Nabertherm

MORE THAN HEAT 30-3000 °C

FURNACES FOR ADVANCED MATERIALS

Made in Germany

www.nabertherm.com

Facts

- Production of Arts & Crafts furnaces, laboratory furnaces, dental furnaces and industrial furnaces since 1947
- Production site in Lilienthal/Bremen - Made in Germany
- 600 employees worldwide
- 150,000 customers in more than 100 countries
- Very wide product range of furnaces
- One of the biggest R&D departments in the furnace industry
- High vertical integration

Global Sales and Service Network

- Manufacturing only in Germany
- Decentralized sales and service close to the customer
- Own sales organization and long term sales partners in all important world markets
- Individual on-site customer service and consultation
- Fast remote maintenance options for complex furnaces
- Reference customers with similar furnaces or systems close to you
- Secured spare parts supply, many spare parts available from stock
- Further informarion see page 90

Setting Standards in Quality and Reliability

- Project planning and construction of tailormade thermal process plants incl. material handling and charging systems
- Innovative controls and automation technology, adapted to customer needs
- Very reliable and durable furnace systems
- Customer test center for process assurance

Experience in Thermal Processing

- Thermal Process Technology
- Additive Manufacturing
- Advanced Materials
- Fiber Optics/Glass
- Foundry
- Laboratory
- Dental
- Arts & Crafts

Table of Contents

Processes under Air

Nabertherm offers various standard furnaces and furnace solutions tailored to customer requirements for the “Advanced Materials” area:

- Debinding up to 850 °C
- Debinding and sintering
- Sintering
- Thermal cleaning, ashing
- Dewaxing
- Electroceramics

Which Furnace for Which Process?

Combi bogie hearth furnace
W 1500/14 DB200-3 with thermal post combustion. lift door and bogie on rails

Debinding in Air up to 850 °C

The debinding of technical ceramics is a demanding process due to the hydrocarbons released, which subject to the corresponding concentration can cause a formation of an ignitable mixture inside the furnace. Nabertherm offers customized furnaces with passive and active safety packages depending on the process and the amount of binder, which enable safe operation of the furnace.

Debinding and Sintering in Air

Debinding and subsequent sintering of technical ceramics is recommended if the charge does not allow for a transfer from a debinding furnace into a sintering furnace. Nabertherm offers furnaces with passive or active safety packages for debinding tailored to the process and amount of binder, enabling safe operation of the furnace. Depending on the product line, the sintering process can be continued directly after debinding with a maximum furnace chamber temperature of up to 1800 °C.

High-temperature bottom loading furnace
HT 166/17 LB DB200-3 with catalytic post combustion system

Sintering in Air

Nabertherm offers a wide range of furnace solutions for sintering, firing, calcining or tempering in the laboratory and production. The furnace can be individually adapted to the process requirements with additional equipment such as multi-zone control to optimize temperature uniformity or a controlled cooling system to shorten the process.

Thermal Cleaning, Ashing

Processes such as ashing of food, thermal cleaning of injection molding tools or determination of ignition loss require furnace systems with a passive safety package to ensure a constant surplus of air for the incineration process. Depending on the charge weight, Nabertherm offers solutions that can be used for applications in the laboratory right through to processes with large amounts of organics or high evaporation rates.

Bottom loading furnace
HF 450/10 LB DB200-2

Dewaxing

For casting with lost models, furnaces solutions are required designed for safely removing the modeling material from the mold and the subsequent firing of the mold. Nabertherm offers different furnace solutions designed according to the demands for these applications.

Electroceramics

The debinding and sintering of multilayer ceramics (e. g. LTCC) requires furnace solutions that combine fast process cycles with precise temperature control and at the same time optimal temperature uniformity. Nabertherm offers solutions for batch processes and continuous processes. The technical design of the furnaces is tailored to the required throughput and the process requirements for heat treatment, such as the process temperature and the required cycle times.

Furnace group	Model	Debinding in air up to 850 °C	Debinding and sintering in air up to 1400 °C	Debinding and sintering in air up to 1800 °C	Calcination, tempering	Sintering in air up to 1400 °C	Sintering in air up to 1800 °C	Thermal cleaning, ashing	Dewaxing	Debinding and sintering of multilayer ceramics	Research and development
Debinding and Sintering in Air											
Chamber furnaces with wire heating, page 16	N ..				●	●					
Chamber furnaces with drawer bottom or as a bogie, page 18	NW ..				●	●					
Combi chamber furnaces for debinding and sintering in one process, page 20	N .. DB..		●							●	●
Bogie hearth furnaces with wire heating, page 22	W ..		●		●	●					
Combi bogie hearth furnaces for debinding and sintering in one process, page 26	W .. DB..		●								
Top hat furnaces or bottom loading furnaces with wire heating, page 28	H ..					●					
Combi-top hat furnaces or combi-bottom loading furnaces for debinding and sintering in one process, page 30	H .. DB..		●								
High-temperature furnaces with $MoSi_2$-heating elements and fiber insulation, page 34	HT ..						●				
High-temperature furnaces with SiC-rod heating and fiber insulation, page 36	HTC ..						●				
High-temperature furnaces with $MoSi_2$-heating elements and refractory brick insulation, page 37	HFL ..						●				
Combi-high-temperature furnaces for debinding and sintering in one process, page 38	HT .. DB..			●							●
High-temperature top hat furnaces or bottom loading furnaces, page 40	HT .. LB/LT						●				
Combi-high-temperature top hat furnaces or bottom loading furnaces for debinding and sintering in one process, page 44	HT .. LB/LT DB..			●							
Forced convection chamber furnaces up to 850 °C for debinding, page 48	NA .. DB..	●									
Chamber furnaces with brick insulation or fiber insulation, page 52	LH .. DB..		●		●	●					●
Thermal Cleaning, Ashing											
Ashing furnaces with integrated catalytic post combustion, page 56	L .. BO	●						●			●
Combi high-temperature furnace with integrated catalytic post combustion, page 57	LHT .. BO			●				●			●
Chamber furnaces for processes with high evaporation rates of organics or for thermal cleaning by incineration, page 58	N(B) .. BO							●			●
Furnace Solutions for the Microelectronic Industry											
Bottom loading furnace for LTCC applications, page 62	HF ..		●							●	
Continuous furnace for burn-out and firing/sintering, page 64	DF ..		●							●	
Furnaces for Special Applications											
Clean room solutions, page 68		●	●	●	●	●	●				
Gas-fired chamber furnaces, page 70	NB ..					●					
Gas-fired bogie hearth furnaces, page 71	WB ..					●					
Dewaxing furnaces, page 72	N .. WAX								●		
High-temperature bogie hearth furnaces with SiC-Rod heating up to 1550 °C, page 73	WHTC ..					●*					

*Tmax 1500 °C

Safety Concept for Debinding in Air

Debinding of technical ceramics is a demanding process due to the released hydrocarbons which subject to the corresponding concentration can cause a formation of an ignitable mixture inside the furnace. Depending on the process and the quantity of binder, Nabertherm offers tailored passive and active safety packages to ensure a safe operation of the furnace.

Debinding in an Electrically Heated Furnace

For debinding in air with electric heating Nabertherm offers various debinding packages tailored to the individual process requirements. All debinding packages have professional integrated safety technology. Passive or active safety concepts are available, depending on the specific requirements. The passive safety concepts differ upon the requirements for the quantity of organic materials, process reliability, and temperature distribution.

Passive Safety Concepts

As standard Nabertherm debinding furnaces are equipped with a passive safety concept to allow for a slow vaporization of flammable substances. The electrically heated furnaces work according to the dilution principle by introducing fresh air to reduce the degassing from the charge to a non-ignitable atmosphere in the furnace. The customer has to choose the quantity of organic materials as well as the temperature curve, to make sure that the maximum permissible rate of vaporization is not exceeded. The furnace DB safety package monitors all safety-relevant process parameters and initiates a respective emergency program in case of a malfunction. The passive safety concept has proven itself in practice due to its good price performance ratio. Depending on the process requirements, the following equipment packages are available.

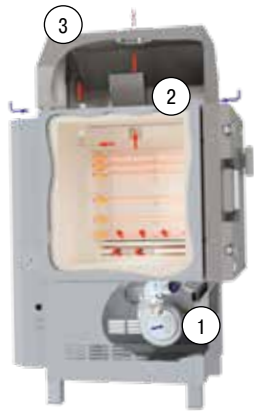
DB50 Debinding Package for Laboratory Furnaces

The DB50 debinding package is especially designed for laboratory furnaces and for processes with low evaporization rates e. g. for product and/or process development. The furnace is equipped with a fresh air fan. The fresh air fan is pre-set in the factory for the minimum volume of fresh air required for the debinding process. The furnace is operated with overpressure during the debinding process.

Monitored process states for safe operation:

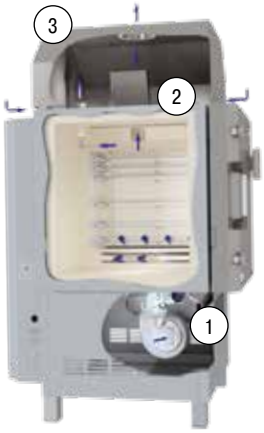
- Fresh air volumetric flow rate

Air Management for the Process Steps Debinding (Left), Sintering (Middle) and Cooling (Right) with Debinding Package DB50:



Debinding: Supply of the defined amount of fresh air via fresh air fan (1), exhaust gases discharged via the exhaust air flap (2) into the exhaust hood (3)

Sintering: Sintering without fresh air supply via fresh air fan (1) and closed exhaust air flap (2)



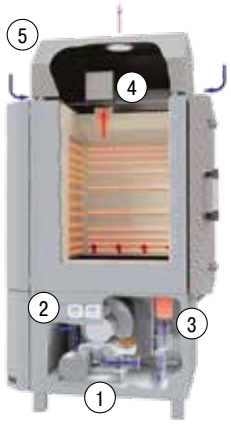
Cooling: Supply of cooling air via the fresh air fan (1) into the furnace chamber, exhaust air discharged via the exhaust air flap (2) into the exhaust hood (3)

DB100 Debinding Package for Production Furnaces with Radiation Heating

The DB100 debinding package is the basic option for safe debinding in furnaces with radiation heating. The furnace is equipped with a fresh air fan and a fresh air preheater. The fresh air fan is pre-set in the factory for the minimum volume of fresh air required for the debinding process. The furnace is operated with overpressure during the debinding process. Exhaust air and exhaust gas are blown out via an outlet equipped with a motorized flap into an exhaust hood with exhaust interruption. The exhaust hood is the interface to the customer‘s exhaust air system.

Monitored devices and process states for safe operation:
- Electromagnetic door lock
- Redundant monitoring of fresh air volume flow
- Position of the fresh-air flap
- Position of the exhaust air flap
- Max. heating speed during debinding
- Power loss (emergency program after power has returned)
- Fresh air fan
- Thermocouple break
- The furnace controls respond differently depending on the specific malfunction and put the furnace into a safe condition.

Air Management for the Process Steps Debinding (Left), Sintering (Middle) and Cooling (Right) with Debinding Package DB100:



Debinding: Supply of the defined amount of fresh air via fresh air fan (1) and monitoring of the amount of fresh air (2), preheating of the fresh air via fresh air preheater (3), discharge of the exhaust gases via the exhaust air flap (4) into the exhaust hood (5)

Sintering: Sintering without fresh air supply via fresh air fan (1) and closed exhaust air flap (4)

Cooling: Supply of cooling air via the fresh air fan (1) into the furnace chamber, exhaust air discharged via the exhaust air flap (4) into the exhaust hood (5)

DB200 Debinding Package for Production Forced Convection Furnaces or Radiation Heating

The DB200 debinding package is the professional solution for the ceramics production because it can be used flexibly for different debinding processes and also for changing debinding processes. Like with the DB100 debinding package, the fresh air required for the process is preheated. The system is available in different performance levels depending on the required evaporation rate. The air is introduced via ceramic tubes that blow the preheated air into the furnace chamber horizontally. This ensures very good heat transfer and improves the temperature uniformity during debinding.

As opposed to the DB100 debinding package, exhaust air and exhaust gas are extracted via separate outlets, each equipped with a motorized flap. The furnace is equipped with a fresh air fan and an exhaust gas fan. Both devices are reconciled so that the volume of air required for the debinding process is blown in and, at the same time, negative pressure is controlled in the furnace chamber. The exhaust gases during the debinding phase are extracted through the exhaust gas outlet, which is connected directly to the local exhaust gas piping. Due to the direct connection, the exhaust gas volumes are reduced and subsequent exhaust gas treatment systems can be dimensioned smaller. Nabertherm also offers catalytic or thermal post combustion systems for furnaces with safety package for debinding.

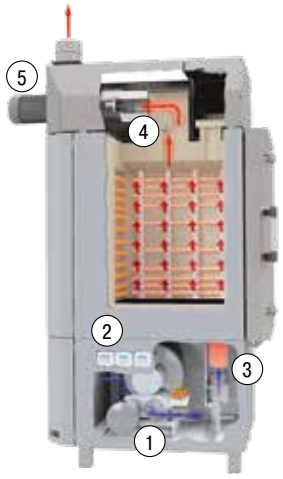
For cooling, the exhaust air blown out into the exhaust hood with exhaust interruption, which is the interface to the customer’s exhaust air system.

Monitored devices and process states for safe operation like DB100, but:
- Position of the exhaust gas flap
- Malfunction of exhaust gas fan
- Underpressure in the furnace chamber

The Main Advantages of the Described DB200 Debinding Package Compared to the DB100 Debinding Package Are:

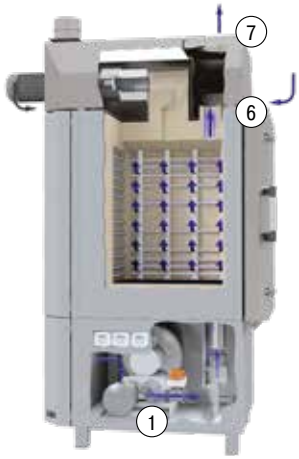
- Automatic control of the exhaust gas fan in relation to the selected volume of fresh air. This is beneficial for temperature management (uniform temperature) and an adaptable extraction of the exhaust gas volumes. Reduced odors and condensation in the exhaust gas piping.
- Horizontal, even supply of preheated fresh air in the charging levels of the furnace chamber via perforated air inlet tubes
- Extension with catalytic or thermal post combustion for a single furnace or for alternating operation with two furnaces. The design of the performance of the post combustion is adapted to the performance of the debinding package DB200.

Air Management for the Process Steps Debinding (Left), Sintering (Middle) and Cooling (Right) with Debinding Package DB200:



Debinding: Supply of the defined amount of fresh air via fresh air fan (1) and monitoring of the amount of fresh air and exhaust gas as well as the oven pressure (2), pre-heating of fresh air via fresh air preheater (3), discharge of the exhaust gases via the exhaust gas flap (4) with exhaust fan (5)

Sintering: Sintering without fresh air supply via fresh air fan (1) and closed exhaust gas (4) and exhaust air flap (6)



Cooling: Supply of cooling air via the fresh air fan (1) into the furnace chamber, exhaust air discharged via exhaust air flap (6) into the exhaust hood (7)

Assignment of the Debinding Packages to the Furnace Groups

	LH 30/.. - LH 120/..	NA 120/.. - NA 1500/..	N 100/..	N 200/.. - N 1500/..	W 1000/.. - W 7500/..	H 125/.. LT - H 1000/.. LT	HT 16/.. - HT 40/..	HT 64/.. - HT 450/..	HT 64/.. LT - HT 400/..LT
Catalog page	52	48	16	16	22	28	34	34	40
Debinding package									
DB50	●		●				●		
DB100				●	●	●	●	●	●
DB200		●		●	●	●	●	●	●

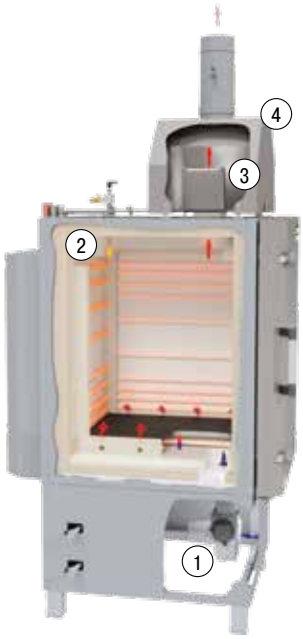
Active Safety Concept

Alternatively, the passive safety concept DB200 can be upgraded with an active safety concept. Compared to the passive safety concept, the limit concentration of hydrocarbons in the furnace chamber is constantly monitored using flame temperature analysis (FTA).

Accordingly, the fresh air and exhaust fans as well as the furnace heating are automatically adjusted to the hydrocarbon concentration that occurs during debinding. The temperature curve can be optimally adjusted or shortened depending on the amount of exhaust gas. In case of an unsafe situation in the furnace, e.g. due to overloading, a too fast heating gradient or too low fresh air supply, the necessary emergency program is initiated in stages, depending on the process step and error category.

Furthermore, the amount of fresh air supplied and the amount of exhaust gas removed is actively reduced in process phases during debinding, in which only little or no binder outgassing are present. As a result, energy consumption of the entire system for these process phases is reduced and respectively energy efficiency is enhanced.

Safety Concept for other Processes where Organic Exhaust Gases Occur



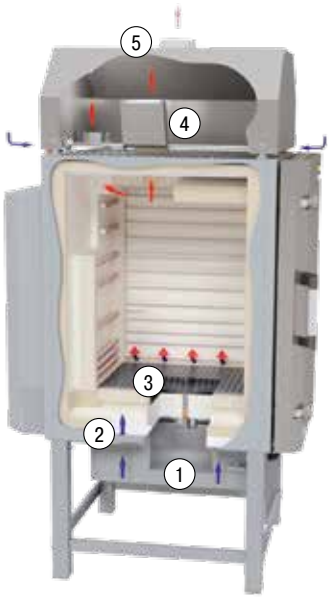
Schematic representation of the chamber furnace with BO safety concept
1. Fan for supplying defined amount of fresh air
2. Gas-fired pilot burner
3. Exhaust air flap to remove exhaust gases during the process
4. Exhaust hood

BO Safety Concept for Processes with High Organic Vaporization Rates

The BO safety concept is recommended for processes with high vaporization dynamics that are difficult to control. Diluting the furnace atmosphere with air is not sufficient to guarantee non-ignitable mixtures in the furnace. Examples of this are processes with high binder amounts or rapid vaporization rates. This furnace concept is also suitable for processes in which the product is incinerated through ignition.

Like for the debinding safety packages, air is constantly supplied to the furnace atmosphere to ensure a constant surplus of air. If the amount of fresh air is not sufficient and an ignitable mixture forms in the atmosphere, this is ignited by a gas-heated pilot burner in the furnace. This system ensures that no larger ignitable concentrations can arise and allows the gas emissions to burn off safely. The concept is generally recommended for products that are not damaged by a sudden increase in temperature. Organic components can also be burned off at temperatures above 500 °C. Depending on the furnace model, the burnout process can be followed by a subsequent process up to a maximum of 1000 °C.

Monitored devices and process states for safe operation:
- Temperature-controlled door lock
- Gas inlet pressure of burner system
- Flame of the ignition burner
- Flow rate of fresh air
- Exhaust gas flow
- The furnace controls respond differently depending on the specific malfunction and put the furnace into a safe condition
- Fresh air fan function
- On-site extraction function



Design of the chamber furnace with WAX safety concept
1. Drawer for wax collection
2. Fresh air supply via supply vents in the furnace bottom
3. Heated drainage and drain pan in the furnace
4. Exhaust flap
5. Exhaust hood

WAX Safety Concept for Electrically Heated Furnaces to Melt Out Wax below its Flashpoint

Furnaces of the WAX series with the corresponding safety concept are suitable for dewaxing parts, e.g. ceramic molds, below the wax flashpoint. The melted wax is collected in a container underneath the furnace. This collection container is positioned in an airtight drawer which can be removed for emptying. The wax runs through a grid into a funnel-shaped drain in the base of the furnace. The drainage channel is heated to stop the wax hardening. The furnace program is started only when the set temperature of the drain is reached. The customer has to choose the melting temperature and the melting time. When the melting process is complete, the furnace can be heated to 850 °C to sinter the molds.

Monitored safety functions for safe processes:
- Temperature of the wax drain
- Two independent over-temperature limiters
  - First over-temperature limiter is set below the wax flashpoint. This prevents the wax from igniting during the melting process. The customer sets the duration of the dewaxing process. When this time has elapsed, the program deactivates the over-temperature limiter so that the furnace can continue the sintering process.
  - Second over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load during sintering

Catalytic and Thermal Post Combustion Systems

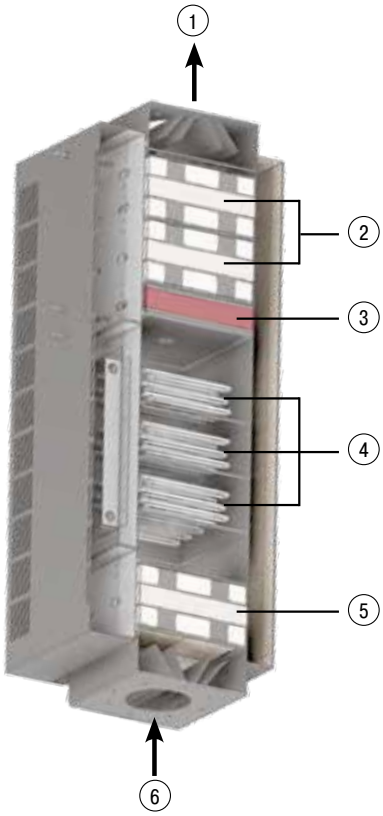
Catalytic post combustion system

For cleaning of exhaust gases especially during debinding, Nabertherm offers post combustion systems tailored to the process for furnace solutions with the safety package for debinding DB200. The post combustion is directly connected to the exhaust gas path of the furnace and accordingly integrated into the controls and the safety matrix of the furnace.

Catalytic Post Combustion Systems (KNV)

Catalytic post combustion systems are useful for oxidation of pure hydrocarbon compounds during debinding processes in air. They are recommended for small to medium-sized exhaust gas volumes.

