Online-Rheometer
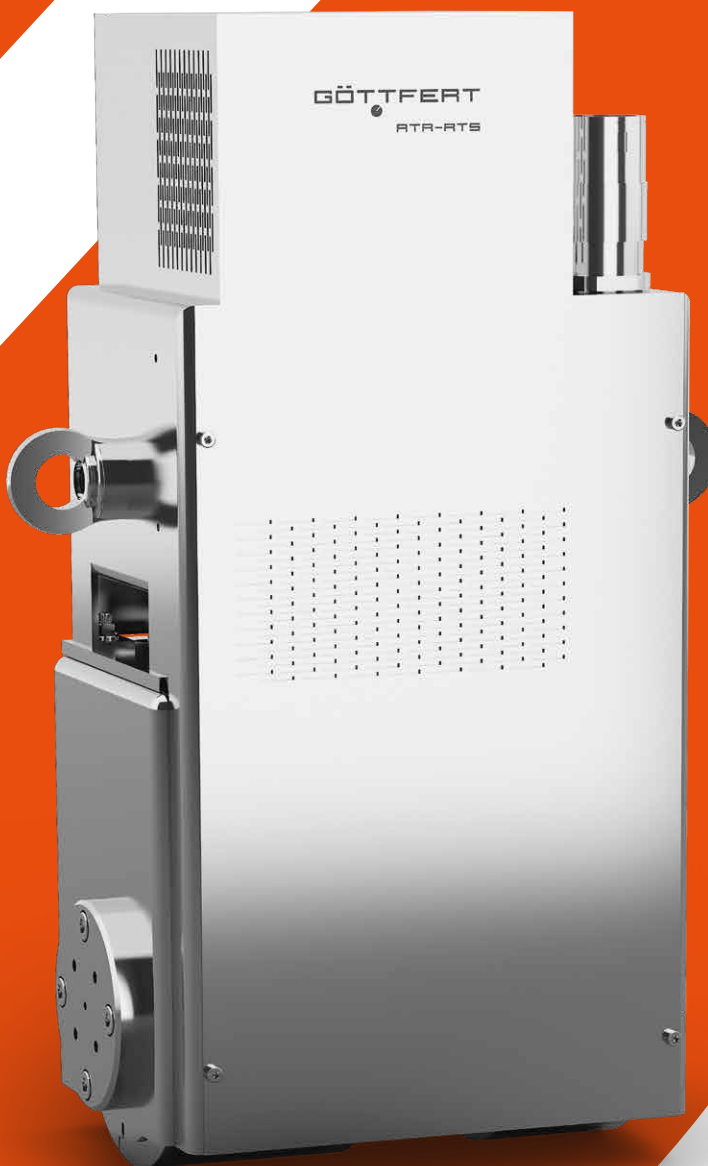
Real-time process information on the rheological and molecular structure of polymers

GÖTTFERT
ATR-RTS

+ **Melt index (MFR/MVR)**

+ **Flow Rate Ratio**

+ **Intrinsic viscosity**

+ **Melt viscosity**

GÖTTFERT

THIS IS RHEOLOGY

ONLINE-RHEOMETER

Real-time process information
regarding rheological and molecular structure of polymers

ONLINE-RHEOLOGY

A GÖTTFERT online rheometer provides 24/7 **measurement data of polymer melts** in order to make statements regarding material properties, as well as processability. Whether with or without melt return, GÖTTFERT rheometers have a very compact design and can be easily integrated into your process.

In most applications the online rheometer is used for process monitoring (MFR/MVR measurement) and control of polymer melts. Due to the high reproducibility of the measured values and the high availability of the rheometer, many of our customers already use the online rheometer for the classification of their products, the Melt Flow Indexer takes a back seat.

With the online rheometers, a **significant cost saving** can be achieved. Whether through automation of the processes and the resulting savings in personnel costs, or through **better process control** during material changes resulting in a minimization of low quality intermediate products.

