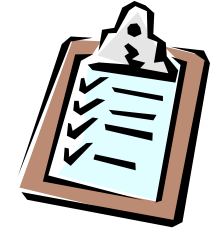


Psychrometry



Ir. Dr. Sam C. M. Hui
Faculty of Science and Technology
E-mail: cmhui@vtc.edu.hk

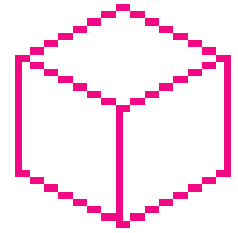
Contents



- Atmosphere and water vapour
- Psychrometric chart (theory)
- The psychrometric equation
- Psychrometric software

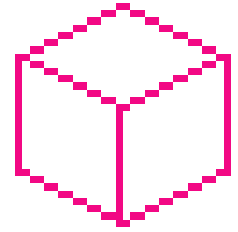
(* Handouts with details can be downloaded from the course website:
Chapter 1 – Introduction to Psychrometry.)

Overview of the handouts



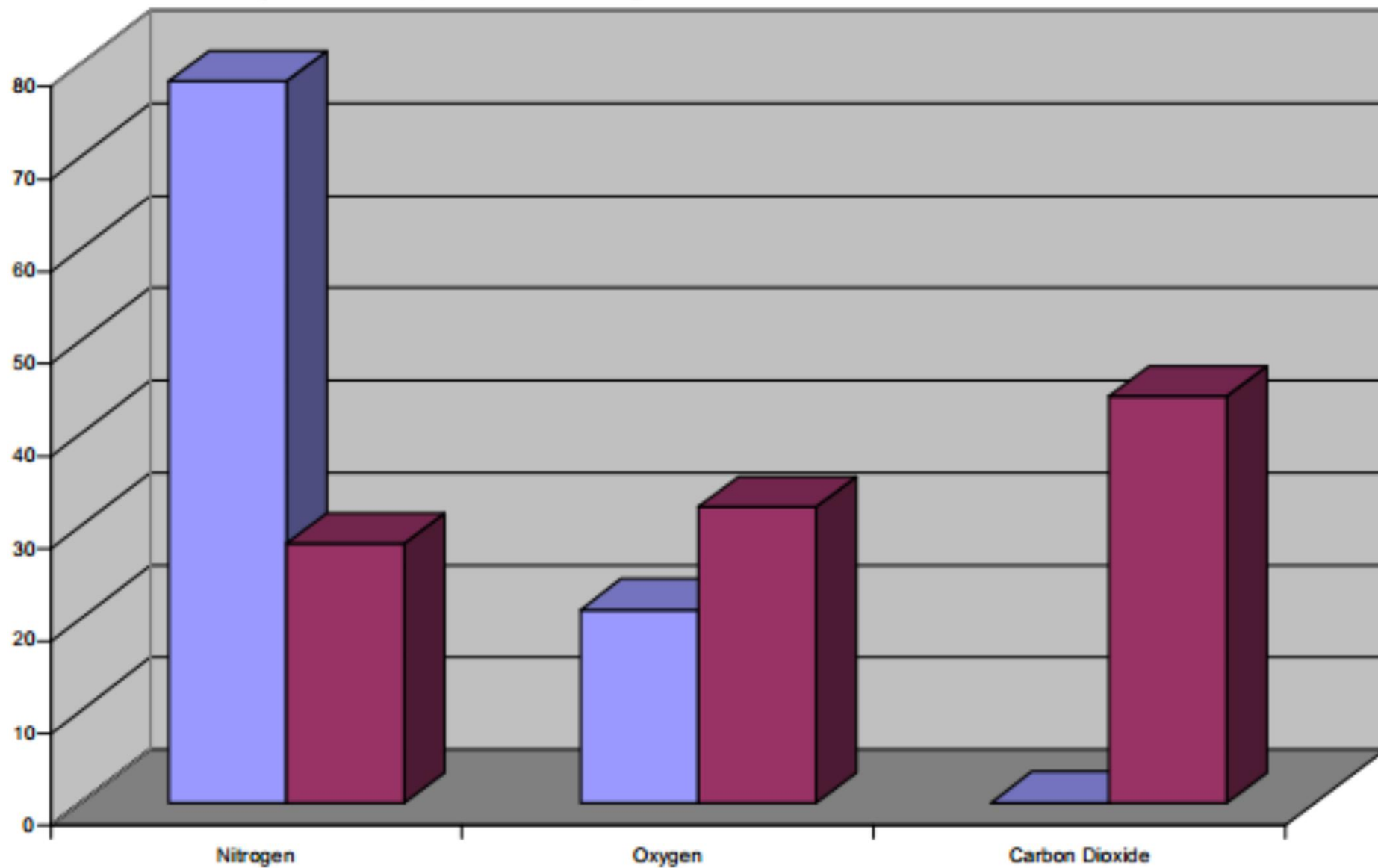
- Chapter 1 – Introduction to Psychrometry
 - Atmosphere and water vapour
 - Psychrometric chart (theory)
 - The psychrometric equation
 - Psychrometric chart (CIBSE)
 - Quick revision study guide (5 questions)
 - Chapter notes (footnotes)
- Appendix - Thermodynamic Basics
 - Perfect gas laws
 - 1st law of thermodynamics
 - Conservation of energy

Atmosphere and water vapour



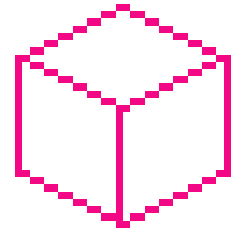
- Psychrometry (測濕學)
 - The measurement or study of the thermodynamic properties of **moist air**
 - The Greek term psuchron (ψυχρόν) meaning "cold" and metron (μέτρον) meaning "means of measurement"
 - Moist air properties: (water vapour + dry air)
 - Dalton's law of partial pressures ($\text{Total} = P_A + P_B$)
 - Standard atmospheric pressure = 101.325 kPa
 - Saturated vapour pressure: Max. pressure of water vapour that can occur at any given temperature

Principle Dry Atmospheric Gases



■ Molecular Weight **■ % Atmosphere**

Psychrometric chart (theory)

