

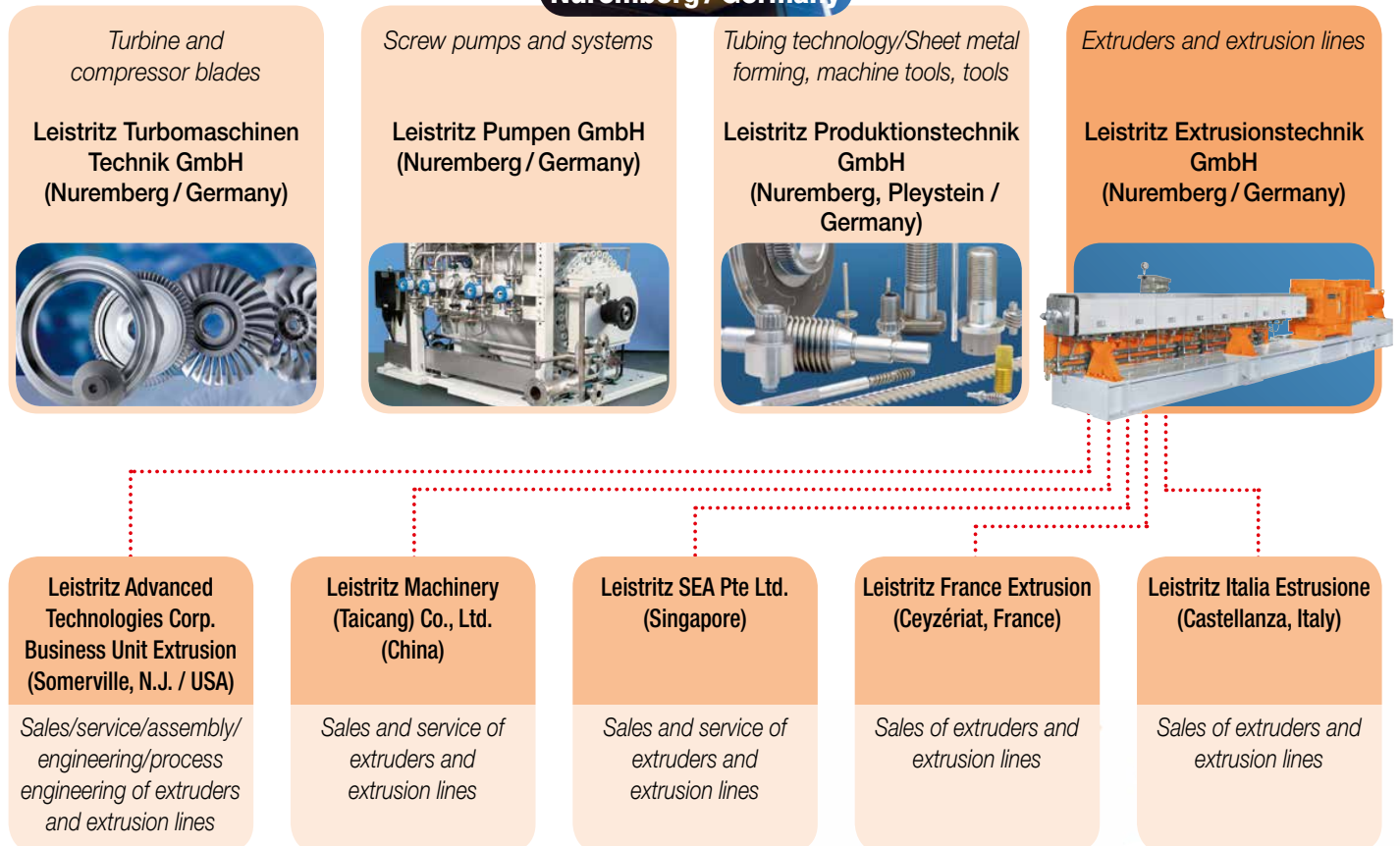
refreshing
extrusion
technology



The success story of Leistritz started back in 1905: Paul Leistritz manufactured his first products in a small workshop in Nuremberg/Germany: blades and profiles for steam turbines. What started small, developed to be a globally acting company. The Leistritz group divisions are turbo machines, pumps, extrusion technology and production technology.

For over 100 years Leistritz has been manufacturing turbine blades. Formerly, they were steam turbine blades based on simple geometries. Today, they are blades for gas turbines, compressors and aircraft engines. Screw spindle pumps, which were initially used as simple devices for pumping lubricants, now operate reliably as complete systems in many different industries. The high performance extruders are based on enhanced and modified versions of the screw pumps that Leistritz produced 70 years ago to pump rubbers. Today's Leistritz twin screw extruders are used in the plastics, pharmaceutical and food industries. The company has been building machine tools for over 25 years. Complex production lines for the efficient production of internal and external screw threads as well as thread-like profiles are designed and realized here.

