Nabertherm

MORE THAN HEAT 30-3000 °C

FURNACES FOR FIBER OPTICS AND GLASS

www.nabertherm.com

Made in Germany

Facts

- Production of Arts & Crafts furnaces, laboratory furnaces, dental furnaces and industrial furnaces since 1947
- Production site in Lilienthal/Bremen - Made in Germany
- 500 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 86

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

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Which Furnace for Which Process?

Chamber furnace N 300/G with controlled cooling

Annealing/Cooling Glass

When glass components are being shaped, mechanical stresses are generated. With soda-lime and borosilicate glass, these stresses can be reduced with defined, slow cooling in the temperature range between 600 °C and 400 °C. The relevant temperature range and the duration of the cooling process depend on the specific type of glass and the geometry of the components. Nabertherm offers various solutions for annealing/ cooling glass. Brick-insulated chamber furnaces (models N ../G see page 28) have been an established solution since many years in numerous workshops and used e. g. for device manuctacturing. All standard controllers allow cooling times to be set as a defined time or as a cooling gradient to enable slow, specific cooling. If the furnace cools faster than the specified rate, the controller automatically starts heating so that the temperature does not fall too quickly.

Forced convection furnaces are especially suitable for cooling technical glass components, fiber optics and optical components, where good temperature uniformity and temperature control is very important (see page 18). With all product lines, the furnaces can be customized with an extensive range of additional equipment to suit the customer's specific needs.

Forced convection chamber furnace NAT 30/85 as tabletop model

Sterilizing Laboratory Glassware

Sterilizing laboratory glassware and containers is a challenging task, but necessary for many analytical processes and measuring methods. Usually, the glass containers are cleaned thoroughly with mechanical and chemical methods. As one of the last steps, the glassware is often heated to 400 °C - 600 °C for several hours to remove traces of organic material and residual deposits. Chamber furnaces with brick insulation (models N ../G see page 28) and forced convection furnaces (see page 18) are particularly suitable for such processes. By using additional equipment, such as a charging trolley with shelves, glass components can be positioned conveniently in several levels.

Bogie hearth furnace W 7500

Tempering Quartz Glass

Mechanical stresses also occur in the manufacture of quartz glass. In quartz glass tempering, the glass is heated to a sufficiently high temperature of 1000 °C - 1200 °C and annealed for some time to relieve stresses. Nabertherm offers many standard and customized systems for quartz glass tempering. Brick-insulated chamber furnaces (Models N ../G see page 28) are ideal for smaller components. For large, heavy components where a crane or forklift truck is required for charging, top loading furnaces (see page 48), bogie hearth furnaces (see page 50) or top hat furnaces (see page 52) are recommended. Optional powerful cooling systems or customized insulation with special fiber material with a low thermal mass enable fast cycle times.

Drying and Curing Coatings

Often a coating is applied to protect the surface of glass, to enhance the product or to give it particular properties. Typical applications include printed or painted glass, precious metal coatings or other protective coatings. With their continuous exchange of air and forced air circulation, heating cabinets (see page 10), ovens (see page 12) and chamber ovens (see page 14) are ideal for drying and curing processes up to 360 °C. For processes in which flammable solvents are released, the ovens can be equipped with the corresponding safety technology according to EN 1539. Higher temperatures are required if, in addition to drying, the coating also has to be cured. Chamber furnaces with brick insulation and radiation heating (see page 28) and forced convection furnaces for higher temperatures (see page 20) are particularly suitable for this task. The ovens can be customized to suit individual requirements, with an extensive range of additional equipment, such as a charging trolley with shelves for chamber furnaces or shelves for forced convection furnaces.

Chamber oven KTR 1500

Fusing

Glass fusing is a process in which different glass parts are melted together. Typical application temperatures are between 700 °C and 900 °C. Fusing unicolored or multicolored glass sheets or small crushed glass pieces (powder and granules) to form a glass sheet are just some examples. For professional glass artists, Nabertherm has fusing furnaces in various sizes and designs (see page 30). The furnaces are also available with an interchangeable table system to increase throughput in commercial applications. The tables can be exchanged before they have cooled completely. An empty table can already be charged while the other one is still in the furnace. This considerably reduces cycle times (see page 34).

Fusing furnace GF 240

Bending and Curving

In curving and bending, sheets of glass are heated so that glass objects are created as the glass bends into the corresponding mold. Examples of this include curved display sheets, glass furniture, shower cabins, glass bowls and other glass objects. Nabertherm has tub furnace (see page 36) and top hat furnace (see page 38) solutions for curving and bending complex glass shapes. The furnaces are heated from several sides and ensure good temperature uniformity. The system is modular and can be extended with more tubs/tables to suite the customer's processes.

Tub furnace GW 2200

High-temperature furnace LHT 01/17 D

Melting Small Samples

To manufacture glass from raw materials in a laboratory, very high temperatures of up to 1700 °C are required so that the individual materials melt and combine with each other. Nabertherm has various solutions for melting small glass samples in customer's crucibles. Small crucibles can be placed in the compact high-temperature tabletop furnace models (see page 56) and heated to 1700 °C. Charging the furnace is simplified considerably with a motorized lift bottom (see page 57).

Chamber furnace N 7/H as tabletop model

Preheating Molds and Tools

In glass production, it is often necessary to preheat metal molds or tools so that the glass does not solidify too quickly or to keep thermal shock to an absolute minimum. Chamber furnaces with radiation heating (see page 42) or forced convection chamber furnaces (see page 20) are ideal for preheating such components. The furnaces are equipped with a lift door or parallel swing door that can be opened while the furnace is still hot. When opening, the hot side of the door swings away from the operator to ease working with the furnace.

Tube furnace RSH 80/500/13 with gas tight tube and water-cooled flanges

Systems for Manufacturing Fiber Optics

From a technical aspect, manufacturing fiber optics is a very challenging process that requires numerous heat treatment steps. Even the raw material – glass powder or granules – is generally heated in a special atmosphere to clean it. Other processes include sintering and degassing preforms. Due to the linear geometry, the flexible design for different atmospheres and the possibility to control local temperature gradients very accurately, in many cases customized tube furnaces are used in the production of fiber optics. With regard to temperature, size and interfaces to higher-level systems or sub-systems, the specifications of the furnace systems are customized to suit the customer's individual requirements. An overview of the basic tube furnaces and the extensive range of additional equipment can be found on page 76.

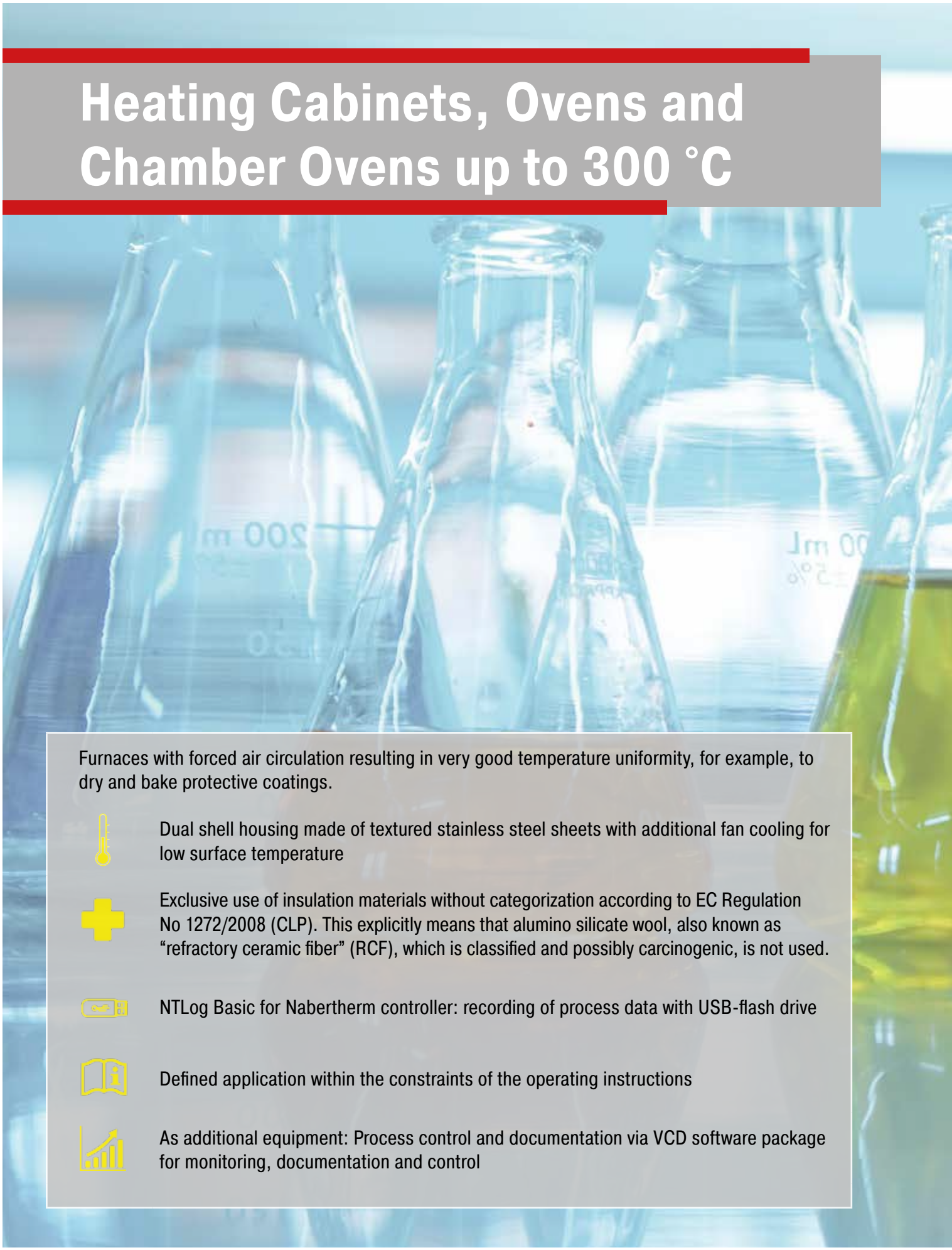
Salt-bath furnace TS 4/50

Chemical Strengthening of Glass

Chemical strengthening is a process used to strengthen very thin glass. The salt-bath furnace TS ../50 (see page 71) is designed especially for chemical strengthening of glass on a laboratory scale. It has a preheating chamber above the salt bath, which is also used after the heat treatment to cool the glass gently.

Furnace group	Model	Drying and curing coatings	Preheating molds and tools	Sterilization	Stress relief/cooling	Fusing	Bending and curving	Tempering quartz glass	Melting small samples	Research and development	Fiber optic production	Chemical strengthening
Heating Cabinets, Ovens and Chamber Ovens to 300 °C												
Heating cabinets, page 10	WK	●										
Ovens, page 12	TR	●										
Chamber ovens, page 14	KTR	●	●									
Forced Convection Furnaces and Chamber Furnaces to 900 °C												
Forced convection chamber furnaces, page 20	NA, N .. HA	●	●	●	●							
Forced convection bogie hearth furnaces, page 26	W .. A	●	●		●							
Brick-insulated chamber furnaces, page 28	N ../G	●		●	●							
Fusing Furnaces, Bending Furnaces and Systems for Curving to 950 °C												
Fusing furnaces with fixed table, page 32	GF					●						
Fusing furnaces with movable table or tub, page 34	GFM					●						
Tub furnaces with wire heating, page 36	GW						●					
Top hat furnaces with wire heating, with table page 38	HW				●		●					
Chamber Furnaces, Top Loading Furnaces, Bogie Hearth Furnaces and Top Hat Furnaces to 1400 °C												
Annealing furnaces, page 42	N ../HS		●									
Laboratory chamber furnaces with brick or fiber insulation, page 44	LH, LF		●					●				
Chamber furnaces with wire heating, page 46	N, N ../H, N ../14							●				
Top loading furnaces, page 48	S							●				
Bogie hearth furnaces, page 50	W, W ../H, W ../14							●				
Top hat furnaces or bottom loading furnaces with wire heating, page 52	H .. LB/LT							●				
High-Temperature Furnaces to 1800 °C												
High-temperature furnace, tabletop model, page 56	LHT, LHT .. LB								●			
High-temperature furnaces with molybdenum disilicide heating elements and fiber insulation up to 1800 °C, page 58	HT								●			
High-temperature furnaces with SiC rod heating and fiber insulation up to 1550 °C, page 60	HTC									●		
High-temperature furnaces with molybdenum disilicide heating elements and refractory brick insulation up to 1700 °C, page 61	HFL								●			
High-temperature top hat or bottom loading furnaces with molybdenum disilicide heating elements and fiber insulation up to 1800 °C, page 62	HT .. LB/LT									●		
Furnaces for Special Applications												
Furnaces for continuous processes, page 68	D	●										
Salt-bath furnaces, page 71	TS											●
Retort furnaces, page 72	NR, NRA									●		
Tube furnaces, page 76										●	●	

Heating Cabinets, Ovens and Chamber Ovens up to 300 °C



Furnaces with forced air circulation resulting in very good temperature uniformity, for example, to dry and bake protective coatings.

- Dual shell housing made of textured stainless steel sheets with additional fan cooling for low surface temperature
- 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.
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Defined application within the constraints of the operating instructions
- As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control

Furnace Group	Model	Page
Heating cabinets up to 150 °C	WK	10
Ovens up to 300 °C	TR	12
Chamber ovens up to 260 °C	KTR	14

Heating Cabinets
Electrically Heated

Heating cabinets are ideal for processes in the low temperature range up to max. 150 °C, such as for drying, preheating molds and tools or tempering and curing plastics. They have a compact design and are especially suitable for large charges. They are heated with a separate heating unit that is generally located behind the heating cabinet.

Heating cabinet WK 4500

Standard Equipment

- Tmax 150 °C
- Separate, electric heating unit, consisting of heater register, air circulation system, fresh air inlet and exhaust air outlet
- Powerful, turbulent air flow inside the oven
- Atmosphere exchange via open fresh air inlet and exhaust air outlet
- Temperature uniformity according to DIN 17052-1 up to +/– 6 °C see page 85
- Wall structure with 50 mm insulation for a surface temperature Tamb.+ 25 °C, slightly higher near the door. The oven thus complies with ISO 13732-1.
- Floor-level charging without floor insulation
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the heating cabinet and load
- Interior with galvanized steel plate
- Controller B400 (5 programs with 4 segments each), alternative controllers see page 81

Heating cabinet WK 12000/S

Additional Equipment

- Steel plate to protect the base against mechanical damage
- Floor insulation, also with drive-in tracks or frame
- Charging trolleys in different designs to allow for charge assembly outside the heating cabinet
- Window in the oven door and interior lighting
- Thermocouple inlets in various sizes
- Cooling system with fan

Heating cabinet WK 10000/S

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Heating power	Connected load*
	°C	b	d	h	in l	W	D	H	in kW	in kW
WK 4500	150	1500	1500	2000	4500	1980	3110	2500	18	21
WK 6000	150	1500	2000	2000	6000	1980	3610	2500	18	21
WK 6001	150	2000	1500	2000	6000	2480	3110	2500	18	21
WK 7500	150	2500	1500	2000	7500	2980	3110	2500	27	30
WK 8000	150	2000	2000	2000	8000	2460	3570	2500	27	32
WK 10000	150	2000	2500	2000	10000	2460	4070	2500	45	50
WK 10001	150	2500	2000	2000	10000	2960	3570	2500	45	50
WK 12000	150	2000	3000	2000	12000	2460	4570	2500	45	50
WK 15000	150	2500	3000	2000	15000	2900	4720	2500	54	62
WK 17500	150	2500	3500	2000	17500	2900	5220	2500	54	62

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

*Please see page 81 for more information about supply voltage

Heating cabinet WK 21600/S with heating unit on the left

Heating register WK 4500

Heating cabinet WK 5100/S with special air flow

Ovens up to 300 °C, also with Safety Technology According to EN 1539

With their maximum working temperature of up to 300 °C and forced air circulation, the ovens achieve a very good temperature uniformity. They can be used for various applications such as e. g. drying, sterilizing or warm storing. Short delivery times from stock are ensured for standard models.

