Minerals Council South Africa

EXAMINATION PAPER

SUBJECT: CHAMBER OF MINES OF SOUTH AFRICA – CERTIFICATE IN MINE ENVIRONMENTAL CONTROL PAPER 3 – PLANNING, ECONOMIC, TECHNICAL LITERATURE **SUBJECT CODE:** COMMEC3 **EXAMINATION DATE :** 10 OCTOBER 2024 **TIME:** 14:30 – 17:30 (3 HOURS)	**EXAMINER:** George Mapele **MODERATOR:** Aldo Oosthuizen **TOTAL MARKS: [100]** **PASS MARK: 60%**

NUMBER OF PAGES 10 (including this page)

Examination Instructions:

This examination question paper consists of **10** pages

1. Answer all **4** questions in *English*.
2. Put your identification number on the outside cover of each book used, and on any graph paper or other loose sheets handed in.
   NB: Your name must NOT appear on any answer book or loose sheets.
3. Show all calculations **and check calculations on which your answers are based**.
4. Hand-held electronic calculators may be used for calculations only.
5. Write in ink on the **right hand page** only – the left hand page will not be marked.
6. Illustrate your answers by means of sketches or diagrams wherever possible.
7. Answers must be given to an accuracy which is typical of practical conditions.
   NB: Ensure that the correct units of measure (SI unit) are recorded as marks will be deducted from answers if the incorrect unit is used (even if the calculated value is correct).
8. In answering the questions, full advantage should be taken of your practical experience as well as data given.
9. Please note that you are not allowed to contact your examiner or moderator regarding this examination.
10. This is **NOT** an open book examination but the approved formula hand out may be used.
11. Cell phones are **NOT** allowed in the examination room.
12. You are encouraged to make use of the CoMCert Tip-off Hotline whenever you witness or suspect any wrongdoing related to the CoMCert Examinations on landline 0800 118 998 or alternatively you can use email COMCert@tip-offs.com. This tip-off hotline and tip-off email is managed anonymously and confidentially through an independent service provider.

QUESTION 1

The following design specifications are given for a Gold Mine in the North West Region (South Africa):

Location of the mine	Klerksdorp
Production rate per month	110 000ton
Design Reject temperature	27.0˚C
Expect fissure water used	12l/s
Service water used	1 ton of water/ton of rock mined
Surface air Temperature	10.0˚C
Temperature Bulk volume air down shaft	8.0˚C
Barometric Pressure at 2 000m depth @ Station	113.5kPa
Temperature at 2 000m depth @ Station	24.0˚C / 28.0˚C
Depth of the mine from surface	2 000m
Distance from the station to the working places	2 500m
Use constant gravitational acceleration	10.0m/s^2
Submit all the charts and/or graphs for each question	

Determine or calculate:

1.1. The Virgin Rock Temperature (VRT) (2)
1.2. The Apparent Specific Volume (2)
1.3. The volume flow and (5)
1.4. The mass flow of air by using the attached graphs. (1)
1.5. The heat due to auto-compression; (2)
1.6. the mine's heat load; (6)
1.7. heat transferred because of fissure water (1)
1.8. the total heat load (1)
1.9. The total cooling capacity and the net cooling capacity if a 13 000kW Refrigeration plant is on surface with a positional efficiency of 85%. Submit the results from the graph attached. (5)

[25]

QUESTION 2

2.1 To calculate the air and refrigeration requirements, the ventilation engineer must refer to existing computer programs, graphs and charts to obtain data. Which factors play a very important role? (10)

2.2 The air flow has dropped drastically in the ventilation district of the mine. List five possible causes from your investigation and provide recommendations. (5)

2.3. You have been informed that a fire is burning in a section of the mine. Immediately after this fire was sealed off, the barometric pressure on both sides of the wall measured as 115.0kPa.

On the next visit, the barometric pressure behind the wall was 125.0kPa and 115.0kPa on the access side. The seal was also found to be leaking.