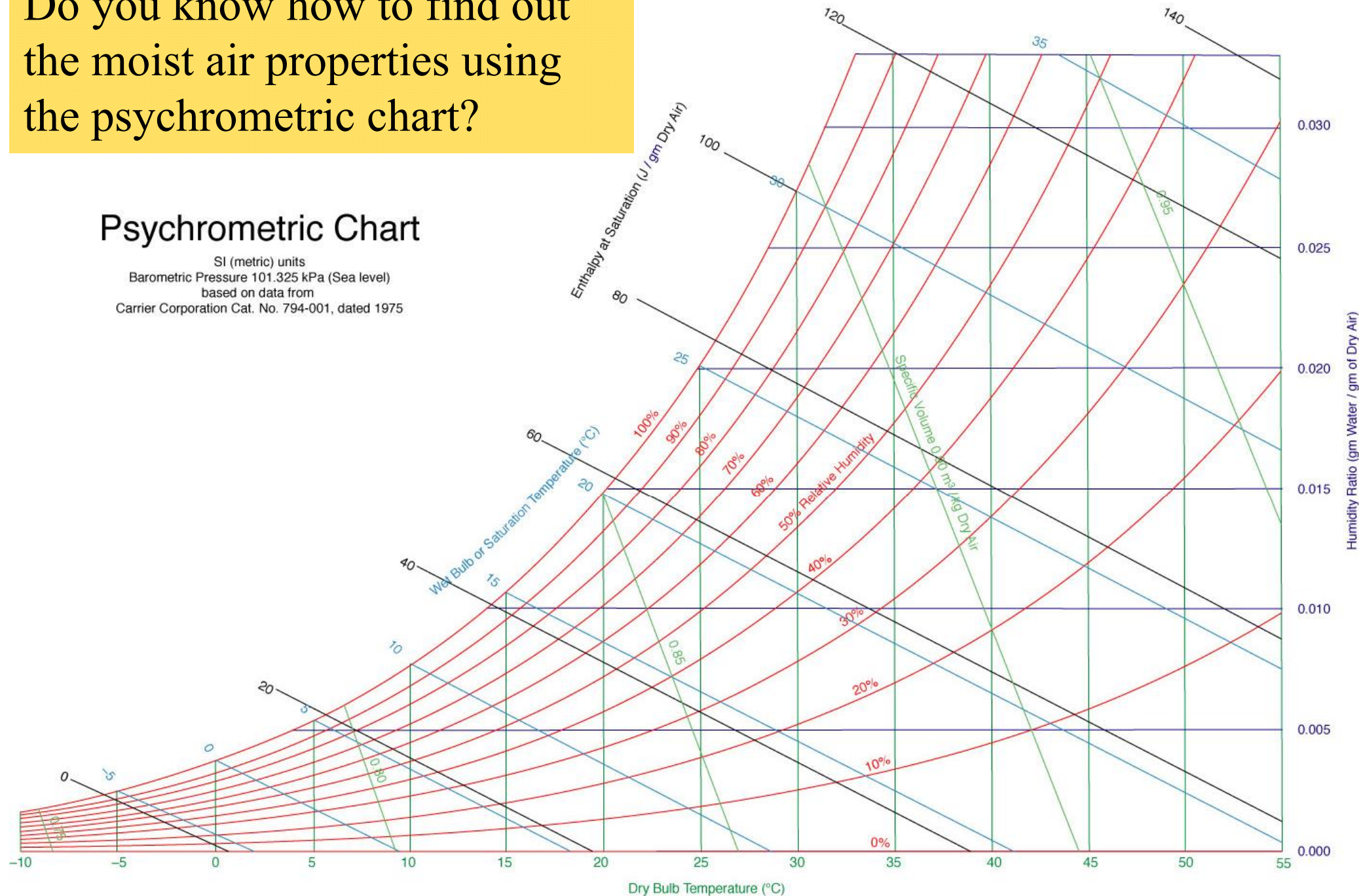


- Major parameters: (see handouts for details)
 - Moisture content (g), or absolute humidity (w)
 - Relative humidity (rh or RH)
 - Percentage saturation (μ)
 - Wet-bulb temperature (t_{wb})
 - Dew-point temperature (t_{dp})
 - Specific enthalpy (h)
 - Specific volume (v)
 - Density (ρ)

Do you know how to find out the moist air properties using the psychrometric chart?

Psychrometric Chart

SI (metric) units
Barometric Pressure 101.325 kPa (Sea level)
based on data from
Carrier Corporation Cat. No. 794-001, dated 1975



Can you read them from the chart?

