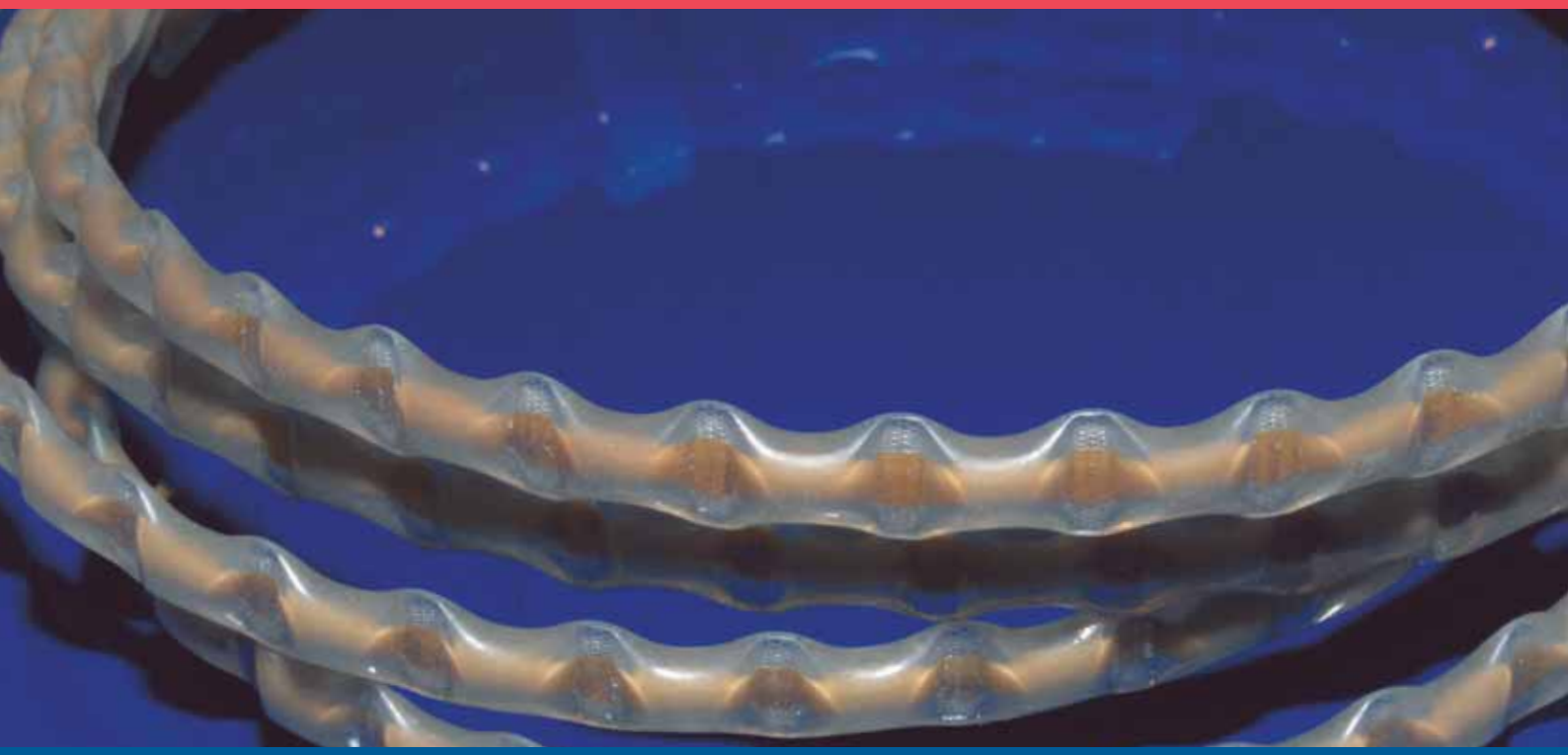
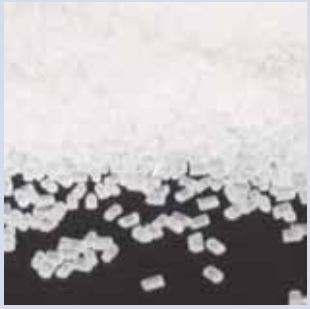
Brabender®



Measuring Extruders and Extrusiograph®

... where quality is measured.

Measuring Extruders and Extrusiograph®



Just Plug & Play

The **Plasti-Corder® Lab-Station** and **Plastograph® EC plus** are the basic units for application oriented investigations or processing tasks in laboratories and simulation.

