The MINI BYPASS RHEOGRAPH is a continuously measuring capillary rheometer used in on-line quality control. It has been designed specifically for finishing and compounding processes, which typically have frequent product changes.

For automatic process control the MBR supplies important rheological variables in real-time mode which are used to assess the properties of the polymer.

One of the most outstanding features of the MBR is its compact size. Even in tight space this new design can be installed without problems. Since the melt is not returned into the system allowing an easy access to the die, it can be changed easily and with a minimum of downtime.

Special design features:

**Compact size:** With a **system width of 130 mm** the MBR can be installed even in tight space. The reduced **weight of approx. 20 kg** eliminates costly mounting arrangements.

**Easy die change:** The **open system** (no melt return flow) together with the **new die exchange system** allows an **easy and fast die exchange** for adaptation to different test tasks.
The measuring head of the MBR is mounted directly on the production unit. The Control Electronics are located in a control cabinet which is completely separate from the measuring head. The unit is controlled via a personal computer or an industrial workstation.

Characteristic features of the MINI BYPASS RHEOGRAPH MBR 71.92:
- Flange-mounted measuring directly on the material supply line, separate Control Electronics
- Compact size
- Simple die exchange
- Large measuring range due to shear rate range of 1:1000
- System can be operated at a constant speed (shear rate) or constant pressure (shear stress)
- Operation, evaluation and visual displays are made via a personal computer, a built in industrial workstation or from the user side by a process control system
- Single or multi-point measurements
- The following test results are supplied depending on the selected operating mode:
  - Melt index MFR or melt volume index MVR with or without temperature-compensation
  - FRR (Flow Rate Ratio), ratio of 2 consecutive MFR/MVR measurements which correspond to laboratory tests with different weights
  - apparent shear stress, -shear rate and -viscosity
- The test results can be:
  - displayed in colour on the PC screen
  - output in the form of a test-data log on a printer
  - supplied via analog outputs 4...20mA (see options)
  - requested via a host computer connected via serial interface (see options)
  - database access via network (to be realized by the customer)
The MINI BYPASS RHEOGRAPH MBR 71.92 comprises the units **MBR-Measuring Head**, **MBR-Control Electronics** and **Operation Software**:

**MBR-Measuring Head** which consists of the following

**Frame housing**
complete with terminal box, lifting frame and protective cover. Housing, frame and cover are made out of acid resistant stainless steel.

**Channel block**
with melt connection, for installation of capillary, pressure transducer, thermocouple and fitted with a bypass valve to release available melt in the inlet pipe or to reduce the residence time

**Heating**
2 electrical cylinder heaters with temperature sensors Pt 100, accuracy 1/3 DIN

**Melt pump**
precision gear pump to supply melt to the die

**Drive**
brushless servo gear motor for driving the melt pump

**Thermocouple**
for measuring the melt temperature in the melt stream, Fe-CuNi, accuracy 1/2 DIN, IEC 584 type ‘JJ’

**Melt connection**
with threaded nozzle M30x1,5 (see drawing)

The measuring head must be supplied with capillary and pressure transducer. The customer must specify these (see options). Customer specific designed melt flanges and adapters are available as options.
1. Frame housing
2. Drive
3. Channel block with melt pump and capillary
4. Bypass valve
5. Pressure transducer
6. Melt connection
7. Connecting cable for Control Electronics

Picture: MBR-measuring head with options
MBR-Control Electronics

The Control Electronics are housed in a separate cabinet and comprise the following components:

Test-data processor
The electronics is microprocessor (slave) controlled and performs the basic measuring and open-loop/closed-loop control functions for the measuring head. The microprocessor

- communicates with the operation PC (master)
- records test data by means of sampling and digital filtering
- linearizes the thermovoltage (melt temperature)
- controls pressure by means of digital PID control algorithm
- monitors pressure and temperature limit values
- performs watchdog functions for monitoring the test data processor

Pressure amplifier
with electronic calibration unit for connecting the pressure transducer

Thermovoltage amplifier
with integrated reference junction for connecting the melt-temperature transducer (Fe-CuNi).

Temperature controller
microprocessor-controlled multi channel temperature controller

Servo-amplifier
for the servo-drives of the melt pump

Control inputs
via external contacts the following functions are available:
start standby mode, start test mode, stop test mode, stop drives

Control outputs potential-free
Alarm: Watchdog, excessively high temperature
Limit value: Watchdog, excessively high temperature and pressure

Serial interface
for communicating with the PC or Device Control System DCS (see options).

Power supply
the Control Electronics must be supplied with the power supply according to customers specification (see options).
MBR operation modes

Together with the Operation Software, the MBR can be operated in various modes and can perform various evaluations in order to determine the melt viscosity, melt index and melt volume index by means of single-point measurements and viscosity functions by means of multi-point measurements.

Single-point measurement with constant pressure:
The MBR is operated in the 'constant pressure' mode with one measuring point. The following variables are determined in this mode:
- melt index MFR(TM), temperature-compensated melt index MFR(T0)
- melt volume index MVR(TM), temperature-compensated melt volume index MVR(T0)
- apparent shear rate, apparent shear stress and apparent viscosity.

Multi-point measurement with constant pressure:
The MBR is operated in the 'constant pressure' mode. 20 pressure steps are approached consecutively in this mode. The following are determined in addition to the variables mentioned above:
- FRR (Flow Rate Ratio), ratio of 2 consecutive MFR/MVR measurements which correspond to laboratory tests with different weights

Single-point measurement with constant speed:
The MBR is operated in the 'constant speed' (shear rate) mode with one measuring point. The following variables are determined in this mode:
- apparent shear rate, apparent shear stress and apparent viscosity

Multi-point measurement with constant speed:
The MBR is operated in the 'constant speed' (shear rate) mode. Several speed steps are approached consecutively in this mode. The following are determined in addition to the variables mentioned above:
- uncorrected flow curve

Alternating test cycles:
In this mode the rheometer alternates between 2 independent test cycles. It is thus possible, for example, to perform a 'constant pressure' cycle in order to determine the melt index and a 'constant speed' cycle to determine the melt viscosity. 1 - 8 speed or pressure steps can be selected per test cycle.

