

Thermo Scientific
Twin-Screw Extruders

Comprehensive Compounding and Extrusion Solutions for Materials Science

Streamlining continuous workflows



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Thermo
SCIENTIFIC

Twin-Screw Extrusion

Mixing. Compounding. Processing.

Why use Twin-Screw Extrusion and Compounding?

Twin-screw extruders are well-established in the industry for mixing, compounding and processing of polymeric materials. They are used in a wide variety of polymer, pharmaceutical and food applications to efficiently develop and produce high-quality products using a continuous process. The modularity of twin-screw extrusion equipment provides great flexibility in designing a process to accomplish your goals. Choose from a wide range of customizable options for twin-screw extruders designed to fit the demanding and ever-changing environments of research, development, production and quality control for the pharmaceutical, polymer and other industrial markets.

Flexibility in Design

Modify the extruder to match your requirements now and in the future. With adaptability in mind, we created our parallel, co-rotating twin-screw extruders with unsurpassed flexibility and modularity. The easy accessibility of the horizontally split, hinged-barrel design lets you observe the material during the extrusion procedure. To optimize the process or change the application, simply convert the screw and barrels to reduce both time and expense. In fact, this is five times faster than most other solutions on the market.

Advantages of Thermo Scientific™ Twin-Screw Extruders

- **Reduce waste** by using smaller quantities of material during compounding
- **Decrease costs** with quick cleaning times and minimal downtime between runs
- **Save time** with fast, simple equipment changes between test materials
- **Measure the extrusion process** and material samples with advanced analytical techniques such as Near-infrared (NIR) and Raman
- **Optimize process simulation** with individual screw configurations to suit your application
- **Customize equipment** configurations to meet unique application demands
- **Be confident** with global support that offers material feasibility testing, qualification support and services

Advanced applications include:

- Polymer compounding
- Masterbatch production
- Nanomaterials research
- Continuous twin-screw granulation (TSG) and hot melt extrusion (HME) for pharmaceuticals
- Processing high-performance and engineered polymers
- Extruding and mixing ceramic and powder metal compounds
- Processing of hazardous ingredients under controlled environments

In-depth Expertise

Good science builds knowledge

If your company develops and manufactures new products in a competitive environment, it's vital that your equipment manufacturer has extensive expertise to meet the process challenges your industry faces. We are scientists and engineers with over 50 years of experience in producing solutions in the field of materials sciences.

Delivering accurate and reproducible solutions are our top priorities to help you shorten time-to-market for your product. We have developed methods that make it easier for you to optimize your process research and development, as well as help you meet the most stringent government regulations or industry standards such as GMP and calibration requirements.

Consult our experts to provide quality-by-design equipment with options that can:

- **Feed and process** challenging raw materials and formulations
- **Work with very small sample** sizes to minimize waste and cost
- **Safely contain hazardous** materials to minimize exposure
- **Provide custom**, industry-specific options and data acquisition
- **Integrate analytical** tools such as NIR and Raman spectroscopy
- **Bundle solutions** with external partners for upstream and downstream equipment

Whether you are in research, development, production, or quality control, rely on us to understand your specific needs and design process equipment that meets your department's requirements.



Comprehensive support enables your success

From feasibility testing to post-installation support, you can be confident that your process will achieve your research and production goals. Consult with our sales engineers to schedule a demonstration of our equipment or conduct an application feasibility study in one of our state-of-the-art facilities in the US and Germany.

Equipment installation supported by skilled, certified engineers and IQ/OQ procedures is just the beginning. We offer an array of fee-based optional services after installation that can help you:

- **Provide comprehensive** training programs for your scientists and technicians
- **Extend the warranty** coverage with all parts and labor included
- **Gain better cost control** over inspection and repair equipment with pre-set fees
- **Minimize downtime** with routine maintenance and calibration as well emergency response services

Accurate and continuous sheet and ribbon haul-off system



Micro-Compounding

Feasibility testing with less waste

Our line of micro-compounders with conical twin-screws is well-suited for research and development in the polymer, pharmaceutical, bioscience, and nanotechnology industries. All models use as little as five grams or seven milliliters of material for compounding. This is especially beneficial if you compound expensive or small-scale materials. By using the optional force feeder attachment, you can continuously extrude very small material volumes.