Equipped with special melt pumps the online rheometers can also be used to measure **products with recyclate content.**

HIGHLIGHTS

- Advanced shear rate range of 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 fluctuations of up to 40 °C

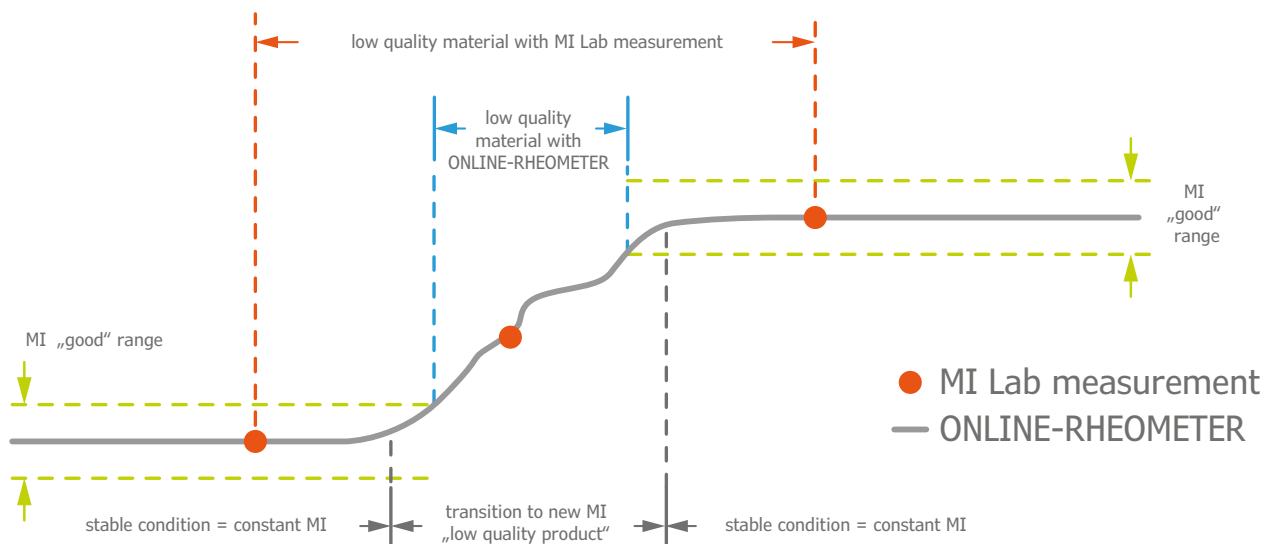- Correlation to intrinsic viscosity or melt index

KNOWLEDGE

Scan QR code and learn more about Online-Rheometer:

Rheo-Infos (Whitepaper)
goettfert.com/rheo-info-online-rheometer

APPLICATION EXAMPLE ONLINE-RHEOMETER

low quality material with MI Lab measurement

low quality material with ONLINE-RHEOMETER

MI „good" range

MI „good" range

MI Lab measurement

ONLINE-RHEOMETER

stable condition = constant MI

transition to new MI „low quality product"

stable condition = constant MI

MBR/MBR-TD

Open loop system

Rheometer without melt return into the process
- Particularly suitable for small batches and frequently changing products
- Small inner volume to reduce the residence time
- Purge valve for fast product changes
- Optionally available to feed melt tensile measurement (RHEOTENS)
- For degrading materials that should not be returned to the process
- Fast adjustment of the measuring range by simple capillary exchange
- Simple installation, only one hole required
- Simple die system or triple die system available

SSR

Closed loop system

Rheometer with melt return
- No generation waste
- Different capillary lengths of up to 92 mm
- Simple installation, only one hole required
- Any installation position
- Cost-effective online rheometer with melt return
- Very compact design

Ex
Rheometer measuring heads and Online-Sampler systems are also available in an explosion-proof design!

