

## HIGH PRESSURE CAPILLARY RHEOMETER RHEOGRAPH 20



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## Introduction

The RHEOGRAPH 20 is an innovative High Pressure Capillary Rheometer, according to DIN 54811, to determine the flow behavior and viscosity of thermoplastics and rubbers. This capillary rheometer is a result of more than 30 years of experience gained with the various machine generations in the field of rheological capillary rheometry.

### The technical highlights

- Constant high piston force 20 kN
- Single or twin barrel system:  $\varnothing$  9,55, 12, 15 or 20 mm design
- Dynamic speed range: 0-40 mm/sec (1:800000)
- Position acquisition: high resolution encoder (0,000053 mm)
- Increased pressure transducer sensitivity: resolution increased by 10 times comparing to the previous model
- Automatic pressure transducer identification: Plug & Test

### Additional features of the RHEOGRAPH 20:

- Windows database software for parameter setting and online monitoring via Ethernet, as well as free definable test evaluation
- Start up, test data recording and current status indication via integrated 14,48 cm (5,7") Color-QVGA-touch screen
- Compact and service friendly design with easily accessible components
- Temperature range up to 400°C (500°C optional), temperature control algorithm, resolution 0,01°C
- 5 temperature calibration data sets each with separate control parameters for optimal adaptation over the full temperature range
- Integrated timer for automatic heat up
- Electrically heated test chamber with easy exchangeable test barrel
- Test barrel and options fitting with up to 5 pressure transducers as well as up to 2 force transducers
- Drive torque monitoring and display
- Infinitely variable manual piston drive control
- Operation modes constant speed, constant pressure/force or PVT measurement and script procedure controlling
- Determination of apparent resp. real shear stress by real test pressure measurement
- Automatic test data acceptance and setting of the next specification value after stabilisation of test data
- PVT measurement isobaric or isothermal (optional)
- Static and dynamic die swell measurement (optional)

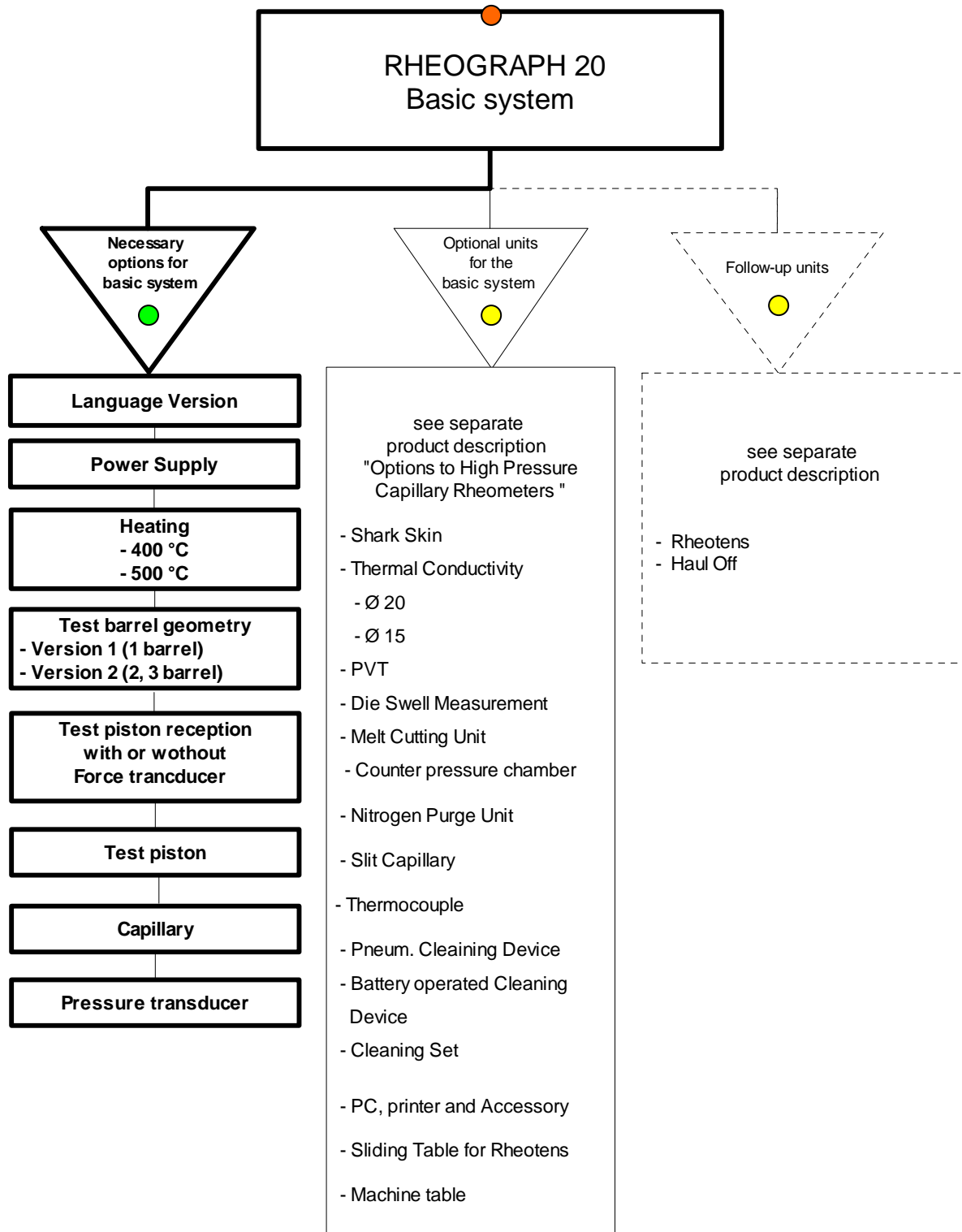
- Thermal Conductivity Measurement (optional)
- Counter Pressure Chamber (optional)
- Shark-Skin (Detection of flow instabilities),

### Application

The test unit must only be used to determine the flow characteristics and viscosity of thermoplastic polymers and rubbers (usage to the intended purpose).  
Plastics pellets or powder are/is melted in a heated test cylinder and pressed out of a capillary with a test piston and a constant force or speed.

