

**Generating and visualizing process information about the rheological and molecular structure of polymers in realtime as well as providing the data for higher level IT systems.**



### Online Measurement Technology

#### Our Highlight:

**The simultaneous detection of the MFR/MVR value, viscosity spectrum and the flow exponent  $n$  ( $MW/Mn$ )**

Beyond these many numerous options offer for example the possibility of the IR /UV or FTNIR determination. Furthermore the Online Rheometer can be modified to an At-Line Rheometer by adding an Extruder as a melt feeder (optional with fully automated Online Sampler for continuous material feeding).

By the use of a 90° deflection head the measurement of elongation, the die swell or the flow instabilities (Shark Skin) of the melt can be extended.

#### Included:

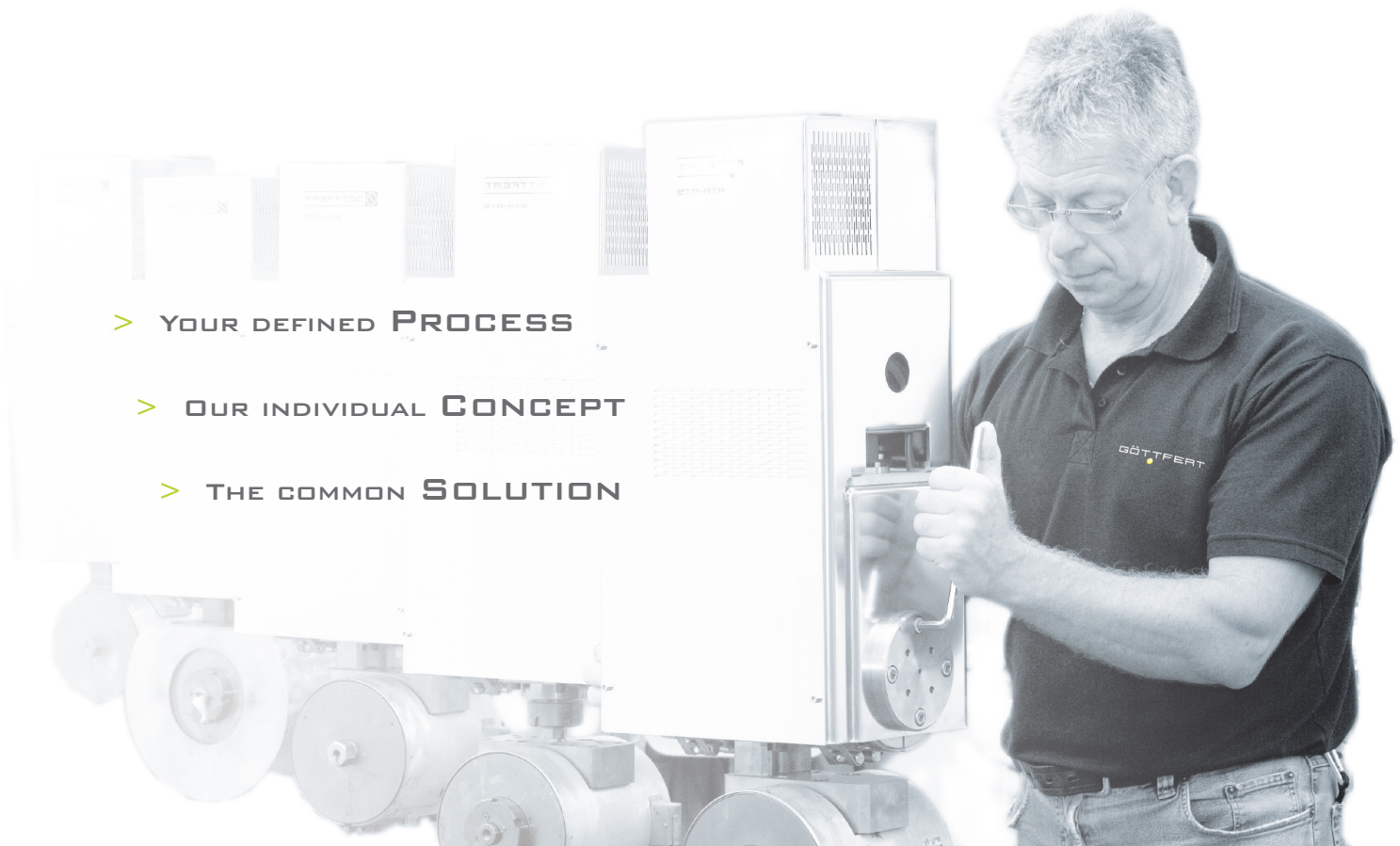
- Advanced shear rate range up to 5 decades
- Online detection of the bagley correction and wall slip
- Consideration of dissipation of the spinning pump and die
- Compensation of process temperature deviations up to 40°C
- Correlation to the intrinsic viscosity

