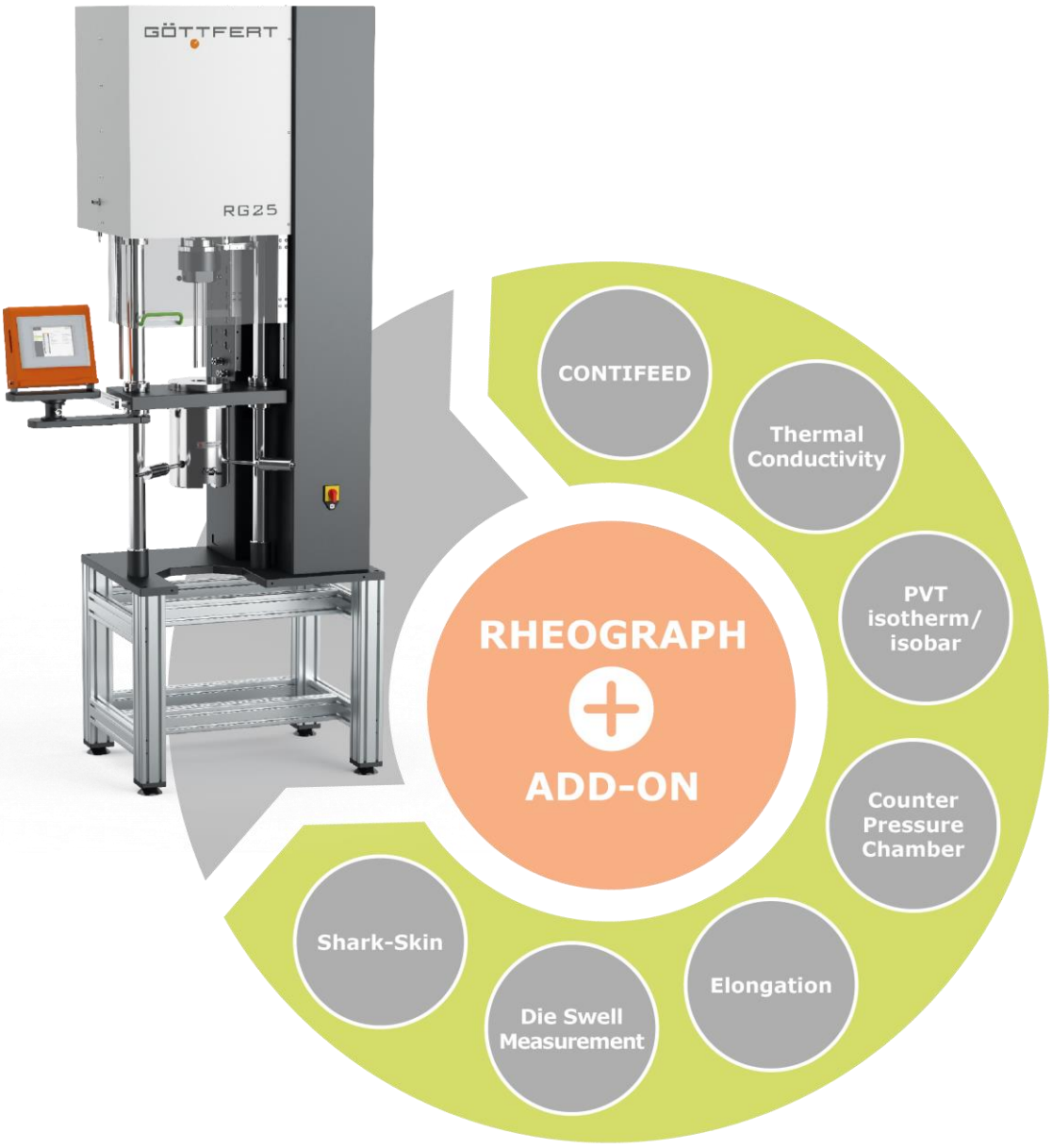
viscosity

OPTIONS FOR HIGH PRESSURE CAPILLARY RHEOMETERS



GÖTTFERT
THIS IS RHEOLOGY

Contents

Introduction

The GÖTTFERT High Pressure Capillary Rheometers RHEOGRAPH 20, 25, 50, 75 and 120 are already equipped with large basic functions.
Our extensive option program provides a more detailed characterisation of the test materials as well as supplementing accessories to the completion of the basic equipment.
The options are also valid for the previous test device generations like RHEOGRAPH 2003/6000, RHEO-TESTER 2000.

Optional Variants

	Test chamber Type	RG20	RG25	RG50	RG75	RG120	SK[1]	TC[2]	PVT[3]	SW[4]	CP[5]	NP[6]	TC[7]	CS[8]	SL[9]
1	Test barrel D 9.55	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
	Test barrel D 12 mm	✓	✓	✓	✓	✓									
	Test barrel D 15 mm	✓	✓	✓	✓	✓		✓							
	Test barrel D 20 mm	✓	✓	✓	✓	✓									
	Test barrel D 25 mm		✓	✓	✓	✓									
	Test barrel D 30 mm		✓	✓	✓	✓									
2	Test barrel 2x D 12 mm	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
	Test barrel 2x D 15 mm	✓	✓	✓	✓	✓		✓							
	Test barrel 1x D 15 mm 1x D 12 mm	✓	✓	✓	✓	✓									
	Test barrel 3x D 12 mm				✓	✓									
	Test barrel 1x D 15 mm 2x D 12 mm				✓	✓		✓							
3	Test barrel 2x D 20 mm					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Test barrel 3x D 15 mm					✓									
	Test barrel 3x D 20 mm					✓									

1) SK = Sharkskin
2) TC = Thermal conductivity measurement
3) PVT = Pressure volume temperature
4) SW = Die swell measurement
5) CP = Counter pressure chamber
6) NP = Nitrogen purge unit
7) TC = Thermocouple
8) CS = Cleaning set
9) SL = Slit die

Components and Order Information

Detection of Flow Instabilities (Sharkskin)

Flow-instabilities such as sharkskin have long been observed, but difficult to measure. Common pressure or force transducers (typical 10 Hz max.) cannot pick up the slight pressure spikes caused by the instability. In cooperation with Professor M. Wilhelm (Institute of Applied Chemistry and Polymer Chemistry in Karlsruhe, Germany), a revolutionary sensory device was developed. Using a slit die and high frequency sensors with up to 20 kHz sampling rate, the smallest pressure peaks can be measured and analyzed. Results are evaluated in our special software and used to optimize extrusion, film and coating processes. An additional heating circuit is required for this option (see `Additional Heating Circuits´ in this product description).

Details and closer information you will find in the separate product description "Detection of Flow Instabilities (Sharkskin)".

Thermal Conductivity

- Measurement of heat conductivity Temperature range up to 450 °C, pressure up to 1000 bar
- Developed according to ASTM D 5930
- Test probe with integrated heater element and temperature sensor
- No mechanical changeover required
- Process simulation and optimization of injection molding cycle times

Note: Capillary quick-lock-system required!

Details and closer information you will find in the separate product description "Thermal Conductivity".

PVT (Pressure – Volume – Temperature)

The PVT behavior of a plastic material describes the specific volume as a function of temperature and pressure. Within the test method the volume of one and the same test sample is measured under given temperature and pressure condition.

- Measurement according to ISO 17744
- Determination of the characteristics pressure, Volume and Temperature
- Measurements isobar and isotherm
- Variable test sample volume
- Easy handling with quick die locking system
- Presentation of a PVT diagram
- Optimizing of the flow and shrinkage properties during production process

The test barrel and test piston system of a high pressure capillary rheometer can be used to determine a PVT diagram in a technological relevant range.
These tests can be run in isothermal and isobar mode, which are standardized in ISO 17744. Comparison measurements in a Round-Robin-Test showed that this procedure can be handled for amorphous and crystalline polymers.
To perform the test in a capillary rheometer the test barrel is closed at its below end. A defined weight of material is filled into the barrel and compressed by the piston. The pressure is controlled by a force transducer. By changing the volume of the sample via moving the test piston position, PVT diagrams from 0-1800 bar can be generated (e.g. test piston diameter 15 mm → max. 31 kN → ~1800 bar), higher values on request. The temperature range of the PVT measurement is up to 20-450 °C. When using an optional external thermostat (see chapter "High power thermostat"), the maximum temperature is limited as per permissible temperature range of the cooling media. The measurement can be performed with all thermoplastic and rubber materials as well also liquids.
Figure 1 show a view cut of a capillary rheometer barrel with tempering jacket necessary for isobaric measurements.

