



Extrusion Technology

Measuring extruders and measuring drives



Extrusion

Extruders and Extrudates



Brabender® GmbH & Co. KG, Brabender Messtechnik® GmbH & Co. KG and Brabender Technologie KG



Dieter Preim, Product Manager for Food Extrusion, Brabender GmbH & Co. KG



Directly- and indirectly-expanded extrudates

Into the future with Brabender® extrusion technology

Extrusion products are among the most trendsetting and promising options for innovations in the food and animal feed industry. Snacks, breakfast cereals, flatbreads, confectionery and pet food are just a few examples of the extrudates that can be tested with laboratory-standard accuracy. **Brabender®** provides just the right solutions for the experimental testing of possible production lines with extrudates in a wide variety of shapes, colours, and flavours.

Our all-round talents

Brabender® Extruders are highly versatile and allow modern food-stuffs to be developed under extremely realistic process conditions. These all-round talents handle all process steps of a production run, such as feeding in, conveying, plasticisation, dispersal, reacting, degassing and pressure build-up - all in a single operation. They are suitable for anyone looking for a good alternative for trying out innovative processes without having to intervene in existing processes in order to carry out experimentation.

For the purposes of entirely redesigning a product matrix, there is practically no other procedure that holds more potential than extrusion. For the development of food textures and structures, the parameters pressure, temperature, and shear can be varied during extruding without changing the starting product.

In this brochure, we would like to present to you our range of extruders with both single and twin screws for food and animal feed, as well as provide examples of their wide range of applications.

The benefits for your product development:

- **Saves time and costs:** Textures and sensory characteristics can be verified before tests need to be carried out in the form of (large-scale) production runs.
- **Quality-oriented:** Already in advance, you have the option of creating methods to measure food quality, from the raw material to the end product, enabling you to better react to quality deviations in future.
- **Potential for innovation:** Ideas for applications are manifoldly variable in terms of raw material, recipe, machine and product.
- **Environmentally-friendly:** Significantly less material is required for tests, and there is practically no product waste.
- **Advanced technology:** The technology allows for measurements of extrusion conditions with small test quantities, rapid changes in test conditions, while at the same time being intuitive to operate and clean. Furthermore, active ingredients and flavouring agents can also be bound to a carrier material, e.g. in snack foods.



Twin Screw Extruder TSE 20/40 with Lab-Station

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... where quality is measured.

Product terms for food extrusion



Directly-expanded products

"ready-to-eat products"

- Products that expand at the die upon exiting the extruder. Their volume increases suddenly and their shape stabilises within a very short amount of time.
- The prerequisites for the manufacturing of expanded products are a defined water content and suitable pressure and temperature conditions.
- Examples: flips, balls, cereals, flatbread



Indirectly-expanded products

- The extrudate is made to expand in an additional process step with the use of a microwave, hot oil, or a stream of hot air.
- Unlike directly-expanded products, the process parameters vary.
- The temperatures are below 100 °C and the water content is higher than for directly-expanded products.
- Examples: snacks, face (pellets in the shape of figures)



Formed products

- The shape of these products is determined by the die when they exit the extruder.
- The temperatures of the extruder lie below 100 °C.
- Examples: noodles/pasta, fruit strings and strips



Gelatinised products

- Refers to product in which the starch grains swell up and expand in the presence of water and warmth, causing the cell walls to burst.
- Examples: noodles

“It makes sense to use a single-screw extruder for quality control and preliminary testing purposes. However, once you move on to dealing with an increasing number of product details, a twin-screw extruder should be preferred.”

Dieter Preim, Product Manager for Food Extrusion, Brabender® GmbH & Co. KG

Selection criteria: Single- vs. Twin-Screw Extruders

Selection criteria	Single-Screw Extruders	Twin-Screw Extruders
Screw configuration	Purchase of ready-made screws ¹	Variable combination of screw elements ²
Feed-port	Raw materials feed-in through 1 opening	Raw material and liquid can be added via 4 top ports and 2 side ports
Temperature settings	2-3 heating zones are heated electrically; cooling is done with compressed air	4 heating zones are heated electrically; cooling is done with water
Experiments during extrusion	-	The extruder can be opened to observe the process and take samples
Input moisture³	up to approx. 30 %	up to approx. 65 %
Fat content³	up to approx. 5 %	up to approx. 20 %

³ Actual values will vary from product to product

¹ Screws for Single-Screw Extruders

A wide variety of screws are available for experimenting with all kinds of materials.

Screws are available e.g. with different compression ratios:

- 1:1 for noodles
- 1:3 for expanded products

² Screws for Twin-Screw Extruders

For tests in the food sector, a screw that only consists of conveying elements, is used as a standard. As the screws are co-rotating, they have a certain degree of mixing properties and a self-cleaning effect.

