

# CRYOSCOPIC-OSMOMETER OSMOMAT® 010

The OSMOMAT® 010 is a universal cryoscopic osmometer for the determination of molar masses in benzolic solutions and of the total osmolality in aqueous solutions. The OSMOMAT® 010 is based on the well approved measuring system of the OSMOMAT® 030, which has been used for many years, especially for medical applications, and which has the following advantages:

- ✓ totally microprocessor controlled
- ✓ response time approx. 1 min
- ✓ simple handling
- ✓ smallest sample volume
- ✓ automatic calibration

## Function of the OSMOMAT® 010

The sample solution is cooled down to a temperature of about 2 °C to 5 °C below the freezing point of the solvent by a peltier cooling system. Thereby the temperature of the liquid is measured by a high sensitive sensor and monitored continuously. Afterwards the supercooled liquid is inoculated by water ice crystals, whereby the crystallization is initialized. The crystallization enthalpy is heating up the sample solution to the true crystallization temperature, whereby, within the simultaneous existence of liquid and ice, a freezing point plateau is formed. This plateau is detected by the device and the corresponding temperature is stored electronically as a digital value. The patented trigger mechanism for the crystallization by means of inoculating ice crystals, has got a second cooling system, which is located above the measuring vessel. By this means, faulty measurements are excluded nearly totally.

## Determination of the Osmolality of Aqueous Solutions

For the determination of the osmolality the OSMOMAT® 010 first of all will be calibrated with water and a solution of a known osmolality. Afterwards the sample solutions may be measured immediately under the same conditions. The results may be read from the display directly in mOsmol / kg.



## Determination of Molar Masses

First the OSMOMAT® 010 will be calibrated with the pure solvent and a solution with known molar concentration. Thereby the OSMOMAT® 010 enables the zero adjustment to the solvent within the range of 10 °C to -5 °C. The calibration solution, which should have a concentration of about 1 to 10 x 10E-2 mol/kg, will be measured with the highest sensitivity. The results (digits) will be divided by the value of the molar concentration and represent the cell constant. For the sample measurement, solutions of concentrations of about 5 to 140 g / kg solvent will be prepared depending on the expected molecular weight. The values, obtained from this sample solutions

will be also divided by the corresponding concentration, whereby the sample quotient is calculated.

By dividing the sample quotients by the cell constant, the result in g / mol is gained directly. For the determination of molar masses below 1000 g / mol, a single point measurement is normally sufficient. Do nonpolar substances behave nonlinear in respect to the ratio measured value / concentration in the range of low molecular weights, at least 3 solutions with graded concentrations should be measured. The values gained this way have to be treated afterwards statistically by means of linear regression analysis.

# TECHNICAL DATA

## OSMOMAT® 010 - Cryoscopic Osmometer

sample volume: 0,05 ml  
 duration of the measurement: 1 minute  
 reproducibility: 0,5 % of calibrated value  
 display: 4 1/2 digit  
 measuring range: up to approx. 3000 mOsmol/kg  
 in benzene approx. 40 up to 5000 dalton  
 resolution: 1 mOsmol/kg over the entire measuring range  
 in benzene approx. 3 digit/mMol/kg  
 cooling: by means of two separate peltier cooling systems with heat dissipation by air  
 stand by temperature: > 0 °C  
 ambient temperature: approx. 10 °C upto 35 °C

## OSMOMAT® 070 - Vapor Pressure Osmometer

	toluene	water
lowest measurable concentration:	3,3 x 10 <sup>-3</sup> Mol/kg	1,7 x 10 <sup>-4</sup> Mol/kg
molecular weight range:	50-50.000	50-5.000 dalton
specific vapor pressure of the solutions to be measured:	< 0,1 % of the solvent used	
measuring probes for 2 temperature ranges:	to be inserted in pairs for aqueous and organic solvents approx. 1 ml per solution, at least 3 solutions in graduated molal conc. 1 mV/digit, max. 10V	
sample volume:	approx. 1 ml per solution, at least 3 solutions in graduated molal conc. 1 mV/digit, max. 10V	
analog output:	260 x 320 x 230 mm	
dimensions:	9,3 kgs	
net weight: approx.	180 VA	
el.rate of power input:	benzil/benzo acid/naphtalene.	
calibration substances:	The molal concentration should lie between 0,1 upto 1,5 Osmol/kg in water or 1 x 10 <sup>-3</sup> up to 3 x 10 <sup>-2</sup> Mol/kg in organic solvents	
Osmolality measurement:	up to approx. 3.000 mOsmol/kg (with control unit SA) up to approx. 1.500 mOsmol/kg (with control unit B)	

temperature range: 5 °C higher than ambient temperature upto 130 °C  
 temperature adjustment: in steps of 1 °C  
 accessories: the GONOTEC osmometers are supplied with all accessories necessary for putting the instrument into first operation