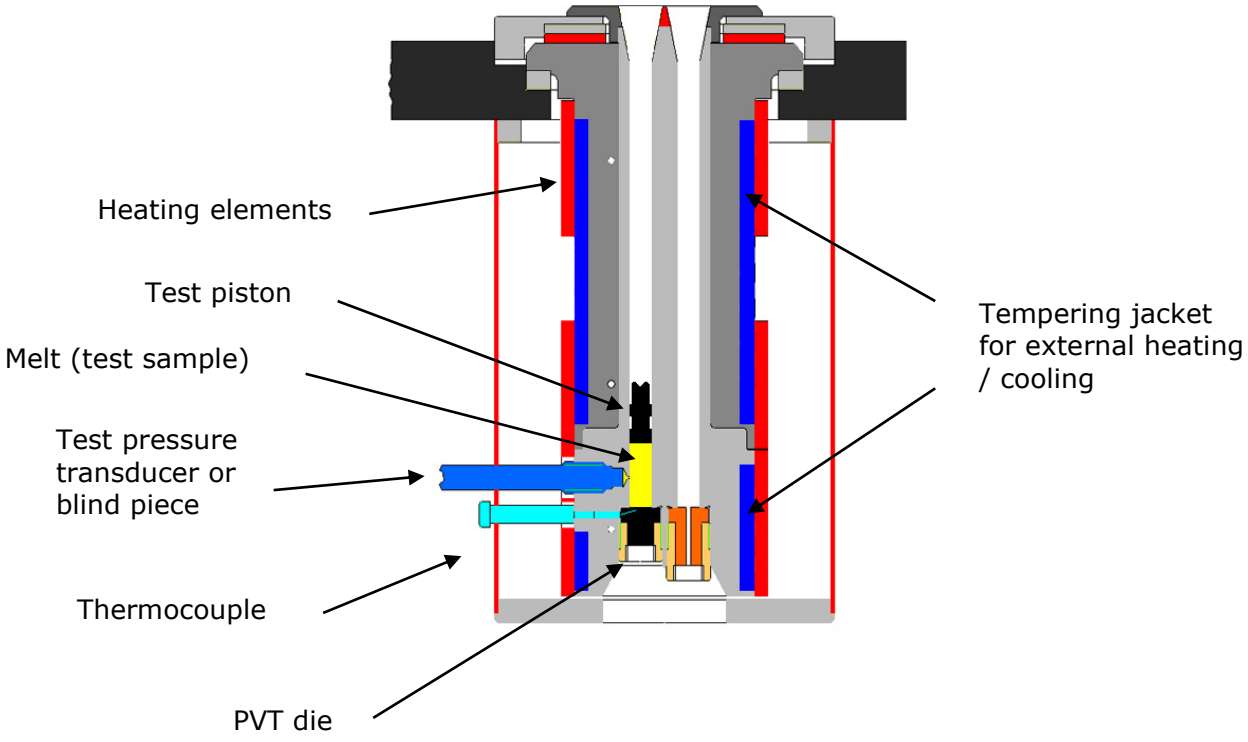


Figure 1: View cut of capillary rheometer barrel with tempering jacket for isobar measurement

For isothermal measurement also a standard test barrel can be used. The isothermal measurement is a standard measurement to generate data for shrinkage and process modeling in extrusion, gear pumps, shrinkage of materials and also injection moulding. Figure 2a, b and c show examples of isothermal and isobaric measurements. The data can be approximated with model equations, for example Tait model, and stored in databases. These data are absolute necessary for modeling the injection moulding process.

At the 2 or 3 test barrel system only one test barrel can be used for the PVT measurement.

Typical examples of PVT measurements (isothermal, isobaric, specific density, specific volume):

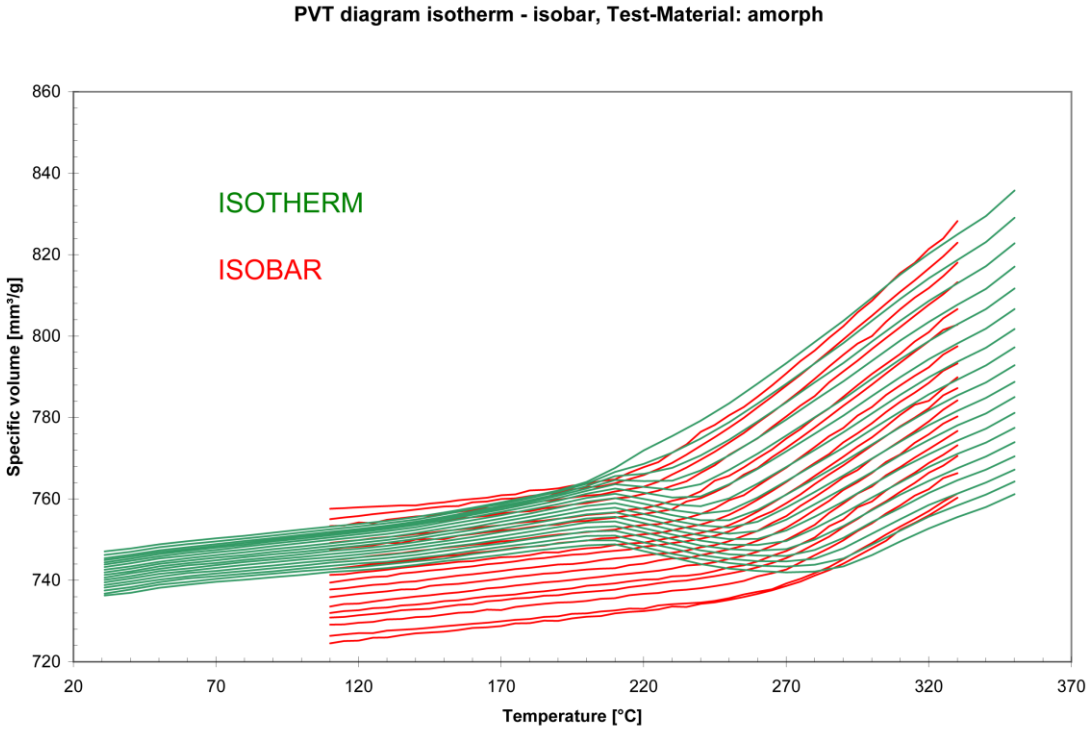


Figure 2a: Isothermal and isobaric PVT measurement of an amorphous testing material

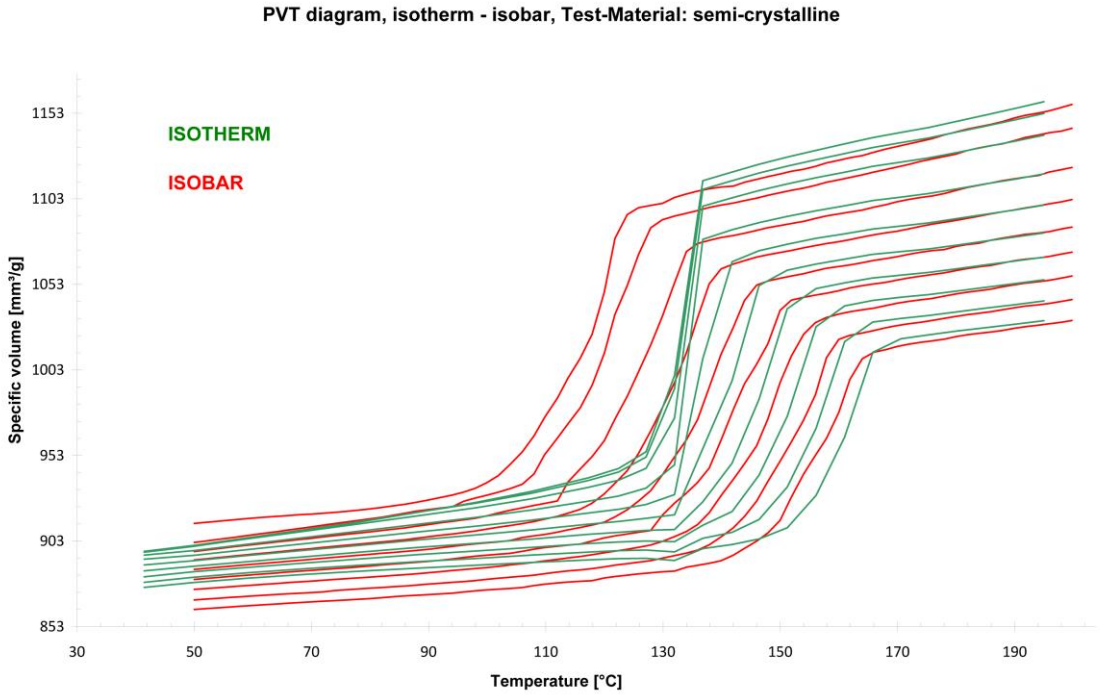


Figure 2a: Isothermal and isobaric PVT measurement of a semi-crystalline testing material

