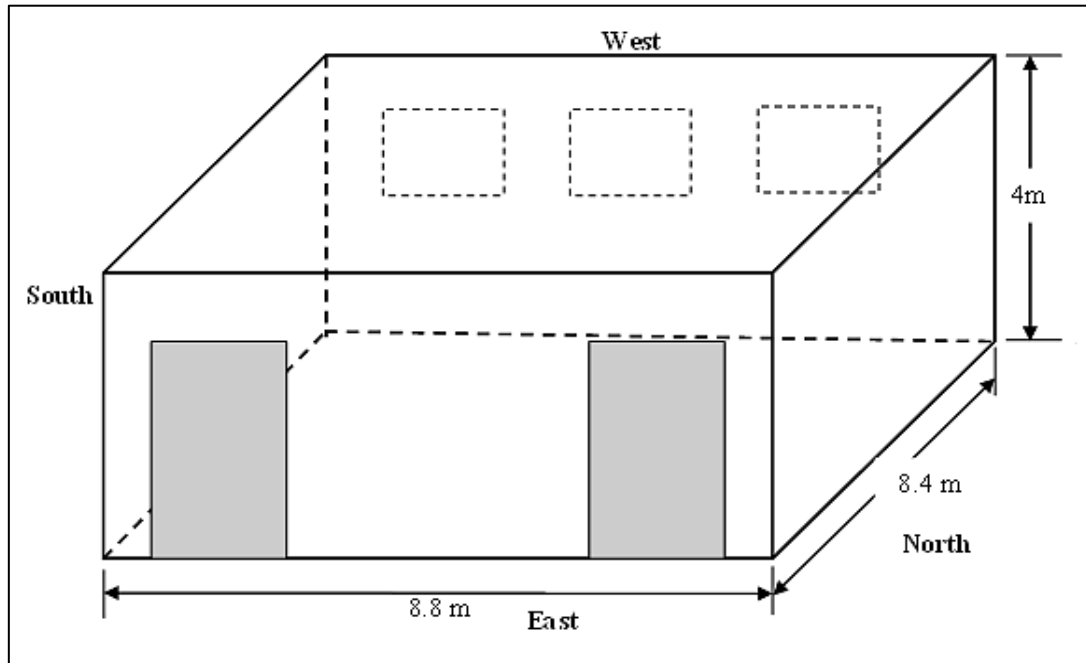


Figure B2 / Rajah B2

- CLO1 (a) Referring to Statement B2, Figure B2 and Table B2(i) (Appendix 4), estimate the cooling load from students and the lecturer using ASHRAE standard formula.

Merujuk kepada Penyataan B2, Rajah B2 dan Jadual B2(i) (Lampiran 4), anggarkan beban penyejukan daripada pelajar dan pensyarah menggunakan formula standard ASHRAE.

[5 marks]

[5 markah]

- CLO1 (b) Based on Statement B2, Figure B2 and Table B2(ii) (Appendix 4), calculate the cooling load for walls, ceiling, floor, doors and windows using ASHRAE standard formula.

Berdasarkan Penyataan B2, Rajah B2 dan Jadual B2(ii) (Lampiran 4), kirakan beban penyejukan bagi dinding, siling, lantai, pintu dan tingkap menggunakan formula standard ASHRAE.

[12 marks]

[12 markah]

- CLO1 (c) By using the data from Statement B2, Figure B2 and also the answers from Question B2(b) and Question B2(c), calculate the total cooling load for the lecture room including internal and external load by using ASHRAE standard formula.

Dengan menggunakan data dari Penyataan B2, Rajah B2 dan juga jawapan daripada Soalan B2(b) dan Soalan B2(c), kirakan jumlah beban penyejukan bagi bilik kuliah termasuk beban dalam dan luaran dengan menggunakan formula standard ASHRAE.