RTR/RTS-TD

Closed loop system

Rheometer like SSR with melt return, additionally the following advantages
- Live measurement data due to minimum response time
- Very short response time due to circulating current even at low MFR/MVR
- RTS-TD with two capillaries: very large MFR/viscosity measuring range; direct measurement of flow exponent
- Especially suitable for production monitoring and control
- RTS-TD: Prepared for installation of IR/UV measuring sensors
- ⊕ Add-on: Measurement of extensional viscosity

Add-on for advanced rheological material characterization

For some applications, it is not the polymer melt that is to be examined, but the upstream product or the granulated end product. For this purpose we offer the perfect solution with our **AT-LINE-RHEOMETER (ALR)**. The online rheometer measuring heads are mounted on a GÖTTFERT small extruder and are supplied with melt. The material feeding of the small extruder is fully automated by our online samplers. Further measuring systems are possible downstream:

- Die-swell measurement
- Melt elongation with RHEOTENS, HAUL-OFF
- Shark Skin
- Film systems with optical film analysis

MBR/MBR-TD

Compact online capillary rheometer for the continuous measurement
of MFR and the viscosity function in the polymer production process

◈ HIGHLIGHTS

- Measuring head can be connected directly to the production line, separate control electronics

- Very compact design

- Easy die change

- Large measuring range due to a shear rate range of 1:1000

- Operation at constant speed (shear rate) or constant pressure (shear stress)

- Single point measurement or multi point measurement

- Operation optionally via PC, built-in industrial workstation or otherwise via process control system
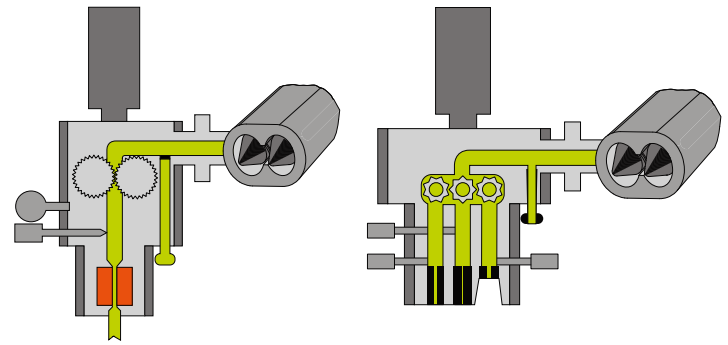
- Cost-effective online rheometer

Measuring principle MBR

MBR-TD with three dies

MBR/MBR-TD –
MINI BYPASS RHEOGRAPH

A compact online capillary rheometer for the **continuous measurement of MFR and the viscosity function** in the polymer production process (the measuring head can be directly integrated to the production extruder).

The MINI BYPASS RHEOGRAPH is characterized above all by its **compact design.** Measuring approx. 150mm in width, this system is one of the **smallest Online-Rheometer** available. Therefore, even the most difficult integration in the respective extruder systems can be mastered. The reduced weight of just 30 kg eliminates costly mounting arrangements. An innovative die lock system facilitates die changes and contributes to user-friendliness.

FURTHER SPECIFICATIONS

Depending on the operating mode, the following **measurement results** are available:

- Melt index MFR or volume index MVR
- FRR (Flow Rate Ratio), ratio of two successive MFR/MVR measurements corresponding to different weight loads during laboratory measurement
- Apparent shear rate, shear stress and viscosity

MBR further measurement options:

- Die Swell measurement (option)
- Measurement of degrading materials that are not to be returned into the process
- Measurement of melt elongation or melt strength with a Rheotens / HaulOff (option)
- Back pressure chamber for generating an adjustable back pressure (option)
- Shark Skin measurement (option)
- Normal Stress Die (option)

All GÖTTFERT Online-Rheometers are also available for operation in hazardous areas of danger zones 1 and 2 with classification **„Gas-Ex: Ex II 2G Ex h IIC/IIB T2 Gb X"** and **„Dust-Ex: Ex II 2D Ex h IIIC/IIIB IP65 Ta,max Db X".**