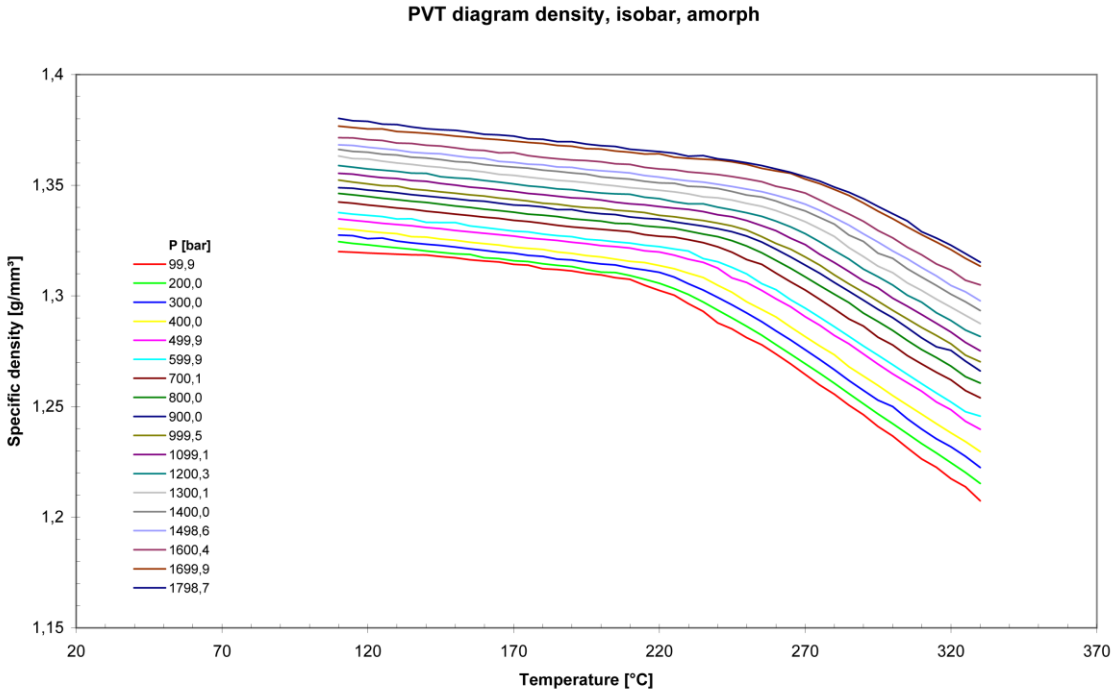


Figure 2a: Isobaric PVT measurement of an amorphous test material, density diagram

PVT measurements according DIN 17744 isotherm in a temperature range* up to 450 °C and isobar up to 400 °C are offered (*for the selection of the optimal sealing the temperature range must be defined exactly). This upper limit provides the possibility to measure and evaluate also the most technical plastics and especially fluor polymers.
For isobaric PVT measurements a test chamber with tempering jacket is required. The use of an external thermostat is recommended to guarantee constant cooling rates (see chapter "High power thermostat).

To achieve a better description of the real injection moulding process, the isobaric measurement is used. During the test the material is cooled down under constant pressure. This measurement describes better the material behavior under high cooling rates of the injection moulding process, which is mostly performed under constant pressure after the initial injection phase. The isobar PVT measurement is essential for exact mould design drawn from simulation data.

Depending on the system, the options **Force Measurement** and **Test Piston with Teflon Ring** or **Test Piston with HP sealing** are required.

Important notes:
For feeding and compressing of the testing material a regular standard test piston without sealing ring is required, which fits to the test barrel. The teflon-, HP- or another test piston with sealing ring is not recommended due to its high tightness behaviour (air must exhaust during compression).
If due to a higher pressure, e.g. at the PVT measurement with >2000 bar, another test piston type with sealing ring as type 5 (standard) is required, so the standard type must be also selected from this material (steel type), and vice versa. All test piston types must be made from the same steel material. This is also valid for the use at viscosity measurements. Please see more details in the table "Steel types".

Table for quick overview of necessary components.

PVT	New device (RG20-120)		Upgrade	
	Complete	Preparation	With preparation	Without preparation
PVT force transducer*	●	●	available	●
Quick locking device *	●	○	●	
Thermoelement	●	○	●	
Thermostat Tempering jacket Double Pt100	optional	○	optional	
LabRheo	available	○	optional	
or				
LabRheo-Update	○	○	optional	
1 x license for PVT-Script-Generator	●	○	optional	
or				
PVT-Software (Indiv. adjusted Script template)	optional	○	optional	
1 x licence for evaluation software WinRheoII	●	○	●	

RHEOGRAPH 20, 25, 50, 75, 120

PVT Software
Order number 5.29.321

Option License for Script-Generator

We recommend the script generator to automatically generate the example script files.
The automatic process of several PVT measurements can be realized with the script generator.
For more detailed product and ordering information, refer to the separate product description "LabRheo".
This option is included in an initial purchase of equipment with PVT.
When retrofitting, it can be co-opted separately.

Additional operating manual, english/german, on paper format
Complete printed operating manual in a single DIN A4 ring binder.
This operating manual is also available as a download on serviceCONNECT.
Order number 5.29.169

Preperation PVT-measurement
For later retrofitting of the PVT measurement at a new RHEOGRAPH.
Order number 5.29.1040

Capillary quick-lock-system

Required to close and release the capillary for PVT- and Thermal Conductivity measurements (essential option at PVT- and Thermal Conductivity measurement).
If PVT and Thermal Conductivity Measurement are ordered together, the capillary quick-lock-system is necessary only one time.
Consisting of capillary locking device, cross bar, blind piece, lockable PVT-capillary and arresting clip for piston reception

RHEOGRAPH 20

For 1-barrel-system
Order number 5.30.512

For 2-barrel-system
Order number 5.30.513

RHEOGRAPH 25, 50, 75, 120

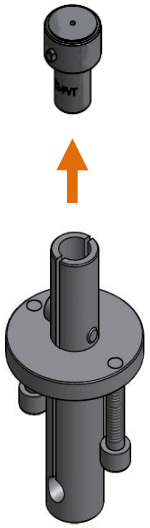
For 1-barrel-system
Order number 5.29.621

For 2-barrel-system
Order number 5.29.623

For 3-barrel-system
Order number 5.29.860

Removal tool for PVT-Capillary

For easy removing of PVT-Capillary with strongly adhering test materials.



Removal tool for PVT-Capillary
Order number 5.32.295

Die Swell Measurement

To detect the static or dynamic die swell value by measuring the strand diameter of the extruded sample.

- Dynamic and static measurement
- Analysis of swell profile
- Swivelling arm with height adjustable mount
- Laser measurement head in standard resolution with 0.44 µm (micrometer)
  or with the high resolution system 0.1 µm
- Optional with melt cutting system

At 2- or 3-test-barrel systems only one test barrel can be used for measuring the die swell.

RHEOGRAPH 20, 25, 50, 75, 120

Die Swell Tester, standard resolution
to determine the static and dynamic die swell by measuring the diameter of the extruded strand about 60 mm below the capillary end (e.g. with capillary L/D=40/2), installed below the test chamber.
Consisting of:

- Laser measuring head: Laser diode class 2 (670nm), resolution 0.44 µm
- Operating range 28 mm, measuring range 0.15 up to 28 mm, repeatability ± 3 µm
- Swiveling arm with adjustable height for reception of laser measuring head and melt cutting unit. Adjustment range: approx. 80 mm.
- Measuring distance of die swell measurement from the lower edge of capillary (L=30 mm) until the measurement point: min. 77 mm to max. 240 mm (RG25-120); min. 75 mm to max. 199 mm (RG20)

Power supply and data acquisition by means of the instrument.
Order number 5.29.608

Die Swell Tester, high resolution
to determine the static and dynamic die swell by measuring the diameter of the extruded strand about 40 mm below the capillary end (e.g. with capillary L/D=40/2), installed below the test chamber.
Consisting of:

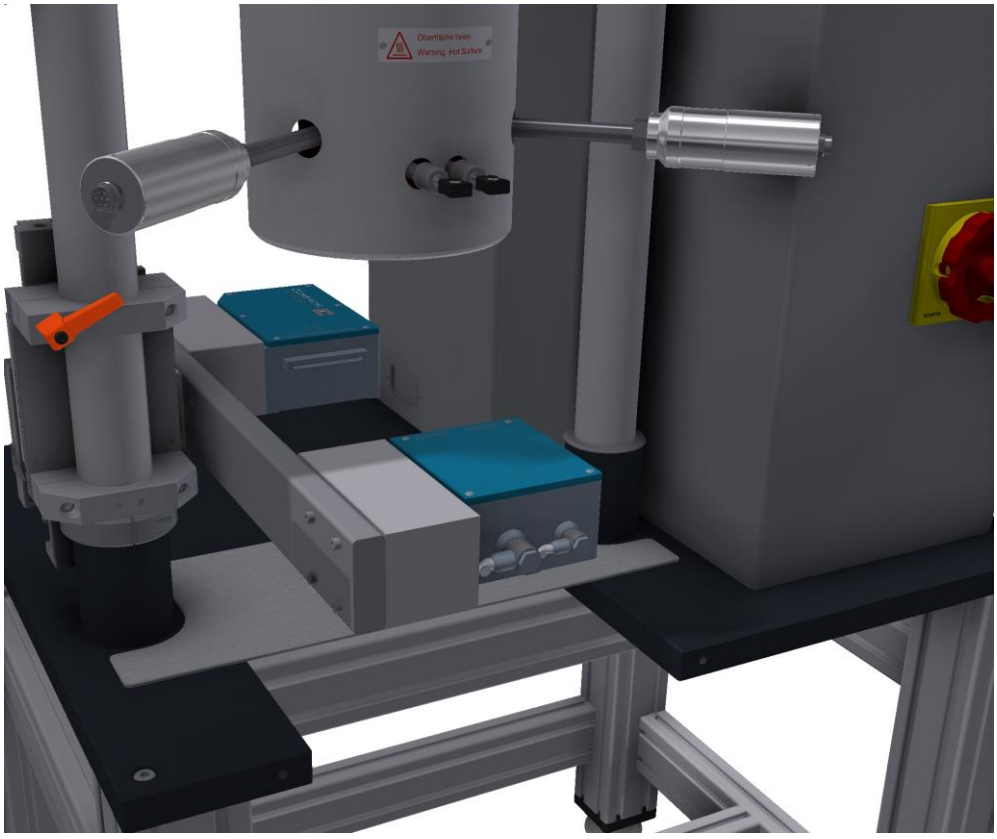
- Laser measuring head: laser unit class 2 (630-680 nm, power < 1 mW), resolution 0.1 µm
- Operating range 32 mm, measuring range 0.2 up to 32 mm, repeatability ± 0.2 µm
- Swiveling arm with adjustable height for reception of laser measuring head and melt cutting unit, Adjustment range: approx. 80 mm.
- Measuring distance of die swell measurement from the lower edge of capillary (L=30 mm) until the measurement point: min. 71 mm to max 239 mm (RG25-120); min. 64 mm to max. 198 mm (RG20)