These small-scale instruments are based on proven conical twin-screw technology with co- and counter-rotating screws that operate as standalone units with complete data export capability. Residence time is well defined due to the channel and bypass valve design. We can show you how to assess your materials and processes with our analytical instruments described to the right.

Gain a more complete understanding of process parameters when you use the micro-compounders in combination with our

- Thermo Scientific™ HAAKE™ MiniJet Pro injection molder to prepare test samples of your compounded material
- Thermo Scientific™ HAAKE™ MARS rheometer platform to characterize the rheological properties of your test sample
- Thermo Scientific™ Nicolet™ iS™5 FT-IR spectrometer to confirm chemical composition

Thermo Scientific™ Pharma *mini* HME Micro-Compounder

Use for special requirements demanded by the pharmaceutical industry. With a completely modular and removable barrel and crevice-free design, this machine provides enhanced features for pharmaceutical API/excipient formulations and regulated environments. The HME process is ideal for feasibility testing of poorly soluble ingredients that require improved bioavailability.

- GMP design and validation protocols for pharmaceutical manufacturers
- Fast and easy feasibility testing of API/excipient formulations for HME
- Quick disassembly to minimize cross-contamination and cleaning downtime



Pharma *mini* HME Micro-Compounder

Thermo Scientific™ HAAKE™ MiniCTW Micro-Conical Twin-Screw Compounder

Use for high-precision control of extrusion and compounding for a wide range of materials used in new product development. By running the instrument in circulation mode, you have full control of the residence time of the extrusion process. At the end of the test, you can open the bypass valve and extrude the sample as a strand. Effectively monitor the reaction process by measuring the torque of the drive motor.

- Ideal for highly viscous material melts
- Removable top barrel for quick, easy cleaning
- Controllable torque speed to monitor reaction



HAAKE miniCTW Micro-Compounder

Thermo Scientific™ HAAKE™ MiniLab II Micro-Compounder

Use to measure structural changes during compounding and assess rheological properties of test materials ideal for R&D. The pneumatic force feeder guarantees easy sample loading. An integrated, bypass valve lets you recirculate the sample in a slit-capillary backflow channel or extrude it for further testing. With its hinged barrel and fast cooling capacity, the HAAKE MiniLab unit allows you to freeze the compound for further examination.

- Measures relative viscosity during the compounding process
- Uses as little as 5 g or 7 ml of material
- Fits in a fume hood to limit exposure to hazardous materials
- Use as a standalone unit or as a computer-controlled system



HAAKE MiniLab II Micro-Compounder

Laboratory Scale

Optimize for scale-up with less risk

Simulate production and optimize your process with Thermo Scientific™ laboratory-scale extruders. Feed different additives (solid, liquid, or gas) along the various barrel ports, while measuring material properties of the melt using in-line sensors.

Our twin-screw extruders can be quickly and easily configured for a wide variety of applications and test conditions.

Benchtop twin-screw compounders offer unique flexibility

Mimic a complete compounding line including feed equipment and downstream equipment for developing industrial processes on a laboratory scale. Starting from as low as 20 g of material per hour, our 11 mm small-scale, twin-screw extruders are specifically designed for the research and development formulation scientists that need to scale-up with minimal parameter changes to our larger Thermo Scientific standalone compounding/extrusion systems for production. Save on expensive floor space and run tests on hot melt and granulation processes to assess the best manufacturing conditions for your formulation.