Automatic MFR-adjustment:
After having started the machine and manually set MFR-values (lab-values), it is possible to run an automatic adjustment as much as one likes MFR(TM)-, MFR(T0)-, MVR(TM)- or MVR(T0)- steps, depending on the selected operation mode.
Technical data MBR - measuring head

Measuring pumps:
- Speed range: 0.1 - 100 rpm
- Accuracy: +/- 0.1 rpm
- Torque: 33 Nm
- Spec. capac.: 0.4 cm³/rev.

Overload protection: mechanical via shearpin, electronic via torque limit

Material impurities: ≤10µm
Impurities larger than 10 µm can destroy the gear pumps

Operation temperature: max. 350 °C

Pressure in the production/polymer/extrusion/pipeline: max. 300 bar

Pressure transducer:
- Quality Class I: combined error ± 0.5 % FSO
- Temperature: max. 400 °C (diaphragm)
- Thread: 1/2"-20 UNF-2A
- Flexible Stem: length = 18"

Temperature sensor: Pt 100 1/3 DIN IEC 751 for temperature control

Thermocouple: Fe-CuNi 1/2 DIN, IEC 584 type ‘JJ’ for measuring the melt temperature

Miscellaneous:
- Dimensions: H = 550 mm, W = 130 mm, D = 330 mm
- Finish: Drive black (mat), press.trans.holding pastel-orange RAL 2003, frame and side panels polished stainless steel
- Weight: approx. 20 kg.

Environ. conditions:
- Temp. range: 0 °C - 50 °C
- Temp. changes: max. +/-10 °C
- Rel. humidity: 90 % without condensation
- Protection: IP 54

Technical data control electronics

Temperature control:
- Sensor: Pt 100 1/3 DIN IEC 751
- Connection: Three-wire switch
- Temp. range: 60 °C - 350 °C
- Resolution: 0.1 °C for setpoint and actual value
- Accuracy: +/- 0.5 °C

Analog outputs:
- Two programmable analog outputs, all real time test values are selectable via menu (pressure, temperature, melt- and volume indices, apparent shear stress, shear speed, viscosity)
- Note: programmable output 1 will be used for option ETA/MFR display.
- Firmly wired analog outputs for P1, TM1 (non-linearised)
- Indicating range for P1: 0 - Pnenn
- TM1: 0 - 480°C
- For all outputs applies:
  - Output: 4 - 20 mA, potential free
  - Output load: 0 - 500 ohms
Tolerance: < 0.2 % from limit value (isolation amplifier)
Connection: dependent to the version 19-pin circular connector outside of control cabinet or terminals inside of cabinet, shielded signal line, the max. length of the cable depends on the cross section of the used cable.

Control inputs:

- 4 functions can be controlled via external inputs:
  - **Start Standby**: Start standby mode
  - **Start Test**: Start test mode, from standstill or standby
  - **Stop Test**: Stop test mode, meas. head changes to standby mode
  - **Stop Drives**: Stop drives, from test or standby mode

Wiring of external inputs:
- **Relay contact**: make contact on customer side, potential free
- **Voltage**: min. 15 V
- **Current**: min. 100 mA
- **Connection**: dependent to the version 19-pin circular connector outside of control cabinet or terminals inside of cabinet, shielded signal line, max. 100 m

Control outputs:

- **Alarm and overload message**
  - Potential free outputs, wiring:
    - **Relay contact**: opening contact in fail-safe version
    - **Voltage**: max. 24 V
    - **Current**: max. 100 mA
    - **Connection**: dependent to the version 19-pin circular connector outside of control cabinet or terminals inside of cabinet, shielded signal line, max. 100 m

Digital outputs: (options)

- (8 outputs) For End of Analysis Signal - EOAS (use of the first digital output), Automatic Range Selection - ARS of Programmable Analog Outputs and User Defined Limit Value messages: relay contact, potential free.
- **Voltage**: max. 230V ac/dc
- **Current**: max. 0.25 A

Serial interface (option)

For connection of:
- Control electronics - PC
- Single Board Computer (SBC) or Industrial Workstation (IWS) (IWS+SBC into control cabinet) - Distributed Control System (DCS)
- PC - Distributed Control System (DCS)
- In RS 232, RS 485 or 20mA-TTY design

Connection: dependent to the version 7-pin circular connector outside of control cabinet or terminals inside of cabinet, shielded signal line

Configuration:
- **Baud rate**: 9600 baud
- **Data format**: 8 data bits, 1 stop bit, no parity

Cable specification for serial interface:
- **Standard length**: 3 m (in basic version)
- **Max. length**: RS 232 interface: 12 m (optional)
  - RS 485 and 20mA interface: 1000 m (optional)
- **Design**: RS 232: data cable min. 6 x 0,14mm², shielded
  - RS 485: data cable min. 2 x 2 x 0,14mm², Twisted pairs, shielded
  - 20mA-TTY: data cable min. 4 x 0,5mm², shielded
Connecting cable measuring head - Control Electronics:
- in protective sheath, at measuring head and at control cabinet plug-in terminals or connectors
- Standard length: 3 m (in basic version)
- Max. length: 200 m (optional)

Environ. conditions:
- Temp. range: 0 °C - 40 °C
- Rel. humidity: 90 % without condensation
- Protection: IP 54

Miscellaneous:
- Control Cabinet Standard:
  - Dimensions: H=1300mm with base, W=600mm, D=400mm
- Control Cabinet PS 4606:
  - Dimensions: H=2000mm without base, W=600mm, D=600mm
- Control Cabinet PS 4808:
  - Dimensions: H=2000mm without base, W=800mm, D=800mm
- Finish: Pebble gray RAL 7032
- Weight: approx. 150 kg

As operation software the Rheo Online Software for Microsoft® Windows NT® operation system is used. About this see the attached product description ,RHEO ONLINE SOFTWARE for WINDOWS NT®‘.

Windows NT is a registered trademark of Microsoft Corporation.