SSR

First online capillary rheometer with melt return through a single bore

HIGHLIGHTS

- No generation of waste

- Different capillary lengths of up to 92mm

- Extruder installation also possible at a later date (only one bore required)

- Variable installation position

- Simple calibration to MFR

- Cost-effective Online-Rheometer with material feedback
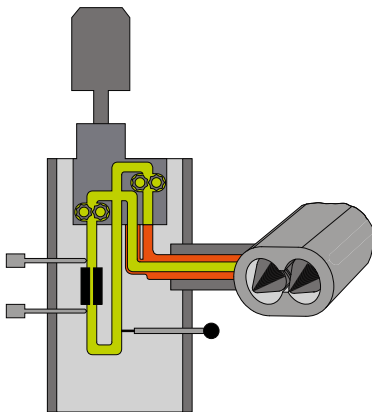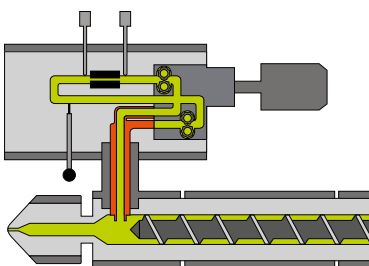
- Very compact design

SSR – SIDE STREAM RHEOMETER

The concept of the SSR side stream rheometer is based on an annular pipe system developed by GÖTTFERT many years ago.

The charge and return melt flow-ways can thus be implemented for Online-Rheometer with melt return. All this is done with a single bore.

SSR, horizontal installation

SSR, vertical installation
(in red melt return)

TECHNICAL SPECIFICATIONS

The SSR annular gap adapter is compatible with the standardized M18 x 1.5 bore. This allows the SSR to be **flexible and quickly connected to any existing bore of the extruder** that already provided space for pressure or temperature measurements.

This means **minimal planning effort at low cost.**

The **compact design** allows horizontal as well as vertical installation with the extruder.

The Windows software ROSWin, known, proven and iteratively developed, allows the determination of the melt index in a range of 0.6-60g/10min, or 5-500g/10min, **without having to change the die.**

All GÖTTFERT Online-Rheometers are also available for operation in hazardous areas of danger zones 1 and 2 with classification **„Gas-Ex: Ex II 2G Ex h IIC/IIB T2 Gb X"** and **„Dust-Ex: Ex II 2D Ex h IIIC/IIIB IP65 Ta,max Db X".**

RTR/RTS-TD

Online capillary rheometer for continuous measurement
of MFR and viscosity under real-time conditions with melt return
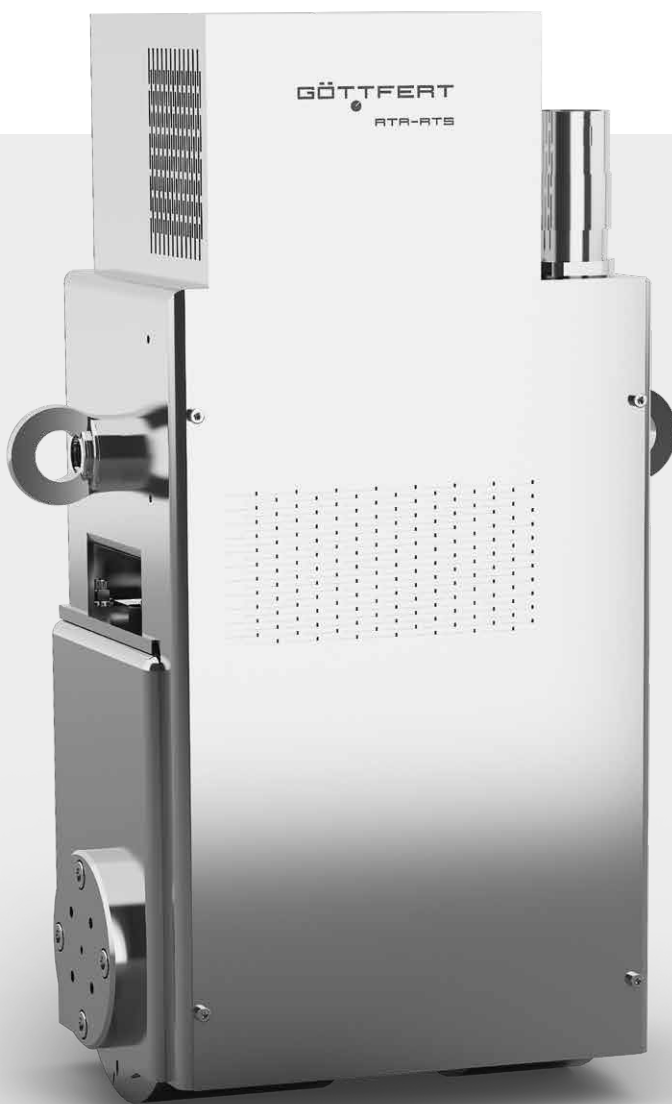
HIGHLIGHTS