Instead of the standard deflection head a wide slit die or round hole die can be installed to operate a follow up unit like a Blown Film or Flat Film System with optical analysis function.

A complete line assembled by single components we call AT-LINE STATION (see the separate brochure).

So this multifunctional system delivers virtually unlimited possibilities of the continuous Online Measurement Technology. Even in hazardous areas!

Our technical application department for the concept design is at your disposal, that no open question will exist.



## The Differences

### Individual properties, specified to your process

In order to give a statement about material characteristics as well as the processability an Online Rheometer delivers data continuously. So the process and the application define the measuring testing device. Here the overview:



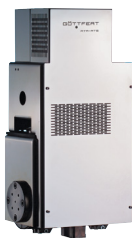
#### > Rheometer without melt return into the process (MBR/MBR-TD)

- Especially suitable for small charges and often changing product
- Small inner volume to reduce the melt holding time
- Purge valve for fast product change
- Extendable with melt tensile measurement (RHEOTENS at melt strand output)
- Costs for waste handling



#### > Rheometer with melt return (SSR)

- No material waste
- Different die lengths of up to 92 mm
- Extruder installation also later possible (only one bore required!)
- Mounting position variable
- Simple calibration to MFR
- Relatively long responding time at low speeds



#### > Realtime Rheometer with melt return and Bypass (RTR/RTS-TD)

- No material waste
- Very short responding time due to circulation pump
- Very short melt holding time to reduce material depending degradation
- Significantly larger MFR measuring range as MBR or SSR
- Continuous circulating volume stream by **second melt pump**
- Especially suitable for production surveillance
- No loss of time by purging procedures

### Extensions for advanced rheological material characterization

By the combination of an AT-LINE RHEOMETER (ALR), existing of the options

- EXTRUSIOMETER
- automatic material feeding (Silo, product line, ...),
- Additive compound metering,
- Online Rheometer,
- Follow up units and including
- Waste management

a complete self-running system can be built up, which does not leave any characteristic values open, serving to a Database or a Distributed Control System.

Our technical application department stands close to your side from the beginning of the project conception, even for special performances. Please see also more details in our separate brochure „AT-LINE STATION“.

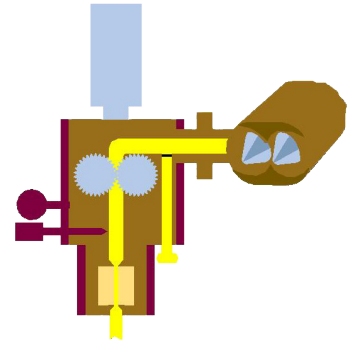


Example view  
AT-LINE RHEOMETER (ALR-R) with options



### MINI BYPASS RHEOGRAPH (MBR)

One of the most outstanding features of the **MINI BYPASS RHEOGRAPH MBR** is its compact size. With a width of **approx. 150 mm** this system is one of the smallest Online Rheometer available. Even in tight space this new design can be installed without problems. The reduced weight of **30 kg only** eliminates costly mounting arrangements. A **new die change system** makes die changes quick and easy.



