



## MEETSYSTEEM GRINDCONTROL

## SEE WHAT OTHERS CAN'T SEE

Modern laboratory applications demand maximum control, highest reproducibility, and complete process transparency. The latest generation of GrindControl provides a solution that consistently meets these requirements — powerful, intelligent, and intuitive to operate.

GrindControl is used in ball mill processes and continuously records pressure and temperature inside the grinding jar. The system consists of a hardware measuring unit and dedicated analysis software, enabling real-time visualization and evaluation of the key process parameters, pressure and temperature.

This makes sample preparation more efficient, protects temperature-sensitive materials, and ensures stable conditions even in demanding applications — for example in mechanochemical syntheses. GrindControl creates transparency in the ball milling process and forms the foundation for reliable and reproducible results.



[Klik om video te bekijken](#)

## GRINDCONTROL IN HET KORT

- | Precise temperature monitoring from -20 °C to +100 °C with 0.1 °C resolution.
- | Accurate internal jar pressure measurement from 0 to 5 bar with 1 mbar resolution.
- | Easy introduction or release of gases via threaded holes in the cover.
- | Intuitive real-time software for monitoring, recording, and analyzing all data.



## VOORDELEN DOOR TECHNOLOGIE

- | Fully standalone system – no mill modifications required.
- | Modular lid design for fast switching between different jar materials and sizes.
- | Simultaneous monitoring of up to four GrindControl units.
- | Reliable wireless transmission up to 5 meters and battery life up to 80 hours.
- | Fast and easy operation and cleaning: tools included.

### GRINDCONTROL

## VOORDELEN VAN HET METEN VAN DRUK EN TEMPERATUUR

Monitoring temperature and pressure provides significant advantages for optimally designing and controlling ball mill processes for particle size reduction, sample preparation, and research applications.

It helps to improve:

**Quality:** Pressure and temperature monitoring for reliable and

reproducible results.

**Efficiency:** Real-time monitoring enables precise control of process conditions. Process parameters such as cooling, frequency, duration, and grinding pause intervals can be adjusted as needed.

**Safety:** Critical changes in pressure and temperature can be detected at an early stage, preventing process errors and safety risks.

**Research & development:** Deeper insights into mechanochemical reactions can be obtained. The relationship between the results and the relevant state variables can be analyzed.



The GrindControl system is available for the Planetary Ball Mills, the Mixer Mills MM 500 nano/control, and Emax. It includes hardware for pressure and temperature measurement plus analysis software.

## ANALYSIS OF PRESSURE AND TEMPERATURE DEVELOPMENT DURING BALL MILLING

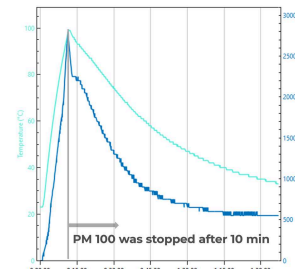
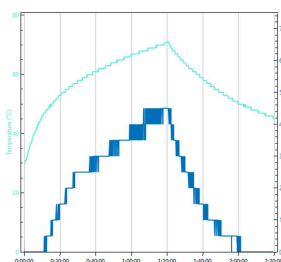
GrindControl supports a broad range of applications, delivering enhanced safety and accurate temperature regulation for controlled and reproducible ball milling.

### EXAMPLE 1: MAXIMUM SAFETY DURING WET GRINDING

During ball milling, temperature and pressure profiles can develop differently depending on the filling level of the grinding jar, the jar material, and the process parameters.

While temperature and pressure increase gradually during the wet grinding of corundum in a 250 ml grinding jar in a planetary ball mill (left diagram), a significantly stronger increase is observed at the same rotational speed in a 500 ml grinding jar with steel balls of larger diameter (right diagram).

By continuously monitoring these state variables with GrindControl, the process can be specifically controlled and overall operational safety can be



enhanced. Grinding jars with elevated temperatures must only be handled with protective gloves. Pressurized grinding jars may only be opened with extreme caution.

