



## OUR PRODUCTS

Consistent Implementation of Customer Needs

# OUR PRODUCTS

Type HP W – Resistance heated, uniaxial hot press	22
Type HP D – Sintering furnace for FAST (SPS), directly heated	21
Type H-HP D – Sintering furnace for FAST (SPS), hybrid heated	20
Type FH W – Resistance heated high-temperature vacuum sintering furnace, horizontally loaded	19
Type FS W – Resistance heated high-temperature vacuum sintering furnace, vertically loaded	18
Type FH I – Induction heated high-temperature vacuum sintering furnace, horizontally loaded	17
Type FS I – Induction heated high-temperature vacuum sintering furnace, vertically loaded	16
Type FP W – Resistance heated gas pressure sintering furnace (Sinter-HIP)	15
CUSTOMIZED SOLUTIONS – Made-to-order plants and concepts	14

# OUR VALUES

CONTACT US	11
SERVICE & MAINTENANCE – Assisting you along the life cycle of your plant	10
USEABILITY – For efficient and process-oriented operations	9
QUALITY – Our strength: a deep-seated quality consciousness	8
RESEARCH & DEVELOPMENT - Investment for the future	7
TECHNICAL CENTER – Comprehensive support even for the most complex of tasks	6
FCT Systeme gmbH - TODAY – From planning to realization	5
OUR STORY – Tradition for over 30 years	4

# TYPE HP W

Resistance heated, uniaxial hot press

HP W Standard types	Ø Heating conductor [mm]	Height heating conductor [mm]	Max. pressing force [kN]	Max. diameter of heading tool [mm]	Max. heating power [kW]
HP W 5	100	125	50	30	17
HP W 25	200	250	250	80	40
HP W 60	250	315	600	120	60
HP W 125	300	400	1250	200	100
HP W 250	440	550	2500	300	150
HP W 400	500	800	4000	400	180
HP W 600	600	1200	6000	500	240
HP W 900	750	1200	9000	550	400

## Functions:

- Working temperature: up to 2200°C (option 1: temperatures of up to 2500°C; option 2: with O<sub>2</sub>/air atmosphere and temperatures of up to 1400°C)
- Vacuum: 5 × 10<sup>-2</sup> mbar(a)
- Working gases: Ar/N<sub>2</sub> (further types of gases available upon request)
- Servo-hydraulic force control
- Precise, rigid portal frame with low deformation, accurate guiding of the heading tool
- Measuring device for compression stroke and compression speed
- Double-walled, water-cooled stainless steel vacuum chamber with a leakage rate of less than 1 × 10<sup>-3</sup> mbar(a) l/s
- Easy accessibility
- Resistance heating (option: induction heating)
- Design and optimization of pressing tools/concepts
- Mould filling and emptying systems
- Optional rapid cooling systems
- Optional overpressure up to 1,0 MPa
- Optional debinding/dewaxing
- Handling systems, especially for large-sized furnaces
- Comprehensive and user-friendly process control Siemens S7 and WinCC
- Special sizes and functions available upon request
- Multi-zone heating



# TYPE HP D

Sintering furnace for FAST (SPS), directly heated

HP D Standard types	Component dimensions [mm]	Max. pressing force [kN]	Max. voltage [V]	Max. current [A]	Max. heating power [kW]
HP D 10	Ø 50	100	7,2	5500	37
HP D 25	Ø 80	250	8	8000	60
HP D 60	Ø 120	600	8	16000	120
HP D 125	Ø 150	1250	8	24000	180
HP D 250	Ø 300	2500	8/16	48000/24000	360

## Functions:

- Working temperature: up to 2400°C
- Vacuum:  $5 \times 10^{-2}$  mbar(a)
- Working gases: Ar/N<sub>2</sub> (further types of gases available upon request)
- Servo-hydraulic force control
- Precise, rigid portal frame with low deformation, accurate guiding of the heading tool
- Measuring device for compression stroke and compression speed
- Double-walled, water-cooled stainless steel vacuum chamber with a leakage rate of less than  $1 \times 10^{-3}$  mbar(a) l/s
- Easy accessibility
- Temperature measurement and control with either axial/radial pyrometer or flexible thermocouples
- Freely programmable sintering parameters with up to 45 segments per recipe
- Pulse on/off is freely programmable (1...255 ms) for each individual segment
- Heating rate: up to 1000 K/min (depending on tool size)
- Comprehensive software for data recording and evaluation of all sintering parameters
- User friendly online process management system available
- Semi-continued furnaces for industrial applications available