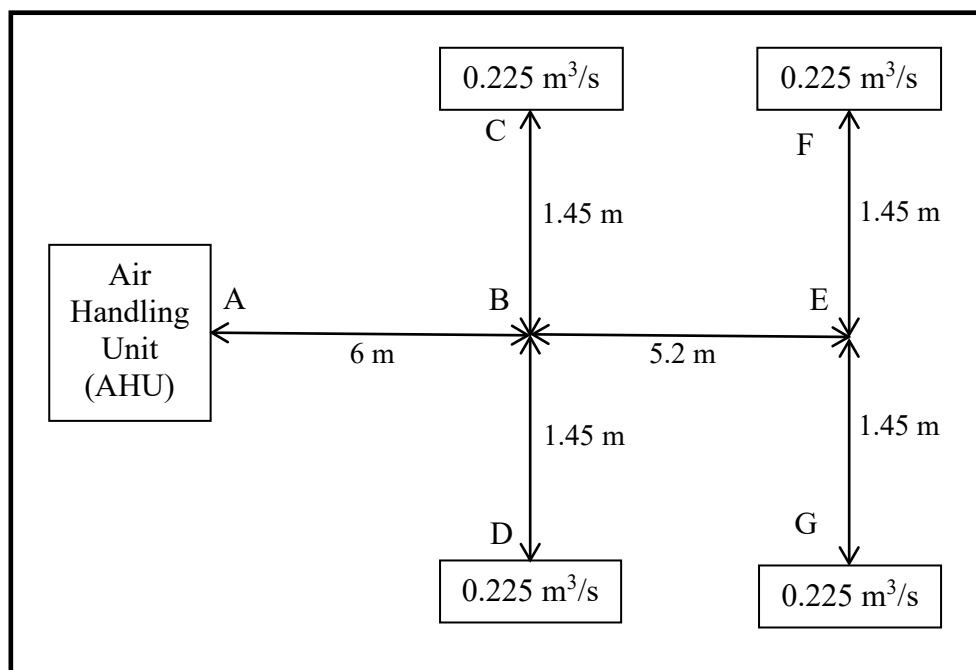
[8 marks]

[8 markah]

QUESTION 3**SOALAN 3**

An office at Zed Air Conditioner factory has internal dimensions of $15.6 \text{ m} \times 8.7 \text{ m} \times 3 \text{ m}$. This office will have its air conditioning system changed from a split unit to a plant unit. In order to supply $0.9 \text{ m}^3/\text{s}$ cold air into this office space later, the supply duct system needs to be designed and installed based on Figure B3 and in compliance with ASHRAE standards.

Sebuah pejabat di kilang Penyaman Udara Zed mempunyai ukuran dalaman $15.6 \text{ m} \times 8.7 \text{ m} \times 3 \text{ m}$. Pejabat ini akan ditukarkan sistem penyaman udaranya daripada unit pisah kepada unit loji. Bagi menyalurkan $0.9 \text{ m}^3/\text{s}$ udara sejuk ke dalam ruang pejabat ini nanti, sistem sesalur udara bekalan perlu direkabentuk dan dipasang berdasarkan Rajah B3 dan dengan mematuhi piawai ASHRAE.

Statement B3 / *Penyataan B3*Figure B3 / *Rajah B3*

- CLO1 (a) From Statement B3 and Figure B3, estimate the air change rate (ACH) for the office.

Daripada Penyataan B3 dan Rajah B3, anggarkan kadar pertukaran udara (PUJ) untuk pejabat.

[5 marks]

[5 markah]

- CLO1 (b) With reference to Statement B3, Figure B3 and Chart 4.33 (Appendix 5), by using an equal friction method and assuming that air velocity at duct AB is 5 m/s, determine the air volume and circular duct size for duct AB, BC, BD, BE, EF and EG.

Merujuk kepada Penyataan B3, Rajah B3 dan Carta 4.33 (Lampiran 5), dengan menggunakan kaedah geseran sama dan anggapan bahawa halaju udara pada sesalur AB adalah 5 m/s, tentukan isipadu udara dan saiz sesalur bulat bagi salur AB, BC, BD, BE, EF dan EG.