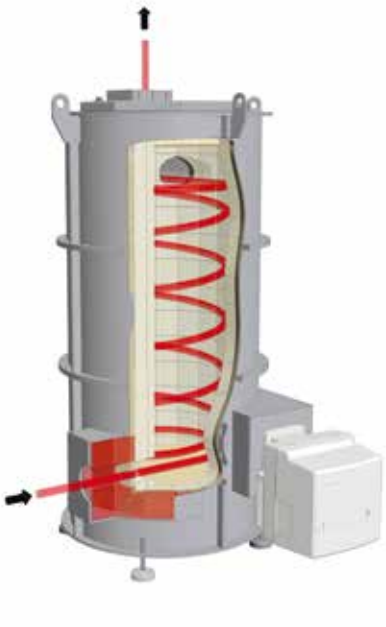
- Perfectly suited for debinding processes in air with only organic exhaust gases
- Decomposition of gases in carbon dioxide and water
- Integrated in a compact stainless steel housing
- Electric heating provides for preheating of the exhaust gas to the optimal reaction temperature for catalytic treatment
- Cleaning in different layers of catalytic honeycombs within the system
- Control thermocouples for the post combustion and to measure the outlet temperatures
- Over-temperature limiter with adjustable cutout temperature protects the catalyst
- Tight connection between the exhaust gas outlet of the debinding furnace and the exhaust gas fan with corresponding integration into the overall system with respect to control and safety technology
- Catalyst dimensioned in relation to the exhaust gas flow
- Measuring port for clean gas measurements



Scheme of a catalytic post combustion system:
1. Outlet for treated exhaust gases (clean gases)
2. Catalytic cleaning
3. Sacrificial layer
4. Heating elements
5. Honeycomb
6. Inlet for exhaust gases

Forced convection chamber furnace NA 500/65 DB200 with catalytic post combustion system

Thermal Post Combustion Systems (TNV)



Scheme of a thermal post combustion system (TNV)

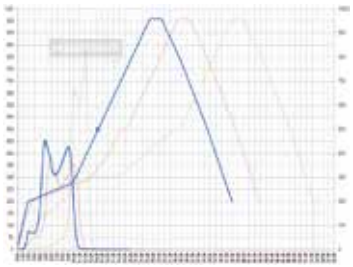
Thermal post combustion systems are used if large volumes of exhaust gas from the debinding process in air must be cleaned and/or if there is a risk that the exhaust gases might damage the catalyst.

The thermal post combustion system is optimally suited for debinding processes in air with large exhaust gas flow, erratic large exhaust gas volumes, large volume flow or for debinding processes under non-flammable or flammable process gases

- Gas-fired to burn the exhaust gases
- Burn-off at temperatures up to 850 °C provides for thermal decomposition of the exhaust gases
- Heating with compact gas burner with automatic firing device
- Thermocouples in the combustion chamber and in the raw gas inlet
- Over-temperature limiter for protecting the thermal post combustion
- Design depending on the exhaust gas flow
- Measuring port for clean gas measurements (FID)

Forced convection chamber furnace
NA 500/06 DB200-2 with thermal post combustion system

Process Optimization by Nabertherm with Flame Ionization Detector (FID)



Process curves before and after optimization

The binder removal often accounts for the largest part of the overall process time. Consequently, there is a lot of potential in this process step to reduce the cycle time.

For process optimization, Nabertherm offers a production accompanying analysis of the debinding process by means of FID measurement. The aim of the measurement is to determine a possible reduction of the process time, an increase in throughput and an associated reduction of production costs. Based on the recommendations, the customer checks and validates the practical feasibility with respect to the material properties of his charge.

- Process analysis including FID measurement and recommendations for potential process optimization
  - Recording of the current raw gas values using FID measurement
  - Evaluation and determination of periods with lower vaporization activity
  - Provision of the FID measurement device
  - Preparation of the evaluation and reports

- Process adjustment
  - Proposals for an optimized temperature profile
  - Implementation of the proposal, by performing one process cycle with accompanying measurement and evaluation after the customer has approved the proposal
  - Recommendations for the customer to carry out further optimization steps if feasible

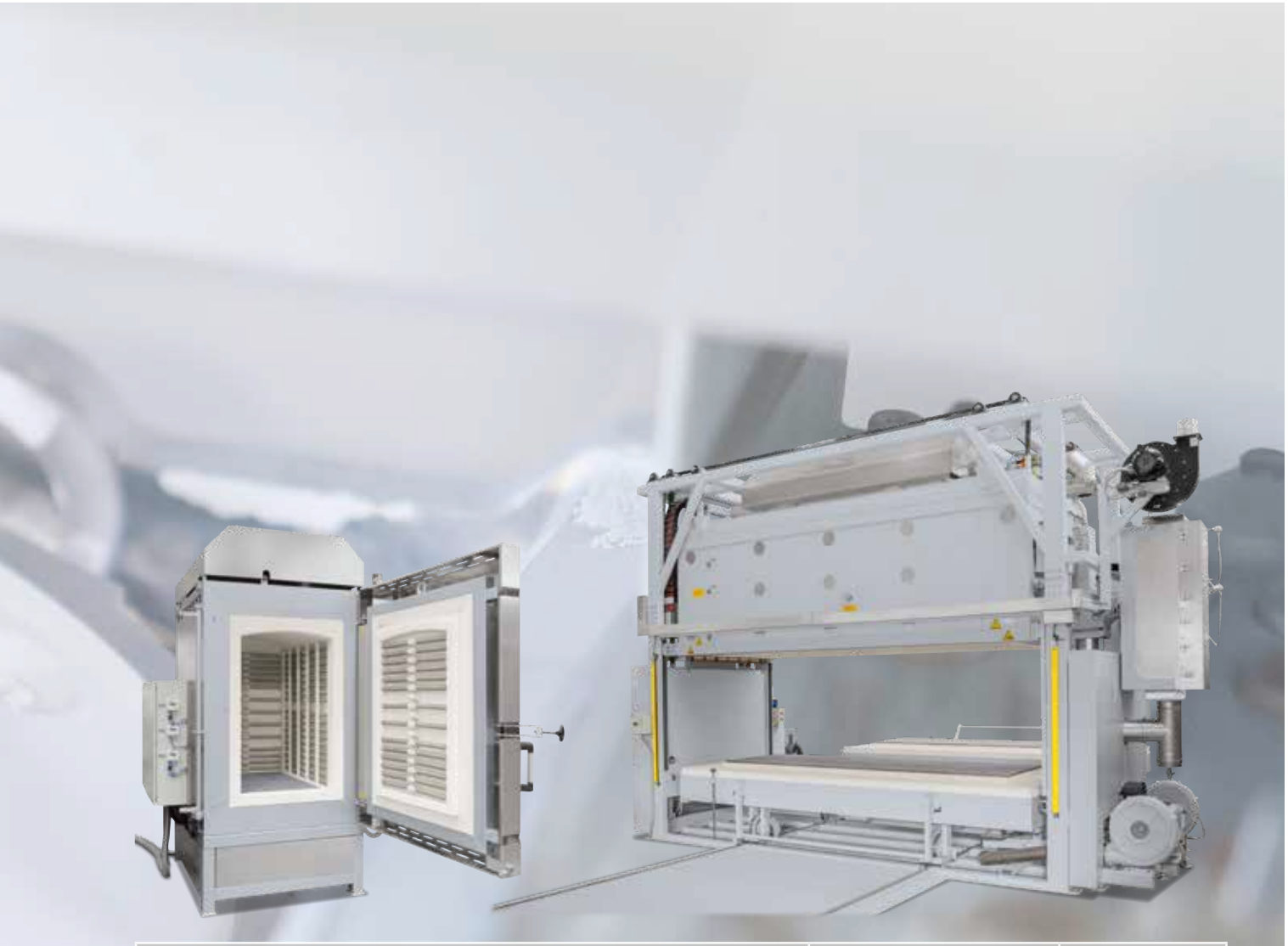
Debinding and Sintering in Air Furnace Solutions up to 1400 °C

For sintering, firing or calcination, Nabertherm offers optimal solutions with chamber, bogie hearth and top hat furnaces that cover the range of applications from laboratory to large-scale production. Additional equipment such as multi-zone controls or intelligent cooling systems allow the furnaces to be individually adapted to customer and process requirements.

The chamber, bogie hearth and top hat furnaces can also be equipped with safety systems for debinding in air, so that debinding and sintering - e.g. in the production of zirconia blanks in the dental industry or in the production of fuel cells - can be carried out in one process step. The production furnaces with debinding package can also be equipped with catalytic or thermal post combustion systems for cleaning of the exhaust gasses during debinding.

The following equipment applies to all furnaces in this chapter:

- Dual shell ventilated housing made of textured stainless steel sheets for low surface temperature and high stability
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- Defined application within the constraints of the operating instructions
- Controller with intuitive touch operation
- Heating elements on support tubes provide for free heat radiation and long service life
- Bottom heating protected by SiC tiles with an even stacking base



Furnace Group	Model	Page
Chamber furnaces with wire heating	N .., N ../H, N ../14	16
Chamber furnaces with drawer bottom or as a bogie	NW .., NW ../H	18
Combi chamber furnaces for debinding and sintering in one process	N .. DB.., N ../H DB.., N ../14 DB..	20
Bogie hearth furnaces with wire heating	W .., W ../H, W ../14	22
Combi bogie hearth furnaces with wire heating for debinding and sintering in one process	W ..DB.., W ../H DB.., W ../14 DB..	26
Top hat furnaces or bottom loading furnaces with wire heating	H ../LB, H ../LT	28
Combi-top hat furnaces or combi-bottom loading furnaces for debinding and sintering in one process	H ../LB DB.., H ../LT DB..	30

Chamber Furnaces with Wire Heating up to 1400 °C

These high-quality chamber furnaces have proven their worth in everyday use for firing, sintering, and tempering. Due to the five-sided heating and a special arrangement of the heating elements, the furnaces ensure good temperature uniformity. With an extensive range of additional equipment, these chamber furnaces can be adapted to suit many different process requirements.

Chamber furnace N 1500

Chamber furnace N 4550/S

Standard Equipment

- Tmax 1300 °C, 1340 °C or 1400 °C
- Five-side heating provide for good temperature uniformity
- Multi-layer insulation consisting of lightweight refractory bricks and backed by special fiber insulation
- Self-supporting and long-life ceiling construction, with bricks laid in arched construction
- Semi-automatic air inlet flap for chamber kilns up to 300 liters
- Infinitely adjustable, manual air inlet from 360 liters
- Exhaust air opening in the lid, including connection for an exhaust air tube (80 mm diameter) up to 300 liters
- Motorized exhaust air flap in the top of the furnace for optimum ventilation of the furnace chamber and for rapid cooling at low temperatures from 300 liters
- Frame included for furnaces up to 660 liters
- Controller mounted on furnace door and removable for comfortable operation
- Controller with touch operation B500 (5 programs with each 4 segments), controls description see page 76
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive see page 82
- Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC see page 82
- Freeware NTGraph for evaluation and documention of firings using Excel™ for Windows™ on the PC see page 82
- MyNabertherm App for online monitoring of the firing on mobile devices for free download see page 78

Additional Equipment

- Automatic control of the air inlet flap (up to 300 liters)
- Motorized exhaust air flap for optimum ventilation of the furnace chamber and for rapid cooling at low temperatures (up to 300 liters, included from 360 liters)
- Cooling system, including P570 Controller, to speed up furnace cooling with a fan and specified temperature gradients or a fixed volume of fresh air. Both operating modes can be activated for different segments, using an extra function of the controller.
- Protective gas connection for purging the furnace with non-flammable process gases
- Manual or automatic gas supply systems
- Multi-zone control for optimal temperature uniformity in the work space
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Special solutions with customer-specific diameters
- Process control and documentation via VCD software package for monitoring, documentation and control see page 83

N 1680/S for long parts

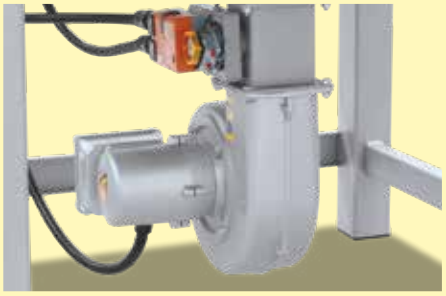
Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Heating power	Electrical	Weight
	°C	w	d	h	in l	W	D	H	in kW[2]	connection*	in kg
N 100	1300	400	530	460	100	710	1130	1440	9	3-phase	280
N 150	1300	450	530	590	150	760	1130	1570	11	3-phase	320
N 200	1300	470	530	780	200	790	1130	1760	15	3-phase	380
N 200/S	1300	400	1000	500	200	795	1710	1605	18	3-phase	300
N 250/S	1300	500	1000	500	250	895	1710	1605	20	3-phase	370
N 300	1300	550	700	780	300	870	1300	1760	20	3-phase	450
N 360/S	1300	600	1000	600	360	995	1710	1705	22	3-phase	500
N 440	1300	600	750	1000	440	1000	1410	1830	30	3-phase	820
N 500/S	1300	600	1400	600	500	995	2110	1705	24	3-phase	1000
N 660	1300	600	1100	1000	660	1000	1750	1830	40	3-phase	950
N 1000	1300	800	1000	1250	1000	1390	1850	2140	57	3-phase	1800
N 1500	1300	900	1200	1400	1500	1590	2050	2290	75	3-phase	2500
N 2200	1300	1000	1400	1600	2200	1690	2250	2490	110	3-phase	3100
N 100/H	1340	400	530	460	100	760	1150	1440	11	3-phase	330
N 150/H	1340	430	530	620	150	790	1150	1600	15	3-phase	380
N 200/H	1340	500	530	720	200	860	1150	1700	20	3-phase	450
N 300/H	1340	550	700	780	300	910	1320	1760	27	3-phase	540
N 440/H	1340	600	750	1000	440	1000	1410	1830	40	3-phase	900
N 660/H	1340	600	1100	1000	660	1000	1750	1830	52	3-phase	1250
N 1000/H	1340	800	1000	1250	1000	1390	1850	2140	75	3-phase	2320
N 1500/H	1340	900	1200	1400	1500	1590	2050	2290	110	3-phase	2700
N 2200/H	1340	1000	1400	1600	2200	1690	2250	2490	140	3-phase	3600
N 100/14	1400	400	530	460	100	760	1150	1440	15	3-phase	370
N 150/14	1400	430	530	620	150	790	1150	1600	20	3-phase	400
N 200/14	1400	500	530	720	200	860	1150	1700	22	3-phase	490
N 300/14	1400	550	700	780	300	910	1320	1760	30	3-phase	620
N 440/14	1400	600	750	1000	440	1000	1410	1830	40	3-phase	1320
N 660/14	1400	600	1100	1000	660	1000	1750	1830	57	3-phase	1560
N 1000/14	1400	800	1000	1250	1000	1390	1850	2140	75	3-phase	2500
N 1500/14	1400	900	1200	1400	1500	1590	2050	2290	110	3-phase	3000
N 2200/14	1400	1000	1400	1600	2200	1690	2250	2490	140	3-phase	3900

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[2]Depending on furnace design connected load might be higher

*Please see page 80 for more information about supply voltage

Chamber furnaces N 200/14 for sintering semiconductors

Charging trolley for chamber furnace N 2200



Controlled cooling as additional equipment

Chamber Furnaces with Drawer Bottom or as a Bogie

The chamber furnaces of NW model series combines the attractive quality advantages of the proven models N 150 - N 1000/H with an outstanding product characteristic which substantially simplifies charging.

With a drawer mechanism (NW 150 - NW 300/H) the kiln table can be easily pulled out of the chamber kiln. The larger models NW 440 - NW 1000/H are designed as shuttle furnace with completely free traversing bogie. Free access in front of the furnace allows for a simplified and clear charging.

Chamber kiln NW 300

Chamber kiln NW 440

Standard Equipment

- Tmax 1300 °C or 1340 °C
- Five-side heating provide for good temperature uniformity
- Multi-layer insulation consisting of lightweight refractory bricks and backed by special fiber insulation
- Self-supporting and long-life ceiling construction, with bricks laid in arched construction
- Furnace table can be pulled-out as drawer (NW 150 - NW 300/H)
- From chamber kiln NW 440 bogie on four castors (two with brakes) which can be pulled out completely. Accession assistance and removable drawbar for bogie
- Semi-automatic air inlet flap for chamber kilns up to 300 liters
- Infinitely adjustable, manual air inlet from 440 liters
- Exhaust air opening in the lid, including connection for an exhaust air tube (80 mm diameter) up to 300 liters
- Motorized exhaust air flap in the top of the furnace for optimum ventilation of the furnace chamber and for rapid cooling at low temperatures from 300 liters
- Frame included for furnaces up to 660 liters
- Controller mounted on furnace door and removable for comfortable operation
- Controller with touch operation B500 (5 programs with each 4 segments), controls description see page 76
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive see page 82
- Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC see page 82
- Freeware NTGraph for evaluation and documention of firings using Excel™ for Windows™ on the PC see page 82
- MyNabertherm App for online monitoring of the firing on mobile devices for free download see page 78

Additional Equipment

- Motorized exhaust air flap for models NW 150 - NW 300/..
- Fan system for faster cooling with manual or automatic control
- Multi-zone control for optimal temperature uniformity in the work space
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Process control and documentation via VCD software package for monitoring, documentation and control see page 83

Chamber kilns with a pull-out bogie for ergonomic loading of the firing chamber

Model	Tmax	Inner dimensions in mm			Volume in	Outer dimensions[1] in mm			Heating power	Electrical	Weight in
	°C	w	d	h	l	W	D	H	kW[2]	connection*	kg
NW 150	1300	430	530	620	150	810	1150	1600	11	3-phase	420
NW 200	1300	500	530	720	200	880	1150	1700	15	3-phase	490
NW 300	1300	550	700	780	300	930	1320	1760	20	3-phase	590
NW 440	1300	600	750	1000	450	1070	1410	1830	30	3-phase	850
NW 660	1300	600	1100	1000	660	1070	1750	1830	40	3-phase	1180
NW 1000	1300	800	1000	1250	1000	1460	1760	2230	57	3-phase	2100
NW 150/H	1340	430	530	620	150	810	1150	1600	15	3-phase	520
NW 200/H	1340	500	530	720	200	880	1150	1700	20	3-phase	590
NW 300/H	1340	550	700	780	300	930	1320	1760	27	3-phase	670
NW 440/H	1340	600	750	1000	450	1070	1410	1830	40	3-phase	940
NW 660/H	1340	600	1100	1000	660	1070	1750	1830	52	3-phase	1310
NW 1000/H	1340	800	1000	1250	1000	1460	1760	2230	75	3-phase	2700

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request
[2]Depending on furnace design connected load might be higher

*Please see page 80 for more information about supply voltage

Ergonomic loading from three sides

Drawer design for chamber furnaces NW up to 300 liters

Heating from five sides and a special arrangement of the the heating elements ensure optimal temperature uniformity

Combi Chamber Furnaces up to 1400 °C for Debinding and Sintering in One Process

The combi chamber furnaces N 100 DB - N 1500/14 DB are specially developed for debinding and sintering in one process. The furnaces have a fresh air supply providing for dilution of the exhaust gases produced during debinding, for safe prevention of an inflammable atmosphere in the furnace chamber. The standard version of the furnaces is equipped with the debinding package DB100. This debinding package provides for an injection of fresh air for atmosphere dilution which means that the furnace works under overpressure during debinding.

As a professional solution for production furnaces, we recommend the debinding package DB200. The furnace then has a warm fresh-air injection with variable speed through distribution tubes in the furnace chamber. The exhaust fan operates also with a variable fan speed. The PLC automatically regulates a negative pressure inside the furnace chamber.

Combi chamber furnace N 300/14 DB200

Standard Equipment

- Tmax 1280 °C, 1340 °C or 1400 °C
- Five-sided heating from all four sides and from the floor for a good temperature uniformity
- Multi-layer insulation consisting of lightweight refractory bricks backed by special insulation
- Self-supporting and long-life ceiling construction, with bricks laid in arched construction
- Motorized exhaust air flap on the furnace roof
- Debinding package DB50 for chamber furnace N 100.. see page 8
- From model N 200: debinding package DB100 with fresh-air fan, air-preheater and controls see page 9
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Controller with touch operation P570 (50 programs with each 40 segments) for models N 100.., controls description see page 76
- From model N 200: HiProSystems H1700, including Siemens PLC control and 7” touch panel as operator interface see page 84

Combi chamber furnace N 1000/14 DB200-3

Additional Equipment

- Multi-zone control adapted to the particular furnace model for optimizing the temperature uniformity
- Commissioning of the furnace with test firing and temperature uniformity measurement (also with load) for the purpose of process optimization see page 13
- Debinding package DB200 with safety concept see page 9
- Thermal or catalytic exhaust cleaning systems see page 12
- Redundant thermocouples to increase process safety
- Calibration interfaces for the measring range
- SiC support beams for ease of loading/unloading using a forklift
- Guiding rails for forklift

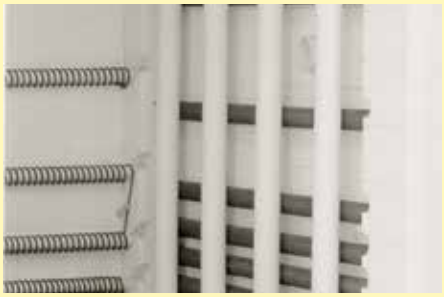
Production line consisting of combi chamber furnaces N 650 DB200 with catalytic post combustion for alternating operation

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Heating power for single-zone heating control	Electrical	Weight
	°C	w	d	h	in l	W	D	H	kW[2]	connection*	in kg
N 100 DB50	1280	400	530	460	90	1100	1150	1850	11	3-phase	350
N 200 DB..	1280	400	530	720	140	850	1350	2220	15	3-phase	500
N 300 DB..	1280	450	700	780	230	900	1600	2280	20	3-phase	800
N 450 DB..	1280	550	760	1000	350	1390	1570	2520	40	3-phase	1400
N 650 DB..	1280	660	850	1100	610	1250	1680	2720	62	3-phase	1600
N 1000 DB..	1280	740	1000	1250	940	1800	1800	2800	57	3-phase	2700
N 1500 DB..	1280	840	1200	1400	1400	1660	2300	2950	75	3-phase	3300
N 100/H DB50	1340	400	530	460	90	1100	1150	1850	15	3-phase	350
N 200/H DB..	1340	400	530	720	140	850	1350	2220	22	3-phase	500
N 300/H DB..	1340	450	700	780	230	900	1600	2280	30	3-phase	800
N 450/H DB..	1340	550	760	1000	350	1390	1570	2520	40	3-phase	1400
N 650/H DB..	1340	660	850	1100	610	1250	1680	2720	62	3-phase	1600
N 1000/H DB..	1340	740	1000	1250	940	1800	1800	2800	75	3-phase	2700
N 1500/H DB..	1340	840	1200	1400	1400	1660	2300	2950	110	3-phase	3300
N 100/14 DB50	1400	400	530	460	90	1100	1150	1850	15	3-phase	350
N 200/14 DB..	1400	400	530	720	140	850	1350	2220	22	3-phase	500
N 300/14 DB..	1400	450	700	780	230	900	1600	2280	30	3-phase	800
N 450/14 DB..	1400	550	760	1000	350	1390	1570	2520	40	3-phase	1400
N 650/14 DB..	1400	660	850	1100	610	1250	1680	2720	62	3-phase	1600
N 1000/14 DB..	1400	740	1000	1250	940	1800	1800	2800	75	3-phase	2700
N 1500/14 DB..	1400	840	1200	1400	1400	1660	2300	2950	110	3-phase	3300

[1]Outer dimensions vary depending on the scope of supply. Dimensions on request.
[2]Depending on furnace design connected load might be higher

*Please see page 80 for more information about supply voltage

Catalytic or thermal post combustion as additional equipment available (picture shows thermal post combustion)



Injection of preheated air through perforated ceramic tubes

SiC support beams for ease of loading/unloading using a forklift

Bogie Hearth Furnaces with Wire Heating up to 1400 °C

Bogie hearth furnaces offer many advantages in production. Outside the furnace, the bogie can be accessed from three sides and can be easily loaded using a crane or forklift truck. If several bogies are used, one can be charged while the other is positioned in the furnace. By adding additional equipment, e.g. multi-zone control for optimization of temperature uniformity or controlled cooling systems to shorten cycle times, these furnaces can be optimally tailored to the respective production process. The upscale into fully automatic systems is also possible, using motor-driven bogies and a rail system for bogie exchange.