Hardware Requirements for the PC

The Rheo Online Software runs on a IBM AT-compatible PC with the following requirements:
- Processor Pentium II or higher
- Minimum clock frequency of 350 MHz
- Min 64 MB RAM
- Min. 1 disk drive 3,5" 1,44 MB
- CD-ROM drive
- Min 2 GB hard disk
- VGA color monitor, 1024x768, 17”
- VGA graphic card with at least 4 MB RAM
- Two serial interfaces, the configuration depends on the option ‘Serial Interfaces’ or three serial Interfaces if the option ‘Remote Access’ is ordered
- Parallel interface PRN1 for connecting the printer
- MF keyboard
- Mouse
- At least two free ISA-bus 16 bit slot (if required for PC interface cards)
- Operation system: Windows NT® Workstation 4.0 with Service Pack 5

The PC itself is not included.

In case the required PC is provided by the customer itself following has to be considered:

The PC must be sent to Göttfert prior to final inspection/despatch of the rheometer system. The final inspection test inhouse Göttfert of the relevant rheometer will be performed only with the customer PC, which will be used onsite for operation, to guarantee a troublefree 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 Göttfert on time.
Supported Printers

In general following 3 printer types are applicable:

- **Needle printer**: Usable for endless paper printing; low maintenance requirement; printer cartridges are less cost extensive; poorer printing quality than with inkjet or laser printer; noisy in comparison to inkjet printers; cheap

- **Inkjet printer**: low cost inkjet printers support only single sheet prints, whereas the paper magazine is limited to about 100 sheets; only with restrictions suitable for protocol prints due to single sheet printing; low printing noise color prints possible; relatively high costs for printer cartridge; expensive

  Inkjet printer are also available with tractor feeder that means printing on endless paper is possible, and therefore, suitable for protocol printing. As color prints are possible also suited for graphic print outs, expensive

- **Laser printer**: proper and clear print, faster printout, no color prints, single sheet feeding, low maintenance requirements, favourable operation costs, expensive

As the printer models change quite fast, we indicate only possible printer types as guide data. On request, we can quote at that time current printers meeting the necessary requirements.

- Needle Printer Epson 24 needles, endless paper feed, black/white prints
- Inkjet Printer Epson Stylus Color Series/ Canon BJC Series, color prints, single sheet feeding with paper magazine
- Inkjet Printer for endless sheet prints Epson Stylus Color Series / Canon BJC Series, color print, single sheet feeding or endless paper feeding
- Laser Printer HP Laserjet-Series, black/white print, single sheet feeding

The **Rheo Online Software** supports all printer models that own a Windows NT 4.0 printer driver.

Supplied accessories

1 tool set for installation and maintenance
1 Anti-Seize grease
1 set shearing pins
1 set filter mats
1 set fuses
1 plug set for connection of analog outputs and external signals
1 user information optional in English or German language

The included documentation is delivered only in English or German language.

**Preconditions for a troublefree operation of the MBR 71.92**
In order to guarantee a troublefree operation of the rheometer when being connected to a production extruder or a polymer line, the following conditions have to be fulfilled by the customer at the connection point:

- Melt must be free from dirt particles (particle size ≤ 8µm)
  Applications with dirt particles > 8µm are possible and successful at use. It has to be considered that dependent on the material to be tested an increased wear of the spinning pump may be possible.
- Sufficient constant process pressure has to be available (if possible non-pulsing)
  Note: Constant pressure is of course dependent on what type of material is being used and the length of the adapter. According to our experience when PE is used with standard adapter, we recommend the following prepressures as guide values:
  - MFR (190/2.16) = 0.46 g/10': minimum pressure approx. 30 bar
  - MFR (190/2.16) = 7 g/10': minimum pressure approx. 20 bar
  - MFR (190/2.16) = 22 g/10': minimum pressure approx. 15 bar

Please note that the unit is fitted with microprocessors. The power supply must be free of any interference in order to guarantee trouble-free operation.

**MBR 71.92 basic module**
**MINI BYPASS RHEOGRAPH**
consisting of Measuring Head, Control Electronics, Operation Software and Accessories corresponding to the present product description.
Order number..........................................................................................................................................................5.41.000

**To complete the MBR, the basic model must be supplied customer-specific with the following optional units:**

- 1 capillary die
- 1 pressure transducer
- German or English version
- Control cabinet
- Power supply
- Personal Computer or Industrial Workstation or Single-Board-Computer
- Serial interface to PC or Device Control System: RS 232, RS 485 or 20mA

Additional application-specific options are listed in this product description.

Subject to change due to technical developments.
MBR 71.92 - EEx
MINI BYPASS RHEOGRAPH in Ex-Design

The MINI BYPASS RHEOGRAPH MBR 71.92 - EEx is a continuously measuring capillary rheometer. It is designed for operation in explosive gas atmosphere in dangerous zones 1 and 2, suited for polymer temperatures from 60°C to 265°C.

The MBR 71.92 - EEx is based on the standard model of the MBR. It is assembled out of the same components. Apart from the following supplements the technical data of the standard model are valid, see page 9.

Supplement technical date of the EEx designed MBR
MBR-Measuring Head in EEx dei IIC T2
for operation in explosive gas atmosphere, dangerous zones 1 and 2 (IEC 79-10), suited for polymer temperatures from 60°C to 265°C. Classifications of explosion proofed electrical equipment:

Channel heating: EEx de IIC T2
Drive: EEx e II T3
Terminal boxes: EEx e II T6, EEx ia II T6
Sensor circuits: EEx ib IIC
Protection: IP56
Polymer temperature: 60°C to 265°C

MBR-Control Electronics
in a cabinet for installation outside the explosive-dangerous areas, corresponding to the standard model, with the following modifications:

Safety barriers: for intrinsically save sensor circuits (pressure, iron-constantan, Pt100)
Temperature limiters: for heating and drive
Protection: IP54
Distance to measuring head: max. 200 m

MBR 71.92 - EEx basic model
MINI BYPASS RHEOGRAPH - Measuring Head in Ex-Design EEx dei IIC T2
consisting of Measuring Head, Control Electronics, Rheo Online Software and Accessories corresponding to the present product description.

Order number....................................................................................................................................................5.41.100

On inquiry the MBR 71.92 - EEx is available in temperature class T3. With the maximum surface temperature of 200°C the maximum possible melt temperature is reduced to 175°C.