If the specific resistance of the seal was estimated to be 500Ns^2/m^8 then answer the following questions:

2.3.1. Which way did the air leak through the seal? (1)

2.3.2. What is the air quantity leaking through the seal? (2)

2.3.3. If 25.0m^3/s of normal air containing 3 000ppm of CO_2 flows past the seal and the concentration of CO_2 leaking from the seal is 7% CO_2 and 2% CO. Determine the percentage (%) of the gases concentration would be after mixing took place on the return air side of the fire. (7)

2.3.4. Comment on the resultant gas concentration and compare them with any statutory requirements. Would you allow people to continue to work downstream of seal? (2)

2.3.5. Calculate the quantity of fresh air required and comment on the answer given that your airway size is 12m^2. (3)

[30]

QUESTION 3

A surface fan installation for an upcast shaft is being designed and various fan drift layouts are being investigated, utilizing scale model tests. The 7.5m diameter circular upcast shaft must handle an upcast air quantity of 800.0m^3/s at a fan inlet density of 0.93kg/m^3.

The scale model of the shaft is 0.3 m diameter and is located where the density is 1.05 kg/m^3 and the airflow rate is 4.65 m^3/s. Model tests with three different layouts gave the following results:

Model layout	**Airflow Rate**	**Total Pressure Loss Shaft to Inlet**
A	4.65m^3/s	2 500Pa
B	4.65m^3/s	1 590Pa
C	4.65m^3/s	500Pa

The estimated costs of the full-size layouts are follows:

Model Layout	**Estimated Cost**
A	R3 500 000.00
B	R3 587 500.00
C	R3 795 000.00

The surface installation has an overall efficiency of 85%, the power cost is R12 755/kW /annum and the present value of R1 @12% over 20years (the installation's expected life) is R7.47.

3.1 What pressure loss would you expect in the actual installation for the three different layouts, assuming that the relationship between pressure loss across the bend and velocity pressure in the shaft is identical for both the scale model and the full-sized shaft? (25)

3.2 Which layout is more economical? (1)

3.3 Which factor (Parameter) gives an indication that the model test gives a reliable result and how? (3)

3.4 What is the formula of factor or parameter? (1)

[30]

QUESTION 4

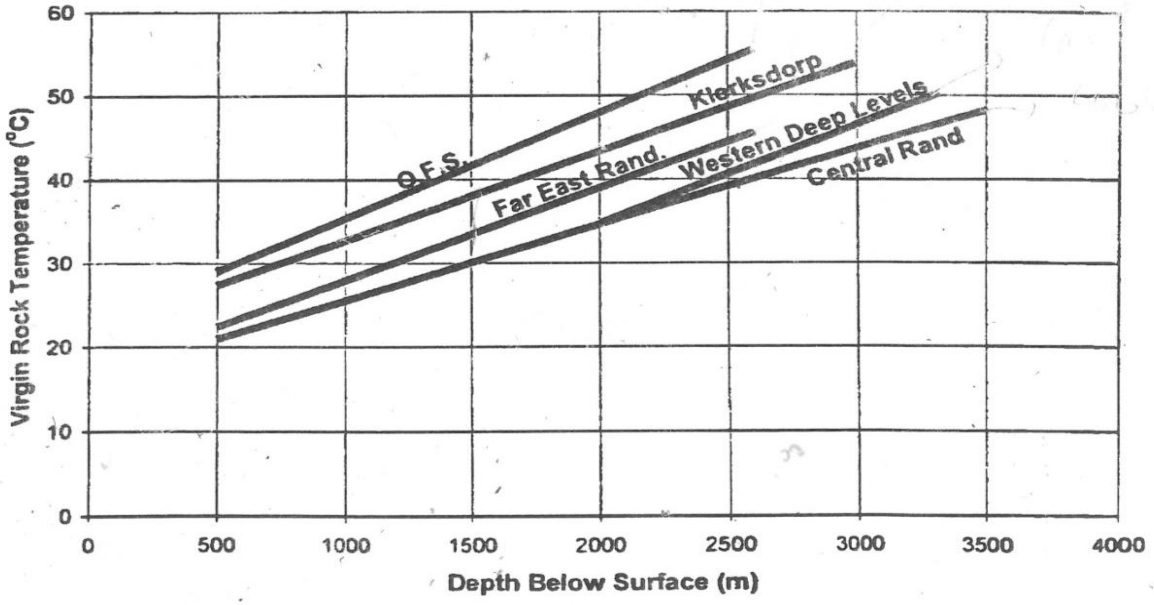
Briefly describe one of the following articles (Choose between 4.1 and 4.2)