Bogie hearth furnace W 7500

Standard Equipment

- Tmax 1280 °C, 1340 °C or 1400 °C
- Swing door hinged on the right side
- Heating from five sides (four sides and bogie) provides for a very good temperature uniformity
- Self-supporting and long-life ceiling construction with bricks laid in arched construction
- Freely moveable bogie with rubber wheels up to model W 3300. Larger models have flange wheels and run on rails.
- Adjustable air inlet damper
- Motorized exhaust air flap on the furnace roof
- Inlets in the front corners of the bogie 2 x D = 40 mm for the customer's thermocouples
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Controller with touch operation P570 (50 programs with each 40 segments), controls description see page 76
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive see page 82
- Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC see page 82
- Freeware NTGraph for evaluation and documention of firings using Excel™ for Windows™ on the PC see page 82
- MyNabertherm App for online monitoring of the firing on mobile devices for free download see page 78

Bogie hearth furnace W 2200 with lift door and motor-driven bogie on rails

Bogie hearth furnace W 1500/14 S with turntable and two bogies

Additional Equipment

- Multi-zone control to optimize the temperature uniformity
- Cooling system to speed up furnace cooling with a fan and specified temperature gradients or a fixed volume of fresh air
- Bogies with flanged wheels running on rails for easy and precise movement of high loads or complex kiln furniture
- Electric chain-driven bogie in combination with rail operation for smooth movement of heavy loads
- Different possibilities for an extension to a bogie hearth furnace system:
  - More bogies
  - Bogie transfer system with parking rails to exchange bogies running on rails or to connect multiples furnaces
  - Fully automatic control of the bogie exchange
- Electro-hydraulic lift door
- Alternating use of two bogies with lift doors in front of and behind the furnace
- Facilities to hold charging trolley/furniture
- Fiber insulation for short process times
- Safety concepts for debinding see page 8
- Thermal or catalytic post combustion systems see page 12
- Process control and documentation via VCD software package for monitoring, documentation and control see page 83

Bogie hearth furnace W 7500/H with lift doors on both sides and two bogies on rails

Bogie hearth furnace W 5000/H with controlled cooling system, lift door and motor-driven bogie on rails

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[2] in mm			Heating power	Electrical	Weight
	°C	w	d	h	in l	W	D	H	in kW[1]	connection*	in kg
W 1000	1280	800	1600	800	1000	1470	2390	1920	57	3-phase	3000
W 1500	1280	900	1900	900	1500	1570	2690	2020	75	3-phase	3500
W 2200	1280	1000	2200	1000	2200	1670	2990	2120	110	3-phase	4500
W 3300	1280	1000	2800	1200	3300	1670	3590	2320	140	3-phase	5300
W 5000	1280	1000	3600	1400	5000	1670	4390	2520	185	3-phase	7300
W 7500	1280	1000	5400	1400	7500	1670	6190	2520	235	3-phase	10300
W 1000/H	1340	800	1600	800	1000	1470	2390	1920	75	3-phase	3000
W 1500/H	1340	900	1900	900	1500	1570	2690	2020	110	3-phase	3500
W 2200/H	1340	1000	2200	1000	2200	1670	2990	2120	140	3-phase	4500
W 3300/H	1340	1000	2800	1200	3300	1670	3590	2320	185	3-phase	5300
W 5000/H	1340	1000	3600	1400	5000	1670	4390	2520	235	3-phase	7300
W 7500/H	1340	1000	5400	1400	7500	1670	6190	2520	370	3-phase	10300
W 1000/14	1400	800	1600	800	1000	1470	2390	1920	75	3-phase	3000
W 1500/14	1400	900	1900	900	1500	1570	2690	2020	110	3-phase	3500
W 2200/14	1400	1000	2200	1000	2200	1670	2990	2120	140	3-phase	4500
W 3300/14	1400	1000	2800	1200	3300	1670	3590	2320	185	3-phase	5300
W 5000/14	1400	1000	3600	1400	5000	1670	4390	2520	235	3-phase	7300
W 7500/14	1400	1000	5400	1400	7500	1670	6190	2520	370	3-phase	10300

[1]Depending on furnace design connected load might be higher

*Please see page 80 for more information about supply voltage

[2]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

Thermocouple inlets (Ø 40 mm) in the front corners of the bogie

Bogie running on steel wheels with gear rack drive, no rails necessary

Electro-hydraulic lift door

Combi furnace system consisting of two bogie hearth furnaces W 5000/H and two additional bogies incl. bogie transfer system and incl. necessary park rails

Combi Bogie Hearth Furnaces with Wire Heating up to 1400 °C for Debinding and Sintering in One Process

The combi bogie hearth furnaces were developed especially for debinding with subsequent sintering in one process. Equipped with a passive safety system, all functions relevant for debinding processes are monitored to ensure safe operation of the furnace. Also as part of the safety package, the furnace atmosphere is diluted with fresh air to prevent forming of a combustible atmosphere by the exhaust gases evaporating from the charge during debinding.

In the basic model, the furnaces are equipped with the DB100 debinding package. With this debinding package, preheated fresh air is supplied into the furnace chamber ensuring that the combi bogie hearth furnace is operated with overpressure during the debinding phase.

For high binder amounts and/or varying debinding processes, these production furnaces are equipped with the DB200 debinding package. The bogie hearth furnace then has a fresh air fan, which blows preheated fresh air into the furnace chamber via an air preheater, and an exhaust gas fan on the exhaust gas duct. This ensures that the volume of fresh air required for the debinding process is blown-in and, at the same time, an underpressure in the furnace chamber is automatically regulated via the furnace control system. The combi bogie hearth furnaces and the debinding packages can be customized to suit many different process requirements.

Combi bogie hearth furnace W 1000 DB200-3

Combi bogie hearth furnace W 1500/14 DB200-3 with thermal post combustion. lift door and bogie on rails

Standard Design

Such as bogie hearth furnaces with wire heating up to 1400 °C (see page 22), however:

- No adjustable fresh air flap
- Stainless steel exhaust air hood as an interface to the customer's extraction system
- HiProSystems H1700, including Siemens PLC control system and 7" touchpanel as operating interface see page 84

Debinding Package DB100

- Basic model for safe debinding operation with small binder amounts
- Fresh air fan and fresh air preheater
- Exhaust gas and exhaust air removed via one outlet with a motor-driven flap in an exhaust hood
- Performance of the debinding package customized to the process requirements
- For more details about the DB100 debinding package see page 9

Debinding Package DB200

- Professional solution for large amounts of binder and changing varying processes
- Fresh air fan, fresh air preheater and monitoring of fresh air and exhaust gas flow rates
- Separate discharge of exhaust gases during debinding and exhaust air during cooling via separate outlets with motor-driven flaps
- Extendable with catalytic or thermal post combustion for a single furnace or alternating operation with two furnaces see page 12
- Performance of the debinding package customized to the process requirements
- For more details about the DB200 debinding package see page 9

Furnace system with six combi bogie hearth furnaces W 2254/14 DB200-3 with catalytic post combustion for alternating operation, lift door and transfer system with loading/unloading station for automatic operation

Two combi bogie hearth furnaces W 2254/14 DB200-4 with catalytic post combustion for alternating operation

Additional Equipment

- Multiple-zone control to optimize temperature uniformity
- Electro-hydraulic lift door
- Various extension options for transfer operations:
  - Additional bogies
  - Bogie with flanged wheels running on rails
  - Electric chain drive for bogie on rails
  - Bogie transfer system manually operated with parking rails to exchange bogies with one or multiples furnaces
  - Automatic operation for bogie transfer system
  - Alternating operation of two bogies with lift doors at the front and back of the furnace or with turntable in front of the furnace
- With debinding package DB200: Thermal or catalytic post combustion systems see page 12

Turntable to exchange bogies in front of the furnace

Thermal post combustion

Electro-hydraulic lift door

Top Hat Furnaces or Bottom Loading Furnaces with Wire Heating up to 1400 °C

Compared to chamber furnaces, the top hat and bottom loading furnaces are offering the advantage of convenient loading and unloading of complex charge setups on a compact footprint. The widely opening electrically or hydraulically driven hood allows for good access to the usable space. Depending on the process conditions, a top hat or bottom loading design is recommended. The system can be upgraded to include one or more tables that are manually or electrically driven. Adding further additional equipment, such as multi-zone controls to optimize temperature uniformity or controlled cooling systems to shorten process times, the furnaces can be individually adapted to the process requirements.

Bottom loading furnace H 1000/LB

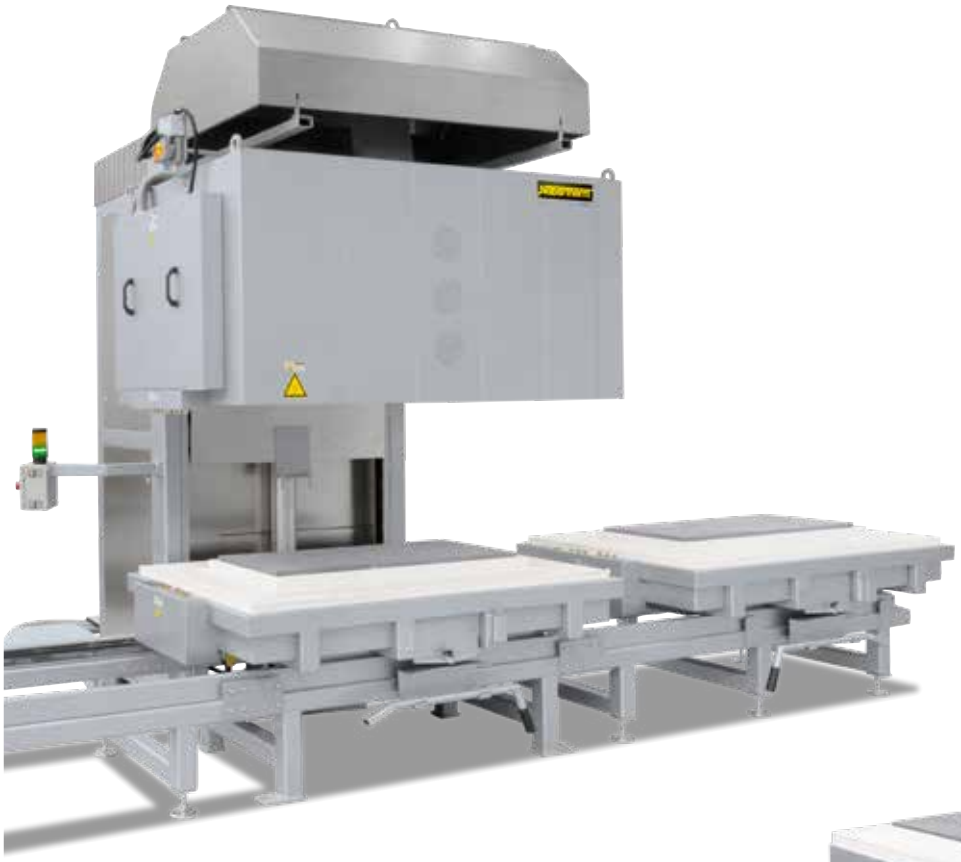
Bottom loading furnace H 1600/S for heat treatment of quartz glass. The furnace is designed to be opened at 1000 °C. The table can be pulled out to process components.

Standard Equipment

- Tmax 1280 °C
- Top hat furnaces (model LT): Electric or hydraulic hood drive with fixed table
- Bottom loading furnaces (model LB): driven table and fixed top hat
- Five-sided heating from all four sides and from the table provides for a temperature uniformity up to +/– 5 °C according to DIN 17052-1 see page 89
- Multi-layer insulation consisting of lightweight refractory bricks backed by special insulation
- Long-life ceiling design with fiber insulation
- Automatic exhaust air flap on the furnace roof
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Controller with touch operation C540 (10 programs with each 20 segments), controls description see page 76
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive see page 82
- Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC see page 82
- Freeware NTGraph for evaluation and documention of firings using Excel™ for Windows™ on the PC see page 82
- MyNabertherm App for online monitoring of the firing on mobile devices for free download see page 78

Additional Equipment

- Tmax to 1400 °C
- Cooling system with fresh air fan for rapid cooling
- Sides with fiber insulation to reduce cycle times
- Fabric cover on the fiber roof (and sides) to reduce fiber dust
- Protective gas connection for purging the furnace with non-flammable process gases
- Automatic gas supply systems
- Multi-zone control adapted to the particular furnace provides model for optimal temperature uniformity
- Commissioning of the furnace with test firing and temperature uniformity measurement (also with load) for the purpose of process optimization
- Additional tables, table changing system, also motorized
- Exhaust air and exhaust gas piping
- Process control and documentation via VCD software package for monitoring, documentation and control see page 83



Top hat furnace H 500 LT with table exchange system and manually movable tables

Bottom loading furnace HF 1220/LBS with fiber insulation, safety barrier to safeguard the danger zone and manually movable table for ease of loading and unloading

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Heating power in	Electrical	Weight
	°C	w	d	h	in l	W	D	H	kW[2]	connection*	in kg
H 125/LB, LT	1280	800	400	400	125	1550	1500	2200	12	3-phase	1250
H 250/LB, LT	1280	1000	500	500	250	1530	1700	2300	18	3-phase	1400
H 500/LB, LT	1280	1200	600	600	500	2020	1800	2500	36	3-phase	1800
H 1000/LB, LT	1280	1600	800	800	1000	2200	2000	2900	48	3-phase	2800
H 1350/LB, LT	1280	2800	620	780	1360	3750	2050	3050	75	3-phase	3500
H 3000/LB, LT	1280	3000	1000	1000	3000	4000	2100	3200	140	3-phase	6200

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[2]Depending on furnace design connected load might be higher

*Please see page 80 for more information about supply voltage

Fiber insulation to reduce heating and cooling times

Two-hands operation with swivel arm

Fabric cover on the fiber roof (and sides) to reduce fiber dust

Combi-Top Hat Furnaces or Combi-Bottom Loading Furnaces with Wire Heating up to 1400 °C for Debinding and Sintering in One Process

Like the bogie hearth furnace, the top hat and bottom loading furnaces will be equipped with a safety system for debinding in air to allow for a safe operation of debinding and sintering processes performed in one step. Based on the dilution principle, fresh air will be supplied to the furnace chamber in a controlled way to reliably prevent a combustible atmosphere forming inside the furnace by the exhaust gases evaporating from the charge. In addition, debinding-related functions will be monitored to protect the operator and the surrounding.

For small amounts of binder, the basic versions of the combi top hat and bottom loading furnaces are equipped with the DB100 debinding package. With this package, pre-heated fresh air is blown into the furnace so that the combi bogie hearth furnace is operated with overpressure during the debinding phase.

The DB200 debinding package is used for alternating debinding processes and/or large amounts of binder. Like the DB100 debinding package, preheated fresh air is supplied to the furnace chamber via a fresh air fan with air preheater. The furnace also has an exhaust gas fan, which removes the exhaust gases from the furnace via a separate outlet during debinding. For this purpose, the flow rates of the fresh air and exhaust gas are coordinated to ensure that there is always a slight underpressure in the furnace chamber during debinding.

Top hat furnace H 3000 DB200-3 with interchangeable table system for two tables and catalytic post combustion system KNV 320 installed on the housing

Top hat furnace H 3000 DB-S with manual interchangeable table system for two tables

Standard Design

Refer to top hat furnaces or bottom loading furnaces with wire heating see page 28

- HiProSystems H1700, including Siemens PLC control system and 7" touchpanel as operating interface see page 84

Debinding Package DB100

- Basic design for safe debinding operation with small amounts of binder
- Fresh air fan and fresh air preheater
- Exhaust gas and exhaust air removed via one outlet with a motor-driven flap in an exhaust hood
- Performance of the debinding package customized to the process requirements
- For more details about the DB100 debinding package see page 9

Debinding Package DB200

- Professional solution for large amounts of binder and changing debinding processes
- Fresh air fan, fresh air preheater and monitoring of fresh air and exhaust gas flow rates
- Separate discharge of exhaust gases during debinding and exhaust air during cooling via separate outlets with motor-driven flaps
- Extendable with catalytic or thermal post combustion for a single furnace or alternating operation with two furnaces see page 12
- Performance of the debinding package customized to the process requirements
- For more details about the DB200 debinding package see page 9

Top hat furnace H 500 DB200 with catalytic post combustion, automatic table changing system and security scanners to protect the danger zone

Lift bottom furnace HF 450/10 LB DB200-2 with fiber insulation for fast heating and cooling times

Additional Equipment

- Tmax 1400 °C
- Sides with fiber insulation to reduce cycle times
- Fabric cover on the fiber roof (and sides) to reduce fiber dust
- Multiple-zone control, adapted for the respective furnace model to optimize temperature uniformity
- Additional tables, interchangeable table system, also motorized
- With debinding package DB200: Thermal or catalytic exhaust air treatment systems see page 12
- Redundant thermocouples to increase process reliability
- Calibration interfaces for the measuring section

Catalytic post combustion integrated on the furnace housing to save space

Manual interchangeable table system for two tables for parallel loading and unloading of the charge

Debinding and Sintering in Air Furnace Solutions up to 1800 °C

In order to achieve the desired mechanical properties of ceramic parts, the components must be sintered at high temperatures after debinding. With the high-temperature chamber and top hat furnaces, Nabertherm offers a wide range of furnace solutions that enable scale-up from small charge loads to mass production.

Adding safety systems for debinding in air the high-temperature chamber and top hat furnaces can be directly used for single-stage debinding and sintering processes. They can be individually adapted to customer and process requirements using various options such as redundant thermocouples to increase process reliability or a thermocouple changing device for more precise control during debinding. An expansion with catalytic or thermal post combustion systems for exhaust air cleaning during debinding is also possible for the furnaces with the DB200 safety package.

The following equipment applies to all furnaces in this chapter:

- Dual shell ventilated housing made of textured stainless steel sheets for low surface temperature and high stability
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- Defined application within the constraints of the operating instructions
- Controller with intuitive touch operation

Furnace Group	Model	Page
High-temperature furnaces with - Molybdenum disilicide heating elements up to 1800 °C - Fiber insulation	HT ..	34
High-temperature furnaces with - SiC rod heating up to 1550 °C - Fiber insulation	HTC ..	36
High-temperature furnaces with - Molybdenum disilicide heating elements up to 1700 °C - Refractory brick insulation	HFL ..	37
Combi-high-temperature furnaces - For debinding and sintering in one process - With molybdenum disilicide heating elements up to 1800 °C - With fiber insulation	HT .. DB..	38
High-temperature top hat furnaces or bottom loading furnaces - Molybdenum disilicide heating elements up to 1800 °C - Fiber insulation	HT ../.. LB, HT ../.. LT	40
Combi-high-temperature top hat furnaces or bottom loading furnaces - For debinding and sintering in one process - With Molybdenum disilicide heating elements up to 1800 °C - With fiber insulation	HT ../.. LB DB.., HT ../.. LT DB..	44

High-Temperature Furnaces with Molybdenum Disilicide Heating Elements with Fiber Insulation up to 1800 °C

Thanks to the sturdy design, the high-temperature furnaces fulfill the demands of everyday use in laboratories and production. The compact standard models are particularly suitable for the production of technical ceramics such as bio ceramics or the sintering of CIM components where high working temperatures are needed and high-quality standards are required. The very good temperature uniformity and useful options set high-quality benchmarks and are the optimum solution for many applications. The furnaces can be extended with extra features from our extensive range to suit specific processes.