The RHEOGRAPH 20 is used in the field of research and development as well as for quality control and inspection of received goods.

## Concept



## Legend:

- Basic system
- Necessary options: These units are necessary
- Optional units: Choice of measurement enhancing additional sub systems

## Optional units

The basic test device is no functioning instrument without adding the following optional units:

- Power Supply
- English Version or German Version
- Test chamber design 1 with
  - Test barrel set
  - Heating
  - Test piston
  - Test piston reception with/without force transducer
  - Capillary

or

- Test chamber design 2 with
  - Test barrel set with capillary block
  - Heating
  - Test piston
  - Test piston reception with/without force transducer
  - Capillary
- Pressure transducer (s)

## Options

The GÖTTFERT High Pressure Capillary Rheometers 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.

- Shark Skin
- Thermal conductivity \*
- PVT \*
- Die swell measurement
- Manual or automatic melt cutting unit
- Counter pressure chamber
- Nitrogen purge unit
- Slit die
- Thermocouple
- Pneumatic cleaning device or battery operated cleaning device
- Cleaning set
- Machine table
- PC, printer and accessory
- Sliding table for Rheotens

\*

GÖTTFERT offers PVT measurements according DIN 17744 isotherm in a temperature range up to 450°C and isobar up to 400°C.

This upper limit provides now the possibility to measure and evaluate also the most technical plastics and especially fluor polymers.

Out of an intensive development work the temperature range for thermal conductivity measurement could be increased up to 450°C. Also here the advantage is given to test technical polymers in that wide area.

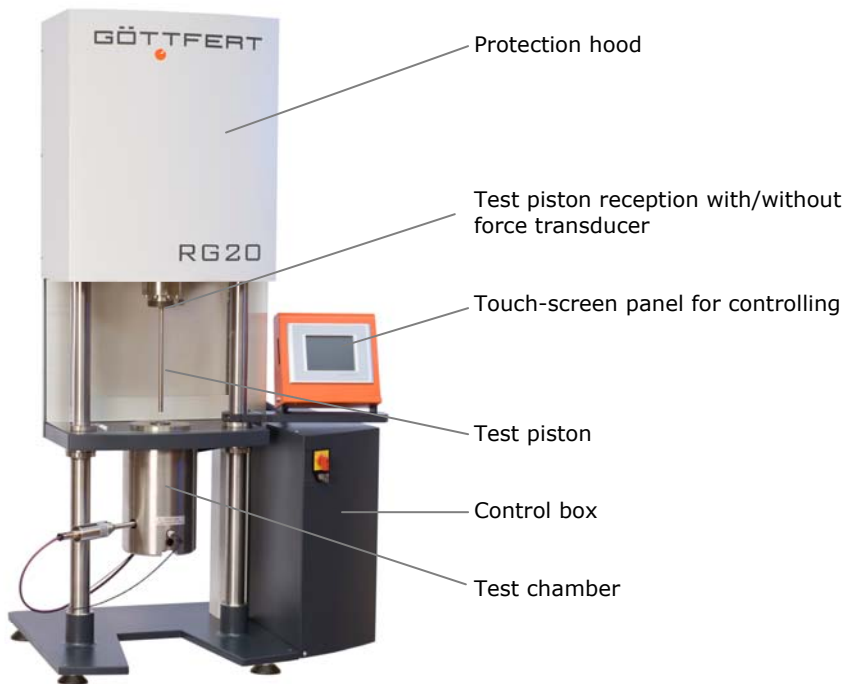
### Follow-up units

These follow-up units can be operated in connection with the Rheograph 20

Rheotens or Haul-Off-System for the determination of melt extensionability

**Details and information to the individual options and follow-up units you will find in the separate product descriptions "Options for High Pressure Capillary Rheometers" and the Follow-up units.**

## Set-up



Picture: Overall view  
RHEOGRAPH 20 tabletop design

## RHEOGRAPH 20 - Stationary System

with a tailor-made table, the Rheograph 20 is used as stationary equipment. By mounting the control box in the lower area, a larger deposit space as well as free working area around the test barrel will be available.



Picture: Overall view RHEOGRAPH 20 with stationary system



The RHEOGRAPH 20 consists of the following components:

**Frame**

The machine body of RHEOGRAPH 20 is designed in a stable frame resp. column type construction in order to cope with the high test forces. Test chamber, electronics and test piston drive are located separately.

**Test piston drive**

The test piston drive is made via a double ball screw shaft, activated by a servo motor with a sprocket belt gear. Sprocket belt gear, ball screw shaft and cylinder rod are located in one housing. The cylinder rod guide is free of lubricant.

**Chamber heating**

The test chamber temperature is controlled by a special temperature control algorithm. The resolution of the set temperatures is 0.1 °C. During the test, the temperatures are displayed on the screen with a 0.01 °C resolution.

**Controlling**

A panel PC with real time processing system controls the device.

All service operations at the device can be handled via touch-screen display (14,48 cm (5,7"), QVGA color).

Connections:            Digital/analogue I/O units via CAN bus  
                              PC via Ethernet  
                              Special options via RS232

**Safety system**

- Comprising of a plastic protective hood (transparent) around the test piston according to VGB 4. For cleaning and filling of the test barrel the hood can be opened. The piston can move only, when the hood is closed.
- Test piston overload detection via torque, pressure transducer and force transducer monitoring
- Touch protection of hot test chamber via reflector cover

**PC-Software LabRheo**

With the PC program "LabRheo" the setting of parameters, the performance of the measurements, as well as the evaluation of the raw data can be carried out by data bases. The advanced rheological evaluation is performed with the established Software "WinRheo II".

Further details, as well as requirements of the PC you will find in the separate product descriptions "LabRheo" and "WinRheo II".