# TYPE H-HP D

Sintering furnace for FAST (SPS), hybrid heated

H-HP D Standard types	Component dimensions [mm]	Max. pressing force [kN]	Max. heating power FAST [kW]	Max. heating power Induction [kW]	Max. heating power Hybrid [kW]
H-HP D 2.5	Ø 30	25	20	6* <sup>2</sup>	10* <sup>1</sup>
H-HP D 25	Ø 100	250	60	80	100* <sup>1</sup>
H-HP D 60	Ø 150	600	120	120	200
H-HP D 250	Ø 300	2500	300	300	500
H-HP D 400	Ø 400	4000	400	400	700

\*<sup>2</sup> Option: flash sintering available

\*<sup>1</sup> Heating element: graphite heater

## Spark Plasma and Hybrid Sintering Furnaces

With this new sintering technique the tool and the component are directly heated by DC current pulses to reduce cycle times to a few minutes. The use of DC current pulses causes an additional increase in sintering activity in various materials due to the processes that occur at the points of contact of the powder particles (Joule heating, generation of plasma, electro migration etc.). Therefore, a significantly lower temperature as well as significantly lower mould pressure than is used for conventional hot pressing and sintering is needed.

Additionally, the furnaces can be equipped with a radial, inductive heating system in order to avoid radial temperature gradients with large-sized components or to heat up materials inductively that are otherwise inadequately conductive at room temperature.

Technology like this offers entirely new possibilities to manufacture numerous materials with extraordinary characteristics, e.g.:

- Sintered nanomaterial without significant grain growth
- FGM ("Functionally Graded Materials")
- Composite materials
- Innovative carbide metals
- Aluminum and copper alloys as well as intermetallic compounds
- Structural and functional ceramics

H-HP D 250



# TYPE FH W

Resistance heated high-temperature vacuum sintering furnace, horizontally loaded

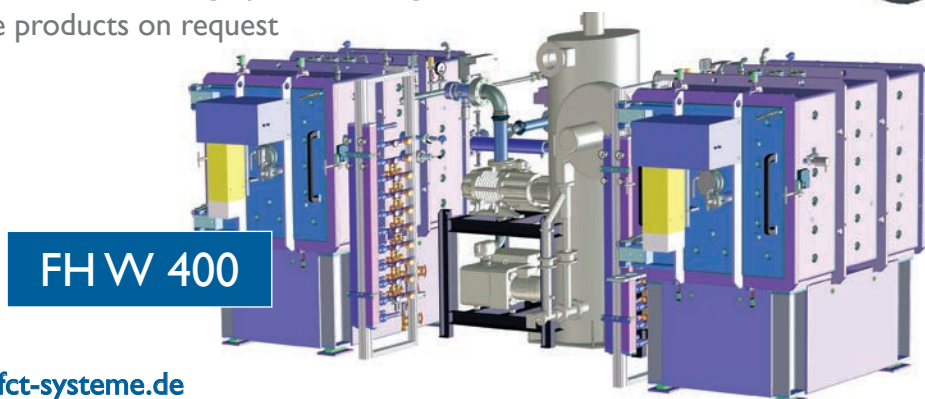
FH W Standard types	Width heating conductor [mm]	Height heating conductor [mm]	Length heating conductor [mm]	Usable volume [dm <sup>3</sup> ]	Heating power [kW] <sup>*1</sup>
FH W 9	250	250	300	9	20
FH W 90	500	500	800	90	80
FH W 250	500	710	1300	250	200
FH W 400	950	780	1000	400	250 <sup>*2</sup>
FH W 500	800	900	1400	500	270
FH W 1250	700	1000	2800	1250	300 <sup>*2</sup>
FH W 2500	900	1200	2800	2500	450 <sup>*2</sup>

<sup>\*1</sup> T = 2000°C with nitrogen (N<sub>2</sub>) atmosphere

<sup>\*2</sup> Option: available as twin system

## Functions:

- Working temperature: up to 2200°C (Option: up to 2500°C)
- Vacuum:  $5 \times 10^{-2}$  mbar (a)
- Leakage rate:  $5 \times 10^{-3}$  mbar(a) l/s
- Working gases: Ar/N<sub>2</sub> (further types of gases available upon request)
- Option: elongated heating zones up to 5000 mm
- Debinding and removal of temporary binders as option for combined processes
- Option: rapid cooling, insulation opening, gas circulation, heat exchanger
- Special sizes and functions available on request
- Special-purpose solutions for composite materials (e.g. C/C or C/SiC)
- Special-purpose solutions for graphite cleaning
- Custom-made products on request



# TYPE FS W

Resistance heated high-temperature vacuum sintering furnace,  
vertically loaded

FS W Standard types	Ø Heating conductor [mm]	Height heating conductor [mm]	Usable volume [dm <sup>3</sup> ]	Heating power [kW]*
FS W 5	200	250	5	25
FS W 25	315	400	25	60
FS W 80	400	1000	80	140
FS W 250	550	1100	250	140
FS W 500	750	1600	500	250
FS W 900	950	1800	900	350

\*T = max. 2200°C with nitrogen (N<sub>2</sub>) atmosphere

Resistance heated high-temperature vacuum sintering furnaces come into operation in a wide range of applications, because they can be operated under vacuum as well as with inert atmospheres. Their main range of application is the debinding and subsequent sintering of ceramics and powder metallurgic components. Furthermore, this type of furnace is also used for high-temperature processes such as carbonization, recrystallization, silicon infiltration, nitriding (formation of Si<sub>3</sub>N<sub>4</sub>), vacuum sintering, metallization or heat treatment at high temperatures.