High-temperature furnace HT 29/17

Standard Equipment

- Tmax 1600 °C, 1750 °C, or 1800 °C
- Recommended maximum working temperature approx. 50 °C below Tmax of the furnace. Higher working temperatures will increase wear and tear.
- Heating from both sides via molybdenum disilicide heating elements
- High-quality fiber insulation backed by special insulation
- Long-life roof insulation with special suspension
- Temperature uniformity at 1450 °C up to +/– 6 °C according to DIN 17052-1 see page 89
- Chain-guided parallel swivel door for precise opening and closing of the door
- Two-door design (front/back) for high-temperature furnaces from HT 276/..
- Labyrinth sealing ensures the least possible temperature loss in the door area
- Reinforced floor as protection for bottom insulation as standard from models HT 16/16 upwards (distributed load 5 kg/dm^2)
- Vapor vent in the furnace roof with motorized exhaust air flap, controlled via the extra function of the controller
- Stainless steel exhaust hood as interface to customer's exhaust system
- Controller with touch operation P570 (50 programs with each 40 segments), controls description see page 76

High temperature chamber furnace HT 450/16 with two locking devices per door

Additional Equipment

- Cooling system to cool the furnace with a defined temperature gradient or with a preset fresh air volume. Both operating modes can be switched on and off for different segments by means of the extra function of the controller.
- Thermocouple inlet with screw cap
- Thermocouple for the heating control with calibration certificate
- Protective gas connection to purge with non-flammable process gases (not completely gas-tight)
- Automatic gas supply system with solenoid valve and rotameter, controlled by the extra function of the controller
- Refractory brick floor insulation for a higher floor load (Tmax 1700 °C)
- Lift door
- Automatic door lock incl. door contact switch
- Heating elements protected against mechanical damage
- Special heating element qualities e. g. for zircon oxide applications
- Ethernet interface

High-temperature furnace HT 160/17 with gas supply system

High-temperature furnace HT 64/17 with PLC controls and additional options

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Connected	Electrical	Weight
	°C	w	d	h	in l	W	D	H	load in kW	connection*	in kg
HT 08/16	1600	150	300	150	8	740	640	1755	8.5	3-phase[2]	215
HT 16/16	1600	200	300	260	16	820	690	1860	12.5	3-phase[2]	300
HT 29/16	1600	275	300	350	29	985	740	1990	9.8	3-phase[2]	350
HT 40/16	1600	300	350	350	40	1010	800	1990	12.5	3-phase	420
HT 64/16	1600	400	400	400	64	1140	890	2040	18.5	3-phase	555
HT 128/16	1600	400	800	400	128	1140	1280	2040	26.5	3-phase	820
HT 160/16	1600	500	550	550	160	1250	1040	2260	21.5	3-phase	760
HT 276/16	1600	500	1000	550	276	1340	1600	2290	43.5	3-phase	1270
HT 450/16	1600	500	1150	780	450	1380	1820	2570	65.0	3-phase	1570
HT 08/17	1750	150	300	150	8	740	640	1755	8.5	3-phase[2]	215
HT 16/17	1750	200	300	260	16	820	690	1860	12.5	3-phase[2]	300
HT 29/17	1750	275	300	350	29	985	740	1990	9.8	3-phase[2]	350
HT 40/17	1750	300	350	350	40	1010	800	1990	12.5	3-phase	420
HT 64/17	1750	400	400	400	64	1140	890	2040	18.5	3-phase	555
HT 128/17	1750	400	800	400	128	1140	1280	2040	26.5	3-phase	820
HT 160/17	1750	500	550	550	160	1250	1040	2260	21.5	3-phase	760
HT 276/17	1750	500	1000	550	276	1340	1600	2290	43.5	3-phase	1270
HT 450/17	1750	500	1150	780	450	1380	1820	2570	65.0	3-phase	1570
HT 08/18	1800	150	300	150	8	740	640	1755	8.5	3-phase[2]	215
HT 16/18	1800	200	300	260	16	820	690	1860	12.5	3-phase[2]	300
HT 29/18	1800	275	300	350	29	985	740	1990	9.8	3-phase[2]	350
HT 40/18	1800	300	350	350	40	1010	800	1990	12.5	3-phase	420
HT 64/18	1800	400	400	400	64	1140	890	2040	18.5	3-phase	555
HT 128/18	1800	400	800	400	128	1140	1280	2040	26.5	3-phase	820
HT 160/18	1800	500	550	550	160	1250	1040	2260	21.5	3-phase	760
HT 276/18	1800	500	1000	550	276	1340	1600	2290	43.5	3-phase	1270
HT 450/18	1800	500	1150	780	450	1380	1820	2570	65.0	3-phase	1570

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[2]Heating only between two phases

*Please see page 80 for more information about supply voltage

Automatic gas supply system with solenoid valve and rotameter

Two-door design for high-temperature furnaces > HT 276/..

High-temperature furnace HT 160/18 DB200-3 with lift door

High-Temperature Furnaces with SiC Rod Heating and Fiber Insulation up to 1550 °C

The high-temperature furnaces HTC 16/16 - HTC 450/16 are heated by vertically hung SiC rods, which makes them especially suitable for sintering processes up to a maximum operating temperature of 1500 °C. For some processes, e. g. for sintering zirconium oxide, the reduction of interactivity between the charge and the SiC rods, these models are more suitable than the alternatives heated with molybdenum disilicide elements. The basic construction of these furnaces make them comparable with the already familiar models in the HT product line and they can be upgraded with the same additional equipment.

High-temperature furnace HTC 160/16

Standard Equipment

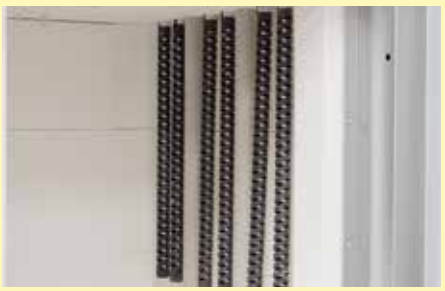
- Tmax 1550 °C
- Recommended maximum working temperature approx. 50 °C below Tmax of the furnace. Higher working temperatures will increase wear and tear.
- Heating from both sides via vertically mounted SiC rods
- High-quality fiber insulation backed by special insulation
- Long-life roof insulation with special suspension
- Temperature uniformity at 1450 °C up to +/– 10 °C according to DIN 17052-1 see page 89
- Chain-guided parallel swivel door for precise opening and closing of the door
- Two-door design (front/back) for high-temperature furnaces from HTC 276/.. up
- Labyrinth sealing ensures the least possible temperature loss in the door area
- Reinforced floor as protection for bottom insulation (distributed load 5 kg/dm²)
- Vapor vent in the furnace roof with motorized exhaust air flap, controlled via the extra function of the controller
- Stainless steel exhaust hood as interface to customer's exhaust system
- Controller with touch operation P570 (50 programs with each 40 segments), controls description see page 76

Additional equipment like HT models see page 34

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Heating Power	Connected	Electrical	Weight
	in°C	w	d	h	in l	W	D	H	in kW	load in kW	connection*	in kg
HTC 16/16	1550	200	300	260	16	820	690	1860	12	16.5	3-phase[2]	220
HTC 40/16	1550	300	350	350	40	1010	800	1990	12	16.5	3-phase	420
HTC 64/16	1550	400	400	400	64	1140	890	2040	18	41.5	3-phase	660
HTC 128/16	1550	400	800	400	128	1140	1280	2040	26	61.0	3-phase	550
HTC 160/16	1550	500	550	550	160	1250	1040	2260	21	40.0	3-phase	535
HTC 276/16	1550	500	1000	550	276	1340	1600	2290	36	73.0	3-phase	1300
HTC 450/16	1550	500	1150	780	450	1380	1800	2570	64	118.0	3-phase	1450

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[2]Heating only between two phases

*Please see page 80 for more information about supply voltage



Vertically mounted SiC rods and optional perforated air inlet tubes of the debinding system in a high-temperature furnace

Two-door design for high-temperature furnaces > HT 276/..

Cooled inspection glass made out of saphire glass (left at working temperature, right at room temperature)

High-Temperature Furnaces with Molybdenum Disilicide Heating Elements and Refractory Brick Insulation up to 1700 °C

High-temperature furnaces HFL 16/16 - HFL 160/17 have a sturdy cladding made from refractory insulation. This design offers better protection if the process produces aggressive gases or acids, such as when glass is melted.

High-temperature furnace HFL 16/17 DB50 with gas supply system

Standard Equipment

Like high-temperature furnaces HT (see page 34), except:

- Tmax 1600 °C or 1700 °C
- Robust refractory brick insulation and special backing insulation
- Furnace floor made of lightweight refractory bricks accommodates higher charge weights

Additional Equipment

- Cooling system to cool the furnace with a defined temperature gradient or with a preset fresh air volume. Both operating modes can be switched on and off for different segments by means of the extra function of the controller.
- Thermocouple inlet with screw cap
- Thermocouple for the heating control with calibration certificate
- Protective gas connection to purge with non-flammable process gases (not completely gas-tight)
- Automatic gas supply system with solenoid valve and rotameter, controlled by the extra function of the controller
- Lift door
- Automatic door lock incl. door contact switch
- Heating elements protected against mechanical damage
- Ethernet interface

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Connected	Electrical	Weight
	in °C	w	d	h	in l	W	D	H	load in kW	connection*	in kg
HFL 16/16	1600	200	300	260	16	1010	890	1990	12.5	3-phase[2]	530
HFL 40/16	1600	300	350	350	40	1140	940	2260	12.5	3-phase	735
HFL 64/16	1600	400	400	400	64	1240	990	2310	18.5	3-phase	910
HFL 160/16	1600	500	550	550	160	1410	1240	2490	21.5	3-phase	1290
HFL 16/17	1700	200	300	260	16	1010	890	1990	12.5	3-phase[2]	530
HFL 40/17	1700	300	350	350	40	1140	940	2260	12.5	3-phase	735
HFL 64/17	1700	400	400	400	64	1240	990	2310	18.5	3-phase	910
HFL 160/17	1700	500	550	550	160	1410	1240	2490	21.5	3-phase	1290

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[2]Heating only between two phases

*Please see page 80 for more information about supply voltage

Automatic gas supply system with solenoid valve and rotameter

Protection of heating elements against mechanical damage during loading and unloading as additional equipment

Light-weight refractory bricks and heating elements made from molybdenum disilicide

Combi-High-Temperature Furnaces with Molybdenum Disilicide Heating Elements up to 1800 °C for Debinding and Sintering in One Process

For combined debinding and sintering processes with sintering temperatures up to 1750 °C, the high-temperature furnaces will be equipped with a passive safety system which ensures a safe operation by monitoring all functions relevant during debinding . In addition, fresh air is supplied to the furnace chamber in a controlled way to reliably prevent a combustible atmosphere forming inside the furnace by diluting the binder gases.

The smaller furnace models can be equipped with the DB50 laboratory debinding package, which is designed for small binder amounts and low vaporization rates. In the basic design, the DB100 debinding package is available for larger furnaces. With this debinding package, preheated fresh air is introduced so that the furnace is operated with overpressure during the debinding phase.

The DB200 debinding package is the ideal solution for high-temperature furnaces used in production processes. With this safety system, the furnace has a fresh air preheater and the preheated air is blown into the furnace horizontally through perforated air inlet tubes. During debinding, the exhaust gases are discharged from the furnace via a separate outlet with exhaust gas fan. The volume flows of fresh air and exhaust gas are controlled so that a slight negative pressure is always maintained in the furnace chamber during debinding.

High temperature chamber furnace HT 160/18 DB200-3 with safety system for debinding in air and pneumatic lift door

Standard Design

Like high-temperature furnaces HT (see page 34), however:

- Stainless steel exhaust hood as interface to the customer's extraction system (DB200 option: separate removal of exhaust gases during debinding)
- Controller with touch operation P570 (50 programs each with 40 segments) for models HT 16.. - HT 40.., description of the controls see page 76
- From model HT 64..: HiProSystems H1700, including Siemens PLC control system and 7" touchpanel as operating interface see page 84

Debinding Package DB50

- Laboratory option for applications with low evaporation rates for high-temperature furnaces HT 16.. - HT 40..
- Fresh air fan to introduce a defined volume of fresh air
- Exhaust gas and exhaust air discharged via one outlet with a motor-driven flap in an exhaust hood
- For more details about the DB50 debinding package see page 8

Debinding Package DB100

- Basic design for safe debinding with small amounts of binder for high-temperature furnaces from model HT 64..
- Fresh air fan and fresh air preheater
- Exhaust gas and exhaust air discharged via one outlet with a motor-driven flap in an exhaust hood
- Performance of the debinding package customized to the process requirements
- For more details about the DB100 debinding package see page 9

High-temperature furnace HT 276/18 DB200-3 with catalytic post combustion

Debinding Package DB200

- Professional solution for large amounts of binder and changing debinding processes
- Fresh air fan, fresh air preheater and monitoring of fresh air and exhaust gas flow rates
- Separate discharge of exhaust gases during debinding and exhaust air during cooling via separate outlets with motor-driven flaps
- Extendable with catalytic or thermal post combustion for a single furnace or alternating operation with two furnaces see page 12
- Performance of the debinding package customized to the process requirements
- For more details about the DB200 debinding package see page 9

High-temperature furnace HT 450/17 DB200-3 with catalytic post combustion

Additional Equipment

- With debinding package DB200: Thermal and catalytic exhaust air treatment see page 12
- Redundant thermocouples to increase process reliability
- Thermocouple to control the heating with calibration certificate
- Calibration interfaces for the measuring section
- Thermocouple exchange system for temperature measurement via thermocouple types B and S with automatic removal device for more exact control during debinding (for models from HT 160/..)
- Special heating elements e.g. for zirconia applications

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Heating power	Electrical	Weight
	°C	w	d	h	in l	W	D	H	in kW[3]	connection*	in kg
HT 16/.. DB50	1600 or 1750 or 1800	200	300	260	16	810	645	1780	12.0	3-phase[2]	280
HT 29/.. DB50		275	300	300	29	975	690	1910	9.3	3-phase[2]	390
HT 40/.. DB50		300	350	350	40	1000	750	1910	12.0	3-phase	430
HT 64/.. DB100-1		400	400	400	64	1190	870	1960	18.0	3-phase	660
HT 64/.. DB200-..		400	400	400	64	1190	870	1960	18.0	3-phase	820
HT 160/.. DB100-..		500	550	550	160	1240	995	2230	21.0	3-phase	815
HT 160/.. DB200-..		500	550	550	160	1240	995	2230	21.0	3-phase	880
HT 276/.. DB200-..		500	1000	550	276	1300	1500	2230	36.0	3-phase	1300
HT 450/.. DB200-..		500	1150	780	450	1350	1690	2500	64.0	3-phase	1450

[1]Outer dimensions vary depending on the scope of supply. Dimensions on request.
[2]Heating only between two phases
[3]Depending on furnace design connected load might be higher

*Please see page 80 for more information about supply voltage

Catalytic or thermal post combustion obtainable as an option

Preheated fresh air blown in via perforated ceramic tubes

Two-door design for high-temperature furnaces > HT 276/..

High-Temperature Top Hat Furnaces or Bottom Loading Furnaces with Molybdenum Disilicide Heating Elements and Fiber Insulation up to 1800 °C

High-temperature top hat furnaces are ideal for applications that require high temperatures, such as sintering of ceramic components. The furnace is designed so that the table can be accessed from three sides and also ensures ergonomic loading and unloading of large components. Complex structures and smaller components can also be charged safely. The furnaces can be equipped with a movable top hat or a movable table.

The basic furnace comes with one fixed table. The system can be extended with one or more changeable tables, either manually or electrically driven, for example, to achieve higher throughput. Other additional equipment, like controlled cooling systems to short process cycles or the addition of a debinding package for debinding and sintering in one process provide for tailored solution for individual needs.

Top hat furnace HT 1000/17 LT

Top hat furnace HT 750/18 LTS

Standard Equipment

- Tmax 1600 °C, 1750 °C or 1800 °C
- Recommended maximum working temperature approx. 50 °C below Tmax of the furnace. Higher working temperatures will increase wear and tear.
- Top hat furnaces: electrohydraulically driven top hat with fixed table
- Bottom loading furnaces: driven table and fixed top hat
- Two-hand operation for manual hood/table movement
- Gently running, low-vibration spindle drive or electrohydraulic drive for larger models
- Motorized hood locking securing the hood in upper position
- Safe and tight closing of the furnace by means of labyrinth seal
- Heating from all four sides provides for good temperature uniformity
- High-quality fiber insulation backed by special insulation
- Side insulation constructed with tongue and groove blocks provides for low heat dissipation to the outside
- Long-life, robust roof insulation with special suspension
- Furnace table with special bottom reinforcement to accommodate high charge weights (distributed load 5 kg/dm^2)
- Motorized exhaust air flap in the furnace roof, controlled via the extra function of the controller
- Heating elements switched via SCR‘s
- Controller with touch operation P570 (50 programs with each 40 segments), controls description see page 76
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive see page 82
- Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC see page 82
- Freeware NTGraph for evaluation and documention of firings using Excel™ for Windows™ on the PC see page 82
- MyNabertherm App for online monitoring of the firing on mobile devices for free download see page 78

High-temperature bottom loading furnace
HT 166/16 LB DB200-3S

Additional Equipment

- Cooling system to cool the furnace with a defined temperature gradient or with a preset fresh air volume. Both operating modes can be switched on and off for different segments by means of the extra function of the controller.
- Stainless steel exhaust hood as interface to customer's exhaust system
- Customer-specific arrangement of the heating elements to optimize temperature uniformity, for example, with heating elements between the charge stacks
- Special heating element qualities e.g. for zirconoxide applications
- Thermoelement for the heating control with calibration certificate
- Protective gas connection for purging the furnace with non-flammable process gases (not completely gas-tight)
- Automatic gas supply system with solenoid valve and rotameter, controlled by the extra function of the controller
- Bottom insulation made of durable lightweight refractory bricks for especially heavy charge weights (Tmax 1650 °C)
- Options for table exchange systems:
  - Manual or automatic table exchange system with one or two tables
  - Multi-table exchange system with tables transportable by fork lift
- An electric mover ensures smooth movement of the freemoving table
- Process control and documentation via VCD software package for monitoring, documentation and control see page 83

Top hat furnace HT 558/18 LT

High-temperature top hat furnace HT 1030/16 LT

High-temperature top hat furnace HT 230/17 LT with driven hood

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Heating power	Electrical	Weight
	°C	w	d	h	in l	W	D	H	in kW[2]	connection*	in kg
HT 64/16 LB, LT	1600	400	400	400	64	1100	1750	2400	36	3-phase	1100
HT 166/16 LB, LT	1600	550	550	550	166	1350	2060	2600	42	3-phase	1500
HT 276/16 LB, LT	1600	1000	500	550	276	1800	2100	2600	69	3-phase	1850
HT 400/16 LB, LT	1600	1200	600	550	400	1900	2200	2680	69	3-phase	2600
HT 500/16 LB, LT	1600	1550	600	550	500	2100	2200	2680	69	3-phase	2700
HT 1000/16 LB, LT	1600	1000	1000	1000	1000	1800	2900	4000	140	3-phase	3000
HT 1030/16 LB, LT	1600	2200	600	780	1030	2950	2500	3050	160	3-phase	3200
HT 64/17 LB, LT	1750	400	400	400	64	1100	1750	2400	36	3-phase	1100
HT 166/17 LB, LT	1750	550	550	550	166	1350	2060	2600	42	3-phase	1500
HT 276/17 LB, LT	1750	1000	500	550	276	1800	2100	2600	69	3-phase	1850
HT 400/17 LB, LT	1750	1200	600	550	400	1900	2200	2680	69	3-phase	2600
HT 500/17 LB, LT	1750	1550	600	550	500	2100	2200	2680	69	3-phase	2700
HT 1000/17 LB, LT	1750	1000	1000	1000	1000	1800	2900	4000	140	3-phase	3000
HT 1030/17 LB, LT	1750	2200	600	780	1030	2950	2500	3050	160	3-phase	3200
HT 64/18 LB, LT	1800	400	400	400	64	1100	1750	2400	36	3-phase	1100
HT 166/18 LB, LT	1800	550	550	550	166	1350	2060	2600	42	3-phase	1500
HT 276/18 LB, LT	1800	1000	500	550	276	1800	2100	2600	69	3-phase	1850
HT 400/18 LB, LT	1800	1200	600	550	400	1900	2200	2680	69	3-phase	2600
HT 500/18 LB, LT	1800	1550	600	550	500	2100	2200	2680	69	3-phase	2700
HT 1000/18 LB, LT	1800	1000	1000	1000	1000	1800	2900	4000	140	3-phase	3000
HT 1030/18 LB, LT	1800	2200	600	780	1030	2950	2500	3050	160	3-phase	3200

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request
[2]Depending on furnace design connected load might be higher

*Please see page 80 for more information about supply voltage

Motorized hood lock

Two-hand operation

Automatic gas supply system

High-temperature top hat furnace HT 550/17 LT with manual interchangeable table system including rail system and second table for optimized loading and unloading

High-temperature top hat furnace
HT 1700/17 LT DB200-5 for debinding and sintering ceramic powders

Combi-High-Temperature Top Hat Furnaces or Bottom Loading Furnaces with Molybdenum Disilicide Heating Elements up to 1800 °C for Debinding and Sintering in One Process

The combi high-temperature top hat and bottom loading furnaces are designed for debinding and sintering in one process with sintering temperatures up to 1750 °C. Equipped with a passive safety system, all functions relevant for debinding processes are monitored to ensure safe operation of the furnace. Also as part of the safety package, the furnace atmosphere is diluted with fresh air to prevent forming of a combustible atmosphere by the exhaust gases evaporating from the charge during debinding.

In the basic design, the DB100 debinding package is available for the top hat and bottom loading furnaces. With this debinding package, preheated fresh air is blown in and the furnace is operated with overpressure during the debinding phase.

The DB200 debinding package is recommended as a solution for production. With this safety system, the furnace has a fresh air preheater and the preheated air is blown into the furnace through perforated air inlet tubes. During debinding, the exhaust gases are discharged from the furnace via a separate outlet with exhaust gas fan. The volume flows of fresh air and exhaust gas are controlled so that a slight negative pressure is always maintained in the furnace chamber during debinding.

High-temperature top hat furnace HT 1700/17 LT DB200-5, for debinding and sintering ceramic powders

Standard Design

Like high-temperature top hat and bottom loading furnaces HT .. LB/LT (see page 40), however:

- Motor-driven exhaust air flap in the furnace roof
- Stainless steel exhaust hood as interface to the customer's extraction system (DB200 option: separate removal of exhaust gases during debinding)
- HiProSystems H1700, including Siemens PLC control system and 7" touchpanel as operating interface see page 84

High-temperature top hat furnace HT 2600/16 LT DB200 for production

Debinding Package DB100

- Basic model for safe debinding with small amounts of binder
- Fresh air fan and fresh air preheater
- Exhaust gas and exhaust air discharged via one outlet with a motor-driven flap in an exhaust hood
- Performance of the debinding package customized to the process requirements
- For more details about the DB100 debinding package see page 9

High-temperature bottom loading furnace HT 166/17 LB DB200-3 with catalytic post combustion system

Debinding Package DB200

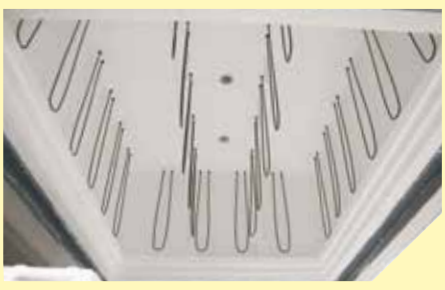
- Professional solution for large amounts of binder and changing debinding processes in everyday production
- Fresh air fan, fresh air preheater and monitoring of fresh air and exhaust gas flow rates
- Separate discharge of exhaust gases during debinding and exhaust air during cooling via separate outlets with motor-driven flaps
- Extendable with catalytic or thermal post combustion for a single furnace or alternating operation with two furnaces see page 12
- Performance of the debinding package customized to the process requirements
- For more details about the DB200 debinding package see page 9

High-temperature top hat furnace HT 400/17 LT DB200-4 with roller doors for automatic table exchange

Additional Equipment

- With debinding package DB200: Thermal and catalytic exhaust air treatment see page 12
- Redundant thermocouples to increase process reliability
- Calibration interfaces for the measuring section
- Interchangeable table options:
  - Manual or automatic interchangeable table system with one or two tables
  - Multiple table system for loading with a forklift truck
- Thermocouple exchange device for temperature measurement via thermocouple types B and S with automatic removal device for more exact control during debinding (for models from HT 160/..)