**The cell units OSMOMAT® 070 and OSMOMAT® 090 are only working with a control unit SA or B.**

## Control-Unit SA

with serial interface, monitor and keyboard and user's guidance : software for OSMOMAT® 070 and OSMOMAT® 090 via monitor and keyboard  
 storage of measuring results : automatically after a pre-set time  
 drift compensation : automatically on call  
 statistical evaluation : automatic calculation of the linear regression, erratic measuring results can be eliminated  
 diagrams: screen projections of the current proceedings of the measuring results in an x-t-diagram or of the linear regression  
 printer output : printing of texts and diagrams with printer suitable for graphics  
 dimensions : control unit : 415 x 380 x 155 mm, keyboard : 280 x 130 x 25 mm  
 weights : control unit : approx. 9,0 kgs, keyboard : approx. 0,5 kgs  
 monitor : 14 inch, VGA, approx. 3,8 kgs

Version 1.3 Stand 09/09



## Integrated printer:

alpha-numerical matrixprinter, 5x7 matrix, date, time for each measurement, 4-digit sample number, 4-digit measuring result, normal paper, 43mm, automatic paper feed or with pushbutton, endless ink ribbon cassette, exchangeable, printer function switch on/off with pushbutton, clear error messages  
 Analog output: through standardized 5-pole socket, output voltage 1 mV/digit  
 RS data output: standardized interface RS 232 C  
 dimensions: 220 x 205 x 360 mm  
 weight: approx. 7 kgs  
 power supply: 230 V (+/- 30 V), 50-60 Hz, 120 VA or 110 V (+/- 15 V), 50-60 Hz

## OSMOMAT 090 - Membrane Osmometer

smallest detectable pressure: 0,1 mm solvent column  
 molecular weight range: 5000 to 2.000.000 dalton depending on the semi-permeable membrane selected  
 measurement cell volume: approx. 0,5 ml  
 membrane diameter: 40 mm  
 solvents: various organic solvents, water and aqueous electrolyte solvents  
 sample volume of polymer solution: at least 3 solutions of 2 ml each (with stepped concentration in the range of 1 to 5 %)  
 dimensions: 260 x 320 x 230 mm  
 weight: approx. 10,0 kgs  
 el.rate of power input: 180 VA

## Control-Unit B

analog recorder output : recommended sensitivity : 1 V for full deflection  
 dimensions : 260 x 320 x 110 mm  
 weight : approx. 3,5 kgs  
 mains voltage for all instruments: 115/220 V, 50/60 Hz  
 Technical data subject to change without notice.

## Manufactured and sold by:



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Information and specifications contained within this publication may be subject to change without notice

# gonotec

## OSMOMETER

### FOR DETERMINATION OF MOLECULAR WEIGHT



## OSMOMAT® 010

Cryoscopic-Osmometer

## OSMOMAT® 070

Vapor Pressure-Osmometer

## OSMOMAT® 090

Membrane-Osmometer



# MEMBRANE-OSMOMETER OSMOMAT® 090

Membrane osmometry enables the measurement of the average molecular weight  $M_n$  of polymers, soluble in aqueous or organic solvents, within the range of 10.000 to  $2 \times 10^6$  dalton. The GONOTEC membrane osmometer OSMOMAT® 090 consists of an osmotic cell, which is located in a cell thermostat. The osmotic cell is divided into two sections by a semi-permeable membrane. In the lower, hermetically sealed half, which is filled with pure solvent, a precision pressure metering system is installed. The upper cell half, positioned above the semi-permeable membrane, is designed as a meander-shaped channel system with a large surface. A funnel tube and a discharge enable rinsing and filling of the cell with solvent resp. polymer solution. Due to the osmotic pressure difference between solvent and solution, a vacuum, which is representative for the concentration of the osmotic actively soluted particles, is generated in the lower cell half.