Subject to change due to technical developments.
Optional units

Language versions and user information:

German version
Control cabinet lettering and user information in German.
Order number....................................................................................................................................................5.41.007

English version
Control cabinet lettering and user information in English.
Order number....................................................................................................................................................5.41.008

User information German
Additional set of user information.
Order number....................................................................................................................................................5.41.010

User information English
Additional set of user information.
Order number....................................................................................................................................................5.41.011

The user information consists of operating manual, technical documentation, calculation basis and program documentation.

Capillaries
With regard to the products to be tested and to the measuring range the appropriate capillaries can be selected from the following.

Capillary die L/D = 20/1
for an MFR range of approx. 1.7 - 1700 g/10 min.
Order number....................................................................................................................................................4.23.428

Capillary die L/D = 40/1
for an MFR range of approx. 1.7 - 1700 g/10 min.
Order number....................................................................................................................................................4.23.434

Capillary die L/D = 20/2
for an MFR range of approx. 0.2 - 200 g/10 min.
Order number....................................................................................................................................................4.23.429

Capillary die L/D = 40/2
for an MFR range of approx. 0.2 - 200 g/10 min.
Order number....................................................................................................................................................4.23.430
Capillary die L/D = 20/3
for an MFR range of approx. 0.06 - 60 g/10 min.
Order number.............................................4.23.432

Capillary die L/D = 40/3
for an MFR range of approx. 0.06 - 60 g/10 min.
Order number.............................................4.23.435

Capillary die L/D = 20/4
for an MFR range of approx. 0.02 - 20 g/10 min.
Order number.............................................4.23.433

Capillary die L/D = 40/4
for an MFR range of approx. 0.02 - 20 g/10 min.
Order number.............................................4.23.431

One Test Pressure Transducers is required in order to measure the melt pressure at the capillary. Please note at the selection of pressure transducer, that you get the highest possible accuracy between 10% and 90% of the nominal values of pressure transducers.

Test Pressure transducers
The following applies for all pressure transducers:
  Quality Class I: combined error ± 0.5 % FSO
  Temperature: max. 400 °C (diaphragm)
  Thread: 1/2"-20 UNF-2A
  Flexible Stem: length = 18"
  Non-German product

Test Pressure transducer 50 bar
Order number.............................................8.81.330

Test Pressure transducer 100 bar
Order number.............................................8.81.331

Test Pressure transducer 200 bar
Order number.............................................8.81.332
The MBR basic unit is supplied with a **Melt Flange** with threaded nozzle M30x1,5 (see drawing at page 3). With this connection the MBR can be flange-mounted on the product line or extruder system without any lifting device.

**Melt Flange as special version**

A special melt flange is available on request and will be designed in accordance with customer specifications.

Order number....................................................................................................................................................9.00.360

On request a heated **Adapter** with or without shut-off valve is available to connect the MBR on the product line or extruder system.

**Adapter as special version**

A special adapter is available on request and will be designed in accordance with customer specifications.

Order number....................................................................................................................................................9.00.786

**Executions of Control cabinet**

**Electronics Cabinet Standard**

for installation of control electronics. The connection cable from the measuring head to the control cabinet is lead into the control cabinet on the right side.

- **Dimensions:**  
  \[ W = 600\text{mm}, \quad D = 400\text{mm}, \quad H = 1300\text{mm}, \quad \text{with pedestal} \]
- **Finish:**  
  Pebble grey RAL 7032

Order number....................................................................................................................................................5.41.220

Alternatively to the control cabinet standard, the control electronics can be installed in one of the following cabinets:

**Electronics Cabinet PS 4606**

for installation of control electronics.

- **Dimensions:**  
  \[ W = 600\text{mm}, \quad D = 600\text{mm}, \quad H = 2100\text{mm}, \quad \text{with pedestal} \]
- **Finish:**  
  Pebble grey RAL 7032

Order number....................................................................................................................................................5.37.307

**Electronics Cabinet PS 4808**

for installation of control electronics.

- **Dimensions:**  
  \[ W = 800\text{mm}, \quad D = 800\text{mm}, \quad H = 2100\text{mm}, \quad \text{with pedestal} \]
- **Finish:**  
  Pebble grey RAL 7032

Order number....................................................................................................................................................5.37.257

**Base 100mm for Electronics Cabinet PS 4606**

Order number....................................................................................................................................................8.50.346
Base 200mm for Electronics Cabinet PS 4606
Order number....................................................................................................................................................8.50.367

Base 100mm for Electronics Cabinet PS 4808
Order number....................................................................................................................................................8.50.350

Base 200mm for Electronics Cabinet PS 4808
Order number....................................................................................................................................................8.50.368

The following options can only be used in connection with the high control cabinets PS 4606 and PS 4808:

By standard, the connection cable from the measuring head to control cabinet is lead into the control cabinet on the right side. Furthermore the following versions are applicable:

**Version of control cabinet**
with cable bushing from **below** into the control cabinet. Installation of fan and filter in the front door, the left and right side wall of control cabinet are kept free.
Order number....................................................................................................................................................5.36.086

**Version of control cabinet**
with cable bushing from **the top** into the control cabinet. Installation of fan and filter in the front door, the left and right side wall of control cabinet are kept free.
Order number....................................................................................................................................................5.36.150

By standard, the connection cables of measuring head sensors are connected in the control cabinet by means of plug-in units. For this purpose following alternative is also applicable:

**Connection of the sensors via terminal strips**
For EEx-devices the connection of the sensors via terminal strips is standard.
Order number....................................................................................................................................................5.41.537
Select one of the following **Power Supplies** for the MBR:

**Power Supply 230V, L+N+PE / 50Hz**
Voltage: 230V, single-phase operation
Permissible voltage fluctuations: ± 10 %
Frequency: 50 Hz ± 1%
Power consumption: Approx. 3.6 kW
Order number: 5.41.005

**Power Supply 3 x 400V, 3L+N+PE / 50Hz**
Voltage: 3 x 400V, three-phase four-wire system
Permissible voltage fluctuations: ± 10 %
Frequency: 50 Hz ± 1%
Power consumption: Approx. 3.8 kW
Order number: 5.41.025