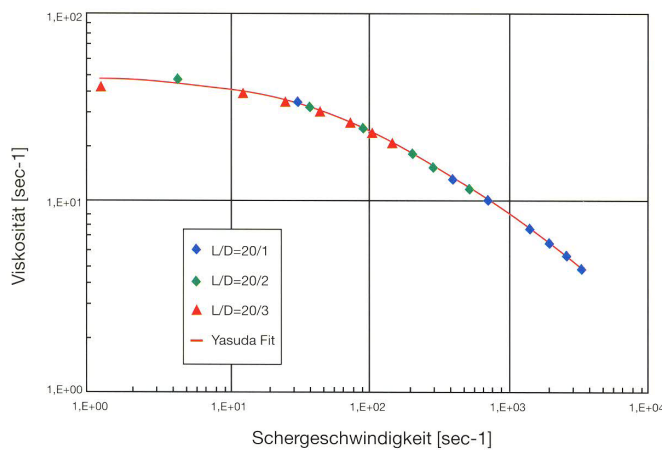
Measuring principle MBR

The MBR has been designed specifically for finishing and compounding processes, which typically have frequent product changes. Its compact size allows a simple and easy installation. 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.

### MBR-TD

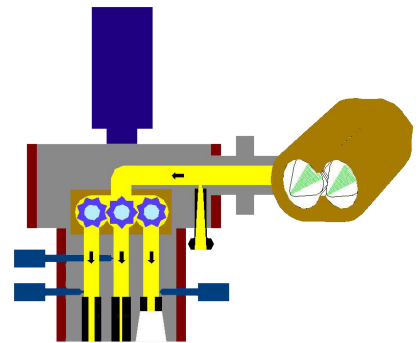
The MBR-TD is the first Online Rheometer with three simultaneously fed dies. The „**MINI BYPASS RHEOGRAPH Triple Die**“ is the consequent further development of the single die MBR, which was equipped with the latest version of drive technology (**high resolution speed control** via servo motor).

So the MBR-TD covers the maximum shear rate range of 5 decades by an Online Rheometer.



#### The Advantages:

- Advanced shear rate range of 5 decades
- 4 parameter Model adjustment (Yasuda)
- Permanent Bagley correction
- Wide speed frequency range (1:1000)



MBR-TD with three dies



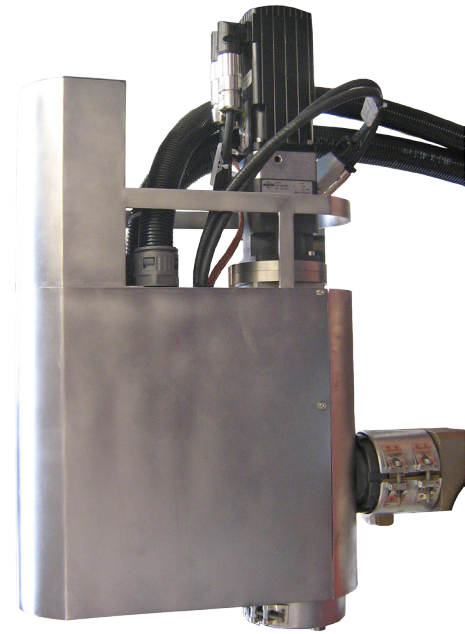
## SIDE-STREAM-RHEOMETER (SSR)

### The melt return Online Rheometer with its unique annular transfer line for one port hole installation

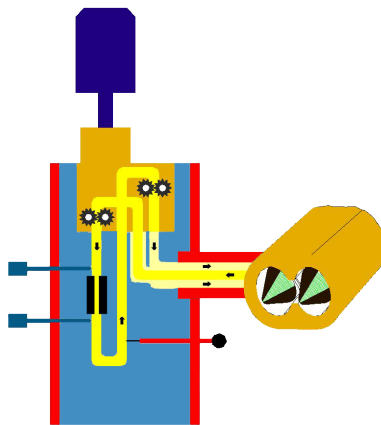
The SSR annular clearance connection is compatible with the standardized M18x1,5" bore (alternatively also M26 or M36 x 1,5"). So a flexible and quick installation is possible to any existing bore of the Extruder, which was prepared for example to a pressure or temperature sensor. This means a minimum of planning effort close to low costs, an expensive modification of the Extruder with a suitable adapter plate is not necessary.

