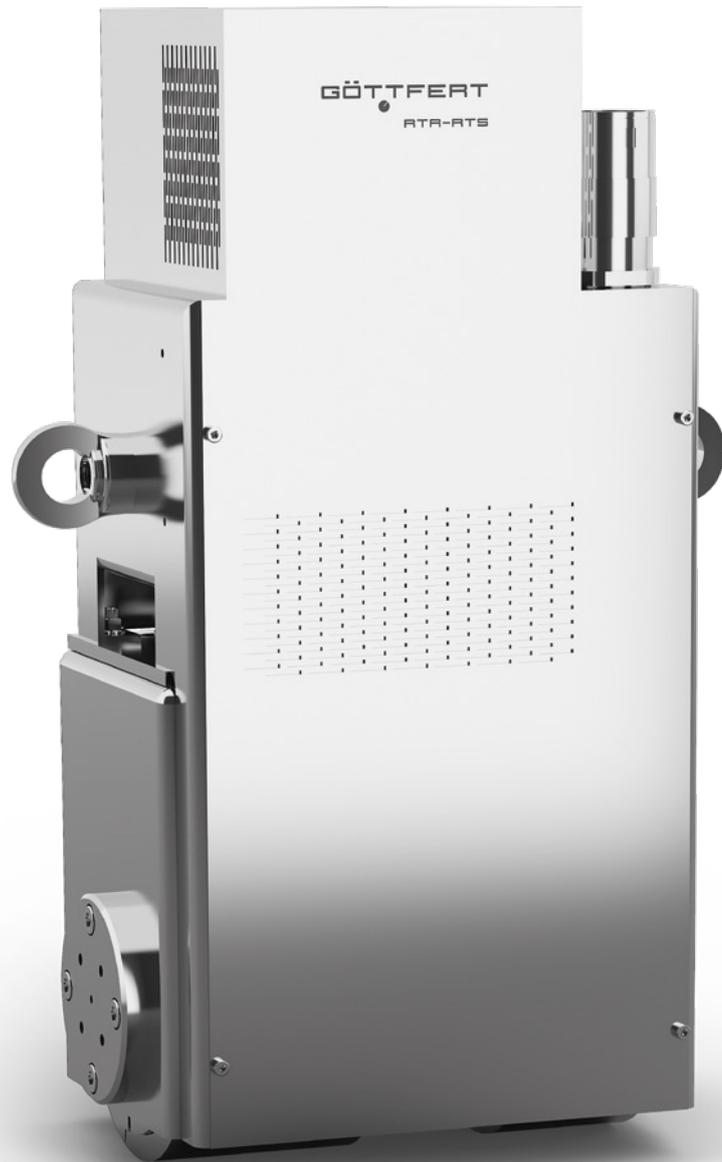


  
viscosity

  
continuous  
process

# ONLINE-RHEOMETER



# ONLINE-RHEOMETER

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

## ONLINE RHEOLOGY

ONLINE-RHEOMETER from GÖTTFERT offer the possibility to generate process information on the rheological and molecular structure of polymers in real time.

In addition, numerous options offer the possibility of IR / UV or FTNIR determination. Furthermore, ONLINE-RHEOMETER can be upgraded to AT-LINE-RHEOMETER if a laboratory extruder is installed upstream as a melt feeder (optionally with fully automatic material feeding (Online Sampler)).

In this case, the use of a 90° deflection head allows online measurements of the elongation at break, the die swell (threshold value) or the flow instabilities (shark skin) of the melt.

If a wide slit die or round hole die is installed instead of the standard deflection head, operation of a downstream blown film or flat film unit with optical film analysis function is possible.

We refer to a complete line of individual components as an AT-LINE STATION (find out more about this in the separate brochure).