Power supply and data acquisition by means of the instrument.
Order number 5.29.800

Die Swell Tester, high resolution (Double strand)
to determine the static and dynamic die swell by measuring the diameter of the extruded strand about 40 mm below the capillary end (e.g. with capillary L/D=40/2), installed below the test chamber.
Consisting of:

- Laser measuring head: laser unit class 2 (630-680 nm, power < 1 mW), resolution 0.1 µm
- Operating range 32 mm, measuring range 0.2 up to 32 mm, repeatability ± 0.2 µm
- Swiveling arm with adjustable height for reception of laser measuring head and melt cutting unit, Adjustment range: approx. 80 mm.
- Measuring distance of die swell measurement from the lower edge of capillary (L=30 mm) until the measurement point: min. 71 mm to max 239 mm (RG25-120); min. 64 mm to max. 198 mm (RG20)

Power supply and data acquisition by means of the instrument.
Order number ..... on request



Note for RHEOGRAPH 20: If you want to combine the options "die swell tester" and "HAUL-OFF", the "sliding table for die swell tester and Haul-Off" (see `Table´ in this product description) is a mandatory option!

Melt Cutting Unit

The pneumatic driven melt cutting unit is used for cutting off the out-flowing melt strand. The melt cutting unit is an additional option to the die swell tester, which helps to achieve a better reproducibility of the test data. The construction of the melt cutting unit is based on two counter-running knifes which work like scissors.

Note:
The melt cutting unit is generally used for a testing of shear rates up to 100 1/s.
The usuage of higher shear rates can only be guaranteed for samples, whose suitability were tested in our application laboratory. Therefore an air connection with quick connect coupling NW9 and 4-6 bar is necessary. The compressed air has to be oil and water free.

RHEOGRAPH 20, 25, 50, 75, 120

Melt Cutting Unit with Pneumatic Drive
high resolution (5.29.800),
the release of the cutting off procedure is software controlled.
Order number 5.29.377

Melt Cutting Unit with Pneumatic Drive
standard resolution (5.29.608),
the release of the cutting off procedure is software controlled.

Order number 5.29.541

Counter Pressure Chamber to measure pressure dependant viscosity

Process conditions in production of plastics and rubber (such as injection molding, extrusion with long deformation paths, pump flow, etc.) often occur under high pressures. Here, viscosity often shows its pressure dependency. The new Counter Pressure Chamber can be adjusted to simulate different pressure drops, thereby measuring the viscosity close to process conditions. An additional heating circuit is required for this option (see `Additional Heating Circuits´ in this product description).

- Detection of pressure coefficient
- Detection of wall slip's critical shear rate
- Max. Pressure (Pm) 120 MPa

Details and closer information you will find in the separate product description "Counter Pressure Chamber to measure pressure dependent viscosity".

Nitrogen Purge Unit

To attach to the feeding bore of the test chamber.
Consisting of a clamp ring with connection part for the nitrogen gas.
The testing material has to be conditioned and fed by the customer.

All nitrogen purge units are incl. pressure controller.

Please note that the nitrogen must be provided by the customer.

RHEOGRAPH 20

1 barrel system and 2 barrel system / Ø 4
Order number 5.30.5014

RHEOGRAPH 25, 50, 75, 120

1 barrel system
for RHEOGRAPH 25, 50, 75 and 120 / Ø 4
Order number 5.29.1070

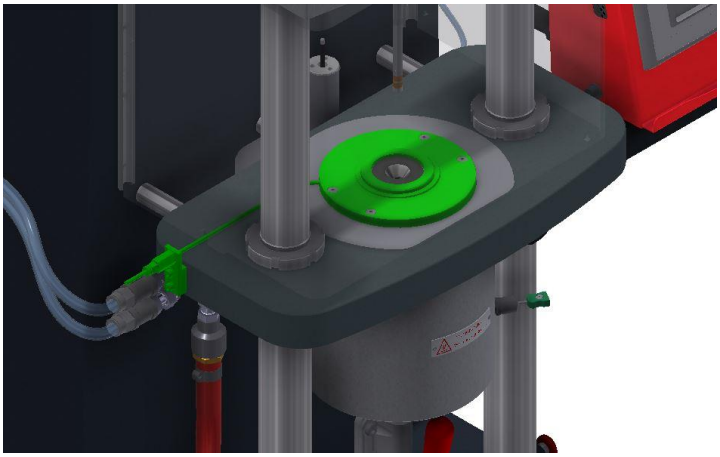
2 barrel system
for RHEOGRAPH 25, 50, 75 and 120 / Ø 6
Order number 5.29.1071

3 barrel system
for RHEOGRAPH 25, 50, 75 and 120 / Ø 6
Order number 5.29.1072

PVT 500

Nitrogen Purge Unit for PVT 500

Note that the min. inlet pressure is 0.3-3 bar.



Order number 5.33.513

Test Piston

Details and closer information you will find in the separate product description "RHEOGRAPH Test Piston".

Test pistons can be equipped with seal rings.

Note:

- all seal rings are wear parts
- the lifetime of such seal rings depend on the application conditions
- it is possible that a seal ring can be used only one time for a measurement
- if a seal ring is torn out after a measurement, the test results of this measurement are valid anyhow.

Slit Capillary

With the slit capillary the pressure difference is determined with the following equation:

$\Delta P = P_{ent} - P_{exi}$

P_{bef}: Test pressure before the capillary
P_{ent}: Test pressure in the inlet of capillary
P_{mid}: Test pressure in the middle of capillary
P_{exi}: Test pressure in the outlet of capillary

With the pressure transducer P_{mid} (option) it is possible to say whether the viscosity of the material is dependent on pressure or not. The viscosity is pressure dependent, if the pressure decrease of the capillary is non-linear. Furthermore, when using P_{mid} the elastic pressure loss at the inlet ΔPe can be more accurately calculated.
The real shear stress is calculated with the pressure difference ΔP under consideration of the gap width and the distance of the pressure transducer.
The direct acquisition of the real wall shear stress with the slit capillaries saves a lot of time compared to several tests with round hole capillaries and following Bagley correction.

Dimensions of slit capillary:
Slit width: 10 mm; Slit height: 0.5 mm, 1 mm or 2 mm; Slit length: 100 mm; Inlet length: 30 mm; Outlet length: 20 mm
Distance of pressure transducer:
P_{ent} - P_{exi}: 50 mm, P_{ent} - P_{mid}: 25 mm, P_{mid}- P_{exi}: 25 mm
Thread: ½"–20 UNF (or M18x1.5).

To use a slit capillary following options are required:
Slit capillary – basic part, depending of basic device configuration also an adapter, slit capillary with slit height 0.5 and/or 1 and/or 2 mm as well as an additional heater circuit (see `Additional Heating Circuits´ in this product description).
Please note that in principle the slit capillary is not suitable for all materials. Furthermore, the accessible shear rate range of the slit capillary is limited compared to the accessible shear rate range of the round hole capillaries.

Only for Test Chamber Design (1 - Barrel)
The slit capillary can be equipped with 3 pressure transducers and 2 thermocouples (FeCo) for test temperature measurement.

Basic part

Slit capillary basic part RHEOGRAPH 20
Order number 5.30.516

Slit capillary basic part RHEOGRAPH 25, 50, 75, 120 (all test barrel systems)
Only for 400 °C
Order number 5.29.381

Slit capillary basic part RHEOGRAPH 25, 50, 75, 120 (all test barrel systems)
Only for 500 °C
Order number 5.32.147

Adapter for RHEOGRAPH 25, 50, 75 and 120

Adapter for slit die at single barrel system and D= 15 mm
Only for 400 °C
Order number 5.29.822

Adapter for slit die at single barrel system and D= 15 mm with tempering jacket (VA)
Only for 400 °C
Order number 5.29.866

Adapter for slit die at 2-/3-test barrel system and D= 15 mm
Only for 400 °C
Order number 5.29.692

Adapter for slit die at 2-/3-test barrel system and D= 15 mm
Only for 500 °C
Order number 5.32.149

RHEOGRAPH 20, 25, 50, 75, 120

Slit capillary
Capillary part with 0.5 mm slit height, only for 400 °C
Order number 5.29.382

Slit capillary
Capillary part with 1.0 mm slit height, only for 400 °C
Order number 5.29.383

Slit capillary
Capillary part with 2.0 mm slit height, only for 400 °C
Order number 5.29.384

Slit capillary
Capillary part with 1.0 mm slit height, only for 500 °C
Order number 5.32.148

Heater element up to operation temperature 400 °C
With reflector jacket for slit capillary.
Order number 5.29.385

Heater element up to operation temperature 500 °C
With Reflector jacket for slit capillary.
Order number 5.29.386

Thermocouple for Slit Capillary
Thermocouple with holder and socket suitable for slit die for measuring the melt temperature.
Length: 87 mm, diameter: 1 mm, type: iron-constantan
Order number 5.13.650

Thermocouple

RHEOGRAPH 20, 25, 50, 75, 120

The following thermocouples can be used to measure the melt temperatures up to 500 °C in the round hole capillaries. There are four inputs for thermocouples available.