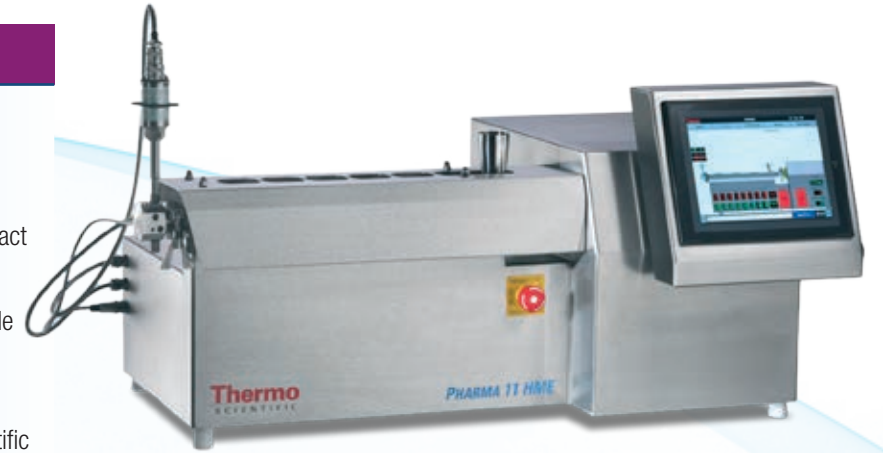
Test process parameters in the early phases of the new product lifecycle to collect data on:

- Viscosity and flow behavior of a compound
- Extrudability and scale-up results
- Predictions for the injection molding process
- Morphology of polymer and nanocomposites
- Recycling properties and reusability of the polymer
- Influence of screw geometry on processes
- Decomposition of biopolymers and active pharmaceutical ingredients
- Direct scale for low-risk technology transfer

Thermo Scientific™ Pharma 11 Twin-Screw Extruder

Use this very small, scalable extruder to switch from Hot Melt Extrusion (HME) to Twin-Screw Granulation (TSG) for a wide range of drug development applications. With a minimum throughput of just 20 g/h, it is ideal for research and development applications when assessing expensive API/excipient formulations. Achieve GMP compliance with the Pharma 11 extruder, which is suitable for the production of validation batches, clinical trial materials and small-scale production for throughputs up to 2.5 kg/h. Full validation is available for FAT, SAT, IQ/OQ, and process control is suitable for PAT.

- Uses small amounts of material for faster, cost-effective development of HME or TSG processes for GMP compliance
- Easy cleaning and validation: all material contact parts easily removable
- Simple to operate with user-friendly, removable touchscreen and integrated feeder control
- Minimizes scale-up risk, cost and time due to geometric similarity with larger Thermo Scientific extruders



Pharma 11 Twin-Screw Extruder

Thermo Scientific™ Process 11 Twin-Screw Extruder

Use this extruder to test a variety of process parameters. Several setup possibilities include:

- Multiple split feeding and venting ports
- A die design for quick changes of the strand diameter
- Eight barrel segments (length: 5 L/D) for accurate temperature profiles

A hygienic model is also available with product-contact parts manufactured from hygienic-grade steel that is required by the food and cosmetics industries.

As a workflow solution, the HAAKE MiniJet Pro Injection Molding System can be used to shape the compounded materials into test samples for further characterization of mechanical or optical properties.

- High-temperature option up to 450 °C is useful for high-performance polymers
- Controlled liquid cooling of the barrel for low-temperature applications
- Fully ported barrel allows maximum flexibility for split feeding and venting
- Screw length adjustment kit reduces the extruder's processing length in 5 L/D steps
- Vacuum venting stack for degassing the polymer melt



Process 11 Extruder

Thermo Scientific™ EuroLab 16 XL Twin-Screw Extruder

Use this extruder for research, development, quality control, and small-scale production. From sample batches of 200 g up to outputs of 10 kg/h, easily configure the extendable barrel design to test a full range of polymer processes. The horizontal split barrel of 25:1 L/D can be quickly changed to 40:1 with modules that are automatically recognized by the EuroLab 16 XL extruder, along with heating controls that appear on the touchscreen interface. Barrel segments are available for feeding solids, liquids and venting. Add secondary feeders and vacuum pumps as needed.

- Operated via a rugged, 4-color touchscreen
- Plug-and-play barrel extensions delivers flexibility for a full range of polymer processes
- Programmable Logic Control (PLC) with real-time trending display and formulation storage to preset extruder parameters ensures process reproducibility
- Advanced heater software delivers precise temperature control
- Low maintenance, brushless 2.5 kW motor drives the screws at 1000 rpm



EuroLab 16 XL Twin-Screw Extruder
Complete strand line with feeder and water bath accessories is shown

Laboratory Scale

Optimize your process in less time

Develop your process knowing that you can transfer parameters to the next scale with fewer test runs.