The special thing about Leistritz is that it still is a family enterprise, which follows values like continuity and social responsibility.



Leistritz Extrusionstechnik GmbH has established itself as one of the leading manufacturers of co-rotating twin screw extruders. This is facilitated by the latest technology and especially by the 150 employees worldwide - a team which stands behind its product.



For more than 50 years, the company has been building and optimizing twin screw extruders for the plastics technology as well as the pharmaceutical and food industries. Nuernberg plays an important role as headquarters. The heart of the extruder - the screws and barrels - are exclusively manufactured by Leistritz. Thus, constant high quality is guaranteed. This is mainly possible by the symbiosis of the various Leistritz product groups in terms of superior in-house metal machining technology, e.g. whirling and ECM (electro chemical machining).

In order to provide state-of-the-art turnkey extrusion systems, the overall concept and the logistics have to be right. A process flow based on the ISO 9001:2008 certification guarantees optimized procedures and fast communication channels. Long lasting partnerships with distributors and customers provide a trustworthy and professional cooperation for complex requirements.

Leistritz customers benefit from a profound experience: The company plans, designs and produces individual extruders and turnkey extrusion lines for a wide variety of processes and applications.



Plastics granulates with a high percentage of additives (20 - 90%), such as color pigments, functional additives or fillers (higher than in the end use), are called masterbatch. The goal of masterbatch production is the optimum incorporation of additives in the polymer matrix. The fine and powdery bulk material often tends to agglomerate and therefore is difficult to work with.

The main component of a masterbatch line is the co-rotating twin screw extruder. It fulfills the task of homogenizing, dispersing (splitting of the agglomerates), wetting and distributing the pigments/additives/fillers in the polymer matrix. This is done either via a premix or a split-feed process.

Premix

A premix consisting of polymer, pigment and dispersion additives is fed to the extruder. Normally, these premixes are produced in batches in a previous mixing step.

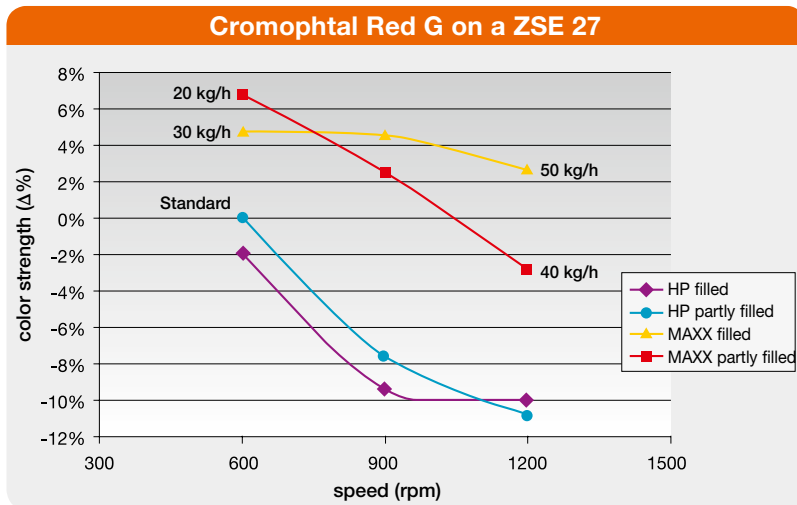
Split-feed

The formulation components are not fed into the extruder at once and together. Pigments, fillers and, if needed, dispersion aids are added via one or two side stuffers. The components are fed via gravimetric feeders.



Example of a
ZSE 27 MAXX

Application example: Production of a color masterbatch with Cromophtal Red G



Results:

- The quality of Cromophtal Red G masterbatches is above industrial standard regarding color strength and agglomeration.
- A substantial improvement of the color strength is achieved (+6-8%).
- There is significantly less agglomeration (to max. 50 µm).
- Using a ZSE 27 MAXX ensures good wetting results and little compaction take place in the melt zone. The masterbatches achieve very high and constant quality.

Leistritz Side Feeder: LSB 52

A side feeder is mainly used for dosing powder. In order to transport the material safely into the process, twin screws are used – similar to the ones in the extruder. An important parameter of the LSB screws lies in the high OD/ID ratio. This facilitates feeding of material with low bulk density.