### Accuracy of pressure measurement

The pressure transducer signal at the RG 20, RG 25, RG 75, RG 120 can be displayed with a resolution of 0.005 % from nominal range, that means 0.1 bar with a 2000 bar transducer.

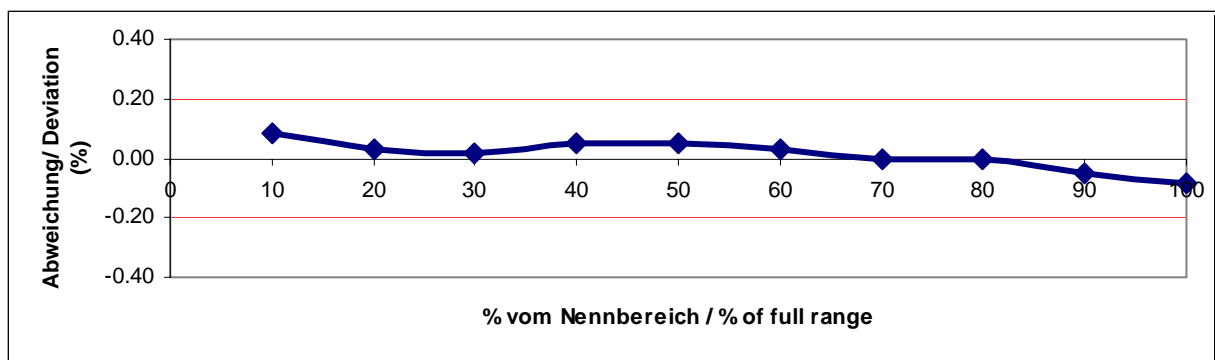
All GÖTTFERT pressure transducers are re-calibrated manually to ensure highest accuracy.

To guarantee reproducibility according to ISO9001, certified measuring and test equipment by the DKD are used during this calibration.

The created test reports are delivered together with the transducer.

#### Example for a manual calibration

Sollwerte / Set values		Istwerte / Actual values				
[%]	[bar]	Messserie 1 <i>Test series 1</i> [bar]	Messserie 2 <i>Test series 2</i> [bar]	Messserie 3 <i>Test series 3</i> [bar]	Mittelwert <i>Mean value</i> [bar]	Abweichung <i>Deviation</i> [%]
10	20	20.5	20.0	20.0	20.17	0.08
20	40	40.2	40.0	40.0	40.07	0.03
30	60	60.1	60.0	60.0	60.03	0.02
40	80	80.1	80.1	80.1	80.10	0.05
50	100	100.1	100.1	100.1	100.10	0.05
60	120	120.1	120.0	120.1	120.07	0.03
70	140	140.0	140.0	140.0	140.00	0.00
80	160	160.0	160.0	160.0	160.00	0.00
90	180	180.0	179.8	179.9	179.90	-0.05
100	200	199.9	199.85	199.82	199.86	-0.07



## Technical Data

### Standards

ISO 11443 - ASTM D 3835 - DIN 54811  
- ASTM D 5930 (option) - ISO 17744  
(option) ASTM D 5099 (option)

### Barrel

Diameter 9.55 +0.01mm (0.376 inches)  
Diameter 12.0 +0.01mm (0.4724 inches)  
Diameter 15.0 +0.01mm (0.5906 inches)  
Diameter 20.0 +0.01mm (0.7874 inches)  
Length 256 mm (10.08 inches)  
Design single - twin barrel  
Interchangeable YES, option  
Material Nitrided hardened steel  
Other options Corrosion (Inconel) and wear resistant design

### Capillaries

Diameter 0.1 - 6 mm (0.00394 - 0.23 inches) ± 0.005 mm

### Test piston

Diameter 9.53 +0.01 mm (0.3752 inches)  
Diameter 11.99 -0.01 mm (0.4720 inches)  
Diameter 14.99 -0.01 mm (0.5902 inches)  
Diameter 19.99 -0.01 mm (0.787 inches)  
Length 285 ± 0,2 mm (11.22 inches)

### Control

Local Touch-screen IPC, heating and material extrusion without PC connection possible  
PC LabRheo program, connection via LAN

### Heater

Temperature range 5°C above room temperature up to 400°C (752°F), optional up to 500°C (932°F)  
Sensors PT100 1/3DIN  
Heater circuits 3  
Controller special algorithm  
Resolution 0.01°C  
Variation over time in usable range less ±0.2°C  
Spatial distribution in usable range: 60 up to 300 °C: < 0.5 °C  
301 up to 400 °C: < 1.0 °C

**Drive**

Motor	Servo drive with high resolution EnDat interface
Resolution position	0.000053 mm
Resolution speed	0.000016 mm/s (0.00096mm/minute)
Lowest speed	0.00005 mm/s (0.003 mm/minute)
Highest speed	40 mm/s (2400 mm/minute)
Range	1:800.000
Realizable shear rate test range	$10^{-4}$ to $10^7$ (depending on test barrel and capillary configuration)
Realizable viscosity test range	1 mPas ( $10^{-3}$ ) to $10^8$ Pas (depending on capillary and pressure transducer)  This means that test measurements from aqueous solutions up to rubber and metal compounds are possible.
Position correction	Automatic position correction of deformation of frame, drive, force transducer for PVT measurement

**Pressure transducers**

Connection	CAN bus, max. 5 transducers
Range	20 - 2000 bar (290 - 29000 PSI)
Accuracy	0.2%
Identification of transducer range and calibration data	automatic when transducer is connected
Zero calibration	automatic
Resolution	0.005 %

**Force transducers**

Range	20 kN
Accuracy	0.4% in 1% - 100% of the nominal range 0.8% < 1% of the nominal range
Zero calibration	automatic
Resolution	0.005 %

**Power supply**

Voltage	1 x 230V, L + N + PE other on request
Tolerance	±10%
Frequency	50 Hz // 60 Hz