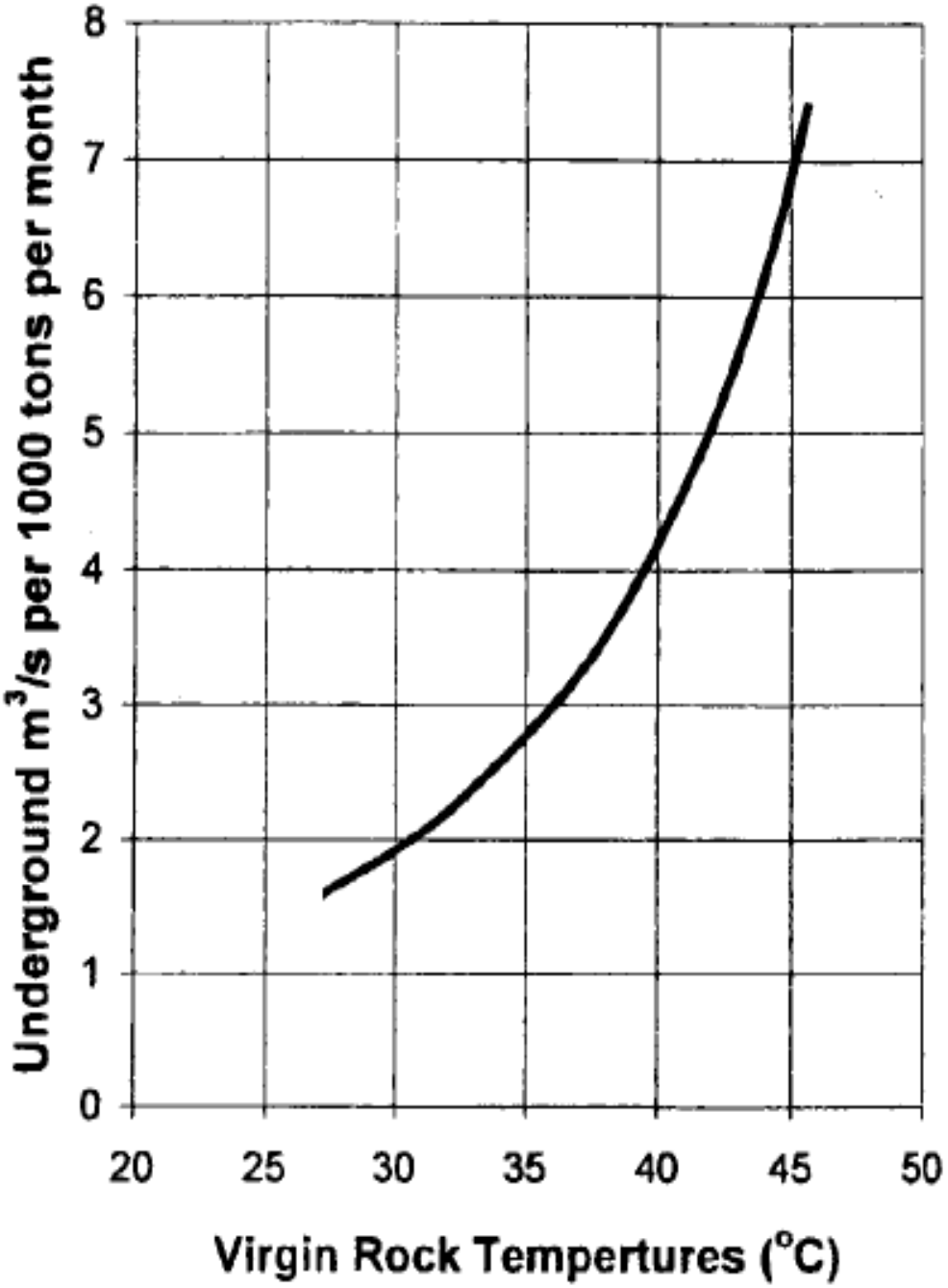
4.1. Maximizing spot cooling potential when utilizing varying mine service-water as heat sink. (*Journal MVSSA Volume 76 Number 3 July / September 2023).*

