Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018

COURSE NAME	:	AIR CONDITIONING SYSTEM DESIGN
COURSE CODE	:	BDE40103
PROGRAMME	:	BDD
EXAMINATION DATE	:	DECEMBER 2017 / JANUARY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	**PART A**: ANSWER **FOUR (4)** QUESTIONS **ONLY** FROM **FIVE (5)** QUESTIONS. **PART B**: ANSWER **ALL** QUESTIONS.

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

PART A

Q1 (a) What is "District Cooling Systems" (DCS) and explain objectives and advantages of DCS?

(8 marks)

(b) Explain and sketch a diagram for all water system and air-water system in an air conditioning system.

(12 marks)

Q2 (a) ASHRAE Standard 55-2004, "Thermal Environmental Conditions for Human Occupancy," is a revision of Standard 55-1992. The standard specifies conditions in which a specified fraction of the occupants will find the environment thermally acceptable. Thermal comfort is perceived as the comfort of human beings unnder given room conditions. Elevated airspeed is one of the factors for thermal comfort. Explain five (5) local thermal discomfort because of elevated speed.

(20 marks)

Q3 (a) What are different between humidity ratio and relative humidity?

(4 marks)

(b) Using the psychometric chart in **Figure Q3 (b)** to complete the properties as shown as in **Table Q3 (b)**.

(8 marks)

(c) An air conditioning unit has a cooling coil that cools and dehumidifies 25,000 CFM of air from 84 °F DB and 60% RH to 65 °F DB and 55 °F DP. Find the flow rate in lb/hr, sensible, latent, and total capacity of the cooling coil (Plot the process on Figure **Q3 (c)** (Psychometric chart).

Given, For air 1 CFM = 4.5 lb/hr.

(8 marks)

Q4 (a) What is the different between heat lost and heat gain?

(4 Marks)

(b) Solar radiation through glass and lighting are heat gain components to contribute to the room cooling load. Finds cooling load for a building wall facing southwest has a window area of 300 ft^2. The glass is ¼ in. single clear glass with-colored interior venetian blinds. The building is of medium construction and is located at 40°N latitude. Find the solar cooling load, if maximum "solar heat gain factor (SHGF)" is 196 BTU/hr-ft^2, "Shading coefficient (SC)" is 0.67, and cooling load factor for glass is 0.83.

(8 Marks)

(c) A room has 130 ft^2 of single glass windows with vinyl frame. Inside air temperature is 70 °F and outdoor average temperature is on a design day is 90 °F. Find cooling load due to conduction heat gain through the windows at 2 PM Daylight saving time with cooling load temperature different 12 °F, correction for latitude and month is -1 and overall heat transfer coefficient (U) for glass is 0.9 BTU/HR-FT^2-F.

(8 Marks)

Q5 (a) A fan is a gas flow producing machine which operates on the same basic principles as a centrifugal pump or compressor. A fan is similar to a centrifugal pump or compressor, which is convert mechanical rotated energy, applied at the shafts, to gas (or fluid) energy. Explain, the following terms for fan performance:

(i) fan Volume
(ii) fan Outlet Velocity
(iii) fan Velocity Pressure
(iv) fan Total Pressure

(4 marks)

(b) The duct show in **Figure Q5 (b)** has 7000 CFM flowing through it. The fiction loss from point 1 to 2 is 0.43 in.w. If the static pressure at 1 is 1.23 in w.g., determine the static pressure at point 2?

(6 marks)

(c) The steel piping system as shown as in **Figure Q5 (c)** is a closed system. According the energy equation, the required pump head rise from *F* to *A* is equal to the pressure drop due to friction loss from *A* to *F* through the system. But to find pump head only the circuit with the greatest pressure drop is chosen through the longest circuit, ***ABCC'DEF,*** Circuits ***ABEF*** and ***ACDF*** are ignored. Using **Table Q5 (c) i, Table Q5 (c) ii and Figure Q5 (c) ii,** determine the required pump head for the piping system.

(10 marks)

PART B

Q6 (a) According ASHRAE 2009, HVAC equipment for a building is one of the major sources of interior noise, and its effect on the acoustical environment. Further, noise from equipment located outdoors often propagates to the community. Explain the glossary of acoustic terminology as below:

i. Air-borne Noise
ii. Frequency
iii. Noise
iv. Sound Power Level
v. Sound Pressure Level

(10 marks)

(b) The noise problem associated with fans may cause noise disturbance to nearby residents (see **Figure Q6 (b)**). It mainly comes from the interaction of flow turbulence and solid surface of fan blades, and blade / fan vibration. The noise is transmitted upstream and downstream in the connecting ducts or to the atmosphere through the fan case. Give two practical remedies to solve this problem. Illustrate the systems with the appropriate figures.