Thermocouple with holder and screwing, suitable for round hole capillaries to measure the melt temperature.
Length: 87 mm, diameter: 1 mm, type: iron-constantan

Thermocouple for Test Chamber Design 1
Order number 5.29.559

Thermocouple for Test Chamber Design 2
and Single barrel system with tempering jacket (VA)
Order number 5.29.537

Thermocouple for Test Chamber Design 3
for RHEOGRAPH 75 and 120
Order number 5.29.537

Temperature control

Measuring instrument (standard calibration base points) without measuring scale
This set consists of the following components:

- Precision measuring instrument
- Special sensor Pt100
- Clamping sleeve
- Sensor tip
- Centering

Order number 6.88.017

Measuring instrument (specific base points) without measuring scale
This set consists of the following components:

- Precision measuring instrument
- Special sensor Pt100
- Clamping sleeve
- Sensor tip
- Centering

The specific base points (max. 5) must be specified when ordering!
Order number 6.88.1003

Spare parts for temperature control

Clamping sleeve
Order number 5.46.011

Tip reception
Order number 5.46.032

Centering
Order number 5.46.031

Precision measuring instrument
Order number 8.86.106

Special sensor Pt100
Order number 8.86.108

Important
If an existing precision measuring instrument with a new special sensor Pt100 is to be used, the precision measuring instrument must first be sent to us for recalibration. This also applies if an existing special sensor Pt100 is to be equipped with a new precision measuring instrument.

Recalibration of the precision measuring instrument

Reccalibration for 5 calibration base points of the precision instrument

5 calibration base points:

standard: K1: 190 °C
K2: 230 °C
K3: 275 °C
K4: 300 °C
K5: 500 °C

For calibration the customer has to send the measuring instrument with special sensor Pt100 to GÖTTFERT free of charge:

GÖTTFERT Werkstoff-Prüfmaschinen GmbH
Siemensstraße 2
74722 Buchen (Odenwald)

The costs for return shipment have to be borne by customer.

Order number 6.88.020

Reccalibration for 5 customer-specific calibration base points of the precision instrument
The specific base points (max. 5) must be specified when ordering!
Order number 6.88.1004

Tip for test barrel

The measuring instrument is delivered without test tip! The necessary test tip must be ordered separately.

Tip for test barrel D=9,5 mm
Order number 5.46.026

Tip for test barrel D=12,0 mm
Order number 5.46.027

Tip for test barrel D=15,0 mm
Order number 5.46.028

Further test tips on request.

External Tempering

High Temperature Circulator (Thermostat)

Powerful High Temperature Circulator for working ranges up to +400 °C.

Suitable

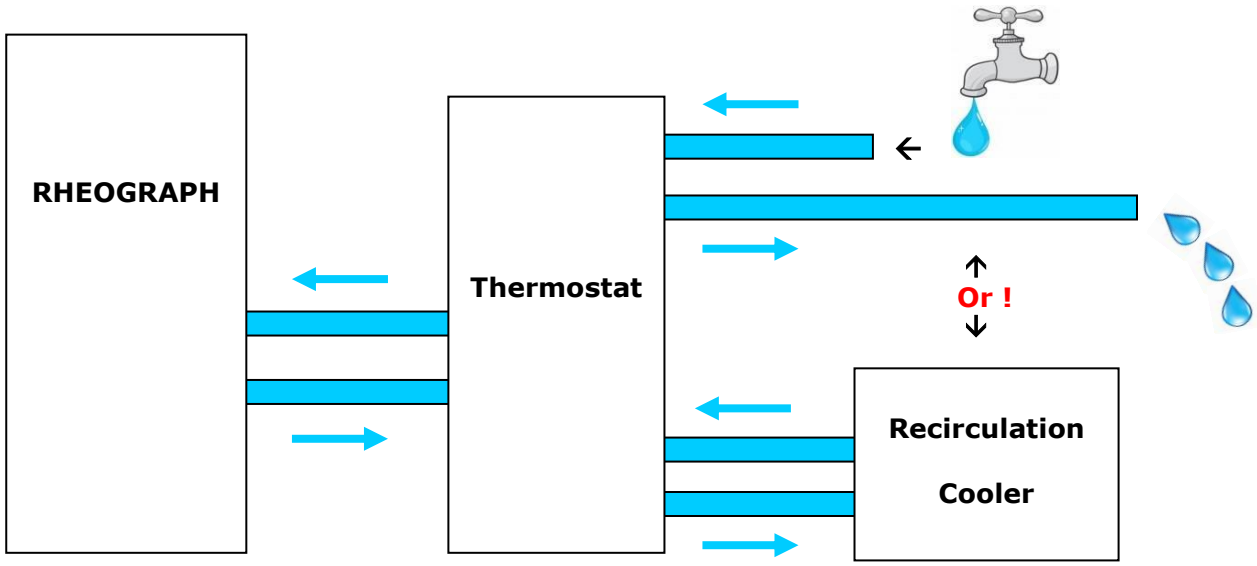
- for heating and cooling of the tempering jacket around the test chamber at the **RHEOGRAPH 20, 25, 50, 75, 120**

Description:

The thermostat can be used for constant cooling rates for isobaric pVT measurements according to ISO 17744 as well as for faster lowering the test chamber temperature when performing viscosity or isothermal pVT measurements (also ISO 17744). The set temperature is being transmitted via the software of the test device or directly onto the control unit display of the thermostat. The controlling of the temperature is completely managed by the thermostat, the measuring of the test chamber temperature is detected by a thermocouple (optional).
The thermostat can also be used for a faster cooling down rate of the test chamber during thermal conductivity measurements.
To control the temperature of the high power thermostat a fresh water supply with a pressure of 0.5 to 6 bar is needed on installation site as well as a waste water connection.
Alternatively an external circulation cooling unit can be used instead. This will conserve environmental resources.

*
Caution! Please take note for the permissible temperature range of the used tempering liquid.
The standard scope of supply consists heat transfer liquid with an application temperature range from +20 °C … +350 °C.

Principle view of the external temperature control for a RHEOGRAPH:



Note:
Concerning the Recirculation Cooler please see more information in the chapter "Recirculating Cooler".

Your advantages

- Working temperature range up to +400 °C
- Bright LCD display
- Self-optimizing temperature controller
- Automatic air-purge allows easy filling
- Automated heat-up feature adjusts to external systems
- Completely sealed, so no oil fumes even at high temperatures
- Electronic level indication

Technical data

Working temperature range	**+40 ... +400 °C**
Temperature stability	±0.01-0.1 °C
Setting / display resolution	0.01 °C
Heating capacity	**3 kW**
Cooling capacity	with tap water 20°C up to **15 kW**
Pump capacity flow rate	**14-18 l/min**
Pump capacity flow pressure	**11.6-17.4 / 0.8-1.2 psi/bar**
Filling volume	2 l
External Pt100 sensor connection	integrated
Ambient temperature	5...40 °C
Dimensions W x L x H	43 x 23 x 58 cm
Weight	35 / 77 kg/LBS

Please note the limited temperature range due to the selected thermal liquid.

Scope of supply:
Thermostat with hose connection, heat transfer liquid (+50…+350 °C), installation platform as well as data cable for set value transfer from the PC.

RHEOGRAPH 25

Thermostat (230 V / 50 Hz (!) design)
Power supply 1x 230 V (207-253 V), 50 Hz
Order number 5.32.200

Thermostat (230 V / 60 Hz (!) design)
Same version as 5.32.200, but in 60 Hz version.
Note: Due to power supply tolerances of +/- 10% at a **200** V power supply the 207 volts can fall below a limit. Therefore we recommend a transformer box (see chapter Accessories)
Order number 5.32.010

RHEOGRAPH 50

Thermostat (230 V / 50 Hz (!) design)
Power supply 1x 230 V (207-253 V), 50 Hz
Order number 5.32.410

Thermostat (230 V / 60 Hz (!) design)
Same version as 5.32.200, but in 60 Hz version.
Note: Due to power supply tolerances of +/- 10 % at a **200** V power supply the 207 volts can fall below a limit. Therefore we recommend a transformer box (see chapter Accessories)
Order number 5.32.413

RHEOGRAPH 75, 120

Thermostat (230 V / 50 Hz (!) design)
Power supply 1x 230 V (207-253 V), 50 Hz
Order number 5.30.410

Thermostat (230 V / 60 Hz (!) design)
Same version as 5.30.410, but in 60 Hz version.
Note: Due to power supply tolerances of +/- 10 % at a **200** V power supply the 207 volts can fall below a limit. Therefore we recommend a transformer box (see chapter Accessories)
Order number 5.30.411

RHEOGRAPH 20

Thermostat (230 V / 50 Hz (!) design)
Power supply 1x 230 V (207-253 V), 50 Hz
Order number 5.30.906

Thermostat (230 V / 60 Hz (!) design)
Order number 5.30.946

Spare Heat transfer liquid
5 liters, this quantity is already included in the delivery.
Permissible temperature range +50 °C...+350 °C
Order number 4.52.706

Recirculating Cooler

Suitable

- for cooling the **High Temperature Circulator** (5.32.200 / 5.32.010) at the RHEOGRAPH, it replaces the fresh drinking water connection, because the tempering fluid circulates constant in a closed system.