[12 marks]

[12 markah]

- CLO1 (c) By using the data from Figure B3, Question B3(b) and Chart 4.19 (Appendix 6), estimate the rectangular duct size for duct AB, BC, BD, BE, EF and EG if the duct dimension ratio is 2:1.

Dengan menggunakan data daripada Rajah B3, Soalan B3(b) dan Carta 4.19 (Lampiran 6), anggarkan saiz sesalur segiempat bagi salur AB, BC, BD, BE, EF dan EG sekiranya nisbah dimensi salur ialah 2:1.

[8 marks]

[8 markah]

QUESTION 4**SOALAN 4**

Gerik Permai Hall measuring $87\text{ m} \times 50\text{ m} \times 10\text{ m}$ will be used for the 15th convocation ceremony of Gerik University. Therefore, all the split unit air conditioners that were used before will be replaced with a package unit where cold air will be supplied into the hall through the supply duct system. Sejuk Dingin Sdn. Bhd. is entrusted to design this new air conditioner unit. An 85 m long supply air duct with a friction factor of 0.1 will be used to bring cool air to all parts of the hall.

Dewan Gerik Permai yang berukuran $87\text{ m} \times 50\text{ m} \times 10\text{ m}$ akan digunakan untuk majlis konvokesyen kali ke-15 bagi Universiti Gerik. Jadi, semua penyaman udara unit pisah yang digunakan sebelum ini akan digantikan dengan unit kemasiap yang mana udara sejuk akan disalurkan ke dalam ruang dewan melalui sistem sesalur udara bekalan. Sejuk Dingin Sdn. Bhd. telah diamanahkan untuk merekabentuk unit penyaman udara baharu ini. Sesalur udara bekalan sepanjang 85 m dengan faktor geseran 0.1 akan digunakan bagi membawa udara sejuk ke semua bahagian dalam ruang dewan ini.

Statement B4 / Pernyataan B4

CLO1

- (a) From Statement B4, estimate the air flow rate in m^3/s required if the air change rate for the hall is 8.

Daripada Pernyataan B4, anggarkan kadar alir udara dalam m^3/s yang diperlukan jika kadar pertukaran udara untuk dewan ialah 8.

[5 marks]

[5 markah]

CLO1

- (b) According to Statement B4 and answers from Question B4(a), calculate the pressure drop in the duct (mm of water) when the duct is circular and it has a diameter of 1.3 m.

Berdasarkan Pernyataan B4 dan jawapan daripada Soalan B4(a), kirakan kejatuhan tekanan dalam sesalur (mm air) apabila sesalur itu berbentuk bulat dan mempunyai diameter 1.3 m.

[12 marks]

[12 markah]

CLO1

- (c) By using the data from Statement B4 and answers from Question B4(a), calculate the pressure drop in the duct (mm of water) when the duct has a cross section of 1.3 square metre.

Dengan menggunakan data daripada Pernyataan B4 dan jawapan daripada Soalan B4(a), kirakan kejatuhan tekanan dalam sesalur (mm air) apabila sesalur mempunyai keratan rentas 1.3 meter persegi.

[8 marks]

[8 markah]