(10 marks)

- END OF QUESTION -

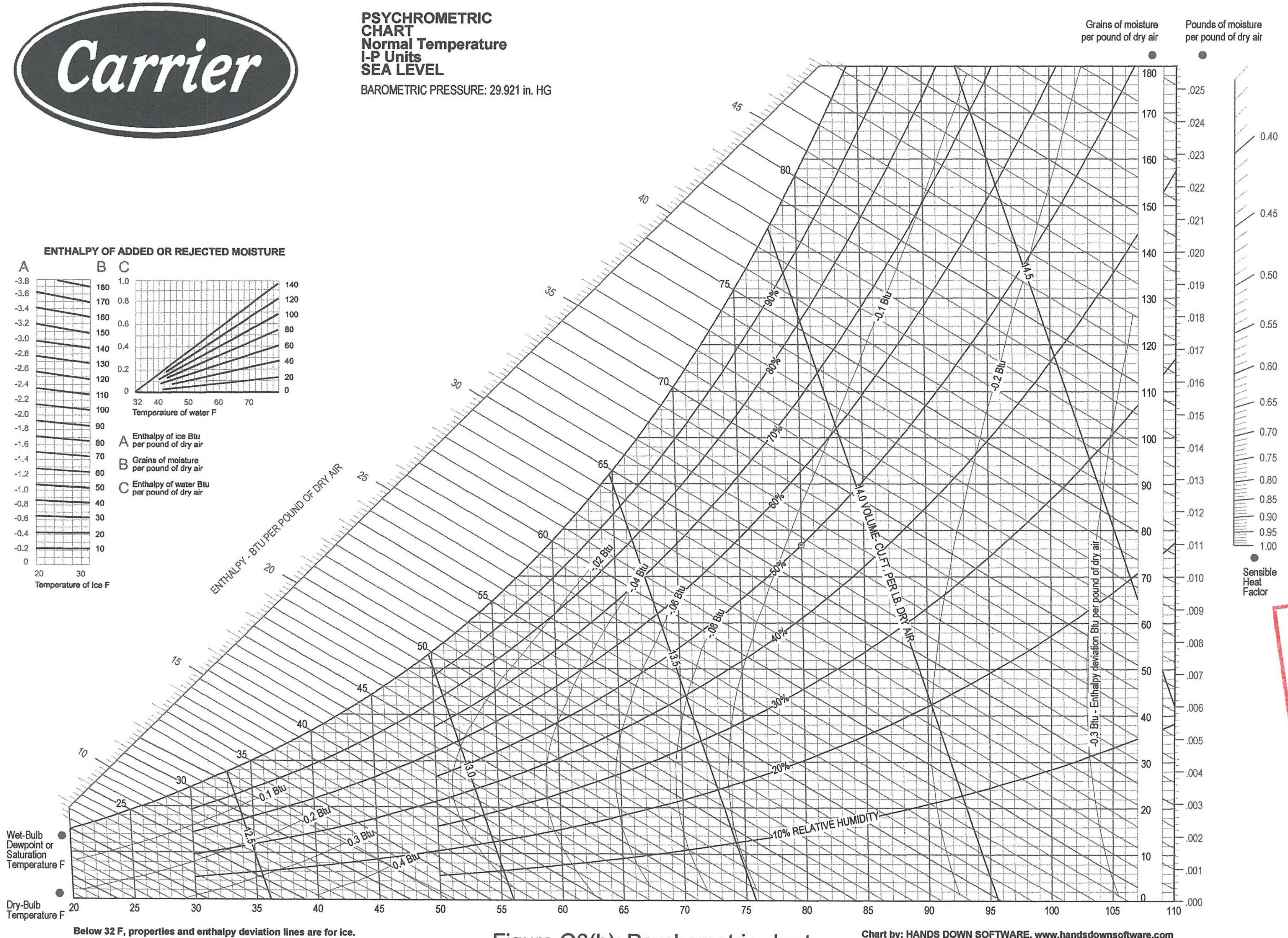

Figure Q3(b): Psychometric chart

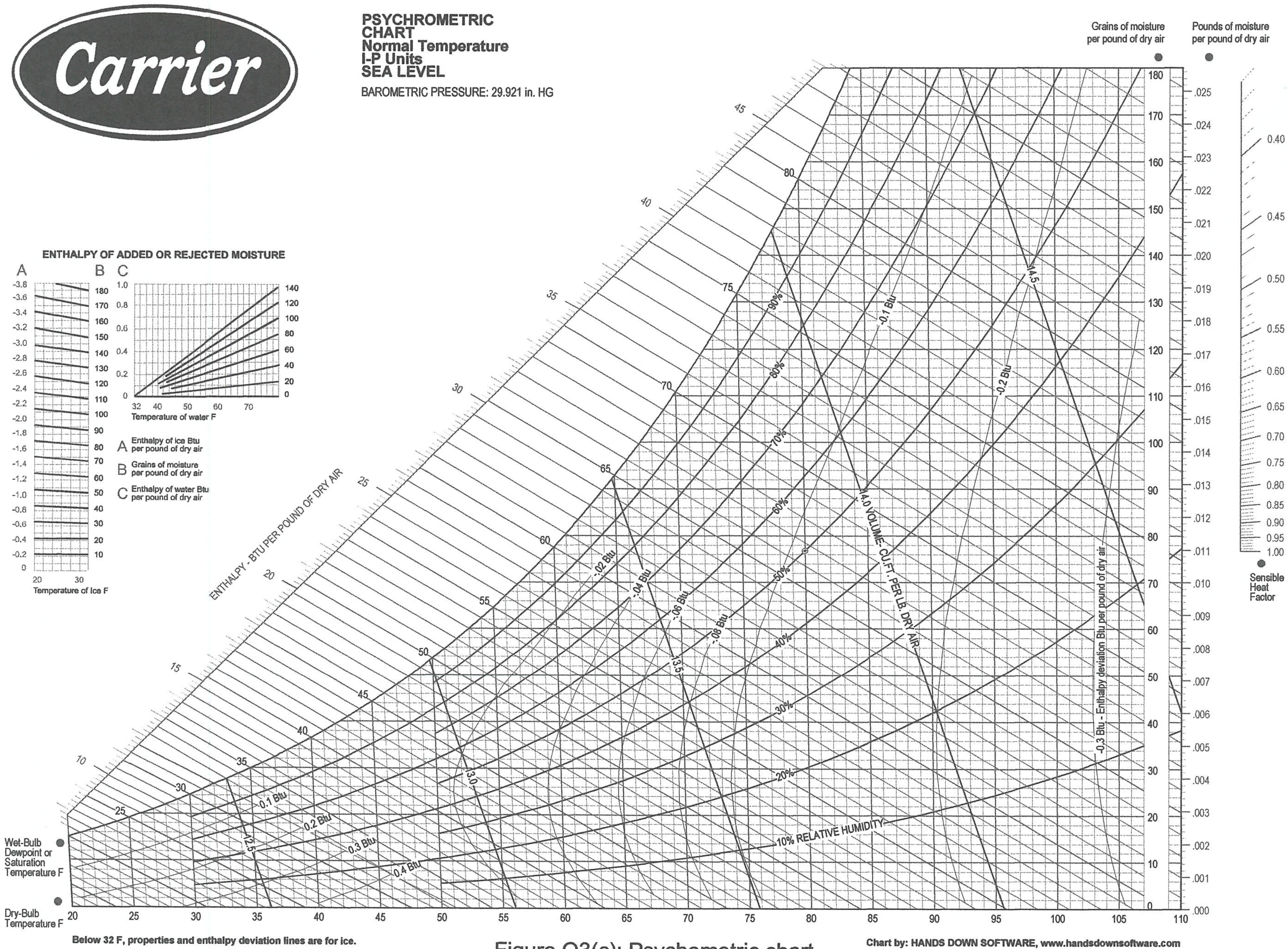

Figure Q3(c): Psychometric chart

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PART A

Table: Q 3 (b)

No.	DB,F	WB,F	DP,F	RH,%	W.gr/ lb d.a	h, Btu/lb
i	80	60				
ii	75		40			
iii		65	50			
iv			50	40		

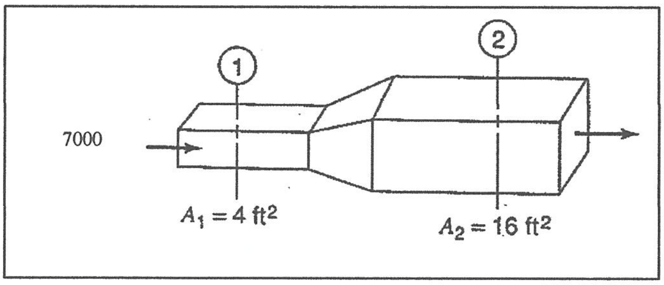

Figure 5(b): Air Flow in the Ducting

Given:

1 in w = 69.6 ft. air

Gravity, g = 32.2 ft. /sec^2

$$\frac{1\ in.w}{69.6\ ft.air}$$

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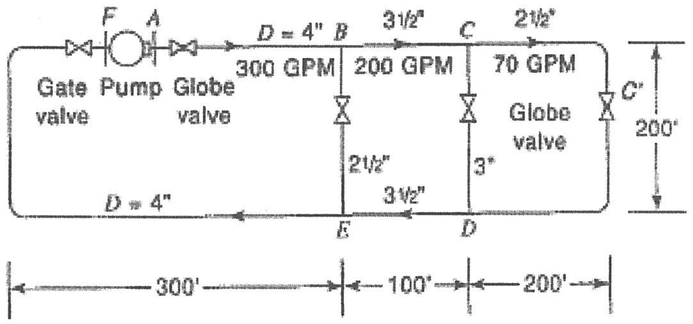

Figure 5(c): Steel piping system.

Table 5(c) i: Piping pressure drop calculation.

Section	Item	D,in	GPM	V FPS	E.L., ft	No.of items	Total length,ft	Friction loss H_f	
								Ft w./100ft	Total ft w.

Note:

D: Diameter Pipe
in: Inch
GPM: Gallon per minute
V: Velocity

FPS: Feet per second
E.L: Elevation
ft: feet
Ft w: Feet water

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Table 5(c) ii: Equivalent Feet of pipe for fittings and valves

	Nominal Pipe Size (inches)												
	½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10
45° Elbow	0.8	0.9	1.3	1.7	2.2	2.8	3.3	4.0	5.5	6.6	8.0	11.0	13.2
90° Elbow standard	1.6	2.0	2.6	3.3	4.3	5.5	6.5	8.0	11.0	13.0	16.0	22.0	26.0
90° Elbow long	1.0	1.4	1.7	2.3	2.7	3.5	4.2	5.2	7.0	8.4	10.4	14.0	16.8
Gate valve open	0.7	0.9	1.0	1.5	1.8	2.3	2.8	3.2	4.5	6.0	7.0	9.0	12.0
Globe valve open	17	22	27	36	43	55	67	82	110	134	164	220	268
Angle valve	7	9	12	15	18	24							
Tee—side flow	3	4	5	7	9	12	14	17	22	28	34	44	56
Swing check valve	6	8	10	14	16	20	25	30	40	50	60	80	100
Tee—straight through flow	1.6	2.0	2.6	3.3	4.3	5.5	6.5	8.0	11.0	13.0	16.0	22.0	26.0
Radiator angle valve	3	6	8	10	13								
Diverting tee		20	14	11	12	14	14	14					
Flow check valve		27	42	60	63	83	104	125	126				
Air eliminator		2	3	4	5	7	8	13	15				
Boiler (typical)	5	7	9	11	13	17							