Oven TR 240

Oven TR 450

Standard Equipment

- Tmax 300 °C
- Working temperature range: + 20 °C above room temperature up to 300 °C
- Ovens TR 30 - TR 420 designed as tabletop models
- Ovens TR 450 - TR 1050 designed as floor standing models
- Horizontal forced air circulation results in temperature uniformity according to DIN 17052-1 better than +/– 5 °C in the empty oven (with closed exhaust air flap) see page 85
- Stainless steel furnace housing, material no. 1.4016 (DIN)
- Stainless steel chamber, alloy 304 (AISI)/(DIN material no. 1.4301), rust-resistant and easy to clean
- Charging in multiple layers possible using removeable grids (number of removeable grids included, see table to the right)
- Large, wide-opening swing door, hinged on the right with quick release for models TR 30 - TR 240 and TR 450
- Double swing door with quick release for models TR 420, TR 800 and TR 1050
- Ovens TR 800 and TR 1050 equipped with transport castors
- Infinitely adjustable exhaust at the rear wall with operation from the front
- PID microprocessor control with self-diagnosis system
- Models TR .. LS: Safety technology according to EN 1539 for charges containing liquid solvents, achievable temperature uniformity +/– 8 °C according to DIN 17052-1 in the empty oven (with closed exhaust air flap) see page 85
- Controller R7 (resp. C450 for TR .. LS), alternative programmable controllers see page 81

Additional Equipment

- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the oven and load
- Fan speed of the air circulation fan can be reduced infinitely
- Window for charge observing
- Further removeable grids with rails
- Side inlet
- Electrical rotary device (associated sample holder will be individually adapted to the charge)
- Exhaust air duct DN 80
- Transport castors for models TR 240 - TR 450
- Upgrading available to meet the quality requirements of AMS2750F or FDA
- Fresh-air filter to reduce dust inside the furnace

Oven TR 420

Oven TR 1050 with double door

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Connected	Electrical	Weight	Minutes	Grids	Grids	Max.
	in °C	w	d	h	in l	W	D	H	load in kW	connection*	in kg	to Tmax[2]	included	max.	total load[3]
TR 30	300	360	300	300	30	610	570	665	2.1	1-phase	45	25	1	4	80
TR 60	300	450	390	350	60	700	610	710	3.1	1-phase	90	25	1	4	120
TR 60 LS	260	450	360	350	60	700	820	710	5.3	3-phase	100	25	1	4	120
TR 120	300	650	390	500	120	900	610	860	3.1	1-phase	120	45	2	7	150
TR 120 LS	260	650	360	500	120	900	820	870	6.3	3-phase	120	45	2	7	150
TR 240	300	750	550	600	240	1000	780	970	3.1	1-phase	165	60	2	8	150
TR 240 LS	260	750	530	600	240	1000	990	970	6.3	3-phase	180	60	2	8	150
TR 420	300	1300	550	600	420	1550	815	970	6.3	3-phase	250	60	2	8	200
TR 450	300	750	550	1100	450	1000	780	1470	6.3	3-phase	235	60	3	15	180
TR 450 LS	260	750	530	1100	450	1000	990	1470	12.6	3-phase	250	60	3	15	180
TR 800	300	1200	670	1000	800	1470	970	1520	6.3	3-phase	360	80	3	10	250
TR 1050	300	1200	670	1400	1050	1470	970	1920	9.3	3-phase	450	80	4	14	250

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request
[2]In the empty and closed oven, connected to 230 V 1/N/PE resp. 400 V 3/N/PE
[3]Max load per layer 30 kg

*Please see page 81 for more information about supply voltage

Oven TR 30 with observation window

Extricable metal grids to load the oven in different layers

Electrical rotating device (in this case with tailored platform for PARR autoclave containers)

Chamber Ovens
Electrically Heated or Gas-Fired

The chamber ovens of the KTR range can be used for complex drying processes and heat treatment of charges to an application temperature of 260 °C. The high-performance air circulation enables optimum temperature uniformity throughout the work space. A wide range of accessories allow the chamber ovens to be modified to meet specific process requirements.

Chamber oven KTR 6125

Direct gas-firing at a chamber oven

Chamber oven KTR 1500 with charging cart

Standard Equipment

- Tmax 260 °C
- Electrically heated (via a heating register with integrated chrome steel heating elements) or gas-fired (direct or indirect gas-fired including injection of the hot air into the intake duct)
- Temperature uniformity up to +/– 3 °C according to DIN 17052-1 (for design without track cutouts) see page 85
- High-quality mineral wool insulation provides for outer temperatures of < 25 °C above room temperature
- Incl. floor insulation
- High air exchange for fast drying processes
- Double-wing door for furnaces KTR 2300 and larger
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the oven and load
- Controller B400 (5 prgrams with each 4 segments), alternative controllers see page 81

Additional Equipment

- Base frame to charge the oven via a charging forklift
- Additional door in the back for charging from both sides or to use the oven as lock between two rooms
- Fan system for faster cooling with manual or motor-driven control of the exhaust flaps
- Programmed opening and closing of exhaust air flaps
- Air circulation with speed control, recommendable for processes with light or sensitive charge
- Observation window and furnace chamber lighting
- Safety technology according to EN 1539 (models KTR .. LS) for charges containing solvents see page 17
- Design for clean room heat treatment processes
- Rotating systems e. g. for tempering processes
- All KTR-models are also available with Tmax 300 °C

Chamber oven KTR 22500/S with chamber lightning and drive-in tracks with insulated plugs which provide for an optimal temperature uniformity

Chamber oven KTR 3100/S for curing of composites in vacuum bags incl. pump and necessary connections in the oven chamber

Accessories

- Adjustable plate shutters to adapt the air guide to the charge and improve temperature uniformity
- Guide-in tracks and shelves
- Shelves with 2/3 extraction with evenly distributed load on the whole shelve surface
- Platform cart in combination with drive-in tracks
- Charging cart with rack system in combination with drive-in tracks
- Sealing shoes for ovens with drive-in tracks to improve temperature uniformity in the work space

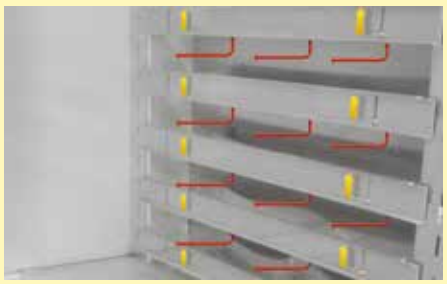
Chamber oven KTR 6250 with double doors in the front and in the back as well as guide-in tracks for use as sluice oven

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[2] in mm			Heating power in kW[1]		Electrical
	°C	w	d	h	in l	W	D	H	KTR	KTR .. LS	connection*
KTR 1000 (LS)	260	1000	1000	1000	1000	1820	1430	1890	18	36	3-phase
KTR 1500 (LS)	260	1000	1000	1500	1500	1820	1430	2390	18	36	3-phase
KTR 2000 (LS)	260	1100	1500	1200	2000	1920	1930	2090	18	36	3-phase
KTR 2300 (LS)	260	1250	1250	1500	2300	2120	1680	2460	27	36	3-phase
KTR 3100 (LS)	260	1250	1250	2000	3100	2120	1680	2960	27	45	3-phase
KTR 3400 (LS)	260	1500	1500	1500	3400	2370	1930	2460	45	54	3-phase
KTR 4500 (LS)	260	1500	1500	2000	4500	2370	1930	2960	45	54	3-phase
KTR 4600 (LS)	260	1750	1750	1500	4600	2620	2175	2480	45	54	3-phase
KTR 6000 (LS)	260	2000	2000	1500	6000	2870	2430	2460	54	54	3-phase
KTR 6125 (LS)	260	1750	1750	2000	6125	2620	2175	2980	45	63	3-phase
KTR 6250 (LS)	260	1250	2500	2000	6250	2120	3035	2960	54	63	3-phase
KTR 8000 (LS)	260	2000	2000	2000	8000	2870	2430	2960	54	81	3-phase
KTR 9000 (LS)	260	1500	3000	2000	9000	2490	3870	2920	72	90	3-phase
KTR 12300 (LS)	260	1750	3500	2000	12300	2620	4350	2980	90	108	3-phase
KTR 13250 (LS)	260	1250	5000	2000	13250	2120	6170	2960	108	108	3-phase
KTR 16000 (LS)	260	2000	4000	2000	16000	2870	4850	2960	108	120	3-phase
KTR 21300 (LS)	260	2650	3550	2300	21300	3600	4195	3380	108	120	3-phase
KTR 22500 (LS)	260	2000	4500	2500	22500	3140	5400	3500	108	120	3-phase

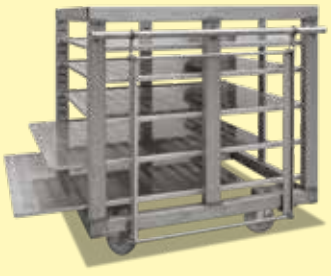
[1]Depending on furnace design connected load might be higher

*Please see page 81 for more information about supply voltage

[2]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.Outer dimensions from chamber ovens KTR .. LS are different



Adjustable plate shutters to adapt the air guide to the charge

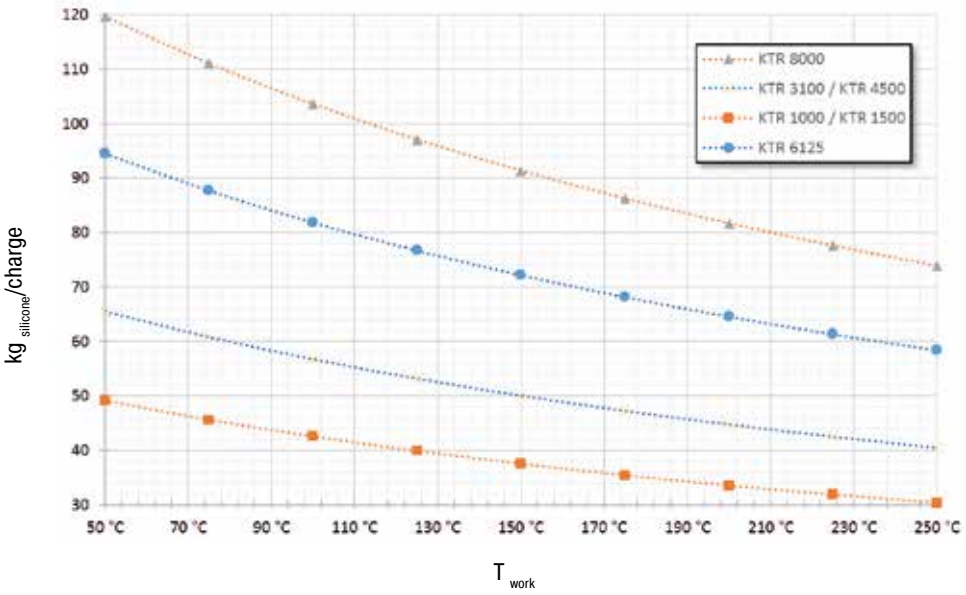


Charging cart with pull-out trays

Pull-out shelves, running on rolls

Adjustable plate shutters to adapt the air guide to the charge

Max. amount of silicone per charge at a fresh air amount of 120 l/min/kg $_{silicone}$



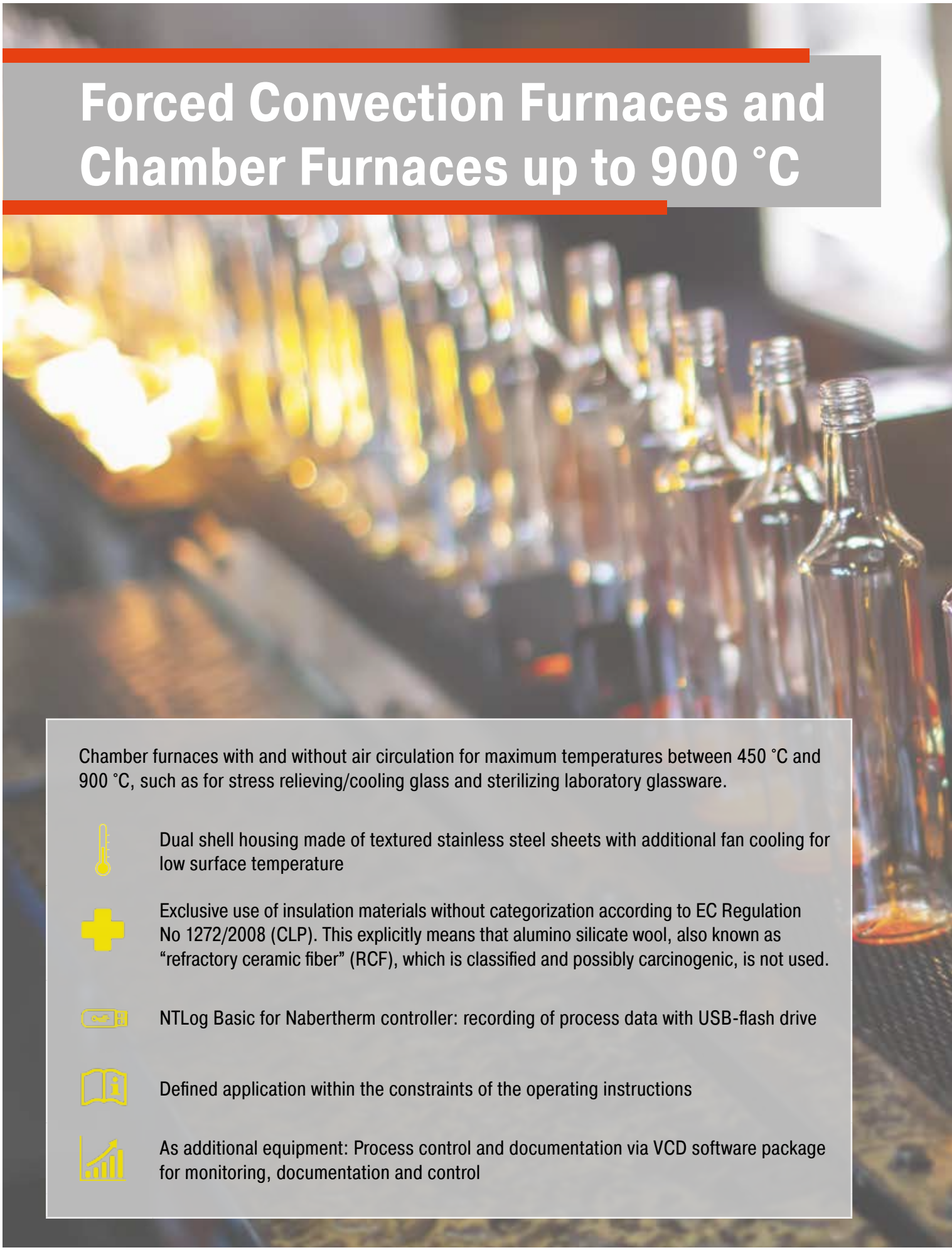
Motor-driven rotary rack with baskets for moving the charge during heat treatment

To ensure safe operation of the oven when tempering silicone, the fresh air supply of the oven must be monitored. A fresh air volume flow of 100 - 120 l/min/kg silicone (6 - 7,2 m³/h/kg silicone) has to be considered. The graph shows the maximum amount of silicone depending on the operating temperature for various KTR models at a fresh air supply of 120 l/min/kg silicone. The oven will be carried out in accordance with the requirements of the standard EN 1539.