Protective earthing  
Short-time breaks  
Power consumption

Earth resistance less than 5 Ohm  
less than 10 msec  
approx. 3,6 kW

### Ambient conditions

Ambient temperature  
Air humidity

+ 10°C up to + 40° C (50°F up to 104°F)  
max. 90 % not-condensing

### Dimensions

Width  
Depth  
Height  
Weight

850 mm (33.46 inches)  
635 mm (24.8 inches)  
1550 mm (61.02 inches)  
approx. 250 kg (552 pounds)

### Frame (test chamber)

Machine stiffness (essential for PVT measurements)

130 kN

### Finish

Front and cover plate  
Test chamber hitch

light gray RAL 7035  
Basalt gray RAL 7012

### Protection

Protection hood with double contacts

### Evaluation of data

with LabRheo / WinRHEO II program

Rheological corrections

Rabinowitsch-Weissenberg, Bagley (linear, non linear), Mooney (wall slip), Heat dissipation, Hagenbach, Gleissle

Models

Ostwald de Waele (Power law), Münstedt, Carreau Winter, Cross, Sabia, Yasuda

Temperature shift

Arrhenius, WLF, Carreau-WLF, Carreau-Arrhenius, Cross-WLF, Cross Arrhenius

Various calculations

Normal stress difference, Extensional viscosity and stress (Cogswell), NNI-Coefficient (non Newton Index) correlation to molecular weight and molecular weight distribution

Calculation for options

Die swell, PVT calculation isobar and isothermal diagrams with Tait equation for Mouldflow and C-mould calculations, Thermal conductivity, Counter pressure chamber, Analysis of flow instabilities (Sharkskin), export of compuplast software, extensional viscosity of Rheotens with Wagner model and for haul-off

Export functions

Export to Excel,  
tables and graphics with copy paste to MS  
Office or other programs via clipboard

#### Note:

Please pay attention to the fact that the RHEOGRAPH 20 is equipped with microprocessors. In order to guarantee a trouble free operation, the power supply must be free of interferences. Should there occur any interference you have to connect line filters resp. mains stabilizers on line side.

#### Residual Current Rating

The Rheograph is operated via a servo amplifier in the drive. Residual current protection devices with error current rating <sup>1)</sup> of  $\geq 100$  mA can be used. It may happen that faulty activations occur:

- when connecting servo amplifiers to the power line (shortterm single or two- phase operation by contact chatter in the mains contactor)
- by higher frequented discharge currents appearing during operation with longer motor cables
- by strong asymmetries of the 3-phase-current system

1)

The ratings indicated by the manufacturers of the protective switches are to be seen as max. values, where the protective switch surely releases.

Usually the protective switch releases already at 60% of the residual current rating.

## Supplied accessories

### RHEOGRAPH 20

- |   |   |
|---|---|
| 1 | CD-Rom „LabRheo“ and 1 CD-Rom „WinRheo II“  |
| 1 | User information consisting of operating manual, technical documentation, program documentation and calculation basis (on CD-Rom) |
| 1 | Operating manual (printed version)  |
| 2 | Keys for main switch  |
| 2 | Keys for cabinet  |
| 1 | Cover disk  |
| 1 | Mirror for magnetic base  |
| 1 | Feeder  |
| 1 | Shovel  |
| 1 | Cleaning tool for pressure transducer with bore 1/2"-20 UNF-B   |
| 1 | Tube graphite paste   |
| 1 | Set fuses   |
| 1 | Set wrenches  |
| 1 | Pair of tweezers  |
| 1 | Brass brush   |

## Order information

### RHEOGRAPH 20

Basic device

Order number..... 5.30.500

**Necessary optional units to basic device:**

## Language version and user information

### English Version

Marking and user information\* (on CD) in English, operating manual on paper format.

Order number..... 5.30.501

### German Version

Marking and user information\* (on CD) in German, operating manual on paper format.

Order number..... 5.30.502

### Additional user information\* English, on paper format

Complete printed English user information\* in single A4 ring binder.

One user information\* on CD belongs to standard scope of the basic instrument.

Order number..... 5.30.503

### Additional user information\* German, on paper format

Complete printed German user information\* in single A4 ring binder.

One user information\* on CD belongs to standard scope of the basic instrument.

Order number..... 5.30.504

\* The user information contains:

Operating manual, technical documentation, LabRheo program documentation and calculation basis.

## Power supply

Following power supply is available:

### Power supply 230V; L/N/PE~50Hz

Voltage: 1 x 230V, L + N + PE

Permissible voltage fluctuations: +/- 10%

Frequency: 50 Hz

Power consumption: approx. 3.6 kW

Order number..... 5.30.505

Other power supply voltages available on request.

**Selection for test chamber type and force measurement**

Test chamber type		Pressure limit value	Force measurement
1	Test barrel D 9,55 mm	At 12 kN Maximum of allowed Pressure 1675 bar	20kN
	Test barrel D 12 mm	At 20 kN Maximum of allowed Pressure 1770 bar	
	Test barrel D 15 mm	At 20 kN Maximum of allowed Pressure 1130 bar	
	Test barrel D 20 mm	At 20 kN Maximum of allowed Pressure 572 bar	
2	Test barrel 2 x D 12 mm	At 2x10 kN Maximum of allowed Pressure 2x885 bar	
	Test barrel 2 x D 15 mm	At 2x10 kN Maximum of allowed Pressure 2x565 bar	
	Test barrel 1 x D 15 mm 1 x D 12 mm	At 2x10 kN Maximum of pressure 565 bar Maximum of pressure 1770 bar	

**1 Test Chamber Design 1****Single Barrel Design for Test Barrels Ø9,55; Ø12; Ø15; Ø20**

The test chamber is electrically heated via a temperature controller with 3 heating circuits. Temperature distribution over the usable test barrel length:  $\pm 0,5^{\circ}\text{C}$ . The test chamber can be equipped with various test barrels, heating and test pistons. Test barrel is equipped with a melt pressure measuring bore with thread  $\frac{1}{2}"-20\text{ UNF}$  at the outlet of the test barrel. Capillaries with a length of up to 30 mm can be handled. Two bores can be added optionally for the thermocouple Fe-Const at the inlet and outlet of the capillary for measuring the temperature.