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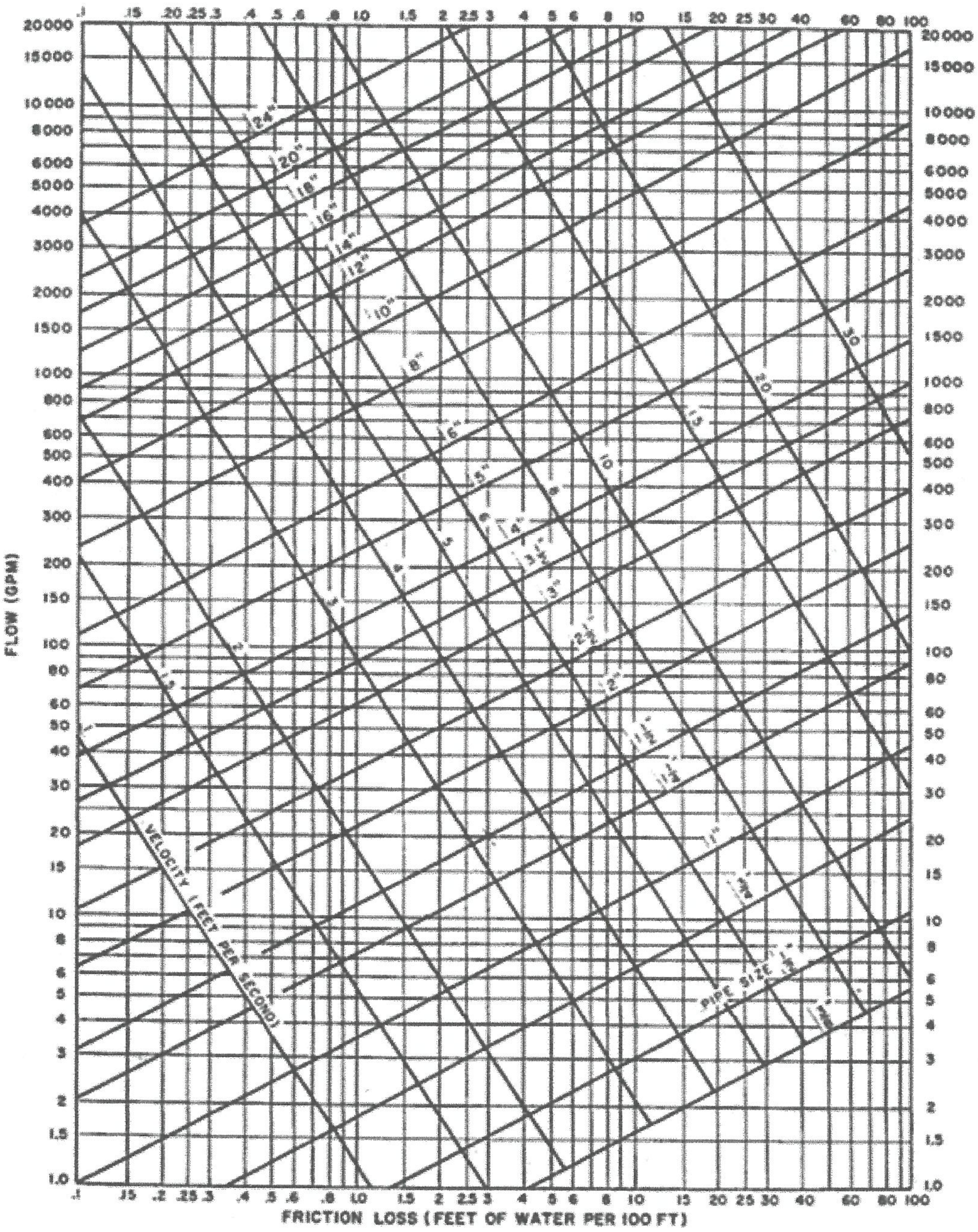

Figure 5 (c) ii: Friction loss for water in Schedule 40 Steel Pipe-Closed system (Courtesy: Carrier Corporation, Syacuse, NY)

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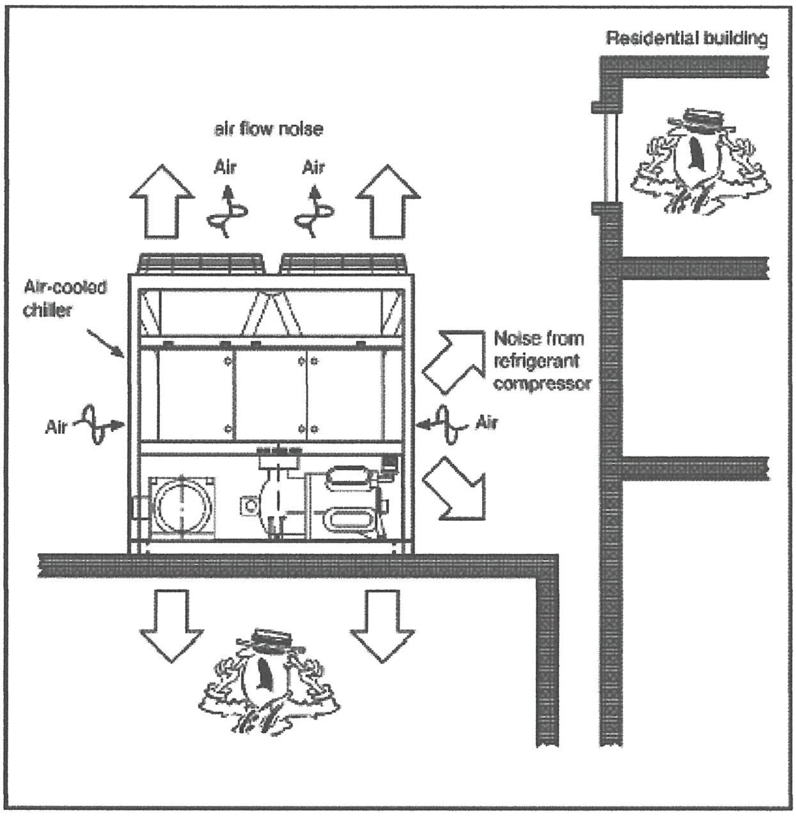

Figure 6 (b) ii: Air-borne Noise from Air-cooled Chillers