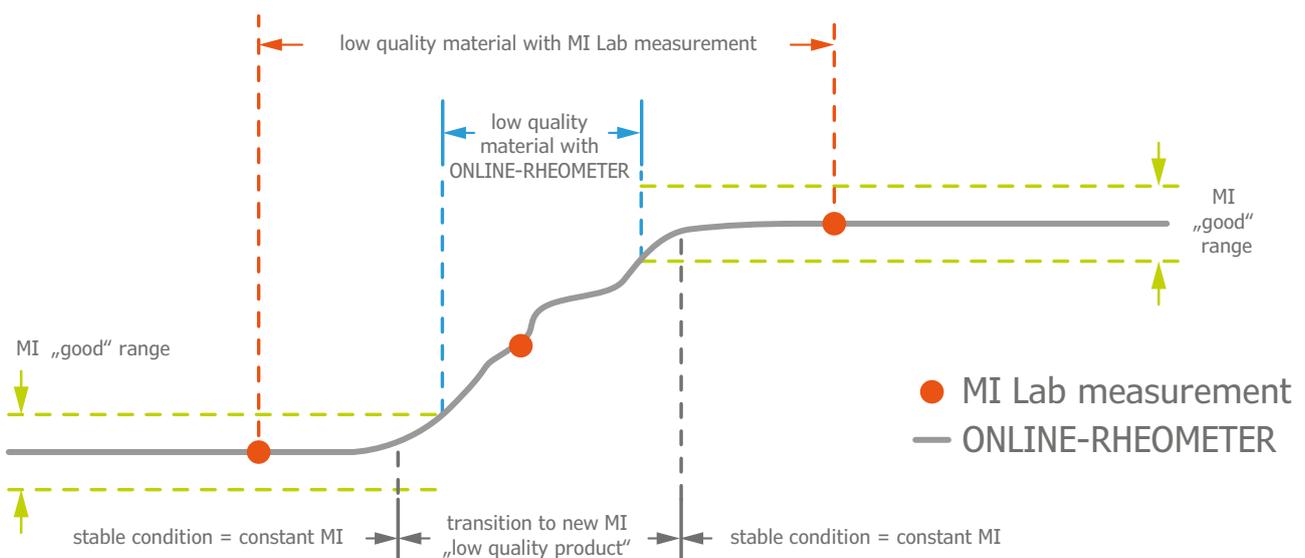
This multifunctional system thus delivers virtually unlimited possibilities for continuous online measurement technology. Even in hazardous areas!

Our technical application department is at your disposal for the concept design, thus ensuring that no questions remain unanswered.

## 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 the intrinsic viscosity

## COMPARISON MI LAB AND ONLINE-RHEOMETER



## INDIVIDUAL PROPERTIES, TAILORED TO YOUR PROCESS

An ONLINE-RHEOMETER continuously delivers data to make statements about material properties and processability. In principle, the process and the application define the measuring instrument. Here an overview:



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

- Particularly suitable for small batches and frequently changing products
- Small inner volume to reduce the residence time
- Purge valve for fast product changes
- Extendable with melt tensile measurement (RHEOTENS at melt strand output)
- Costs for material waste handling
- Measuring head can be directly integrated with the production extruder



### Rheometer with melt return (SSR)

- No material waste
- Different capillary lengths of up to 92 mm
- Extruder installation also possible at a later date (only one bore required)
- Variable installation position
- Simple calibration to MFR
- Relatively long response time at low speeds



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

- No material 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



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

## EXTENSIONS FOR ADVANCED RHEOLOGICAL MATERIAL CHARACTERIZATION

By combining an AT-LINE-RHEOMETER (ALR), consisting of the options a completely independently operating system can be set up, which measures almost all values with regard to characteristic data delivery to a database or a process control system.