SOALAN TAMAT

FORMULA

- 1) $Q = U \times A \times CLTD$
- 2) $Q = A \times SC \times SCL$
- 3) $Q_s = 1210 \times \text{Airflow} \times \Delta T$
- 4) $Q_L = 3010 \times \text{Airflow} \times \Delta W$
- 5) $\text{Airflow} = (N \times V) \div 3600$
- 6) $\Delta W = m_{so} - m_{sr}$
- 7) $Q_s = N \times SHG \times CLF$
- 8) $Q_L = N \times LHG$
- 9) $Q_L = N \times \text{Ballast Factor} \times CLF$, $Q_L = (LPD \times A) \times \text{Ballast Factor} \times CLF$
- 10) $Q_E = W \times CLF$
- 11) $m_a = V_1/V_{s1}$
- 12) $SH = m_a (h_3 - h_2)$
- 13) $LH = m_a (h_1 - h_3)$
- 14) $SHF = \frac{SH}{SH + LH}$
- 15) $Q = \frac{ACH \times \text{Room Volume}}{3600}$
- 16) $A = \pi D^2/4$, $A = a \times b$
- 17) $C = Q/A$
- 18) $P = \pi D$, $P = 2(a + b)$
- 19) $m = A/P$
- 20) $p_f = \frac{fL}{m} \left(\frac{C}{4.04} \right)^2$
- 21) $\frac{Q_1}{Q_2} = \frac{N_1}{N_2}$
- 22) $\frac{P_1}{P_2} = \left(\frac{N_1}{N_2} \right)^2$
- 23) $\frac{W_1}{W_2} = \left(\frac{N_1}{N_2} \right)^3$
- 24) Fan Efficiency = $\frac{\text{Air flow volume (m}^3/\text{s)} \times \text{Fan total pressure (Pa)}}{\text{Fan power (W)}} \times 100$
- 25) 1 tonnes = 3516.85 watts, 1 hp = 746 watts

Table 1 Representative Rates at Which Heat and Moisture Are Given Off by Human Beings in Different States of Activity

Degree of Activity		Total Heat, W		Sensible Heat, W	Latent Heat, W	% Sensible Heat that is Radiant ^b	
		Adult Male	Adjusted, M/F ^a			Low V	High V
		Seated at theater	Theater, matinee	115	95	65	30
Seated at theater, night	Theater, night	115	105	70	35	60	27
Seated, very light work	Offices, hotels, apartments	130	115	70	45		
Moderately active office work	Offices, hotels, apartments	140	130	75	55		
Standing, light work; walking	Department store; retail store	160	130	75	55	58	38
Walking, standing	Drug store, bank	160	145	75	70		
Sedentary work	Restaurant ^c	145	160	80	80		
Light bench work	Factory	235	220	80	140		
Moderate dancing	Dance hall	265	250	90	160	49	35
Walking 4.8 km/h; light machine work	Factory	295	295	110	185		
Bowling ^d	Bowling alley	440	425	170	255		
Heavy work	Factory	440	425	170	255	54	19
Heavy machine work; lifting	Factory	470	470	185	285		
Athletics	Gymnasium	585	525	210	315		

Notes:

1. Tabulated values are based on 24°C room dry-bulb temperature. For 27°C room dry bulb, total heat remains the same, but sensible heat values should be decreased by approximately 20%, and latent heat values increased accordingly.
2. Also see Table 4, Chapter 9, for additional rates of metabolic heat generation.
3. All values are rounded to nearest 5 W.
- ^aAdjusted heat gain is based on normal percentage of men, women, and children for the application listed, and assumes that gain from an adult female is 85% of that for an adult male, and gain from a child is 75% of that for an adult male.
- ^bValues approximated from data in Table 6, Chapter 9, where V is air velocity with limits shown in that table.
- ^cAdjusted heat gain includes 18 W for food per individual (9 W sensible and 9 W latent).
- ^dFigure one person per alley actually bowling, and all others as sitting (117 W) or standing or walking slowly (231 W).