This furnace type is available with usable volumes between 9 dm<sup>3</sup> and 900 dm<sup>3</sup> and with maximum temperatures of up to 2500°C.



# TYPE FH I

Induction heated high-temperature vacuum sintering furnace,  
horizontally loaded

FH I Standard types*	Susceptor width [mm]	Susceptor height [mm]	Susceptor length [mm]	Usable volume [dm <sup>3</sup> ]	Heating power [kW]
FH I 1250	600	1000	2800	1250	400
FH I 2500	870	850	4000	2500	600
FH I 4000	870	1200	4500	4000	800

\* Specific customizations on request

## Functions:

- Working temperature: up to 2500°C  
(Option: up to 2800°C)
- Vacuum:  $5 \times 10^{-2}$  mbar(a)
- Working gases: Ar/N<sub>2</sub> (further types of gases available upon request)
- Option: elongated heating zones up to 8000 mm
- Debinding and removal of temporary binders as option for combined processes
- Option: rapid cooling, insulation opening, gas circulation
- Special sizes and functions available on request
- Special-purpose solutions for composite materials (e.g. C/C or C/SiC)
- Special-purpose solutions for graphite cleaning

The constant release of energy of the induction-heated graphite susceptor enables the achievement of excellent uniformity of temperature even at temperatures of more than 2500°C.

The higher investment costs for such furnaces in comparison to resistance-heated furnaces are compensated by a longer life cycle of this furnace type. In particular cases, these technically sophisticated furnaces can be conceptualized and optimized in close collaboration with the end-user and can also be adjusted to individual tasks.





# TYPE FS I

Induction heated high-temperature vacuum sintering furnace,  
vertically loaded

FS I Standard types*	Susceptor dimensions [mm]	Usable volume [dm <sup>3</sup> ]	Heating power [kW]
FS I 750	Ø 920 x 1400	750	500
FS I 1200	850 x 850 x 2400	1200	900

\* Specific customizations on request



# TYPE FP W

High-temperature gas pressure sintering furnace (Sinter-HIP),  
resistance heated, 10 MPa

FP W Standard types	Ø Heating conductor [mm]	Height Heating conductor [mm]	Usable volume [dm <sup>3</sup> ]	Heating power [kW]
FP W 1.25	125	180	1.25	25
FP W 6	180	300	6	60
FP W 12.5	250	315	12.5	80
FP W 25	280	550	25	120
FP W 90	400	900	90	160
FP W 250	600	1600	250	250
FP W 600	700	1800	600	350
FP W 900	860	2000	900	500

## Functions:

- Working temperature: up to 2000°C  
(Option: up to 2400°C)
- Vacuum: up to  $5 \times 10^{-2}$  mbar(a)
- Working pressure: up to 100 bar(g) (10 MPa)  
(Option: up to 20 MPa)
- Debinding/dewaxing - sintering - gas pressure sintering in a combined process (Sinter-HIP)
- Rapid cooling (overpressure)
- Design: vertically loaded from the bottom
- Special sizes and functions available upon request
- Loading and handling systems available upon request
- Process control with superordinated visualization system
- Temperature measurement and control via optional pyrometer and/or optional thermocouple
- Adjustable gas mixing
- Special MIM/CIM-furnaces (MIM = Metal Injection Moulding / CIM = Ceramic Injection Moulding)
- Optional dilatometer



# SPECIAL PURPOSE MACHINERY

Made-to-order high-temperature sintering plants and complete manufacturing concepts



Photo: Copyright Fraunhofer ISE

In addition to numerous system solutions based on a standardized delivery program for sintering units, FCT Systeme GmbH today also offers specific customized solutions for extraordinary applications:

- CVD/CVI coating systems
- Squeeze casting (gas pressure infiltration)
- Diffusion welding using FAST/SPS technology
- High-vacuum furnaces with metal heaters

Additional components on our furnaces enable the accomplishment of special tasks and provide our customers with complete, efficient and process oriented solutions:

- Thermal post-combustion for combined processes
- Debinding units
- Flare systems for operations with H<sub>2</sub>
- Special filtering systems
- Specific gas vacuum systems for partial pressure regulation and client-specific tasks
- Optional gas analysis

The better part of special purpose machinery developed by FCT Systeme GmbH in the past represent state-of-the-art technology today.