Drive-in ramp

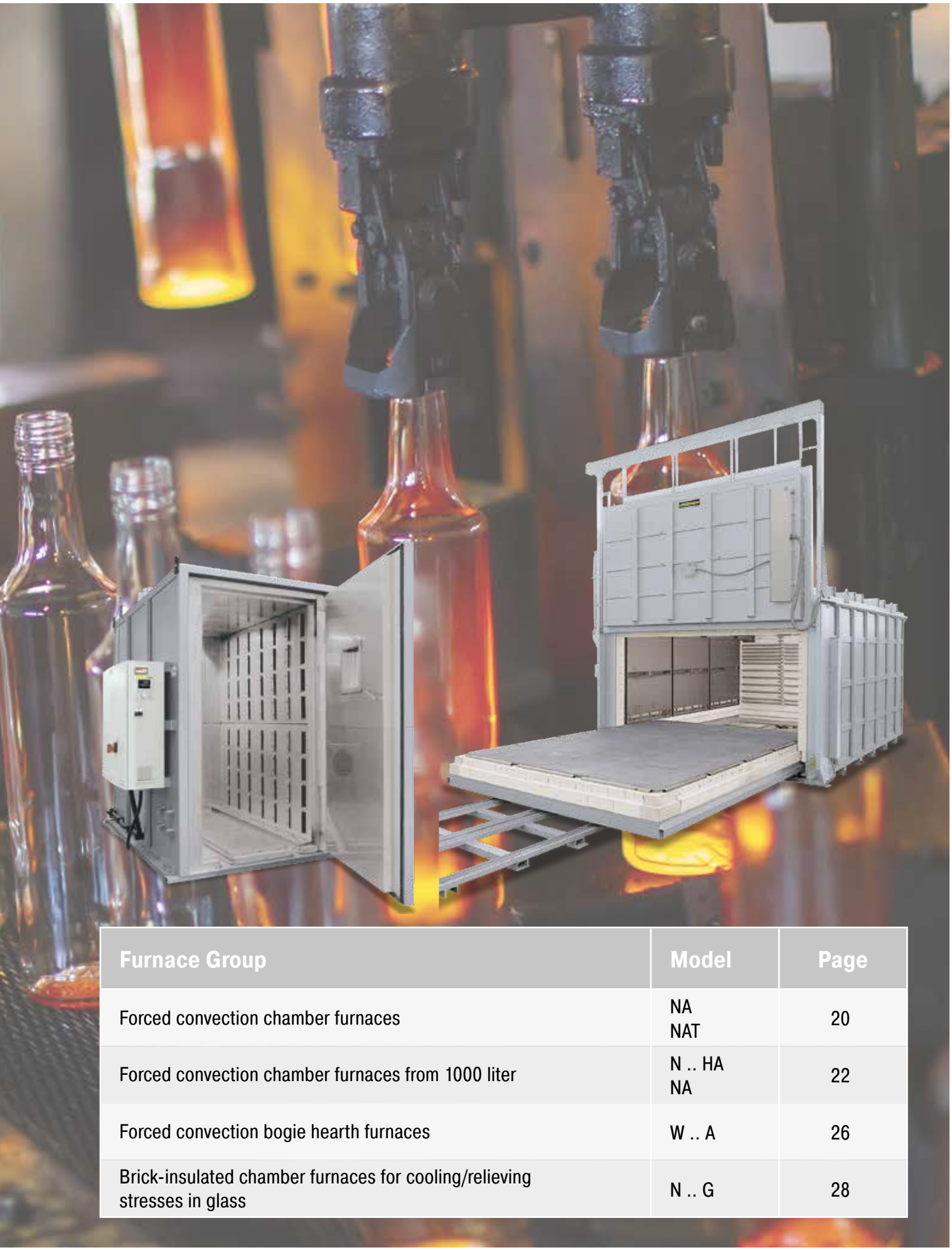
KTR 3100 DT with rotating system for tempering of silicone parts. Four baskets will be charged in the frame and can be taken out separately

Forced Convection Furnaces and Chamber Furnaces up to 900 °C



Chamber furnaces with and without air circulation for maximum temperatures between 450 °C and 900 °C, such as for stress relieving/cooling glass and sterilizing laboratory glassware.

- Dual shell housing made of textured stainless steel sheets with additional fan cooling for low surface temperature
- 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.
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Defined application within the constraints of the operating instructions
- As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control



Furnace Group	Model	Page
Forced convection chamber furnaces	NA NAT	20
Forced convection chamber furnaces from 1000 liter	N .. HA NA	22
Forced convection bogie hearth furnaces	W .. A	26
Brick-insulated chamber furnaces for cooling/relieving stresses in glass	N .. G	28

Forced Convection Chamber Furnaces
Electrically Heated

Due to their very good temperature uniformity, these forced convection chamber furnaces with air circulation are suitable for processes such as stress relieving, artificial aging, and cooling glass as well as pre-heating glass molds. To burn in release agents in glass molds, to burn in organic pastes or to sterilize laboratory glassware, the forced convection chamber furnaces are equipped with the corresponding passive safety concepts. The modular design of the forced convection chamber furnaces allows them to be adapted with appropriate accessories to suit process requirements.

Forced convection chamber furnace NAT 15/85 as table-top model

Standard Equipment

- Tmax 450 °C, 650 °C, or 850 °C
- Horizontal air circulation with optimum distribution through stainless steel baffles
- Swing door hinged on the right
- Temperature uniformity up to +/– 4 °C according to DIN 17052-1 (NAT 15/65 up to +/– 5 °C, NAT ../85 up to +/– 6 °C) in the empty work space see page 85
- One frame sheet and rails for two additional trays included in the scope of delivery (Models NAT .. without frame sheet)
- Base frame included in the delivery, models NAT .. designed as table-top model
- Controller B400/B410 (5 programs with each 4 segments), alternative controllers see page 81

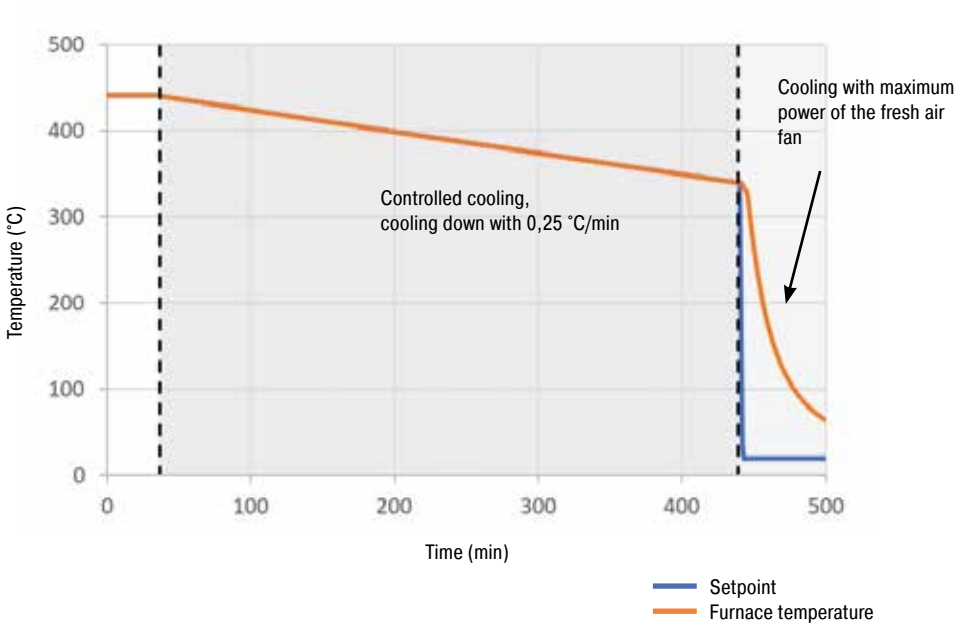
Forced convection chamber furnace NA 120/45

Additional Equipment (not for Models NAT ..)

- Optimization of the temperature uniformity up to +/– 3 °C according to DIN 17052-1 in the empty work space see page 85
- Air inlet and exhaust air flaps when used for drying
- Controlled cooling with Controller P470, for example, to relieve stresses in glass at low cooling rates (optional: PLC with controlled cooling and optimized control accuracy for cooling rates as low as 0.2 °C per hour)
- Manual lift door (up to model NA 120/..)
- Electro-hydraulic/pneumatic lift door
- Air circulation with speed control, recommendable for processes with light or sensitive charge
- Additional frame sheet
- Gas supply boxes different charging methods
- Feed and charging aids
- Safety technology according to EN 1539 (models NA .. LS) for charges containing solvents
- Furnaces in DB design with fresh air preheating, exhaust gas fan, and extensive safety package for processes with low evaporation rates of organic material
- Inlets, measuring frames and thermocouples for TUS measurements charge or comparative measurements
- Charge control with documentation of the charge thermocouple

Forced convection chamber furnace NA 30/65 with manual lift door and protective gas box

Temperature curve with additional equipment „controlled cooling“ switched on



Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[3] in mm			Heating power in kW[4]		Electrical	Weight
	in °C	w	d	h	in l	W	D	H	NA	NA .. LS	connection*	in kg
NA 30/45 (LS)	450	290	420	260	30	1040	1290	1385	3.0	9.0	1-phase	290
NA 60/45 (LS)	450	350	500	350	60	1100	1370	1475	6.0	12.0	3-phase	350
NA 120/45 (LS)	450	450	600	450	120	1250	1550	1550	9.0	18.0	3-phase	460
NA 250/45 (LS)	450	600	750	600	250	1350	1650	1680	12.0	24.0	3-phase	590
NA 500/45 (LS)	450	750	1000	750	500	1550	1900	1820	18.0	24.0	3-phase	750
NA 675/45 (LS)	450	750	1200	750	675	1550	2100	1820	24.0	30.0	3-phase	900
NAT 15/65[1]	650	295	340	170	15	470	790	460	2.8		1-phase	60
NA 30/65	650	290	420	260	30	870	1290	1385	6.0		3-phase[2]	350
NA 60/65	650	350	500	350	60	910	1390	1475	9.0		3-phase	450
NA 120/65	650	450	600	450	120	990	1470	1550	12.0		3-phase	520
NA 250/65	650	600	750	600	250	1170	1650	1680	20.0		3-phase	730
NA 500/65	650	750	1000	750	500	1290	1890	1825	27.0		3-phase	950
NA 675/65	650	750	1200	750	675	1290	2100	1825	27.0		3-phase	1050
NAT 15/85[1]	850	320	320	150	15	690	880	570	3.0		1-phase	85
NAT 30/85[1]	850	320	320	300	30	690	880	720	3.0		1-phase	100
NAT 50/85[1]	850	400	320	400	50	770	880	820	4.5		3-phase	130
NA 60/85	850	350	500	350	60	790	1330	1440	9.0		3-phase	315
NA 120/85	850	450	600	450	120	890	1420	1540	12.0		3-phase	390
NA 250/85	850	600	750	600	250	1120	1690	1810	20.0		3-phase	840
NA 500/85	850	750	1000	750	500	1270	1940	1960	30.0		3-phase	1150
NA 675/85	850	750	1200	750	675	1270	2190	1960	30.0		3-phase	1360

[1]Table-top model
[2]Heating only between two phases
[3]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[4]Depending on furnace design connected load might be higher

*Please see page 81 for more information about supply voltage

Port for thermocouple

Tray

Roller conveyor in furnace chamber

Forced Convection Chamber Furnaces from 1000 Liter
Electrically Heated or Gas-Fired

These forced convection chamber furnaces are available for maximum operating temperatures of 450 °C, 600 °C or 850 °C and are suitable for a wide range of processes. Due to their robust and solid design even heavy loads can be heat treated. These furnaces are suited for use with baskets, pallets, and mobile furnace racks. The charging can be carried out with fork lift, pallet truck, or charging trolley. Charging can be simplified by roller conveyors, if necessary also motorized. All furnaces are available with electric heating or gas heating.

Forced convection chamber furnace NA 3240/45S

Forced convection furnace NA 4010/45 with track cutouts, chamber lighting and observation window

Forced convection chamber furnace NA 4000/45

Standard Equipment for Models up to 600 °C (850 °C Models See Page 23)

- Tmax 450 °C or 600 °C
- Electrically heated or gas-fired
- Electric heating by means of heater coils
- Direct gas heating or upon request with indirect gas heating with radiation tube, e. g. for heat treatment of aluminum
- Horizontal air circulation (type ../HA)
- High air exchange for perfect heat transfer
- Temperature uniformity up to +/– 5 °C according to DIN 17052-1 see page 85
- Furnace chamber lined with alloy 1.4301 (DIN)
- High quality mineral wool insulation provides for low outer temperatures
- Inside unlocking device for furnaces with walk-in work space
- Furnace sizes suitable for common charging systems, such as pallets, baskets, etc.
- Double-wing door for furnaces with an internal width of more than 1500 mm (450 °C models). Furnaces for higher temperatures and with smaller sizes are equipped with a single-wing door.
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load

Additional Equipment for Models up to 600 °C

- Entry ramps for palet truck or drive-in tracks for entry of charging carts for models with floor insulation (not for 600 °C models)
- Electro-hydraulic lift door
- Cooling systems for faster cooling
- Motor-driven control of air inlet and exhaust air flaps for better ventilation of the furnace chamber
- Observation window and/or furnace chamber lighting (not for 600 °C models)
- Optimization of the temperature uniformity up to +/– 3 °C according to DIN 17052-1 see page 85
- Safety technology according to EN 1539 for charges containing solvents (not for 600 °C models)
- Charging systems or roller conveyors, also electrically driven provide for easy charging
- Catalytic or thermal exhaust gas cleaning systems
- Power-reduced version to save energy on request

Forced convection chamber furnace NA 5600/45S

Forced convection chamber furnace N 1500/85HA with lift door and work piece holders in the furnace

Standard Equipment for Models 850 °C

- Tmax 850 °C
- Electrically heated or gas-fired
- Electric heating with heating elements on supports tubes
- Direct gas heating into the outlet of the air circulation fan
- Optimal air circulation for your charge by means of adjustable air outlets
- Horizontal air circulation (type ../HA)
- High air exchange provides for perfect heat transfer
- Base frame with 500 mm charging height
- Temperature uniformity up to +/– 5 °C according to DIN 17052-1 see page 85
- Air baffles made of 1.4828 (DIN)
- High quality mineral wool insulation provides for low outer temperatures
- Furnaces sizes perfectly suited to accommodate common charging systems, e. g. like pallets or pallet boxes
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load

Forced convection chamber furnace N 1500/85HA with electric charging system for heavy loads

Additional Equipment for Models 850 °C

- Electro-hydraulic lift door
- Cooling systems for faster cooling
- Motor-driven air inlet and control of exhaust air flaps for better ventilation of the furnace chamber
- Optimization of the temperature uniformity up to +/– 3 °C according to DIN 17052-1 see page 85
- Base frame for customized charging height
- Charging systems or roller conveyors, also electrically driven provide for easy charging

Forced convection chamber furnace NA 1500/45 on base with guide rails and end stop for a custom-built charging forklift, custom-built charge support and ramming protection

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Circulation	Heating	Electrical
	°C	w	d	h	in l	W	D	H	rate m^3/h	power in kW^2	connection*
NA 1000/45	450	1000	1000	1000	1000	2015	2150	1700	3600	36	3-phase
NA 1500/45	450	1000	1500	1000	1500	2015	2650	1700	3600	36	3-phase
NA 1500/45B	450	1500	1000	1000	1500	2515	2150	1700	3600	36	3-phase
NA 2000/45	450	1100	1500	1200	2000	2115	2650	1870	6400	48	3-phase
NA 2000/45B	450	1500	1100	1200	2000	2515	2250	1870	6400	48	3-phase
NA 2010/45	450	1000	1000	2000	2000	2015	2200	2670	9000	48	3-phase
NA 2880/45	450	1200	1200	2000	2880	2215	2400	2670	9000	60	3-phase
NA 4000/45	450	1500	2200	1200	4000	2515	3350	1870	6400	60	3-phase
NA 4000/45B	450	2200	1500	1200	4000	3315	2650	1870	6400	60	3-phase
NA 4010/45	450	1000	2000	2000	4000	2015	3200	2670	9000	60	3-phase
NA 4010/45B	450	2000	1000	2000	4000	3015	2200	2670	9000	60	3-phase
NA 4500/45	450	1500	1500	2000	4500	2550	2750	2670	9000	60	3-phase
NA 7200/45	450	2000	1500	2400	7200	3050	2750	3070	9000	108	3-phase
NA 1000/60	600	1000	1000	1000	1000	2015	2150	1700	3600	36	3-phase
NA 1500/60	600	1000	1500	1000	1500	2015	2650	1700	3600	36	3-phase
NA 1500/60B	600	1500	1000	1000	1500	2515	2150	1700	3600	36	3-phase
NA 2000/60	600	1100	1500	1200	2000	2115	2650	1870	6400	48	3-phase
NA 2000/60B	600	1500	1100	1200	2000	2515	2250	1870	6400	48	3-phase
NA 2010/60	600	1000	1000	2000	2010	2015	2200	2670	9000	48	3-phase
NA 2880/60	600	1200	1200	2000	2010	2215	2400	2670	9000	60	3-phase
NA 4000/60	600	1500	2200	1200	4000	2515	3350	1870	6400	60	3-phase
NA 4000/60B	600	2200	1500	1200	4000	3315	2650	1870	6400	60	3-phase
NA 4010/60	600	1000	2000	2000	4010	2015	3200	2670	9000	60	3-phase
NA 4010/60B	600	2000	1000	2000	4010	3015	2200	2670	9000	60	3-phase
NA 4500/60	600	1500	1500	2000	4500	2550	2750	2670	9000	60	3-phase
NA 7200/60	600	2000	1500	2400	7200	3050	2750	3070	9000	108	3-phase
N 1000/85HA	850	1000	1000	1000	1000	2100	2160	1900	3400	40	3-phase
N 1500/85HA	850	1500	1000	1000	1500	2600	2000	1900	6400	40	3-phase
N 1500/85HA1	850	1000	1500	1000	1500	2100	2600	1900	6400	40	3-phase
N 2000/85HA	850	1500	1100	1200	2000	2700	2320	2100	9000	60	3-phase
N 2000/85HA1	850	1100	1500	1200	2000	2300	2800	2100	9000	60	3-phase
N 4000/85HA	850	1500	2200	1200	4000	2700	3700	2100	12600	90	3-phase

[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 81 for more information about supply voltage

Drive-in ramps at furnaces with bottom insulation for processes which require a good temperature uniformity

Forced convection chamber furnaces, gas fired, e. g., with compact burner

Enclosed heater coils on electrically heated models

Directly gas-fired forced convection chamber furnace NB 10080/26HAS with driven charging cart

Forced Convection Bogie Hearth Furnaces

The forced convection bogie hearth furnaces W 1000/60A - W 8300/85A are used when heavy charges weighing have to be heat-treated. They are ideal for processes such as solution like glass tempering or cooling from glass, for which a good temperature uniformity is crucial. The high-performance air circulation assures that the temperature uniformity achieved throughout the work space is outstanding. A broad selection of additional equipment enables these bogie hearth furnaces to be optimally adapted to suit specific processes.