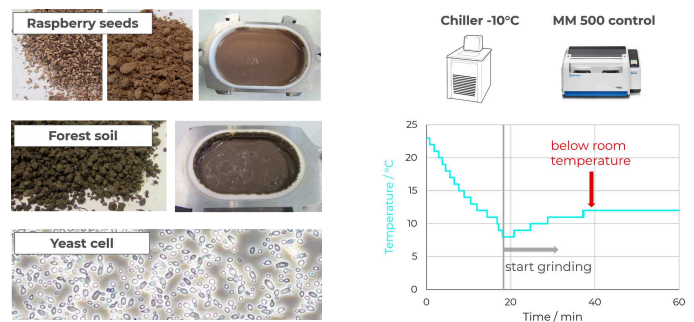
In addition, GrindControl enables the optimal selection of grinding and pause times, particularly for long-term grinding processes.

## EXAMPLE 2: GENTLE BALL MILLING OF TEMPERATURE-SENSITIVE SAMPLES

When grinding temperature-sensitive materials, temperature control plays a crucial role. For such samples, targeted cooling or grinding pauses are often applied to protect sensitive substances from thermal damage. This is particularly advantageous when processing food products, organic samples, or during cell disruption, as it prevents the loss or denaturation of temperature-sensitive components.

In this example, the system is operated with the MM 500 control, which is connected to an external chiller. Using GrindControl, the process parameters inside the grinding chamber are continuously monitored. As illustrated, the grinding chamber is pre-cooled to below 10 °C and remains below room temperature throughout the entire process.

Continuous temperature monitoring with GrindControl enables precise process control, ensures reproducible results, and simultaneously protects sensitive materials.

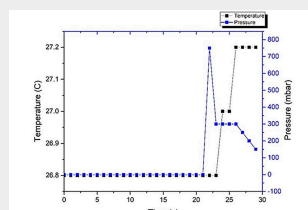


## SYSTEMATIC ANALYSIS OF PARAMETERS AFFECTING MECHANOCHEMICAL REACTIONS

Monitoring pressure and temperature provides valuable insight into what happens inside the grinding jar. GrindControl is widely used to investigate material syntheses such as mechanical alloying and other mechanochemical reactions.

### EXAMPLE 1: MONITORING OF A SELF-PROPAGATING MECHANOCHEMICAL SYNTHESIS REACTION (MSR)

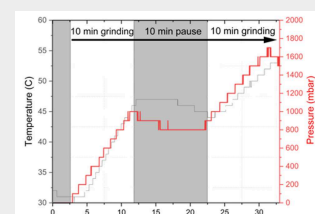
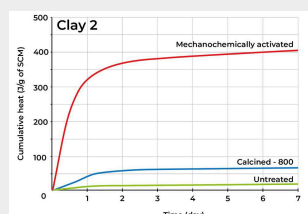
A mechanochemical synthesis was performed in an MM 500 nano using a 125 ml stainless steel jar with GrindControl. The reactants were milled at 20 Hz using 32 × 10 mm balls under air.



After about 20 seconds of milling, an ignition event occurred, leading to a pressure increase to approx. 730 mbar and a temperature rise. GrindControl captured the ignition point precisely – the key parameter for this self-propagating mechanochemical synthesis reaction (MSR). [8]

### EXAMPLE 2: MECHANOCHEMICAL ACTIVATION OF CLAYS FOR “GREEN CEMENT”

In research on sustainable cement, the GrindControl system supports the analysis of the mechanochemical activation of clay minerals. In this process, the pozzolanic reactivity can be significantly increased compared to untreated or calcined samples (see left figure). The activated clays serve as Supplementary Cementitious Materials (SCMs) and enable a reduction in CO<sub>2</sub> emissions by partially replacing clinker.



Processing is carried out in a PM 100 planetary ball mill at 500 rpm, using a 500 ml grinding jar with twelve 20 mm stainless steel balls (ball-to-powder ratio of 25:1). By linking pressure and temperature data with reactivity measurements, the activation

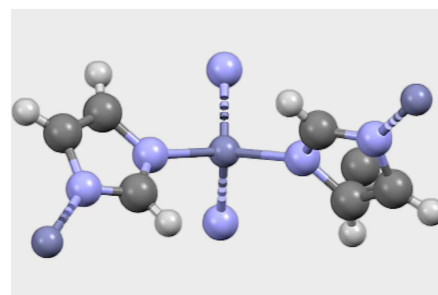
## GRINDCONTROL APPLICATION AREAS



When processing temperature-sensitive materials, the temperature must be monitored precisely. With GrindControl, compliance with specified temperature limits can be reliably ensured.



