

## GELNORM ® - GEL TIMER



With GELNORM - Gel Timer it is possible to evaluate all factors which influence the gel time of reaction resins such as type and quantity of hardener, accelerator, inhibitor, filler, pigments, as well as temperature and moisture. The instrument is extremely easy to operate and normally needs no maintenance.

The principle of measurement of GELNORM - Gel Timer is simple: A stamper made from aluminium or glass performs an up-down cycle in a thermostated test tube filled with resin. When the point of gelation is reached, the test tube is pulled up by the stamper. This stops the clock which was started at the beginning of the experiment and the gel time can be read of.

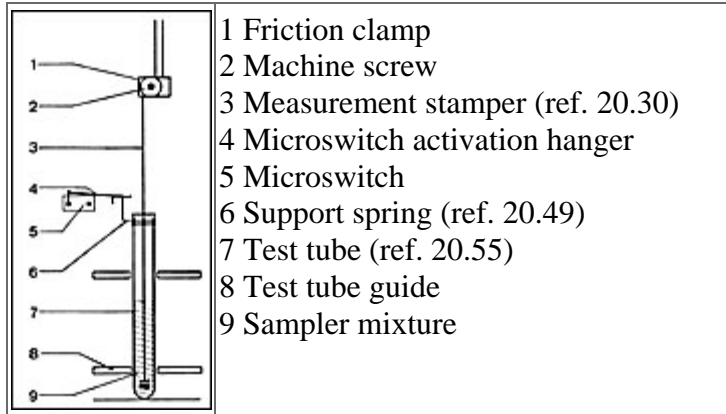
### DESCRIPTION OF INSTRUMENT

GELNORM - Gel Timer consists of a control unit and individual test units. The following types are available:

Gel - Timer with one test unit (Ref. 20.11)

Gel - Timer with up to three test units (Ref. 20.10)

According to DIN 16 916, stampers (Ref. 20.30) made of aluminium wire with a coiled head are used. This design provides the same gel time measurement as the glass stamper specified in the specification of DIN 16 945 but is more economical. The design of the aluminium stamper moreover provides a minimum of surface area, which leads to a minimized air inhibition which is especially important for unsaturated polyesters.



- 1 Friction clamp
- 2 Machine screw
- 3 Measurement stamper (ref. 20.30)
- 4 Microswitch activation hanger
- 5 Microswitch
- 6 Support spring (ref. 20.49)
- 7 Test tube (ref. 20.55)
- 8 Test tube guide
- 9 Sampler mixture

It is also possible to use a glass stamper ( $\varnothing$  3 mm, length 230 mm with fused base) according to DIN 16 945. (Please notice that another stamper attachment clamp (Ref. 20.48) is used in this case.) Test tubes are of 160 x  $\varnothing$  16 mm with lip (Ref. 20.55).

## TEMPERATURE MEASUREMENT

A GELNORM-Therm-Box (Ref. 160.70) can be connected to the control unit to determine the exothermic reaction by means of a Ni-Cr-Ni-thermopile beside of the gel time.

The gel time as well as the change of temperature inside the probe can be recorded by means of a line recorder. (Please note, that only one GELNORM-Therm-Box can be connected to each control unit.)

## TIME MEASUREMENT AND MEASURING CYCLE

The control units are provided with digital LCD-clock-modules. The automatic digital time measurement gives a reading of 1 second for test durations up to 24 hours. By starting a new measurement the clock is automatically reset to zero.

The continuous up-down motion cycle of the stamper is set to 10 seconds as our standard. For individual needs, test units with other motion cycles are available upon request.