#### Other outstanding features:

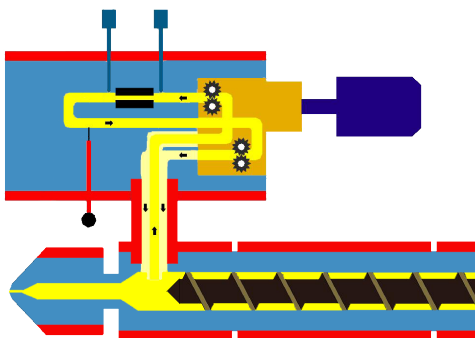
- Compact design, isolated pressure transducers
- With the exception of the pump and closing valve completely made of stainless and acid resistant steel
- Bypass valve in melt inlet and outlet after the die
- Huge measuring range by a shear rate range of 1:1000
- Operation with a constant speed (shear rate) or constant pressure (shear stress)
- Two-components pump for a maximum of control accuracy



SSR Standard



SSR, horizontal installation

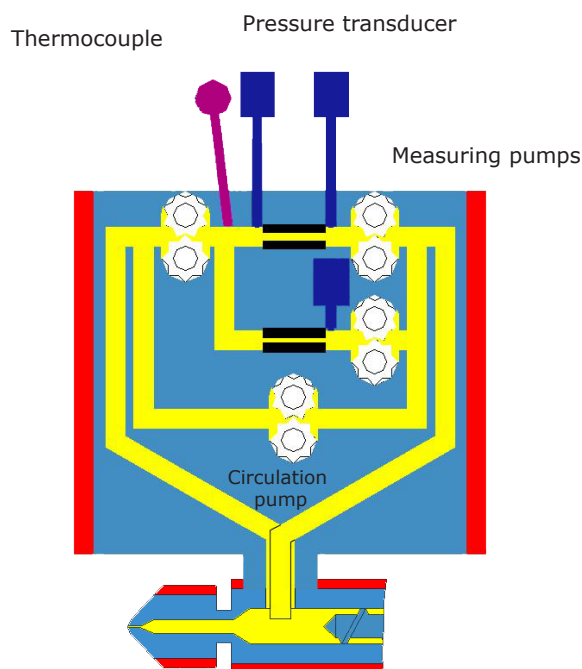


SSR, vertical installation



SSR in explosion safe design





Working principle of the RTS-TD

### The Real Time Concept - The solution: RTR/RTS-TD

The RTR was the first Online Capillary Rheometer on the market with its patented three-pump-system. The number of installations worldwide in the **three digit range** are a positive proof that the RTR has defined the best-in-class in Online Rheometry.

Especially for low MI materials, it is crucial to generate the measurement results as fast as possible. This can take an ordinary rheometer (single pump) more than an hour. The independently controlled circulation pump in the RTR delivers the melt to the capillary autonomous of the viscosity of the material, within minutes, mandatory for fast process control.

### Round Hole versus Slit Die

- Better simulation of the melt index lab test (instrument similarity)
- Better self cleaning capabilities of a round capillary compared to a slit die with dead edges
- Larger measuring window using a capillary
- Less prone for slippage in a round capillary
- Capable of using a second capillary for extended measurement range

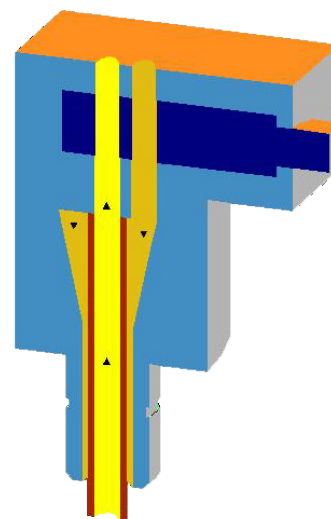
### Inlet- and outlet stream in one pipe – the annular die system

For the melt return into the main polymer stream of the Extruder normally a separate inlet and outlet pipe connection with two bores would be necessary; also to disconnect the Rheometer or for Service work two shutoff valves are required.