- |   |                    |
|---|--------------------|
| • EXTRUSIOMETER                                   | • ONLINE-RHEOMETER |
| • Automatic material feeding (silo, product line) | • Follow-up units  |
| • Additive compound metering                      | • Waste management |

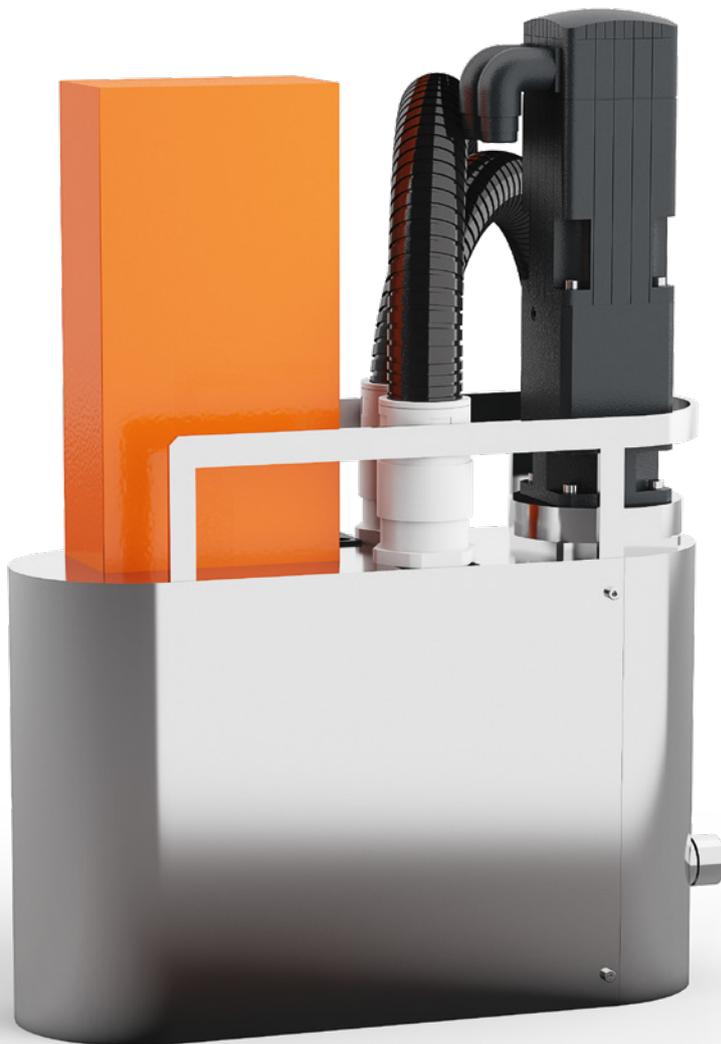
Our technical application department is by your side right from the start during the concept design phase, also when dealing with special applications.



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

# 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
- 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 or multi-point tests
- Operation optionally via a PC, a built-in industrial workstation or otherwise via the process control system



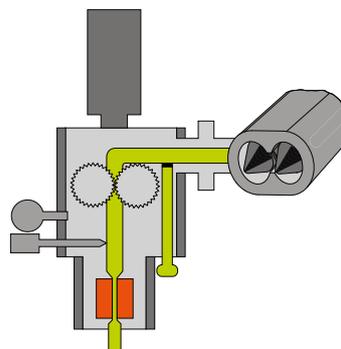
## MBR/MBR-TD – MINI BYPASS RHEOGRAPH

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 with the production extruder).

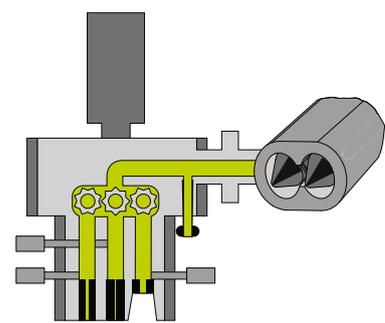
The MINI BYPASS RHEOGRAPH is characterized above all by its compact design. Measuring approx. 150 mm in width, this system is one of the smallest ONLINE-RHEOMETER available. Therefore, even the most difficult integration in the respective extruder systems can be mastered. The reduced weight of just 30 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 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 rate, shear stress and viscosity
- The measurement results are provided in various ways:
  - » Colored display on the PC screen
  - » Protocol on the test value printer
  - » Provision of analog outputs 4 ... 20 mA
  - » Host connection via serial interface
  - » Database access via network (to be implemented by the customer)
- The device is also available as a version for use in hazardous areas of zone 1 and 2 with the classification Ex II 2 G EEx de ia c/k IIC T2/T3.



