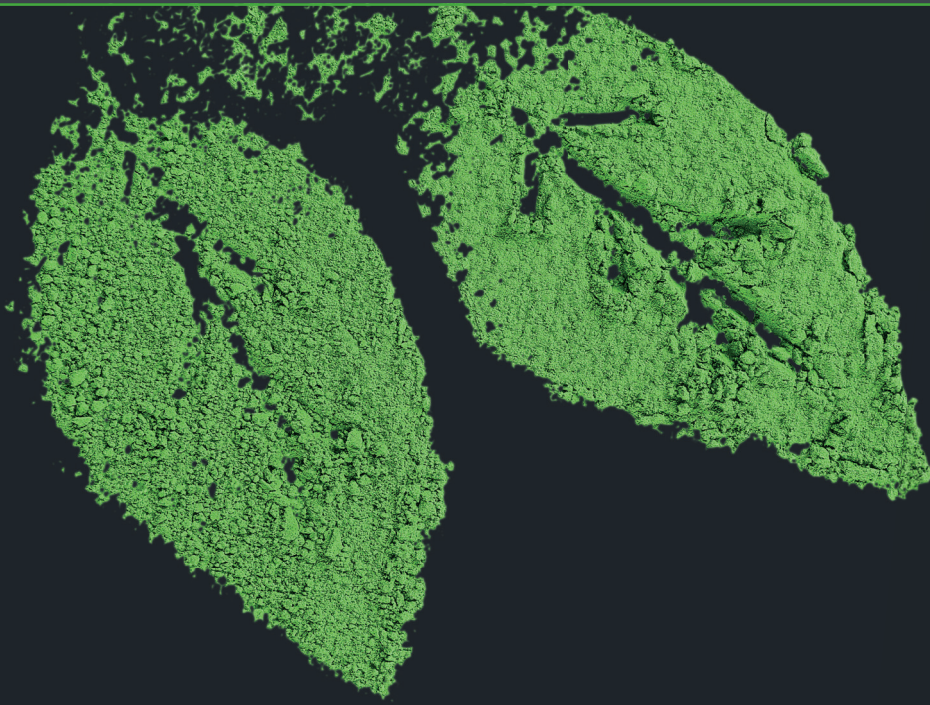
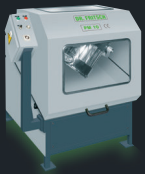


Overview

FAST/SPS & Powder Processing Technologies



SPS is GREEN 



70
Years
Dr. Fritsch
70 Years FAST/SPS

DR. FRITSCH
POWDER SHAPING TECHNOLOGIES

Over 70 years of milestones in the FAST/SPS Sintering Technology

Since the foundation of the company in 1953, Dr. Fritsch has continually set milestones in sintering technology according to the quality standards of the label "Made in Germany".

As the company that delivered the first commercially available FAST/SPS Sintering Press in the world, this technology triggered a small revolution in this field, as it finally allowed a significantly shorter sintering cycle. Furthermore, this lowered the production costs at higher productivity and allowed the development of new materials and products with considerably improved properties.

Today, Dr. Fritsch is the market leader in FAST/SPS technology. We have supplied more than 1.000 FAST/SPS systems all over the world, which is more than all other suppliers combined. This fundamental experience makes Dr. Fritsch the right choice especially for industrial applications and R&D.

For more than 70 years FAST/SPS has been an established technology in the diamond tool industry, where Dr. Fritsch initially started its activities. Meanwhile FAST/SPS has proven itself in many other industries, such as the production of brakes and clutches, sputter targets, as well as in the hard metal industry and at universities and research institutes. By applying temperature and pressure at the same time, FAST/SPS allows you to process a huge range of different materials, which regularly opens up new applications.

In addition to these innovative FAST/SPS Sintering Presses, Dr. Fritsch offers field-tested solutions for the mixing, dosing, granulating and cold pressing of metal and ceramic powders.

Our customers are the center of our business – that is what our employees as well as our representatives all over the world stand for. Our highly qualified service technicians guarantee a comprehensive and competent support on site. The close interdisciplinary cooperation of our development teams allows the development of individual solutions as well as complete production lines according to your requirements.

In our application center we offer extensive test possibilities on nearly all machines from our product range. Upon request, we also provide assistance in the field of mold design.

Our aim is to face the challenges of the future together with you. We would like to contribute our experience, innovations, high quality and first class service to your business success.

We look forward to cooperating with you!

Your DR. FRITSCH team



70 Years

Dr. Fritsch
70 Years FAST/SPS



The Dr. Fritsch DSP-6 FAST/SPS sinter press from 1953, developed for the diamond tool industry. This industry required a solution for the undesired carbonization of diamonds when they were exposed to heat for too long time. The short sinter cycles of FAST/SPS solved that issue and revolutionized the production of diamond tools.