Forced convection bogie hearth furnace W 10430/85AS

Standard Equipment

- Tmax 600 °C or 850 °C
- Dual shell housing with rear ventilation provides for low shell temperatures for the 850 °C models
- Swing door hinged on the right side
- Heating from chrome steel heating elements for the 600 °C models
- Heating from three sides (both side walls and the trolley) for the 850 °C models
- High-performance air circulation fan with vertical circulation
- Temperature uniformity up to +/– 5 °C according to DIN 17052-1 see page 85
- Bottom heating protected by SiC tiles on the bogie providing level stacking surface for the 850 °C models
- Furnace chamber fitted with inner sheets made of stainless steel 1.4301 for 600 °C models and of 1.4828 for 850 °C models
- Insulation structured with high-quality mineral wool for 600 °C models
- Bogies with flanged wheels running on rails for easy and precise movement of heavy loads
- Electric chain-driven bogie in combination with rail operation for smooth movement of heavy loads from model W 4800
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Controller B400 (5 prgrams with each 4 segments), alternative controllers see page 81

Forced convection bogie hearth furnace W 3300/85S with chain drive

Additional Equipment

- Electric chain-driven bogie in combination with rail operation for smooth movement of heavy loads up to Model W 4000
- Optimization of the temperature uniformity up +/– 3 °C according to DIN 17052-1 see page 85
- Different possibilities for an extension to a bogie hearth furnace plant:
  - Additional bogies
  - Bogie transfer system with parking rails to exchange bogies running on rails or to connect multiples furnaces
  - Motorized bogies and cross-traversal system
  - Fully automatic control of the bogie exchange
- Electro-hydraulic lift door
- Motorized fresh-air and exhaust air flaps, adjustable via the program
- Cooling systems for more rapid cooling
- Bar supports or grids for higher charge weights and/or better load distribution
- Commissioning of the furnace with test firing and temperature uniformity measurement (also with load) for the purpose of process optimization

Forced convection bogie hearth furnace W 19150/60AS for tempering of semi-finished borosilicate glass products

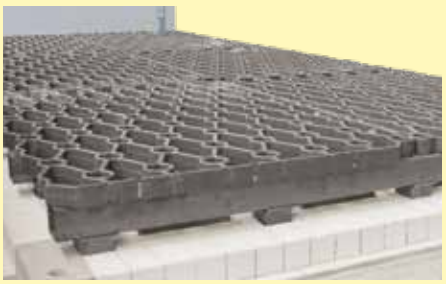
Model	Tmax	Inner dimensions in mm			Volume	Max. charging weight	Outer dimensions[1] in mm			Heating power	Electrical
	°C	w	d	h	in l	in kg	W	D	H	in kW[2]	connection*
W 1000/.. A	600	800	1600	800	1000	800	1780	2450	2350	48	3-phase
W 1600/.. A	600	1000	1600	1000	1600	1000	1920	2450	2510	48	3-phase
W 2200/.. A	600	1000	2250	1000	2200	1500	1980	3100	2560	96	3-phase
W 3300/.. A	600	1200	2250	1200	3300	1900	2180	3100	2750	96	3-phase
W 4000/.. A	600	1500	2250	1200	4000	2400	2480	3100	2800	120	3-phase
W 4800/.. A	600	1200	3300	1200	4800	2800	2180	4380	2850	120	3-phase
W 6000/.. A	600	1500	3300	1200	6000	3700	2480	4380	2900	144	3-phase
W 6600/.. A	600	1200	4600	1200	6600	4000	2280	5680	2780	144	3-phase
W 7500/.. A	600	1400	3850	1400	7500	4000	2380	4930	3020	144	3-phase
W 8300/.. A	600	1500	4600	1200	8300	5200	2580	5680	2950	192	3-phase
W 1000/.. A	850	800	1600	800	1000	800	1780	2450	2350	45	3-phase
W 1600/.. A	850	1000	1600	1000	1600	1000	1920	2450	2510	45	3-phase
W 2200/.. A	850	1000	2250	1000	2200	1500	1980	3100	2560	90	3-phase
W 3300/.. A	850	1200	2250	1200	3300	1900	2180	3100	2750	90	3-phase
W 4000/.. A	850	1500	2250	1200	4000	2400	2480	3100	2800	110	3-phase
W 4800/.. A	850	1200	3300	1200	4800	2800	2180	4380	2850	110	3-phase
W 6000/.. A	850	1500	3300	1200	6000	3700	2480	4380	2900	140	3-phase
W 6600/.. A	850	1200	4600	1200	6600	4000	2280	5680	2780	140	3-phase
W 7500/.. A	850	1400	3850	1400	7500	4000	2380	4930	3020	140	3-phase
W 8300/.. A	850	1500	4600	1200	8300	5200	2580	5680	2950	185	3-phase

[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 81 for more information about supply voltage

Cooling fan for accelerated cooling

Charge thermocouples with plug-in connection



Charging grid in an forced convection boogie hearth furnace for even load distribution

Brick-Insulated Chamber Furnaces for Cooling/Relieving Stresses in Glass

The chamber furnaces to 900 °C are ideally suited for cooling and relieving stresses in glass. Other applications include sterilizing glass components after they have been cleaned and burning in coatings. 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 660/G with exhaust flue and switchgear on the side (special design)

Standard Equipment

- Tmax 900 °C
- Five-side heating provide for good temperature uniformity
- Heating elements on support tubes provide for free heat radiation and long service life
- 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
- Bottom heating protected by SiC tiles with an even stacking base
- 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 P470 (50 programs with each 40 segments), controls description see page 80

Chamber furnace N 300/G with controlled cooling

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 P470 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 protective or reaction gases
- Automatic gas supply system for nitrogen or argon
- 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
- Metal charging trolley with inserts for Tmax 550 °C or Tmax 800 °C
- Special solutions with customer-specific diameters

Chamber furnace N 500/GS

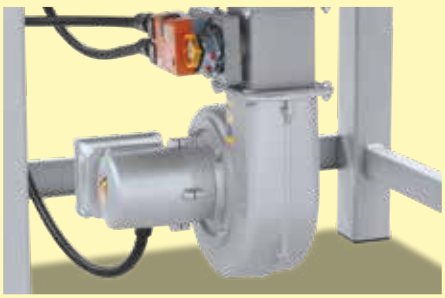
Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Heating power	Electrical	Weight
	°C	w	d	h	in l	W	D	H	in kW[2]	connection*	in kg
N 100/G	900	400	530	460	100	720	1130	1440	7	3-phase	275
N 150/G	900	450	530	590	150	770	1130	1570	9	3-phase	320
N 200/G	900	470	530	780	200	790	1130	1760	11	3-phase	375
N 200/GS	900	400	1000	500	200	795	1710	1605	16	3-phase	300
N 250/GS	900	500	1000	500	250	895	1710	1605	18	3-phase	370
N 300/G	900	550	700	780	300	870	1300	1760	15	3-phase	450
N 360/GS	900	600	1000	600	360	995	1710	1705	20	3-phase	500
N 440/G	900	600	750	1000	440	1000	1410	1830	20	3-phase	820
N 500/GS	900	600	1400	600	500	995	2110	1705	22	3-phase	1000
N 660/G	900	600	1100	1000	660	1000	1750	1830	26	3-phase	950
N 1000/G	900	800	1000	1250	1000	1390	1760	2000	40	3-phase	1680
N 1500/G	900	900	1200	1400	1500	1490	1960	2150	57	3-phase	2300
N 2200/G	900	1000	1400	1600	2200	1590	2160	2350	75	3-phase	2800

[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 81 for more information about supply voltage

Charging trolley	Trolley dimensions in mm			Insert dimensions in mm			Removable rails	
for model[3]	W	D	H	W	D	H	Quantity	Distance in mm
N 100/G	370	505	410	315	470	22	12	30
N 150/G	430	505	540	375	470	22	12	40
N 200/G	450	505	730	395	470	22	17	40
N 300/G	530	675	730	478	640	22	17	40

[3]Charging trolley for larger models available as a special design

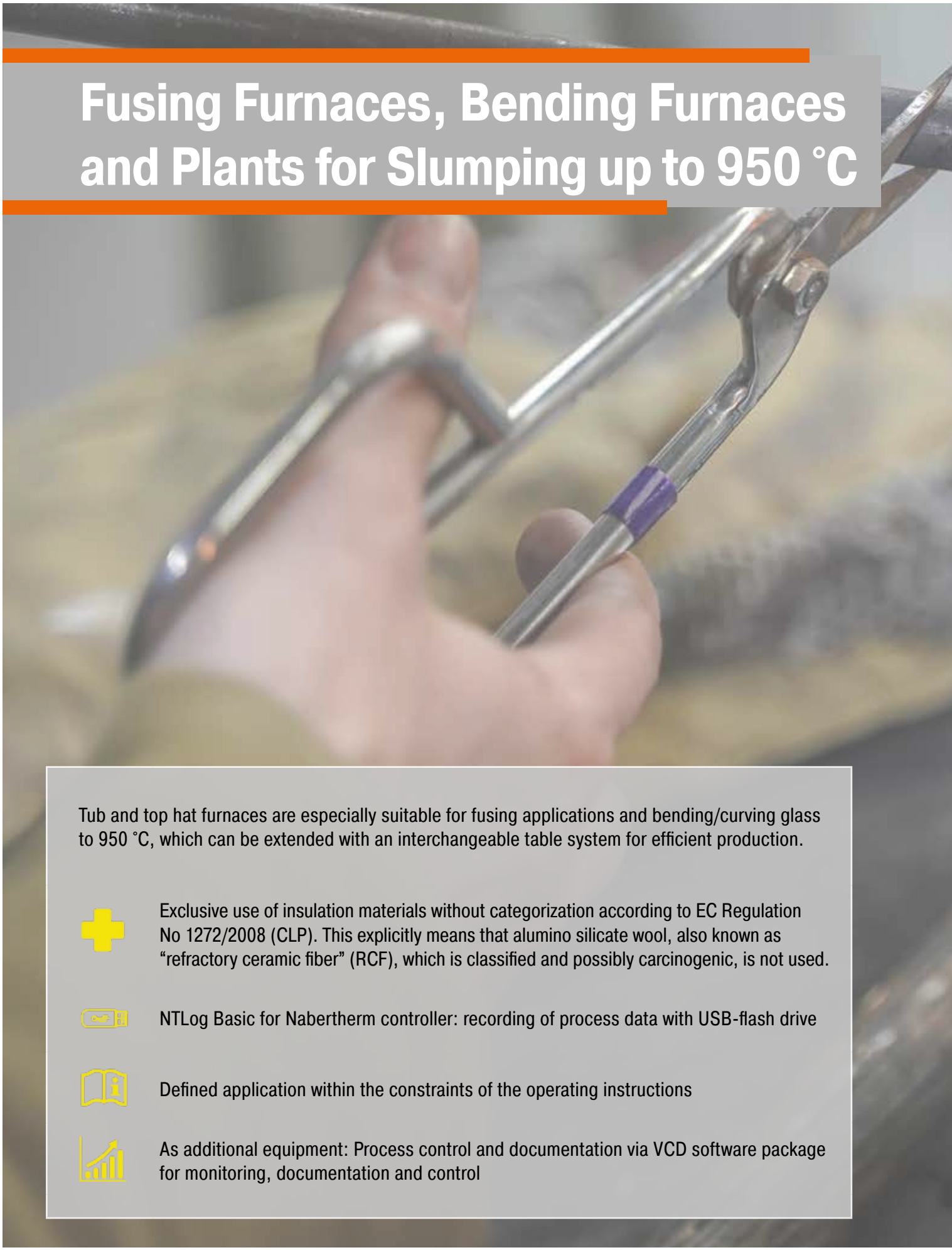


Controlled cooling as additional equipment

Charging trolley for chamber furnace N 2200

Switchgear on the side (special design)

Fusing Furnaces, Bending Furnaces and Plants for Slumping up to 950 °C



Tub and top hat furnaces are especially suitable for fusing applications and bending/curving glass to 950 °C, which can be extended with an interchangeable table system for efficient production.

- 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.
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Defined application within the constraints of the operating instructions
- As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control

Furnace Group	Model	Page
Fusing furnaces with fixed table	GF	32
Fusing furnaces with movable table	GFM	34
Tub furnaces with wire heating	GW	36
Top hat furnaces with wire heating with table	HG	38

Fusing Furnaces with Fixed Table

The fusing furnaces in the GF 75 - GF 1425 series are designed for professionals. Closely arranged heating elements protected in quartz glass tubes ensure very good temperature accuracy during fusing or bending on the complete area of the table. All models have an appealing, dual-shell stainless steel housing. The level table surface made from rugged, durable refractory material and the lid opening with gas pressure springs as support simplify charging of the furnace. The optimized electrical connected load ensures that the glass heats up quickly.

