NEW!

Retsch®
Solutions in Milling & Sieving

High Energy Ball Mill

2,000 min-1 max. speed
unique liquid cooling

The revolution in ultrafine grinding

- Faster and finer grinding than with any other ball mill
- Speed of up to 2000 min^{-1} provides ultra-fast pulverization of the sample
- Innovative water cooling permits continuous operation without cool down breaks
- Narrow particle size distribution thanks to special jar design which improves mixing of the sample
- Jars with integrated safety closure
- Easy operation via touch screen, memory for 10 SOPs
- Range of jar materials ensures contamination free grinding

part of VERDER scientific

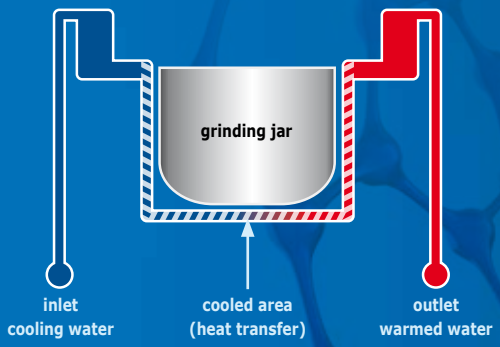
„The extremely high energy input in combination with the new liquid cooling system provides perfect conditions for mechanical alloying and colloidal grinding down to the nanometer range."

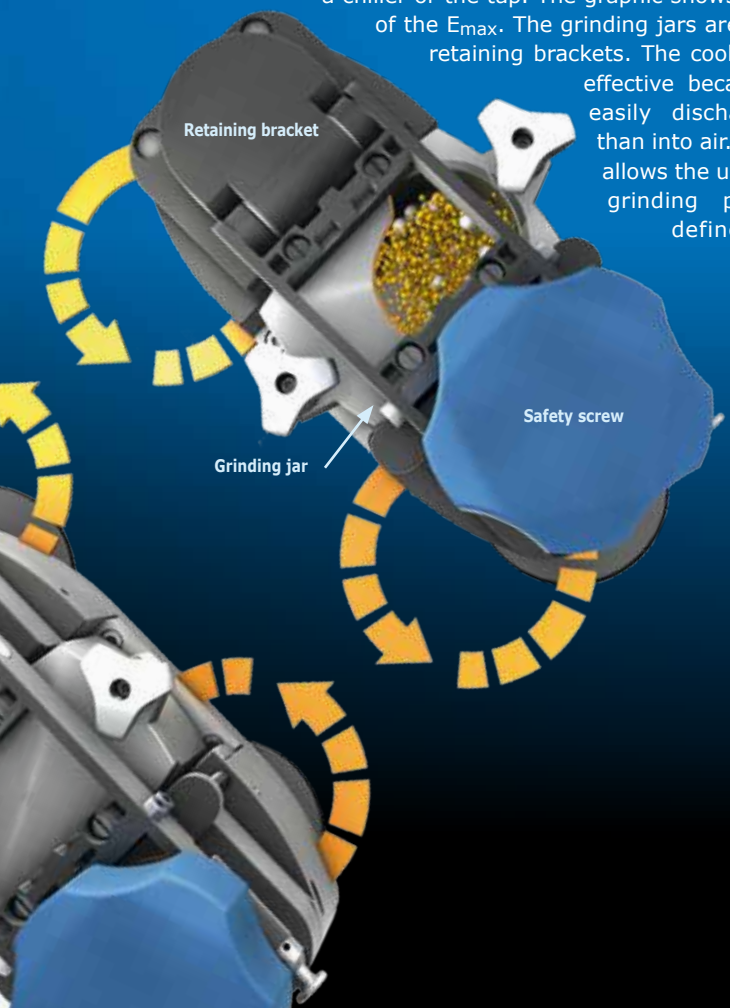
High Energy Ball Mill

The E_{max} is an entirely new type of ball mill which was specifically designed for high energy milling. The impressive speed of 2,000 min^{-1}, so far unrivaled in a ball mill, in combination with the special grinding jar design generates a vast amount of size reduction energy. The unique combination of impact, friction and circulating grinding jar movement results in ultrafine particle sizes in the shortest amount of time. Thanks to the new liquid cooling system, excess thermal energy is quickly discharged preventing the sample from overheating, even after long grinding times.

Highly efficient liquid cooling

The grinding jars of the E_{max} are cooled by an integrated water cooling system. To further reduce the temperature, the mill can be connected to a chiller or the tap. The graphic shows the cooling circuit of the E_{max}. The grinding jars are cooled via the jar retaining brackets. The cooling system is very effective because heat is more easily discharged into water than into air. The E_{max} software allows the user to carry out the grinding process within a defined temperature range, i. e. he can set a minimum and a maximum temperature. When the maximum temperature is exceeded, the mill automatically stops and starts again upon reaching the minimum temperature.





The novel size reduction mechanism of the E_{max} unites the advantages of different mill types: high-frequency impact (mixer mill), intensive friction (vibratory disc mill) and controlled circular jar movement (planetary ball mill) allow for unrivaled grinding performance. This significantly improves the mixing of the particles resulting in smaller grind sizes and a narrower particle size distribution than ever achieved in ball mills.