## TEMPERATURE CONTROL SYSTEM

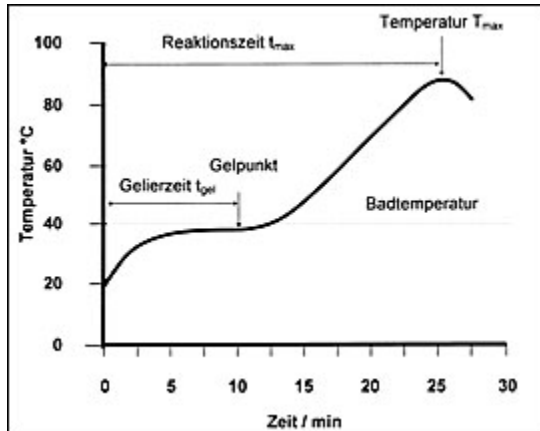
A prerequisite for an exact and reproducible determination of the gel time is a high precision thermostatic system. For temperatures up to 120 °C we recommend a thermostatic bath, up to 200 °C our Heating Block GT in connection with our temperature controller TC-2.

### 1. THERMOSTATIC BATH

It is possible to perform tests at defined temperatures by submersing the portion of the test tube with the reaction resin into a thermostatic bath (fig. 3). The amount of the liquid in the bath should be adjusted such that it's level is about 1 cm higher than the level of the reaction resin in the test tube. (Please note, that the volume excluded by the test tube influences the experiment and, hence, it has to be constant in order to reach an optimal reproducibility of the results.)

The method is recommended for temperatures from 20 to 120 °C. Two different thermostatic baths are available for one (Ref. 20.50) and three test units (Ref. 20.51). Special supports for the test units enable measuring in a closed thermostatic bath.

fig. 3: Heating Block GT with Temperature Controller TC-2



Curing behavior of an unsaturated polyester resin

## 2. ELECTRIC HEATING BLOCK GT

At temperatures of 120 up to 200 °C our Electric Heating Block GT (Ref. 20.41) can be used, fig. 4. Temperature control of the heating block is performed with the temperature controller TC-2 (Ref. 70.01).

## TEST PROCEDURE

### 1. PREPARING THE TEST MIXTURE

Weigh 100 g of reaction resin (deviation of 1 % permitted according to DIN 16 945) in a beaker.

Weigh hardener and accelerator according to instructions, accurate to 0,01 g.

After mixing well for approx. 1 minute, place the sample mixture in a test tube (160 x Ø 16 mm, net weight approx. 10 g) up to a height of abt. 70 mm (weight of resin approx. 12 g). Test tube and resin mixture should have a total weight of 22 g. To obtain exact and reproducible results, it is essential to pay attention to the total weight.

The time between completion of mixing the sample and starting the test should be less than one minute.

### 2. PERFORMING THE TEST

Place the test tube (including support spring) with the sample into the support of the test unit. Attach the support spring to the micro switch. Press the start button on the control unit. The button cannot be activated until the sample is attached to the micro switch. After having pressed the start button, the clock is started.

Insert the stamper into the sample and attach to the clamp.

When the gel point is reached, the stamper remains in the sample, the drive motion lifts the test tube and, via the micro switch, stops the clock.

For the simultaneous determination of the maximum temperature  $T_{max}$  the GELNORM-Therm-Box with an attached Ni-Cr-Ni-thermopile is connected to the control unit. The thermopile is inserted into the reaction resin together with the stamper at the beginning of the test.

Test tube and stamper are thrown away after the test. There is no cleaning necessary.

## TECHNICAL DATA

Time measurement	24 hours (accuracy 1 sec.)
Drive motion cycle	standard: 10 sec, others on request
Stamper	aluminium wire (Ref. 20.30)
Test container	Test tube 160 x Ø 16mm (Ref. 20.55 }
For temperature	GELNORM-Therm-Box, Thermoelement Ni-Cr-Ni (Ref. 160.70)
Power supply	220 V / 50 Hz or 110 V / 60 Hz, ± 10 %
Fuse	250 mA
Number of measuring place	depending on control unit, 1 to 3 test units
Weight	Control unit ST/3: 2,2kg Control unit ST/1: 1,2kg Test unit 2,5kg