Measuring principle MBR



MBR-TD with three dies

# SSR

First online capillary rheometer with melt return through a single bore



## HIGHLIGHTS

- No material waste
- Different capillary lengths of up to 92 mm
- Extruder installation also possible at a later date (only one bore required)
- Variable installation position
- Simple calibration to MFR
- Relatively long response time at low speeds

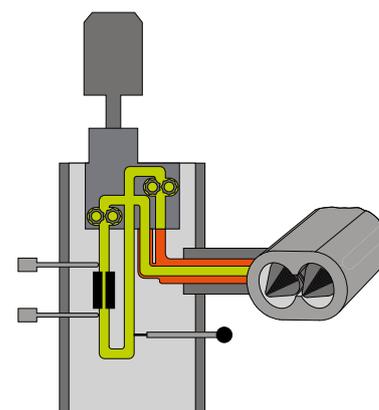


## SSR – SIDE STREAM RHEOMETER

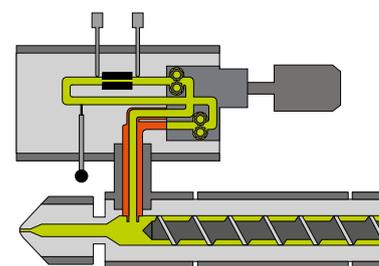
The concept of the SSR side stream rheometer is based on an annular clearance system developed by GÖTTFERT many years ago. The charge and return melt flow-ways can thus be implemented for ONLINE-RHEOMETER with melt return. All this is done with a single bore.

## TECHNICAL SPECIFICATIONS

- The SSR annular clearance adapter is compatible with the standardized M18 \* 1.5 bore. This way, the SSR can be connected flexibly and quickly to any existing bore in the extruder that was already provided for pressure or temperature measurements, for example.
- This means minimum planning effort at low costs, since complex extruder modification with corresponding adapter plate is no longer necessary.
- The compact design allows for horizontal as well as vertical installation with the external extruder.
- The SSR is optionally available in a dual die design and with different geometries. This enables the simultaneous measurement of the viscosity or melt index as well as the flow exponent, which is an important indicator of change in molecular weight distribution.
- The Windows software ROSWin, well known and tested from the RTR-RTS and MBR series, enables the determination of the melt index in a range of 0.6–60 cm<sup>3</sup>/10min or 5–500 cm<sup>3</sup>/10min without having to change the dies.
- The device is also available as a version for use in hazardous areas of zone 1 and 2 with the classification Ex II 2 G EEx de ia c/k IIC T2/T3.



SSR, horizontal installation



SSR, vertical installation

# RTR/RTS-TD

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



## HIGHLIGHTS

- No material 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



## RTR/RTS-TD – REAL TIME RHEOMETER

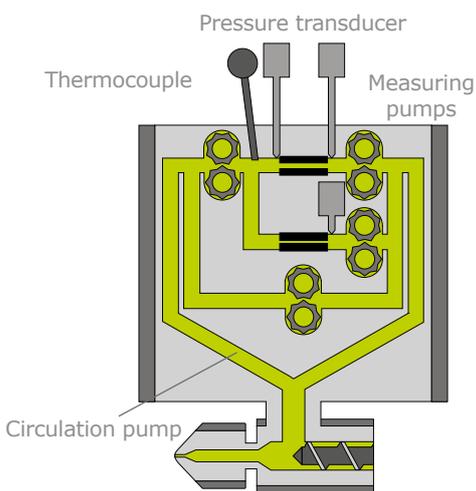
The REAL TIME RHEOMETER RTR/RTS is a continuously measuring capillary rheometer for use in online quality control. The unit is used for production monitoring and control of high and low viscosity polymers in the production and processing of raw materials. In a closed circuit, the RTR returns the melt removed from the product line after testing.