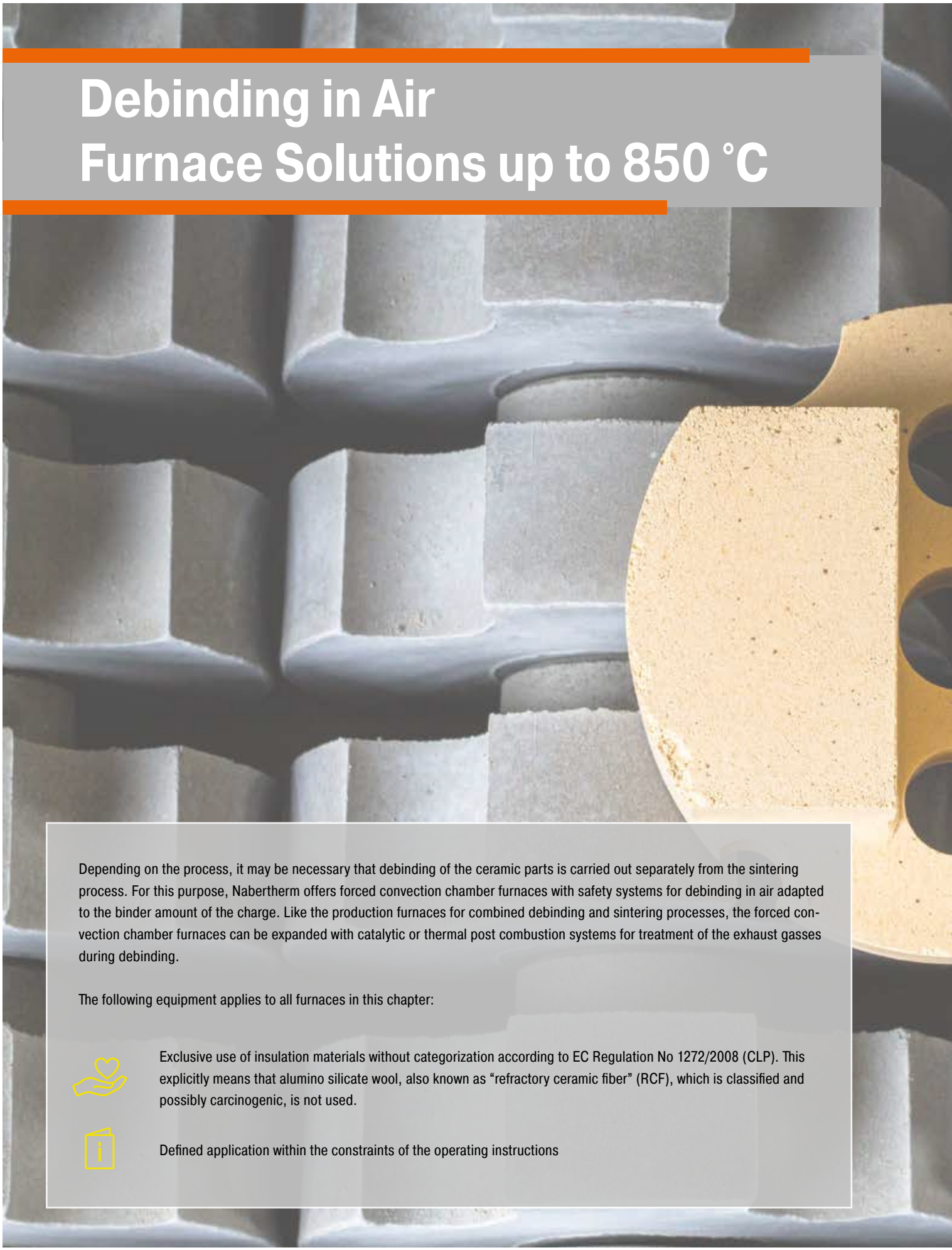
Safety zone protected with roller doors and safety barrier



Heat from all sides and between the stack to optimize temperature uniformity

Table with drive and sensor grips for precise movement with no effort

Debinding in Air
Furnace Solutions up to 850 °C

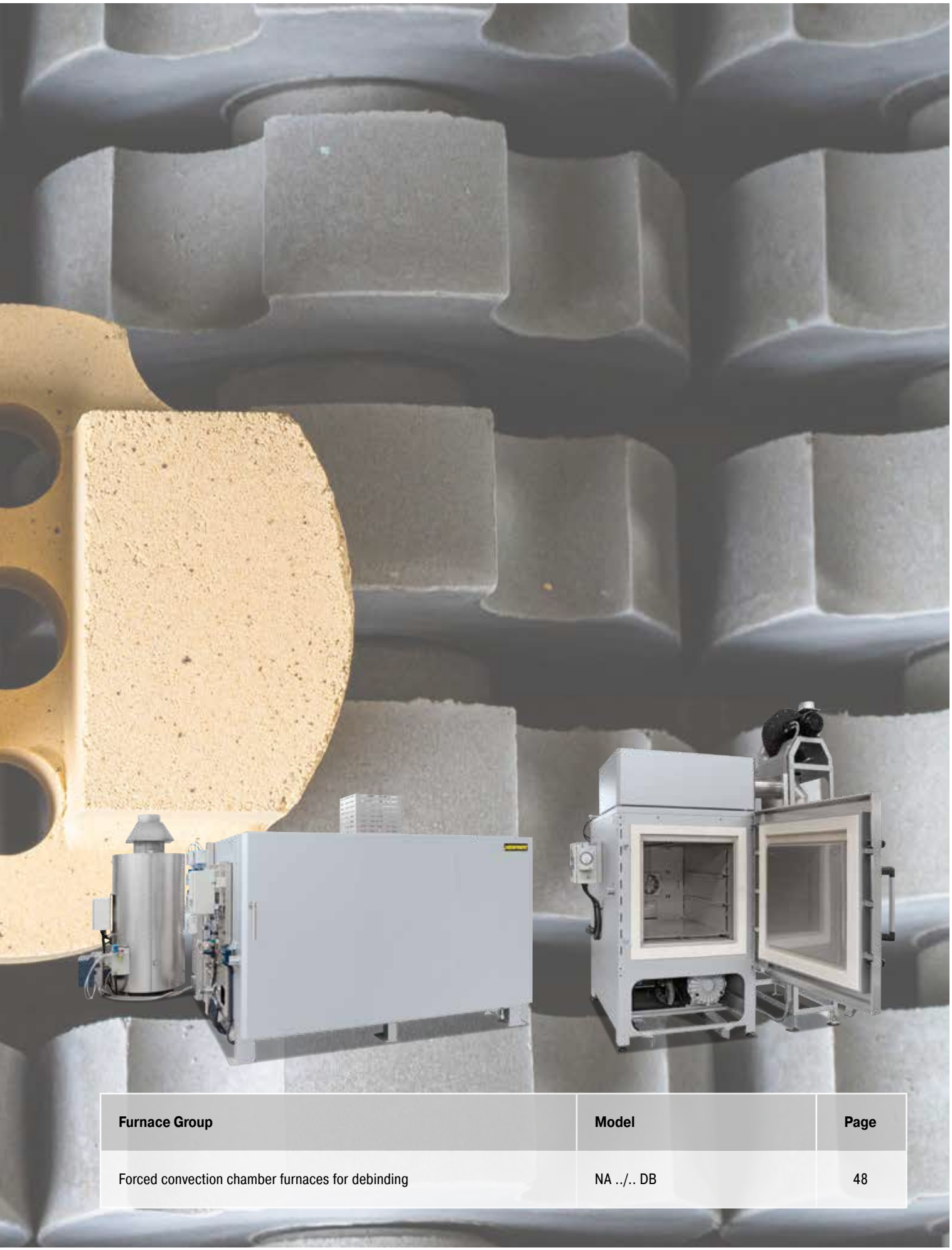


Depending on the process, it may be necessary that debinding of the ceramic parts is carried out separately from the sintering process. For this purpose, Nabertherm offers forced convection chamber furnaces with safety systems for debinding in air adapted to the binder amount of the charge. Like the production furnaces for combined debinding and sintering processes, the forced convection chamber furnaces can be expanded with catalytic or thermal post combustion systems for treatment of the exhaust gasses during debinding.

The following equipment applies to all furnaces in this chapter:

Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.

Defined application within the constraints of the operating instructions



Furnace Group	Model	Page
Forced convection chamber furnaces for debinding	NA ../.. DB	48

Forced Convection Chamber Furnaces up to 850 °C for Debinding

Forced convection chamber furnaces equipped with a passive safety system are suitable for pure debinding processes. With their air circulation, these furnaces provide very good temperature uniformity and very good heat transfer into the product. Equipped with the DB200 debinding package, the furnaces have a fresh air fan which supplies preheated fresh air into the furnace chamber. The PLC control system monitors all functions which are relevant for debinding to protect the operator and the surrounding. In addition, a slight underpressure is ensured in the furnace via an exhaust gas fan with variable speed, so that the exhaust gases are actively removed from the furnace during debinding. Consequently, the forced convection chamber furnaces can be used flexibly for various applications from development through to production.

Forced convection chamber furnace NA 500/85 DB200-3 with safety package for debinding in air and thermal post combustion

Standard Design

- Tmax 600 °C, 650 °C or 850 °C
- Temperature uniformity according to DIN 17052-1 to +/- 5 °C see page 89
- Optimum air distribution ensured with high flow rates
- Double door from an interior width of 1500 mm and above (450 °C models), higher temperatures and smaller sizes are equipped with a single, right-hinged door
- Motor-driven exhaust air flaps in the furnace roof for separate discharge of the exhaust gases during debinding and the exhaust air during cooling (850 °C models with stainless steel exhaust hood)
- Over-temperature limiter with manual reset as over-temperature protection for the furnace and the charge
- Debinding package DB200
  - Professional solution for large amounts of binder and changing debinding processes
  - Fresh air fan, fresh air preheater and monitoring of fresh air and exhaust gas flow rates
  - Separate discharge of exhaust gases during debinding and exhaust air during cooling via separate outlets with motor-driven flaps
  - Extendable with catalytic or thermal post combustion for a single furnace or alternating operation with two furnaces see page 12
  - Performance of the debinding package customized to the process requirements
  - For more details about the DB200 debinding package see page 9

Production plant with three forced convection chamber furnaces NA 250/85 DB200 for debinding and catalytic post combustion system KNV 320 (reduced footprint construction)

Additional Equipment

- Temperature distribution measurement
- Thermal and catalytic exhaust air treatment see page 12
- Redundant thermocouples to increase process reliability
- Calibration interfaces for the measuring section
- Design for processes in low-dust atmospheres
- Other/customized furnace sizes on request

Forced convection chamber furnace NAC 250/65 DB200-3 with safety package for debinding in air in a low-dust atmosphere and catalytic post combustion

Forced convection chamber furnace NA 4000/60B DB200 for debinding in air with gas-fired thermal post combustion system TNV 300

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Electrical
	°C	w	d	h	in l	W	D	H[2]	connection*
NA 120/65 DB200	650	450	600	450	120	990	1470	2215	3-phase
NA 250/65 DB200	650	600	750	600	250	1170	1650	2550	3-phase
NA 500/65 DB200	650	750	1000	750	500	1290	1890	2600	3-phase
NA 120/85 DB200	850	450	600	450	120	885	1420	2215	3-phase
NA 250/85 DB200	850	600	750	600	250	1115	1685	2250	3-phase
NA 500/85 DB200	850	750	1000	750	500	1290	1890	2600	3-phase
NA 1000/60 DB200	600	1000	1000	1000	1000	2015	2150	2415	3-phase
NA 1500/60B DB200	600	1500	1000	1000	1500	2015	2650	2450	3-phase

[1]Outer dimensions vary depending on the scope of supply. Dimensions on request.
[2]Height including exhaust gas fan

*Please see page 80 for more information about supply voltage

Thermal post combustion

Customized charging rack on request

Optional design with lift door for furnaces up to 500 liters

Debinding and Sintering in Air
Furnace Solutions for Laboratory Applications

In the context of R&D applications for technical ceramics, the heat treatment processes are often defined with small quantities. Such activities requiring furnace solutions that enable safe debinding processes. With the LH chamber furnaces equipped with the debinding package DB50, Nabertherm offers a smart and cost-effective solution for corresponding applications, which also meets the requirements for good temperature uniformity in the sintering phase.

The following equipment applies to all furnaces in this chapter:

- Dual shell ventilated housing made of textured stainless steel sheets for low surface temperature and high stability
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- Defined application within the constraints of the operating instructions
- Controller with intuitive touch operation
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC
- Freeware NTGraph for evaluation and documention of firings using Excel™ for Windows™ on the PC
- MyNabertherm App for online monitoring of the firing on mobile devices for free download
- As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control

Furnace Group	Model	Page
Chamber furnaces with brick insulation or fiber insulation	LH .., LF ..	52

Chamber Furnaces with Brick Insulation or Fiber Insulation

In the standard version, the LH .. and LF .. models are designed for sintering processes in air. For debinding and sintering processes on a laboratory scale, these furnaces can be equipped with the DB50 laboratory version designed for low evaporation rates. By introducing fresh air, the furnace is operated with overpressure during the debinding phase.

Chamber furnace LH 216/12 with fresh air fan to accelerate the cooling times

Standard Equipment

- Tmax 1200 °C, 1300 °C, or 1400 °C
- High furnace chamber with five-sided heating for very good temperature uniformity
- Heating elements on support tubes ensure free heat radiation and a long service life
- Controller mounted on furnace door and removable for comfortable operation
- Protection of bottom heating and flat stacking surface provided by embedded SiC plate in the floor
- LH models: multi-layered insulation of light refractory bricks and special backup insulation
- LF models: high-quality fiber insulation with corner bricks for shorter heating and cooling times
- Motorized exhaust air flap
- Freely adjustable air inlet integrated in furnace floor
- Base included
- Controller with touch operation B500 (5 prgrams with each 4 segments), alternative controllers see page 76

Debinding Package DB50

- Laboratory version for applications with low evaporation rates for chamber furnaces LH 30/.. to LH 120/..
- Fresh air fan for introducing a defined amount of fresh air
- Exhaust gas and exhaust air discharged via one outlet with a motor-driven flap in an exhaust hood
- Further details about the debinding package DB50 see page 8

LH 60/13 DB50 for debinding in air

Additional Equipment

- Parallel swinging door (user protected from heat radiation)
- Lift door with electro-mechanic linear drive for opening when hot
- Cooling system to cool the furnace with a defined temperature gradient or with a preset fresh air volume. Both operating modes can be switched on and off for different segments by means of the extra function of the controller.
- Protective gas connection to purge with non-flammable process gases
- Manual or automatic gas supply system
- Stainless steel exhaust hood as interface to customer's exhaust system

Chamber furnace LH 30/12 with manual lift door

Chamber furnace LF 60/14

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Connected	Electrical	Weight
	in °C	w	d	h	in l	W	D	H	load in kW	connection*	in kg
LH 15/12	1200	250	250	250	15	680	860	1230	5	3-phase[2]	170
LH 30/12	1200	320	320	320	30	710	930	1290	7	3-phase[2]	200
LH 60/12	1200	400	400	400	60	790	1180	1370	8	3-phase	300
LH 120/12	1200	500	500	500	120	890	1180	1470	12	3-phase	410
LH 216/12	1200	600	600	600	216	990	1280	1590	20	3-phase	470
LH 15/13	1300	250	250	250	15	680	860	1230	7	3-phase[2]	170
LH 30/13	1300	320	320	320	30	710	930	1290	8	3-phase[2]	200
LH 60/13	1300	400	400	400	60	790	1180	1370	11	3-phase	300
LH 120/13	1300	500	500	500	120	890	1180	1470	15	3-phase	410
LH 216/13	1300	600	600	600	216	990	1280	1590	22	3-phase	470
LH 15/14	1400	250	250	250	15	680	860	1230	8	3-phase[2]	170
LH 30/14	1400	320	320	320	30	710	930	1290	10	3-phase[2]	200
LH 60/14	1400	400	400	400	60	790	1180	1370	12	3-phase	300
LH 120/14	1400	500	500	500	120	890	1180	1470	18	3-phase	410
LH 216/14	1400	600	600	600	216	990	1280	1590	26	3-phase	470
LF 15/13	1300	250	250	250	15	680	860	1230	7	3-phase[2]	150
LF 30/13	1300	320	320	320	30	710	930	1290	8	3-phase[2]	180
LF 60/13	1300	400	400	400	60	790	1180	1370	11	3-phase	270
LF 120/13	1300	500	500	500	120	890	1180	1470	15	3-phase	370
LF 15/14	1400	250	250	250	15	680	860	1230	8	3-phase[2]	150
LF 30/14	1400	320	320	320	30	710	930	1290	10	3-phase[2]	180
LF 60/14	1400	400	400	400	60	790	1180	1370	12	3-phase	270
LF 120/14	1400	500	500	500	120	890	1180	1470	18	3-phase	370

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[2]Heating only between two phases

*Please see page 80 for more information about supply voltage

Parallel swinging door for opening when hot

Model with brick base

LF furnace design provides for shorter heating and cooling times

Thermal Cleaning, Ashing

Processes such as food ashing, the thermal cleaning of injection molding tools or the determination of ignition loss require furnace systems that enable safe process control. Depending on the charge weight, Nabertherm offers solutions that can be used for laboratory applications up to processes with high organic quantities or high evaporation rates. The L .. BO ashing furnaces and the LHT 08/17 BO are also suitable for debinding and sintering processes for 3D-printed ceramic parts.

The following equipment applies to all furnaces in this chapter:

- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- Defined application within the constraints of the operating instructions
- Controller with intuitive touch operation
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC
- Freeware NTGraph for evaluation and documention of firings using Excel™ for Windows™ on the PC
- MyNabertherm App for online monitoring of the firing on mobile devices for free download
- As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control

Furnace Group	Model	Page
Ashing furnaces L .. BO up to 1100 °C with integrated catalytic post combustion	L .. BO	56
Combi-high-temperature furnace LHT 08/17 BO up to 1750 °C with integrated catalytic post combustion	LHT .. BO	57
Chamber furnaces N(B) .. BO for processes with high evaporation rates of organics or for thermal cleaning by incineration	N .. BO, NB .. BO	58

Ashing Furnaces L ../11 BO up to 1100 °C with Integrated Catalytic Post Combustion

The ashing furnaces L ../11 BO are specially designed for processes in which organic substances have to be evaporated from the charge, as e. g. during debinding of small ceramic products after additive manufacturing. Other processes, for which this furnace series is designed for, are for example, ashing of (food) samples, thermal cleaning of injection molding tools or loss on ignition determination.

The ashing furnaces therefore have a passive safety system and integrated exhaust gas post combustion. An exhaust gas fan extracts the exhaust gases from the furnace and simultaneously supplies fresh air to the furnace atmosphere with the result that sufficient oxygen is always available for the process. The incoming air is guided behind the furnace heating and preheated to ensure good temperature uniformity. Exhaust gases are directly led from the furnace chamber to the integrated post combustion system, where they are burned and catalytically cleaned. After the debinding/ashing process (up to max. 600 °C), a sintering process up to max. 1100 °C can be performed.

Ashing furnace L 40/11 BO

Standard Equipment

- Tmax 600 °C for the incineration process
- Tmax 1100 °C for the subsequent process
- Three-side heating (both sides and bottom)
- Ceramic heating plates with embedded heating wire
- Steel collecting pan protects the bottom insulation
- Spring-assisted closing of the furnace door (flap door) with mechanical locking against unintentional opening
- Thermal/catalytic post combustion, integrated in the exhaust channel, up to 600 °C in function
- Temperature control of post combustion can be set up to 850 °C
- Monitored exhaust air
- Inlet-air preheated through the bottom heating plate
- Controller with touch operation C550 (10 programs with each 20 segments), alternative controllers see page 76

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[2] in mm			Max. loading weight of organic substances	Max. evaporation rate of organic substances	Connected load	Electrical	Weight
	in °C[1]	w	d	h	in l	W	D	H[3]	in g	g/min	in kW	connection*	in kg
L 9/11 BO	1100	230	240	170	9	415	575	750	75	1.0	7.0	3-phase	60
L 24/11 BO	1100	280	340	250	24	490	675	800	150	2.0	9.0	3-phase	90
L 40/11 BO	1100	320	490	250	40	530	825	800	200	2.1	11.5	3-phase	110

[1]Recommended working temperature for processes with longer dwell times is 1000 °C
[2]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[3]Including exhaust tube (Ø 80 mm)

*Please see page 80 for more information about supply voltage

Ashing furnace L 9/11 BO

Steel collecting pan protects the bottom insulation

Schematic presentation of air circulation in ashing furnace L 24/11 BO

Combi High-Temperature Furnace LHT 08/17 BO up to 1750 °C with Integrated Catalytic Post Combustion

The combi furnace LHT 08/17 BO complements the muffle furnaces L ../11 BO (see page 56) and provides a solution for debinding/ashing processes up to 600 °C with subsequent sintering processes at high temperatures. Specified with a maximum temperature of 1750 °C, the LHT 08/17 BO can be used for process temperatures up to 1700 °C. The compact size of the furnace makes it ideal for research and development applications but also for debinding and sintering of small additively manufactured components. The furnace can also be used to determine loss on ignition where, after the ashing process, the samples must be treated at temperatures above 1050 °C.