All **Brabender®** measuring extruders and **Extrusiograph®** can be supplied with CAN bus technology to be docked to this basic units.

Principle

Simulate Production Realistically on a Laboratory Scale

Brabender® single screw measuring extruders and **Extrusiograph®** are interchangeable measuring heads which, in connection with a **Brabender® Plasti-Corder® Lab-Station** or **Plastograph® EC plus**, serve for testing the extrudability of polymers and for studying thesis occurring in research and development as well as in practical application. The **Brabender®** modular system allows a complete instrumentation of the extruders for the control and development of raw material. Different screws, die heads, and downstream equipment fulfill all kinds of extrusion tasks.

Application

In the measuring extruder / **Extrusiograph®**, the sample material is plastified under practice-oriented conditions and extruded through the die head. All measuring values such as torque, melt temperature, melt pressure are recorded continuously and represented in the form of tables and diagrams parallel to the current test.

The extrudate is tested for various criteria:

- Uniform plastification, gloss, gels
- Color dispersion and color matching
- Transparency and formation of streaks, e.g. with transparent materials
- Swelling and contraction behaviour
- Segregation of individual recipe components of a compound at the die and/or at the screw`s tip (e.g. titanium dioxide)
- Output per unit of time, etc.

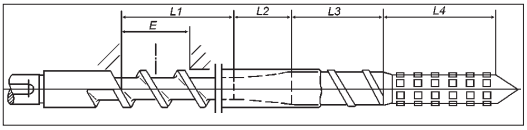
Besides, subsequent mechanical material tests can be run with the extruded specimens.

The **Brabender®** measuring extruders and **Extrusiograph®** can be mounted very quickly and easily to the drive unit. The torque is transmitted electronically which protects both the drive unit and the measuring extruders and **Extrusiograph®** from damage due to overload.

Screws

For each **measuring extruder**/ **Extrusiograph®**, different screws are available.

The screws are made of special steel, the flight basis and the lands are chromium-plated. Single- and multi- stage screws with various compression ratios and different lengths are available for testing a large range of materials.



E = feed opening of the extruder
L1 = feed section
L2 = compression section
L3 = metering section
L4 = mixing section

Plastograph® EC plus
with measuring extruder 19/25 D

Heating/cooling

All **Brabender®** measuring extruders and **Extrusiograph®** consist of an extruder barrel with honed and nitrided bore, water-cooled feed zone, and various heating or heating/cooling zones with electric heating and air cooling. The measuring extruders and **Extrusiograph®** have additional solenoid valves for controlled cooling air supply to the individual heating/cooling zones.

The temperature of the individual-extruder zones is controlled and displayed by self-optimizing electronic temperature controllers. Two threaded bores (1/2" x 20 UNF) opposite each other are provided at the end of the barrel of each measuring extruder for taking a thermocouple and a pressure transducer for measuring the temperature and the pressure of the melt in front of the die channel.

All **Extrusiograph®** have six threaded bores (1/2" x 20 UNF) opposite each other along the barrel for taking thermocouples and pressure transducers.

An additional measuring ring is available for all measuring extruders and **Extrusiograph®** which can be installed between the extruder and the die. It has two bores (1/2" x 20 UNF) opposite each other for taking a pressure transducer for measuring the melt pressure and an immersion-type thermocouple for determining the melt temperature in the cross section of the melt flow.

Software

WINExt / EXTCor32

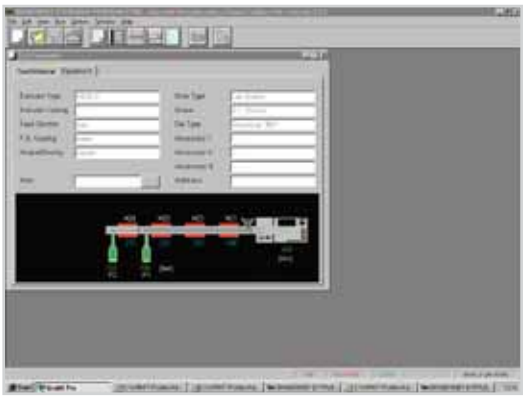
Evaluate your measuring results according to the most recent standards with the user-optimized Windows® software.

On-line diagrams keep you informed of progress and evaluation results through the test.

The WINExt software saves your data in MS Access® databases to allow processing of the stored values with commercial office programs and implementation of the data in your own spreadsheets.