Fusing furnace GF 75

Fusing furnace GF 240

Standard Equipment

- Tmax 950 °C, GF 75: Tmax 900 °C
- Heating element, protected in quartz tubes
- High current connection capacities for short warm-up times and energy-saving way of working
- Arranged closely beside each other on the top, heating elements ensure direct and uniform radiation of the glass
- Dual shell hood made of stainless steel with slotted cover lid
- Controller integrated to save space on the right side of the furnace
- Level table surface with insulation made of robust lightweight refractory bricks and marked charge surface
- Top hat insulated with high-quality fiber material; 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.
- Adjustable, large quick-release fasteners - can be used while working in gloves
- Handles on the left and right side of the hood for opening and closing the furnace
- Hood safety switch
- Solid state relays provide for low-noise operation
- Rapid switching cycles result in precise temperature control
- Type K thermocouple
- Hood easy to open and close, supported by compressed-gas springs
- Lockable air inlet opening for ventilation, fast cooling and observation of charge
- Robust base on rollers (two of them can be locked down) with tray for glass and tools
- Comfortable charging height of 860 mm
- Controller C440 (10 programs with each 20 segments), controls description see page 80

Additional Equipment

- Motorized lid opening for faster cooling for models GF 380 up
- Bottom heating for uniform through heating of large objects
- Cooling fan for accelerated cooling with closed lid
- Motorized exhaust air flap for faster cooling of the fusing furnace
- Air inlet flap with window for observing the glass

Fusing furnace GF 920

Model	Tmax	Inner dimensions in mm			Floor space	Outer dimensions[5] in mm			Heating power	Electrical	Weight
	°C	w	d	h	in m²	W	D	H[3]	in kW[4]	connection*	in kg
GF 75	900	620	620	310	0.38	1170	950	1370	3.6	1-phase	180
GF 75 R	950	620	620	310	0.38	1170	950	1370	5.5	3-phase[1]	180
GF 190 LE	950	1010	620	400	0.62	1460	950	1460	6.0	1-phase[2]	210
GF 190	950	1010	620	400	0.62	1460	950	1460	6.4	3-phase[1]	210
GF 240	950	1010	810	400	0.81	1460	1140	1460	11.0	3-phase	275
GF 380	950	1210	1100	400	1.33	1660	1460	1460	15.0	3-phase	450
GF 420	950	1660	950	400	1.57	2110	1310	1460	18.0	3-phase	500
GF 520	950	1210	1160	400	1.40	1660	1520	1460	15.0	3-phase	550
GF 600	950	2010	1010	400	2.03	2460	1370	1460	22.0	3-phase	600
GF 920	950	2110	1160	400	2.44	2560	1520	1460	26.0	3-phase	850
GF 1050	950	2310	1210	400	2.79	2760	1570	1460	32.0	3-phase	1050
GF 1425	950	2510	1510	400	3.79	2960	1870	1460	32.0	3-phase	1250

[1]Heating only between two phases
[2]Fusing of 32 A if connected to 230 V
[4]Depending on furnace design connected load might be higher

*Please see page 81 for more information about supply voltage
[3]Base included
[5]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

Exhaust air flap

Bottom heating for uniform through heating of large objects

Pneumatic lift door

Fusing Furnaces with Movable Table

Fusing furnaces in the “GFM” series were developed for special production requirements. The GFM series combines the impressive quality benefits of the GF series with the option of charging the table outside the furnace. The table runs on swivel castors and can thus be moved freely.

The scope of delivery includes a flat table for fusing work; additional tables can be added. An interchangeable table system is especially economical, as one table can be charged while the other is in the furnace. Instead of flat tables, different tables with different heights can be used if the furnace is to be used for higher components, for example.

Fusing furnace GFM 920

Standard Equipment

- Tmax 950 °C
- Heating element, protected in quartz tubes
- High current connection capacities for short warm-up times and energy-saving way of working
- Arranged closely beside each other on the top, heating elements ensure direct and uniform radiation of the glass
- Infrared heated in hood which is attached to stand
- Dual shell hood made of stainless steel with slotted cover lid
- Scope of delivery includes a table
- Table on wheels, freely movable
- Controller integrated to save space on the right side of the furnace
- Level table surface with insulation made of robust lightweight refractory bricks and marked charge surface
- Top hat insulated with high-quality fiber material; 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.
- Adjustable, large quick-release fasteners - can be used while working in gloves
- Handles on the left and right side of the hood for opening and closing the furnace
- Hood safety switch
- Solid state relays provide for low-noise operation
- Type K thermocouple
- Hood easy to open and close, supported by compressed-gas springs
- Lockable air inlet opening for ventilation, fast cooling and observation of charge
- Comfortable charging height of 860 mm
- Controller C440 (10 programs with each 20 segments), controls description see page 80

Tables for expansion of the furnace system as additional equipment; Interchangeable table system to use the residual heat of the furnace and to reduce cycle times by changing table in warm state

Additional Equipment

- Motorized lid opening for faster cooling for models GFM 420 up
- Bottom heating for uniform through heating of large objects
- Cooling fan for accelerated cooling with closed lid
- Tables for expansion of the furnace system; Interchangeable table system to use the residual heat of the furnace and to reduce cycle times by changing table in warm state
- Table designed as a basin
- Motorized exhaust air flap for faster cooling of the fusing furnace
- Air inlet flap with window for observing the glass

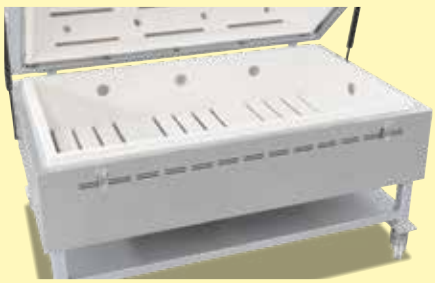
GFM 1425 fusing furnace with motorized lid opening

Model	Tmax	Inner dimensions in mm			Floor space	Outer dimensions[2] in mm			Heating power	Electrical	Weight
	°C	w	d	h	in m²	W	D	H	in kW[1]	connection*	in kg
GFM 420	950	1660	950	400	1.57	2230	1390	1460	18	3-phase	620
GFM 520	950	1210	1160	400	1.40	1780	1600	1460	15	3-phase	670
GFM 600	950	2010	1010	400	2.03	2580	1450	1460	22	3-phase	730
GFM 920	950	2110	1160	400	2.44	2680	1600	1460	26	3-phase	990
GFM 1050	950	2310	1210	400	2.79	2880	1650	1460	32	3-phase	1190
GFM 1425	950	2510	1510	400	3.79	3080	1950	1460	32	3-phase	1390

[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 81 for more information about supply voltage

Motorized lid opening for faster cooling for models GFM 420 up



GF 420/S with basin and floor heating

Inspection window in air inlet opening for observation of the glass as additional equipment

Tub Furnaces with Wire Heating

For slumping and bending of complex glass parts, e. g. glass furniture, shower cabins, etc., tub furnaces are the right choice. Full coverage heating: from the lid, all 4 sides and the tub bottom. Due to the modular system additional tubs in customized dimensions can be provided.

Tub furnace GW 1660

Standard Equipment

- Tmax 900 °C
- Full coverage heating: from lid, all 4 sides and bottom
- 3-zone temperature control from top to bottom for optimal temperature uniformity
- Heating elements mounted on ceramic support tubes for free heat radiation and long service life
- Bottom heating covered by SiC tiles
- Top hat insulated with high-quality fiber material; 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.
- Manual hinged lid with gas struts for easy opening and closing
- Manually operated exhaust air flaps
- Tub on wheels can be pulled out manually
- Rails on floor for perfect tub guidance included
- Controls description see page 80

Tub furnace GW 2200

Additional Equipment

- Electro-hydraulic lid instead of manual hinged lid
- Tub insert to elevate bottom height, in order to use the furnace for glass fusing applications (in this product version the tub heating can be switched off
- Automatic lid opening, can be programmed using the extra function of the controller, for faster cooling
- Motorized exhaust air flap for faster cooling
- Cooling system to assist cooling the furnace below the quartz inversion
- Interchangeable table system running on rails: to shorten process times and optimise operational capacity, two or more furnace tubs, placed alternately under the hood, can be used. An automatic tub changing system is also available on request.

Top hat furnace GW 2208/S with electro-hydraulically driven hood, tub can be pulled out on rails

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[2] in mm			Heating	Electrical	Weight
	°C	w	d	h	in l	W	D	H	power in kW[1]	connection*	in kg
GW 830	900	1200	1150	600	830	2140	1980	1250	36	3-phase	820
GW 840	900	1650	850	600	840	2590	1680	1250	36	3-phase	980
GW 1200	900	2000	1000	600	1200	2940	1830	1250	40	3-phase	1210
GW 1500	900	2100	1150	600	1450	3040	1980	1250	70	3-phase	1420
GW 1660	900	2300	1200	600	1660	3240	2030	1250	80	3-phase	1780
GW 2200	900	2300	1200	800	2200	3240	2030	1400	90	3-phase	2160
GW 8000	900	3700	2700	800	8000	4640	3530	1400	180	3-phase	2980

[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 81 for more information about supply voltage

Automatic lid opening via electromechanical spindle

Motorized exhaust air flaps as additional equipment

Bottom heating covered by SiC tiles to create level stacking support

Top Hat Furnaces with Wire Heating with Table

Nabertherm markets this range of top hat furnaces for bending and slumping of large glass parts. The top hat furnace is equipped with one table running on rails which can be pulled out for easy charging. As accessory an additional table can be integrated, which is charged while the other table is in the furnace. The top hat furnaces are heated from the ceiling and from the table.

Top hat furnace HG 1196/S with top hat and table heating; table heating can be switched-off during fusing

Standard Equipment

- Tmax 900 °C
- Heating from lid and table
- 3-zone temperature control (lid-inner circular element, lid-outer circular element, table) for optimal temperature uniformity
- Table heating can be switched-off for fusing
- Heating elements on supporting tubes provide for long service life
- Table heating elements covered by SiC tiles for level stacking support
- Top hat insulated with high-quality fiber material; 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.
- Table insulated with multi-layer resistant, lightweight refractory bricks
- Top hat to be opened by overhead crane in floor shop
- Protection guides for easy top hat opening and closing
- Manually-operated exhaust air flap
- Furnace table on fixed chassis for user-friendly charging height (approx. 800 mm)
- Controller P470 (50 programs with each 40 segments), controls description see page 80

Top hat furnace HG 2000

Additional Equipment

- Top hat side heating in case of high top hat dimensions
- Design without table heating or with disengageable table heating for fusing
- Electro-hydraulically driven top hat
- Motorized exhaust air flap for faster cooling of the fusing furnace
- Cooling system to assist cooling the furnace below the quartz inversion
- Table on wheels for free movement
- Interchangeable table system running on rails: to shorten process times and optimise operational capacity, two or more tables, placed alternately under the hood, can be used. An automatic table changing system is also available on request.

Top hat furnace HG 5208/S with two tables for bending and slumping of glass

Model	Tmax	Inner dimensions in mm			Floor space	Outer dimensions[2] in mm			Heating power	Electrical	Weight
	°C	w	d	h	in m²	W	D	H	in kW[1]	connection*	in kg
HG 750	900	2100	1200	300	2.52	2550	1800	1350	35	3-phase	1200
HG 1000	900	1750	1000	550	1.75	2200	1450	1600	33	3-phase	1500
HG 1500	900	2100	1250	550	2.63	2550	1700	1600	44	3-phase	2000
HG 1800	900	2450	1850	400	4.35	2950	2350	1600	45	3-phase	2500
HG 2000	900	2450	1500	550	3.68	2900	1950	1600	55	3-phase	2500
HG 2640	900	3000	2200	400	6.60	3500	2700	1450	75	3-phase	3400
HG 3000	900	3500	2200	400	7.70	4000	2800	1600	75	3-phase	3800
HG 4800	900	5500	2100	400	11.55	6000	2700	1600	90	3-phase	4500
HG 5208/S	900	3100	2100	800	6.51	3990	2590	3140	110	3-phase	5000
HG 7608/S	900	3800	2500	800	9.50	4690	2990	3140	143	3-phase	7000

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

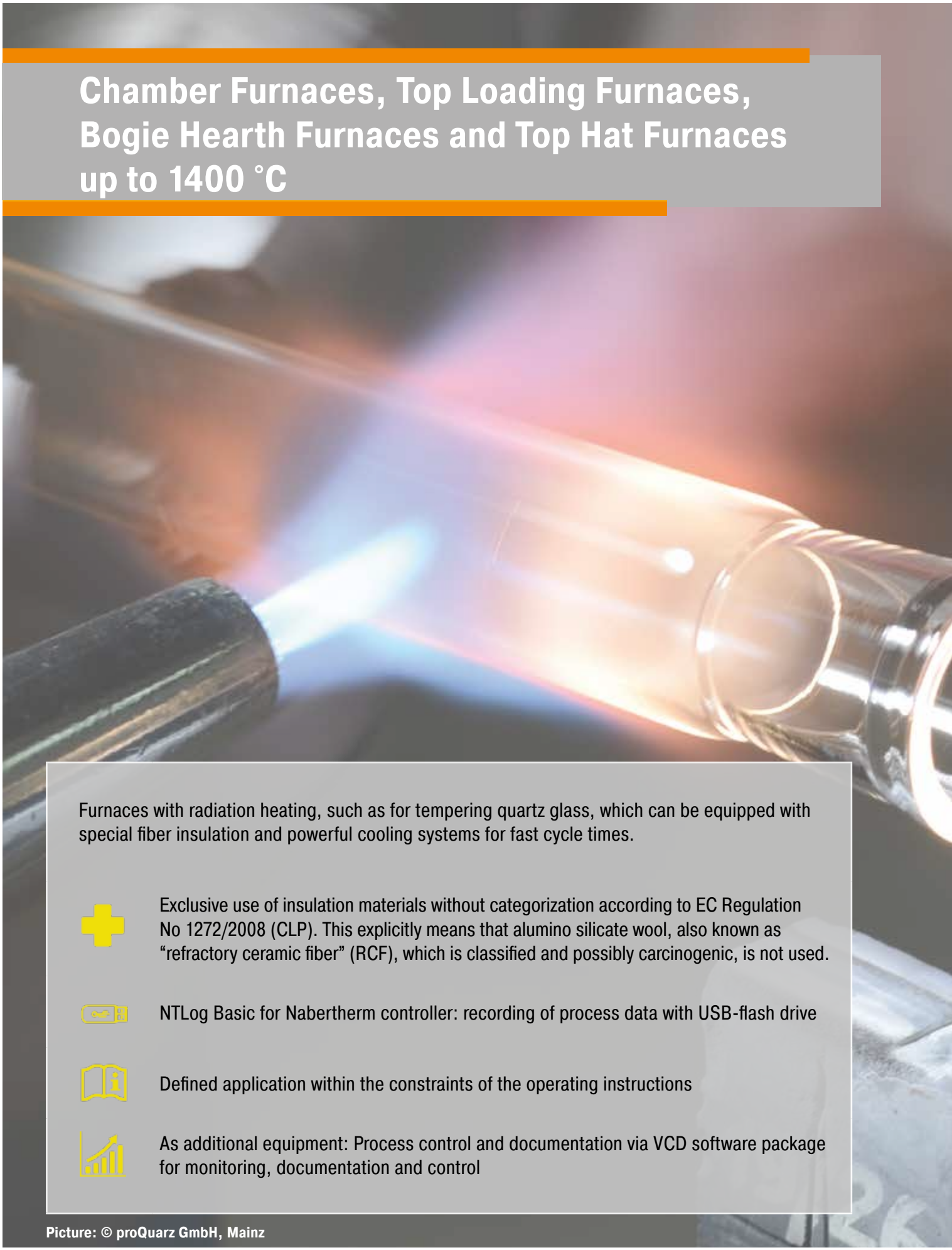
*Please see page 81 for more information about supply voltage

Motorized exhaust air flaps as additional equipment

Heating elements in furnace hood

Fiber insulation covered with fabric to reduce dust in the furnace

Chamber Furnaces, Top Loading Furnaces, Bogie Hearth Furnaces and Top Hat Furnaces up to 1400 °C



Furnaces with radiation heating, such as for tempering quartz glass, which can be equipped with special fiber insulation and powerful cooling systems for fast cycle times.

- 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.
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Defined application within the constraints of the operating instructions
- As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control

Picture: © proQuarz GmbH, Mainz

Furnace Group	Model	Page
Chamber furnaces to preheat molds and tools	N/N .. H N .. 13	42
Chamber furnaces with wire heating up to 1400 °C	LH	44
Chamber furnaces with wire heating up to 1400 °C	N/N .. H N .. 14	46
Top loading furnaces	S/S ../G	48
Bogie hearth furnaces with wire heating up to 1400 °C	W/W .. H W .. 14	50
Top hat furnaces or bottom loading furnaces with wire heating up to 1400 °C	H .. LB H ..LT	52

Chamber Furnaces to Preheat Molds and Tools

These universal chamber furnaces with radiation heating are ideal for preheating metal molds and tools. This furnace range has especially robust refractory insulation. The default vertical door opening allows ergonomic and safe working with the furnace when molds and tools are being placed in or removed from the hot furnace. The furnaces are also ideal for processes in toolmaking and in the hardening shop, such as annealing, hardening and forging. With a wide range of accessories, the furnaces can be customized to meet your needs and requirements.