## TECHNICAL SPECIFICATIONS

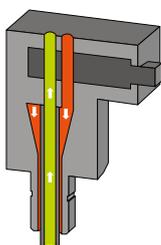
- Melt return**  
 No melt is lost. The disposal and removal of melt is no longer necessary.
- Short residence time**  
 Since the flow rate of the circulating stream (CS) is up to 100 times higher than that of the measuring stream (MS), the corresponding residence times are short and prevent polymer 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. 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 lead to a corresponding short response time when the material is changed.

## ADD-ONS

- 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 circuit 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 device is also available as a version for use in hazardous areas of zone 1 and 2 with the classification Ex II 2 G EEx de ia c/k IIC T2/T3.



Working principle of the RTS-TD



Sectional drawing of the annular clearance principle

# 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-RHEOMETER and measuring extruders (Extrusimeter). Follow-up units can be easily integrated.

ROSWin runs on all Windows operating systems and is the stable foundation for ONLINE-RHEOMETER and the peripheral devices. Regular in-house tests and the successful and smooth use in customer applications guarantee interruption-free operation of the components.

Easy usage, flexible views and open interfaces make ROSWin the standard solution in online technology. Beside 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 well-tried software "WinRheo II" can be used for post-editing the measurement data.

## TECHNICAL SPECIFICATIONS

- 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



## MAINTENANCE AND CALIBRATION

### Testers for a long lifetime combined with a low failure rate

Periodical maintenance of reliable testers ensures long-term reproducible and reliable test results. Our globally operating team of highly qualified service engineers guarantees reliable and precise rheological test results.

Only regular maintenance ensures long-term reliability. We offer service contracts, which are tailored to your individual needs in order to keep systems operating at the highest quality level at all times. Our professionally trained service team and our certified quality management system (according to international standard DIN EN ISO 9001) guarantee fast and reliable service worldwide. Further details can be found on our website in the Service section: [www.goettfert.com/service](http://www.goettfert.com/service)

# SPECIFICATIONS



Model	MBR/MBR-TD	SSR	RTR/RTS-TD
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)*	•	•	•
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		
Shear stress	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	•	•	•
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	+/- 0.1 min <sup>-1</sup>		
Torque range	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 mechanical	•	•	•
Multiple-die reception	- / •	-	- / •
Diameter 0.5 bis 10 mm, lengths of up to 40 mm, e.g. L/D=20/0.5, 40/10	•	• (up to 92 mm 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 14.48 cm (5.7") color QVGA touchscreen	•	•	•
Microsoft Windows® data base software "ROSWin" (if necessary, WR II) on external PC	•	•	•
Measuring head installation position	specified	optional	optional
Circulating stream (bypass)	- / -	-	•
Purge valves	- / -	-	•
Three-phase mains voltages possible acc. to local conditions	•	•	•
Dimensions measuring head (height 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
Weight	approx. 20 kg/ approx. 22 kg	approx. 30 kg	approx. 70 kg