Psychrometric Chart

Wet-bulb temperature

Enthalpy

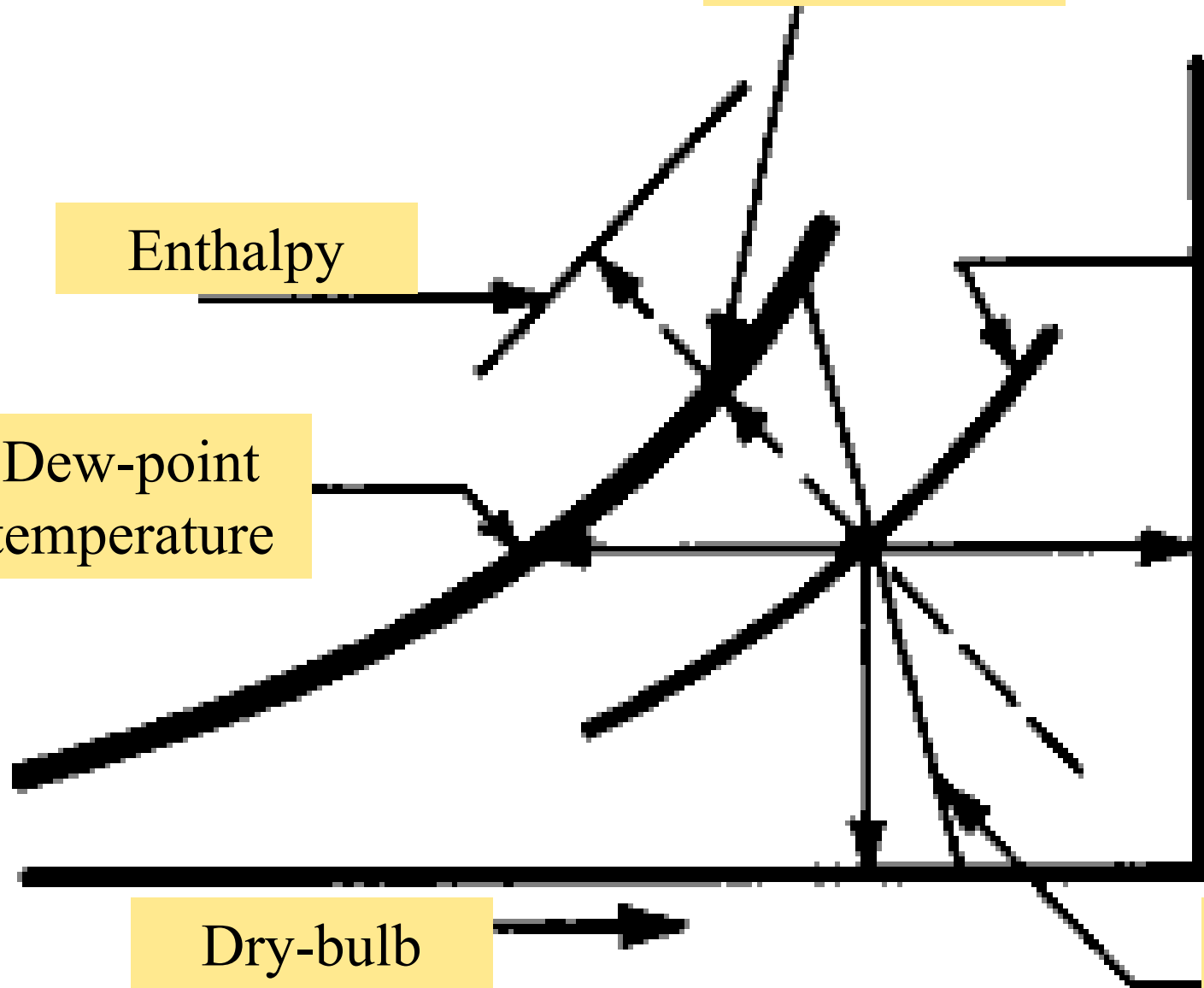
Relative humidity

Dew-point temperature

Humidity ratio

Dry-bulb temperature

Specific volume



Measurement of moist air by sling psychrometer

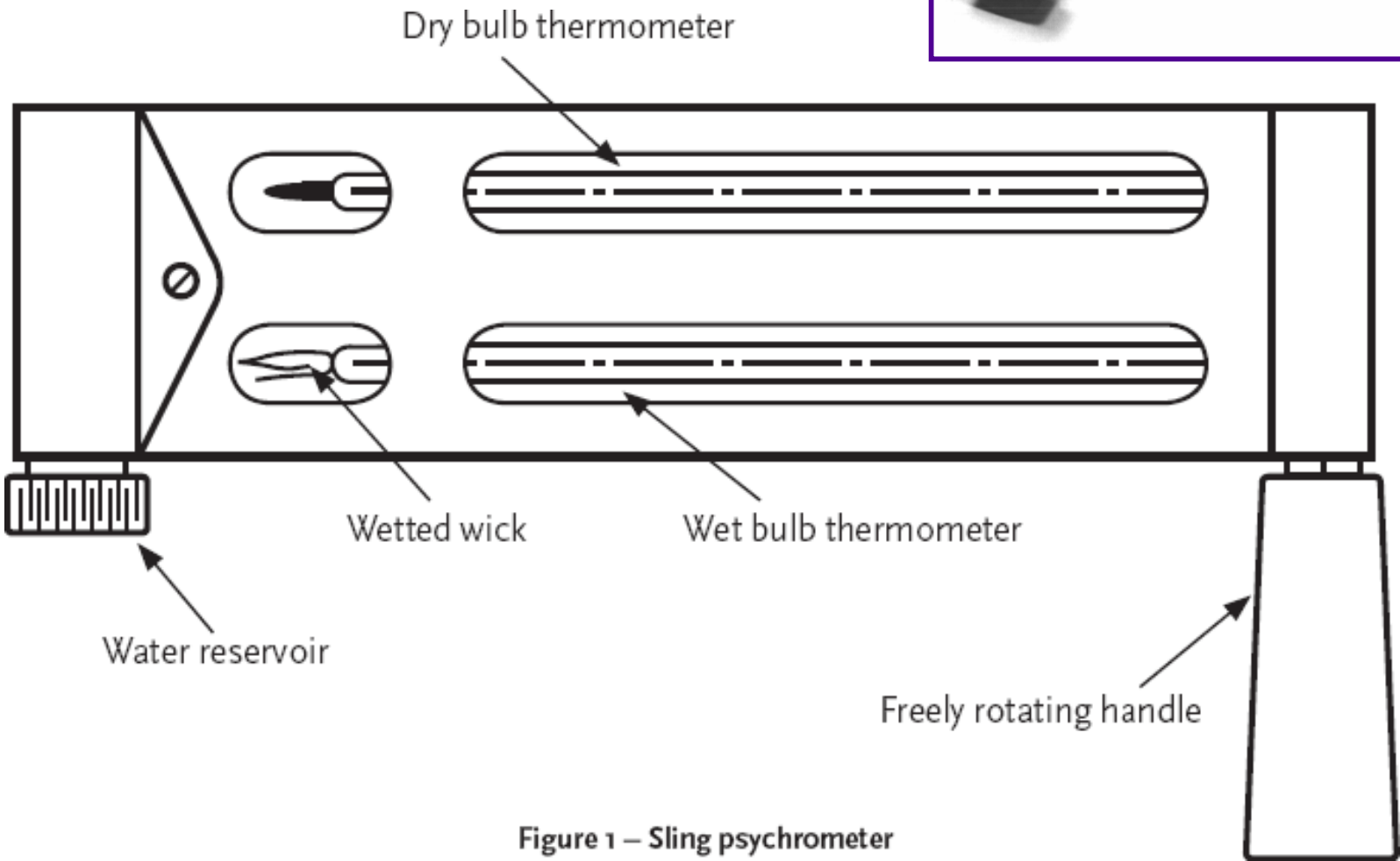
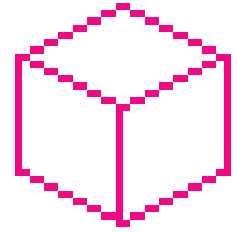


Figure 1 – Sling psychrometer

Psychrometric chart (theory)



- Commonly used psychrometric charts
 - ASHRAE psychrometric chart
 - CIBSE psychrometric chart
 - Carrier psychrometric chart
 - Trane psychrometric chart
 - Mr. S K Wang (similar to Trane)
 - Mollier chart in Mainland China (濕空氣焓濕圖)
- You should learn how to read and use the psychrometric charts for HVAC design



ASHRAE PSYCHROMETRIC CHART NO.1

NORMAL TEMPERATURE

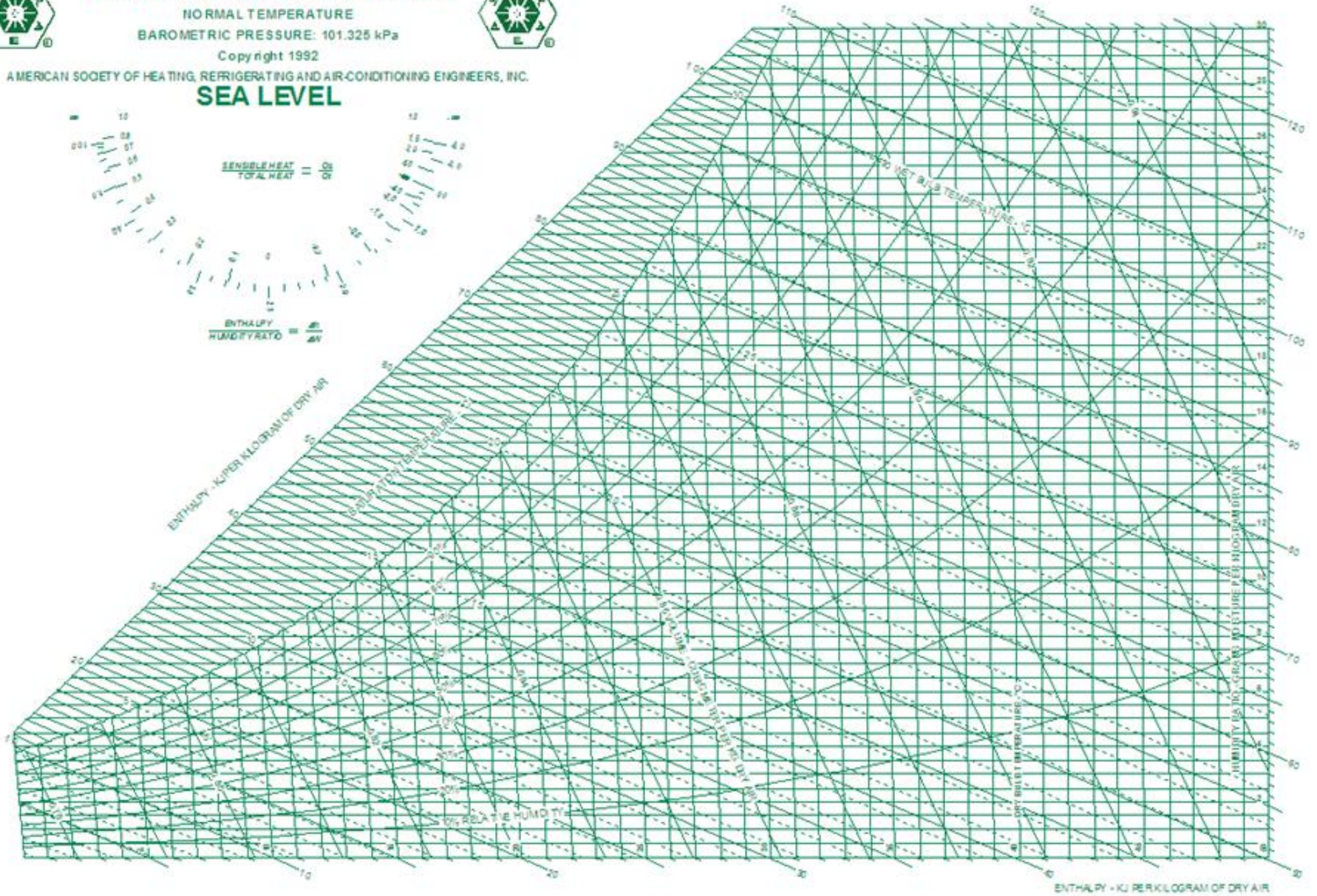
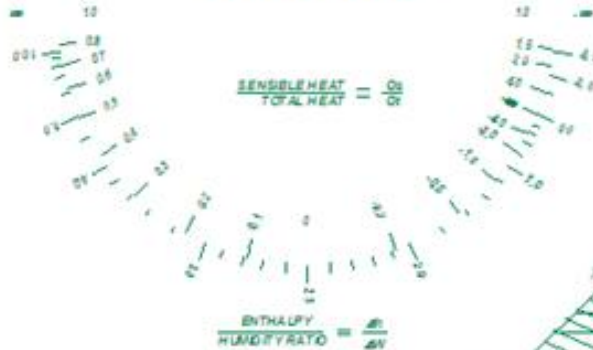
BAROMETRIC PRESSURE: 101.325 kPa

Copyright 1992

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.