With the LSB 52 Leistritz thought one step further. A specific feature of this side feeder is the possibility of using segmented screws. Similar to the extruder, the screws can be configured according to the material properties. This way it is possible to e.g. pre-compact the product and to remove air from the process. The adaption of the LSB to the extruder was also reconsidered. Now tie rods are used, which are placed at the cool, easily accessible back of the gear box. With them the LSB can be fixed to the extruder barrels – without any risk of injuries. Optimum handling is facilitated by the according barrels at the extruder, which were redesigned. Both screws and barrels can be manufactured from any existing material which is appropriate for the extruder. It is therefore possible to feed abrasive (e.g. TiO₂) as well as highly corrosive products via the side feeder.

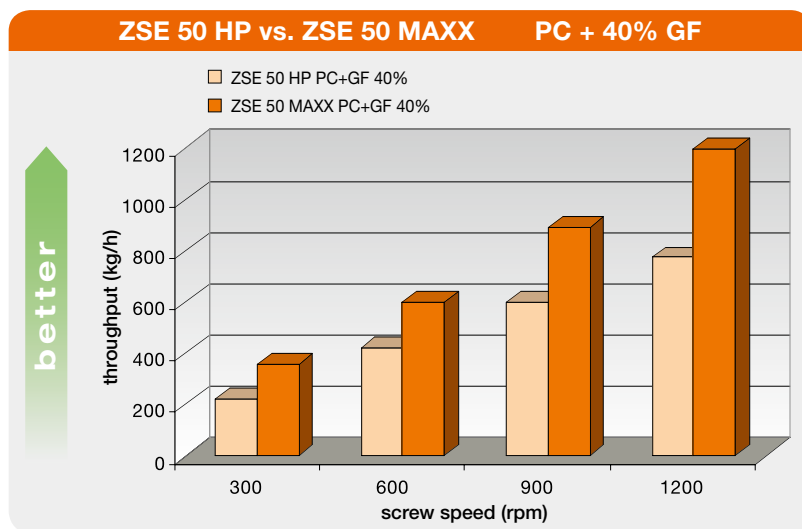
Optionally, it is possible to cool the screws internally. This is done by means of a special gear construction: The drive shafts are designed as tubes. So the cooling agent can be transported into the screws via attached rotary feeders.

Compounding is one of the main application fields for Leistritz twin screw extruders. The excellent incorporation characteristics for additives, filling and reinforcing materials creates products that are used in many fields (e.g. computer housings, front ends in automobiles, flooring sheets etc.)

In applications where parameters such as breaking strength or impact resistance are relevant, the polymer is reinforced with fibers. Glass fibers are used predominantly, but other fibers can also enable linkage with polymer carrier substances. This addition and linkage of the fibers to the polymer chains produces materials with high break and impact resistance, which also convince with their low weight.

Application example: Incorporation of glass fibers (40%) into polycarbonate (60%)

Especially when processing temperature sensitive material, where gentle energy input is crucial, the Leistritz ZSE MAXX technology facilitates above average throughput rates with its combination of high volume (OD/ID = 1.66) and high torque (15.0 Nm/cm³). Due to the fact that the shear sensitive polycarbonate has not reached its thermal degradation limit, it can be processed on a ZSE 50 MAXX with much higher screw speeds.



Results:

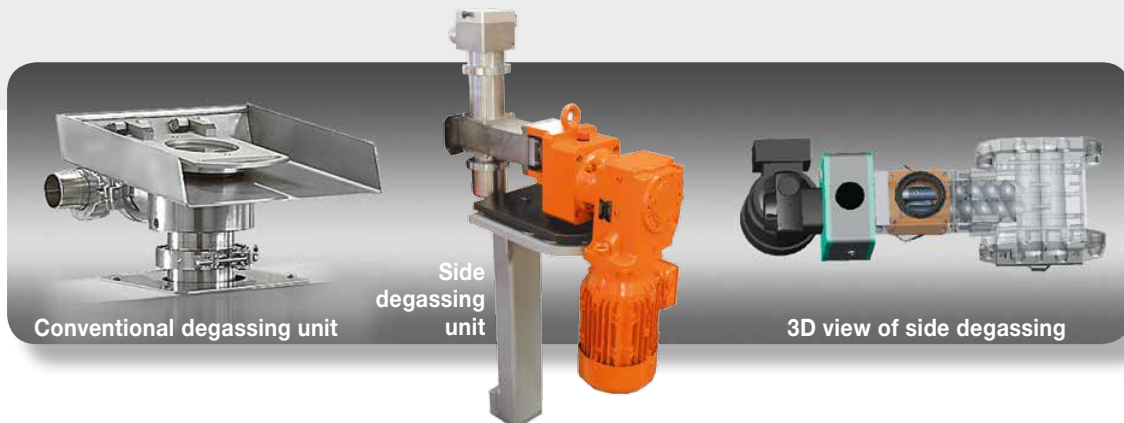
- The ZSE MAXX extruder achieves an increase in throughput of up to 55% (while the quality is kept constant).
- Due to higher loading, energy savings between 12 - 18% can be realized.
- The ZSE MAXX extruder is the ultimate choice for running shear sensitive processes at maximum throughputs.