Each test barrel set consists of necessary capillary nuts and capillary nut wrenches. With cleaning tools for the relevant test barrel diameter, comprising of a brass scraper, a piston for cleaning the test barrel, a steel brush and a tamping piston.

The test piston reception with and/or without force transducer must be selected additionally.

Please select a Test Barrel Set.

Order number..... 5.30.646

**Diameter 9.55 mm****Test Barrel Set 9.55**

Order number..... 5.30.687

**Diameter 12 mm****Test Barrel Set Ø12**

Order number..... 5.30.652



**Diameter 15 mm****Test Barrel Set Ø15**

Order number..... 5.30.688

**Diameter 20 mm****Test Barrel Set Ø20**

Order number..... 5.30.689

**1 Heating**

Test chamber heating, comprising of heater element, reflector jacket and temperature sensor PT 100 DIN for the required temperature range.  
Please select a heating.

**Heating up to 400°C for Test barrel set**

Order number..... 5.30.657

**Heating up to 400°C for Test barrel set**

Order number..... 5.30.661

**Heating up to 400°C for Test Barrel Set with tempering jacket, stainless**

for connecting an external tempering unit (e.g. thermostat). The tempering jacket is divided into two tempering circuits (top and bottom). The circuits can be connected serial, parallel or separately. This option is recommended for standard measurements at temperatures under +60°C and especially for PVT measurements in all temperature ranges.

Order number..... 5.30.663

**Heating up to 500°C for Test Barrel Set with tempering jacket, stainless**

for connecting an external tempering unit (e.g. thermostat). The tempering jacket is divided into two tempering circuits (top and bottom). The circuits can be connected serial, parallel or separately. This option is recommended for standard measurements at temperatures under +60°C and especially for PVT measurements in all temperature ranges.

Order number..... 5.30.671

**1 Test Piston reception**

The **Test Piston receptions without Force transducer** are equipped with a blind plug, which can be later on replaced by the force transducer.

The **Test Piston receptions with Force transducer** are equipped with a precision force transducer for the relevant measuring range with following technical data:

- Accuracy class 0,02
- Total deviation (in regard to actual value)
  - 0,4% within test range 1% up to 100%
  - 0,8% within test range 0,4% up to 1%

The standard design considers that the force transducer is installed at the piston holder of test piston 1 (barrel 1).

If this should be different, then you have to indicate this in your purchase order.

Please select a test piston reception.

**Test Piston reception for 2xD12 without Force transducer**

(prepared for 20 kN Force transducer)

Installed in the test piston holder of the test piston 1 (barrel 1)

Order number..... 5.30.697

**Test Piston reception for 2xD12 with 20 kN Force transducer**

incl. Measuring amplifier CAN-Bus Module

Installed in the test piston holder of the test piston 1 (barrel 1)

Order number..... 5.30.698

**Test Piston reception for 1xD12/1xD15 without Force transducer**

(prepared for 20 kN Force transducer)

Installed in the test piston holder of the test piston 1 (barrel 1)

Order number..... 5.30.699

**Test Piston reception for 1xD12/1xD15 with 20 kN Force transducer**

incl. Measuring amplifier CAN-Bus Module

Installed in the test piston holder of the test piston 1 (barrel 1)

Order number..... 5.30.700

**1 Capillaries**

Round Hole Capillaries for Single Barrel Design D = 9.55 mm up to 20 mm

Each capillary has a bore hole to receive a thermocouple Fe-Const. to measure the test temperature in the inlet of capillary.

Capillaries with 30 mm length have a second bore hole to receive a second thermocouple to measure the test temperature in the outlet of capillary.

Capillaries with a length up to 10 mm are completely made of hard metal.

Capillaries with more than 10 mm length consist of a hard metal insert and a hardened steel jacket.

*Note: all capillaries with a length of < 20 mm have for constructional reasons a total outer length of 20 mm, whereas the inner length is equal with the indicated measuring length.***Diameter 0,5 mm****Capillary L/D = 5/0,5**

With 0,5 mm diameter, 5 mm Length

Order number..... 4.23.350

**Capillary L/D = 10/0,5**

With 0,5 mm diameter, 10 mm Length

Order number..... 4.23.351

**Capillary L/D = 15/0,5**

With 0,5 mm diameter, 15 mm Length

Order number..... 4.23.352

**Capillary L/D = 20/0,5**

With 0,5 mm diameter, 20 mm Length

Order number..... 4.23.353

**Capillary L/D = 30/0,5**

With 0,5 mm diameter, 30 mm Length

Order number..... 4.23.271

**Diameter 1 mm****Capillary L/D = 0/1**

With 1 mm diameter, 0 mm Length, only for D=15 mm with 1-barrel-design

Order number..... 4.23.743

**Capillary L/D = 5/1**

With 1 mm diameter, 5 mm Length

Order number..... 4.23.355

**Capillary L/D = 10/1**

With 1 mm diameter, 10 mm Length

Order number..... 4.23.270

**Capillary L/D = 15/1**

With 1 mm diameter, 15 mm Length

Order number..... 4.23.365

**Capillary L/D = 20/1**

With 1 mm diameter, 20 mm Length

Order number..... 4.23.274

**Capillary L/D = 30/1**

With 1 mm diameter, 30 mm Length

Order number..... 4.23.272

**Capillary L/D = 40/1**

With 1 mm diameter, 40 mm Length.

In order to apply capillaries L = 40 the capillary locking flange 5.29.595 or 5.29.594 is required.

Order number..... 4.23.359

**Diameter 2 mm****Capillary L/D = 0/2**

With 2mm diameter, 0 mm Length, only for D=15 mm with 1-barrel-design

Order number..... 4.23.743

**Capillary L/D = 5/2**

With 2 mm diameter, 5 mm Length

Order number..... 4.23.356

**Capillary L/D = 10/2**

With 2 mm diameter, 10 mm Length

Order number..... 4.23.278

**Capillary L/D = 20/2**

With 2 mm diameter, 20 mm Length

Order number..... 4.23.279

**Capillary L/D = 30/2**

With 2 mm diameter, 30 mm Length

Order number..... 4.23.273

**Capillary nut for Round Hole Capillaries with 40 mm Length**

Order number..... 5.30.203

Further capillary geometries – also with entry angle – on request.