**Power Supply 3 x 400V, 3L+PE / 50Hz**
Voltage: 3 x 400V, three-phase three-wire system
Permissible voltage fluctuations: ± 10 %
Frequency: 50 Hz ± 1%
Power consumption: Approx. 3.8 kW
Order number: 5.41.026

**Power Supply 3 x 230V, 3L+PE / 60Hz**
Voltage: 3 x 230V, three-phase three-wire system
Permissible voltage fluctuations: ± 10 %
Frequency: 60 Hz ± 1%
Power consumption: Approx. 3.8 kW
Order number: 5.41.006

Other power supply voltages available on request.
Computer Configuration

The rheometer will be operated via the Rheo Online Software, which runs on an AT-compatible PC. Different operation modes are possible:

- Stand alone mode: manual operation at the Rheometer
- Stand alone mode with Host Connection: manual operation at the rheometer and test data transmission to a process control system
- Remote mode: Host Connection, operation and test date processing via a process control system

Adjusted to the requirements of the user and the desired control concept, different computer configurations are possible:

- Desktop Personal Computer: stand alone or remote mode possible
- Industrial Workstation: integrated in the control cabinet: stand alone or remote mode possible
- Single-Board-Computer: integrated in the control cabinet: only usable in remote mode

Personal Computer

If the rheometer should be operated via a PC, please see the necessary hardware requirements as listed on page Fehler! Textmarke nicht definier, of this product description. If the operation PC should be supplied by Göttfert, please contact us for an suitable offer, which fulfills these requirements.

Special table

for the Personal Computer and printer.
With multiple socket outlet (x6) for 230-V power supply.
Width: 1100 mm, depth: 750 mm, height: 720 mm

Industrial Workstation

with integrated color display and membrane keypad, installed in the door of control cabinet, for operating the rheometer in stand alone mode or optionally with Host Connection, equipped with:

- Processor P233, 64MB RAM, 2 ser. + 1 parallel interface, ISA VGA graphic
- Hard disk 3 GByte, 3.5” FDD in the front panel
- IMOLA Front panel with color display, membrane keyboard and mouse sensor
- With UPS (uninterruptible power supply)
- 12.1” color TFT display
- MF2-keyboard
- Windows® NT Workstation 4.0 with Service Pack 5 in English or German

The previous listed equipment may vary depending on the application.
The Industrial Workstation can be used only together with the high built cabinets, Option 5.37.307 or 5.37.257.

Industrial Workstation, English Version

Order Number : ..................................................5.40.695

Industrial Workstation, German Version

Order Number : ..................................................5.40.694

Single-Board-Computer
It can be used a single board computer (SBC) of controlling the test device alternative to a desktop PC or a industrial workstation.
The SBC can be installed in a standard control cabinet and works without display and keyboard. All operation functions have to be taken over by the DCS. It is not possible to operate and control the rheometer via the control cabinet.
For commissioning and servicing purposes it is possible to connect a monitor and a keyboard.
As the controlling of the single board computer is happened via a data control system (DCS) you have to lay down the software interface between SBC and host computer (modbus or a other protocol).

Please contact us for an actual offer about a Single Board Computer.

**Remote Access**

To help you with problems with the operating software or with the handling of the machine we recommend to use a remote control software. This will enable our service technicians to control your machine from our company remotely. It is also possible to install program updates and to fix configuration problems.

We strongly recommend the usage of the option “Remote Access”

Option “Remote Access” contains the remote control software, a modem, one serial interface card for PCI-bus (only by PC and IWS) and the needed cable material. The connections for the analog telephone lines are realized as terminal strips.

**Remote Access for personal computers / PC (desktop)**

English version of the remote control software
Order Number .......................................................... 5.40.308

German version of the remote control software
Order Number .......................................................... 5.40.319

**Remote Access for Industrial Workstation / IWS**

English version of the remote control software
Order Number .......................................................... 5.40.321

German version of the remote control software
Order Number .......................................................... 5.40.320

**Remote Access for Single-Board-Computer / SBC**

English version of the remote control software
Order Number .......................................................... 5.40.323

German version of the remote control software
Order Number .......................................................... 5.40.322
Serial Interfaces

For detailed information on the available serial interfaces and their application purpose – please refer to page 22 ‘Application of Serial Interfaces’.

For connecting the control electronics and the visualization PC following serial interfaces are available:

**RS 232 Interface**
With connection cable to the PC. The connection cable at the PC side is terminated with a 9-poles socket (female).
Order Number ...................................................................................................................................................5.39.186

**RS 485 Interface with PC plug in card**
With interface in the control cabinet, connection cable and PC plug in card, opto-isolated.
Order Number ...................................................................................................................................................5.39.170

**RS 485 Interface with interface at the PC**
With interface in the control cabinet, connection cable and RS 485 <> RS 232 interface to connect at the standard RS 232 PC-interface, opto-isolated. The connection of the interface at the PC is executed as 25-poles socket or via an adapter as 9-poles socket (female).
Order Number ...................................................................................................................................................5.39.171

**20mA Interface (TTY)**
With interface in the control cabinet, connection cable and PC plug in card, opto-isolated.
Order Number ...................................................................................................................................................5.39.172

For connecting the PC and the Device Control System (DCS) the following serial interfaces are available:

**RS 232 Interfaces**
With connection cable from the standard RS 232 PC-interface to the DCS.
Order Number ...................................................................................................................................................6.82.506

**RS 485 Interfaces with PC plug in card**
With PC plug in card and connection cable from PC to the DCS, opto-isolated.
Order Number ...................................................................................................................................................5.39.176

**RS 485 Interfaces with interface at the PC**
With RS 485 <> RS 232 interface at the standard RS 232 PC-interface and connection cable from PC to the DCS, opto-isolated.
Order Number ...................................................................................................................................................5.39.177
**20mA Interfaces (TTY)**
With PC plug in card and connection cable from PC to the DCS, opto-isolated.
Order Number ...................................................................................................................................................5.39.178

If the PC is provided by the customer we recommend the serial interface configuration ‘RS 485 Interfaces with interface at the PC’. By this implementation you have not to make changes in your PC-hardware to realize a RS485 connection.

The standard scope of supply includes a 3m connection cable, which is delivered together with your ordered serial interface. If you require a longer connection cable, you have to order the additionally required length (see options ‘cable extension of interfaces’ on page 22).