Increased Degassing Performance: Leistritz Side Degassing

Besides the commonly known processing steps like melting, mixing or homogenizing, degassing of volatile substances represents an important part of processing technology. Leistritz meets the concern regarding increased requirements of compound quality. While conventional degassing systems are mounted above the processing unit, the Leistritz side degassing is assembled on the side (with a mobile base frame). This facilitates quick (dis-) assembling and easy cleaning.

Though the screws, which are located in the degassing barrel, push the melt back into the processing chamber, gases can still escape. This way, plugging of the vacuum port can be avoided. Also deposits in the vacuum port, which might return into the melt and contaminate it, are prevented.



Quick Cleaning: Leistritz Strand Die Heads

Minimizing downtimes and thus increasing productivity is an essential goal in a compounding facility. Leistritz die heads substantially contribute to that: They are pivoted, partly have integrated filters, are easy to handle and facilitate quick and convenient cleaning.



Example of a customized extrusion line

More information in the „Compounding“ brochure.

Direct Extrusion

Direct extrusion or inline-compounding can manufacture products in a more efficient manner by combining various process tasks in a single extrusion line. The process has particular relevance when the pelletizing step can be left out and the compounder is also used for shaping the product. E.g. by using a certain die with adequate downstream equipment, films, sheets, pipes or injection moulding parts can be produced.

With direct extrusion the materials have one less heat and shear history which often results in improved mechanical properties of the end product.

Advantages:

- The pelletizing step is eliminated.
- The polymer has to undergo less heat and shear stress.
- Valuable formulation know-how stays in house.
- The production planning and product design is flexible.
- The process saves energy.

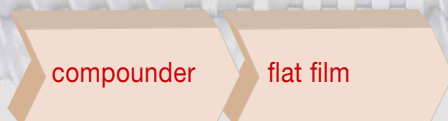


Example: In-line PET processing with and without predrying for multi-layer films in a co-extrusion process

PET process with predrying

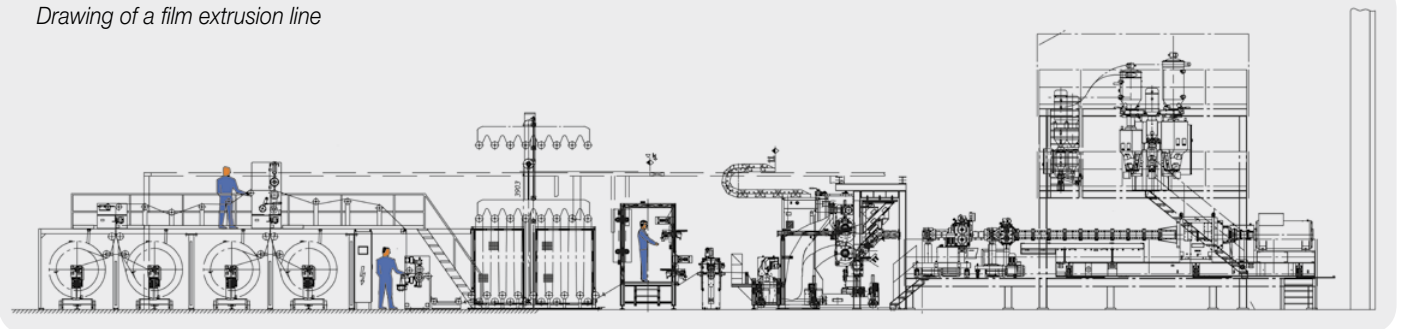


The in-line process is in contrast to that:



The pelletizing step as well as the second melting step and the predrying of the polymer are omitted.

Drawing of a film extrusion line



Research, development and sample production are the most important fields of operation of a lab extruder. The results that are gained on these flexible machines are the key for the upscale to larger production machines. Analogue to large ZSE MAXX machines, this is facilitated by the modular design of Leistritz lab extruders - the NANO 16, ZSE 18 HP_e, ZSE 18 MAXX and ZSE 27 MAXX as well as the MICRO 27 GL/GG.