Your advantages

- Ergonomic design and easy operation by large, bright LED display
- Reliable Microprocessor PID temperature control
- Filling level indicator
- Permissible temperature in return line +80 °C
- Low liquid level protection with optical and audible alarm signal
- Removable venting grid for cleaning of the condenser
- Pressure Indicator
- By-pass valve to adjust pump pressure

Technical data

Working temperature range	**-20 ... +40 °C**
Temperature stability	±0.5 °C
Setting / display resolution	0.1 °C
Cooling capacity (Medium Ethanol)	+20°C 1.7 kW, 0°C 1 kW, -20°C 0.3 kW
Pump capacity flow rate	**40 l/min**
Pump capacity flow pressure	**7.25...43.51 / 0.5-3.0 psi/bar**
Filling volume	12 ... 17 l
Ambient temperature	5...40 °C
Dimensions W x L x H	19.7 x 29.9 x 25.2 / 50 x 76 x 64 inch/cm
Weight	201 / 91 LBS/kg
Cooling of compressor	Air

RHEOGRAPH 20, 50, 25, 75, 120

Recirculating Cooler (230 V / 50 Hz (!) design),
including connection technology and heat transfer liquid, please see more details in chapter "High Temperature Circulator (Thermostat)"
Order number 5.29.184

Recirculating Cooler (230 V / 60 Hz (!) design)
Same version as 5.29.184, but with power supply 1x 230 V (207 - 253 V), 60 Hz, current load at 230 V = 11 A.
Note: Due to power supply tolerances of +/- 10 % at a 200 V power supply the 207 volts can fall below a limit. Therefore we recommend a transformer box (see chapter Accessories)
Order number 5.32.011

Spare Heat transfer liquid
20 litres, this quantity is already included in the delivery.
Permissible temperature range -30 °C...+80 °C
Order number 4.52.725

Power supply (Trafo-Box) for Recirculating Cooler / Thermostat

A separate power supply (trafo box) is required, when the rated voltage is not suitable for a Thermostat / Recirculating Cooler (mostly country depending).

Power supply 200 V, 50-60 Hz for circulation cooler and/or thermostat
Pre-transformator in small control cabinet with separate main switch and electrical installation, completely ready to run. The box will be placed on the side of the RHEOGRAPH 20, 25, 50, 75 or 120.
Input 200 V, 50-60 Hz, output 230 V, 50-60 Hz, max. current load 26,1 A, 2x protective contact sockets
Dimensions: 500 x 500 x 300

Order number 5.29.1008

Further Trafo boxes with different power supply voltages and installation possibilities on request.

Note

Danger of corrosion of heat exchanger due to unsuitable quality of cooling water.

If one or more criteria concerning the water quality are relevant, we recommend the use of a circulation cooling unit. There will not be any guarantee /warranty services for damages caused by disregarding the specifications. The quality limit values can be sent to on request.

- Due to its high content of lime, hard water is not suitable for cooling and causes scale in the heat exchanger
- Ferrous water or water containing ferrous particles will cause formation of rust even in heat exchangers made of stainless steel
- Chlorinated water will cause pitting corrosion in heat exchangers made of stainless steel
- Due to their corrosive characteristics, distilled water and deionized water are unsuitable and will cause corrosion of the bath
- Due to its corrosive characteristics, sea water is not suitable
- Due to its microbiological (bacterial) components, which settle in the heat exchanger, untreated and unpurified river water and water from cooling towers is unsuitable
- Avoid particulate matter in cooling water
- Avoid putrid water

Air-Cooling system

Air cooling system to cool down the test chamber
Can only be used with a RHEOGRAPH with a 1 or 2-test barrel system!

Applicable for cooling of the tempering jacket around the test chamber at the Rheograph. Can be used for controlled cooling rates for isobaric PVT measurements according to ISO 17744 as well as for faster lowering the test chamber temperature when performing viscosity or isothermal PVT measurements (also ISO 17744).

The cooling is activated by script and controlled by an algorithm in RG device.

Compressed air supply is required:
- purity level ISO 8573-1 (6:4:4)
- Temperature -5 to 50 °C
- Flow rate approx. 1000 l/min
- Pressure 6 bar

RHEOGRAPH 20

Order number 5.30.5010

RHEOGRAPH 25, 50, 75, 120

Order number 5.32.414

Gas-Aspiration

During measurement it is possible that health concern gases can be occurring (depends of temperature and test material). To reduce this considerably, we recommend the use of aspiration, possibly with filter system. The exhaust connection has a diameter of 79.5 mm and the room volume behind the protection hood above the test chamber is approx. 55 dm³.

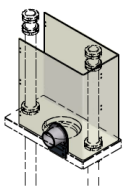
RHEOGRAPH 20

Exhaust tube
for external aspiration of gases, smokes, … in the top test chamber area

Order number 5.30.805

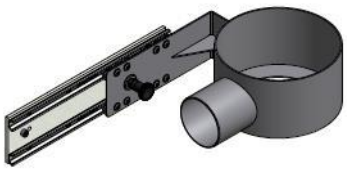
RHEOGRAPH 25, 50

Aspiration connection complete
for external aspiration of gases, smokes, … in the top test chamber area.



Order number 5.32.094

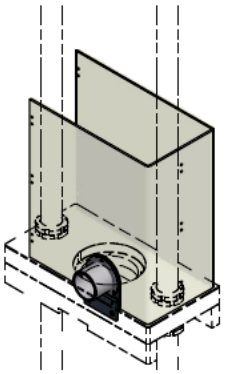
Aspiration ring with tube connection, bottom position
for external aspiration of gases, smokes, … in the bottom test chamber area. The aspiration ring can be moved backwards for cleaning or installation works.



Order number 5.29.119

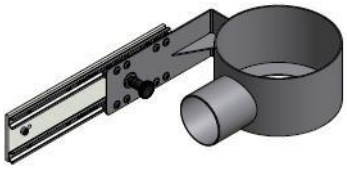
RHEOGRAPH 75

Aspiration connection complete
for external aspiration of gases, smokes, … in the top test chamber area.



Order number 5.29.214

Aspiration ring with tube connection, bottom position
for external aspiration of gases, smokes, … in the bottom test chamber area. The aspiration ring can be moved backwards for cleaning or installation works.



Order number 5.29.119

Aspiration and filter unit
for aspiration of gases, smokes and humid and sticky dusts in the top and bottom test chamber area. Effective air volume stream 30…480 m^3/h, multi step filter system (incl. activated carbone filter), max distance to aspiration point about 12 m, aspiration ports: 2x NW50, 1x NW80, 1x NW125, completely with filter elements as well as tube connectors (5.29.128 und 5.29.119), power supply cable and 4 wheels for movable use, electronic control, weight about 90 kg, size HxWxD 1010x350x655 mm, power supply 230 V / 50 Hz.

Order number 5.29.120

PVT 500

Gas aspiration for PVT 500

for external aspiration of gases, smokes, … in the top test chamber area.
The exhaust connection has a diameter of 70 mm and the room volume behind the protection hood above the test chamber is approx. 80 dm³.

Order number ..... on request

Cleaning

Semi automated cleaning devices

With the following cleaning tools the cleaning of the test barrel can be performed faster and easier as when comparing to the manual cleaning devices, especially for hard and sticky testing materials.

Angled cleaning device (accu-driven)
For an easy cleaning of the test barrel. A coupling to attach the cleaning sets is integrated:
Technical data:

- 12 V nominal voltage
- 0-800 min-1 idling speed
- Torque 12 Nm
- Clock/counter clock wise rotation
- Overload protection
- Weight 1.1 kg

The delivery contains:

- 1 Accu charger 220-240 V
- 2 Spare accumulators 12 V; 1,5 Ah
- 1 Coupling

Order number 5.11.180

Angled Cleaning device (accu-driven)
Identical with order number 5.11.180, but in 115 V design.
Order number 5.11.181

Pneumatic cleaning device
Manually use, air driven rotary cleaning tool for quick and easy cleaning of the test barrel. The device needs a compressed air supply of 4-6 bar (oiled and water free).
Technical data: Idle speed 2000 rpm, Power 300 watt, weight 0.62 kg
Including air hose (about 1,5 m) and quick connect coupling
Order number 5.11.082

Maintenance unit (for pneumatic cleaning device)
2-fold, consisting of 2 m compressed air tube with 1/4" thread connection, filter controller for pressure range from 0.5-12 bar and filter 40 ym with semi automated condensate drain, oiler with 90 cm3 filling volume and 2-fold coupling unit NW 7,2 for connecting 2 cleaning units, throughput: max. 1660 l/min, input pressure 0.8-14 bar, temperature range: -10 to +60 °C, medium: oiled and unoiled compressed air, oil dosing: 1 to 2 drops/min at 1000 l/min
Order number 5.21.180

Cleaning Set

Consisting of the cleaning tools cleaning brush and cleaning piston for the cleaning of test barrel with respectively one hinge part, suitable for the battery cleaning device or for the pneumatic cleaning device.