For Connecting the **Industrial Workstation (IWS)** or **Single Board Computer (SBC)** and the **Device Control System (DCS)** following serial interfaces are available:

**RS 232 Interfaces**
With connection cable from control cabinet to the DCS.
Order Number ...................................................................................................................................................5.39.173

**RS 485 Interfaces**
With RS 485 <> RS 232 interface in the control cabinet and connection cable from the control cabinet to the DCS, opto-isolated.
Order Number ...................................................................................................................................................5.39.174

**20mA Interfaces**
With 20mA <> RS 232 interface in the control cabinet and connection cable from control cabinet to the DCS, opto-isolated.
Order Number ...................................................................................................................................................5.39.175

The standard scope of supply includes a 3m connection cable, which is delivered together with your ordered serial interface. If you require a longer connection cable, you have to order the additionally required length (see options ‘cable extension of interfaces’ on page 22).

The standard connection cable to the DCS is executed for connection to terminal strips. If required, the connection cable at DCS connection side can be additionally equipped by a plug connector with shielded housing:

**Connection 9-polig Socket (female) DSUB**
Order Number ...................................................................................................................................................5.39.181

**Connection 9-polig Plug (male) DSUB**
Order Number ...................................................................................................................................................5.39.182

**Connection 25-polig Socket (female) DSUB**
Order Number ...................................................................................................................................................5.39.183

Connection 25-polig Plug (male) DSUB
Order Number ...................................................................................................................................................5.39.184

Cable extensions of the interfaces

To the extension of the serial connection of:
- Electronic and PC or
- PC and Device Control System or
- Industrial Workstation or Single Board Computer and Device Control System

The standard connection cable and the respective extension is supplied as one unit.

Cable extension of RS 232 interface
The connecting cable can be extended to a maximum of 12 m. Please specify the cable extension (m) when placing the order.
Order Number ...................................................................................................................................................5.39.159

Cable extension of RS 485 interface
The connecting cable can be extended to a maximum of 1000 m. Please specify the cable extension (m) when placing the order.
Order Number ...................................................................................................................................................5.39.029

Cable extension of 20mA interface
The connecting cable can be extended to a maximum of 1000 m. Please specify the cable extension (m) when placing the order.
Order Number ...................................................................................................................................................5.39.180

Application of Serial Interfaces

RS 232: for short distances (max. 12m) between operation PC and rheometer – for example for laboratory applications.

RS 485: for larger distances (upto 1000m) for production applications, not sensitive by suppression of common-mode interferences, BUS system, high data transmission rate (upto 100 kBaud).

20 mA: for larger distances (upto 1000m) for production applications, safe data transfer by transmission via impressed current, low data transmission rate (normally max. 9600 Baud).
Analog test data output

There are 2 programmable analog outputs available in addition to the preassigned outputs listed below.

Both programmable analog outputs are configured separately via a menu in the Rheo Online Software. One of the measured or calculated signals of single-point measurement can be selected for each programmable analog output ordered:

- speed-, pressure-, melt temperature- and steel temperature values
- melt index MFR(TM), temperature compensated melt index MFR(T0)
- melt volume index MVR(TM), temperature compensated melt volume index MVR(T0)
- apparent viscosity, apparent shear stress and apparent shear rate

The indicating range of the two programmable analog outputs can be set in two ways:

- manually adjustable indicating ranges
- automatic range selection between several free defined ranges. The indication of the active ranges is given via digital outputs.

The following values apply for all analog outputs:

<table>
<thead>
<tr>
<th>Output</th>
<th>Load</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 - 20 mA, potential free</td>
<td>0 - 500 ohms</td>
<td>&lt; 0.2 % from the limit value</td>
</tr>
</tbody>
</table>

**Programmable analog output 1**
Output current 4 - 20 mA
Order number.................................5.39.169

**Programmable analog output 2**
Output current 4 - 20 mA
Order number.................................5.39.168

**Analog output pressure P1**
Output current 4 - 20 mA corresponding 0 - Pnom.
Order number.................................5.39.021

**Analog output melt temperature TM**
Output current 4 - 20 mA corresponding 0 - 480°C, non-linearized
Order number.................................5.39.023
Digital Outputs

The option digital outputs contains 8 potential free relay-outputs. Output 1 is realized as a change-over contact and the outputs 2-8 are realized as closing contacts. For technical data see ‘Technical Data Control Electronics’.

Following signals can be given out via digital outputs:

- **EOAS - End of Analysis Signal**
  To find out, in connection with the analog outputs, when a test point was taken, there is given a pulse over a digital output. The signal can be realized as an opening or closing contact. The first digital output will be designated.

- **Limit Value Indicator**
  The operation program supports user defined limit values for all measured and calculated values. If the limit of a value is exceeded, a signal can be output digitally. For each limit value you need one digital output.

- **Operation state**
  Following states are given out:
  - motors in operation
  - test active
  - standby mode active
  - error active
  One digital output is required for one status signal.

- **Automatic Range Switching - ARS**
  For the options „programable analog outputs“: The automatic range switching can be used for improvement of the resolution range, when a connection to the DCS is made via the programable analog outputs. That means there are several ranges defined for a value to be measured, between which the rheometer can switch automatically. The indication of the active measuring range is coded via digital outputs.

  The quantity of possible measuring ranges is calculated out of the equation $2^n$, where $n$ is the amount of digital outputs, which are applicable for this analog output. Please see the below table:

<table>
<thead>
<tr>
<th>Max. quantity of applicable measuring ranges</th>
<th>Required digital outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>16</td>
<td>4</td>
</tr>
</tbody>
</table>
Digital Outputs
8 potential-free relay contacts (the first is a change-over contact and the other 7 are closing contacts)
Order Number ...................................................................................................................................................5.40.328

Start/Stop at the extruder
Separate console with emergency stop switch and two start/stop buttons with following functions:
Standby: the pumps are started in standby mode
Start test: the test is started from standstill or standby mode
Stop test: the test is finished and the pumps work in standby mode
Stop: the test is finished and the pumps are switched off.

We recommend that this console be used if the PC is not positioned in the immediate vicinity of the measuring head.