The annular die system of the RTR/RTS-TD **requires only a single bore** with a minimum diameter of 26 mm.

Further, only **one** single shutoff valve is required to interrupt both inlet and outlet streams.

The annular die system offers the most flexible option to install the RTR/RTS-TD onto extruder heads, needing only a single bore. This simplifies the problem of retrofitting extruders with limited access.



Sectional drawing of the annular clearance principle

**RTR/RTS-TD**

The **REAL TIME RHEOMETER** is a Capillary Rheometer used in online quality control, which performs measurements on a continuous basis. Its purpose is in production control and for monitoring high and low-viscosity polymers in the production and processing of raw materials.

Important rheological variables in real-time mode are being supplied, which are used to access the properties of the polymer.

The melt from the material supply line is fed back into the process stream by the REAL TIME RHEOMETER in a closed circuit after the test has been performed.

Fresh melt is continuously supplied to the capillary via a circulating stream (CS) which is overlaid to the actual measuring stream (MS).

To extend the measuring range the RTR can be modified easily to a RTS-TD by an optional kit.



RTR-Ex  
(in explosion-proof design)



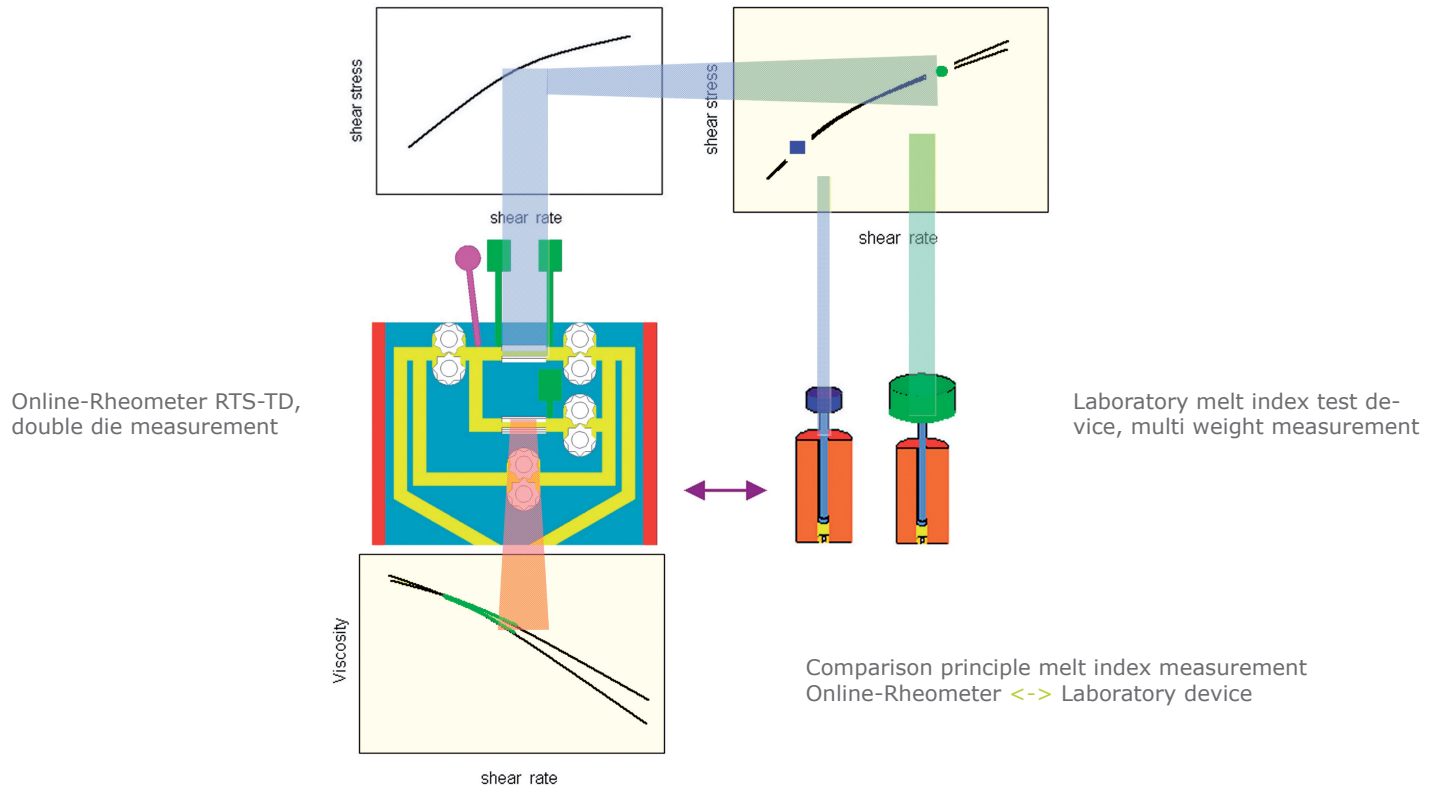
RTR in standard design

**Characteristic features of the REAL TIME RHEOMETER:**

- Measuring Head connectable directly to the production line
- Separated control electronics
- Melt return flow
- Circulating stream helps keeping residence times and response time to a minimum
- Large measuring range due to shear rate range of 1:1000
- Run at a constant speed (shear rate) or constant pressure (shear stress)
- Single or multi-point measurement
- Operation selectable between PC, Industry Workstation or higher level IT system (DCS)
- Prepared with additional measuring bores e.g. for IR/UV measurement
- 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 corresponds to laboratory tests with different weights
  - Apparent viscosity, shear stress and shear rate
  - Elastic fluid components

### From Real Time Rheometer RTR to Real Time Spectrometer RTS-TD

- By the use of the newly developed twin dies and the work of 3 or 4 pressure transducers a specified range of the viscosity function under single point conditions are saved continuously.