Table 37 Cooling Load Factors for People and Unhooded Equipment

Hours in Space	Number of Hours after Entry into Space or Equipment Turned On																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Zone Type A																								
2	0.75	0.88	0.18	0.08	0.04	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.75	0.88	0.93	0.95	0.22	0.10	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.75	0.88	0.93	0.95	0.97	0.97	0.23	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
8	0.75	0.88	0.93	0.95	0.97	0.97	0.98	0.98	0.24	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
10	0.75	0.88	0.93	0.95	0.97	0.97	0.98	0.98	0.99	0.99	0.24	0.12	0.07	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00
12	0.75	0.88	0.93	0.96	0.97	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.25	0.12	0.07	0.04	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01
14	0.76	0.88	0.93	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03	0.02	0.02	0.01	0.01
16	0.76	0.89	0.94	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03	0.02	0.02
18	0.77	0.89	0.94	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03	0.02

Table 38 Cooling Load Factors for Lights

Hours Lights On	Number of Hours after Lights Turned On																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Zone Type A																								
8 h	0.85	0.92	0.95	0.96	0.97	0.97	0.97	0.98	0.13	0.06	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10 h	0.85	0.93	0.95	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.14	0.07	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
12 h	0.86	0.93	0.96	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.14	0.07	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
14 h	0.86	0.93	0.96	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.15	0.07	0.05	0.03	0.03	0.03	0.02	0.02	0.02	0.02
16 h	0.87	0.94	0.96	0.97	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.15	0.08	0.05	0.04	0.03	0.03	0.03	0.02	0.02

Table A2 / Jadual A2

Type Of Air Conditioning System	Cooling Capacity
Carrier VRF (38VT022173HQSS)	61.5 kW
Daikin VRV AHU (AHUR20CBVJ/DBVJ/DBBVJ)	59.0 kW
Mitsubishi VRF FDC 670 KXZXE1	67.0 kW
Hitachi VRF CNCQ Series (RAS-24CNBCMQR)	68.0 kW

CIBSE PSYCHROMETRIC CHART

BASED ON BAROMETRIC
PRESSURE OF 101.325 KPa

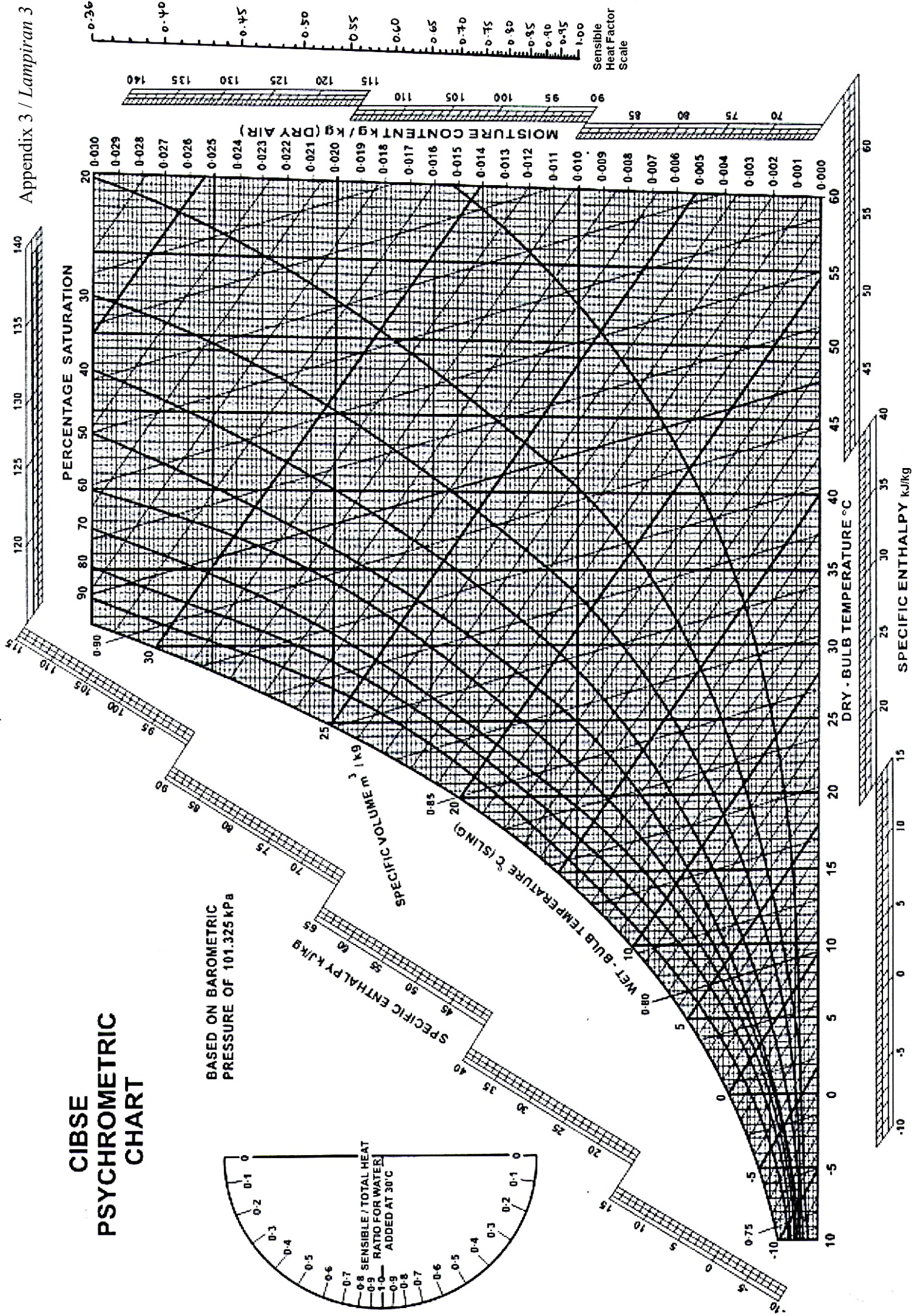
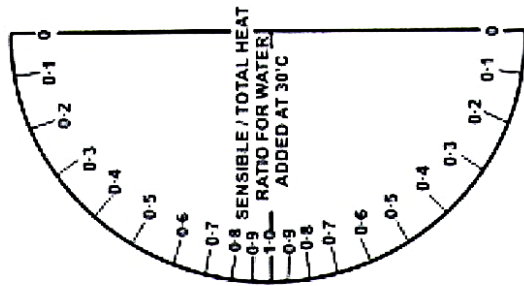