- No generation waste

- Very short response time

- Very short residence time to prevent polymer-related degradation

- Significantly larger MVR measuring range than MBR or SSR

- Continuous circulating stream due to a second pump

- Particularly suitable for production monitoring

- No time loss due to purging procedures

- Variable installation position

- Friendly maintenance

- Extensional viscosity (Add-on)

- Ports for IR/UV measurements (option)

RTR/RTS-TD – REAL TIME RHEOMETER

The REAL TIME RHEOMETER RTR/RTS is a continuously measuring capillary rheometer for use in online quality control. The unit is used for production monitoring and control of high and low viscosity polymers in the production and processing of raw materials.

In a closed loop, the RTR returns the melt removed from the product line after testing.
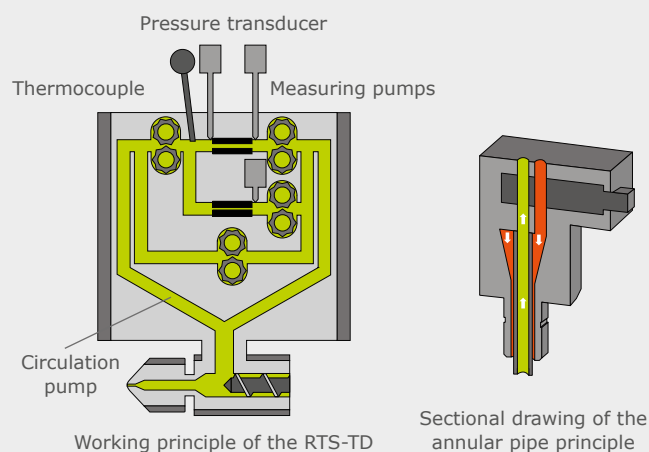
OPTIONS

Using the newly developed twin dies and three pressure transducers, a defined range of the viscosity function is measured continuously under single-point test conditions.

As with the RTR 91.97, the melt and/or volume index is also determined.
Measured variables are MVR, the viscosity function and the flow exponent.

The RTS-TD is a further development of the patented REAL TIME RHEOMETER. As with the RTR 91.97, the melt from the product line is fed back in a closed loop after testing. The RTS-TD 97.00 is the first online capillary spectrometer to deliver real-time information on the rheological and molecular structure of polymer melts. In a continuous measurement, a viscosity spectrum and the flow exponent are determined in addition to the melt index.

The system is also available for use in hazardous areas zone 1 and 2 with the classification "Gas-Ex: Ex II 2G Ex h IIC/IIB T2 Gb X" and "Dust-Ex: Ex II 2D Ex h IIIC/IIIB IP65 Ta,max Db X".

Working principle of the RTS-TD

Pressure transducer
Thermocouple
Measuring pumps
Circulation pump

Sectional drawing of the annular pipe principle

TECHNICAL SPECIFICATIONS

Melt return
No melt is lost. The disposal and removal of melt is no longer necessary.