With more than 1,000 FAST/SPS sinter presses installed worldwide since 1953, Dr. Fritsch is the leading manufacturer of this technology. Renown universities and industrial corporations rely on the unparalleled FAST/SPS portfolio and know-how from Dr. Fritsch.

Technology	Page 4
Applications	Page 5
Mixing / Dosing / Granulating	Page 6 – 7
Cold Pressing	Page 7
FAST/SPS Sintering	Page 8 – 12
Automation	Page 13
Data and Process Management	Page 14
Service	Page 15

DR. FRITSCH
POWDER SHAPING TECHNOLOGIES

FAST/SPS Technology

FAST/SPS stands for Field Assisted Sintering Technique and Spark Plasma Sintering.

This refers to the heating of a mold by means of current flow. The concept of Joule heating is applied, so that the workpiece is not heated from the outside as is usual in a furnace (indirectly), but from the inside (directly). Dr. Fritsch applies an optimized direct current process. This process can also be used with electrical semiconductors and, by heating up the surrounding die, even with non-conductive materials.

The FAST/SPS heating technology has significant advantages:

Improved Material Properties:

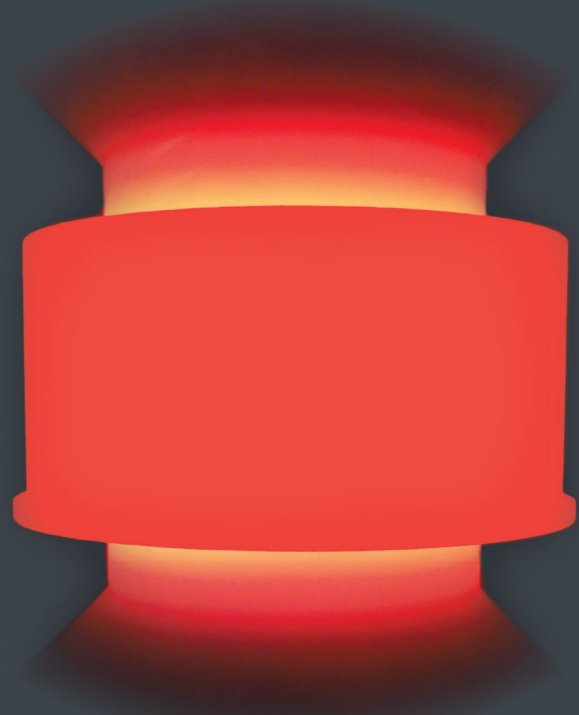
- Significant reduction of grain growth (nanoscale)
- Highest density achievable
- Homogeneous microstructure

Higher Productivity:

- Very short sinter cycles
- Near net shape production reduces or even omits post-processing steps, which are necessary when using traditional sintering techniques

More Flexibility:

- Development time for new materials can be substantially shortened
- Quick change over to other materials and dimensions

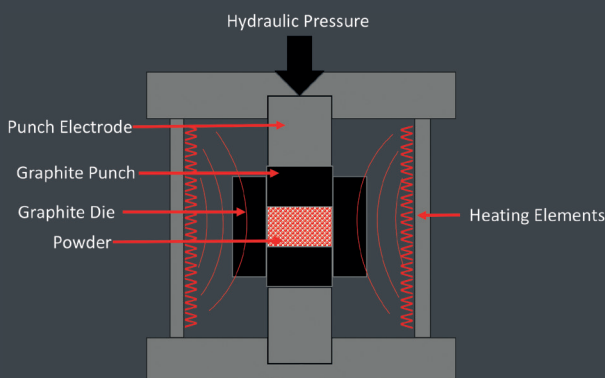


Conventional Sintering:

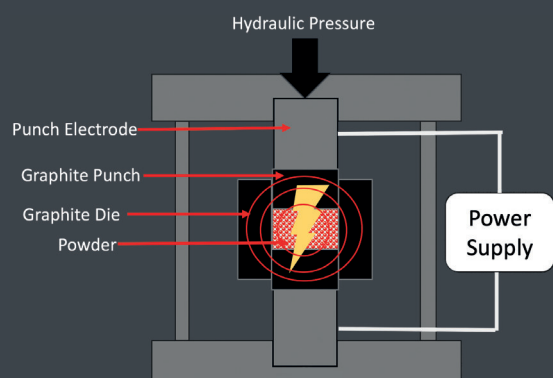
- slow
- sluggish
- imprecise

FAST/SPS Technology:

- fast
- direct
- precise



Conventional Sintering / Hot Pressing
Indirect Heating



FAST/SPS Sintering Technology
Direct Heating

DR. FRITSCH SPS is GREEN



Up to 40 % less energy consumption
compared to traditional hot pressing



Scan this QR-Code to see
the process in action



Applications

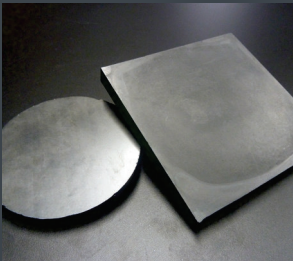
Dr. Fritsch has more than 70 years of experience in the production of FAST/SPS Sintering Presses for industrial applications. The machines are designed for a daily 3-shift operation; all reasonable work processes are automated and easy to operate. The equipment is arranged in a compact housing. The risk of operating errors is reduced thanks to strictly separated system access levels. In co-operation with our customers and due to continuous development and optimization we successfully enter new application areas. Today, our machines are used in the following areas:



Sputter Targets



Friction Material Industry



Advanced Ceramics



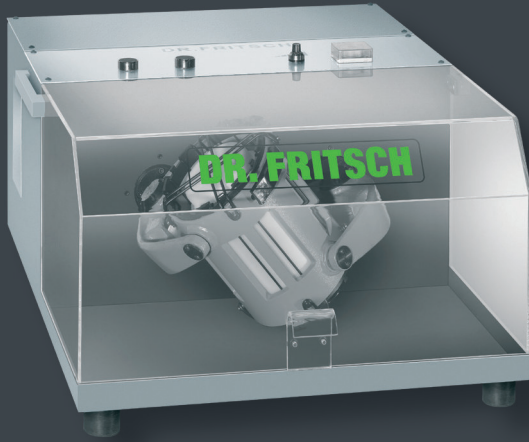
Research and Development



Others

3D Shaker Mixer

PM 2



- Continuously adjustable rotating speed
- Particularly suitable for dry powder mixtures
- Timer

Capacity	2 l
----------	-----

3D Shaker Mixer

PM 10

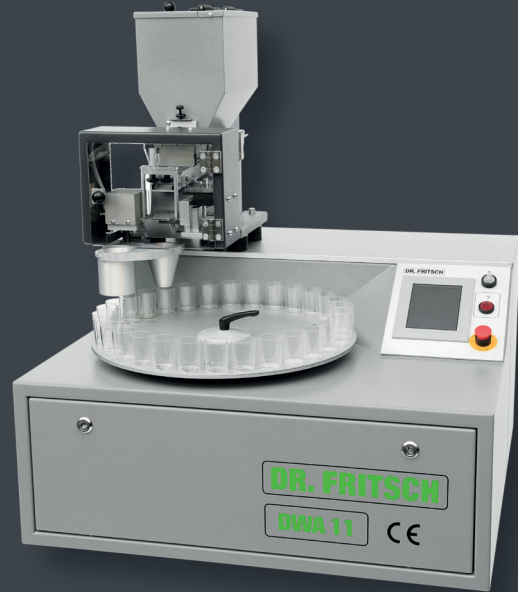


- Continuously adjustable rotating speed
- Particularly suitable for dry powder mixtures
- Timer

Capacity	up to 15 l
----------	------------

Dosing Machine

DWA 11



- Automated weighing of metal and ceramic powders
- Tool-free changing of all parts that carry powder for better cleaning
- Automatic rejection of weights which are out of tolerance
- Self-optimization after each weighing cycle
- 30 powder cups (50 ml)

Options

- Turntable plate 30 / 18 for two cup sizes (50 ml / 200 ml)
- Exchange parts to avoid powder contamination
- Base frame

Granulating machine GGM 130



- For economical use of batch sizes starting from 500 g

- Powder carrying parts can be exchanged quickly and cleaned outside of the machine. This prevents contamination
- Production of granules with very good flowability

Output rate	Up to 5 kg / hour
Sieve size	0,6 – 1,2 mm

Granulating Machine GA 300



- High output
- Production of granules with very good flowability
- Easy access for cleaning and maintenance.
- Powerful suction system
- Powder storage (storage hopper) allows unattended operation, capacity approx. 28 l

Output rate	Approx. 20 kg / hour
Sieve size	0,4 – 1,2 mm

Volumetric Cold Press KPV 300



- Possibility to use tools with multi-cavities (option) or larger workpiece geometries by using dies of \varnothing 120 mm
- Constant workpiece weight due to self-optimizing positioning adjustment of the lower punch
- Radial filling-system motor-driven with tubes or
- Linear filling-system motor-driven with pre-dosing without tubes
- Quick changeover with only one tool
- Reject function for workpieces out of tolerance

Options

- Active suction with ventilator
- Automated stacking of cold-pressed workpieces
- Multi-cavity tool sets upon request
- Pressing force of 60 – 600 kN

Cycle time (number of workpieces/min., approx.)