Table B2(i) / Jadual B2(i)

Hours in Space	Number of Hours after Entry into Space or Equipment Turned On																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Zone Type A																							
2	0.75	0.88	0.18	0.08	0.04	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.75	0.88	0.93	0.95	0.22	0.10	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.75	0.88	0.93	0.95	0.97	0.97	0.23	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
8	0.75	0.88	0.93	0.95	0.97	0.97	0.98	0.98	0.24	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
10	0.75	0.88	0.93	0.95	0.97	0.97	0.98	0.98	0.99	0.99	0.24	0.12	0.07	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00
12	0.75	0.88	0.93	0.96	0.97	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.25	0.12	0.07	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01
14	0.76	0.88	0.93	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03	0.02	0.02	0.01
16	0.76	0.89	0.94	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03	0.02
18	0.77	0.89	0.94	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03

Table B2(ii) / Jadual B2(ii)

Structure/ Struktur	U- value/ Faktor U (W/m ² K)
Concrete wall / Dinding konkrit	3.1
Hollow brick wall with plaster / Dinding batu bata berongga dengan lepa	1.9
Hollow tile floor / Lantai jubin berongga	2.27
Concrete floor / Lantai konkrit	3.5
Wooden floor / Lantai kayu	2.9
Metal coffered ceiling + insulation / Siling geledak logam + penebatan	0.52
Tile roof ceiling + fiberglass / Siling bumbung jubin + kaca gentian	0.69
Tile roof ceiling + fiberglass / Siling bumbung Jubin + dinding gipsum	3.4
Single glazed window / Tingkap kaca tunggal	6.0
Double glazed window / Tingkap kaca kembar	3.2
Wooden door / Pintu kayu	3.0