Chamber furnace N 61/H

Standard Equipment

- Deep furnace chamber with three-sides heating: from both side walls and bottom
- Heating elements on support tubes ensure free heat radiation and a long service life
- Bottom heating protected by heat-resistant SiC plate
- Stainless steel upper door jamb protects furnace structure when furnace is opened hot
- Temperature uniformity up to +/– 10 °C according to DIN 17052-1 see page 85
- Low energy consumption due to multi-layer insulation
- Base frame included in the delivery, N 7/H - N 17/HR designed as table-top model
- Exhaust opening in the side of the furnace, or on rear wall of chamber furnace in the N 31/H models and higher
- Parallel guided downward swinging door (user protected from heat radiation)
- Door movement cushioned with gas dampers/struts
- Heat resistant zinc paint for protection of door and door frame (for model N 81 and larger)
- Controller B400 (5 prgrams with each 4 segments), alternative controllers see page 81

Chamber furnace N 81/13 with pneumatic door opening

Additional Equipment

- Side heating elements protected with SiC tiles
- Thermocouple inlet with a diameter of 15 mm in the side
- Frame on rollers for ease of movement
- Pneumatic door opening, controlled by foot pedal

Chamber furnace with electro-hydraulic lift door on transportable base for preheating

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Heating	Electrical	Weight
	in °C	w	d	h	in l	W	D	H	power in kW[2]	connection*	in kg
N 7/H	1280	250	250	140	9	800	650	600	3.0	1-phase	60
N 11/H	1280	250	350	140	11	800	750	600	3.5	1-phase	70
N 11/HR	1280	250	350	140	11	800	750	600	5.5	3-phase[3]	70
N 17/HR	1280	250	500	140	17	800	900	600	6.4	3-phase[3]	90
N 31/H	1280	350	350	250	31	1040	1100	1340	15.0	3-phase	210
N 41/H	1280	350	500	250	41	1040	1250	1340	15.0	3-phase	260
N 61/H	1280	350	750	250	61	1040	1500	1340	20.0	3-phase	400
N 87/H	1280	350	1000	250	87	1040	1750	1340	25.0	3-phase	480
N 81	1200	500	750	250	80	1300	2000	2000	20.0	3-phase	950
N 161	1200	550	750	400	160	1350	2085	2300	30.0	3-phase	1160
N 321	1200	750	1100	400	320	1575	2400	2345	47.0	3-phase	1570
N 641	1200	1000	1300	500	640	1850	2850	2650	70.0	3-phase	2450
N 81/13	1300	500	750	250	80	1300	2000	2000	22.0	3-phase	970
N 161/13	1300	550	750	400	160	1350	2085	2300	35.0	3-phase	1180
N 321/13	1300	750	1100	400	320	1575	2400	2345	60.0	3-phase	1600
N 641/13	1300	1000	1300	500	640	1850	2850	2650	80.0	3-phase	2500

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

*Please see page 81 for more information about supply voltage

Working with protective gas boxes for a protective gas atmosphere using a charging cart

Chamber furnace N 7/H as table-top model

Deep furnace chamber with three-sides heating

Chamber Furnaces with Brick Insulation or Fiber Insulation

Chamber furnaces LH 15/12 - LF 120/14 are suitable for many different glass applications. They are available with either a robust insulation of light refractory bricks (LH models) or with a combination insulation of refractory bricks in the corners and low heat storage, quickly cooling fiber material (LF models). With a wide variety of optional equipment, these chamber furnaces can be adapted optimally and individually to suit your processes.

Chamber furnace LH 30/14

Standard Equipment

- Tmax 1200 °C, 1300 °C, or 1400 °C
- Dual shell housing with rear ventilation, provides for low shell temperatures
- 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 B400 (5 prgrams with each 4 segments), alternative controllers see page 81

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

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 protective or reaction 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	5.0	3-phase[2]	170
LH 30/12	1200	320	320	320	30	710	930	1290	7.0	3-phase[2]	200
LH 60/12	1200	400	400	400	60	790	1080	1370	8.0	3-phase	300
LH 120/12	1200	500	500	500	120	890	1180	1470	12.0	3-phase	410
LH 216/12	1200	600	600	600	216	990	1280	1590	20.0	3-phase	450
LH 15/13	1300	250	250	250	15	680	860	1230	7.0	3-phase[2]	170
LH 30/13	1300	320	320	320	30	710	930	1290	8.0	3-phase[2]	200
LH 60/13	1300	400	400	400	60	790	1080	1370	11.0	3-phase	300
LH 120/13	1300	500	500	500	120	890	1180	1470	15.0	3-phase	410
LH 216/13	1300	600	600	600	216	990	1280	1590	22.0	3-phase	460
LH 15/14	1400	250	250	250	15	680	860	1230	8.0	3-phase[2]	170
LH 30/14	1400	320	320	320	30	710	930	1290	10.0	3-phase[2]	200
LH 60/14	1400	400	400	400	60	790	1080	1370	12.0	3-phase	300
LH 120/14	1400	500	500	500	120	890	1180	1470	18.0	3-phase	410
LH 216/14	1400	600	600	600	216	990	1280	1590	26.0	3-phase	470
LF 15/13	1300	250	250	250	15	680	860	1230	7.0	3-phase[2]	150
LF 30/13	1300	320	320	320	30	710	930	1290	8.0	3-phase[2]	180
LF 60/13	1300	400	400	400	60	790	1080	1370	11.0	3-phase	270
LF 120/13	1300	500	500	500	120	890	1180	1470	15.0	3-phase	370
LF 15/14	1400	250	250	250	15	680	860	1230	8.0	3-phase[2]	150
LF 30/14	1400	320	320	320	30	710	930	1290	10.0	3-phase[2]	180
LF 60/14	1400	400	400	400	60	790	1080	1370	12.0	3-phase	270
LF 120/14	1400	500	500	500	120	890	1180	1470	18.0	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 81 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

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

Standard Equipment

- Tmax 1300 °C, 1340 °C or 1400 °C
- Five-side heating provide for good temperature uniformity
- Heating elements on support tubes provide for free heat radiation and long service life
- 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
- Bottom heating protected by SiC tiles with an even stacking base
- 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 P470 (50 programs with each 40 segments), controls description see page 80

Chamber furnace N 4550/S

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 P470 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 protective or reaction 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

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	720	1130	1440	9	3-phase	275
N 150	1300	450	530	590	150	770	1130	1570	11	3-phase	320
N 200	1300	470	530	780	200	790	1130	1760	15	3-phase	375
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	1760	2000	57	3-phase	1800
N 1500	1300	900	1200	1400	1500	1490	1960	2150	75	3-phase	2500
N 2200	1300	1000	1400	1600	2200	1590	2160	2350	110	3-phase	3100
N 100/H	1340	400	530	460	100	760	1150	1440	11	3-phase	325
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	430
N 300/H	1340	550	700	780	300	910	1320	1760	27	3-phase	550
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	1760	2000	75	3-phase	2320
N 1500/H	1340	900	1200	1400	1500	1490	1960	2150	110	3-phase	2700
N 2200/H	1340	1000	1400	1600	2200	1590	2160	2350	140	3-phase	3600
N 100/14	1400	400	530	460	100	760	1150	1440	15	3-phase	325
N 150/14	1400	430	530	620	150	790	1150	1600	20	3-phase	380
N 200/14	1400	500	530	720	200	860	1150	1700	22	3-phase	430
N 300/14	1400	550	700	780	300	910	1320	1760	30	3-phase	550
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	1760	2000	75	3-phase	2500
N 1500/14	1400	900	1200	1400	1500	1490	1960	2150	110	3-phase	3000
N 2200/14	1400	1000	1400	1600	2200	1590	2160	2350	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 81 for more information about supply voltage

Chamber furnaces N 200/14 for sintering semiconductors

Charging trolley for chamber furnace N 2200

Door locking kit

Top Loading Furnaces

Top loading furnaces are ideal for tempering quartz glass. With smaller components, the furnaces are filled manually from the top and, with larger or heavier components, they are filled with the help of an indoor crane. With their adapted heating and the special arrangement of the heating elements, the furnaces ensure good temperature uniformity. With an extensive range of additional equipment, top loading furnaces can be adapted to suit many different process requirements.

Top loading furnace S 430

Standard Equipment

- Tmax 900 °C or 1240 °C
- Three or five-sided heating for optimum temperature uniformity
- Heating elements on carrier tubes ensure free heat radiation and a long service life
- Multi-layer refractory insulation and special rear insulation
- Bottom heating protected by SiC tiles with an even stacking base
- Fiber insulation in the lid
- Lids are opened and closed with various standardized solutions
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and charge
- Controller C440 (10 programs with each 20 segments), controls description see page 80

Pit-type furnace S 11988/S with rolling lid

Additional Equipment

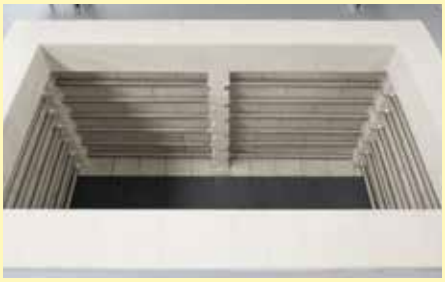
- Manual fresh air opening in lower area of the top loading furnace
- Manual exhaust air opening in the lid
- Automatic exhaust air flap for faster cooling
- Cooling system to speed up furnace cooling with a fan and specified temperature gradients or a fixed volume of fresh air. Both operating modes can be activated for different segments, using an extra function of the controller.
- Multiple-zone control of the heating to optimize temperature uniformity
- Fabric cover to reduce fiber dust
- Split lid to divide the furnace chamber into two halves
- Special solutions with customer-specific dimensions and equipment options are available

Top loading furnace S 750/S

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[2]	in kW[3]	connection*	in kg
S 220/G	900	2450	300	300	220	3000	1000	2000	18	3-phase	1000
S 430/G	900	1200	600	600	432	1900	1300	2200	24	3-phase	1100
S 500/G	900	2450	450	450	500	3000	1100	2000	26	3-phase	1600
S 620/G	900	3050	450	450	620	3860	1100	2000	30	3-phase	2200
S 750/G	900	3000	500	500	750	3860	1500	2100	36	3-phase	2600
S 220	1240	2450	300	300	220	3000	1000	2000	24	3-phase	1250
S 430	1240	1200	600	600	432	1900	1300	2200	30	3-phase	1400
S 500	1240	2450	450	450	500	3000	1100	2000	36	3-phase	1800
S 620	1240	3050	450	450	620	3860	1100	2000	40	3-phase	2400
S 750	1240	3000	500	500	750	3860	1500	2100	57	3-phase	2800

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

*Please see page 81 for more information about supply voltage



Furnace chamber S 430

Fabric cover to reduce fiber dust

Cooling system with fresh air fan

Bogie Hearth Furnaces with Wire Heating up to 1400 °C

Bogie hearth furnaces have a wide range of benefits in production. The bogie can be loaded outside the furnace. The bogies can be charged using a crane without any problem. If several bogies are used, one can be charged while the other is in the furnace. With their sturdy construction and very good temperature uniformity, these models are ideal for cooling and relieving stress in glass, for burning in coatings and for tempering quartz glass.

Bogie hearth furnace W 8250/S for tempering quartz glass

Standard Equipment

- Tmax 1280 °C, 1340 °C or 1400 °C
- Dual shell housing with rear ventilation, provides for low shell temperatures
- Swing door hinged on the right side
- Heating from five sides (four sides and bogie) provides for a very good temperature uniformity
- Heating elements mounted on support tubes provide for free radiation and long service life
- Bottom heating protected by SiC tiles on the bogie providing level stacking surface
- 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 P470 (50 programs with each 40 segments), controls description see page 80

Bogie hearth furnace W 7500

Additional Equipment

- Multi-zone control adapted to the particular furnace provides model for optimal 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
- Rail cover
- 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
  - Motorized bogies and cross-traversal system
  - 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

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

Bogie-hearth furnace W 2394/S with heat shields

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

*Please see page 81 for more information about supply voltage

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

Bogie hearth furnace for tempering quartz rods

Electro-hydraulic lift door

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

These top hat furnaces or bottom loading furnaces were specially developed for tempering quartz glass, cooling complex structures or when the process requires the treatment of warm glass, e. g., the welding process in glass apparatus manufacturing. The wide-opening electro-hydraulically driven top hat allows furnace opening even at high temperatures and provides easy access from 3 sides. Depending on process conditions, a top hat or bottom loading version is advisable. The system can be expanded to include one or more changeable tables, either manually or motorized. Further additional equipment like a multi-zone control to optimize the temperature uniformity or controlled cooling systems for shorter processes provide for customized solution with respect 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
- Dual shell housing with rear ventilation, provides for low shell temperatures
- Top hat furnaces (model LT): electrohydraulically driven top hat 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 +/– 10 °C according to DIN 17052-1 see page 85
- Heating elements mounted on support tubes provide for free radiation and long service life of the heating wire
- Bottom heating protected by SiC tiles which provide for a level stacking surface
- 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 P470 (50 programs with each 40 segments), controls description see page 80

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 protective or reaction 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

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

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 81 for more information about supply voltage

Fiber insulation to reduce heating and cooling times

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

Cooling system with fresh air fan for rapid cooling

High-Temperature Furnaces up to 1800 °C

High-temperature furnaces as tabletop or floor-standing models for maximum temperatures between 1550 °C and 1800 °C, for example, to melt glass and develop new technical glass products.

- 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.
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Defined application within the constraints of the operating instructions
- As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control

Furnace Group	Model	Page
High-temperature furnaces with molybdenum disilicide heating elements and fiber insulation up to 1800 °C as table-top model	LHT	56
High-temperature bottom loading furnaces with molybdenum disilicide heating elements and fiber insulation up to 1650 °C as table-top model	LHT .. LB Speed	57
High-temperature furnaces with molybdenum disilicide heating elements and fiber insulation up to 1800 °C	HT	58
High-temperature furnaces with SiC rod heating and fiber insulation up to 1550 °C	HTC	60
High-temperature furnaces with molybdenum disilicide heating elements and refractory brick insulation up to 1700 °C	HFL	61
High-temperature top hat furnaces or bottom loading furnaces with molybdenum disilicide heating elements and fiber insulation up to 1800 °C	HT .. LB HT .. LT	62

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

Designed as tabletop models, these compact high-temperature furnaces have a variety of advantages. The first-class workmanship using high-quality materials, combined with ease of operation, make these furnaces all-rounders in research, for example, to melt small glass samples.

High-temperature furnace LHT 03/17 D

Standard Equipment

- Tmax 1600 °C, 1750 °C, or 1800 °C
- Recommended working temperature 1750 °C (for models LHT ../18), increased wear and tear must be expected in case of working at higher temperatures
- Dual shell housing made of textured stainless steel sheets with additional fan cooling for low surface temperature
- High-quality molybdenum disilicide heating elements
- Adjustable air inlet opening, exhaust air opening in the roof
- Type B thermocouple
- Controller P470 (50 programs with each 40 segments), controls description see page 80

Additional Equipment

- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Protective gas connection to purge with non-flammable protective or reaction gases, not gas tight
- Manual or automatic gas supply system

Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Connected	Electrical	Weight	Heating time
	in °C	w	d	h	in l	W	D	H[2]	load in kW	connection*	in kg	in min[3]
LHT 02/16	1600	90	150	150	2	470	630	760+260	3.0	1-phase	75	30
LHT 04/16	1600	150	150	150	4	470	630	760+260	5.2	3-phase[4]	85	25
LHT 08/16	1600	150	300	150	8	470	810	760+260	8.0	3-phase[4]	100	25
LHT 01/17 D	1650	110	120	120	1	385	425	525+195	2.9	1-phase	28	35
LHT 03/17 D	1650	135	155	200	4	470	630	760+260	3.0	1-phase	75	30
LHT 02/17	1750	90	150	150	2	470	630	760+260	3.0	1-phase	75	35
LHT 04/17	1750	150	150	150	4	470	630	760+260	5.2	3-phase[4]	85	30
LHT 08/17	1750	150	300	150	8	470	810	760+260	8.0	3-phase[4]	100	30
LHT 02/18	1800	90	150	150	2	470	630	760+260	3.6	1-phase	75	60
LHT 04/18	1800	150	150	150	4	470	630	760+260	5.2	3-phase[4]	85	40
LHT 08/18	1800	150	300	150	8	470	810	760+260	9.0	3-phase[4]	100	40

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[2]Including opened lift door
[3]Heating time of the empty and closed furnace up to Tmax −100 K (connected to 230 V 1/N/PE rsp. 400 V 3/N/PE)
*Please see page 81 for more information about supply voltage
[4]Heating only between two phases

High-temperature furnace LHT 01/17 D

Saggars with top lid for LHT 01/17 D

Example of an over-temperature limiter

High-Temperature Bottom Loading Furnaces with Molybdenum Disilicide Heating Elements and Fiber Insulation up to 1650 °C

The motorized lifting table significantly simplifies the charging of the high-temperature furnaces LHT .. LB Speed. The heating all around the cylindrical furnace chamber provides for an opitimal temperature uniformity.