The console must be mounted by the customer. The Connection on the measuring head is made via the supplied cable with connector. The standard cable length is made up of a 3m cable from the Control Electronics to the measuring head and a 3m cable from the console to the measuring head.
For special applications, where the Start/Stop is not located near to the measuring head as usual, the connection cables between the console and the Control Electronics have to be installed separately.
Order number....................................................................................................................................................5.41.015

Cable extension Start/Stop - Control Electronics
The connecting cable is made up of the cable between Control Electronics and measuring head and the cable extension between measuring head and consol. Please specify the cable extension (m) when placing the order.
Order number....................................................................................................................................................5.40.211

ETA/MFR display at the extruder
4-digit digital display which indicates the viscosity or the MFR value. This display uses programmable analog output 1. Therefore there is only one other programmable analog output available.

The digital display must be mounted by the customer. The Connection ensues via the supplied cable with connector. The standard cable length is made up of a 3m cable from the Control Electronics to the measuring head and a 3m cable from the display to the measuring head.
For special applications, where the display is not located near to the measuring head as usual, the connection cables between the display and the Control Electronics have to be installed separately.
Order number....................................................................................................................................................5.40.214

Cable extension ETA/MFR display - Control Electronics
The connecting cable is made up of the cable extension between Control Electronics and measuring head and the cable extension between measuring head and display. Please specify the cable extension (m) when placing the order.
Order number....................................................................................................................................................5.40.213
Cable extension measuring head - Control Electronics
The connecting cable between the measuring head and Control Electronics can be extended to 200 m. The cable extension has a 3-m protective sheath at either end. Please specify the cable extension (m) when placing the order.

Order number....................................................................................................................................................5.41.013

Optional Units for the EEx-designed models:

Start/Stop at the extruder in EEx-design
Separate console with emergency stop switch and two start/stop buttons with following functions:
- Standby: the pumps are started in standby mode
- Start test: the test is started from standstill or standby mode
- Stop test: the test is finished and the pumps work in standby mode
- Stop: the test is finished and the pumps are switched off.

Classifications of the explosion proofed electrical equipment:
- Console: EEx de IIC T6
- Circuits: EEx ib IIC
- Connectors: EEx i I/II

We recommend that this console be used if the PC is not positioned in the immediate vicinity of the measuring head.

The console must be mounted by the customer. The Connection on the measuring head is made via the supplied cable with connector. The standard cable length is made up of a 3m cable from the Control Electronics to the measuring head and a 3m cable from the console to the measuring head. For special applications, where the Start/Stop is not located near to the measuring head as usual, the connection cables between the console and the Control Electronics have to be installed separately.

Order number....................................................................................................................................................5.41.136

Cable extension Start/Stop - Control Electronics in EEx-design
The connecting cable is made up of the cable extension between Control Electronics and measuring head and the cable extension between measuring head and consol. Please specify the cable extension (m) when placing the order. Please specify the cable extension (m) when placing the order.

Order number....................................................................................................................................................5.41.139

ETA/MFR display in EEx-design
4-digit digital display which indicates the viscosity or the MFR value. This display uses programmable analog output 1. Therefore there is only one other programmable analog output available.

Classifications of the explosion proofed electrical equipment:
- Display: EEx de IIC T6
- Circuits: EEx ib IIC
- Connectors: EEx i I/II

The digital display must be mounted by the customer. The Connection ensues via the supplied cable with connector. The standard cable length is made up of a 3m cable from the Control Electronics to the measuring head and a 3m cable from the display to the measuring head. For special applications, where the display is not located near to the measuring head as usual, the connection cables between the display and the Control Electronics have to be installed separately.

Order number....................................................................................................................................................5.41.137
Cable extension ETA/MFR display - Control Electronics in EEx-design
The connecting cable is made up of the cable extension between Control Electronics and measuring head and the cable extension between measuring head and display. Please specify the cable extension (m) when placing the order. Please specify the cable extension (m) when placing the order.
Order number...............................................................................................................................................................5.41.138

Cable extension EEEx-measuring head - Control Electronics
The connecting cable between the EEEx-measuring head and Control Electronics can be extended up to 200m. The cable extension has a 3m protective sheath at either end. Please specify the cable extension (m) when placing the order.
Order number...............................................................................................................................................................5.41.140

Engineering Support
On request, Göttfert can provide special engineering assistance to our customers. This support would cover following:

- Customer will be provided with detailed plans, drawings for adaption of the rheometer on customer site
- A dummy model of the rheometer (dimensional accordance to original rheometer) for evaluation of the space requirements on extruder side
- Negotiations and discussions for the best solution with the extruder manufacturer to optimize spool piece and rheometer adapter as well as joint supply of both parts
- Definition of optimal test parameters for the customer material grades in Göttfert’s lab to optimize the calibration of the rheometer at customer site

Order number...............................................................................................................................................................9.01.557

Following design is possible on request:
- Control Cabinet design in IP 65

Subject to change due to technical developments.
<table>
<thead>
<tr>
<th>Order number</th>
<th>Naming</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic units:</strong></td>
<td></td>
</tr>
</tbody>
</table>
| 5.41.000 | **MBR 71.92 MINI BYPASS RHEOGRAPH**  
basic model comprising measuring head,  
control electronics and Software |
| 5.41.100 | **MBR 71.92 - EEx MINI BYPASS RHEOGRAPH**  
basic model comprising EEx-measur. head,  
control electronics and Software |
| **Options:** | |
| 5.41.007 | **German version**  
Control cabinet lettering and  
user manual in German. |
| 5.41.008 | **English version**  
Control cabinet lettering and  
user manual in German. |
| 5.41.010 | **User manual**  
MBR 71.92, German |
| 5.41.011 | **User manual**  
MBR 71.92, English |
| 4.23.428 | **Capillary die L/D = 20/1** |
| 4.23.434 | **Capillary die L/D = 40/1** |
| 4.23.429 | **Capillary die L/D = 20/2** |
| 4.23.430 | **Capillary die L/D = 40/2** |
| 4.23.432 | **Capillary die L/D = 20/3** |
| 4.23.435 | **Capillary die L/D = 40/3** |
| 4.23.433 | **Capillary die L/D = 20/4** |
| 4.23.431 | **Capillary die L/D = 40/4** |
| 8.81.330 | **Test Pressure transducer 400°C, 0–50 bar**  
Thread: 1/2"-20UNF-2A  
Class I: ±0.5% of nominal value |
8.81.331  **Test Pressure transducer 400°C, 0–100bar**  
Thread: 1/2"-20UNF-2A  
Class I: ±0.5% of nominal value