Productivity	10 – 12 strokes / min
Pressing force	40 – 400 kN
Filling height tolerance	$\pm 0,01$ mm

Overview FAST/SPS Sintering Presses

	LSP 100	DSP 507	DSP 615	DSP 520/535	MSP 5
Max. heating power [kW]	44 – AC *38 – DC (pulsed)	79	173	242/415	415
Pressing force in [kN]	5 – 50 *TRI-FORCE: Inner cylinder (2x): 3 – 30 Contact ring: 5 – 50	22 – 259 *3 – 28 & 22 – 259	15 – 650	39 – 461 & 51 – 603 *35 – 414 & 47 – 555 *61 – 725 & 76 – 904 *92 – 1.092 & 119 – 1.424 *49 – 482 & 173 – 2.072 *49 – 482 & 223 – 2.676	500 – 5.000 Smaller pressing forces on request
Graphite electrodes in [mm]	Ø100 x 70 *TRI-FORCE: Contact ring: OD = 100; ID = 44 (sample max. Ø = 40) Inner punches: Ø30 x 85	165 x 145 x 40 *200 x 200 x 40 *Ø 200 x 40	180 x 180 x 60 (opt. 40) *220 x 220 x 60 (opt. 40) *Ø 220 x 60 (opt. 40)	350 x 350 x 60 (opt. 40) *Ø 350 x 60 (opt. 40)	450 x 450 x 100 Ø 450 x 100
Max. opening height in [mm] with optional 40 mm electrodes. Standard electrodes [60 mm] reduce the opening height by 40 mm.	128 *TRI-FORCE: 128 (2 x 50 mm stroke of inner punches)	180 *174 (in case of high temperature)	217	505	500
Temperature measuring	Thermocouple Ni-Cr-Ni: 0 – 1.050 °C Pyrometer: 250 – 2.400 °C	Thermocouple Ni-Cr-Ni: 0 – 1.050 °C *Pyrometer: 300 – 2.400 °C	Thermocouple Ni-Cr-Ni: 0 – 1.050 °C *Pyrometer: 300 – 2.400 °C	Thermocouple Ni-Cr-Ni: 0 – 1.050 °C *Pyrometer: 300 – 2.400 °C	Pyrometer: 300 – 2.400 °C *Thermocouple: 0 – 1.050 °C
Atmosphere	Vacuum (20 mbar) + inert gas	Vacuum (20 mbar) + inert gas *Fine vacuum (0,05 mbar)	Vacuum (20 mbar) + inert gas *Fine vacuum (0,05 mbar)	Vacuum (20 mbar) + inert gas *Fine vacuum (0,05 mbar)	Vacuum (20mbar) + inert gas
Dimensions of sintering chamber without insulation material in [mm]	350 x 320 x 330	370 x 390 x 330	490 x 540 x 390	590 x 690 x 620	730 x 857 x 1.025
Dimensions of machine W x L x H in [mm]	1.250 x 900 x 1950	1.820 x 1.350 x 2.150	1.960 x 1.760 x 2.300	2.690 x 2.350 x 2.720	3.485 x 2410 x 2730
Weight approx. in [kg]	1.200	Approx. 2.200	Approx. 3.800	Approx. 6.300/6.550	15.000

*Options

FAST/SPS Sintering Press

LSP 100 LABORATORY SINTERING PRESS



The LSP 100 Laboratory Sintering Press is very compact and designed for small laboratories. Attached wheels allow flexible and easy positioning of the machine. A glovebox can be connected and an independent cooling water supply is optionally available as well. Typically for Dr. Fr. Fritsch is the intuitive operation and clear access authorization. In this way, even less experienced persons can work quickly and safely with the FAST/SPS systems.

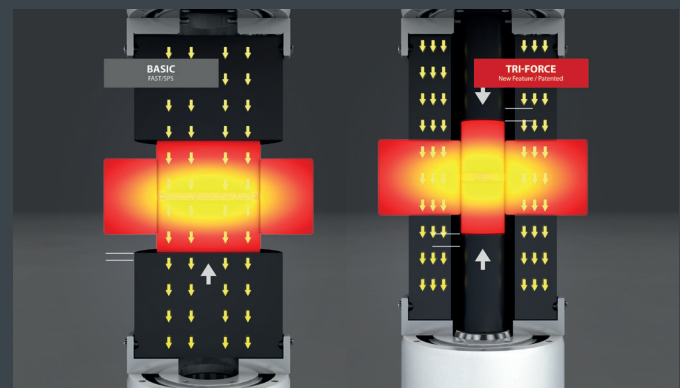
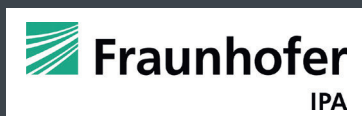
Total electrical power	Approx. 47 kVA *Approx. 38 kVA – DC pulsed
Max. heating current	Up to 7.300 A
Pressing force	5 – 50 kN *TRI-FORCE: Inner cylinder (2x): 3 – 30 kN Contact ring: 5 – 50 kN
Opening height, max/min [mm]	128 / 0 *TRI-FORCE: 128 / 0 (2 x 50 mm stroke of inner punches)
Temperature measurement	Thermocouple *Pyrometer
Sintering atmosphere	Vacuum (20 mbar) + inert gas