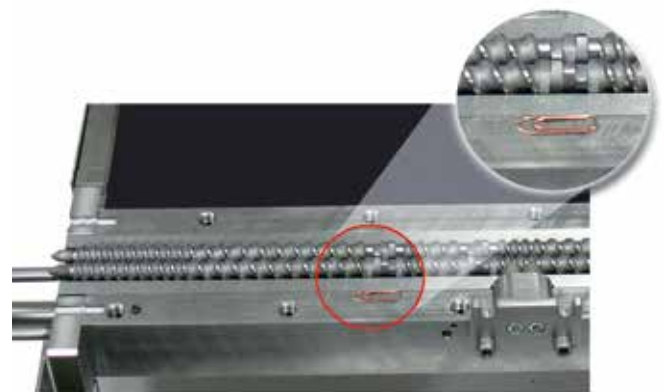
The screw configuration should not be modified until the first tests have been performed.



Differences in preconditioning

Raw materials are preconditioned in order to adjust their moisture content to the required level when starting the extruder. A gradual reduction of the moisture content increases the pressure in the extruder, thereby creating the necessary conditions for the product to expand when it leaves the die.

This procedure is commonly employed when using a single-screw extruder. For a twin-screw extruder, however, it is only used when it is a necessary part of the process.



Miniature screws compared with a paper clip

... where quality is measured.

Extruders and Drives

Single-Screw Extruders



Single-Screw Extruder KE 19/25

The **Brabender® KE 19/25** is a robust and autonomous compact extruder for laboratories and technical facilities. A wide selection of screws and tools makes this machine the ideal solution for the following tasks:

- Developing new materials and products
- Verifying processing behaviour when developing recipes and during incoming and outgoing goods inspections
- Quality control during production
- Creating quality profiles
- Viscosity measurement

Extruder 19/20

The **Extruder 19/20** is characterised by its robustness during direct extrusion. It has grooves along its entire length of 20 D in order to provide a good shear ratio and

optimal material conveyance in the barrel. The two barrel zones are electrically heated via heating/cooling sleeves and air-cooled.



Extruder 19/25

The **Extruder 19/25** is characterised by an additional two measurement points in the extruder. It also has an additional opening near the raw materials feed-in opening, and

also allows a liquid pump to be used. This is particularly advantageous for the manufacturing and analysis of noodles/pasta.

	Single-Screw Extruder KE 19/25	Single-Screw Extruder 19/20	Single-Screw Extruder 19/25
Screw length (L : D)	25 D	20 D	25 D
Drive power	2,4 kW	3,8 kW	3,8 kW
Speed	2 - 150 min ⁻¹	2 - 250 min ⁻¹	2 - 250 min ⁻¹
Max. torque	150 Nm	150 Nm	150 Nm
Max. working temp.	450 °C	450 °C	450 °C
Max. output	1 - 10 kg/h	1 - 10 kg/h	1 - 10 kg/h
Dimensions (L x W x H)	1005 x 440 x 1400 mm	575 x 460 x 230 mm	670 x 230 x 460 mm
Weight	(with stand) approx. 156 kg	approx. 21.5 kg	approx. 27 kg
Vertical forced feed-in	approx. 10 kg	approx. 10 kg	approx. 10 kg

**The Do-Corder “Plus”:
a measuring drive and
its possibilities**

- True multitasking
- Real-time transmission of test procedures and reactions
- Self-recognition and validation

Do-Corder “Plus”



Application — Measuring Extruder

The Do-Corder “Plus” serves as a measuring drive for the **Single-Screw Extruder 19/20** and

19/25. This combination allows for a real-life simulation of all types of extrusion relevant for production.



Do-Corder „Plus”	
Power	3,8 kW
Speed	2 - 250 min ⁻¹ infinitely variable, digital display
Speed constancy	0.2 % through digital feedback
Torque measuring range	0 - 150 Nm
Accuracy	Better than ± 0.5 % of selected measuring range
Direction of rotation	right
Temperature control	6 zones
Mains connection	3 x 400 V; 50/60 Hz + N + PE; 32 A
Dimensions (L x W x H)	1150 x 650 x 1300 mm
Weight	approx. 174 kg (with rack)

Application — Planetary Mixer P600

The Do-Corder “Plus” can also be used as a measuring drive for the **Planetary Mixer P600**.

The **Planetary Mixer** is used in the manufacture of soft doughs and whipped mixtures.



... where quality is measured.

Extruders and Drives

Twin-Screw Extruders



Lab-Compounder KETSE 20/40

The **Brabender® Lab-Compounder KETSE 20/40** is an excellent laboratory device. The process unit consists of a horizontal barrel with a length of 40 D which can be tilted opened. This allows individual processing steps to be visually assessed. Furthermore, this enables the screws to be removed easily

and the barrel to be cleaned quickly. In addition to the main feed-in opening, gravimetric feed-in or venting options are also available for a barrel length of 10 D, 20 D and 30 D. If required, volumetric feed-ins can be installed for barrel lengths of 12 D and 22 D.

Twin-Screw Extruder TSE 20/40

The co-rotating **Twin Screw Extruder TSE 20/40**, with its low output rates of 0.6 to 20 kg/hour, is specially designed for research and development applications.

A special feature is the horizontally split hinged barrel that can be opened on both sides. This allows the segmented screws to be easily accessed.