**2 Test Chamber Design 2****Twin Barrel Design for Test Barrels 2xØ12; 2xØ15; 1xØ15/1xØ12**

The test chamber is electrically heated via a temperature controller with 3 heating circuits. Temperature distribution over the usable test barrel length:  $\pm 0,5^{\circ}\text{C}$ . The test chamber can be equipped with various test barrels, heating and test pistons.

Die Prüfkammer ist mit einer Massedruckmess-Bohrung Gewinde  $\frac{1}{2}$ "-20 UNF am Auslauf vom Prüfkanal ausgestattet. In der Prüfkammer können Vollkreiskapillaren bis 30 mm Länge eingesetzt werden. 2 Bohrungen zur Massetemperaturmessung am Einlauf und Auslauf der Kapillare mittels Thermoelemente ist vorgesehen.

Mit Kapillarenmutter, Kapillarenmutter Schlüssel und Reinigungswerkzeug für den jeweiligen Prüfkanaldurchmesser, bestehend aus einem Messingschaber, einem Kolben zum Reinigen des Prüfkanals, einer Röhrenbürste und einem Materialstopfer.

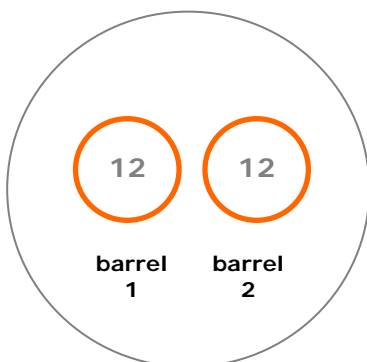
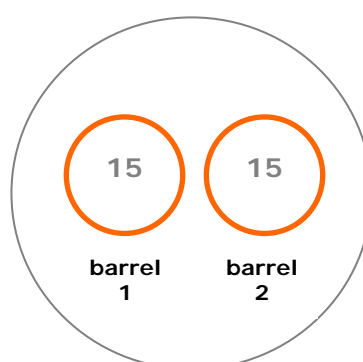
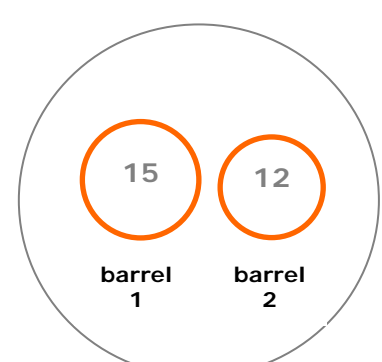
The test piston reception with and/or without force transducer must be selected additionally.

Please select a Test Barrel Set.

Order number..... 5.30.646

**2-Barrel design**

Front view (user side)

**Test barrel-set 2x12****Test barrel-set 2x15****Test barrel-set 1x15 mm / 1x12****Diameter 2x 12 mm****Test Barrel Set 2xØ12**

Order number..... 5.30.653

**Diameter 2x 15 mm****Test Barrel Set 2xØ15**

Order number..... 5.30.690

**Diameter 1x 15 mm / 1x 12 mm****Test Barrel Set 1xØ15/1xØ12**

Order number..... 5.30.692

**2 Heating**

Test chamber heating, comprising of heater element, reflector jacket and temperature sensor PT 100 DIN for the required temperature range.  
Please select a heating.

**Heating up to 400°C for Test Barrel Set**

Order number..... 5.30.658

**Heating up to 500°C for Test Barrel Set**

Order number..... 5.30.662

**Heating up to 400°C for Test Barrel Set with tempering jacket, stainless**

for connecting an external tempering unit (e.g. thermostat). The tempering jacket is divided into two tempering circuits (top and bottom). The circuits can be connected serial, parallel or separately. This option is recommended for standard measurements at temperatures under +60°C and especially for PVT measurements in all temperature ranges.

Order number..... 5.30.664

**Heating up to 500°C for Test Barrel Set with tempering jacket, stainless**

for connecting an external tempering unit (e.g. thermostat). The tempering jacket is divided into two tempering circuits (top and bottom). The circuits can be connected serial, parallel or separately. This option is recommended for standard measurements at temperatures under +60°C and especially for PVT measurements in all temperature ranges.

Order number..... 5.30.672

**2 Test Piston reception**

The **Test Piston receptions without Force transducer** are equipped with a blind plug, which can be later on replaced by the force transducer.

The **Test Piston receptions with Force transducer** are equipped with a precision force transducer for the relevant measuring range with following technical data:

- Accuracy class 0,02
- Total deviation (in regard to actual value)
  - 0,4% within test range 1% up to 100%
  - 0,8% within test range 0,4% up to 1%

The standard design considers that the force transducer is installed at the piston holder of test piston 1 (barrel 1).

If this should be different, then you have to indicate this in your purchase order.

Please select a test piston reception.

**Test Piston reception for 2xD12 without Force transducer**

(prepared for 20 kN Force transducer)

Installed in the test piston holder of the test piston 1 (barrel 1)

Order number..... 5.30.697

**Test Piston reception for 2xD12 with 20 kN Force transducer**

incl. Measuring amplifier CAN-Bus Module

Installed in the test piston holder of the test piston 1 (barrel 1)

Order number..... 5.30.698

**Test Piston reception for 1xD12/1xD15 without Force transducer**

(prepared for 20 kN Force transducer)

Installed in the test piston holder of the test piston 1 (barrel 1)

Order number..... 5.30.699

**Test Piston reception for 1xD12/1xD15 with 20 kN Force transducer**

incl. Measuring amplifier CAN-Bus Module

Installed in the test piston holder of the test piston 1 (barrel 1)

Order number..... 5.30.700

**2****Capillaries****Round hole capillaries for Test Chamber Design 1****Single Barrel design D = 9,55 mm to 20 mm**

Each capillary has a bore hole to receive a thermocouple Fe-Const. to measure the test temperature in the inlet of capillary. Capillaries with 30 mm length have a second bore hole to receive a second thermocouple to measure the test temperature in the outlet of capillary. Capillaries with a length up to 10 mm are completely made of hard metal.