*Options



Scan this QR-Code to see the video animation of LSP 100

An excerpt from our references in R&D:



TRI-FORCE is a patented optional feature of the LSP 100. For the first time in FAST/SPS sintering, TRI-FORCE allows users to apply pressure only when it is required for densification. If not required, for instance during heating up, the system can be operated pressureless. This allows:

- Gassing out without hindrance.
- Sintering with liquid phases, since liquids won't be pressed out of the mold.
- Ejection of the inner pin of rings in hot state
- Homogeneous heating of non-conductive and semi-conductive materials

FAST/SPS Sintering Press

DSP 507



- For research and development as well as production
- Vacuum (20 mbar) and inert gas (N₂ / 95 % N₂ and 5 % H₂ / Ar)
- Offers all the advantages of short cycle times by FAST/SPS technology (see page 4)
- Precise measurement of temperature and pressure
- Up to three thermocouples connectable, two of them for control of exchange parts
- Software for process documentation via PC

Options

- Sintering temperature up to 2.400 °C
- Fine vacuum (0,05 mbar)
- Different pressure ranges
- Electronic stroke control system to show the compression
- Rack for up to eight thermocouples, two of them for control of exchange parts
- Temperature control with pyrometer
- Glove box connectable
- Measurement and recording of secondary current/voltage and vacuum
- Active suction
- UPS (uninterrupted power supply) for control
- Insulation of vacuum chamber with graphite felt
- Barcode reader for automated sinter program selection
- Suitable water cooling system (chiller & water tank)
- Software for sinter program administration via PC

Total electrical power	Approx. 85 kVA
Max. heating current	20.800 A
Pressing force	Up to 259 kN
Graphite electrodes (LxWxH)	165 x 140 x 40 mm or 200 x 200 x 40 mm or Ø 200 x 40 mm
Opening height, max/min [mm]	180 / 30 *174 / 24 (in case of high temperature)
Temperature measurement	Thermocouple *Pyrometer
Sintering atmosphere	Vacuum (20 mbar) + inert gas *Fine vacuum (0,05 mbar)

*Options

FAST/SPS Sintering Press

DSP 615



- Production of high-quality workpieces by precise control of temperature, pressure, stroke and time
- Three fold control of temperature
- Vacuum (20 mbar) and inert gas (N₂ / 95 % N₂ and 5 % H₂ / Ar)
- High productivity due to short cycle time and customized machine configuration
- Offers all the advantages of short cycle times by FAST/SPS (see page 4)
- Easy operation by a 12" / 30 cm panel, clear and intuitive menu navigation; manuals and maintenance videos can also be viewed
- Software for process documentation via PC

Options

- Inert gas
- Sintering temperature up to 2.400°C
- Fine vacuum (0,05 mbar)
- Rack for up to eight thermocouples, two of them for control of exchange parts
- Automatic thermocouple feeding
- Temperature control with pyrometer
- Active suction
- UPS (uninterrupted power supply) for control
- Insulation of vacuum chamber with graphite felt
- Barcode-reader for automated sinter program selection
- Display of cooling water amount and temperature
- Kilowatt-hour meter
- Software for sinter program administration via PC

Total electrical power	Approx. 180 kVA
Max. heating current	34.000 A
Pressing force	15 – 650 kN
Graphite electrodes (LxWxH)	180 x 180 x 60 (opt. 40) mm or *220 x 220 x 60 (opt. 40) mm or * Ø 220 x 60 (opt. 40) mm
Opening height, max/min [mm]	145/0 (opt. 185/35)
Temperature measurement	Thermocouple *Pyrometer
Sintering atmosphere	Vacuum (20 mbar) + inert gas *Fine vacuum (0,05 mbar)

*Options

FAST/SPS Sintering Press

DSP 520/535



Sintering example: Stacked motorcycle brake pads inside and outside of the sintering chamber. The green body can be sintered directly on the copper plate. This reduces or even omits post processing steps.

- Suitable for high quantities as well as large sintering parts
- Large graphite electrodes with large opening height
- Three fold control of temperature
- Vacuum (20 mbar) and inert gas (N_2 / 95 % N_2 and 5 % H_2 / Ar)
- Offers all the advantages of short cycle times by FAST/SPS (see page 4)
- Precise measurement of temperature, pressure and stroke with display of the compression
- Up to three thermocouples connectable, two of them for control of exchange parts
- Software for process documentation via PC

Options

- Sintering temperature up to 2.400 °C
- Fine vacuum 0,05 mbar
- Different pressure ranges
- Rack for up to eight thermocouples, two of them for control of exchange parts
- Temperature control with pyrometer
- Additional temperature control with pyrometer
- Active suction
- USV (uninterrupted power supply) for control
- Insulation of sintering chamber with graphite felt
- Barcode-reader for automated sinter program selection
- Suitable for automation
- Additional cooling plates to reduce cooling time
- Adjustment of opening height
- Software for sinter program administration via PC