4.2 A review of application of the continuous real -time monitoring in noise risk management. (*Journal MVSS Volume 77 Number 1 January / March 2024).*

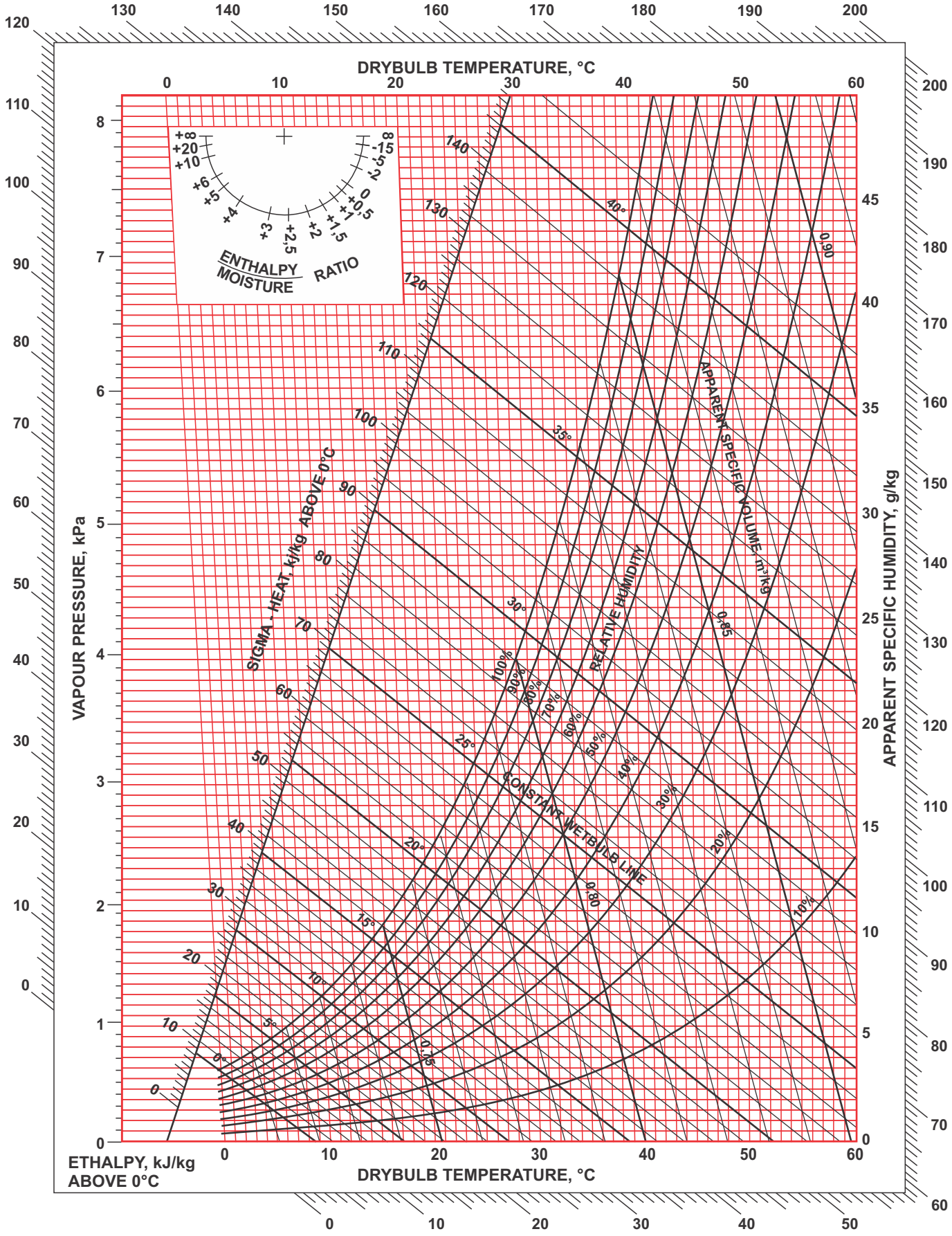
[15]