During wet grinding processes, long grinding times and high energy input can lead to significant temperature increases and pressure build-up. GrindControl enhances operational safety during handling and enables the optimization of grinding and pause intervals.



In mechanochemistry, specific temperature and pressure conditions are crucial. With GrindControl, these parameters can be precisely monitored and systematically correlated with the respective reaction outcomes.



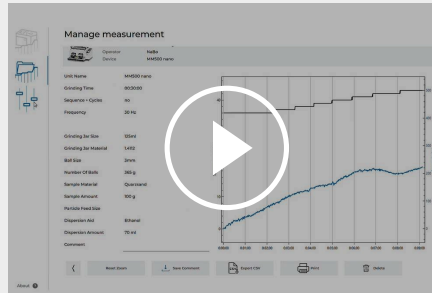
## GRINDCONTROL

# GRINDCONTROL IN PRACTICE

The following videos provide a concise overview of the available versions, the system structure, and proper cleaning procedures.



[Klik om video te bekijken](#)



[Klik om video te bekijken](#)



[Klik om video te bekijken](#)

## HARDWARE

This video introduces the different available GrindControl versions and explains the respective hardware components. It also provides an overview of compatibility with various mill types and materials.

## SOFTWARE

This video demonstrates how to use the software and explains its structure. It also clearly illustrates the acquisition and visualization of the measured data.

## CLEANING

This video demonstrates the proper cleaning procedure for the GrindControl system after use. It provides important instructions on safe handling and the preservation of components to ensure long-term and reliable operation.

## FUNCTIONERINGSPRINCIPE

Pressure and temperature are transmitted in real time via Bluetooth from the GrindControl electronics to a PC. The software records five measurements per second, generating a detailed log of the pressure and temperature profiles.

The sensors are integrated into the lid of the grinding jar, capturing the physical conditions in a





way that most accurately reflects the environment inside the jar.

Sintered filters reliably protect the sensors from contact with solid sample material. At the same time, they prevent material from escaping the grinding jar when the gas inlets are used.

The software is available free of charge and is supported from Windows 11 onward.

## GRINDCONTROL

# TECHNISCHE GEGEVENS

|                                     |                                                                                                                                                                                                           |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Toepassingen</b>                 | pressure and temperature measuring for Planetary Ball Mills, Emax and Mixer Mills MM 500 nano/control                                                                                                     |
| <b>Toepassingsdomein</b>            | Milieu / Recycling, biologie, bouwmaterialen, chemie / kunststoffen, engineering / electronica, geneesmiddel / medicijnen, geologie / metallurgie, glas / keramiek, landbouw, material synthesis, voedsel |
| <b>Meetbereiken</b>                 | gas pressure: 0 - 500 kPa (5 bar)<br>temperature: -20°C - +100 °C                                                                                                                                         |
| <b>Droog malen</b>                  | Ja                                                                                                                                                                                                        |
| <b>Nat malen</b>                    | Ja                                                                                                                                                                                                        |
| <b>Cryogeen malen</b>               | yes min. -20 °C                                                                                                                                                                                           |
| <b>Maalbekertypes</b>               | Screw-Lock (MM) and EasyFit jars (PM)                                                                                                                                                                     |
| <b>Materiaal van maalwerktuigen</b> | hardened stainless steel, zirkoniumoxide                                                                                                                                                                  |
| <b>Maalbeker maten</b>              | 125 ml (MM); 50 - 500 ml (PM)                                                                                                                                                                             |
| <b>Transmission frequency</b>       | 5 /s                                                                                                                                                                                                      |
| <b>Interface</b>                    |                                                                                                                                                                                                           |
| <b>Gegevens electriciteit</b>       | battery (up to 80 h operation time)                                                                                                                                                                       |
| <b>Toebehoren</b>                   | opening aid, cleaning tools, o-ring, Software download, sintered filter, (lid insert not included)                                                                                                        |
| <b>Netto gewicht</b>                | lid with sensor unit<br>360 g (MM)<br>1780 g / 1140 g (PM)                                                                                                                                                |
| <b>Standaarden</b>                  | CE                                                                                                                                                                                                        |
| <b>Technical requirements</b>       | PC with Windows 11 and Bluetooth 5.0 or higher                                                                                                                                                            |
| <b>Software</b>                     | live monitoring of measurement data, full measurement protocol, storable templates, list of performed measurements, data export in .pdf and .csv                                                          |

MM = Mixer Mill; PM = Planetary Ball Mill | The GrindControl for the planetary ball mills is only compatible with the EasyFit grinding jars. Grinding jars "comfort" have other dimensions and are not compatible.