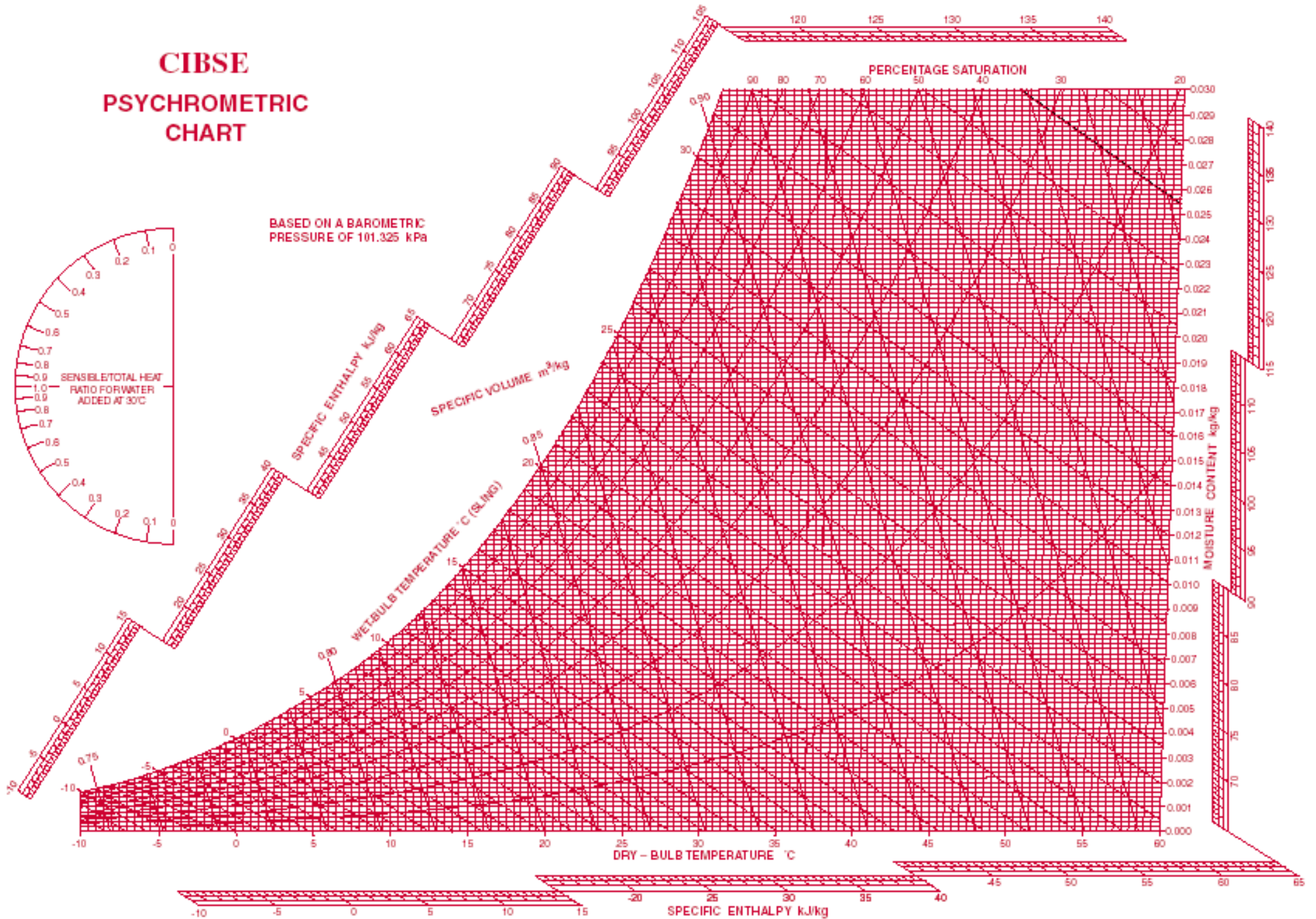
SEA LEVEL



ENTHALPY - KJ PER KILOGRAM OF DRY AIR

CIBSE PSYCHROMETRIC CHART

BASED ON A BAROMETRIC
PRESSURE OF 101.325 kPa

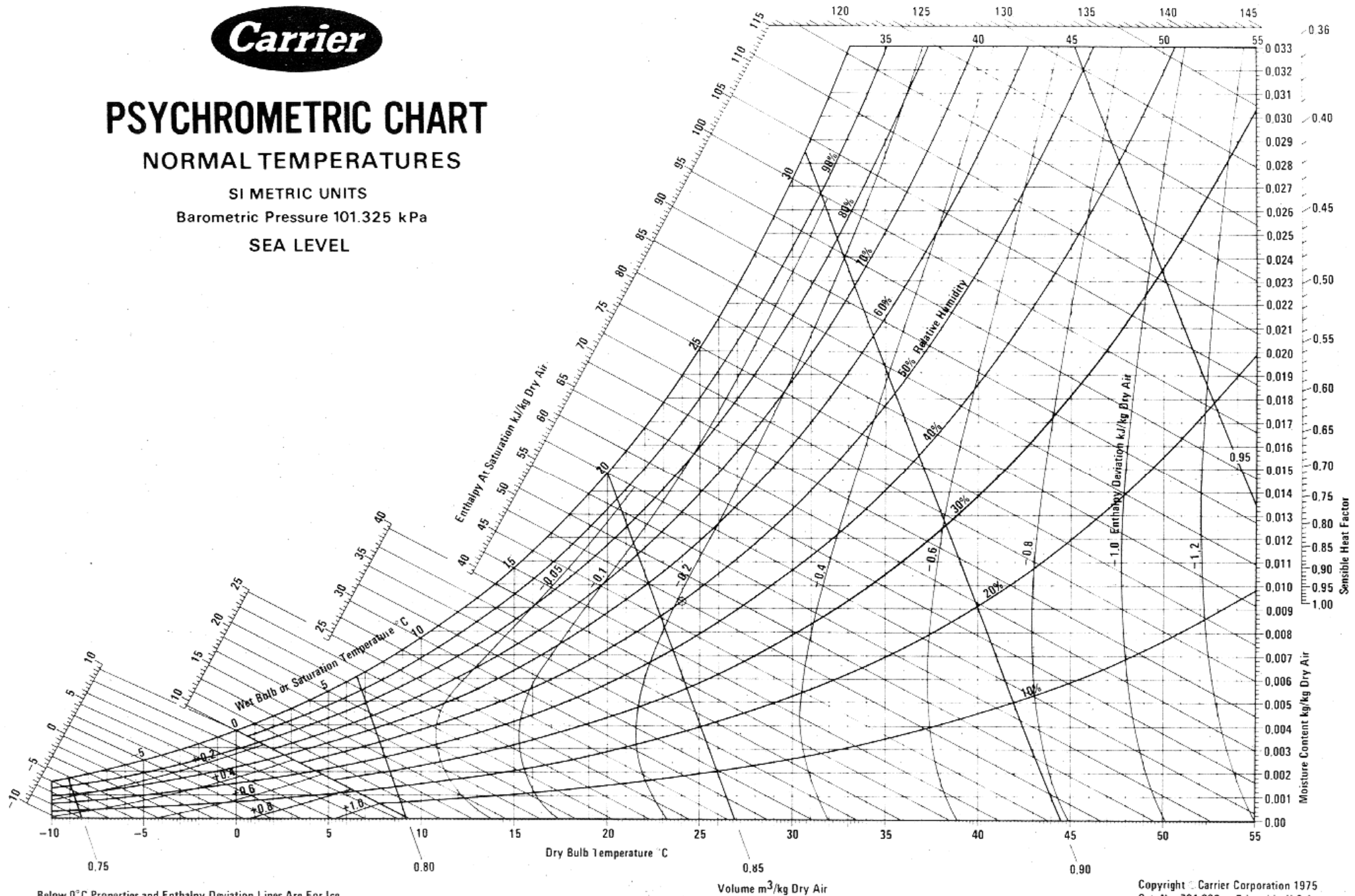




PSYCHROMETRIC CHART

NORMAL TEMPERATURES

SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL



Below 0°C Properties and Enthalpy Deviation Lines Are For Ice

Copyright © Carrier Corporation 1975
Cat. No. 794-002 Printed in U.S.A.