TOTAL MARKS [100]




Underground m³/s per 1000 tons per month
0
1
2
3
4
5
6
7
8
20
25
30
35
40
45
50
Virgin Rock Tempertures (°C)

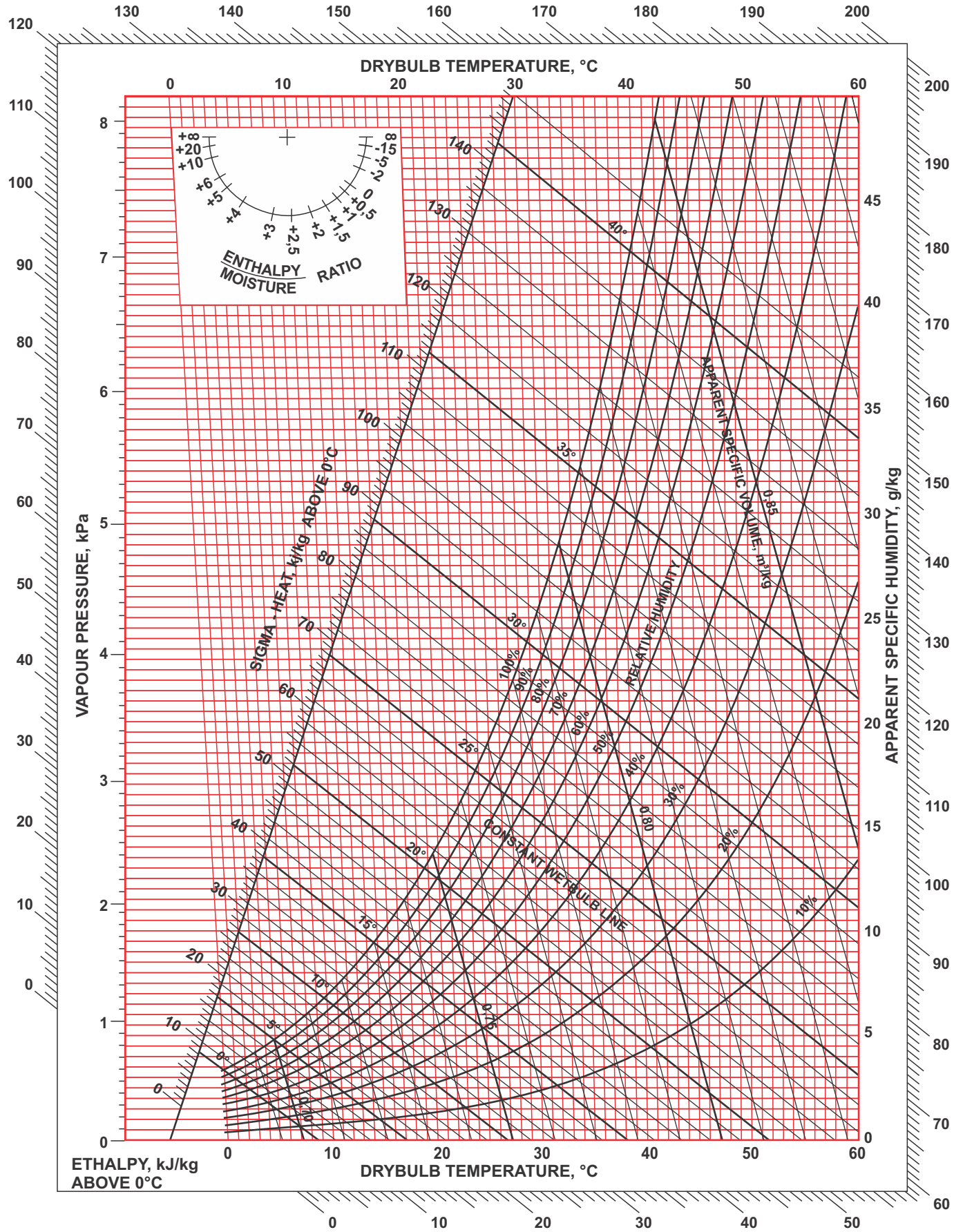
PSYCHROMETRIC CHART
112,5 kPa



A.W.T.B.