Short residence time
Since the flow rate of the circulating stream (CS) is up to 100 times higher than that of the measuring stream (MS), the corresponding residence times are short and prevent polymer degradation.

Large measuring range
As the circulating stream always ensures a sufficient flow rate, the measuring stream can be run at the lowest pump speeds. The usable control range is 1:1000. This corresponds, for example, to an MFR range of approx. 0.3–100g/10min with one set of dies. Changes in the molecular structure can be measured from a minimum shear rate of 0.1 1/s, wherein the residence time is drastically reduced by the CS.

Short response time
The short residence times resulting from the CS leads to a corresponding short response time when the material is changed.

SOFTWARE

ROSWin – Multifunctional software system for the complete control
of all Online-Rheometer, measuring extruders and follow-up units

FUNCTIONS

The **Rheo-Online-Software** for Windows, in short ROSWin, is the operating and visualization software for all continuously measuring Online-Rheometers and measuring extruders (Extrusiometer). Downstream units can be easily integrated.

ROSWin runs on all Windows operating systems and is the **stable foundation** for our Online-Rheometers and the irperipheral devices. Regular in-house tests and the successful implementation are a good basis for customers interruption-free operation of the components.

Easy **use, flexible views and open interfaces** make ROSWin the standard solution in online technology. Besides analog data transmission, interfaces such as Modbus RTU/ ASCII, Profibus DP and OPC Server are also supported.

The Rheo-Online-Software comes with an extensive evaluation package; the proven software "WinRheo II" can be used for further analysis of the measurement data.

SUITABLE SERVICE

for various requirements

To ensure sustainably reproducible and reliable test results, periodic maintenance of reliable test equipment is essential. The **globally active and highly trained team** of our service technicians ensures sustainably reliable and accurate rheological test results.

Only **regular maintenance** ensures long-term reliability. We offer you a service contract tailored to your needs to ensure that your equipment is always maintained at the highest quality level. Our professionally trained service team and our certified quality management system (according to the international standard DIN EN ISO 9001) guarantee fast and **reliable service worldwide**.
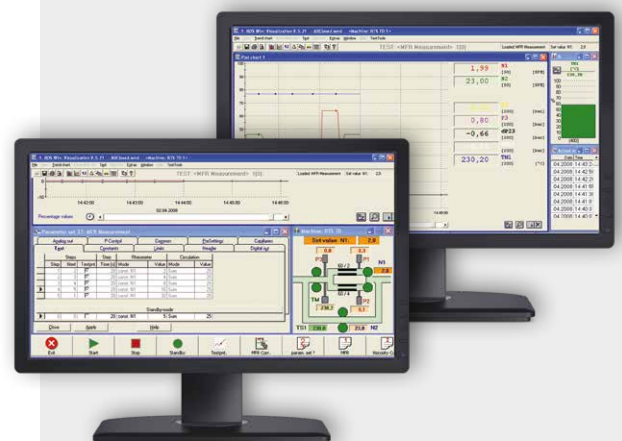
Learn more
goettfert.com/maintenance

HIGHLIGHTS

- Configuration of the rheometer for various measurement procedures via parameter sets

- Storage of all parameters and measurement data in databases

- Rheological evaluation of the measurement data (extended evaluation with WinRheo II)

- Display of all measured variables in tables as well as diagrams and trends

- Freely definable protocol printouts of test values, alarms and parameter files

- Access rights and freely definable window arrangements for individual visualization

- Automatic calibration of the rheometer to preset MFR/MVR set values

- Adjustable limits for all measured variables

- Digital output of operational states

- Network connection

- Digital interfaces: Modbus RTU, Modbus TCP, Profibus DP, Profinet as well as OPC server