Reproduced courtesy of Carrier Corporation

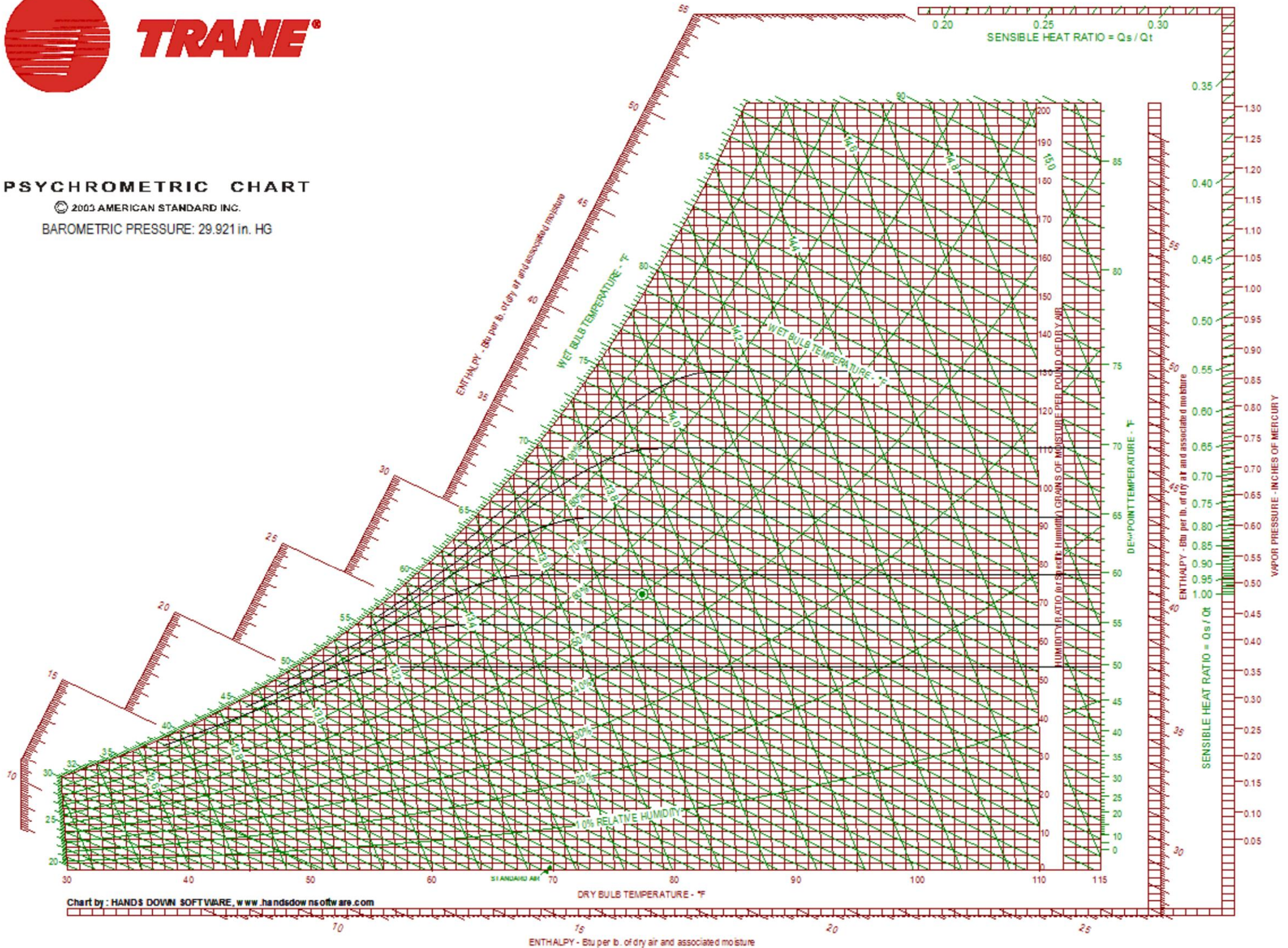


TRANE®

PSYCHROMETRIC CHART

© 2005 AMERICAN STANDARD INC.