- As like a basic feature in the RTR of course the melt index and/or volume index (MFI / MVI) are being determined
- Measurement values are the MVR, the viscosity function and the flow exponent



### Out of the construction principle of the RTR/RTS-TD follows these advantages:

- **Melt return:** No melt is lost. There is no waste handling and removal necessary
- **Short remain time:** As the capacity of the circulation volume stream is up to 100 times above the capacity of the measuring volume stream, polymer-induced degradation processes are prevented by the corresponding short holding time
- **Short responding time:** By the short remaining time results in a short responding time when changing the material
- **Huge measuring range:** As by the circulation volume stream always a sufficient output capacity is given, the measuring volume stream can be run with smallest pump speeds. The usable control range is 1:1000, this means for example a MFR range from 0.3 to 100 [g/10 Min.]
- Change of the molecular structure can be detected down to a shear rate of 0.1 [1/s]
- No moving parts used at the outside, so less susceptibility and service-friendly continuous operation
- Use of CAN bus technology, a proven technology even at wide distances of up to 200 m
- Comfortable control by PC or industry workstation Software and separate touch screen for status information in the control cabinet, even under rough production conditions



**ROSWin****Multifunctional Software-System for the complete control of all Online Rheometers, EXTRUSIOMETER and Follow Up Units**

The Rheo Online Software for Windows, short named ROSWin, is the operating and visualization software for all continuously measuring Online-Rheometers and measuring extruders (EXTRUSIOMETER). Follow up units can be included easily.

ROSWin runs on all Microsoft Windows™ 32 bit operating systems and stands as a stable base for all Online Rheometer as well as the periphery.

Continuous inhouse tests and successful and problem-free running customer applications guarantee an interruption-free operation of the components. Easy usage, flexible views and open interfaces make ROSWin to the standard in the online technology.

Beside the analog data communication also interfaces like Modbus RTU/ASCII, Profibus DP as well as OPC-Server and fibre glass are being supported to communicate with higher level IT systems (DCS).