Model	MBR/MBR-TD	SSR	RTR/RTS-TD
MFR (Melt Flow Rate)*	0.0375-29600g/10min / 0.06-1700g/10min	0.035-27600g/10min	0.035-27600g/10min
FRR (Flow Rate Ratio)*	•	•	•
MVR (Melt Volume Rate)*	0.07 - 3700cm³/10min	0.07 - 3400cm³/10min	0.001 - 5500cm³/10min
Viscosity	0.3Pa*s - 500 KPa*s		
Shear stress	280Pa - 31Mpa		
Shear rate	0.065s^{-1} - 54200s^{-1}	0.06s^{-1} - 50600s^{-1}	0.06s^{-1} - 50600s^{-1}
Single or multi-point measurements	•	•	•
Alternating tests (freely definable test cycles)	•	•	•
Automatic MFR adjustment (MFR(TM), MFR(T0))	•	•	•
Bagley- and Mooney-Correction	- / •	-	•
Test mode constant pressure/speed	•	•	•
Working range	40 - 350 °C / 60 - 350 °C	40 - 350 °C	40 - 350 °C
Temperature control algorithm, display +/- 0.01 °C	•	•	•
Temperature control via Pt100 sensor (1/3 DIN B)	•	•	•
Thermocouple Fe-CuNi Type "J", Class 1, for melt temperature	•	•	•
5 temperature calibration and controlling data sets	•	•	•
Ambient control cabinet conditions	0 - 55 °C / IP54 (IP65**)		
Servo drive, accuracy	+/- 0.1min^{-1}		
Torque range	0.1 - 100min^{-1}		0.1 (5) - 100min^{-1}
Torque	33Nm / 50Nm	100Nm	MP 100 Nm, ULP 70Nm
Displacement rate	0.4cm³/U	0.372cm³/U	MP (2x) 0.595cm³/U ULP 1.321cm³/U
Overload protection, electronic and mechanical	•	•	•
Multiple-die reception	- / •	-	- / •
Diameter 0.5 to 10mm, lengths of up to 40mm, e.g. L/D=20/0.5, 40/10 RTR: 60mm long capillaries, but also zero die	•	• (up to 92mm length)	•
Tolerance dimensions +/- 0.0005	•	•	•
Pressure transducer (bar) / max. system pressure (bar)	20, 50, 100, 200 / 300		
Accuracy (bar)	+/- 0.1		
Automatic pressure transducer detection	•	•	•
Adaptive signal resolution of pressure signal	+/- 0.005 %		
Internal PC with 14.48cm (5.7") color QVGA touchscreen	•	•	•
Machine control (PLC) with Microsoft Windows® database software „ROS-Win" (if necessary WR II) on external PC; Internal PC -> PLC Machine	•	•	•
Measuring head installation position	fixed	variable	variable
Circulating stream (bypass)	- / -	-	•
Purge valves	• / •	•	•
Three-phase mains voltages possible acc. to local conditions	•	•	•
Dimensions measuring head (hight x width x depth)	550 x 175 x 335mm / 580 x 140 x 410mm	664 x 147 x 361mm	550 x 175 x 335mm
Weight	approx. 20kg/approx. 22kg	approx. 30kg	approx. 70kg

**Optional expansion and follow-up units:**
- Distance from control cabinet to measuring head up to 400m
- Explosion-proof version, Gas-Ex: Ex II 2G Ex h IIC/IIB T2 Gb X and Dust-Ex: Ex II 2D Ex h IIIC/IIIB IP65 Ta,max Db X
- Connection to process control system via Modbus RTU, Modbus TCP, Profibus DP, Profinet as well as OPC server
- Pre-pressure control unit (recommended for pulsating system pressure)
- Programmable analog measured value output
- Programmable digital outputs

- Remote control and digital display on extruder
- Additional heating circuits
- Special adapters for connection to various (third-party) extruder systems
- Integrated industrial workstation
- Remote maintenance via telephone or internet connection
- Engineering support
- Various PC configurations
- Further applications and modifications on request
- Subject to technical modifications