High-temperature furnace LHT 02/17 LB Speed with a set of saggars

Standard Equipment

- Tmax 1650 °C
- High-quality heating elements made of molybdenum disilicide offer very good protection against chemical interaction between charge and heating elements
- Dual shell housing made of textured stainless steel sheets with additional fan cooling for low surface temperature
- Excellent temperature uniformity thanks to three (LHT 02/17 LB Speed) or four-sided (LHT 01/17 LB Speed) heating of the furnace chamber
- Furnace chamber with a volume of 1 or 2 liters, table with large floor space
- Precise, motorized toothed belt drive of the table with button operation
- Opening time of table approx. 30 sec., completely open
- Exhaust air vent in the roof
- Type S thermocouple
- Controller P470 (50 programs with each 40 segments), controls description see page 80

Additional Equipment

- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Stackable saggars for loading in up to two or three levels, depending on model
- Reduced opening time of table to 10 sec., completely open
- Adjustable air inlet through the floor

Model	Tmax	Work space dimensions[2] in mm			Charging area in mm		Volume	Outer dimensions[1] in mm			Connected	Electrical	Weight
	in °C	w	d	h	w	d	in l	W	D	H	load in kW	connection*	in kg
LHT 01/17 LB Speed	1650	75	110	60	95	130	1	350	590	695	2.9	1-phase	45
LHT 02/17 LB Speed	1650	Ø 115		110	135	135	2	390	590	785	3.3	1-phase	55

[1]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
[2]Corresponds to charge saggars with spacer

*Please see page 81 for more information about supply voltage

Electrically driven lift-bottom

Saggar

Furnace chamber heated on four sides for model LHT 01/17 LB Speed

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

With their solid construction, these high-temperature furnaces fulfill the demands of everyday work in laboratories and production. The compact standard models are suitable for melting small quantities of glass samples, for quartz glass or glass-ceramic application where high working temperatures are required and high levels of precision are needed. The very good temperature uniformity and practical details set very 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

High-temperature furnace HT 64/16S with lift door

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.
- Dual shell housing with fan cooling provides for low shell temperatures
- 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 85
- 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
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load

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
- Protective gas connection to purge with non-flammable protective or reaction 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
- Ethernet interface

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

High-temperature furnace HT 64/17 DB100-2 with safety package for debinding

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 08/16	1600	150	300	150	8	740	640	1755	8.0	3-phase[2]	215
HT 16/16	1600	200	300	260	16	820	690	1860	12.0	3-phase[2]	300
HT 29/16	1600	275	300	350	29	985	740	1990	9.3	3-phase[2]	340
HT 40/16	1600	300	350	350	40	1010	800	1990	12.0	3-phase	420
HT 64/16	1600	400	400	400	64	1140	890	2040	18.0	3-phase	555
HT 128/16	1600	400	800	400	128	1140	1280	2040	26.0	3-phase	820
HT 160/16	1600	500	550	550	160	1250	1040	2240	21.0	3-phase	880
HT 276/16	1600	500	1000	550	276	1310	1600	2290	43.0	3-phase	1300
HT 450/16	1600	500	1150	780	450	1360	1800	2570	57.0	3-phase	1450
HT 08/17	1750	150	300	150	8	740	640	1755	8.0	3-phase[2]	215
HT 16/17	1750	200	300	260	16	820	690	1860	12.0	3-phase[2]	300
HT 29/17	1750	275	300	350	29	985	740	1990	9.3	3-phase[2]	340
HT 40/17	1750	300	350	350	40	1010	800	1990	12.0	3-phase	420
HT 64/17	1750	400	400	400	64	1140	890	2040	18.0	3-phase	555
HT 128/17	1750	400	800	400	128	1140	1280	2040	26.0	3-phase	820
HT 160/17	1750	500	550	550	160	1250	1040	2240	21.0	3-phase	880
HT 276/17	1750	500	1000	550	276	1310	1600	2290	43.0	3-phase	1300
HT 450/17	1750	500	1150	780	450	1360	1800	2570	57.0	3-phase	1450
HT 08/18	1800	150	300	150	8	740	640	1755	8.0	3-phase[2]	215
HT 16/18	1800	200	300	260	16	820	690	1860	12.0	3-phase[2]	300
HT 29/18	1800	275	300	350	29	985	740	1990	9.3	3-phase[2]	340
HT 40/18	1800	300	350	350	40	1010	800	1990	12.0	3-phase	420
HT 64/18	1800	400	400	400	64	1140	890	2040	18.0	3-phase	555
HT 128/18	1800	400	800	400	128	1140	1280	2040	26.0	3-phase	820
HT 160/18	1800	500	550	550	160	1250	1040	2240	21.0	3-phase	880
HT 276/18	1800	500	1000	550	276	1310	1600	2290	42.0	3-phase	1300
HT 450/18	1800	500	1150	780	450	1360	1800	2570	64.0	3-phase	1450

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

*Please see page 81 for more information about supply voltage

Automatic gas supply system with solenoid valve and rotameter

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

Reinforced floor as protection for bottom insulation for high-temperature furnace HT 16/16 and higher

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 1550 °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
- Dual shell housing with fan cooling provides for low shell temperatures
- 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 85
- 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
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load

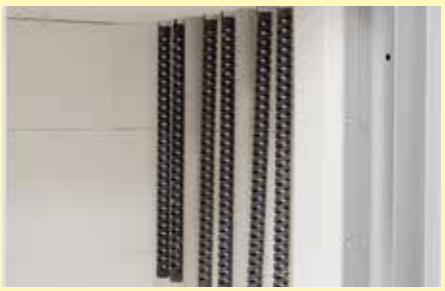
Additional Equipment

Like HT models see page 58

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	810	700	1500	12.0	16.0	3-phase[2]	270
HTC 40/16	1550	300	350	350	40	1000	800	1620	12.0	16.1	3-phase	380
HTC 64/16	1550	400	400	400	64	1130	900	1670	18.0	41.1	3-phase	550
HTC 128/16	1550	400	800	400	128	1130	1290	1670	26.0	60.4	3-phase	750
HTC 160/16	1550	500	550	550	160	1250	1050	1900	21.0	39.2	3-phase	800
HTC 276/16	1550	500	1000	550	276	1300	1600	1900	36.0	72.5	3-phase	1100
HTC 450/16	1550	500	1150	780	450	1350	1740	2120	64.0	118.0	3-phase	1500

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

*Please see page 81 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/..

Automatic gas supply system

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

Standard Equipment

Like high-temperature furnaces HT (see page 58), 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
- Protective gas connection to purge with non-flammable protective or reaction 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

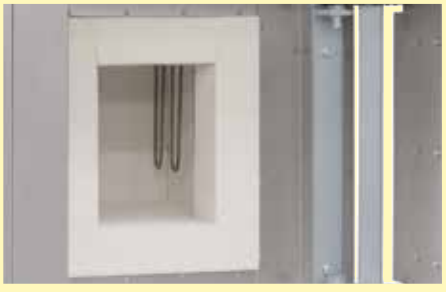
Model	Tmax	Inner dimensions in mm			Volume	Outer dimensions[1] in mm			Connected	Electrical	Weight
	in °C	w	d	h	in l	W	D	H	load in kW	connection*	in kg
HFL 16/16	1600	200	300	260	16	1000	890	1620	12	3-phase[2]	500
HFL 40/16	1600	300	350	350	40	1130	915	1890	12	3-phase	660
HFL 64/16	1600	400	400	400	64	1230	980	1940	18	3-phase	880
HFL 160/16	1600	500	550	550	160	1400	1250	2100	21	3-phase	1140
HFL 16/17	1700	200	300	260	16	1000	890	1620	12	3-phase[2]	530
HFL 40/17	1700	300	350	350	40	1130	915	1890	12	3-phase	690
HFL 64/17	1700	400	400	400	64	1230	980	1940	18	3-phase	920
HFL 160/17	1700	500	550	550	160	1400	1250	2100	21	3-phase	1190

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

*Please see page 81 for more information about supply voltage

Gas supply system for non-flammable protective or reaction gases

Thermocouple port in the ceiling with tripod



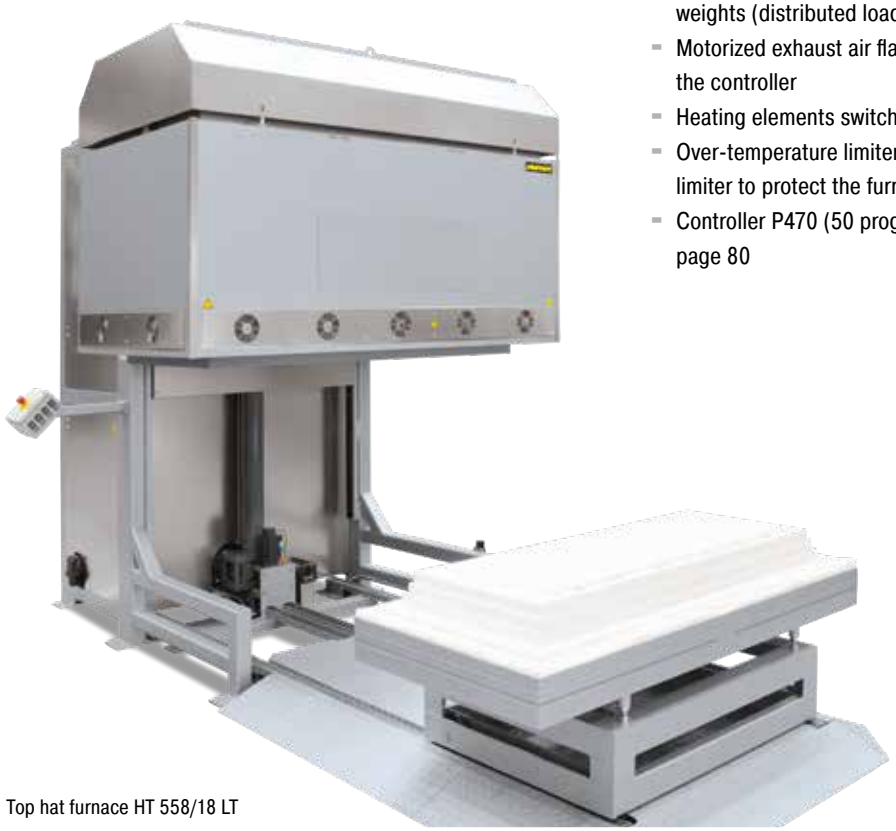
Light-weight refractory bricks and heating elements made from molybdenum disilicide

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 ceramizing quartz glass. 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 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.

Bottom loading furnace HT 500/17 LB



Top hat furnace HT 558/18 LT

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.
- Dual shell housing with fan cooling provides for low shell temperatures
- Top hat furnaces: electrohydraulically driven top hat with fixed table
- Bottom loading furnaces: driven table and fixed top hat
- Gently running, low-vibration spindle drive or electrohydraulic drive for larger models
- 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
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Controller P470 (50 programs with each 40 segments), controls description see page 80

Top hat furnace HT 750/18 LTS

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
- Temperature measurement with thermocouples, types B and type S with automatic pull-out device for precise control results in the low temperature range
- Customer-specific arrangement of the heating elements to optimize temperature uniformity, for example, with heating elements between the charge stacks
- Protective gas connection for purging the furnace with non-flammable protective or reaction 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)
- Various interchangeable table systems (manual or motorized)
- An electric mover ensures smooth movement of the freemoving table

HT 1700/17 LT DB200-5 for debinding and sintering ceramic powders

High-temperature top hat furnace HT 1000/17 LT with manual interchangeable table system including rail system and second table for optimized loading and unloading

High-temperature top hat furnace HT 550/17 LT DB200-3 with motorized 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	3450	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	3450	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	3450	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 81 for more information about supply voltage

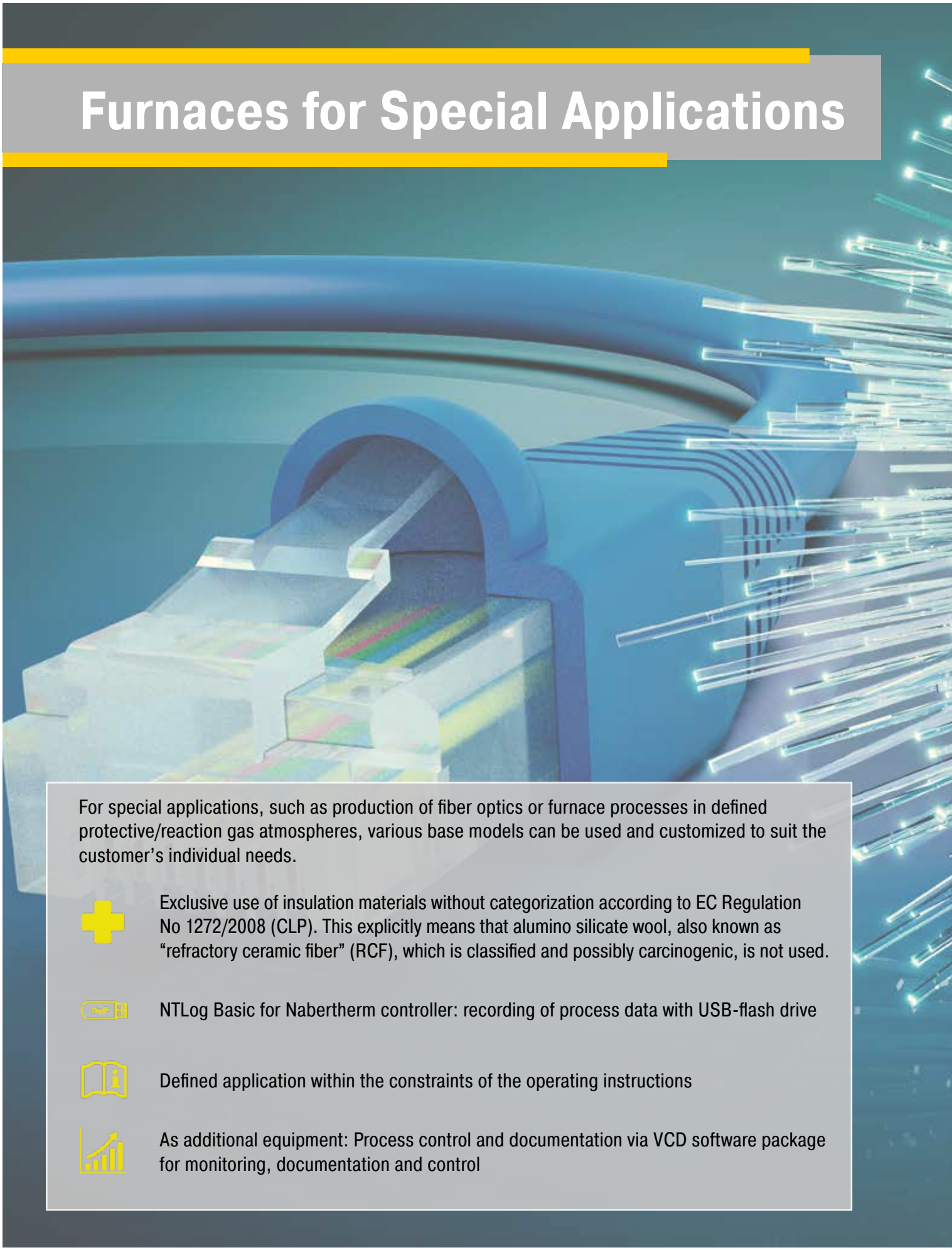
Heat from all sides and between the stack to optimize temperature uniformity

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

Measurement setup to determine the temperature uniformity in a high-temperature bottom loading furnace

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

Furnaces for Special Applications



For special applications, such as production of fiber optics or furnace processes in defined protective/reaction gas atmospheres, various base models can be used and customized to suit the customer's individual needs.

