



UNIVERSITI KUALA LUMPUR
MALAYSIA FRANCE INSTITUTE

FINAL EXAMINATION
JANUARY 2010 SESSION

SUBJECT CODE : FRB 40203
SUBJECT TITLE : COLD ROOM AND REFRIGERATED SHOWCASE
LEVEL : BACHELOR
TIME/DURATION : 9 AM – 12 Noon
3 HOURS
DATE : 26 April 2010

INSTRUCTIONS TO CANDIDATES

1. All documents authorized (Open Book Examination)
 2. This question paper is printed on both sides of the paper.
 3. Please write your answers on the answer booklet provided.
 4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
 5. This question paper consists only one section. Answer all questions.
 6. Answer all questions in English.
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THERE ARE 3 PRINTED PAGES OF QUESTIONS.



INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1-

(a). A cold store warehouse for fresh products is to be maintained at 0 °C and 85% RH
The size of the building is: length 80 m, width 50 m and 6 m height

The ceiling and the walls are constructed in panels with a U value of 0.277 W/m².K
The floor U value is 0.9 W/m².K

The external conditions are:

- one 80 m x 6 m wall open to outside – 30 °C and 70 % RH
- remaining three walls and roof inside another warehouse - 28 °C and 70 % RH
- Ground temperature 22 °C

Two doors (2.5 m x 2.5 m) of loading and unloading, one located at 80 m external wall and the other 50 m internal wall. They are equipped with air curtains. To simplify and to calculate on the safe side consider infiltration of air from external ambient.

Flow of goods received each day 600 bins of 500 kg fruit per bin at 26 °C is cooled to storage temperature in 30 hours, sensible heat being 3.5 kJ/kg

Duration of opening of a door for loading or unloading of pallet truck of 50 bins: 15 minutes

Lighting is 12 W / m² during 8 hours

8 people are present simultaneously during 8 h with a release of heat of 250 W

Handling is ensure by 8 carriages of 2500W over 8 hours

To calculate the hourly refrigerating power for a maximum running time per day of 16 hours

- (b). Explain diversity factor for cold rooms in a couple of sentences

(10 marks)

Question 2

Assuming that the plant capacity is now fixed as 150 TR (independent of your answer to question 1) and it is required to select a screw compressor with liquid injection features as given in annex 1:

- (a). Determine the number of compressors required, total power input and cooling tower capacity required.
- (b). Does it require compressor head cooling? Why?
- (c). Draw a refrigeration schematic with the necessary features.

(5 marks)

Question 3

'Carbon dioxide is becoming increasingly popular in supermarket refrigeration'

- (a). The operating pressures of CO₂ system are high which poses some practical difficulties in the system implementation. But there are some advantages due to the high pressures. List 2 of such advantages and briefly explain each
- (b). What is the critical pressure and temperature of CO₂? How their values affect the system implementation?
- (c). What is the most important safety feature a CO₂ system should have?

(3 marks)

Question 4

Refrigerant pipe sizing

Verify the compressor suction pipe size for the same compressor model, the dimensions data of which are given in annex 2

The operating conditions are:

Refrigerant: R 134a


Operating conditions: as per annex 1

Refrigerant properties are given in annex 3

(2 marks)

END OF QUESTION

Annex 1: Compressor data

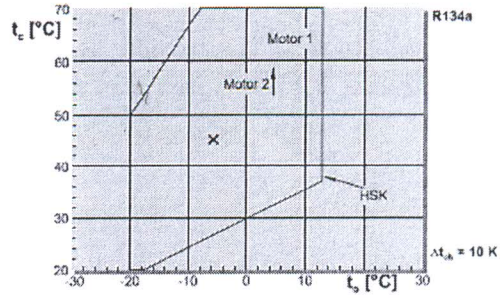
 Version 5.1.2	UniKL Project May 2010 4/21/2010 / All data subject to change.
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Compressor Selection: Semi-hermetic Screw Compressors

Input Values

Cooling capacity	530kW
Refrigerant	R134a
Reference temperature	Dew point temp.
Evaporating SST	-6°C
Condensing SDT	45°C
Operating mode	ECO
Liquid temperature	Auto
Discharge gas temp.	80°C
Suct. gas superheat	10K
Useful superheat	100%
Power supply	400V-3-50Hz
Capacity Control	100%

Application Limits (ECO)



Output

Compressor model **HSK8571-110-40P**

Cooling capacity	192.2 kW
Cooling capacity *	197.1 kW
Evaporator capacity	192.2 kW
Power input	68.8 kW
Current (400V)	116.9 A
Voltage range	380-415V
Condensing capacity	261 kW
COP/EER	2.79
COP/EER *	2.84
Mass flow LP	4147 kg/h
Mass flow HP	4880 kg/h
Operating mode	ECO
Liquid temp. (sc)	26.8 °C
Mass flow ECO	734 kg/h
sub cooler load	31.2 kW
sat. ECO Temp.	16.81 °C
ECO pressure	5.18 bar(a)
Oil volume flow	1.86 m³/h
DG w/o cooling	75.2 °C

Largest compressor type - partition in several units required

*According to EN12900 (10K suction gas superheat, liquid subcooling in Economiser with 5K temperature difference)

Annex 3: R 134a properties

Thermophysical Properties of Refrigerants

20.17

Refrigerant 134a (1,1,1,2-Tetrafluoroethane) Properties of Saturated Liquid and Saturated Vapor

Table with columns: Temp., Pressure, Density, Volume, Enthalpy, Entropy, Specific Heat, Velocity of Sound, Viscosity, Thermal Cond., Surface Tension. Rows range from -103.30 to 101.06.

*Temperatures on ITS-90 scale *Triple point bNormal boiling point cCritical point