Due to the fact that they require only little space and can freely be positioned, the user gets the flexibility of a lab machine which can be adopted for batch production as well as for lab research.

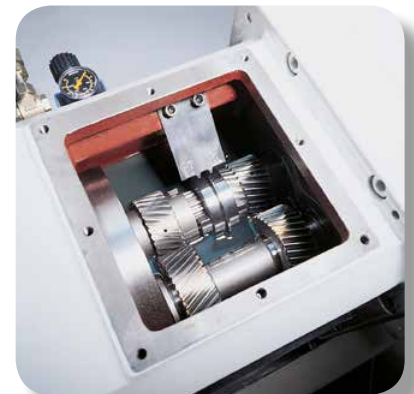
Advantages:

- The processing units of the NANO 16 and the ZSE 18 HP_e extruder are interchangeable.
- The processing units of the MICRO 27 GL/GG and the ZSE 27 MAXX are interchangeable.



From Co- to Counter-Rotation: MICRO 27 GL/GG

The Leistritz MICRO 27 lab extruder has a unique feature worldwide: the gearbox can simply be switched from co- to counter-rotation - of course after also switching the screw profile. Since in lab extrusion there is often a need to test, if a certain product would be best processed on a co- or counter-rotating twin screw extruder, this feature presents a significant advantage. A multitude of motor variations and gearbox settings facilitate exact tuning of the extruder according to the requirements.



Co- and counter-rotation switch

Example of a
MICRO 27 GL/GG

In the last two decades, extrusion technology has become an interesting alternative to common manufacturing processes for pellets, tablets or transdermal systems. With its GMP compliant extrusion lines, Leistritz is leading in this demanding market field.

The extruder's main task is mixing, homogenizing and sometimes also degassing of the product. This is done in a continuous process (extrusion terminology typically refers to a throughput in kg/h). That means: By means of gravimetric feeders each ingredient of a formulation (solid, liquid or gaseous state of aggregation) can be fed into the machine. That way, carrier and auxiliary substances as well as active components can be added into various parts of the processing unit in an exact proportion. Depending on the final product (pellets, tablets, transdermal systems) various extrusion lines can be used.

In pharma extrusion, there are two kinds of processes that need to be distinguished: wet extrusion and hot melt extrusion. In wet extrusion, liquid is fed into a powdery substance. The liquid is used for granulation of the extrudate (material in the extruder) and normally is removed in a later drying phase. In hot melt extrusion, the fluid state is reached by melting the carrier substance during the process above its glass transition point. After being discharged from the extruder, the extrudate is cooled and thus solidified.

Documentation and Validation

The validation of pharma extrusion lines within the scope of GMP requirements is inevitable in order to produce constantly high-class products. With its qualification package, Leistritz offers design, installation and operational specifications for the GMP compliant extrusion line, including equipment and computer system (PLC SCADA and visualization). The package also comprises conclusive quality control plans for FATs (Factory Acceptance Tests) and SATs (Site Acceptance Tests).

The great advantage: This Qualification Package simplifies and reduces the validation effort of the customer by referring to test results made by Leistritz during IQ (Installation Qualification) and OQ (Operation Qualification).

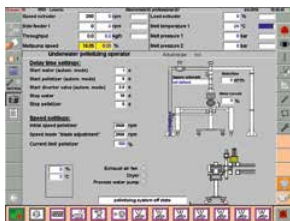


More information in the „Pharma Extrusion“ brochure.

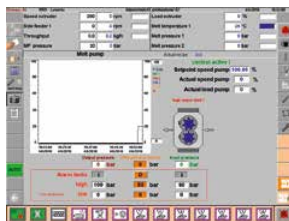
In the control unit all the bits and pieces come together. The philosophy of the Leistritz process and control technology is to integrate the extruder and all up- and downstream equipment, necessary for the compounding task in one visualization and operating panel. It does not matter whether it is about controlling gravimetric feeders, underwater pelletizers or a melt pump. Leistritz offers various control systems made with Siemens hardware and individually programmed by the Leistritz engineers, depending on machine and customer requirements.

All quality relevant parameters are displayed, controlled and recorded. BUS systems facilitate communication between all line components.