Use the special data correlation program EXTCor32 for further analysis. Compare the results of different tests of one or several test series within a single diagram. Automatic calculation and numerical and graphical display of mean values and standard deviations make it easy to spot irregularities, assess trends in data or compare against standards. Determination of mastercurves acc. to the time-temperature superposition principle is another outstanding feature of this software.

A snap-shot function is standard in the programs and enables import of data from the Windows® clipboard into other applications.



Brabender® Plasti-Corder® Lab-Station and **Measuring Extruder**
Kinematic Viscosity with Round Capillary Die Head

Plasti-Corder® Lab-Station
with Dockingstation and
measuring extruder 19/25 D

… where quality is measured.

Measuring Extruders and Extrusiograph®

Measuring Extruders and Extrusiograph®

Measuring Extruder / Extrusiograph® 19/25 D

Application: Thermoplastics

Measuring Extruder 19/10 DW

Application: Elastomers

Pin Barrel Extruder 19/20 D

Application: Elastomers

Thermoset Extrusiograph® 30/15 D

Application: Thermosets

Extruder	Meas. Extruder 19/10 DW	Meas. Extruder 19/15 D	Meas. Extruder 19/20 D	Grooved Extruder 19/20 DN	Meas. Extruder 19/25 D	Extrusio-graph® 19/25 D	Thermoset Extrusio-graph® 30/15 D	Extrusio-graph® 30/20 D	Meas. Extruder 30/25 D	Extrusio-graph® 30/25 D
Barrel diameter D [mm]	19.1 (3/4")	19.1 (3/4")	19.1 (3/4")	19.1 (3/4")	19.1 (3/4")	19.1 (3/4")	30	30	30	30
Screw length	10 D	15 D	20 D	20 D	25 D	25 D	15 D	20 D	25 D	25 D
Number of heating zones [H] and heating/cooling [HK]	1 HK	1 H 1 HK	1 H 1 HK	2 HK	1 H 2 HK	1 H 2 HK	3 HK	3 HK	4 HK	4 HK
Electric heating power per zone	1500 W	250 W 1500 W	1500 W 1500 W	liquid	1500 W 1500 W	1500 W 1500 W	liquid	2000 W	2000 W	2000 W
Max. operating[1)] temperature	300°C	450°C	450°C	350°C	450°C	450°C	350°C	450°C	450°C	450°C
Max. torque	150 Nm	150 Nm	150 Nm	150 Nm	150 Nm	150 Nm	400 Nm	400 Nm	400 Nm	400 Nm
Number of measuring points for control temperature melt temperature melt pressure	1 1 1	2 1 1	2 1 1	2 1 1	3 1 1	3 3 3	3 1 1	3 3 3	4 1 1	4 4 4
Output dep. on material and speed [kg/h]	0.5 - 5	0.5 - 5	0.5 - 5	0.5 - 5	0.5 - 8	0.5 - 8	0.5 - 10	0.5 - 15	0.5 - 15	0.5 - 15

[1)] dep. on oil and thermostat

Die heads

Manifold die heads

The **Brabender**® die heads can easily be connected to the different measuring extruders and **Extrusiograph**®.

The die heads can be interchanged quickly and easily. They are heated electrically and have a separate control circuit.

The energy is supplied via the measuring extruder from the temperature control unit. Upon request, die heads with liquid heating/cooling are also available.

The die heads are made of anti-corrosion steel and can be disassembled for cleaning. Various die heads are available for specific measuring tasks.

Ribbon die head, adjustable

Tubing die head

Film blowing die head with cooling ring

Round die head

Viscosity

An important example for the manifold test methods are measurements with a measuring extruder equipped with a rheometric capillary die head.

Rheometric capillary die heads are used for measuring shear stress, shear rate, and viscosity of polymers and other plastic and plastifiable materials. By means of a measuring extruder or **Extrusiograph**® connected to a **Plasti-Corder**® **Lab-Station** or **Plastograph**®, the sample material is plastified under practice-oriented conditions and extruded continuously through a rheometric capillary die.

Differential pressure, melt temperature, and throughput are recorded. Due to the manifold geometries of the capillary die heads, a wide range of shear rates is covered. Thus, reliable information can be obtained about the processibility of polymers with all important industrial production processes.

The advantage of such a measuring system as opposed to conventional high-pressure capillary viscometers is that a measuring extruder equipped with a rheometric capillary die head enables plastification and continuous measurements under practice-oriented conditions.