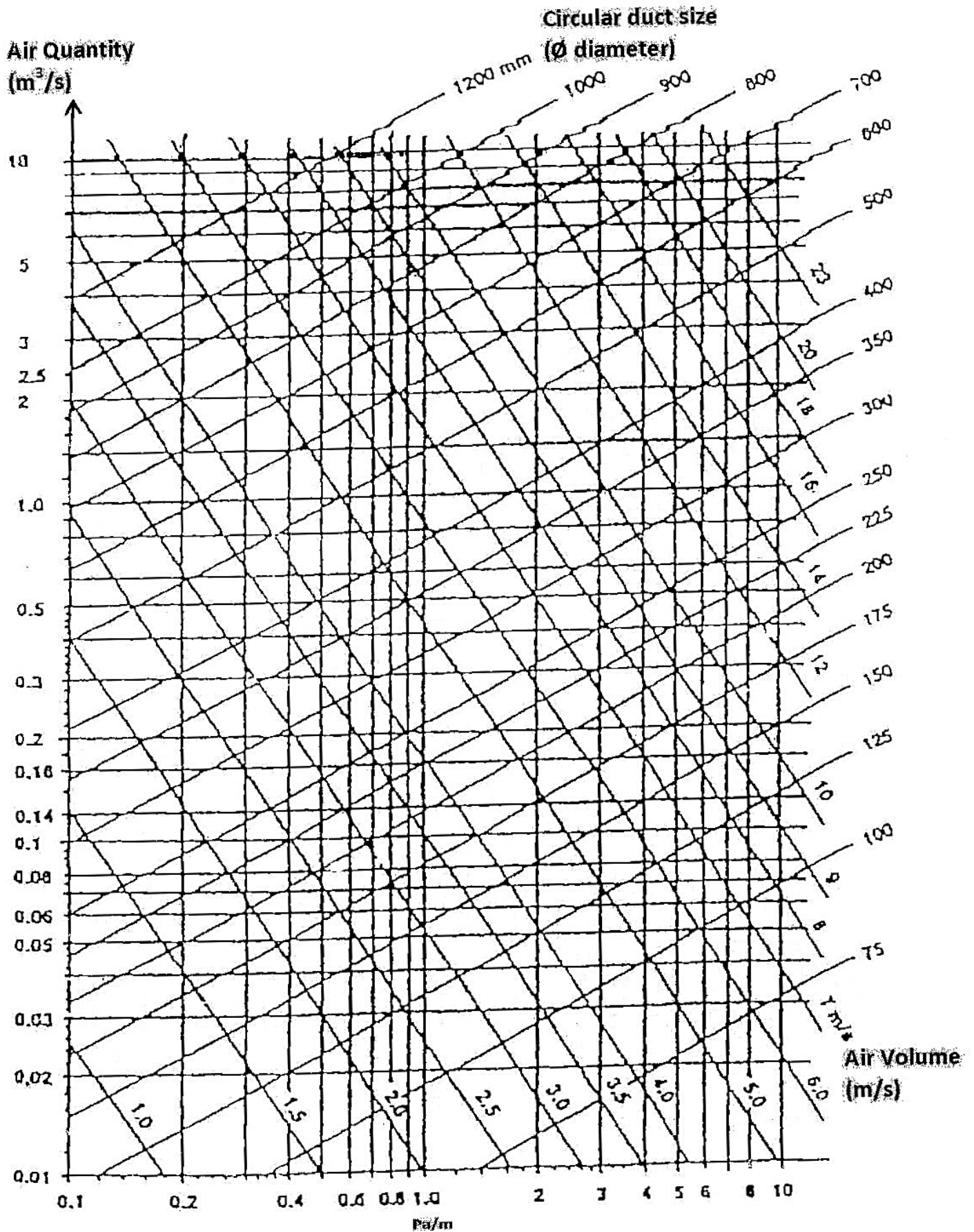


Chart 4.33: Determination of Air Duct Sizing