#### Optional add-on and follow-up units:

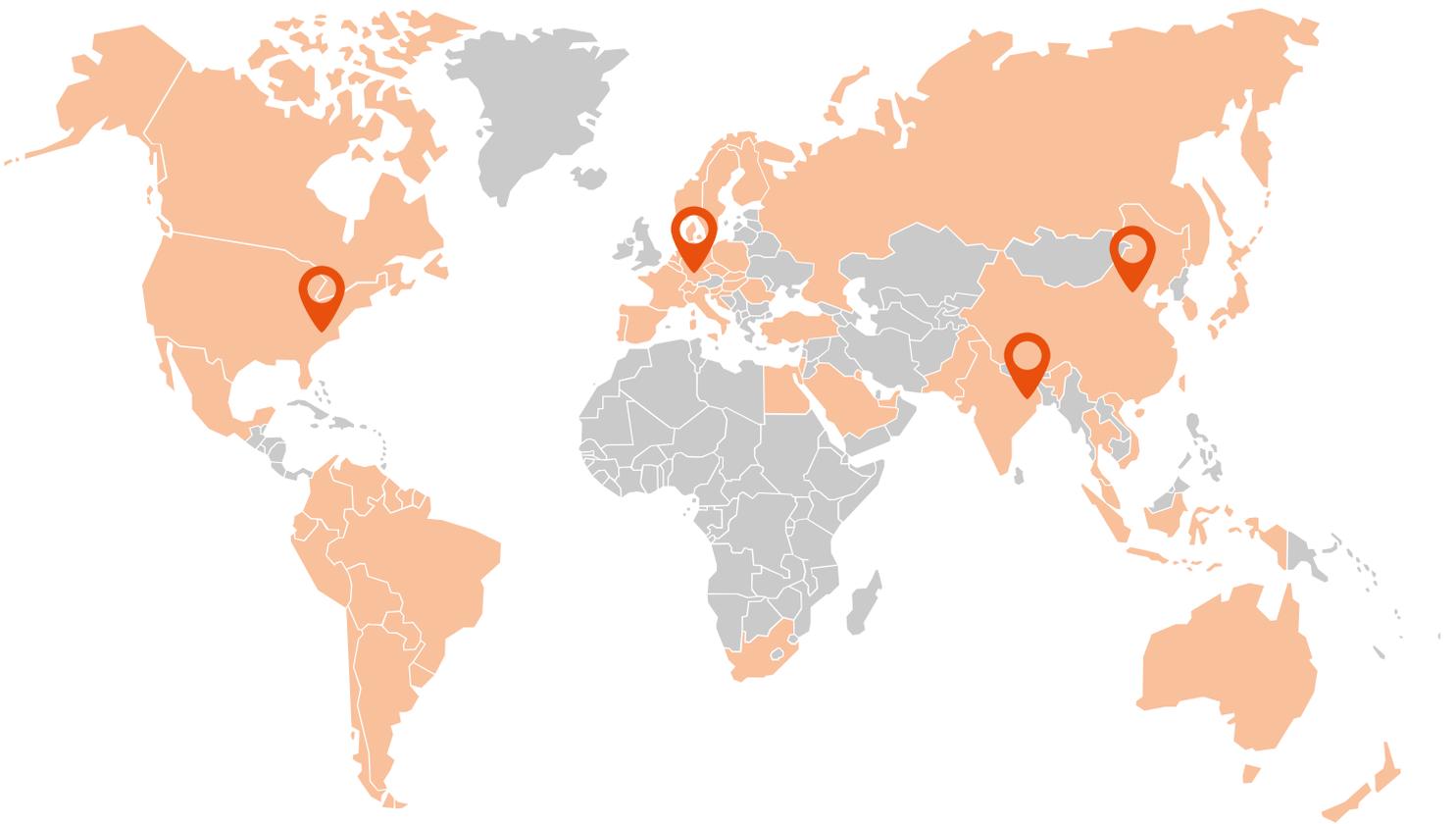
- Distance of control cabinet to measuring head up to 200 m
- Explosion-proof design, Ex II 2 G Ex de ia c/k IIC T2
- Connection to process control system via analog, digital, fiber glass, Modbus, Profibus, OPC
- Primary pressure control unit (recommended for pulsating system pressure)
- Programmable analog test value output
- Programmable analog outputs
- Remote control and digital display at the extruder
- Additional heating circuits

- Special adapter for connection to several (external) extruder systems
- Integrated industrial workstation
- Remote maintenance via telephone line or Internet connection
- Engineering support
- Various PC configurations
- Further applications and modifications on request, subject to technical changes

\* Depending on the material, die and operating mode

\*\* Optional

# THIS IS RHEOLOGY



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