Twin-Screw Extruder TSE 25

The co- or counter-rotating **Twin Screw Extruder TSE 25** with a barrel diameter of 25 mm is the true all-rounder among the **Brabender® extruders**. With its

variable processing length of 16 to 48 D, it can be used for multi-stage preparatory tasks, as a pilot system, for reactive extrusion, and for recipe development.

	TSE 20/40	TSE 25	KETSE 20/40
Screw length (L : D)	40	16 - 48	40
Drive power	16 kW / 6,8 kW	16 kW / 6,8 kW	11 kW
Speed	1200 min ⁻¹	550 min ⁻¹	1200 min ⁻¹
Max. torque	2 x 40 Nm	2 x 90 Nm	2 x 40 Nm
Max. working temp.	400 °C	400 °C	400 °C
Max. output	0,5 - 10 kg/h	0,6 - 30 kg/h	0.5 - 10 kg/h
Segmented barrel/screw	No/Yes	Yes/Yes	No/Yes
Screw rotation/ special features	Co-rotating, horizontally split barrel	Co-rotating/ counter-rotating	Co-rotating
Dimensions (L x W x H)	1350 x 730 x 1160 mm	-	1660 x 730 x 1230 mm
Weight	approx. 323 kg	-	approx. 500 kg

Lab-Station

Lab-Station, the universal measuring drive

- Plug & Play
- Increased measuring precision
- Individually scalable
- Can be used with twin-screw extruders, single-screw extruders and the Planetary Mixer P600



The **Brabender® Lab-Station** is the product of continuous development which has been pursued over several decades. It is the basic unit for application-related tests or processing tasks in laboratories and technical facilities.

The **Twin-Screw Extruders** are directly connected to the **Lab-Station**.

The **Single-Screw Extruders** and the **Planetary Mixer P600** are connected to the drive with the help of a Universal-docking station.

Lab-Station / Lab-Station EC

Dynamometer	Digital AC inverter motor, carried in a pendulum bearing
Power	16 kW / 6.8 kW
Speed	$\pm 0,2 - 350 \text{ min}^{-1}$ / $\pm 0,2 - 200 \text{ min}^{-1}$
Speed constancy	0.2 % through digital feedback
Direction of rotation	left or right (key switch)
Torque measuring range	0 - 400 Nm (Lab-Station) 0 - 300 Nm (Lab-Station EC)
Torque constancy	$\pm 0,15 \%$
Temperature control	Maximum of 8 zones
Mains connection	3 x 400 V; 50/60 Hz + N + PE; 63 A 3 x 400 V; 50/60 Hz + N + PE; 32 A
Dimensions (L x W x H)	1200 x 700 x 1300 mm
Weight	approx. 340 kg / approx. 340 kg

... where quality is measured.

Dies and Die Heads

Die Heads

Versatile die heads

The assembly and replacement of die heads on the extruder is an easy and quick affair: they are attached to the barrel with a ring nut. The die heads are made of corrosion-resistant steel and can be dismantled for cleaning. Various die heads are available for special versions.



Round Die Head

This standard die head is outfitted with a heating sleeve. It can generally be used with screw-in dies with a die diameter of 1 to 7 mm, which can be used depending on the product. The screw-in dies allow products from the categories listed to be generated.



Noodle Die Head

The **noodle die head** is primarily used for producing noodles. Special feature: the head can be cooled both with air or with water.



The **round die head** is the only die head that can be outfitted with a cutting mechanism.



Flat Die Head

The **flat die head** allows products such as expanded flatbread, confectionery products and indirectly-expanded products to be produced.



Hollow Die Head

The **hollow die head** allows formed products such as macaroni to be produced.

Dies

Dies for the Round Die Head



Rice die



Round die head inserts

Dies for the Noodle Die Head



Dies for noodle die head



Extrudate

Software



System parameter settings screen

With program modules such as

- WinExt* for our measuring extruders
- WinMix for the Planetary Mixer P600

*From Version 4.x onwards, the WinExt-Software requires one of the following operating systems to run: Windows® 2000, XP, Vista or Windows® 7 or 8.

Application

The user-friendly Windows® software allows operating data to be logged and for measurement results to be evaluated according to the latest standards. Online diagrams provide a quick overview of measurement data and evaluation results, already

during an ongoing measurement. The saving of measurement values in MS Access database format, as well as true 32-bit software offer the user speed, data security, and a great deal of flexibility while remaining easy to use.

The features of the program include:

- Logging of experimental conditions
- Description of material to be investigated
- Control and data collection
- Representation and online printout of experimental data
- Graphical representation of experimental data obtained



... where quality is measured.



Brabender® GmbH & Co. KG

Kulturstr. 51-55 · 47055 Duisburg · Germany
Phone: +49 203 7788-0
food-sales@brabender.com
www.brabender.com

OOO Brabender®

г. Казань, ул. Ягодинская, 25, Россия, 420124
Тел.: +7 987 40 300 40
ooo.brabender@mail.ru
www.brabender.com

Brabender® USA

C.W. Brabender Instruments Inc.

50 East Wesley Street · P.O. Box 2127
South Hackensack · New Jersey 07606
Phone: +1-201-3438425
foodsales@cwbrabender.com
www.cwbrabender.com



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