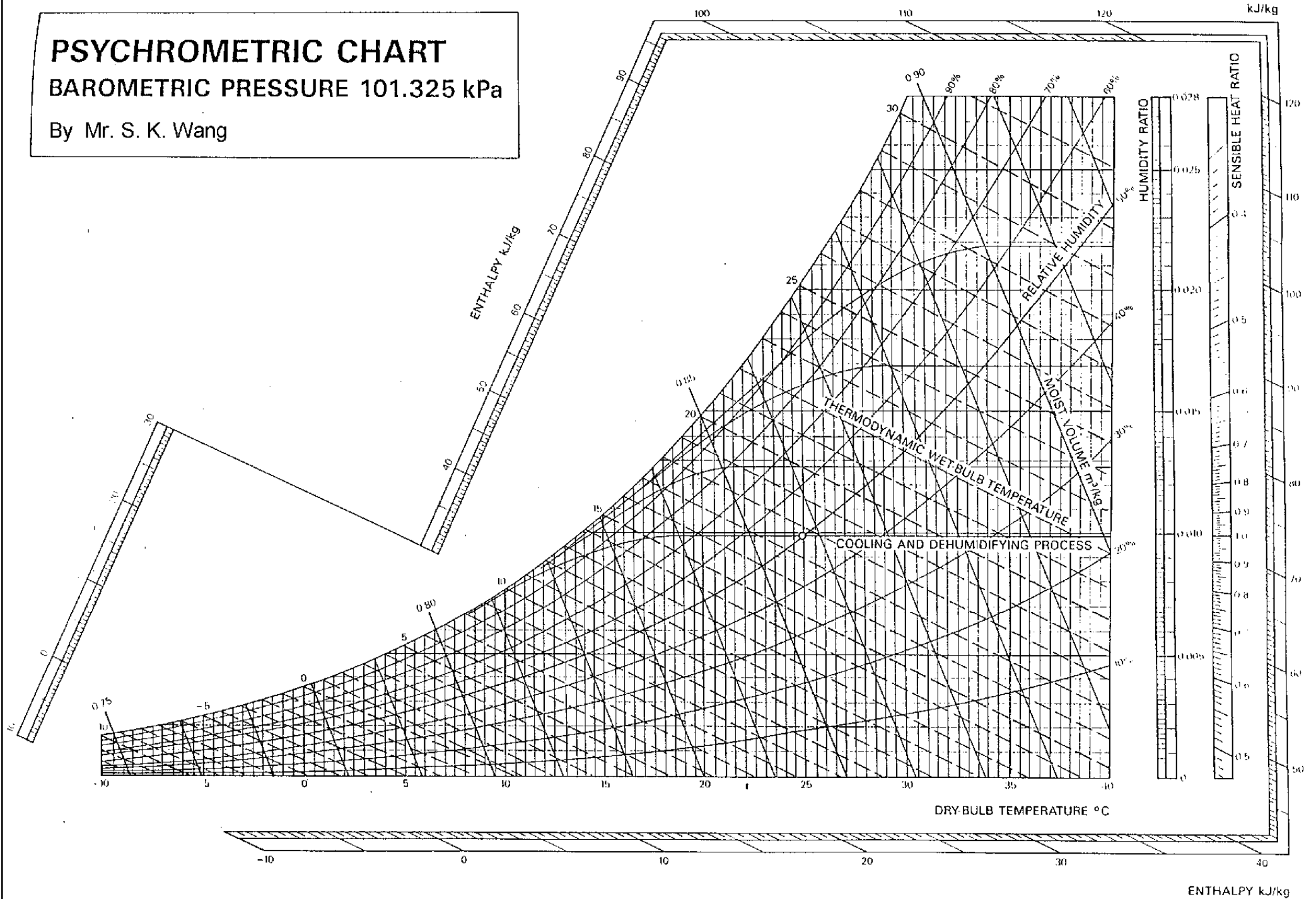
BAROMETRIC PRESSURE: 29.921 in. HG

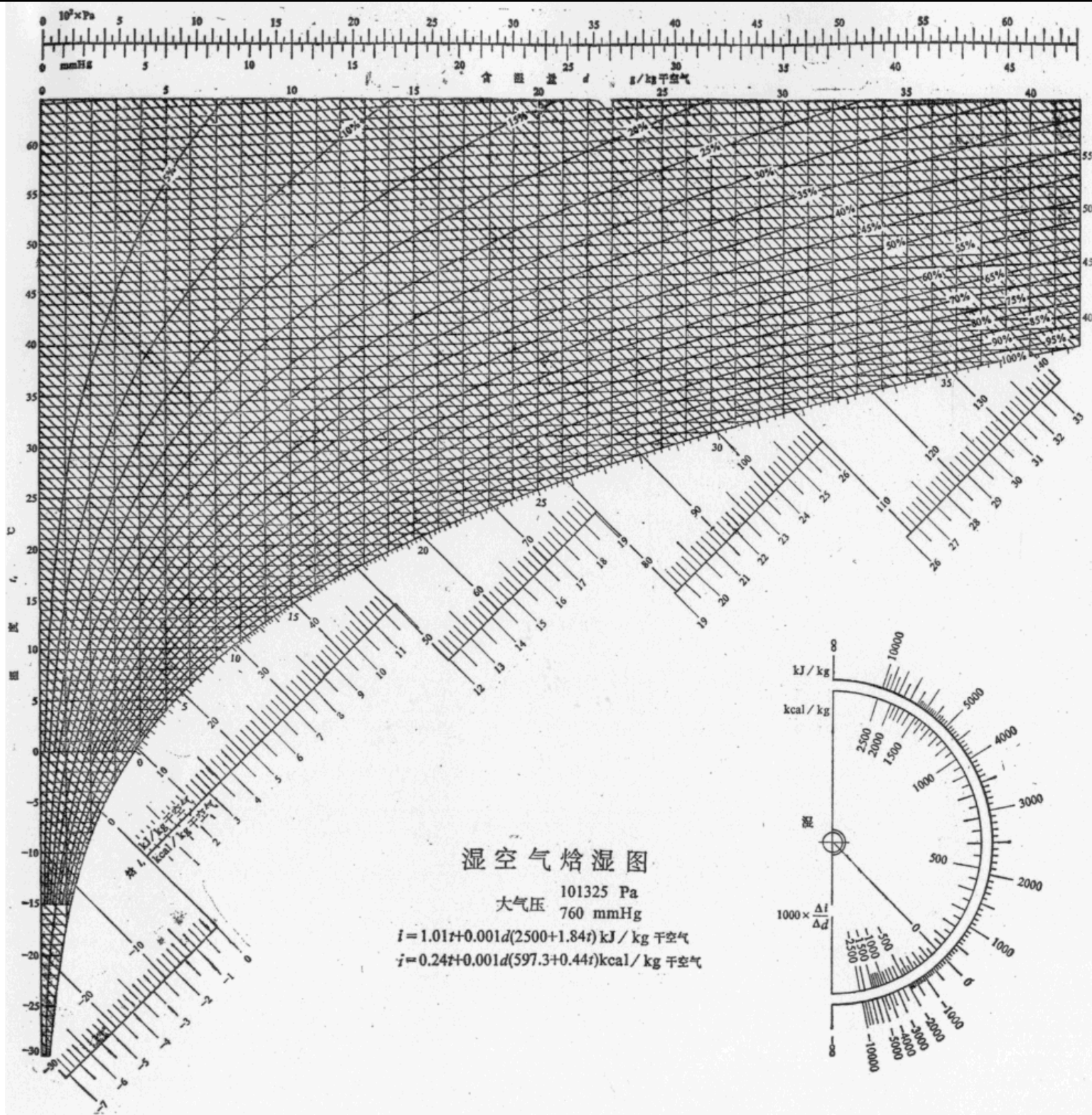


PSYCHROMETRIC CHART

BAROMETRIC PRESSURE 101.325 kPa

By Mr. S. K. Wang



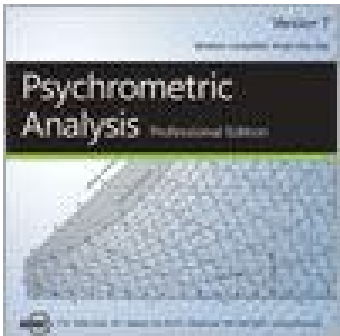


Mollier
chart style

Psychrometric software



- ASHRAE Psychrometric Analysis CD-ROM (2012, 2007, 2002) [AV 697 P97]
 - The program allows the user to plot typical psychrometric processes and perform the corresponding energy calculations
 - The program produces near-exact replications of the charts and can output a listing of points and processes in a tabular report with calculated properties and energy values for each. It includes a presentation of the ASHRAE climate data presented in the 2009 ASHRAE Handbook - Fundamentals



Psychrometric software



- Psychrometric analysis software:
 - ArchiSci Software - PSYCHWIN
 - <http://arch.hku.hk/teaching/archisci/archisci.zip>
 - Psychrometric Chart (PSY) software
 - <http://www.vector.co.jp/soft/win95/business/se288946.html>
 - Daikin's Psychrometrics tool
 - [http://me.hku.hk/bse/MEBS6006/Psychrometric diagram viewer V210 tcm24-133157.zip](http://me.hku.hk/bse/MEBS6006/Psychrometric%20diagram%20viewer%20V210%20tcm24-133157.zip)
- Free Online Psychrometric Chart
 - <http://www.flycarpet.net/en/PsyOnline>

Free Online Psychrometric Chart <http://www.flycarpet.net/en/PsyOnline>

www.flycarpet.net/en/PsyOnline

Home About Projects Contact

Free Online Psychrometric Chart World's first online, and only! A convenient, precise and powerful psychrometric chart & calculator tool for HVAC engineers.