Total electrical power	Approx. 250/420 kVA
Max. heating current	47.500 / 85.500 A
Pressing force	Up to 2676 kN
Graphite electrodes (LxWxH)	*350 x 350 x 60 (opt. 40) mm or *Ø 350 x 60 (opt. 40) mm
Max. opening height - at temperatures > 1.100 °C	460 (opt. 500) mm 460 mm
Temperature measurement	Thermocouple/ *Pyrometer
Sintering atmosphere	Vacuum (20 mbar) + inert gas *Fine vacuum (0,05 mbar)

*Options

FAST/SPS Sintering Press

MSP 5 / MSC 5

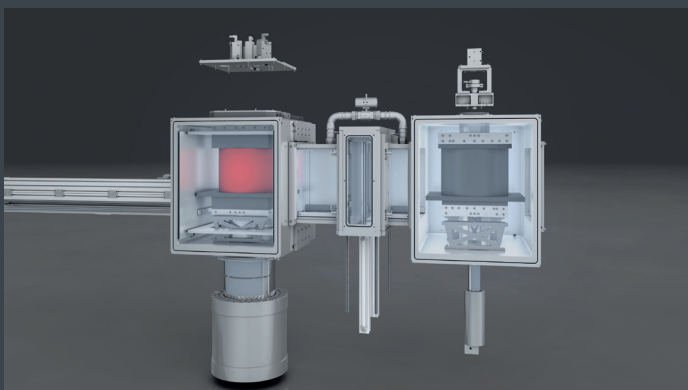
Machine for large workpieces and high production volumes: after sintering in the FAST/SPS Sintering Press MSP-5, the workpiece may be shifted to the optional Cooling Unit MSC 5 under inert gas and vacuum. For materials with long times, this increases productivity significantly.



Scan this QR-Code to see the video animation of MSP 5 / MSC 5



The picture shows the MSP 5 with the optional Cooling Unit MSC 5



HIGH PRODUCTIVITY IN A COMPACT DESIGN

The MSP-5 is the FAST/SPS sinter press. Workpieces of up to Ø400 mm are possible due to high pressing forces, large graphite electrodes and high heating power.

PRECISION AND SPEED THROUGH AUTOMATION

The MSC 5 is the machine unit for the cooling process. Cooling takes place under vacuum and inert gas, as well as pressing force. The MSC 5 can be retrofitted as a modular extension of the MSP 5.

	Sintering Press MSP 5	Cooling Unit MSC 5 (Option)
Total electrical power	420 kVA	-
Max. heating current	85.500 A	-
Pressing force	Max. 5000 kN (Range 10-100%) other pressing forces on request	Max. 50 kN
Graphite electrodes (LxWxH)	450 x 450 x 100 Ø 450 x 100 mm	450 x 450 x 100 Ø 450 x 100 mm
Opening height	Max. 500 mm Min. 350 mm	Max. 500 mm
Temperature measurement	Thermocouple/Pyrometer (up to 4)	
Sintering atmosphere/Cooling atmosphere	Vacuum (20 mbar) + inert gas	

Automation



With more than 70 years experience in FAST/SPS, Dr. Fritsch is the best choice especially for industrial applications. On request, Dr. Fritsch will develop automated solutions tailored to your individual requirements.

An example of an implemented automated sintering process for producing sputter targets:

The station of mold preparation is connected with the sintering press by a central transport module. The design and flexible control allow an installation of several sintering presses in this fully automated production process – if required even with cooling stations and a mold discharge station.

Advantages:

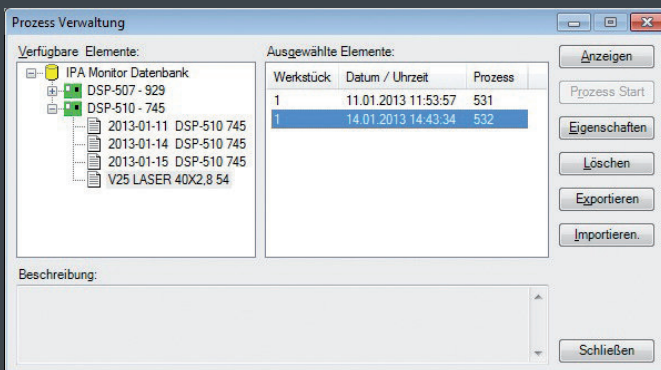
- Unmanned operation process, for example, during the night shift
- Higher productivity by cooling the molds outside of the machine
- Less electricity costs per piece
- Consequently automatic sintering of different materials and dimensions
- Safe handling of very hot and heavy loads
- Complete CE-conform protection with monitoring sensors
- Simple expandability due to a modular design