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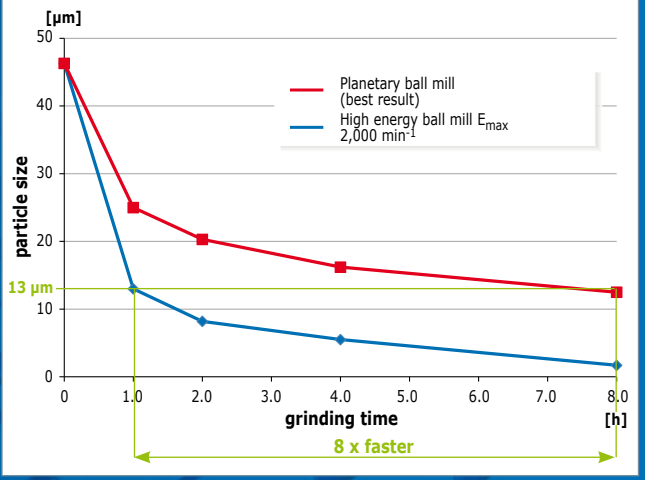
E_{max}

Product video E_{max} at www.retsch.com/emax

Benchmark test: fineness and grinding time

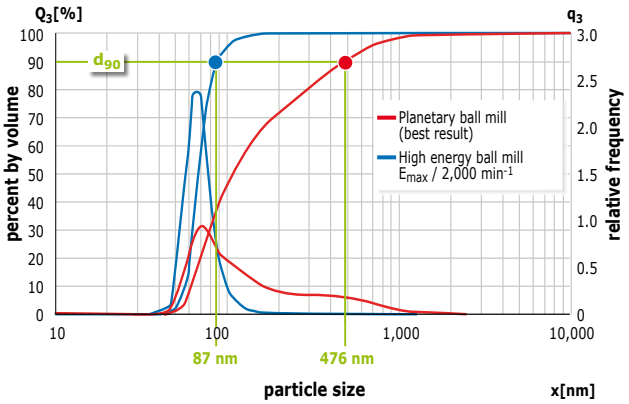
Graphite: 8 x faster 7 x finer

Comparison of grinding time and fineness in the E_{max} and in a planetary ball mill



Titanium dioxide: 5 x finer

Grinding of titanium dioxide in the E_{max} and in a planetary ball mill



Grind sizes at the nanoscale can only be achieved by wet grinding. For this method a large number of grinding balls with 0.1 mm to 3 mm Ø is used to create as much friction as possible. The resulting grinding energy is extended even further by the high speed of 2,000 min^{-1} in the E_{max}. The high energy input is fully exploited as the unique liquid cooling system quickly discharges the frictional heat. The superiority of the E_{max} becomes apparent when looking at the grinding time. The graphic shows the results of grinding graphite in the E_{max} at 2,000 min^{-1} (50 ml grinding jar of zirconium oxide, 110 g matching grinding balls 0.1 mm Ø, 5 g sample, 13 ml isopropanol) and in the most powerful planetary ball mill. Graphite is a lubricant and therefore requires a particularly high energy input for size reduction. After only 1 hour of grinding 90 % of the E_{max} sample possessed a fineness of 13 microns. This grind size was achieved by the planetary ball mill only after 8 hours of grinding (excl. cooling breaks). After 8 hours of grinding in the E_{max} its superior performance is again quite obvious: With a d_{90} value of 1.7 µm the grind size is 7 times finer than the one achieved in the planetary ball mill (12.6 µm).

In another comparative trial, the pigment titanium dioxide was pulverized in a planetary ball mill and in the E_{max} (50 ml grinding jar of zircomium oxide, 110 g matching grinding balls 0.1 mm Ø, 10 g sample, 15 ml 1% sodium phosphate).
After only 30 minutes the d_{90} value of the E_{max} sample was 87 nm. The total processing time in the most powerful planetary ball mill amounted to 90 minutes (30 minutes net grinding time) due to the required cooling breaks. After this time, the sample had a final fineness of only 476 nm. Consequently, the E_{max} achieved a 5 times higher final fineness in a third of the time required by the planetary ball mill.

Higher final fineness in less time with narrower particle size distribution:
E_{max} – The new dimension in high energy milling

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Maximum safety

During product development of the E_{max} special attention was paid to operational safety. The position of the grinding jar is automatically monitored, so that the mill cannot be started if the position is not correct. Possible imbalances are controlled at all times. If they become too strong the mill automatically stops. The remaining grinding time is displayed and the process can be re-started once balance has been restored.

APPLICATION EXAMPLES

Aluminum oxide
Final fineness: <0.14 µm
Parameters: 2,000 min^{-1}, 15 min

Graphite
Final fineness: <1.7 µm
Parameters: 2,000 min^{-1}, 8 h

Quartz
Final fineness: <16 µm
Parameters: 1,000 min^{-1}, 30 min

Titanium dioxide
Final fineness: <87 nm
Parameters: 2,000 min^{-1}, 30 min

TECHNICAL DATA

www.retsch.com/emax	
Applications	size reduction, homogenization, nano grinding, mechanical alloying, colloidal grinding
Material feed size*	<5 mm
Final fineness*	<80 nm
Batch size / feed quantity*	max. 2 x 45 ml (two grinding stations)
Grinding jar sizes	50 ml / 125 ml
Speed	300 – 2,000 min^{-1}
Cooling	controlled integrated water cooling system / option: external chiller
Type of grinding jars	with integrated safety closure devices, optional aeration covers
Material of grinding tools	stainless steel, tungsten carbide, zirconium oxide
Storable SOPs	10
Dimensions (W x H x D)	625 x 525 x 645 mm
Weight	120 kg

*depending on feed material and instrument configuration/settings

ORDER DATA

High Energy Ball Mill E_{max}	Item no.	Item no.
E_{max} (please order grinding jars and balls [up to 15 mm] separately)		
E_{max} for 200-240 V		20.510.0001
Grinding jar E_{max}	50 ml	125 ml
Grinding jar, stainless steel	01.462.0305	01.462.0313
Grinding jar, tungsten carbide	01.462.0317	-
Grinding jar, zirconium oxide	01.462.0312	01.462.0307

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