Thermo Scientific™ HAAKE™ Rheomex PTW 16 OS Twin-Screw Extruder

Use this parallel twin-screw, small-scale compounder for running early-stage compounding and blending tests. With its 16 mm screw diameter, only very small sample volumes are needed for research and development teams to run tests in the early stages of formulation scale-up. The horizontally split barrel, with the top half fitting upward, allows easy inspection of the melting and mixing behavior. For optimization of this behavior, the screws can be configured individually.

- Small sample size wastes less material in early-stage formulation development
- Design allows easy inspection of melting and mixing behavior



HAAKE Rheomex PTW 16 OS Extruder (left) connected to the PolyLab OS Drive Unit (right)

Thermo Scientific™ HAAKE™ PolyLab OS System

Measure rheological properties of your material and control process parameters when you connect the PolyLab OS rheometer platform to any Rheomex extruder.

The PolyLab OS system provides:

- An on-line torque rheometer
- Extrusion process control software
- Connectivity between extrusion accessories and sensors

Thermo Scientific™ HAAKE™ Rheomex PTW 24 OS Twin-Screw Extruder

Use this 24 mm screw-diameter extruder for laboratory applications with higher throughput needs. The barrel layout and screw geometries are taken directly from the production process. The individually configurable barrel and screws enable users to adapt to changing requirements in compound development and process optimization.

- Quick setup for high-throughput, continuous compounding applications
- Easy to configure barrels/screws when changing from one material to another



HAAKE Rheomex PTW 24 Extruder with open barrel and segmented screws

Thermo Scientific™ HAAKE™ Rheomex CTW 100 OS Twin-Screw Extruder

Use this counter-rotating, conical twin-screw extruder for high-shear compounding of materials such as PVC, wood fiber compounding, and blending of polymers with different viscosities. A wide range of applications can be performed using different screw geometries to adapt to the needs of the laboratory or pilot plant. The counter-rotating design supplies a positive material displacement from the hopper to the die, delivering high levels of pressure and shear, and allowing control of residence times.

- Excellent for processing heat-sensitive compounds
- Conical design minimizes residence times; avoids dead volumes



HAAKE Rheomex CTW 100 Extruder (left) connected to the PolyLab OS Drive Unit (right)

Pilot-scale Processing and Production

Flexible compounding with less effort

Smaller, pilot-scale extruders are an excellent choice when working with modest quantities of expensive or difficult polymers and pharmaceutical ingredients.

Thermo Scientific twin-screw extruders offer flexible compounding configurations that can move you from small batches in lab-scale production to pilot-scale production or low-volume manufacturing. The co-rotating, twin-screw extruders feature:

- Segmented screws and modular barrels; split-barrel design with barrel-liners
- Industrial standard Siemens PLC* for seamless integration into full-line units
- Short cleaning time and fast product exchanges with full-length barrel that opens
- Minimum use of expensive materials
- Small footprint to save floor space

* Programmable Logic Controller

Thermo Scientific™ TSE 24 MC Twin-Screw Extruder

Use this floor-mounted extruder for test samples and small-scale manufacturing with sample outputs up to 50 kg/h. The hinged, horizontally split barrel is ideal for quick, easy cleaning and fast access to the 24 mm diameter screws, while segmented barrel modules permit rapid configuration changes. The TSE 24 extruder options include: replaceable steel barrel liners, barrel segments for venting or feeding solids and liquids, secondary feeders, and vacuum pumps.

The large, color touchscreen interface displays trending in real time. Optional accessory downloads data to a remote computer for archiving and analysis. The PLC stores formulation data with preset extruder temperature profiles for reproducible process conditions.