The combi furnace LHT 08/17 BO has a passive safety system with integrated exhaust gas post combustion. Fresh air is fed through the back of the furnace via an exhaust gas fan so that there is always sufficient oxygen available for the process. The incoming air is guided past the furnace heating and preheated which ensures good temperature uniformity. At the same time, exhaust gases are extracted from the furnace to the integrated post combustion system, where they are incinerated and catalytically cleaned.

Combi furnace LHT 08/17 BO

Standard Design

- Tmax 1750 °C
- Tmax 600 °C for the debinding/ashing process
- Recommended maximum working temperature approx. 50 °C below Tmax of the furnace. Higher working temperatures will increase wear and tear.
- Heating from two sides
- Spring-supported door closing (lift door) with mechanical lock to prevent unintended opening
- Thermal/catalytic post combustion in the exhaust air duct, to max. 600 °C furnace temperature in operation
- Temperature control of post combustion adjustable to 850 °C
- Fresh air preheated by additional heating element on the back wall of the furnace chamber
- Controller with touch operation P570 (50 programs each with 40 segments), for a description of the controls see page 76

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[2] in mm			Max. loading weight of organic substances	Max. evaporation rate of organic substances	Connected load	Electrical	Weight
	in °C[1]	w	d	h	in l	W	D	H[3]	in g	g/min	in kW	connection*	in kg
LHT 08/17 BO	1750	150	250	150	6	530	705	690	75	1	11	3-phase	90

[1]Tmax 600 °C für den Entbinderungs-/Veraschungsprozess
[2]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[3]Including exhaust tube (Ø 80 mm)

*Please see page 80 for more information about supply voltage

Combi furnace LHT 08/17 BO

High-temperature heating in furnace chamber

Schematic representation of the air flow in combi furnace LHT 08/17 BO

Chamber Furnaces N(B) .. BO for Processes with High Evaporation Rates of Organics or for Thermal Cleaning by Incineration

The chamber furnaces of the series N .. BO (electrically heated) and NB .. BO (gas-fired) are designed for thermal treatment of products that release flammable gas mixtures when heated or that are themselves flammable but are not damaged by an uncontrolled rise in temperature that may occur during the process. Processes where the product or impurities are incinerated by ignition can also be carried out safely in these chamber furnaces.

Examples include residual dewaxing of molds or thermal treatment of catalytic converters to remove soot or fuel residues. Undesired organic components can be incinerated at temperatures up to 800 °C. The introduction of volatile organic compounds, such as solvents or substances that form flammable atmospheres below 80 °C is not permitted. Nabertherm offers other furnace concepts for the respective processes and will be happy to advise you.

The chamber furnaces are electrically heated or gas-fired. As an element of the safety system, the furnace chamber is constantly purged with fresh air during the process. The occurring exhaust gases are removed from the furnace via an exhaust air outlet with motor-driven flap. To ensure safe operation, the furnace door is locked when the program is started and can be opened only when the temperature has fallen below a defined value at the end of the process. The electrically heated chamber furnaces N .. BO are recommended for processes that rely on good temperature control via the heating program. For safety reasons, the furnace is then equipped with an integrated pilot burner to ignite the flammable components in the furnace atmosphere. This prevents an accumulation of flammable components and enables safe burning.

In gas-fired furnaces, this task is performed by the gas burner. In case of burner malfunctions or gas shortage the process is stopped. The gas-fired chamber furnaces NB .. BO, where the burner flame is directly in the furnace chamber, are suitable for simple burn-out or ashing processes where temperature accuracy is not an important aspect.

Electrically heated chamber furnace N 300 BO

Standard Design

- Tmax 1000 °C
- Electrically heated or gas-fired
- 300 liters or 650 liters furnace chamber, other sizes on request
- Stainless steel exhaust flue
- Automatic temperature control
- Passive safety system BO (see page 11) with
  - monitored gas-fired pilot flame (natural gas or LPG)
  - Monitored fresh air
- Fresh air fan to dilute the furnace atmosphere during burn-off and for cooling after the process
- Switchgear mounted on the side of the furnace or alternatively installed in a separate upright cabinet (depending on furnace model)
- HiProSystems H1700, including Siemens PLC control system and 7” touchpanel as operating interface see page 84

Additional Equipment

- Thermal post combustion (integrated in the furnace or stand-alone) see page 13

Gas-fired chamber furnace NB 650 BO with integrated thermal post combustion

Gas-fired bogie hearth furnace WB 6200/12 BO with lift door and manually movable bogie

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Max. loading weight of organic substances	Output burner in
	°C	w	d	h	in l	W	D	H	in g	kW[2]
N 300 BO	1000	550	700	780	300	1350	1450	1750	2000	20
NB 300 BO	1000	550	700	780	300	1250	1650	1850	2500	60
N 650 BO	1000	700	850	1100	650	1700	1900	2350	3000	60
NB 650 BO	1000	700	850	1100	650	1600	2100	2450	3500	135

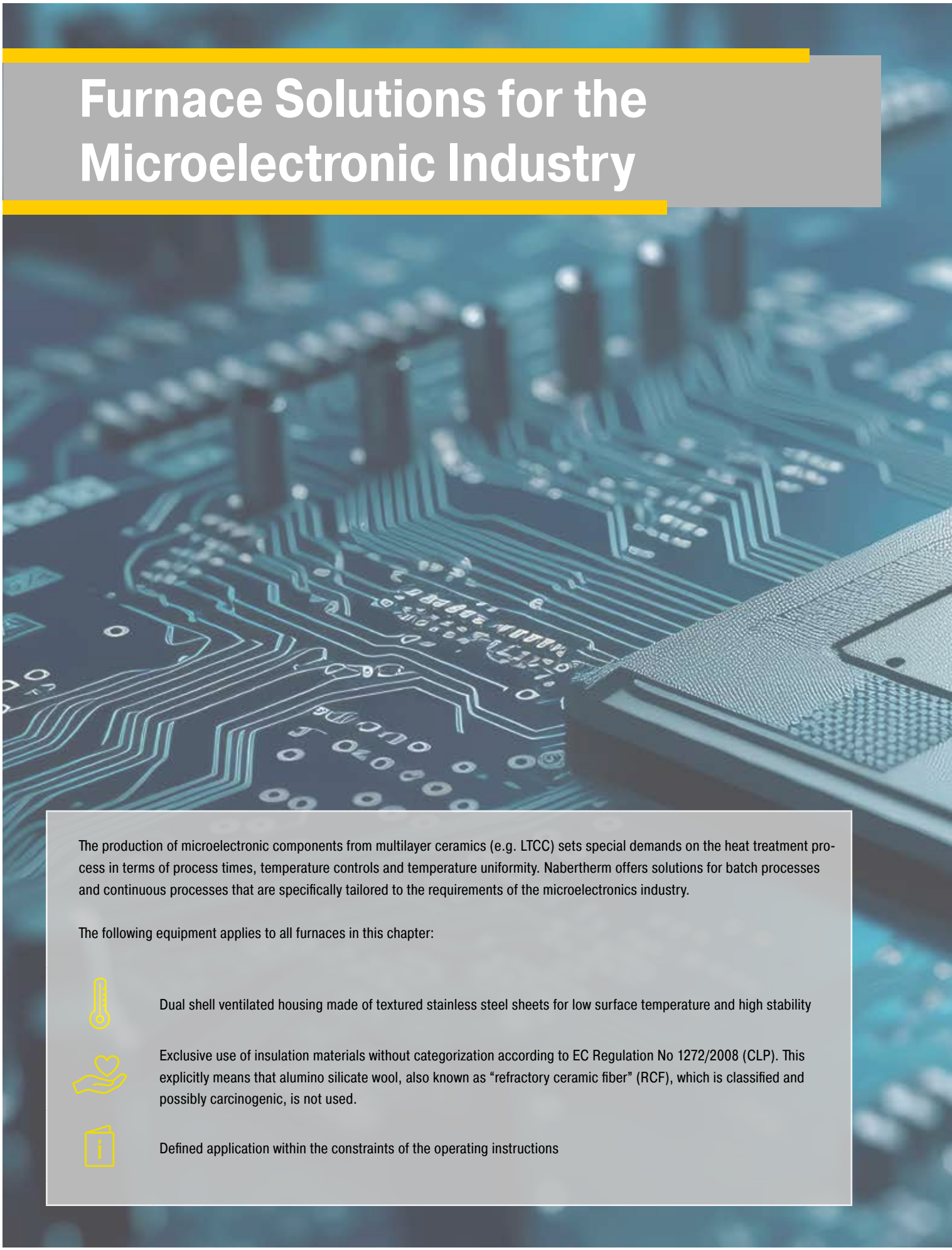
[1]Outer dimensions vary depending on the scope of supply. Dimensions on request.
[2]Depending on furnace design connected load might be higher

Furnace chamber N 300 BO with gas-operated pilot flame and electric furnace heating

Furnace chamber NB 650 BO with gas-fired furnace heating

Schematic representation of the air flow in the chamber furnace N(B) .. BO

Furnace Solutions for the Microelectronic Industry



The production of microelectronic components from multilayer ceramics (e.g. LTCC) sets special demands on the heat treatment process in terms of process times, temperature controls and temperature uniformity. Nabertherm offers solutions for batch processes and continuous processes that are specifically tailored to the requirements of the microelectronics industry.

The following equipment applies to all furnaces in this chapter:

- Dual shell ventilated housing made of textured stainless steel sheets for low surface temperature and high stability
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- Defined application within the constraints of the operating instructions

Furnace Group	Model	Page
Bottom loading furnace for LTCC applications	HF ..	62
Continuous furnace for burn-out and firing/sintering	DF ..	64

Bottom Loading Furnace for LTCC Applications

The bottom loading furnace HF 450/10 LB DB200-2 was developed especially for debinding and sintering of LTCC (low temperature co-fired ceramics). The insulation of the furnace hood with high-quality fiber material makes fast process cycles possible. Multi-zone heating (side bottom, side middle and side top) ensures precise temperature control and optimum temperature uniformity in the workspace.

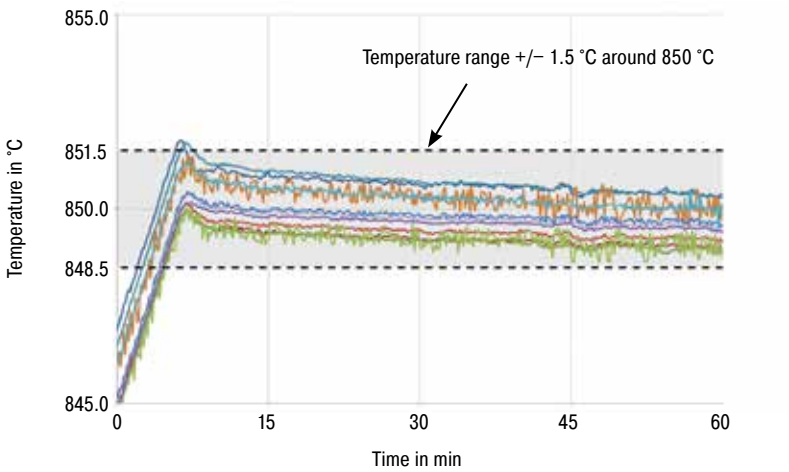
During the debinding phase, a fresh air fan supplies preheated fresh air into the furnace; the preheated air is distributed evenly throughout the chamber by perforated air inlet tubes on the side walls. This results in good heat transfer and improved temperature uniformity during the debinding process. In addition, the passive safety system DB200 reliably removes the exhaust gases from the furnace chamber by means of an exhaust gas fan. An independently adjustable gas inlet with gas injection system for clean and dry air allows the atmosphere to be adjusted during the sintering process above 600 °C. All process parameters, including temperature ramps and hold times, can be programmed.

Bottom loading furnace HF 450/10 LB DB200-2 with optional table that can be pulled out to the front for optimized loading and unloading

Standard Design

- Tmax 1000 °C
- Passive safety system for debinding in air to 600 °C at max. 8 g/min
- Temperature uniformity in empty furnace according to DIN 17052-1 see page 89
  - +/– 4 °C at 850 °C for workspace 1
  - +/– 1.5 °C at 850 °C for workspace 2
- Workspace 1 (maximum dimensions): 500 x 500 x 500 mm (w x d x h)
- Workspace 2 (reduced workspace for optimized temperature uniformity): 400 x 400 x 400 mm (w x d x h)
- Electrically driven table with fixed hood
- HiProSystems H1700, including Siemens PLC control system and 7" touchpanel as operating interface see page 84

Schematic diagram of workspace 2



Measurement of temperature uniformity with 11 measuring points in empty workspace 2 (400 x 400 x 400 mm)

Bottom loading furnace HF 450/10 LB DB200-2

Additional Equipment

- Catalytic post combustion to clean exhaust gases during debinding see page 12
- Connection box and thermocouple feed-through in the furnace table for additional documentation thermocouples
- Control, visualization and documentation via Nabertherm Control Center (NCC) see page 86

Model	Tmax	Inner dimensions in mm			Volume in	Outer dimensions[1] in mm			Temperature uniformity of +/– 5K in the empty workspace			Heating power[2] in
	°C	w	d	h	l	W	D	H	w	d	h	kW
HF 450/10 LB DB200-2	1000	750	750	800	450	1850	1700	2700	400	400	400	54

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[2]Depending on furnace design connected load might be higher

Air injection tubes for an even supply of fresh air during debinding

Thermocouple connection box as additional equipment

Catalytic post combustion to clean the exhaust air as additional equipment

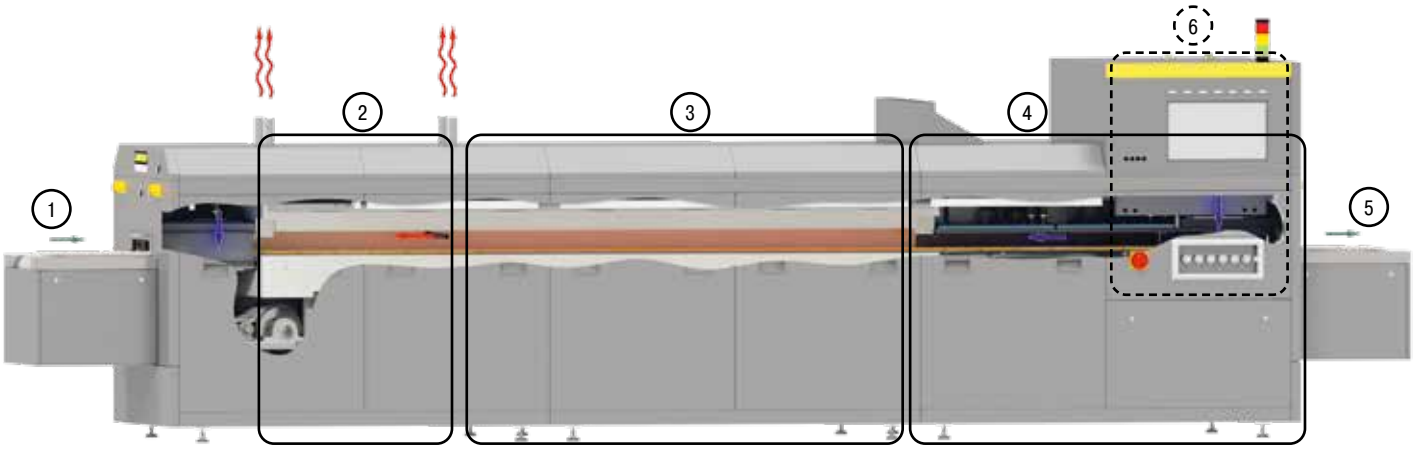
Continuous Furnace for Burn-Out and Firing/Sintering

The continuous furnaces of the DF series are designed for continuous processes in air and are therefore suitable for thick-film applications and LTCC firing processes. The product (usually charged on a carrier plate) is moved through the furnace on a metal belt, loading and unloading takes place at approx. 500 mm long entry and exit zones in front of and behind the furnace.

The temperature curve for the process can be adjusted to suit product requirements via the several control zones located one behind the other and via the belt speed (adjustable between approx. 20 - 300 mm/min). The maximum working temperature (peak temperature) can be up to 1050 °C. The temperature uniformity across the belt is crucial for the product quality, the uniformity across the belt is specified with +/– 2K in the empty furnace.

The schematic diagram shows the DF furnace in detail:
In the loading area [1], the charge is positioned on the metal belt and conveyed into the first furnace zone (burn-out zone, [2]) to evaporate the binders from the charge. In this zone, clean dry air (CDA) is injected in counterflow to the belt movement to prevent the formation of an explosive atmosphere. This also means that the exhaust gases are optimally removed from the furnace via appropriate outlets in the furnace ceiling. After the subsequent sintering zone [3], the charge is cooled down by indirect water cooling [4] so that it can be removed at the furnace exit [5].

The furnace series is designed to meet the high requirements of the electronics industry and modern production. The Nabertherm Control Center is therefore already included as standard for control, visualization and documentation (specifically designed for continuous processes). Since a compact design is crucial for these furnaces, the operator interface, all control elements and the switchgear are completely integrated into the furnace housing [6], so that no additional components need to be set up.



Schematic diagram of the continuous furnace DF 36/320/5/10 W
1 Loading area
2 Burn-out zone
3 Sintering zone
4 Cooling zones
5 Furnace exit
6 Controls and switchgear

Direction of metal belt movement
Direction of process gas flow
Exhaust air/exhaust gas

Model	Tmax °C	Belt width in mm	Heated length in mm	Number of heating zones	Heating power[1] in kW
DF 23/244/5/10 WK	1050	225	2440	8	32
DF 36/320/5/10 WK	1050	360	3200	7	47
DF 64/320/5/10 WK	1050	630	3200	7	82

[1]Depending on furnace design connected load might be higher

Continuous furnace DF 36/320/5/10 WK for the microelectronics industry with integrated user interface and switchgear

User Interface and unloading zone

Standard Design

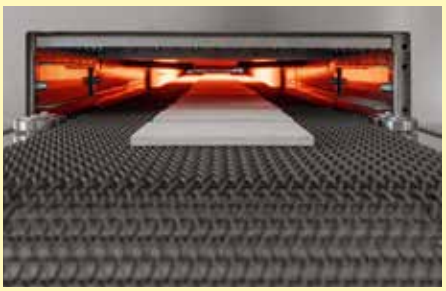
- Tmax 1050 °C
- Temperature uniformity across the belt width +/– 2 °C see page 89
- Metal belt with adjustable speed (20 - 300 mm/min)
- Maximum charging weight 20 kg/m²
- Charging length 500 mm
- Workspace height 50 mm
- Independent over-temperature protection monitoring for each heating zone
- Three process zones: Burn-out, sintering and cooling
- Passive safety system for debinding in the burn-out zone of the furnace
- Indirect water cooling in cooling zone
- Operator interface integrated in the housing, control and documentation via Nabertherm Control Center (NCC) for continuous processes see page 86

Additional Equipment

- Customized design (e.g. special dimensions, number of heating zones, belt design, increased Tmax, cooling system)
- Ultrasonic cleaning of the belt
- Catalytic post combustion to clean the exhaust gases from the burn-out zone see page12
- Gassing with non-flammable process gasses
- Stainless steel muffle for minimizing of possible insulation dust and for processes under protective gas atmospheres

Adjustable gas injection for clean, dry air (CDA). Can be locked to increase process safety

Display of all settable values via NCC (e.g. temperature monitoring for heating zones, flow rates of gassing)



Belt speed controlled and settable via NCC

Furnaces for Special Applications

For special applications, such as dewaxing, sintering of large or heavy components, or sintering ceramics in a reducing atmosphere, various basic furnaces which can be tailored to customer-specific requirements are available. Nabertherm also offers solutions for the integration of furnaces in clean room/grey room environments.

The following equipment applies to all furnaces in this chapter:

- Dual shell ventilated housing made of textured stainless steel sheets for low surface temperature and high stability
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- Defined application within the constraints of the operating instructions
- Controller with intuitive touch operation
- As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control

Furnace Group	Model	Page
Clean room solutions		68
Gas-fired chamber furnaces	NB ..	70
Gas-fired bogie hearth furnaces up to 1400 °C	WB ..	71
Dewaxing furnaces	N ../WAX	72
High-temperature bogie hearth furnaces with SiC rod heating up to 1550 °C	WHTC ..	73

Clean Room Solutions

Clean room applications impose particularly high requirements to the design of the chosen furnace. If the complete furnace is operated in a clean room an essential contamination of the clean room atmosphere must be avoided. Especially, the particle contamination must be reduced to a minimum.

The specific application determines the choice of the required furnace technology. In many cases forced convection furnaces are required to achieve the necessary temperature uniformity at lower temperatures. For higher temperatures, Nabertherm has also delivered many furnaces with radiant heating.

Forced convection chamber furnace NACS 250/65 DB200-3 for debinding processes in a clean room execution

Furnace Installation in the Clean Room

If the complete furnace is supposed to be positioned in the clean room, then it is important that both the furnace chamber and the furnace housing as well as the controls provide for good protection against contamination. Surfaces must be easy to clean. The furnace chamber is tightly sealed to the insulation behind it. If necessary, additional equipment such as filters for the fresh air supply or the air circulation in the furnace can be used to improve the cleanliness class. It is recommended to install the switchgear and the furnace controls outside the clean room.

High-temperature furnace with loading from the clean room; switchgear and furnace installed in grey room

Combi chamber furnace N 650 DB 200-3 for debinding and sintering in clean room/gray room installation

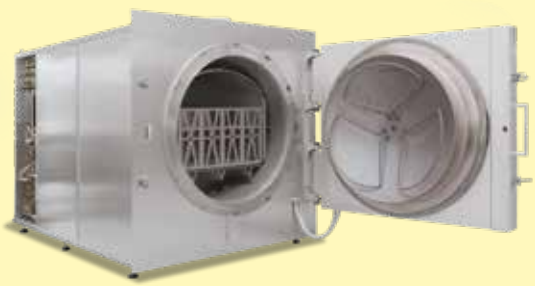
Furnace Installation in the Grey Room, Furnace Charging from the Clean Room

Optimal results with respect to cleanness will be achieved by placing the furnace in the grey room with charging from the clean room. This significantly reduces the amount of costly space needed in the clean room to a minimum. The front and the furnace interior in the clean room are designed for easy cleaning. With this configuration even the highest clean room classes can be achieved.