Underwater pelletizer



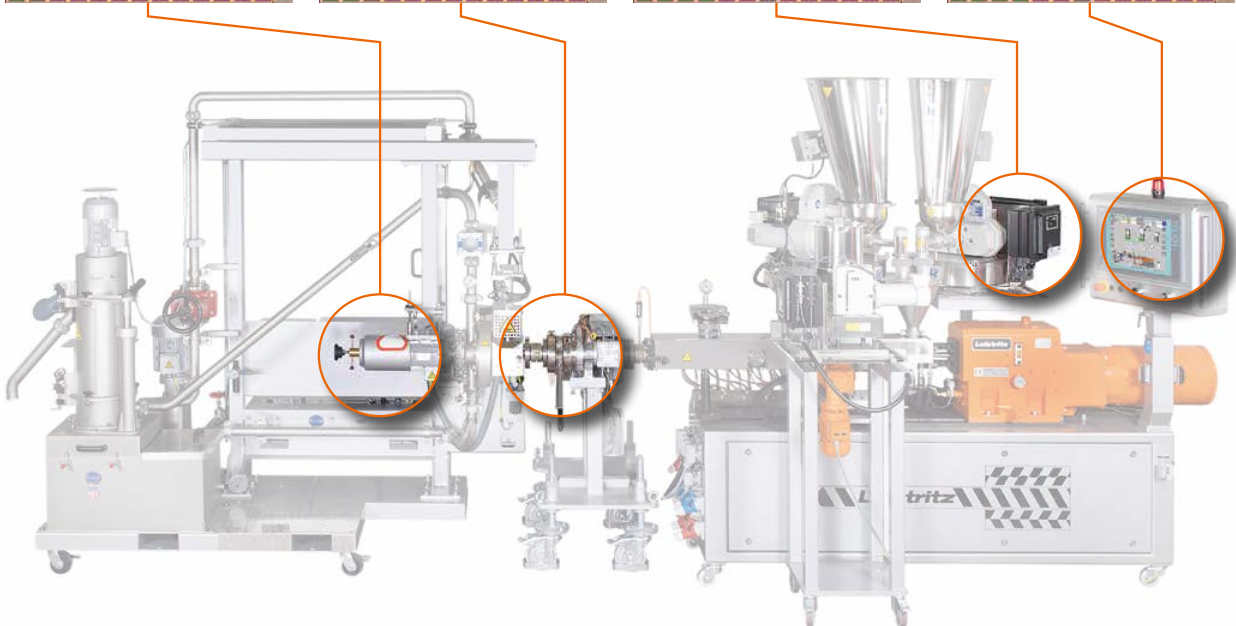
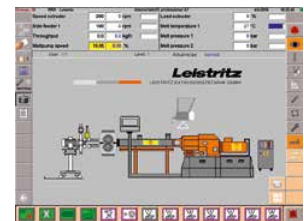
Melt pump



Feeder control



MacromateXX professional S7



Service Features in Automation Technology















- electrical planning of the whole extrusion line
- implementation of other common line components according to customer requests
- integration of all upstream and downstream line components
- optimum control and monitoring of all extruder components
- use of Siemens hardware guarantees a huge support network
- global spare parts service
- remote servicing

Modular Screw System

Screws and barrels are the heart of an extruder. Leistritz offers an extensive variety of screw geometries for an almost endless number of variations. Generally, there are conveying, kneading and mixing elements. The competence of the Leistritz processing experts is to create an optimum screw design for the according application. Depending on the screw geometry, various screw elements are slid onto the shaft in the desired configuration.

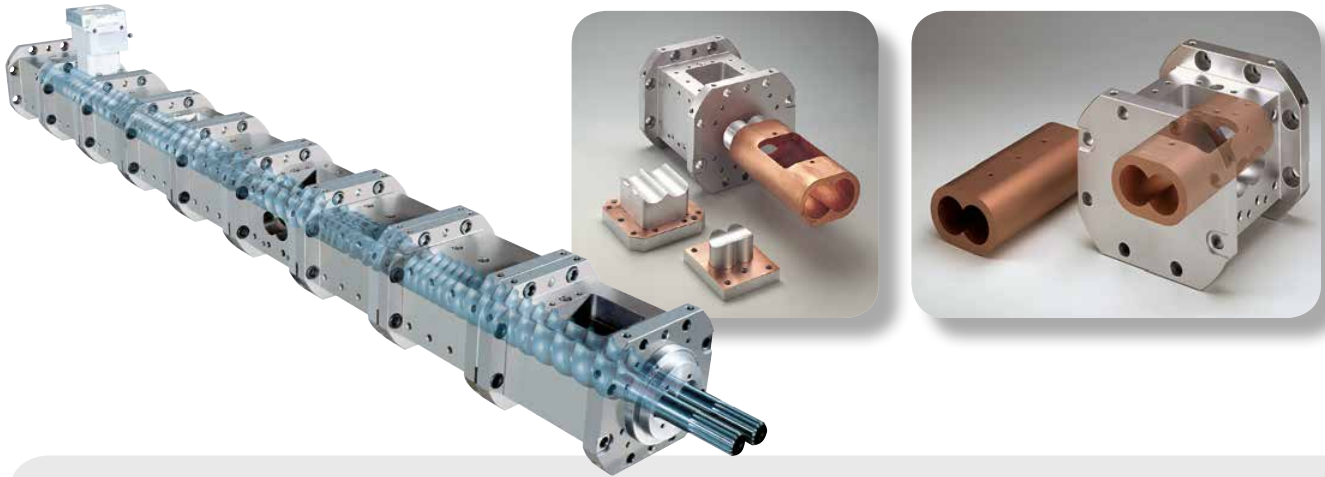


Material overview:

Material Code	Material	Thickness (mm)	Hardness (HRC)	Protection against		Remarks
				Abrasion	Corrosion	
				<i>very high</i>	<i>none</i>	<i>very high</i>
VSA100	Nitrided steel	0.4	>750HV			on request
VSA200	Hot-work steel	through hardened	59±1			standard
VSA300	Stainless steel	through hardened	57-2			on request
VSA401	CrV-HIP material	through hardened	64±1			on request
VSA402	CrNbV-HIP material	through hardened	61±1			standard
VSA503	Hastelloy/Stellite	3	45+5			on request
VSA504	WC material	through hardened	1450HV			on request



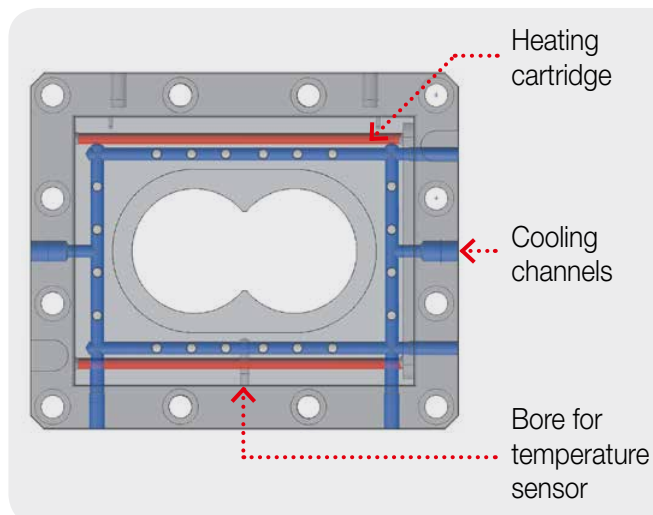
Leistritz extruders are designed as modular systems, which comprise several barrel modules that are either flanged together or - depending on the size of the line - are connected with tie rods. Leistritz offers barrels with different openings and inserts for material feeding, venting and degassing.



Material overview:

Material Code	Material	Thickness (mm)	Hardness (HRC)	Protection against		Remarks
				Abrasion	Corrosion	
				<i>very high</i>	<i>none</i> / <i>very high</i>	
VSA100	Nitrided steel	0.4	>750HV			on request
VSA200	Hot-work steel liner	through hardened	58+2			standard
VSA300	Stainless steel liner	through hardened	57-2			on request
VSA402	CrNbV-HIP liner	through hardened	60±2			standard
VSA403	NiCrB-HIP liner	3	60±2			on request
VSA404	WCNiCrB-HIP liner	3	63±2			on request
VSA501	NiCrB cast liner	through hardened	60±2			on request
VSA502	Conforma Clad	3	63±2			on request
VSA504	WC liner	through hardened	1450HV			on request

One of the extruder's essential quality characteristics is the optimum combination of cooling and heating in the control loop of the temperature device. Thereby, each barrel has a separate heating/cooling zone.