- Segmented module barrel adapts to a wide variety of polymer processes
- PLC recognizes integrated feeders and accessories for easy line exchanges
- Low maintenance, brushless 5.5 kW motor drives the screws at 500 rpm. If higher output is needed, an 11 kW drive doubles the screw speed
- Processing length up to 40:1 L/D with independent temperature control for each barrel segment



Thermo Scientific™ Pharma 16 Twin-Screw Extruder

Use this 2-in-1 extruder to switch from an HME and a TSG process when developing drug formulations or performing scale-up studies. The co-rotating screws provide easy track recording and handling. Ensure reliable and reproducible results with a PLC system that archives formulation data matched to specific process parameters. A clamshell barrel with removable liners allows easy cleaning of contact parts without disconnecting the barrel. Produce multiple samples from small amounts of API with minimal scale-up risks.

- Switch from HME to TSG process with one instrument
- HME lines can deliver product in pellet or flake form
- Minimal use of expensive APIs and excipients
- Process parameters directly scalable to Pharma 24 and Pharma 11 extruder
- Stainless steel extruder helps you meet GMP compliance with validation support (e.g., FAT, SAT, IQ/OQ)



Pharma 16 Twin-Screw Extruder

Thermo Scientific™ Pharma 24 Twin-Screw Extruder

Use this extruder to continue your drug formulation scale-up from the Pharma 16 extruder. Similar geometries between the Thermo Scientific™ Pharma extruders mean less time and cost need to be spent on optimizing equipment parameters. Choose from options to have a dedicated HME or TSG process instrument or a one that combines both processes in one unit. The Pharma 24 extruder also offers GMP compliance, PLC data and parameter archiving, removable barrel liners and easy cleaning with clamshell design.

- Proven solutions for continuous wet granulation
- Scale up from process development to production
- Stainless steel extruder helps you meet GMP compliance with validation support (e.g., FAT, SAT, IQ/OQ)
- Integrates with upstream and downstream equipment to build a continuous production line



Pharma 24 Twin-Screw Extruder

Twin-Screw Extruders for Every Phase of Your Product Development

	Barrel Diameter [mm]	Barrel Length L/D	Da/Di	Achievable Output [kg/h]	Temperature [°C]	Screw Design	Max. Screw Speed [rpm]	Temperature Zones ***	Unit Control	Drive Power [kW]	Segmented Screw
Micro-Compounding Only 5 g of material needed!											
HAAKE MiniCTW	Conical			0.01 to 0.1	300	Conical co- and counter rotating	360	2*	PC	0.4	○
Pharma <i>mini</i> HME	Conical			0.01 to 0.1	280	Conical co- and counter rotating	360	2*	TS	0.4	○
HAAKE MiniLab	Conical			0.01 to 0.1	350 (420)	Conical co- and counter rotating	360	2*	PC / TS	0.4	○
Laboratory Scale											
Pharma 11	11	40	1.72	0.02 to 2.5	280	Parallel co-rotating	1000	8	TS	1.5	●
Process 11	11	40	1.72	0.02 to 2.5	350 (450)	Parallel co-rotating	1000	8	TS	1.5	●
EuroLab XL	16	25 (40)	1.73	0.2 to 10	400 (450)	Parallel co-rotating	500 (1000)	7 (10)	TS	1.25 (2.5)	●
HAAKE Rheomex PTW 16 OS	16	25 (40)	1.73	0.2 to 10	400 (450)	Parallel co-rotating	1100	7 (10)	PC	7 (16)**	●
HAAKE Rheomex PTW 24 OS	24	28 (40)	1.77	0.5 to 50	400 (450)	Parallel co-rotating	1100 (560)	7 (10)	PC	16 (7)**	●
HAAKE Rheomex CTW 100 OS	Conical			0.2 to 5	450	Conical counter rotating	250	3	PC	7 (16)**	○
Pilot Processing and Production											
TSE 24 MC	24	28 (40)	1.77	0.5 to 50	400 (450)	Parallel co-rotating	500 (1000)	7 (10)	TS	5.5 (11)	●
Pharma 16	16	40	1.73	0.2 to 5	300	Parallel co-rotating	1000	8	TS	2.5	●
Pharma 24	24	40	1.77	0.5 to 20	300	Parallel co-rotating	1000	8	TS	11	●

PC = External computer control
TS = Integrated touchscreen control

* = Common set point
** = Driven by PolyLab drive unit
*** = Depends on barrel length

() = Optional
○ = no
● = yes

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