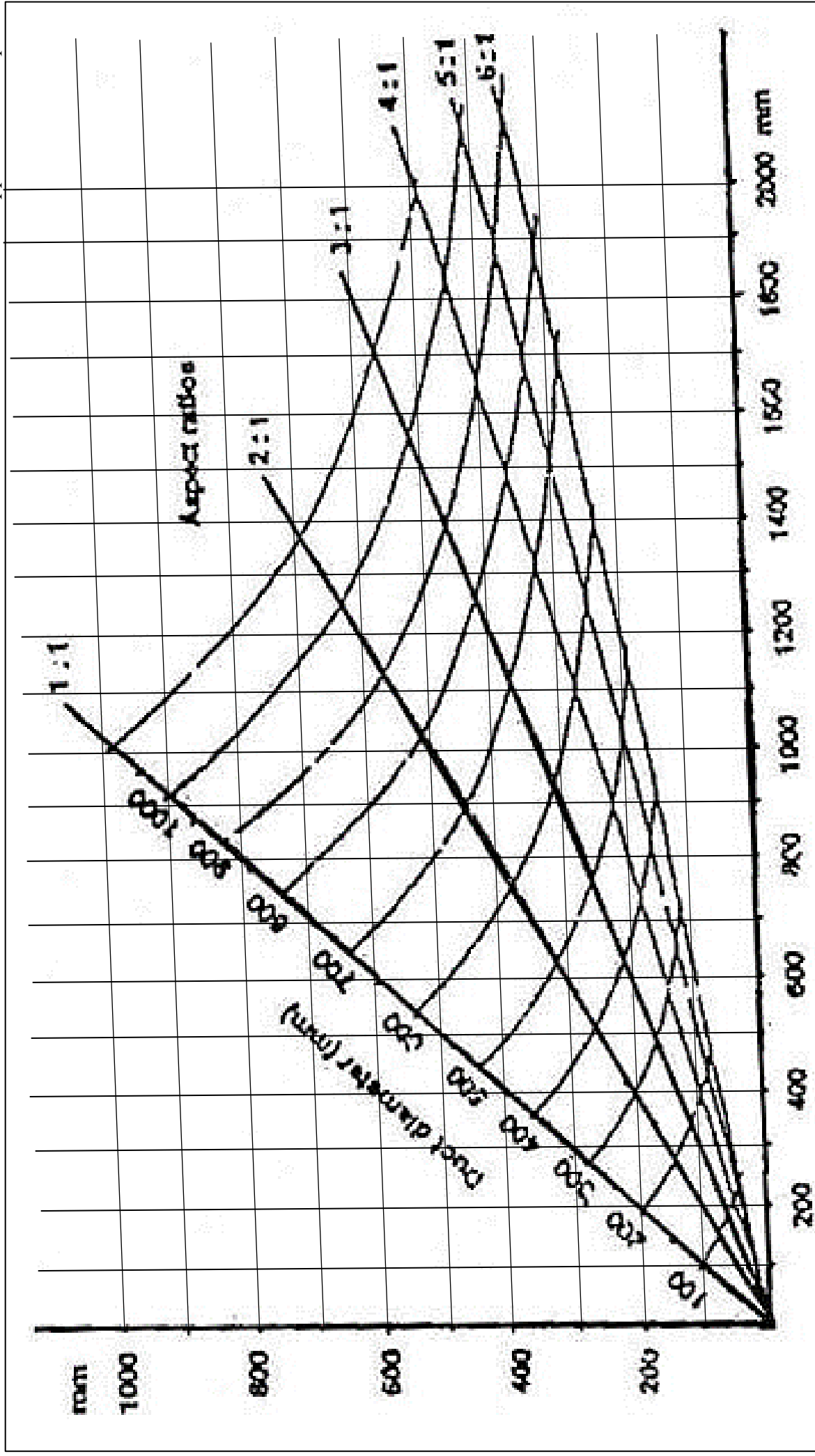


Chart 4.19: Circular to Rectangular Ductwork Conversion Chart