Barrel Heating / Barrel Cooling

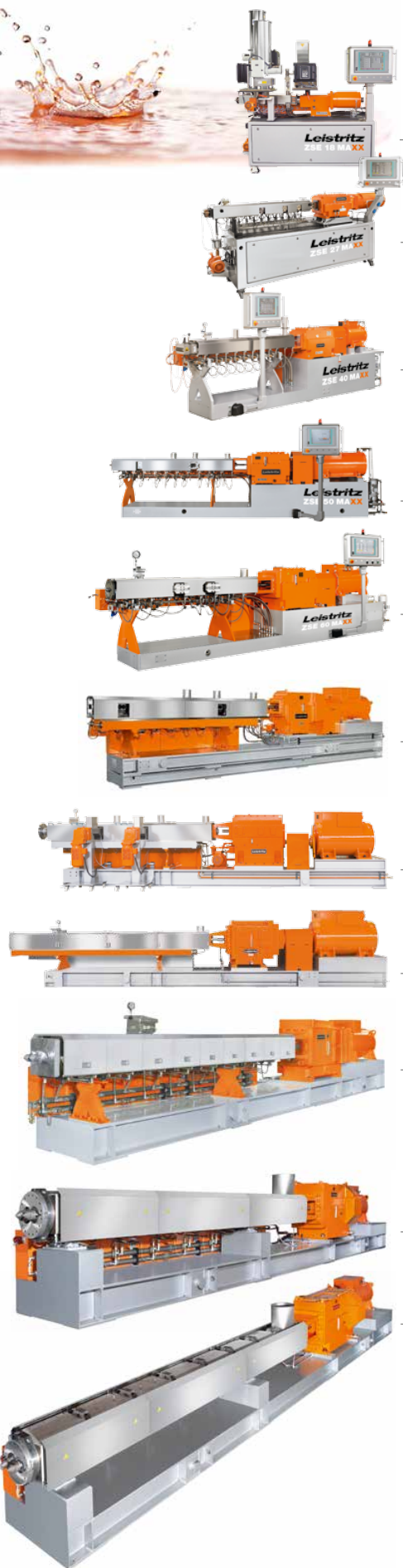
In order to heat up the barrel in a fast and effective way, heating cartridges are used. They enable:

- quick warm up
- quick melting and wetting
- energy saving ⇒ heating inside the barrel in contrast to heating bands or angular heaters (see figure on the left)
- efficient spare part administration ⇒ same type of heating cartridges for all barrels of one extruder type

The ZSE MAXX series has taken the successful machine concept of its predecessor to a new dimension in terms of maXXimum possibilities and increased user confidence.

50% increase of throughput by means of:

- **maXXvolume** - Increased free volume in the screw (OD/ID = 1.66)
- **maXXtorque** - Very high available specific torque for co-rotating twin screw extruders (15.0 Nm/cm³)
- **maXXshaft** - Very high total torque by new splined shaft design
- **maXXcooling** - 30% increased barrel cooling capacity by means of optimized flow of the liquid coolant through the barrel cooling bores



Type	Screw Diameter OD (mm)	OD/ID	Spec. total torque (Nm/cm ³) standard	maXXtorque (Nm/cm ³)
18	18.5	1.66	11.0	-
27	28.3	1.66	11.0	12.5
40	41.4	1.66	11.0	15.0
50	51.0	1.66	11.0	15.0
60	61.6	1.66	11.0	15.0
75	77.0	1.66	11.0	15.0
87	89.4	1.66	11.0	15.0
110	113.1	1.66	11.0	15.0
135	138.7	1.66	-	15.0
160	158.9	1.66	-	15.0
180	178.8	1.66	-	15.0



More information in the „ZSE MAXX“ brochure.

Personal and individual customer support is the basis of the Leistriz service. This refers to the whole range of our services: starting from our spare parts service, line optimization and lab trials to our various training programmes.

Spare Parts Department

With our original spare parts „made in Germany“ we offer top quality. Leistriz customers benefit from quick and flexible delivery from our well-equipped warehouse. Those who want to be safe, contact the experienced service team, who makes sure that the Leistriz machines keep on running!

Leistriz Service-Hotline: +49 (0) 911 4306-444



Line Optimization

Prevention is better than cure! That applies for many fields - also for machines. If reducing downtimes of machines or increasing the availability is in the focus, one should conduct regular inspections. Also when it comes to increasing the performance of a line, improving its quality or reducing wear, Leistriz will happily advise and support its customers.

Example: measuring of barrels and screws



Lab Trials

The best way to put an extrusion line or process to the test is in the Leistriz lab. There, trials can be conducted and formulations developed, optimized and validated. Naturally, all common up- and down-stream equipment are at disposal.

*Plastics and pharmaceutical labs
in Nuremberg and Somerville (USA)*



Trainings and Workshops

Practice makes perfect! Good results can only be realized with well trained staff. In a mixture of theoretical lectures and practical demonstrations participants learn, for example about assembling and operating an extrusion line.

The annual Leistriz workshops have become a fixed date in the industry calendar. Predominant topics: masterbatch, compounding or pharma extrusion. Not only do the participants benefit from an event, which combines top-class speakers and live shows in the Leistriz lab, but they also get an interesting inside view into the industry.



The Leistriz workshops have become an event highlight in the industry.

Leistritz

LEISTRITZ GROUP

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TURBOMASCHINEN TECHNIK GMBH**

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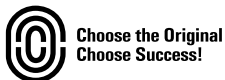
Extruders and Extrusion Lines

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