Basic Process Cycle 1 Cycle 2 Setting Display 简体中文

Click on chart for air properties

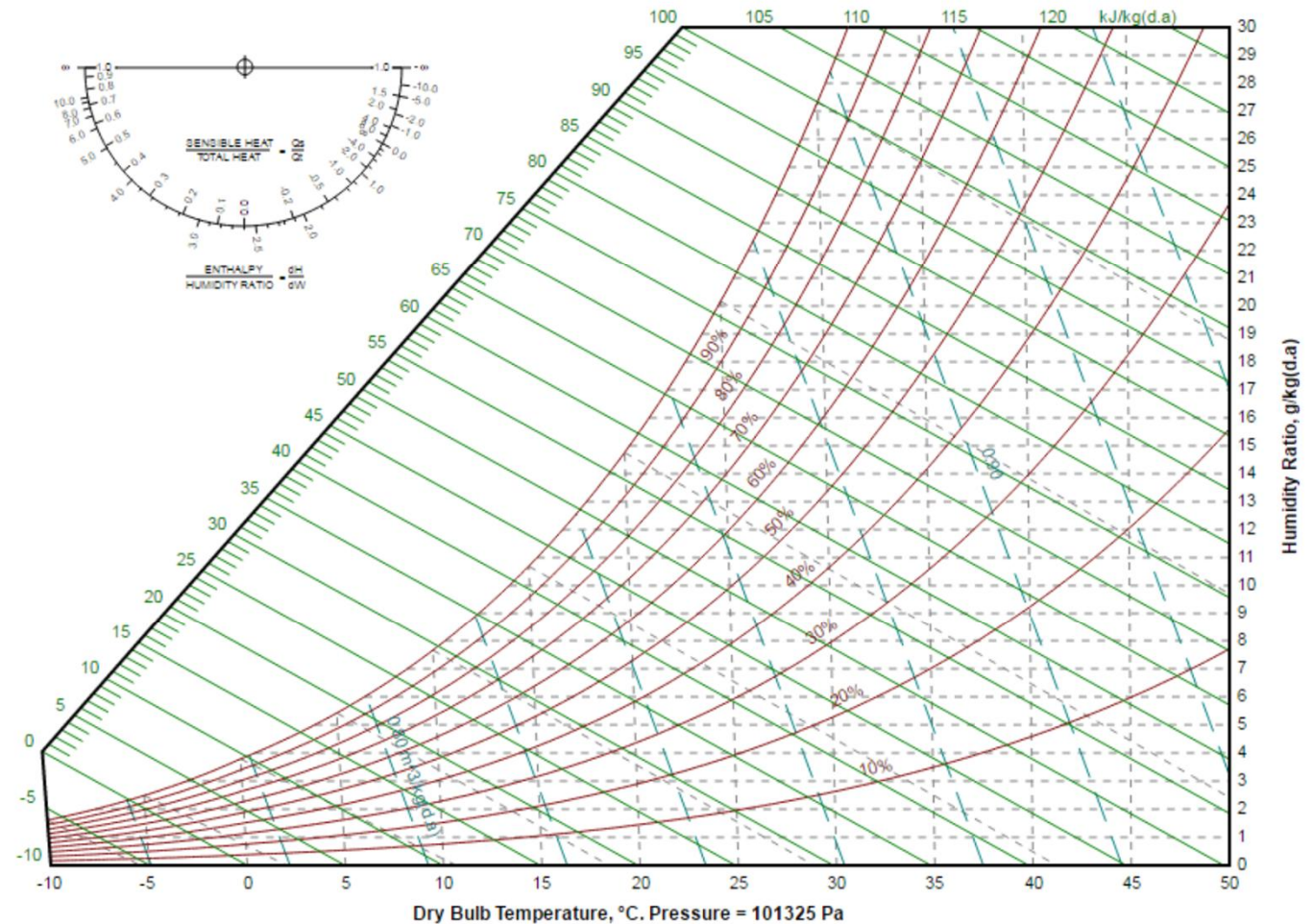
Or input data for air properties

T.Dry, °C 25

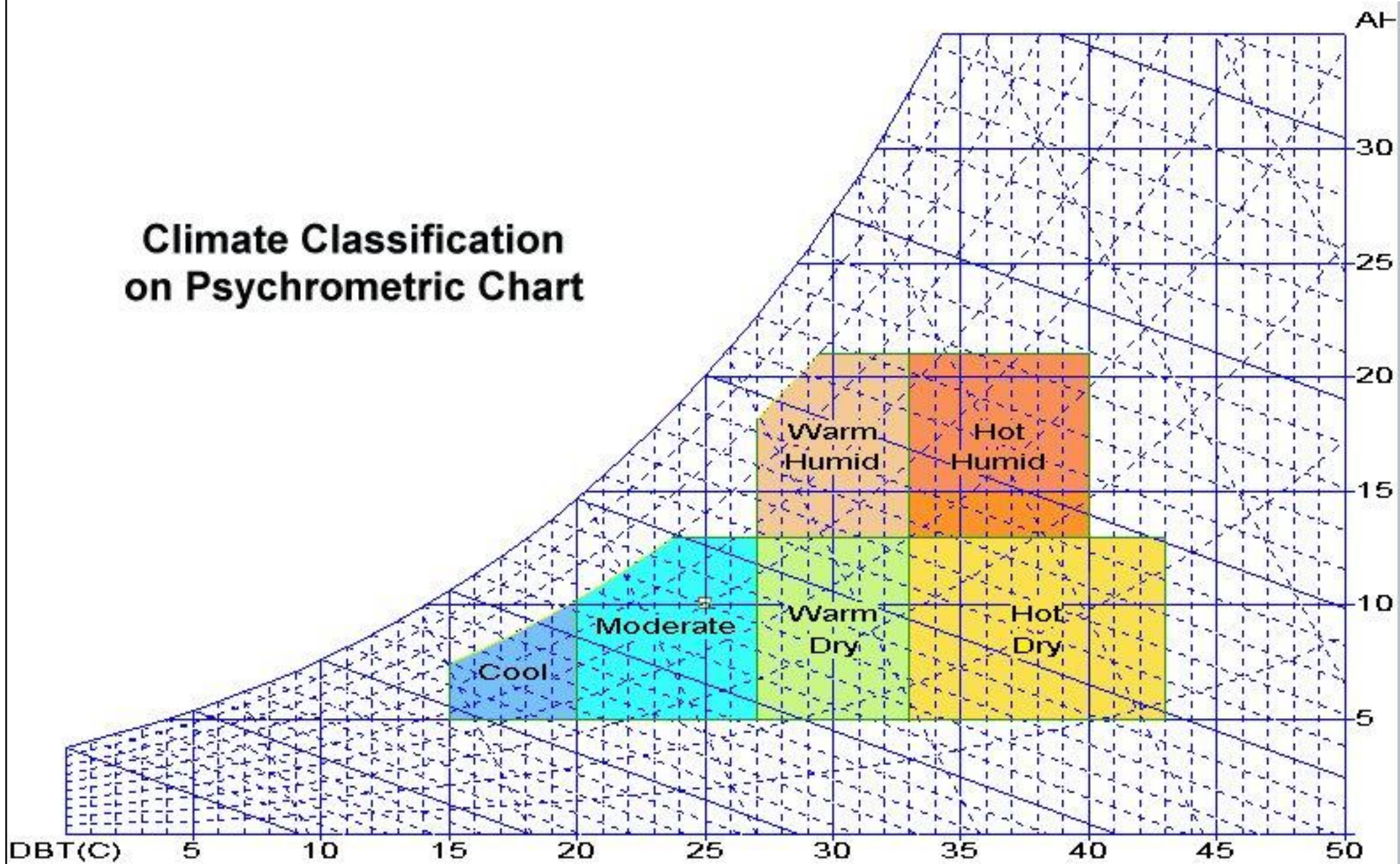
Rel.Humid, % 50

Quantity	Value	Units
P.Ambient		Pa
T.Dry.Bulb		°C
Humid.Ratio		g/kg(d.a)
Rel.Humid		%
T.Wet.Bulb		°C
T.Dew		°C
T.Saturation		°C
Enthalpy		kJ/kg(d.a)
P.Vapour		Pa
P.Sat.Vapour		Pa
Spec.Heat		kJ/(kg.K)

Stop and Play. We have a free small game for you: Survive Broken. Click to start play.