Capillaries with more than 10 mm length consist of a hard metal insert and a hardened steel jacket.

*Note: all capillaries with a length of < 20 mm have for constructional reasons a total outer length of 20 mm, whereas the inner length is equal with the indicated measuring length.*

**Diameter 0,5 mm****Capillary L/D = 5/0,5**

With 0,5 mm diameter, 5 mm Length

Order number..... 4.23.350

**Capillary L/D = 10/0,5**

With 0,5 mm diameter, 10 mm Length

Order number..... 4.23.351

**Capillary L/D = 15/0,5**

With 0,5 mm diameter, 15 mm Length

Order number..... 4.23.352

**Capillary L/D = 20/0,5**

With 0,5 mm diameter, 20 mm Length

Order number..... 4.23.353

**Capillary L/D = 30/0,5**

With 0,5 mm diameter, 30 mm Length

Order number..... 4.23.271

**Diameter 1 mm****Capillary L/D = 0/1**

With 1 mm diameter, 0 mm Length

Order number..... 4.23.743

**Capillary L/D = 5/1**

With 1 mm diameter, 5 mm Length

Order number..... 4.23.355

**Capillary L/D = 10/1**

With 1 mm diameter, 10 mm Length

Order number..... 4.23.270

**Capillary L/D = 15/1**

With 1 mm diameter, 15 mm Length

Order number..... 4.23.365

**Capillary L/D = 20/1**

With 1 mm diameter, 20 mm Length

Order number..... 4.23.274

**Capillary L/D = 30/1**

With 1 mm diameter, 30 mm Length

Order number..... 4.23.272

**Capillary L/D = 40/1**

With 1 mm diameter, 40 mm Length

In order to apply capillaries L = 40 the capillary nut 5.30.203 is required.

Order number..... 4.23.359

**Diameter 2 mm****Capillary L/D = 0/2**

With 2 mm diameter, 0 mm Length

Order number..... 4.23.743

**Capillary L/D = 5/2**

With 2 mm diameter, 5 mm Length

Order number..... 4.23.356

**Capillary L/D = 10/2**

With 2 mm diameter, 10 mm Length

Order number..... 4.23.278

**Capillary L/D = 20/2**

With 2 mm diameter, 20 mm Length

Order number..... 4.23.279

**Capillary L/D = 30/2**

With 2 mm diameter, 30 mm Length

Order number..... 4.23.273

**Capillary nut for Round Hole Capillary with 40 mm Length**

Order number..... 5.30.203

Further capillary geometries – also with entry angle – on request.

## 1 2 Test Piston

The **standard test piston** made from completely hardened tool steel can be used for the most common materials. The maximum temperature is 500°C.

The **test piston** made from **corrosion resistant tool steel** can be used for materials with abrasive and corrosive additives. The maximum temperature is 500°C.

The **test piston with teflon-sealing** (PTFE with 60% bronze content) is especially suited for low viscose medias, like polyolefines, partly also polyamids, polycarbonates and polyester with a melt temperature higher than 120°C. The recommended temperature range is from 100...240°C, the length is 285 mm.

The **test piston with Vespel-sealing** is especially suited for technical plastics, like LCP, PEEK or PA66. The recommended temperature range is from 240...300°C, the length is 285 mm.

The **test piston with HP-system-sealing** is especially suited for the testing of low viscous media and for the PVT measurement. It is mainly used for media being in liquid state at room temperature. The HP-system-sealing comprises of an active and a passive sealing system. The passive sealing system is made of various high performance polymers. The active sealing system is made mainly of sintered materials on basis of PTFE. The HP-system-sealing seals liquid and gas media. The length of this test piston is 285 mm.

The special characteristics of the HP-system-sealing are:

- High lifetime at high wear resistance
- Lowest possible friction value
- No clatter (Slip-Stick) at low rates
- No sticking to the tread area also after a longer standstill
- Operation temperature up to +180°C
- Operation pressure up to 2000 bar
- Max. speed is 40 mm/s

More test piston materials, temperature ranges and sealing systems on request.  
Please select one or several test pistons suitable to the test barrel.