Sluice Furnace between Grey Room and Clean Room

Logistics between clean room and grey room can often be easily sorted out. Lock furnaces with one door in the grey room and the other door in the clean room are the perfect choice for these applications. The inner chamber as well as the furnace front in the clean room will be especially designed for lowest particle contamination.

Chamber furnace LH 30/12S DB50 with clean room specs



Hot-wall retort furnace NRA 1700/06 with charging frame for installation in grey room with charging door in clean room

KTR 8000 designed as a production oven in the clean room with filters for air circulation

Gas-Fired Chamber Furnaces

Certain heat treatment processes require a gas-fired chamber furnace. Short heating times due to the high power are a convincing argument. The chamber furnaces, equipped with powerful, fully automatic burners, cover a wide variety of these processes and can be upgraded with other useful accessories depending on the equipment.

Chamber furnace NB 4330/S

Standard Equipment

- Tmax 1300 °C
- Powerful, fully automatic burners according to industry standard for operation with natural gas (min. 9.9 kWh/m^3) or propane gas. Required flow pressure under full load min. 45 mbar.
- Depending on the application, special positioning of the gas burners with flame guidance provides for optimal temperature uniformity
- Fully automatic temperature control
- Gas fittings with gas pressure control and safety line
- Multi-layer, reduction-proof insulation with light-weight refractory bricks and special back-up insulation result in low gas consumption
- Self-supporting and robust ceiling, bricks laid in arched construction
- Exhaust hood

Chamber furnace NB 361/S

Additional Equipment

- Fan burner with fully automatic control
- Indirect gas firing with radiation tubes for flame protection of the charge
- Exhaust air and exhaust gas piping
- Thermal or catalytic exhaust cleaning systems see page 12
- Recuperator technology for heat recovery

Gas stretch with two burners in the back wall of the furnace

Compact burners for standard models up to NB 600

Indirect gas firing with radiation tubes

Gas-Fired Bogie Hearth Furnaces up to 1400 °C
for heat treatment in air or under reducing atmosphere

Gas-fired bogie hearth furnaces distinguish by their unique efficiency. The use of high-speed burners allows for short heating times. The burners are arranged according to the furnace geometry providing for a optimum temperature uniformity. Depending on the furnace dimensions, the burners can alternatively be equipped with recuperator technology to save energy. The high-quality, long-life fiber insulation, classified as non-carcinogenic, with storage capacity provides for short heating and cooling times.

Gas-fired bogie hearth furnace WB 6200/12 BO for burning out ceramic insulating materials

Standard Equipment

- Tmax up to 1400 °C, depending on furnace design
- Powerful, sturdy high-speed burner with special flame control in the furnace chamber provide for optimum temperature uniformity
- Operation with city gas, natural gas or liquified gas
- Fully automatic PLC control of the temperature as well as monitoring of the burner function
- Reduction-resistant fiber insulation with low heat storage provides for short heating and cooling times.
- Exhaust hood with fittings for further discharge of the exhaust gases

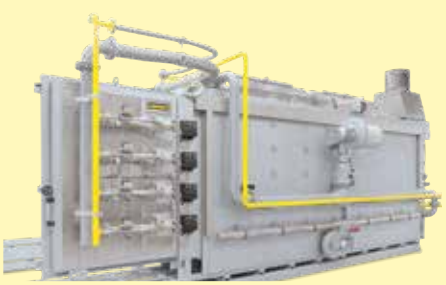
Additional Equipment

- Automatic lambda control to set the furnace atmosphere
- Exhaust air and exhaust gas piping
- Recuperator burners utilizing part of the waste heat in the exhaust tract to preheat the combustion air and considerably contribute to energy saving
- Thermal exhaust cleaning systems see pages 13
- Other additional equipment for bogie hearth furnaces

Combi furnace plant consisting of one gas-fired bogie hearth furnace WB 11000/HS and two additional bogies incl. bogie transfer system and incl. necessary park rails

Furnace chamber with eight high-speed burners

Bogie hearth furnace WB 4000/70AS with door as heat shield



Optimum temperature uniformity due to flame entry in door and rear wall

Dewaxing Furnaces
electrically heated

The electrically heated N ../WAX furnaces are particularly suitable for dewaxing of ceramic molds below the flash point of the wax and subsequent firing. The electrically heated chamber furnaces have a heated outlet in the bottom of the furnace chamber, formed as a funnel with the discharge near the center of the furnace. The drain pan on the furnace bottom is covered with stainless steel grids, which provide for an even charging surface for the molds and can be removed for cleaning. The molten wax is collected in a sealed stainless steel container with a removable drawer below the furnace. After the dewaxing process is completed, the furnace continues heating to sinter the molds. Fresh air inlets in the bottom area and a motorized exhaust air flap ensure good ventilation of the furnace chamber during the process. The resulting exhaust air is discharged via the exhaust hood and further customer-provided piping.

Dewaxing furnace N 300/WAX

Standard Equipment

- Tmax 850 °C
- Chamber furnace with wide-opening swinging door
- Fresh air inlets in the bottom for continuous air exchange
- Motorized exhaust air flap in the furnace ceiling with exhaust hood for connection to customer provided ductwork
- Four side heating with freely radiating heating elements on ceramic support tubes
- Heated outlet in the furnace bottom, controlled and monitored by a separate controller with a temperature working range of min. 200 °C - max. 300 °C, to safely prevent the escaping wax from solidifying
- The furnace heating is released after a preset temperature has been reached in the drainage to protect the wax outlet from clogging
- Stainless steel floor pan with grid bottom for level loading
- Rugged self-supporting, vaulted arch construction
- Over-temperature limiter for the furnace chamber, which must be set below the flash point of the wax and prevents the wax from igniting during the melting process. The duration of the dewaxing process is specified by the customer. After this time, the over-temperature limiter is deactivated so that the furnace can continue with the sintering process.
- Controller with touch operation B500 (5 programs with each 4 segments), controls description see page 76

Model	Tmax	Inner dimensions in mm			Volume in	Outer dimensions[2] in mm			Max. drain-off volume in	Heating power in	Electrical	Weight in
	°C	w	d	h	l	W	D	H	l	kW[1]	connection*	kg
N 100/WAX	850	400	530	460	100	720	1130	1440	5	7.5	3-phase	325
N 300/WAX	850	550	700	780	300	870	1300	1760	15	15.5	3-phase	550
N 440/WAX	850	600	750	1000	450	1000	1400	2000	17	20.5	3-phase	800

[1]Depending on furnace design connected load might be higher
[2]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

*Please see page 80 for more information about supply voltage

Grid bottom

Drain pan in floor

Drawer for collection of liquid wax

High-Temperature Bogie Hearth Furnaces with SiC Rod Heating up to 1550 °C

Bogie hearth furnaces equipped with SiC rod heating can be used in the production of technical ceramics, especially for sintering at working temperatures up to 1550 °C. The bogie hearth furnaces WHTC with especially robust design can hold heavy charges including kiln furniture. The furnace chamber is equipped with a high-quality insulation made of high-temperature fiber blocks. The bogie insulation is structured in multi-layer lightweight refractory bricks on the heating chamber side.

The furnace is heated along both sides by vertically installed SiC heating rods. This heating technology permits processes requiring working temperatures above 1350 °C which cannot achieved with wire heating elements. The SiC rods are controlled by thyristor controller which counteract the aging of the heating elements by means of automatic power compensation.

High-temperature bogie hearth furnace
WHTC 3300/15

Standard Equipment

- Tmax 1550 °C
- Swing door hinged on the right side
- Heating from both sides via vertically mounted SiC rods
- Thyristor controllers with automatic output compensation counteract the aging of SiC rods
- Multi-layer insulation with high-quality fiber modules on the heating chamber side
- Bogie for heavy loads lined with lightweight refractory bricks
- Bogie hand driven on rubber tires
- Motorized exhaust air flap on the furnace roof
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive see page 82
- Controller with touch operation P570 (50 programs with each 40 segments), controls description see page 76
- Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC see page 82
- Freeware NTGraph for evaluation and documention of firings using Excel™ for Windows™ on the PC see page 82
- MyNabertherm App for online monitoring of the firing on mobile devices for free download see page 78

Additional Equipment

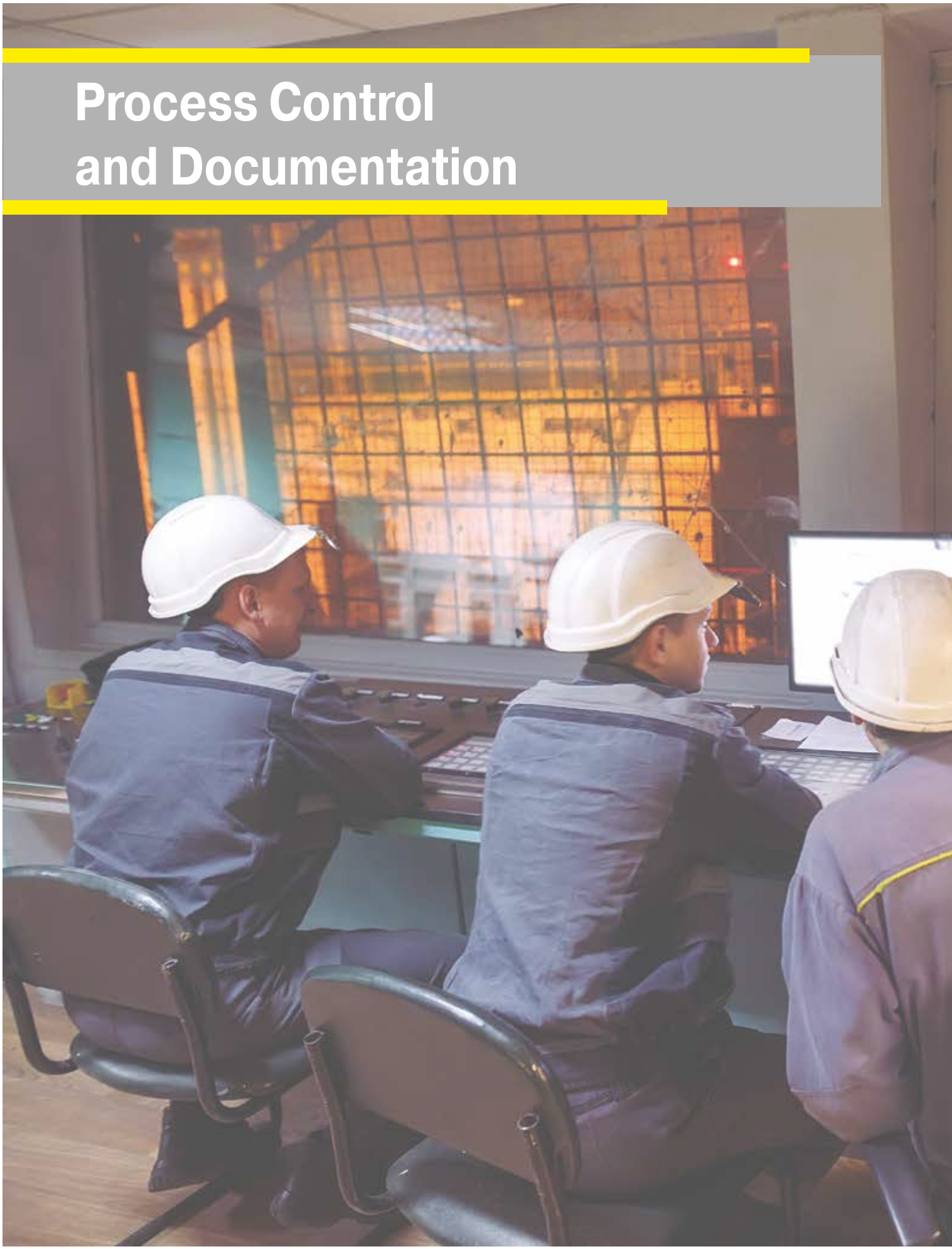
- Safety concepts see page 8
- Exhaust air and exhaust gas piping
- Thermal or catalytic post combustion systems see page 12

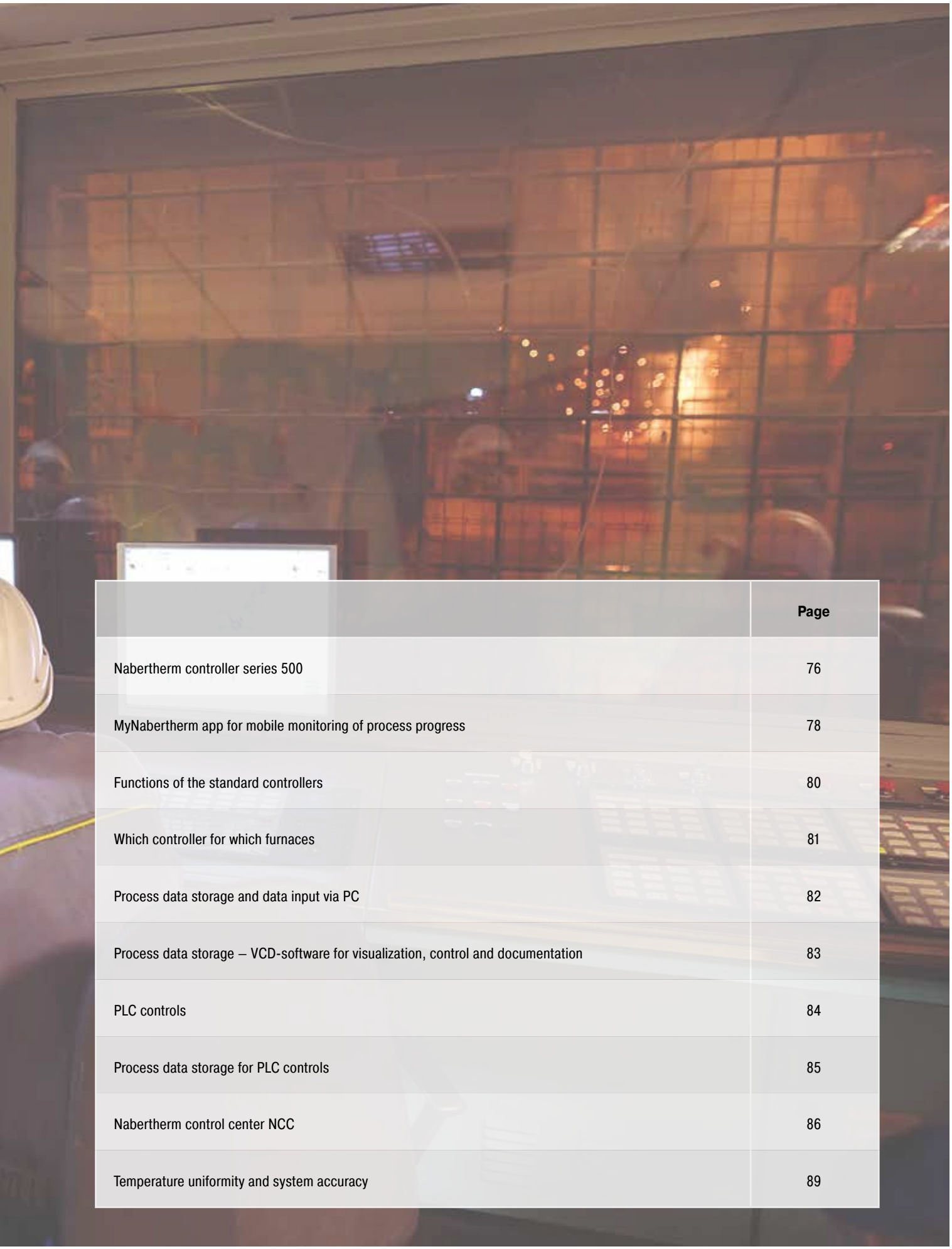
Design with two doors and two bogies, on rails, allows for rapid bogie changes

SiC rod elements on both sides of the bogie hearth furnace

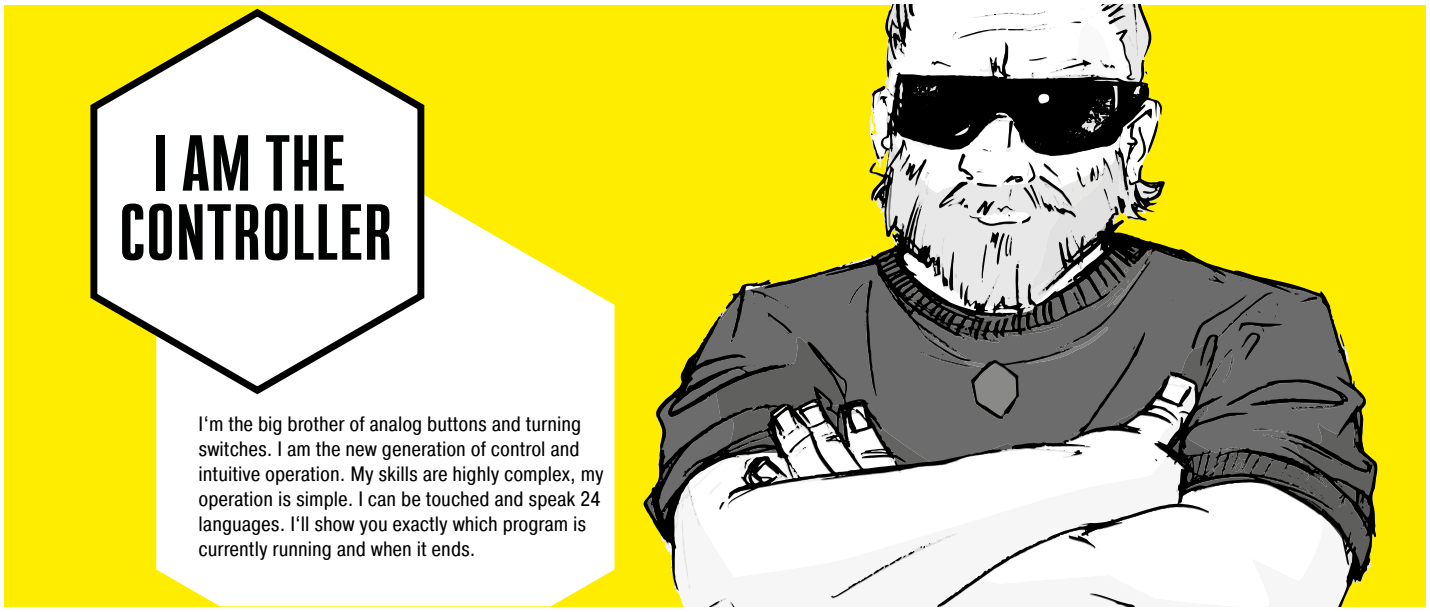
WHTC 4000/15 with bogie on rails and fan cooling

Process Control and Documentation





Nabertherm Controller Series 500



The controller series 500 impresses with its unique scope of performance and intuitive operation. In combination with the free "MyNabertherm" smartphone app, the monitoring of the furnace is even easier and more powerful than ever before. The operation and programming takes place via a high-contrast, large touch panel, which shows exactly the information that is relevant at the moment.

B510, C550, P580

B500, C540, P570

Standard Equipment

- Transparent, graphic display of the temperature curves
- Clear presentation of the process data
- 24 operating languages selectable
- Consistent, attractive design
- Easily understandable symbols for many functions
- Precise and accurate temperature control
- User levels
- Program status display with estimated end time and date
- Documentation of the process curves on USB storage medium in .csv file format
- Service information can be read out via USB stick
- Clear presentation
- Plain text display
- Configurable for all furnace families
- Can be parameterized for the different processes

Highlights

In addition to the well-known and matured controller functions, the new generation offers you some individual highlights. Here is an overview of the most important ones for you:

Modern Design

Colored display of temperature curves and process data

Easy Programming

Simple and intuitive program entry via touch panel

Integrated Help Function

Information on various commands in plain text

Program Management

Temperature programs can be saved as favorites and in categories

Segment Player

Detailed overview of process information including setpoint, actual value and switched functions

Wi-Fi-Capable

Connection with the MyNabertherm app

Intuitive touch screen

Easy program entry and control

Precise temperature control

User levels

Process documentation on USB

Further information on Nabertherm controllers, process documentation and tutorials on operation can be found on our website:
https://nabertherm.com/en/series-500

MyNabertherm App for Mobile Monitoring of Process Progress

MyNabertherm app – the powerful and free digital accessory for Nabertherm 500 Series Controllers. Use the app for convenient online progress monitoring of your Nabertherm furnaces – from your office, while on the way or from wherever you wish. The app always keeps you in the picture. Just like the controller itself, the app is also available in 24 languages.

Convenient monitoring of one or multiple Nabertherm furnaces simultaneously

Display of program progress for each furnace

Easy to contact

App-Functions

- Convenient monitoring of one or multiple Nabertherm furnaces simultaneously
- Clear presentation as a dashboard
- Individual overview of a furnace
- Display of active/inactive furnaces
- Operating status
- Current process data

Display of Program Progress for Each Furnace

- Graphical representation of the program progress
- Display of furnace name, program name, segment information
- Display of start time, program run time, remaining run time
- Display of additional functions such as fresh-air fan, exhaust air flap, gassing, etc.
- Operating modes as symbol

Push Notifications in Case of Malfunctions and at Program End

- Push notification on the lock screen
- Display of malfunctions with an associated description in the individual overview and in a message list

Contact with Service Possible

- Stored furnace data facilitate rapid support for you

Requirements

- Connection of the furnace to the Internet via the customer‘s Wi-Fi
- For mobile devices with Android (from version 9) or IOS (from version 13)

Monitoring of Nabertherm furnaces with 500 series touch panel controller for Arts & Crafts, laboratory, dental, thermal process technology, advanced materials and foundry applications.

Available in 24 languages

Push notifications in case of malfunctions

Clear contextual menu

Any addition of Nabertherm furnaces

Everything on display in the new Nabertherm app for the new controller series 500. Get the most out of your furnace with our app for iOS and Android. Don't hesitate to download it now.