## REFERENCES

[8] Reaction scheme and performance of the experiments: Dr. Matej Balaz, Institute of Geotechnics, Slovak Academy of Sciences (SAS).

[9]: Department of Architecture & Civil Engineering, Centre for Climate Adaptation & Environment Research, University of Bath

[www.retsched.com/grindcontrol](http://www.retsched.com/grindcontrol)

## BESTELGEGEVENS

### PRESSURE AND TEMPERATURE MEASURING SYSTEM GRINDCONTROL FOR MIXER MILLS

**incl. sensors and transmitter unit, case, opening aid and cleaning accessories for MM 500 control / nano / Emax (please order lid insert and grinding jar separately)**

|             |                                                                                               |
|-------------|-----------------------------------------------------------------------------------------------|
| 22.782.0032 | GrindControl for MM 500 control/nano/Emax grinding jar 125 ml                                 |
| 03.474.0242 | GrindControl lid insert for MM 500 control/nano and Emax grinding jar 125 ml, stainless steel |
| 03.474.0245 | GrindControl lid insert for MM 500 control/nano and Emax grinding jar 125 ml, zirconium oxide |

### ACCESSORIES FOR MM 500 CONTROL/NANO GRINDCONTROL

|             |                                                                                     |                                                                |
|-------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------|
| 05.114.0122 |  | O-ring for 125 ml grinding jars (MM 500 control/nano and Emax) |
| 22.186.0007 |                                                                                     | Sintered filter with O-ring, set of 10 pieces                  |
| 22.864.0001 |  | Valve set M8x1 for GrindControl and aeration lids              |

### PRESSURE AND TEMPERATURE MEASURING SYSTEM GRINDCONTROL FOR PLANETARY BALL MILLS

**incl. sensors and transmitter unit, insert of lid, software, case, opening aid and cleaning accessories for PM (please order grinding jars separately)**

|             |                                                                                     |                                                       |
|-------------|-------------------------------------------------------------------------------------|-------------------------------------------------------|
| 22.782.0033 |  | GrindControl for PM grinding jar EasyFit 50 - 125 ml  |
| 22.782.0034 |  | GrindControl for PM grinding jar EasyFit 250 - 500 ml |

### GRINDCONTROL LID INSERTS

|             |                                                             |
|-------------|-------------------------------------------------------------|
| 03.474.0243 | GrindControl lid insert for 50, 80, 125 ml, stainless steel |
| 03.474.0246 | GrindControl lid insert for 50, 80, 125 ml, zirconium oxide |

|             |                                                            |
|-------------|------------------------------------------------------------|
| 03.474.0244 | GrindControl lid insert for 250 or 500 ml, stainless steel |
| 03.474.0247 | GrindControl lid insert for 250 or 500 ml, zirconium oxide |

## ACCESSORIES FOR PM GRINDCONTROL WITH GRINDING JARS EASYFIT

|             |                                                                                    |                                                       |
|-------------|------------------------------------------------------------------------------------|-------------------------------------------------------|
| 05.114.0056 |   | O-ring for 50, 80 or 125 ml                           |
| 05.114.0054 |   | O-ring for 250 ml - 500 ml grinding jars EasyFit (PM) |
| 03.111.0438 |                                                                                    | Flat gasket for 50 ml, 80 ml or 125 ml                |
| 03.111.0439 |                                                                                    | Flat gasket for 250 ml - 500 ml                       |
| 22.186.0007 |                                                                                    | Sintered filter with O-ring, set of 10 pieces         |
| 22.864.0001 |  | Valve set M8x1 for GrindControl and aeration lids     |