CHART NO 15
112,5 kPa

PSYCHROMETRIC CHART
115,0 kPa



A.W.T.B.

CHART NO 16
115,0 kPa

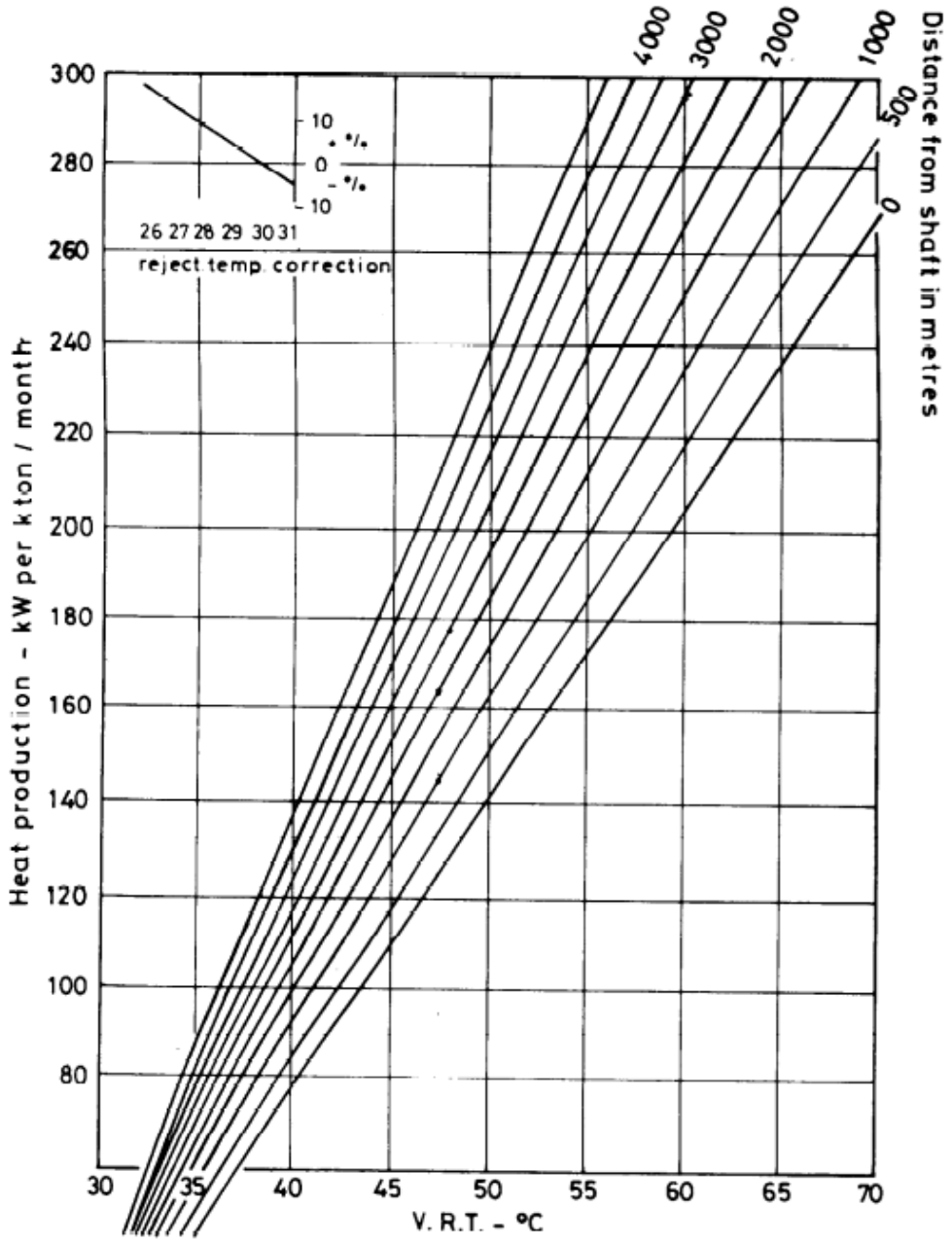

Heat production - kW per k ton / month
300
280
260
240
220
200
180
160
140
120
100
80
30