The high performance measuring cell is designed for:

- ✓ short response times

- ✓ small sample volumes
- ✓ highest measuring resolution of 0,1 mm liquid column per digit
- ✓ avoiding „balloon effects“
- ✓ membrane diameter of 40 mm

The osmotic cell, constructed of stainless steel, is installed within a heated thermostat, which is adjustable in steps of 1 °C from about 30 °C to 130 °C. As semi-permeable membranes ultra-filters with a pore size of down to 0,01 µm, corresponding to a cut-off of 10.000 Dalton, are used. The cut-off of the membranes defines the low limit of the molecular weight, which is to be measured. For a complete determination of the molecular weight, at least three polymer solutions with graded concentrations in the range of 1 g to 5 g / 100 ml are required. For rinsing the cell, 2 ml to 3 ml of each polymer solution are required. The whole measuring system is made of stainless steel, glass and PTFE and is thus suitable for nearly all organic and inorganic solvents. However, restrictions, concerning the usable solvents, result from the material of the semi-permeable membrane. The sealing of the cell is done exclusively by compressing the

membrane at the sealing-surface. For measurements at higher temperatures or with the use of membranes with low permeability, a cell head is assigned, which may be positioned above the measuring cell. This cell head is automatically selfadjusting to the preselected cell temperature. The cell unit OSMOMAT® 090 includes the cell thermostat with osmotic cell and pressure transducer, the precision amplifier with integral digital zero adjustment and auto zero and the electronics for temperature control of the cell including power supply as well.

**The cell unit may be operated only by a GONOTEC control unit “SA” or “B”. The control unit is responsible for all control-, monitoring- and measuring-functions, for the temperature control of the cell and for acquisition and display of the measured values.**



# VAPOR PRESSURE OSMOMETER OSMOMAT® 070

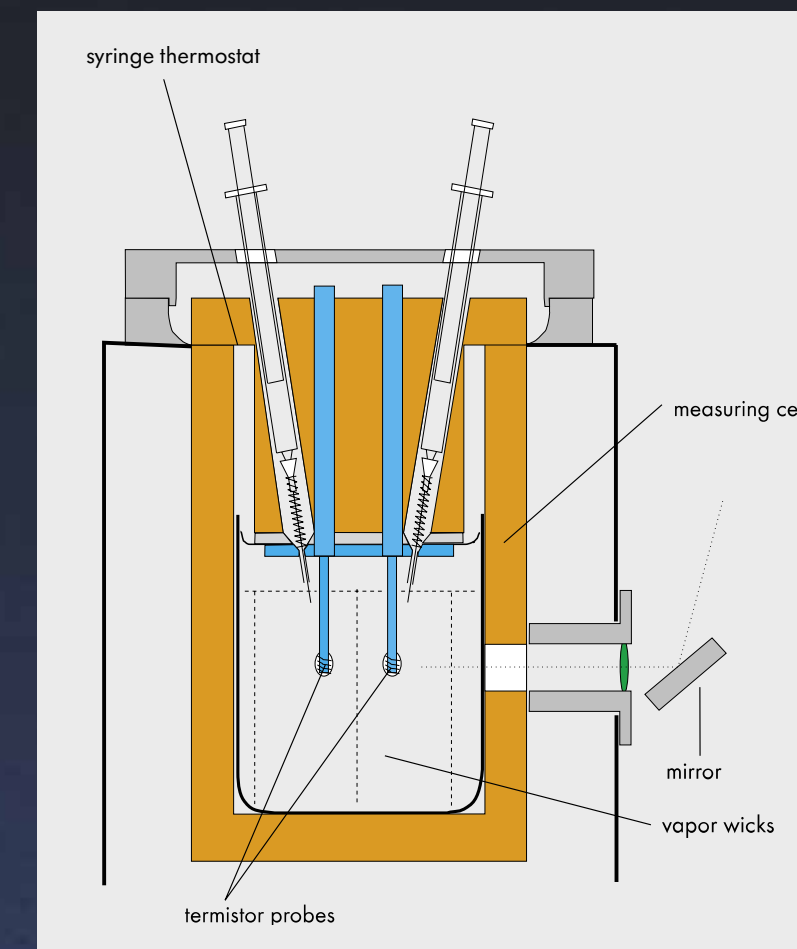
This method is suitable for the determination of the average molecular weight of polymers, which are soluble in different organic solvents and for the determination of the osmolality of aqueous solutions as well. The range, which has got to be measured, lies between 40 and 50.000 g / mol in organic solutions and up to 5.000 g / mol in water. Two thermistors, connected for difference measurement, are suspended hanging in a thermostated measuring cell, which is filled with the saturated vapor of the solvent. The measuring probes, which are first covered with solvent droplets, will adapt to the cell temperature. Thus there is no temperature difference between them. Exchanging the solvent droplet of one of the probes by a droplet of the solution, will lead, due to the lower vapor pressure of the solvent above the solution, to condensation of solvent vapor. The thereby released condensation enthalpy increases the temperature of the solution droplet, which simultaneously leads to an increase of the vapor pressure. After reaching the vapor pressure