### Diameter 9.5 mm

#### Test Piston Ø9.55 Standard

Order number..... 5.09.100

#### Test Piston Ø9.55 with Teflon-sealing

Order number..... 5.12.170

#### Test Piston Ø9.55 with Vespel-sealing

Order number..... 5.30.712

#### Test Piston Ø9.55 with HP-system-sealing

Order number..... 5.30.713



**Diameter 12 mm****Test Piston Ø12 Standard**

Order number..... 5.09.101

**Test Piston Ø12 with Teflon-sealing**

Order number..... 5.12.116

**Test Piston Ø12 with Vespel-sealing**

Order number..... 5.12.421

**Test Piston Ø12 with HP-system-sealing**

Order number..... 5.12.192

**Diameter 15 mm****Test Piston Ø15 Standard**

Order number..... 5.09.102

**Test Piston Ø15 with Teflon-sealing**

Order number..... 5.12.175

**Test Piston Ø15 with Vespel-sealing**

Order number..... 5.12.412

**Test Piston Ø15 with HP-system-sealing**

Order number..... 5.12.408

**Diameter 20 mm (not to be used at multiple test barrel system)****Test Piston Ø20 Standard**

Order number..... 5.29.610

**Test Piston Ø20 with Teflon-sealing**

Order number..... 5.29.616

**Test Piston Ø20 with Vespel-sealing**

Order number..... 5.29.613

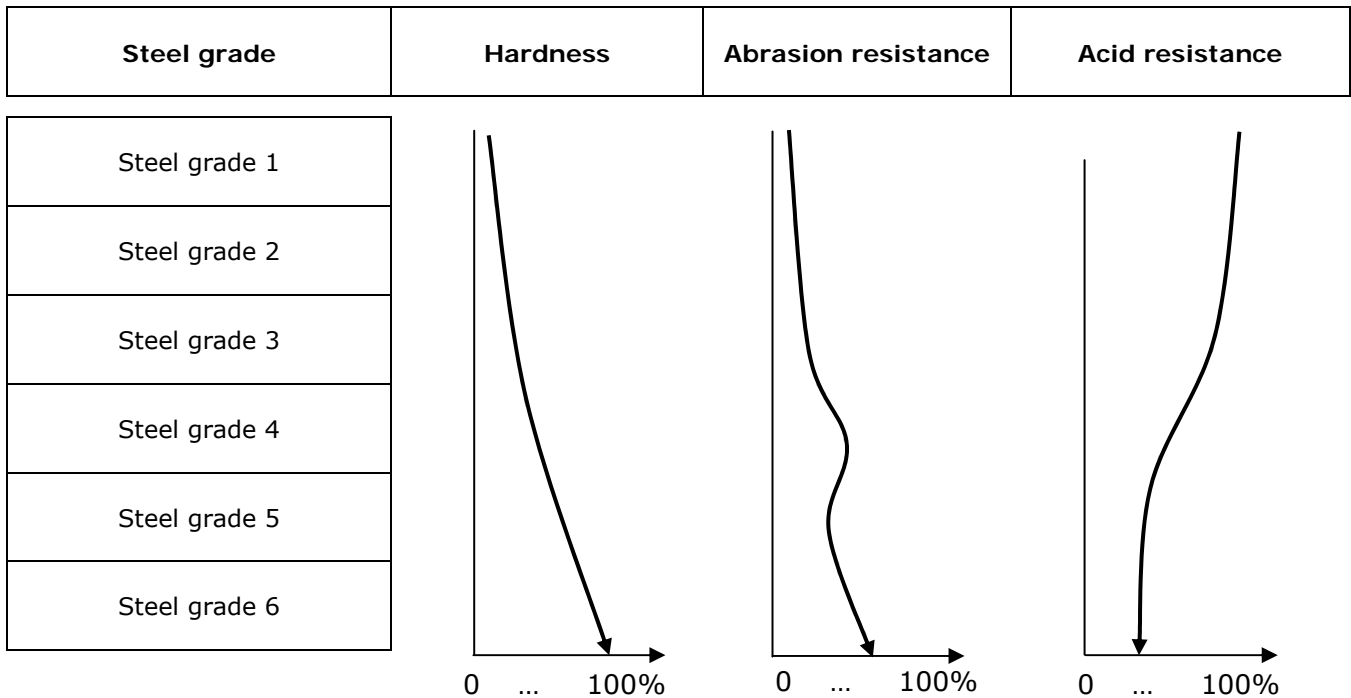
**Test Piston Ø20 with HP-system-sealing**

Order number..... 5.29.611

## Steel grades

This graphic shows the possibility to select according to the application out of different steel grades. If no information was given to us during the order procedure we will select **steel grade No. 5** automatically. Here it is the part number with the addition "Standard".

### Applicable steel grade types, comparison table:



For more details please contact us.

## 1 2 Test pressure transducer

For determination of test pressure one or more pressure transducers with CAN bus supply are necessary.

Suitable transducers can be ordered from GÖTTFERT.

Maybe that foreign products can be installed. But they has to be checked by GÖTTFERT and prepared for the CAN bus.

The special calibrated transducers with integrated limit control guarantees a resolution of  $\pm 0,2$  % from end value.

### Up to 400 °C:

#### Test pressure transducer 0 - 2000 bar Quality class I up to 400°C

With measuring amplifier for feeding in to the CAN-Bus..

Thread: 1/2"-20 UNF.

Order number..... 8.81.182

#### Test pressure transducer 0 - 1000 bar Quality class I up to 400°C

With measuring amplifier for feeding in to the CAN-Bus..

Thread: 1/2"-20 UNF.

Order number..... 8.81.181

**Test pressure transducer 0 - 1400 bar Quality class I up to 400°C**

With measuring amplifier for feeding in to the CAN-Bus..

Thread: ½"-20 UNF.

Order number..... 8.81.188

**Test pressure transducer 0 - 700 bar Quality class I up to 400°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.187

**Test pressure transducer 0 - 500 bar Quality class I up to 400°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.180

**Test pressure transducer 0 - 200 bar Quality class I up to 400°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.186

**Test pressure transducer 0 - 100 bar Quality class I up to 400°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.185

**Test pressure transducer 0 - 50 bar Quality class I up to 400°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.184

**Test pressure transducer 0 - 20 bar Quality class I up to 400°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.183

**Up to 500 °C:****Test pressure transducer 0 - 2000 bar Quality class I up to 500°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.399

**Test pressure transducer 0 - 1400 bar Quality class I up to 500°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.398

**Test pressure transducer 0 - 1000 bar Quality class I up to 500°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.397

**Test pressure transducer 0 - 700 bar Quality class I up to 500°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.396

**Test pressure transducer 0 - 500 bar Quality class I up to 500°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.395

**Test pressure transducer 0 - 200 bar Quality class I up to 500°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.394

**Test pressure transducer 0 - 100 bar Quality class I up to 500°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.393

**Test pressure transducer 0 - 50 bar Quality class I up to 500°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.392

**Test pressure transducer 0 - 20 bar Quality class I up to 500°C**

With measuring amplifier for feeding in to the CAN-Bus.

Thread: ½"-20 UNF.

Order number..... 8.81.391

Other pressure transducer ranges are available on request.

**Machine table**

Details and order information, see separate product description „Options for High Pressure Capillary Rheometers“.

## Note

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.

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.

Subject to change due to technical developments

QUALITY COULD NOT BE PROVEN – IT HAS TO BE PRODUCED...

THIS IS RHEOLOGY