35
40
45
50
55
60
65
70
V. R.T. - °C
4000
3000
2000
1000
500
0
Distance from shaft in metres
10
+ %
0
- %
10
26 27 28 29 30 31
reject temp. correction

Figure 17.5a

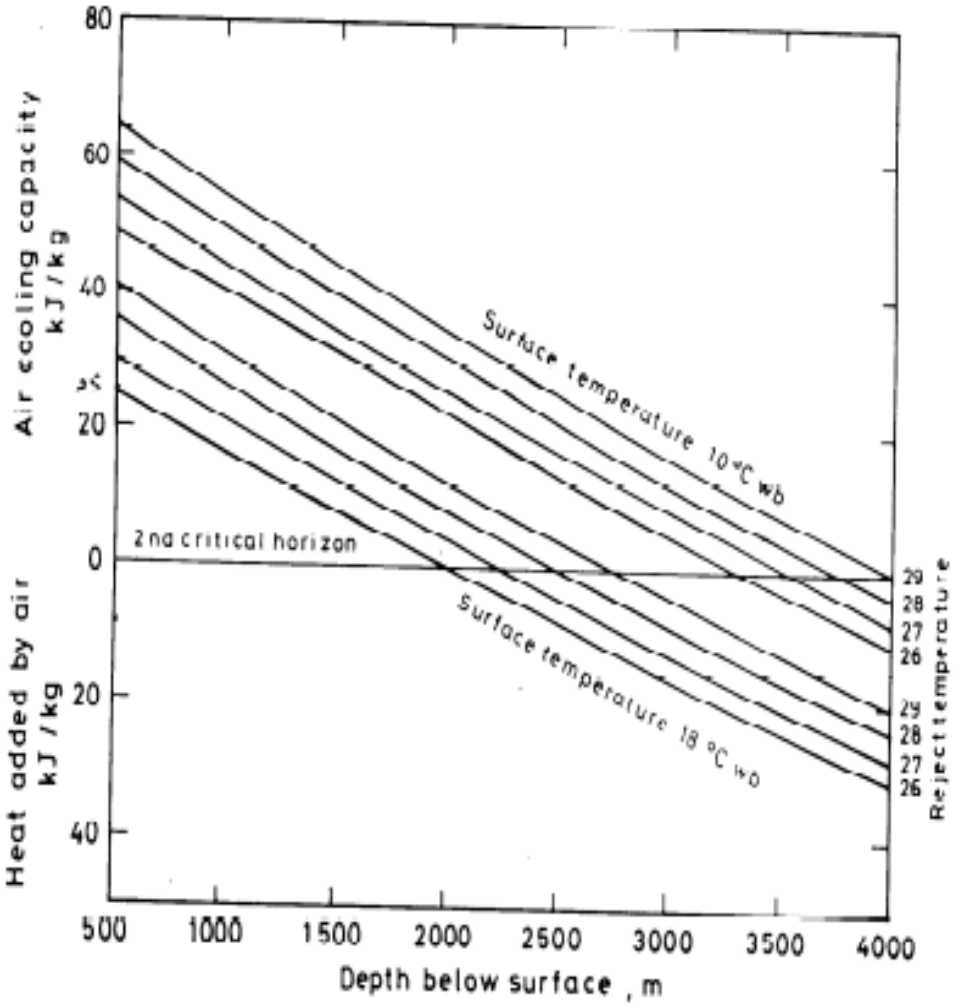


Figure 17.9.1