equilibrium between the saturated vapor atmosphere of the measuring cell and the surface of the solution droplet, a relative stable temperature is obtained at the solution droplet, resulting in a temperature difference between the two probes, which are part of a Wheatstone-bridge. The temperature difference is measured with a resolution of about  $5 \times 10^{-5} \text{ °C}$  and converted to a direct voltage signal. The resulting relative measuring value is nearly proportional to the osmolal concentration of the solution, may be however affected by heat losses and non ideal behaviour of the polymer solutions. Therefore the system has got to be calibrated with solutions of known molality resp. osmolality. Due to the nonlinear behaviour of the osmotic pressure of polymer solutions versus concentration, at least 3 solutions with graded concentrations have to be measured. By means of a final statistic calculation, based on a linear regression method, the nonlinear behaviour may be eliminated. The beaker jar shaped measuring cell is located in a cell

thermostat with very high temperature constance, which is adjustable in steps of 1 °C between 30 °C and 130 °C. The optimal vapor saturation of solvent is supported by vapor wicks with large evaporating surface. The measuring probes consist of two thermistors covered by thinwalled tubes of stainless steel. This enables measuring electrically conducting liquids as well. The probes are equipped with stainless steel spirals at the lower end to guarantee a constant size of the droplets. Besides rinsing of the probes is made easier because of the spiral shaped liquid stream. The solvent and also the solutions are loaded to the probes by preheated glass syringes.

Preheating is done by a syringe thermostat located above the measuring cell. The thermostat temperature automatically follows the cell temperature. The syringes are arranged inside the thermostat in a way, that they are directed exactly to the target point above the spirals of the probes. Two syringes are assigned for pure solvent, four for solutions of a graded concentration line of the sample substance. The total cell unit of the OSMOMAT® 070 consists of the cell thermostat with syringe thermostat, a pair of measuring probes, precision amplifier with integral bridge adjustment and auto zero and electronics for the cell thermostat including power supply.

**The cell unit may be operated only by a GONOTEC control unit “SA” or “B”. The controller is responsible for all monitoring-, control-, and measuring-functions, for controlling the cell temperature and for the acquisition and display of the measured values.**



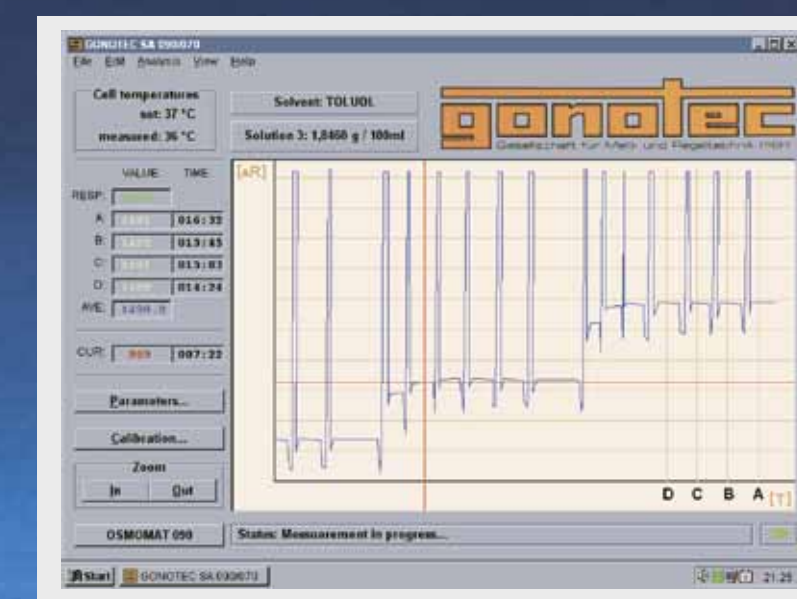
# CONTROL UNIT OSMOMAT® 070/090

## Control Unit “SA”

This unit includes a personal computer with a software, especially developed for this application. Besides the control-, monitoring- and measuring-functions, the unit undertakes the user guiding through the total measuring procedure by text and graphic pages and a final statistic evaluation of the measurement. On the evaluation page all measuring parameters and results are summarized and treated by a statistical calculation. Simultaneously in the background the final evaluation is carried out and the result  $M_n$  (average molecular weight in g / mol) is displayed. Further a graphic display of the linear regression curve is retrievable. All text and graphic pages may be printed.

## Control Unit “B”

Control unit “B” includes all control, monitoring and measuring functions required for determination of the molecular weight.



Thereby the measuring parameters are being adjusted manually by switches at the front panel of the device. The 4-digit display alternatively shows the actual measuring result (1 digit equals to 1 mV at the output of the

amplifier), or the actual temperature of the measuring cell. The control unit is equipped with an analog output for connecting a potentiometric recorder (recommended sensitivity 1 V full scale).