* Depending on the material, die and operating mode
** Optional
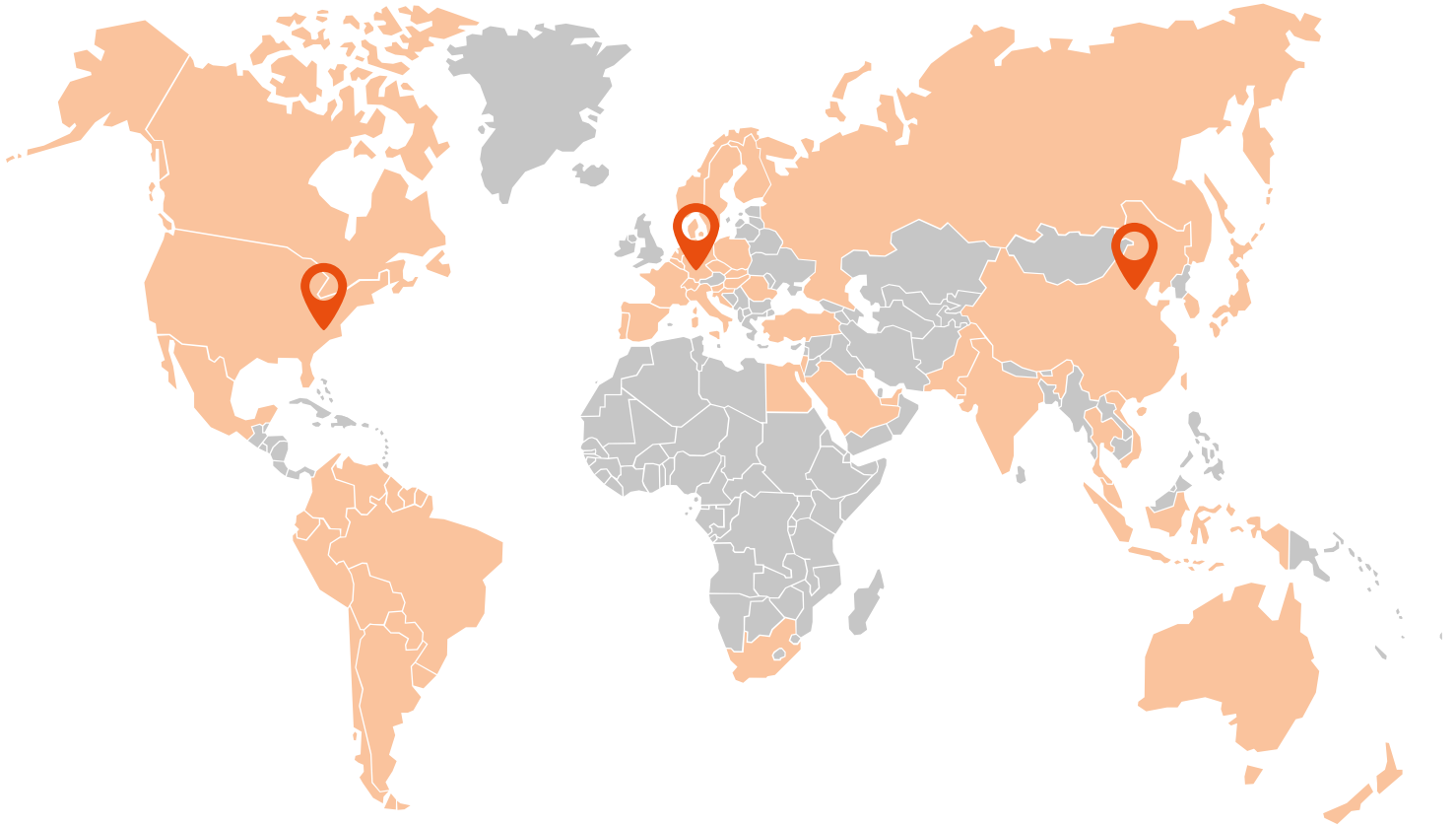
THIS IS RHEOLOGY

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