Cleaning tools

Cleaning brush with coupling part
Steel version, for the pre-cleaning of the test barrel, with coupling part for the pneumatic cleaning device and the angled cleaning device (accu driven)

Cleaning piston
Brass brush with hinge part, for cleaning the test barrel with the cleaning tape or the tape blanks. The delivery contains also the coupling part, as well as the insert with spin for the pneumatic cleaning device and the angled cleaning device.

Cleaning set for 9.55 mm test barrel
Order number 5.11.135

Cleaning set for 12 mm test barrel
Order number 5.11.136

Cleaning set for 15 mm test barrel
Order number 5.11.137

Cleaning set for 20 mm test barrel
Order number 5.11.166

Cleaning set for 25 mm test barrel
Order number 5.11.161

Cleaning set for 30 mm test barrel
Order number 5.11.159

Cleaning Set consumables

Cleaning brush (steel)

Ø 12 mm, made from soft steel, which does not damage the test barrel, consumable material for 5.11.135
Order number 4.50.302

Cleaning brush (steel)
Same design as 4.50.302, but with Ø 15 mm
Order number 4.50.303

Insert with spin

Ø 12 mm, complete made from brass material, cleaning tool for canvas cloths, consumable material for 5.11.135
Order number 5.11.061

Hinge part D = 12 mm
Spare part, without brush or spin insert, Ø 12 mm
Order number 5.11.060

Cleaning tape and cut pieces

Cleaning tape (nature)

Recommended for all RHEOGRAPH devices for cleaning of standard polymers.

- Material: 100 % cotton, nature, coil design
- Rough surface structure
- Width 50 mm, length 100 m
- Thickness approx. 0.4 mm
- Maximum temperature influence: 350 °C
- Maximum residence time at Tmax: 5 seconds

Order number 4.50.749

Cleaning tape (nature, soft)

Identical as 4.50.749, but design „soft"
The tape design is a bit softer and more suitable for specific testing materials.

- Material: 100 % cotton, nature, coil design
- Rough surface structure
- Width 50 mm, length 100 m
- Thickness approx. 0.4 mm
- Maximum temperature influence: 350 °C
- Maximum residence time at Tmax: 5 seconds

Order number 4.50.764

Steel wool
Recommended for cleaning specific testing materials in temperature ranges, where the upper described cotton material can not be used anymore.

- Very elastic, long-fibered and tear resistant
- Not damage to the test barrel
- Maximum temperature influence: 500 °C
- Maximum residence time at Tmax: 20 seconds

Order number 1.43.112

Cleaning brush

Cleaning brush D10

The cleaning brush D10 mm can be used to clean the side placed bore of the pressure transducer of the test barrel. The shaft is put into the bayonet holder of the angled cleaning device (accu-driven) (respectively of the pneumatic cleaning device). The rotation movement rubs the residual material out of the bore. For support a piece of cleaning tape can be put between.

Order number 5.07.119

Cleaning brush D22

The cleaning brush D22 mm can be used to clean the bore of the die reception at the lower end of the test barrel. The shaft is put into the bayonet holder of the angled cleaning device (accu-driven), respectively of the pneumatic cleaning device. The rotation movement rubs the residual material out of the bore. For support a piece of cleaning tape can be put between.

Order number 5.07.152

Die cleaning tool

For an easier cleaning of the capillary bore of a RHEOGRAPH die we recommend the burning out of the material in an oven at max. 500°C. Afterwards the residual material can be removed with the help of the die cleaning tool (tool holder with drill).
Some testing materials, as for example PE or PP probably can be cleaned directly by drilling out the cold residual testing material. A warming in an oven is not absolutely required.

Drill HSS D=1,0 mm
The drill can be fixed into the tool holder

Order number 1.10.171

Drill HSS D=0,9 mm
Order number ..... on request

Drill HSS D=1,5 mm
Order number 1.10.162

Drill HSS D=2,0 mm
Order number 1.10.172

Other drill sizes on request.

Tool holder for drill
Tool holder for the HSS drill
Clamping range >0 to max. 1.0 mm.

Order number 4.56.204

Tool holder for the HSS drill
Clamping range >1 to max. 2.0 mm.

Order number 4.56.119

Further cleaning utensils on request

Cleaning tool for the die surface

With this cleaning tool the die surface can be cleaned during installed die.

Cleaning tool – front surface D=12 mm
Order number 5.13.990

Cleaning tool – front surface D=15
Order number 5.13.991

PC, Printer and Accessory

For visualization and for the operation of GOETTFERT testing devices personal computers (PC's), with the Microsoft Windows® operating system, are used.

Details and closer information you will find in the separate product description "PC Specifications for GOETTFERT systems".

Table

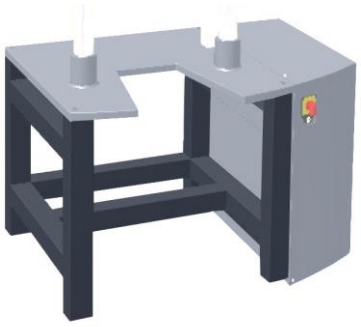
Note:
At option „machine table" (stationary system) the machine feet are not needed.
When selected the "table top design" please order here the machine feet separately (4 pieces):

Machine feet

Machine foot
For stepless height adjustment, please order 4 pieces

Order number 5.11.007

Machine table (RHEOGRAPH 20)
For reception of the RHEOGRAPH 20.
The RHEOGRAPH is screwed tight with the machine table.
The table is made of powder-coated steel profile.
Width: 600 mm, Depth: 600 mm, Height: 530 mm



Order number 5.30.710

Machine table (RHEOGRAPH 25 or 50)
For reception of the RHEOGRAPH 25 and 50.
The RHEOGRAPH is screwed tight with the machine table.
The table is made of anodized aluminium beams
Width: 790 mm, Depth: 600 mm, Height: 620 mm

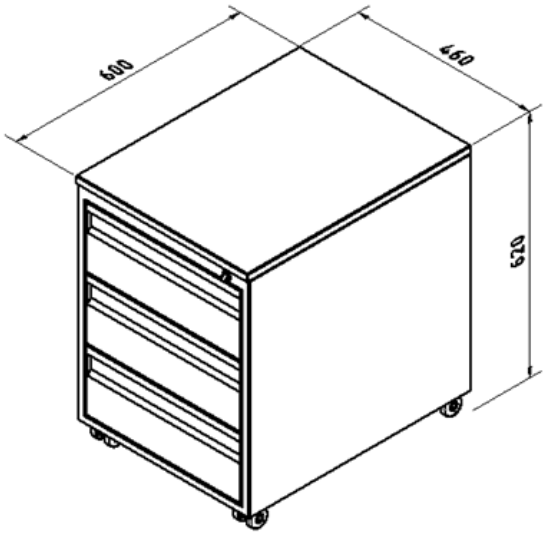
Order number 5.32.170

Machine table (RHEOGRAPH 75)
For reception of the RHEOGRAPH 75
(photo see machine table RHEOGRAPH 25 and 50).
The RHEOGRAPH is screwed tight with the machine table.
The table is made of anodized aluminium beams
Width: 790 mm, Depth: 700 mm, Height: 620 mm
Order number 5.30.409

Machine table (RHEOGRAPH 120)
The machine table is already part of the basic device delivery.

Roll container

- Mobile container with roll with 3 drawer
- Drawers fully extendable by means of stable telescopic slides
- Central lockable, including 2 keys
- Material steel, color light grey RAL 7035
- Width 460 mm / height 620 mm / depth 600 mm



RHEOGRAPH 25, 50, 75, 120
Order number 4.51.160

PC Table see separate product description "PC Specifications for GÖTTFERT systems".

Sliding table for RHEOTENS (RHEOGRAPH 20)
For reception of the RHEOTENS equipment.
RHEOTENS see separate product description.

Order number 5.30.517

Sliding table for RHEOTENS (RHEOGRAPH 25, 50, 75, 120)
For reception of the RHEOTENS equipment (photo see Sliding table RHEOGRAPH 20).
RHEOTENS see separate product description.
Order number 5.29.332

Sliding table for die swell tester and Haul-Off (Only for RHEOGRAPH 20)
If you combine the die swell tester and the Haul-Off this table is a mandatory option.

Order number 5.30.940

Automatic Protection Hood Locking

Automatic Protection Hood Locking
When starting a measurement the protection hood is being fixed in the closed position (held by a magnetic switch) until the end or the manual break.
Order number 5.29.738

Additional emergency-stop button

Additional emergency stop button
The main switch performs the function of an emergency stop button.
Due to increased customer demands for example triggering of the emergency stop button via a push button this requirements can be fulfilled by the option „additional emergency stop button. The test piston drive stops immediately, but the device remains in operation.
The heaters work on to prevent freezing of the test material.