These measurements can be optimized and automized by mounting a high-pressure melt pump between the extruder barrel and the capillary die head. The melt pump compensates for pressure variations occurring in the extruder e.g. due to wall adhesion effects and, thus, ensures a continuous and uniform melt flow under constant pressure through the capillary die.

The melt pump gives the exact volume of the polymer flow through the die. A possible error of its calculation through multiplication of the extruded mass by the density is avoided, this density at extrusion temperature being usually unknown and difficult to measure.

The Rabinowitsch and Bagley corrections as well as further rheological laws (Carreau, WLF, etc.) are calculated automatically.
The corrected values are automatically calculated, displayed on the monitor, and printed. Shear stress and viscosity versus shear rate appear in a diagram. All other parameters such as time, speed, temperature, pressure, output, etc. can be related to each other and displayed in diagrams.

$$\tau = \frac{\Delta p \cdot R}{2 \cdot L} \quad Pa$$

$$\dot{\gamma} = \frac{4 \cdot \dot{V}}{\pi \cdot R^3} \quad s^{-1}$$

$$\eta = \frac{\tau}{\dot{\gamma}} \quad Pa \cdot s$$

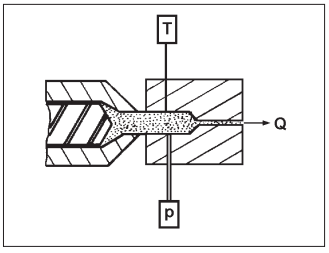
Evaluation of kinematic viscosity with a rheometric round capillary die head

$$\tau = \frac{\Delta p \cdot H}{2 \cdot L} \quad Pa$$

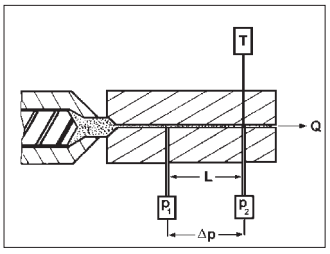
$$\dot{\gamma} = \frac{6 \cdot \dot{V}}{B \cdot H^2} \quad s^{-1}$$

$$\eta = \frac{\tau}{\dot{\gamma}} \quad Pa \cdot s$$

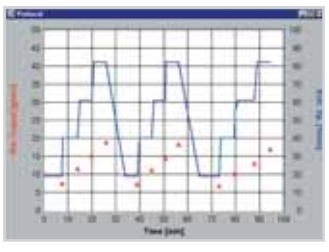
Evaluation of kinematic viscosity with a rheometric slot capillary die head



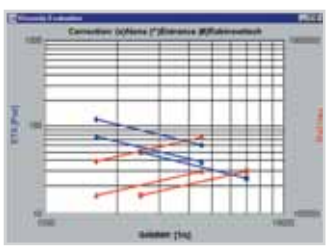
Schematic of a round capillary die head



Schematic of a slot capillary die head



On-line diagram



Flowcurve

… where quality is measured.

Measuring Extruders and Extrusiograph®

Additional Equipment

Brabender® supplies manifold additional equipment for the different measuring extruders and **Extrusiograph®** such as e.g. metering screws, a conveyor belt for taking off extruded profiles from the measuring extruder / **Extrusiograph®**, a take-off and winding equipment, a film blowing unit, a UNIVEX take-off system for simultaneously taking off, cooling, smoothing, and winding up flat films with continuously adjustable take-off speed and adjustable roll gap, a pelletizer, a water bath for cooling extruded profiles prior to winding or pelletizing, pressure transducers, thermocouples for measuring the melt temperature, control thermocouples, etc.

Filtratest

for testing the purity of polymer melts

Film blowing unit

with blower and adjustable roll assembly for blowing, cooling, taking off, and winding up extruded films

UNIVEX take-off system

for simultaneously taking off, cooling, smoothing, and winding up flat films.
To be used vertically or horizontally (upon request)

FSR take-off system

for taking off, cooling, smoothing, and winding film, sheet and ribbon.

Brabender® support

A modern application laboratory is at the disposal of all customers and interested parties for trials with their own materials.

All **Brabender®** measuring systems can be tested under severe conditions.

An experienced expert team will assist the tests and will stay at your disposal at any time for further questions.

Together, we will find the optimum solution for your specific problems and prove its suitability.

Brabender® experimental laboratory

Made in Germany

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