The Rheo Online Software comes with an extensive ammount of evaluation features, the wellproven Software "WinRheo II" can be used for the post-editing of the measured data.

**More comfortable highlights of ROSWin:**

- Configuration of the rheometer for different measurement procedures with data sets
- Saving of all parameters and measuring data in databases
- Rheologic evaluation of the measured data (extended evaluation with WinRheo II)
- Display of all measuring values in tables as well as diagrams and trends
- Protocol printouts of measurements, alarms and parameters, free definable
- Access rights und free definable window arrangements for individual visualization
- Automatic calibration of the rheometer to preset MFR/MVR set values
- Limits for all measuring values configurable
- Digital output of operational state
- Network connection

## Our customer support services

**Especially for instruments mounted directly in the manufacturing process, a fast solution of problems is highly appreciated to continue the control.**

GÖTTFERT testing devices stands for a **long lifetime** with an extremely low default rate. Numerous reference projects confirm this.

However, should there be any troubles with your instrument you can rely on our world wide service net, which enables a fast reaction in any case. Our specially trained Service-Team keeps your devices and the test results constantly on a high level of accuracy, even when they are exposed under heavy operational stress.

## Maintenance and Servicing

Regular maintenance visits improve the reliability of your equipment! We offer Service contracts unique to your needs to keep the systems always on a high level of quality. Our team of specialists and the certified quality management system according to the international standard DIN EN ISO 9001 guarantee this for your satisfaction.

## Remote maintenance

The use of our special remote control software, the **RemoteNet**, enables our Service Engineers to control your instrument from our company remotely (by telephone line or Internet). This allows us to give you support for the operating Software, the handling of the instrument or to install program updates and fix configuration problems. Even training lessons might be a nice possibility to keep you always informed.

## Your Advantages::

- Worldwide well trained, specialized Service Team
- Continuous control of your equipment
- Full service in case of emergencies
- Know how for your company and your staff
- High rate of spare part availability, even for older devices




## Workshops:

People are the most valuable asset of a company.  
So invest into the qualification of your employees.  
Our know-how and practical approach you can fully trust.

We teach practical and theoretical knowledge in personal or group workshops and seminars on which you can rely in your daily work.  
Of course we include your individual specifications and test material requirements.