Download on the App Store

GET IT ON Google Play

Functions of the Standard Controllers

	R7	3216	3208	B500/ B510	C540/ C550	P570/ P580	D580[4]	3504	H500	H1700	H3700	NCC
Number of programs	1	1	1	5	10	50	> 50	25	20	20	20	100
Segments	1	8	1	4	20	40	7	500[3]	20	20	20	20
Extra functions (e. g. fan or autom. flaps) maximum				2	2	2-6		2-8[3]	3[3]	6/2[3]	8/2[3]	16/4[3]
Maximum number of control zones	1	1	1	1	1	3	1	2[1,2]	1-3[3]	8	8	8
Drive of manual zone regulation				●	●	●						
Charge control/bath control						●		○	○	○	○	○
Auto tune		●	●	●	●	●		●				
Real-time clock				●	●	●	●		●	●	●	●
Graphic color display				●	●	●	●		4" 7"	7"	12"	22"
Graphic display of temperature curves (program sequence)							●					
Status messages in clear text			●	●	●	●	●	●	●	●	●	●
Data entry via touchpanel				●	●	●	●		●	●	●	
Entering program names (i.e.“Sintering“)				●	●	●	●			●	●	●
Keypad lock				●	●	●	●	●				
User levels				●	●	●	●		○	○	○	●
Skip-button for segment jump				●	●	●	●		●	●	●	●
Program entry in steps of 1 °C or 1 min.	●	●	●	●	●	●	1 sec.	●	●	●	●	●
Start time configurable (e. g. to use night power rates)				●	●	●			●	●	●	●
Switch-over °C/°F	○	○	○	●	●	●	●	○	●	●[3]	●[3]	●[3]
kWh meter				●	●	●	●					
Operating hour counter				●	●	●	●		●	●	●	●
Set point output			○	●	●	●		○		○	○	○
NTLog Comfort for HiProSystems: recording of process data on an external storage medium									○	○	○	
NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive				●	●	●	●					
Interface for VCD software				○	○	○						
Malfunction memory				●	●	●	●		●	●	●	●
Number of selectable languages				24	24	24	24					
Wi-Fi-capable („MyNabertherm“ app)				●	●	●	●					

[1] Not for melt bath control
[2] Control of additional separate slave regulators possible
[3] Depending on the design
[4] Controls description for D580 see chapter „Firing furnace and pressing furnace“ in catalog „Dental Furnaces“

● Standard
○ Option

Mains Voltages for Nabertherm Furnaces

1-phase: all furnaces are available for mains voltages from 110 V - 240 V at 50 or 60 Hz.

3-phase: all furnaces are available for mains voltages from 200 V - 240 V or 380 V - 480 V, at 50 or 60 Hz.

The connecting rates in the catalog refer to the standard furnace with 400 V (3/N/PE) respectively 230 V (1/N/PE).

Which Controller for Which Furnaces

	N 100 - N 2200/14	NW 150 - NW 1000/H	N 100 DB50 - N 1500/14 DB..	W 1000 - W 7500/14	W .../.. DB..	H .../LB, H .../LT	H .../DB..	HT 08/16 - HT 450/18	HTC 16/16 - HTC 450/16	HFL 16/16 - HFL 160/17	HT .../.. DB..	HT .../.. LB, HT .../.. LT	HT .../.. LB DB.., HT .../.. LT DB..	NA 120/65 DB200 - NA 1500/60B DB200	LH 15/12 - LH 216/14, LF 15/13 - LF 120/14	L 9/11 BO - L 40/11 BO	LHT 08/17 BO	N 300 BO - NB 650 BO	HF ..	DF 23/244/5/10 WK - DF 64/320/5/10 WK	NB ..	WB ..	N 100/WAX - N 440/WAX	WHTC ..
Catalog page	16	18	20	22	24	28	30	34	36	37	38	40	44	48	52	56	57	58	62	64	70	71	72	73
Controller																								
B500	●	●													●								●	
C540	○	○													○								○	
C550																●								
P570	○	○	●[1]	●		●[1]		●[1]	●[1]	●[1]	●[1]	●[1]			○		●							●
H500/PLC	○			○				●[1]	●[1]	●[1]	●[1]	●[1]			○									○
H1700/PLC			●[1]	○	●	●[1]	●	○	○	○	○	○	●	●				●	●		●	●	○	
H3700/PLC			○	○	○	○	○	○	○	○	○	○	○	○							○	○		○
NCC			○	○	○	○	○	○	○	○	○	○	○	○					○	●	○	○		○

● Standard
○ Option
[1]Depending on the design

Process Data Storage and Data Input via PC

There are various options for evaluation and data input the processes for optimal process documentation and data storage. The following options are suitable for data storage when using the standard controllers.

Data Storing of Nabertherm Controllers with NTLog Basic

NTLog Basic allows for recording of process data of the connected Nabertherm Controller (B500, B510, C540, C550, P570, P580) on a USB stick. The process documentation with NTLog Basic requires no additional thermocouples or sensors. Only data recorded which are available in the controller.
The data stored on the USB stick (up to 130,000 data records, format CSV) can afterwards be evaluated on the PC either via NTGraph or a spreadsheet software used by the customer (e.g. Excel™ for MS Windows™). For protection against accidental data manipulation the generated data records contain checksums.

Visualization with NTGraph for MS Windows™ for Single-Zone Controlled Furnaces

The process data from NTLog can be visualized either using the customer‘s own spreadsheet program (e.g. Excel™ for MS Windows™) or NTGraph for MS Windows™ (Freeware). With NTGraph Nabertherm provides for an additional user-friendly tool free of charge for the visualization of the data generated by NTLog. Prerequisite for its use is the installation of the program Excel™ for MS Windows™ (from version 2003). After data import presentation as diagram, table or report can be chosen. The design (color, scaling, reference labels) can be adapted by using prepared sets. NTGraph is available in eight languages (DE/EN/FR/ES/IT/CN/RU/PT). In addition, selected texts can be generated in other languages.

Software NTEdit for MS Windows™ for Entering Programs on the PC

By using the software NTEdit for MS Windows™ (Freeware) the input of the programs becomes clearer and thus easier. The program can be entered on customers PC and then be imported into the controller (B500, B510, C540, C550, P570, P580) with a USB stick. The display of the set curve is tabular or graphical. The program import in NTEdit is also possible. With NTEdit Nabertherm provides a user-friendly free tool. A prerequisite for the use is the client installation of Excel™ for MS Windows™ (from version 2007). NTEdit is available in eight languages (DE/EN/FR/ES/IT/CN/RU/PT).

NTGraph, a freeware for the easy-to-read analysis of recorded data using Excel™ for MS Windows™

Recording of process data of the connected controller via USB stick

Process input via the NTEdit software (freeware) for MS Windows™

Process Data Storage
VCD-software for visualization, control and documentation

Documentation and reproducibility are more and more important for quality assurance. The powerful VCD software represents an optimal solution for single multi furnace systems as well as charg documentation on the basis of Nabertherm controllers.

The VCD software is used to record process data of the series 500 and series 400 as well as various further Nabertherm controllers. Up to 400 different heat treatment programs can be stored. The controllers are started and stopped via the software at a PC. The process is documented and archived accordingly. The data display can can be carried-out in a diagram or as data table. Even a transfer of process data to Excel™ for MS Windows™ (.csv format *) or the generation of reports in PDF format is possible.

Example lay-out with 3 furnaces

Features

- Available for controllers series 500 - B500/B510/C540/C550/P570/P580, series 400 - B400/B410/C440/C450/P470/P480, Eurotherm 3504 and various further Nabertherm controllers
- Suitable for operating systems Microsoft Windows 7/8/10/11
- Simple installation
- Setting, Archiving and print of programs and graphics
- Operation of controllers via PC
- Archiving of process curves from up to 16 furnaces (also multi-zone controlled)
- Redundant saving of archives on a server drive
- Higher security level due to binary data storage
- Free input of charge date with comfortable search function
- Possibility to evaluate data, files exportable to Excel™ for MS Windows™
- Generation of a PDF-report
- 24 languages selectable

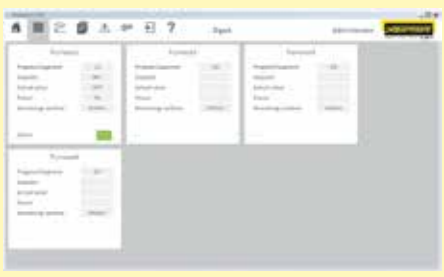
Extension Package 1 for display of an additional temperature measuring point, independant of the furnace controls

- Connection of an independent thermocouple, type S, N or K with temperature display on a supplied C6D display, e. g. for documentation of charge temperature
- Conversion and transmission of measured values to the VCD software
- For data evaluation, please see VCD-software features
- Display of measured temperature directly on the extension package

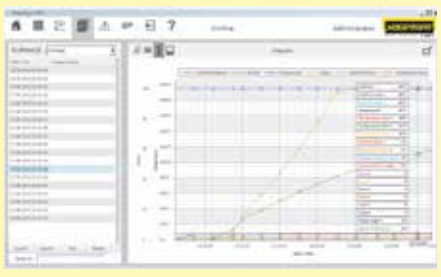
Extension Package 2 for the connection of up to three, six or nine measuring point, independant of the furnace controls

- Connection of three thermocouples, tpye K, S, N or B to the included connecting box
- Possible extension of up to two or three connecting boxes with up to nine measuring points
- Conversion and transmission of measured values to the VCD software
- Data evaluation, see VCD features

VCD Software for Control, Visualisation and Documentation



Graphic display of main overview (version with 4 furnaces)



Graphic display of process curve

PLC Controls
HiProSystems

This professional process control with PLC controls for single and multi-zone furnaces is based on Siemens hardware and can be adapted and upgraded extensively. HiProSystems control is used when process-dependent functions, such as exhaust air flaps, cooling fans, automatic movements, etc., have to be handled during a cycle, when furnaces with more than one zone have to be controlled, when special documentation of each batch is required and when remote service is required. It is flexible and is easily tailored to your process or documentation needs.

Alternative User Interfaces for HiProSystems

Process Control H500
This basic panel accommodates most basic needs and is very easy to use. Firing cycle data and the extra functions activated are clearly displayed in a table. Messages appear as text. Data can be stored on a USB stick using the „NTLog Comfort“ option.

Process Control H1700
Customized versions can be realized in addition to the scope of services of the H500. Display of basic data as online trend on a color 7“ display with graphically structured interface.

Process Control H3700
Display of functions on a large 12“ display. Display of basic data as online trend or as a graphical system overview. Scope as H1700.

Remote Maintenance Router – Fast Support in Case of a Malfunction

For fast failure diagnosis in case of a malfunction, remote maintenance systems are used for HiProSystems-plants (depending on the model). The plants are equipped with a router, which will be connected to the internet by the customer. In case of a malfunction, Nabertherm is able to get access to the furnace controls via a secured connection (VPN tunnel) and to perform a malfunction diagnosis. In most cases, the problem can be directly solved by e technician on site according with supervision from Nabertherm.

If no Internet connection can be provided, we offer optionally the remote maintenance via LTE network as additional equipment.

H1700 with colored, tabular depiction

H3700 with colored graphic presentation

Router for remote maintenance

Process Data Storage

The following options are available for industrial process documentation and the recording of data from several furnaces. These can be used to document the process data for the PLC controls.

NTLog Comfort for data recording of a Siemens PLC via USB stick

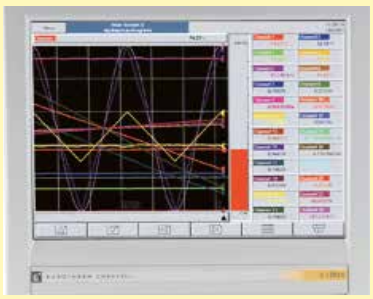
Data Storing of HiProSystems with NTLog Comfort

The extension module NTLog Comfort offers the same functionality of NTLog Basic module. Process data from a HiProSytems control are read out and stored in real time on a USB stick. The extension module NTLog Comfort can also be connected using an Ethernet connection to a computer in the same local network so that data can be written directly onto this computer.

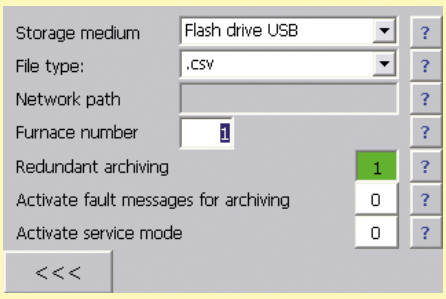
Temperature Recorder

Besides the documentation via the software which is connected to the controls, Nabertherm offers different temperature recorders which can be used with respect to the application.

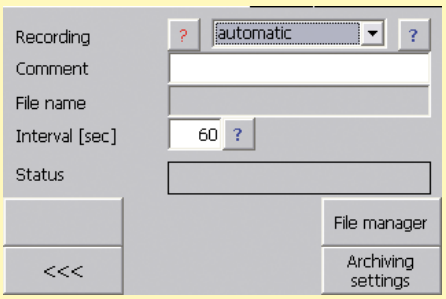
	Model 6100e	Model 6100a	Model 6180a
Data input using touch panel	x	x	x
Size of colour display in inch	5.5"	5.5"	12.1"
Number of thermocouple inputs	3	18	48
Data read-out via USB-stick	x	x	x
Input of charge data		x	x
Evaluation software included	x	x	x
Applicable for TUS-measurements acc. to AMS2750G			x



Temperature recorder



NTLog Comfort - Data recording via USB stick



NTLog Comfort - Data recording online on the PC

Nabertherm Control Center NCC
PC-based control, process visualization and process documentation software

With the Nabertherm Control Center, a PC-based control system is offered as an ideal extension for furnaces with PLC-based HiProSystem control systems. The system has proven itself in many applications with increased demands on documentation and process reliability and also for convenient multi-furnace management. Many customers from the automotive, aviation, medical technology or technical ceramics sectors are working successfully with this powerful software.

Retort furnace NR 300/08 for treatment in high vacuum with NCC in separate cabinet

Basic Equipment

- Central operator interface in modern design
- Overview and central operation for up to 8 furnaces
- Convenient program management with 100 programs
- Simple, intuitive operation of the PC user interface
- Access management with 3 user levels and as many users as required
- Charge data input for each furnace operation
- Start times can be specified in order to pre-plan heat treatment cycles
- Tamper-proof, encrypted storage of charge documentation
- Live view of current furnace operations
- Archive with overview of performed cycles
- Search function for charge data and temperature curves of performed cycles
- Report function to assess the process as PDF or printout
- Delivery includes PC, monitor and printer

Retort furnace NR 80/11 with IDB safety concept for debinding in non-flammable protective gases with NCC in a separate cabinet

Aviation/Automotive Design

- Documentation according to AMS2750G (NADCAP) and CQI-9
- Integration of additionally needed thermocouples according to instrumentation type as a switching condition (e.g. start “hold time”)
- Instrumentation type adaptable by customer
- Choice of programmed or continuous operation
- Automatic adjustment of the monitored value for overtemperature protection of the charge
- Calibration for all elements of the measuring section in several temperature ranges
- Calendar function for SAT, IT and TUS measurements

System Overview

With several connected furnaces:

- Overview on actual process values and messages for the connected furnaces
- Symply switching to the furnace overview by selecting a furnace

Furnace Overview

- Clear presentation of status information and process values of the furnace/ furnace system
- Display of charge information, current value and setpoint, as well as remaining time of the active program
- Direct access to live view, furnace settings and control of furnace functions

Program Input

- Intuitive program input with plain text fields and clear symbols for the furnace functions
- Free text fields for program name and additional information
- Adjustable number of segments (by default up to 20 segments), function to insert and delete individual segments
- Preview of the setpoint curve for created program

Charge Preparation

- Information texts for guided charge data entry
- Program selection with display of the program name and additional information
- Preview of the setpoint curve for selected program
- Entry of charge data, operator ID and free text fields for additional information
- Start times can be specified in order to pre-plan heat treatment cycles

Process Documentation

- Charge and process data is output displayed graphically as a trend, encrypted and saved on the PC in CSV format
- Documentation can be tracked by entering the charge data
- Preview of the setpoint curve for selected program
- Automatic report generation at the end of a process cycle in PDF format with charge data and temperature curve

Extension Options

- Enter charge data via barcode
- Simple data recording, ideal for changing charges
- Ensure data quality with defined charge data
- Compare charge and program to increase process reliability
- Access rights via employee cards
- Software extension with documentation according to the requirements of the Food and Drug Administration (FDA), Part 11, EGV 1642/03
- Interface to connect higher level systems (OPC-UA), SQL connection, redundant data storage
- Control from different PC workstations
- Available as panel PC or virtual machine
- PC cabinet with UPS for PC
- Further customization possible on request

You will find more information about the Nabertherm Control Center with tutorial and click dummy on our website: NCC | Nabertherm

https://nabertherm.com/de/ncc

Temperature Uniformity and System Accuracy

Temperature uniformity is defined as the maximum temperature deviation in the work space of the furnace. There is a general difference between the furnace chamber and the work space. The furnace chamber is the total volume available in the furnace. The work space is smaller than the furnace chamber and describes the volume which can be used for charging.

Holding frame for measurement of temperature uniformity

Specification of Temperature Uniformity in +/− K in the Standard Furnace

In the standard design the temperature uniformity is specified in +/− K at a defined set-temperature with the work space of the empty furnace during the dwell time. In order to make a temperature uniformity survey the furnace should be calibrated accordingly. As standard our furnaces are not calibrated upon delivery.

Calibration of the Temperature Uniformity in +/− K

If an absolute temperature uniformity at a reference temperature or at a defined reference temperature range is required, the furnace must be calibrated appropriately. If, for example, a temperature uniformity of +/− 5 K at a set temperature of 750 °C is required, it means that measured temperatures may range from a minimum of 745 °C to a maximum of 755 °C in the empty work space.

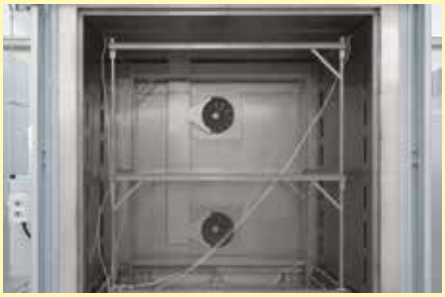
System Accuracy

Tolerances may occur not only in the work space, they also exist with respect to the thermocouple and in the controls. If an absolute temperature uniformity in +/− K at a defined set temperature or within a defined reference working temperature range is required, the following measures have to be taken:

- Measurement of total temperature deviation of the measurement line from the controls to the thermocouple
- Measurement of temperature uniformity within the work space at the reference temperature or within the reference temperature range
- If necessary, an offset is set at the controls to adjust the displayed temperature at the controller to the real temperature in the furnace
- Documentation of the measurement results in a protocol

Temperature Uniformity in the Work Space incl. Protocol

In standard furnaces, temperature uniformity is guaranteed as +/− K without measurement of temperature uniformity. However, as an additional feature, a temperature uniformity measurement at a target temperature in the work space compliant with DIN 17052-1 can be ordered. Depending on the furnace model, a holding frame which is equivalent in size to the work space is inserted into the furnace. This frame holds thermocouples at up to 11 defined measurement positions. The measurement of the temperature uniformity is performed at a target temperature specified by the customer after a static condition has been reached. If necessary, different target temperatures or a defined target working temperature range can also be calibrated.



Pluggable frame for measurement for forced convection chamber furnace N 7920/45 HAS

The system accuracy is defined by adding the tolerances of the controls, the thermocouple and the work space

Precision of the controls, e. g. +/− 1 K

Deviation of thermocouple, e. g. +/− 1.5 K

Deviation from measuring point to the average temperature in the work space e. g. +/−3 K

Spare Parts and Customer Service – Our Service Makes the Difference

For many years the name **Nabertherm** has been standing for top quality and durability in furnace manufacturing. To secure this position for the future as well, Nabertherm offers not only a first-class spare parts service, but also excellent customer service for our customers. Benefit from more than 75 years of experience in furnace construction.

In addition to our highly qualified service technicians on site, our service specialists in Lilienthal are also available to answer your questions about your furnace. We take care of your service needs to keep your furnace always up and running. In addition to spare parts and repairs, maintenance and safety checks as well as temperature uniformity measurements are part of our service portfolio. Our range of services also includes the modernization of older furnace systems or new linings.

The needs of our customers always have highest priority!

- Very fast spare parts supply, many standard spare parts in stock
- Worldwide customer service on site with its own service points in the largest markets
- International service network with long-term partners
- Highly qualified customer service team for quick and reliable repair of your furnace
- Commissioning of complex furnace systems
- Customer training in function and operation of the system
- Temperature uniformity measurements, also according to standards like AMS2750G (NADCAP)
- Competent service team for fast help on the phone
- Safe teleservice for systems with PLC controls via a secured VPN line
- Preventive maintenance to ensure that your furnace is ready for use
- Modernization or relining of older furnace systems

Contact us:

Spare parts	spares@nabertherm.de	+49 (4298) 922-0
Customer service	service@nabertherm.de	+49 (4298) 922-333

The whole World of Nabertherm: www.nabertherm.com

Please visit our website **www.nabertherm.com** and find out all you want to know about us - and especially about our products.

In addition to current information and exhibition dates, there is of course the possibility of direct contact or an authorized dealer from our worldwide dealer network.

Professional Solutions for:

- Thermal Process Technology
- Additive Manufacturing
- Advanced Materials
- Fiber Optics/Glass
- Foundry
- Laboratory
- Dental
- Arts & Crafts

Nabertherm
MORE THAN HEAT 30 - 3000 °C

Headquarters

Nabertherm GmbH
Bahnhofstr. 20
28865 Lilienthal, Germany
Tel +49 4298 922 0
contact@nabertherm.de

Sales Organisation

China
Nabertherm Ltd. (Shanghai)
No. 158, Lane 150, Pingbei Road, Minhang District
201109 Shanghai, China
Tel +86 21 64902960
contact@nabertherm-cn.com

France
Nabertherm SARL
20, Rue du Cap Vert
21800 Quetigny, France
Tel +33 6 08318554
contact@nabertherm.fr

Great Britain
Nabertherm Ltd., United Kingdom
Tel +44 7508 015919
contact@nabertherm.com

Italy
Nabertherm Italia
via Trento N° 17
50139 Florence, Italy
Tel +39 348 3820278
contact@nabertherm.it

Switzerland
Nabertherm Schweiz AG
Altgraben 31 Nord
4624 Härkingen, Switzerland
Tel +41 62 209 6070
contact@nabertherm.ch

Benelux
Nabertherm Benelux, The Netherlands
Tel +31 6 284 00080
contact@nabertherm.com

Spain
Nabertherm España
c/Marti i Julià, 8 Bajos 7ª
08940 Cornellà de Llobregat, Spain
Tel +34 93 4744716
contact@nabertherm.es

USA
Nabertherm Inc.
64 Reads Way
New Castle, DE 19720, USA
Tel +1 302 322 3665
contact@nabertherm.com

All other Countries: Follow
https://www.nabertherm.com/contacts