Only for RHEOGRAPH 20
Order number 5.30.558

Only for RHEOGRAPH 25, 50, 75, 120
Order number 5.70.631

External additional heating circuit

Additional heating circuit for RHEOGRAPH 20, 25, 50, 75, 120
Necessary option, if one of these options are chosen:

- Slit Capillary
- Counter pressure chamber
- Shark-Skin

Order number 5.29.871

External additional heating circuit

Can be used, when an additional heating circuit is required (e.g. if counter pressure chamber is used or for additional delivery of various application); digital temperature controlling from 0…400 °C; adaptable to the control system; self optimizing; 4 pole socket for 1x Pt100 temperature sensor (not included in the delivery); power supply 100…240 VAC (with 5 A melt fuse); Power supply cable
Order Number 6.81.015

Uninterrupted Power Supply (UPS)

UPS buffering system, used for bridging power fails in the main supply to save measurement values and controlled shut down the software of the test device.

Note: In this condition, the test device is not able to start or perform further measurements! Current measurements are aborted!

Please note that the batteries in the UPS buffer system have a different lifetime depending on the ambient temperature.

Uninterrupted Power Supply (30 minutes)

Battery runtime (approx.)
- at 20 °C 4 years
- at 30 °C 2 years
- at 40 °C 1 year
- at 50 °C 0,5 year

Order number 6.90.008

Battery runtime (approx.)
- at 20 °C 15 years
- at 30 °C 10 years
- at 40 °C 9 years
- at 50 °C 2 years

Order number 6.90.010

Signal lamp

The signal lamp is mounted on the control cabinet of the RHEOGRAPH. It indicates the states of the RHEOGRAPH at any moment.

Signal lamp
Colors: red, yellow and green.

Only for RHEOGRAPH 20
Order number 5.30.2023

Only for RHEOGRAPH 25, 50, 75, 120
Order number 5.29.1220

Accessories

Reference material

Reference material
PE granules M80064 (1 kg) for checking and verification of the correct test data acquisition.

The delivery includes the specification for melt index testing devices as well as the one for the high pressure capillary rheometer.

Order number 4.58.302

Heat protecting gloves and safety glasses

Heat protecting gloves
Heat isolation up to 350 °C, high cut resistance.

Size 7
Order number 1.44.218

Size 9
Order number 1.44.217

Safety glasses
Very comfortable to wear, good adaptability by multi adjustability, glass made from high-impact polycarbonate, colour: orange/dark blue

Order number 1.40.131

Service platform serviceCONNECT

serviceCONNECT is a platform for your GÖTTFERT testing instrument. The service solution enables our users to send service requests for the test equipment to the GÖTTFERT customer service quickly, easily and specifically.
After a simple registration you will have an insight into many service topics around your testing device and will benefit from our High Quality Service.

- Preferred service processing
- Quick and easy registration of your test device
- Easy and fast communication with chat and video function
- Direct line to our service experts
- Documents related to the device, e.g. operating manual, circuit diagrams, spare parts lists available for downloading

For more information about serviceCONNECT, please visit our homepage at
https://www.goettfert.com/services/serviceconnect

Note: In order to take advantage of the best possible and fast service from GÖTTFERT, we recommend immediate registration with serviceCONNECT when a test device is put into operation.

Note

PC hardware

GÖTTFERT GmbH provides full warranty for the function of machines that have been supplied as complete system that means with PC and printer by GÖTTFERT. PC means generally the complete system comprising of PC, monitor, keyboard, interfaces, mouse and if applicable joysticks.
Principally, we do not give a functioning guarantee for connecting externally supplied PCs and printers (non-GÖTTFERT supply).

If the customer provides the PC by himself, GÖTTFERT cannot guarantee the troublefree functioning of PC and GÖTTFERT unit. Service work, which will be essential due to appearing problems in regard to configuration, serial interfaces, connection cables, communication etc. do not belong to the warranty obligations and will therefore be invoiced on an actual expense basis.

The PC must be sent to GOETTFERT prior to final inspection.
The final inspection test in house GOETTFERT of the relevant rheometer will be performed only with the customer PC, which will be used onsite for operation, to guarantee a trouble-free operation of the total system. In order to being able to prepare the PC best possible for operation with the rheometer, please make sure that the PC is sent to GOETTFERT on time.

Some GÖTTFERT devices require the application of PC extension cards. By default they are executed in full construction height, consequently the application of a mini Tower PC is necessary. If the customer provides a PC in „Small-Form-Factor" format by himself, then low profile extension cards have to be used.
Please refer with the order if a PC with low profiles extension slots shall be used! GÖTTFERT is checking if low profile cards are available for the requested application and will offer these extension cards. Please specify the brand and type of the used PC when placing the order!

Due to the various printer executions that are available on the market, we do not give any function guarantee for printers not supplied by GÖTTFERT. Support for possible adjustments will be charged on an actual expense basis.

PC operating system and configuration

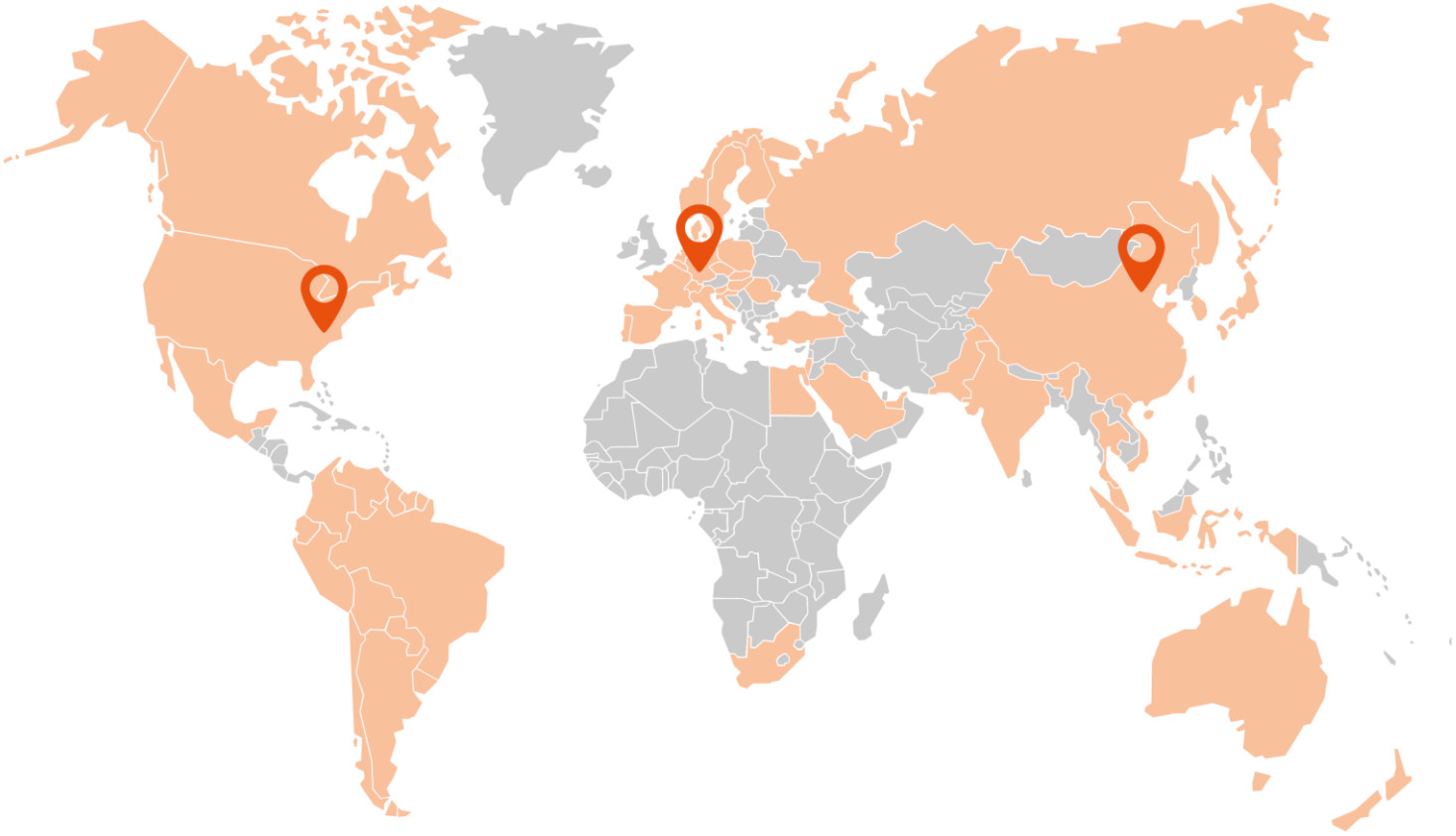
The PC with Microsoft Windows operating system is delivered by GÖTTFERT with Windows standard settings. The operator is responsible for the security settings (anti-virus, firewall, update, etc.) and their functionality and must ensure that they are properly set up. Please note that the PC can restart itself with the standard settings of the Windows Updates. This can interrupt a running measurement.
GÖTTFERT does not assume any liability for malfunctions caused by Windows security settings!

LAN configuration

The required IP addresses have to be provided at the latest on the day of commissioning if you want to integrate the test machine, the PC or the printer into your network. Let your IT ensure that the network is configured accordingly.

All data are based on rated voltage and standard frequency as well as a surrounding temperature of +20°C (68 °F).
Subject to change due to technical developments.
Images may deviate from the original.

THIS IS RHEOLOGY



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