8.81.332  **Test Pressure transducer 400°C, 0–200bar**  
Thread: 1/2"-20UNF-2A  
Class I: ±0.5% of nominal value

9.00.360  **Melt Flange as special version**  
in accordance with customer specifications

9.00.786  **Adapter in special version**  
in accordance with customer specifications

5.41.220  **Electronics Cabinet Standard**  
Width: 600mm, depth: 400mm, height: 1300mm

5.37.307  **Electronics Cabinet PS 4606**  
Width: 600mm, depth: 600mm, height: 2100mm

5.37.257  **Electronics Cabinet PS 4808**  
Width: 800mm, depth: 800mm, height: 2100mm

8.50.346  **Base 100mm for Electr. Cabint PS4606**

8.50.367  **Base 200mm for Electr. Cabint PS4606**

8.50.350  **Base 100mm for Electr. Cabint PS4808**

8.50.368  **Base 200mm for Electr. Cabint PS4808**

5.36.086  **Version of Control Cabinet**  
with cable bushing from below into control cabinet

5.36.150  **Version of Control Cabinet**  
with cable bushing from the top into control cabinet

5.41.537  **Connection of the sensors via terminal strips**

5.41.005  **Power supply 230V, L+N+PE, 50Hz**  
230V, single-phase operation.

5.41.025  **Power supply 3 x 400V, 3L+N+PE, 50Hz**  
3 x 400V, three-phase four-wire system.

5.41.026  **Power supply 3 x 400V, 3L+PE, 50Hz**  
3 x 400V, three-phase three-wire system.
5.41.006  **Power supply 3 x 230 V, 3L+PE, 60Hz**  
3 x 230V, three-phase three-wire system.

5.13.300  **Special table**  
Width:1100mm, depth:750mm, height:720mm

5.40.695  **Industrial Workstation**  
English Version

5.40.694  **Industrial Workstation**  
German Version

5.40.308  **Remote Access for PC (desktop)**  
English Version

5.40.319  **Remote Access for PC (desktop)**  
German Version

5.40.321  **Remote Access for IWS**  
English Version

5.40.320  **Remote Access for IWS**  
German Version

5.40.323  **Remote Access for SBC**  
English Version

5.40.322  **Remote Access for SBC**  
German Version

5.39.186  **RS 232 interface (Electr.-PC)**

5.39.170  **RS 485 interface (Electr.-PC)**  
With interface in the control cabinet and PC card

5.39.171  **RS 485 interface (Electr.-PC)**  
With interface in the control cabinet and RS485<>RS232 interface at the PC

5.39.172  **20mA interface (TTY) (Electr.-PC)**  
With interface in the control cabinet and PC card

6.82.506  **RS 232 interface (PC-PLS)**

5.39.176  **RS 485 interface (PC-PLS)**  
With interface in the control cabinet and connection cable to the DCS

5.39.177  **RS 485 interface (PC-PLS)**  
With RS485<>RS232 interface at the PC and connection cable to the DCS
20mA interface (TTY), (PC-PLS)  
With PC card and connection cable to the DCS

RS 232 interface (IWS,SBC-PLS)  
With connection cable to the DCS

RS 485 interface (IWS,SBC-PLS)  
With interface in the control cabinet and connection cable to the DCS

20mA interface (TTY), (IWS,SBC-PLS)  
With interface in the control cabinet and connection cable to the DCS

Connection 9-polig socket DSUB  
for connection cable PC, IWS, SBC - PLS

Connection 9-polig plug DSUB  
for connection cable PC, IWS, SBC - PLS

Connection 25-polig socket DSUB  
for connection cable PC, IWS, SBC - PLS

Connection 25-polig plug DSUB  
for connection cable PC, IWS, SBC - PLS

Cable extension of RS232 interface  
Specify the cable extension (m) when placing the order.

Cable extension of RS485 interface  
Specify the cable extension (m) when placing the order.

Cable extension of 20mA interface  
Specify the cable extension (m) when placing the order.

Programmable analog output 1  
for all test values of single point measurement, output 4 - 20 mA

Programmable analog output 2  
for all test values of single point measurement, output 4 - 20 mA

Analog output pressure P1
Output current 4 - 20 mA

5.39.023 Analog output melt temperature TM1
Output current 4 - 20 mA, non-linearised

5.40.328 Digital Outputs
8 potential-free relay contacts

5.41.015 Start/Stop at extruder
Console with emergency stop and start/stop buttons, mounted by the customer.

5.40.211 Cable extension Start/Stop-Control
Electronics, specify the cable extension (m) when placing the order (max. 17m)

5.40.214 ETA/MFR display at the extruder
4-digit digital display for viscosity or MFR, mounted by the customer

5.40.213 Cable extension ETA/MFR disp.-Control
Electronics, specify the cable extension (m) when placing the order (max. 17m)

5.41.013 Cable extension meas.head-Control Elect.
Specify the cable extension (m) when placing the order (max. 197m)

5.39.029 Cable extension Control Electronics - PC
Specify the cable extension (m) when placing the order (max. 997m)

5.41.136 Start/Stop at extruder in EEx-design
EEx deib IIC T6, console with emerg.stop and start/stop, mounted by the customer.

5.41.139 Cable extension Start/Stop in EEx-design
Specify the cable extension (m) when placing the order (max. 17m)

5.41.137 ETA/MFR display in EEx-design
EEx ib IIC T6, 4-digit digital display for ETA or MFR, mounted by the customer

5.41.138 Cable extension ETA/MFR in EEx-design
Specify the cable extension (m) when placing the order (max. 17m)

5.41.140 Cable extension EEx-meas.head-Control Electronics. Specify the cable extension (m) when placing the order (max. 197m)

9.01.557 Engineering Support engineering assistance to our customers