## TECHNICAL DATA

				
Model		MBR / MBR-TD	SSR	RTR / RTS-TD
Process data	MFR (Melt Flow Rate) *	0.0375-29600 g/10 min. / 0.06-1700 g/10 min.	0.035-27600 g/10 min.	0.035-27600 g/10 min.
	FRR (Flow Rate Ratio) *	Yes	Yes	Yes
	MVR (Melt Volume Rate) *	0.07 - 3700 cm <sup>3</sup> /10 min.	0.07 - 3400 cm <sup>3</sup> /10 min.	0.001 - 5500 cm <sup>3</sup> /10 min.
	Viscosity *	0.3 Pa*s - 500 KPa*s	0.3 Pa*s - 500 KPa*s	0.3 Pa*s - 500 KPa*s
	Shear stress *	280 Pa - 31 Mpa	280 Pa - 31 Mpa	280 Pa - 31 Mpa
	Shear rate *	0.065 s <sup>-1</sup> - 54200 s <sup>-1</sup>	0.06 s <sup>-1</sup> - 50600 s <sup>-1</sup>	0.06 s <sup>-1</sup> - 50600 s <sup>-1</sup>
	Single or multi-point measurements	Yes	Yes	Yes
	Alternating test cycles (free definable test cycles)	Yes	Yes	Yes
	Automatic MFR-adjustment (MFR(TM), MFR(T0))	Yes	Yes	Yes
	Bagley- and Mooney-Correction	No / Yes	No	No / Yes
	Test mode constant pressure / speed	Yes	Yes	Yes
	Working range	40-350°C / 60-350°C	40-350 °C	40-350°C
Temperature	Temperature control algorithm, display +/- 0.1°C	Yes	Yes	Yes
	Temperature control via Pt100-Fühler (1/3 DIN B)	Yes	Yes	Yes
	Thermocouple Fe-CuNi Typ "J", class 1, for melt temperature	Yes	Yes	Yes
	5 Temperature-calibration- and controlling data sets	Yes	Yes	Yes
	Control cabinet - Environ. conditions **	0 - 55°C / IP54 (**IP65)	0 - 55°C / IP54 (**IP65)	0 - 55°C / IP54 (**IP65)
Drive	Servo drive, accuracy	+/- 0.1 min <sup>-1</sup>	+/- 0.1 min <sup>-1</sup>	+/- 0.1 min <sup>-1</sup>
	Torque range	0.1 - 100 min <sup>-1</sup>	0.1 - 100 min <sup>-1</sup>	0.1 (5) - 100 min <sup>-1</sup>
	Torque	33 Nm / 50 Nm	100 Nm	MP 100 Nm, ULP 70 Nm
	Delivery rate	0.4 cm <sup>3</sup> /U	0.372 cm <sup>3</sup> /U	MP (2x) 0.595 cm <sup>3</sup> /U ULP 1.321 cm <sup>3</sup> /U
	Overload protection, electronic and mechanic	Yes	Yes	Yes
Dies	Multiple-die consumption	No / Yes	No	No / Yes
	Diameter 0.5 bis 10 mm, lengths to 40 mm, e.g. L/D=20/0.5, ..., 40/10	Yes	Yes (up to 92mm length)	Yes
	Tolerance dimensions +/- 0.0005	Yes	Yes	Yes
Sensor	Pressure transducer (bar) / max. system pressure (bar)	20, 50, 100, 200 / 300	20, 50, 100, 200 / 300	20, 50, 100, 200 / 300
	Accuracy (bar)	+/- 0.1	+/- 0.1	+/- 0.1
	Automatic pressure transducer detection	Yes	Yes	Yes
	Adaptive Signal resolution of pressure signal	+/- 0.005 %	+/- 0.005 %	+/- 0.005 %
General	Internal PC with 14.48 cm (5,7") color-QVGA-touchscreen	Yes	Yes	Yes
	Microsoft Windows® data base software "ROSWin" (if so WR II) at external PC	Yes	Yes	Yes
	Measuring head-installation position	specified	optional	optional
	Circulation stream (Bypass)	No / No	No	Yes
	Purge valves	No / No	No	Yes
	Dimensions measuring head (hight x width x depth)	550 x 175 x 335 mm / 580 x 140 x 410 mm	664 x 147 x 361 mm	550 x 175 x 335 mm
	Three-phase mains voltages realized on local conditions	Yes	Yes	Yes
	Weight	approx. 20 kg / 22 kg	approx. 30 kg	approx. 70 kg
* material-, dies- and driving style depending / ** optional				
Optional Add-on- and Follow-up units				
<ul style="list-style-type: none"> <li>Distance control cabinet to measuring head up to 200 m</li> <li>Explosion-proof design, Ex II 2 G Ex de ia c/k IIC T2</li> <li>Connection at process control system via analog, digital, fiber glass, Modbus, Profibus, OPC</li> <li>Primary pressure control unit (recommend by pulsating system pressure)</li> <li>Programmable analog outputs</li> <li>Programmable digital outputs</li> <li>Remote control at the extruder</li> <li>Digital display at the extruder</li> <li>Extra heating zones</li> <li>Special adapter to connect on several (different) extruder systems</li> <li>Intergrated industrial workstation</li> <li>Remote access via telefon line and internet connection</li> <li>Engineering support</li> <li>Different PC configurations</li> <li>Further applications and modifications upon request, subject to technical changes</li> </ul>				

THIS IS RHEOLOGY



WE TAKE CARE OF OUR INSTRUMENTS; YOU TAKE CARE OF ITS MEASUREMENTS.  
OUR REPUTATION IN EACH OTHER'S HANDS.

## THIS IS RHEOLOGY

since 1962

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