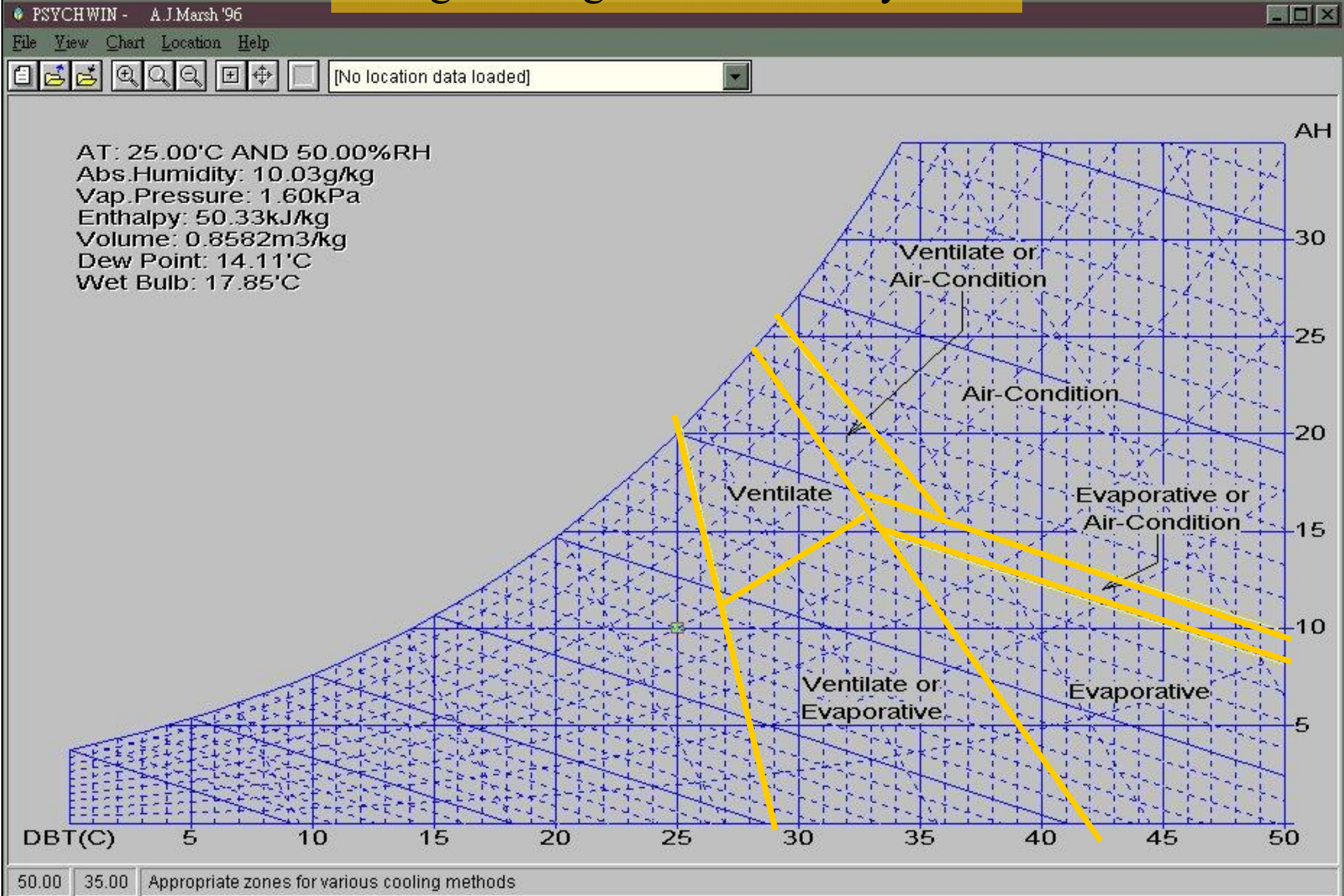


Climate Classification on Psychrometric Chart



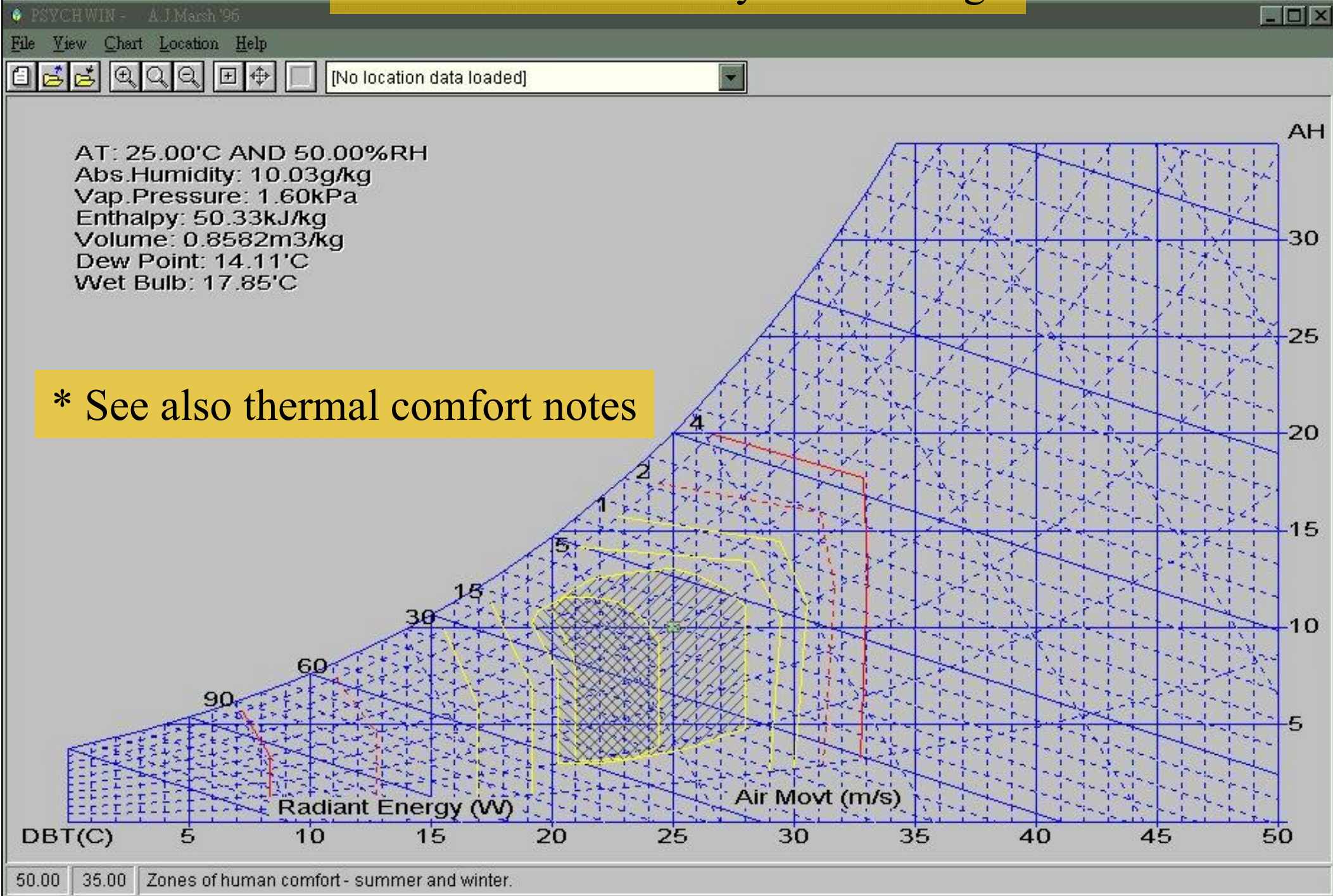
(Source: ArchiSci Software - PSYCHWIN)

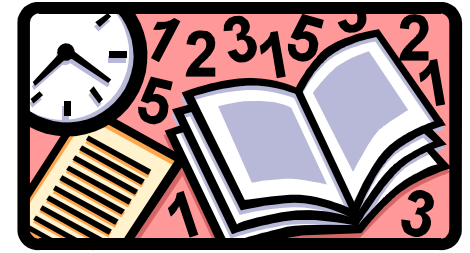
Design strategies for HVAC systems



(Source: ArchiSci Software - PSYCHWIN)

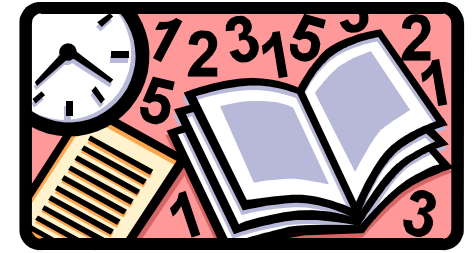
Thermal comfort analysis and design





Further Reading

- Air Conditioning: Psychrometrics (pages 1 to 4)
 - http://www.arca53.dsl.pipex.com/index_files/psy1.htm
- CIBSE Journal CPD Programme:
 - <http://www.cibsejournal.com/cpd/>
 - The properties of air (Apr 2009)
 - Applying the psychrometric relationships (Aug 2009)
- NPTEL E-learning course -- Refrigeration and Air Conditioning <http://nptel.ac.in/courses/112105129/>
 - Lesson 27 Psychrometry <http://nptel.ac.in/courses/112105129/27>



References

- ASHRAE Psychrometrics Tools
 - www.ashrae.org/resources--publications/bookstore/psychrometrics
 - Psychrometric Chart App (on iPad)
 - ASHRAE HVAC Psychrometric Chart App (8:11)
<http://www.youtube.com/watch?v=VFFqkBHDqPk>
 - Psychrometric Analysis CD, Version 7 (2012)
 - Understanding Psychrometrics, 3rd ed. (2013)