PC-Connection of Dr. Fritsch Sintering Presses

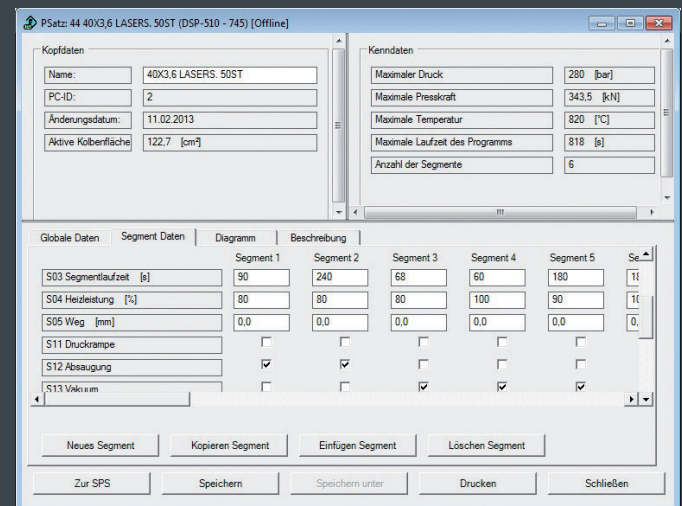
Visualization software and process management

- Installation of the software on PC or Laptop
- The Dr. Fritsch FAST/SPS Sintering Press is connected to the PC
- With a suitable connection via your network the process control can take place not only on-site but also at other locations
- The software allows display and recording of process curves and data
- Individual configuration, access to the selected process parameters
- Error messages and warnings are displayed and recorded
- Set-up of direct data connection is possible

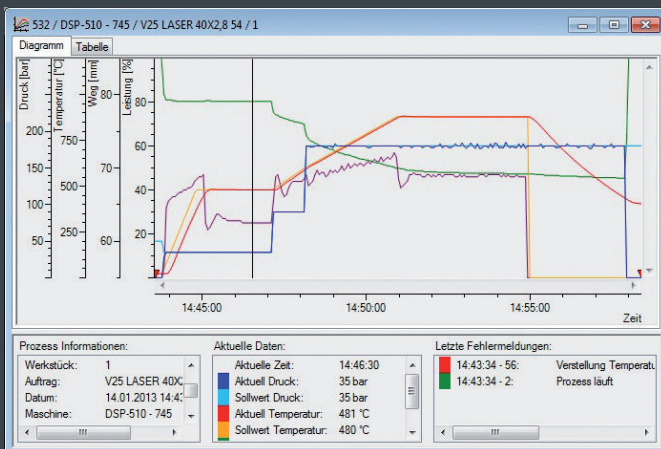
- The process data can be exported to Excel or SAP for further evaluation
- User-friendly design and administration of parameter sets on the PC
- Database to copy, edit, delete and file the parameter sets
- Data transfer of the parameter sets from PC to the machine and vice versa
- Printout of the parameter sets



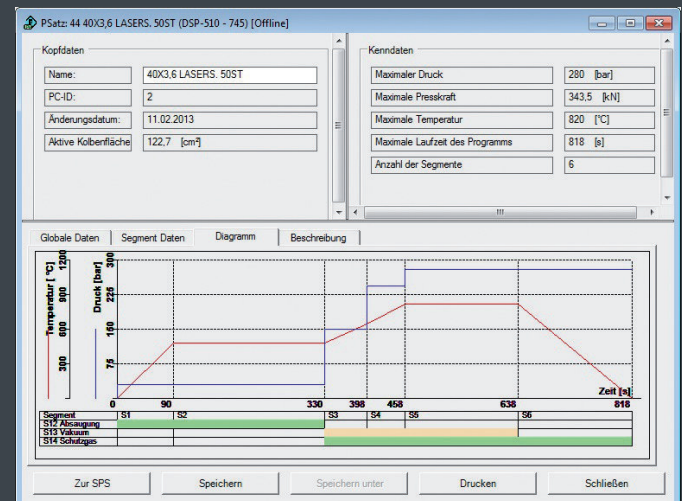
Process administration:
Jobs of the connected machines (left)
Processes of the selected jobs (right)



Parameter sets



Process data display:
Display as curve diagram, e.g. pressure and temperature curves, error messages



Graphic display of set points

DR. FRITSCH

SERVICE

For immediate disposal we have up to 3.500 different spare and wear parts in our stock. Our understanding of service is not only commissioning and machine repairs but also intensive advice, targeted trainings and transfer of know-how. Our service offers:

Parts & Logistics	After-sales service	Training	Improvement/Adaption	Performance/Quality
<ul style="list-style-type: none"> - Original parts and equipment - Safe packing - Shipment - Insurance 	<ul style="list-style-type: none"> - Repair - Installation - Maintenance - Inspection - Machine relocations 	<ul style="list-style-type: none"> - Operation - Maintenance - Application 	<ul style="list-style-type: none"> - Modification - Software update - Program optimization 	<ul style="list-style-type: none"> - Factory layout - Consulting - Analysis - Remote services

Customized service contracts – Benefits for our Customers

Technology

All FAST/SPS Sintering Presses and most of our other machines are designed for remote diagnostics. A suitable hardware can be easily retrofitted. For data transfer our customers can use their company's data network or a cellular connection.

Advantages

- Effective troubleshooting
- Reduction of repair, labor and travel expenses
- Online data acquisition and analysis
- Reduction of maintenance costs
- Increase of machine availability
- More efficient production
- Value retention of the machine



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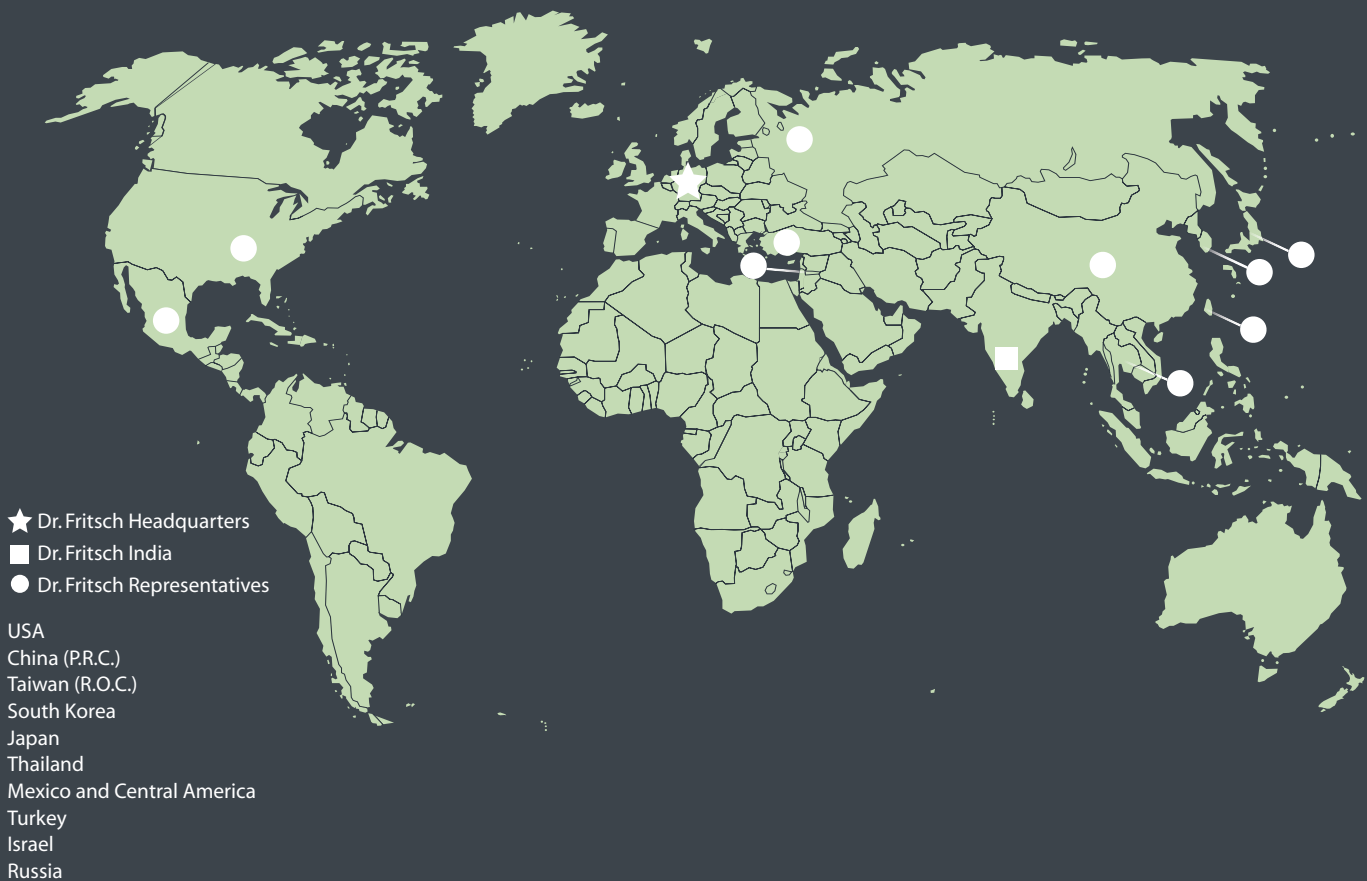
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South Korea
Japan
Thailand
Mexico and Central America
Turkey
Israel
Russia

For contact details visit our website.

Technical data and design subject to modification.

DR. FRITSCH
POWDER SHAPING TECHNOLOGIES

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