- 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.
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Defined application within the constraints of the operating instructions
- As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control

Furnace Group	Model	Page
Furnaces for continuous processes		68
Salt-bath furnaces for chemical hardening of glass	TS	71
Hot-wall retort furnaces up to 1100 °C	NR(A)	72
Hot-wall retort furnaces H_2 version for operation with flammable process gases	NR .. H_2	74
Hot-wall retort furnaces IDB version for debinding under non-flammable protective gases	NR .. IDB	74
Hot-wall retort furnaces Vacuum version for operation in high vacuum	NR(A)	74
Hot-wall retort furnaces Solutions for customer-specific applications		75
Tube furnaces		76
Special tube furnaces for the production of glass fiber material		77

Furnaces for Continuous Processes
Electrically Heated or Gas-Fired

Continuous furnaces are the right choice for processes with fixed cycle times such as drying or preheating, curing, aging, vulcanisation or degassing. The furnaces are available for various temperatures up to a maximum of 1100 °C. The furnace design depends on the required throughput, the process requirements for heat treatment and the required cycle time.

The conveyor technology is tailored to the required working temperature, geometry and weight of the charge and to the requirements regarding available space and integration into the process chain. The conveyor speed and the number of control zones are defined by the process specifications.

Heat treatment plant D 1600/6100/800/26AS according to EN 1539 with cooling station KS 1600/6100/800/AS for vulcanization processes of hoses

Conveyor Concepts

- Conveyor belt
- Metal conveyor belt with adjusted mesh gauges
- Drive chain
- Roller conveyors
- Paternoster
- Pusher-type
- Rotary hearth

Heating Systems

- Electric heating, radiation or convection
- Direct or indirect gas-fired
- Infrared heating
- Heating with the use of external heat sources

Rotary hearth furnace for preheating

Temperature Cycles

- Control of working temperature across the whole length of the furnace, such as for drying or preheating
- Automatic control of a process curve applying defined heat-up, dwell and cooling time
- Heat treatment including a final quenching of the charge

Process Atmosphere

- In air
- For processes with organic outgassings incl. mandatory safety technology according to EN 1539
- In non-flammable protective or reactive gases such as nitrogen, argon or forming gas
- In flammable protective or reactive gases such as hydrogen incl. the necessary safety technology

Roller continuous furnace N 650/45 AS for heat treatment of heavy workparts

Continuous belt furnace D 1000/4000/140/35 AS for black wash drying on sand cores

Basic Configuration Criteria

- Conveyor speed
- Temperature uniformity
- Operating temperature
- Process curve
- Work space width
- Charge weights
- Cycle time or throughput
- Length of charge and discharge zone
- Generated exhaust gases
- Specific industry standards such as AMS2750F, CQI-9, FDA etc.
- Other individual customer requirements

Pusher-type furnace system D 520/2600/55-04 S to sinter teflon coatings under protective atmosphere

Continuous furnace D 700/10000/300/45S with chain conveyor for 950 °C, gas-fired

Continuous furnace D 1500/3000/300/14 for thermal ageing with mesh belt transport system and subsequent cooling station

Mesh belt drive in a continuous furnace

Continuous furnace for bulk materials in baskets

Continuous furnace D 1000/1250/200/26AS for tempering of injection molded parts

Salt-Bath Furnaces for Chemical Hardening of Glass

Salt-bath furnace TS ../50 is designed especially for chemical tempering of glass in the laboratory. Chemical tempering is a process used to strengthen thin glass with wall thicknesses of just a few millimeters. The benefit of chemical pre-stressing is that the surface quality remains intact. Almost all glass with a high sodium content can be strengthened through ion exchange.

Salt-bath furnace TS 8/50

Standard Equipment

- Tmax 500 °C
- Salt-bath furnace in compact design with salt-bath and pre-heated-/cooling chamber above the salt-bath
- Bath temperature control
- Indirect heating of the preheated chamber from the salt-bath
- Automatic, time controlled movement from the preheating chamber into the salt-bath and back
- Electrical door lock
- Crucible made of hiqh-quality CrNi steel
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Controller P470 (50 programs with each 40 segments), controls description see page 80

Additional Equipment

- Hood for connection to local exhaust system
- Charging basket according to customers drawing
- Active heating for the preheated chamber
- PLC

Model	Tmax	Inner dimensions crucible in mm			Volume	Outer dimensions[2] in mm			Heating power	Electrical	Weight
	°C[1]	w	d	h	in l	W	D	H	in kW[3]	connection*	in kg
TS 8/50	500	300	100	100	8	1600	1050	2400	2	3-phase	650
TS 90/50	500	650	300	450	90	1600	1050	2400	20	3-phase	700

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

*Please see page 81 for more information about supply voltage

Charging basket

Example of an over-temperature limiter

Crucible made of hiqh-quality CrNi steel

Hot-Wall Retort Furnaces up to 1100 °C

These gas tight retort furnaces are equipped with direct or indirect heating depending on temperature. They are perfectly suited for various heat treatment processes requiring a defined protective or a reaction gas atmosphere with a slight overpressure. These compact models can also be laid out for heat treatment under vacuum up to 600 °C. The furnace chamber consists of a gas tight retort with water cooling around the door to protect the special sealing. With the corresponding safety technology, retort furnaces are also suitable for applications under reaction gases, such as hydrogen or, in combination with the IDB package, for inert debinding or for pyrolysis processes.

Different model versions are available depending on the temperature range:

Retort furnace NR 80/11

Models NRA ../06 with Tmax 600 °C

- Heating elements located inside the retort
- Retort made of 1.4571 (X6CrNiMoTi 17-12-2)
- Air circulation fan and baffle for directed gas flow
- Insulation made of mineral wool
- Furnace temperature control with measurement inside the retort

Models NRA ../09 with Tmax 900 °C

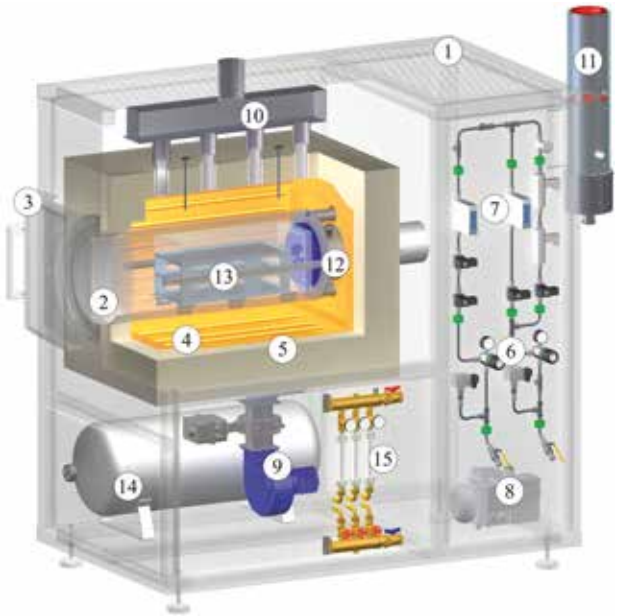
Design like models NRA ../06 with following differences:

- Outside heating with heating elements around the retort
- Retort made of 1.4828 (X15CrNiSi 20-12)
- Multi-layer refractory insulation and micro-porous panel material
- Furnace temperature control with measurement outside the retort

Models NR ../11 with Tmax 1100 °C

Design like models NRA ../09 with following differences:

- Retort made of 1.4841 (X15CrNiSi 25-21)
- Without gas-circulation and baffles
- Welded support brackets



Schematic presentation of a hot-wall retort furnace NRA 40/09 H_2 with additional equipment

1 Housing with integrated switchgear
2 Retort
3 Door with bayonet catch (additional equipment)
4 Heating
5 Insulation
6 Gas management system
7 Mass flow controller MFC (additional equipment)
8 Vacuum pump (additional equipment)
9 Fan for indirect cooling (additional equipment)
10 Outlet indirect cooling (additional equipment)
11 Exhaust torch (additional equipment - H_2-safety package)
12 Fan for gas circulation (NRA models)
13 Charging frame (on request)
14 Emergency flushing container (additional equipment - H_2-safety package)
15 Open cooling water system

Retort furnace NRA 40/09

Retort furnace NR 20/11 with parallel swing door

Standard Equipment

- Compact design with integrated control and gas supply (up to retort furnace NR(A) 700/..)
- Swivel door hinged on right side
- Open cooling water system
- Control divided into several heating zones
- Temperature uniformity up to +/− 8 °C according to DIN 17052-1 in the empty work space see page 85
- Gas supply system for one non-flammable protective or reaction gas with flow meter and magnetic valve
- Controller P470

Additional Equipment

- Upgrade for other non-flammable gases
- Mass flow controller MFC
- Process controls H3700, H1700 (PLC) including remote maintenance module
- Temperature control as charge control with temperature measurement inside and outside the retort
- Indirect and/or direct cooling
- Heat exchanger with closed-loop cooling water circuit for door cooling
- Oxygen sensor and dew point sensor
- Parallel swing door or electric bayonet catch
- Retort, made of 2.4633 for Tmax 1150 °C
- External switchgear with or without cabinet cooling
- Charge support or custom-built charging trolley
- Temperature uniformity optimized according to DIN 17052 or AMS2750F to +/− 5 °C in empty work space see page 85

	NRA ../06	NRA ../09	NRA ../11
Tmax in °C	600	900	1100[1]
Atmosphere circulation	✓	✓	–
Operation with non-flammable protective gas	✓	✓	✓
Operation with air/oxygen[2]	✓	✓	✓
Operation with flammable gas[3]	✓[5]	✓	✓
Inert debinding IDB[3]	✓	✓	✓
Low vacuum ≤ 10 mbar[4]	✓	✓	✓
Fine vacuum > 10^{-3} mbar[4]	✓	✓	✓
High vacuum < 10^{-4} mbar[4]	✓[5]	✓	✓
Retort Heating	outside/inside[6]	outside	outside

[1]Up to 1150 °C with 2.4633 as retort material without a circulation fan
[2]Increased wear on the retort and the attachments
[3]Only in connection with the corresponding safety package
[4]Up to 600 °C vacuum operation; 650 °C with 2.4633 as retort material without a circulation fan
[5]Only if heated from the outside
[6]Only available from size NRA 300/06 on

Model	Outer dimensions[1] in mm			Work space dimensions in mm			Useful volume	Connected[1]
	W	D	H	w	d	h	in l	load in kW*
NR(A) 20/..	1100[2]	1600	1700	225	400	225	20	34
NR(A) 40/..	1200[2]	1600	1900	325	400	325	40	34
NR(A) 80/..	1200[2]	2000	1900	325	750	325	80	44
NR(A) 100/..	1400[2]	1800	2100	450	500	450	100	64
NR(A) 160/..	1400[2]	2100	2100	450	800	450	160	74
NR(A) 300/..	2200	3100	2600	590	900	590	300	157
NR(A) 400/..	2200	3400	2600	590	1200	590	400	187
NR(A) 500/..	2300[3]	3300	2700	720	1000	720	500	217
NR(A) 700/..	2300[3]	3500	2700	720	1350	720	700	287
NR(A) 1000/..	2300[3]	3600	2800	870	1350	870	1000	307

[1]Outer dimensions and connected load of models NR ../11
[2]Outer dimensions plus separate switchgear with gas supply package for flammable gases or PLC control
*Please see page 81 for more information about supply voltage
[3]Outer dimensions plus separate switchgear

Retort furnace NRA 300/09 H_2 for heat treatment under hydrogen

H_2 Version for Operation with Flammable Process Gases

When using flammable process gases, such as hydrogen from ambient temperature, these furnaces are equipped with a safety package. Only certified components are used as safety-relevant sensors.

Standard Equipment

- Safety concept for using flammable gases
- Supply of flammable process gas at controlled overpressure of 50 mbar relative
- Process control H3700 with PLC for data input
- All safety-relevant values monitored by a failsafe PLC system
- Redundant magnetic valves for hydrogen
- Monitored pre-pressures of all process gases
- Bypass for safe flushing of furnace chamber with inert gas
- Torch for thermal post combustion of exhaust gases
- Emergency flood container for purging the furnace in case of failore

Retort furnace NRA 400/03 IDB with thermal post combustion system

IDB Version for Debinding under Non-Flammable Protective Gases

For debinding under non-flammable protective gases or for pyrolysis processes.

Standard Equipment

- Safety concept for inert debinding and pyrolysis processes
- Process control under monitored overpressure
- Process control H1700 with PLC controls and graphic touch panel for data input
- All safety-relevant values monitored by a failsafe PLC system
- Monitored gas pre-pressure of the process gas
- Bypass for safe flushing of furnace chamber with inert gas
- Thermal post combustion of exhaust gases

Retort furnace NR 300/08 for treatment in high vacuum

Vacuum Version for Operation in High Vacuum

The furnaces can be equipped with the corresponding high vacuum technology for processes that take place in high vacuum to 600 °C.

Standard Equipment

- Process control H1700 with PLC controls
- Turbomolecular pump with booster pump for an ultimate vacuum of $< 10^{-5}$ mbar in the cold furnace
- Process gas connection with protective gas or compressed air to fill the furnace at the end of the process

Hot-wall retort furnaces NR 1000/11 in production

Hot-wall retort furnace NRA 3300/06 with automatic door opening for the integration in a fully automatic quench & temper plant

Solutions for Customer-Specific Applications

With their high level of flexibility and innovation, Nabertherm offers the optimal solution for customer-specific applications.

Based on our standard models, we develop individual solutions also for integration in overriding process systems. The solutions shown on this page are just a few examples of what is feasible. From working under vacuum or protective gas via innovative control and automation technology for a wide selection of temperatures, sizes, lenghts and other properties of retort furnaces – we will find the appropriate solution for a suitable process optimization.

Semi-automatic annealing plant with retort furnace NR 50/11 and water quenching bath on rails

Hot-wall retor furnace NRA 1700/06 with chargin frame. For grey room/clean room installation for heat treatment of glass under protective gases.

Electric bayonet catch

Charging support and TUS measuring frame for retort furnace NR 20/11

Gas supply system with mass flow controller

Tube Furnaces

Tube furnaces can be used for many different processes. The extensive range of additional equipment enables precise configuration to suit the respective requirements. Tube furnaces have an unbeatable price/performance ratio, especially for processes in a protective gas atmosphere or in vacuum.

Nabertherm has a wide range of standard tube furnaces for use in laboratories or pilot plants. For detailed descriptions, refer to our catalog “Laboratory Furnaces“.

Furnace group	Model	Tube diameter in mm		Heated length in mm		Tmax in °C	
		from	to	from	to	from	to
Compact tube furnaces	R, RD	30	170	200	1000	1200	1300
Tube furnaces with stand for horizontal and vertical operation	RT	30	50	200	250	1100	1500
High-temperature tube furnaces with SiC rod heating	RHTC	80	80	230	710	1500	1500
High-temperature tube furnaces with $MoSi_2$-heating for horizontal or vertical operation	RHTH, RHTV	50	120	150	600	1600	1800
Split-type tube furnaces for horizontal or vertical operation	RSH, RSV	50	170	250	1000	1100	1300
Rotary tube furnaces for batch operation	RSRB	80	120	500	1000	1100	1100
Rotary tube furnaces for processes with continuous movement	RSRC	80	120	500	1000	1100	1300

Tube furnace RSH 80/500/13 with gas tight tube and water-cooled flanges

Examples of Possible Additional Equipment

- Charge control with temperature measurement in the working tube
- Three-zone control for optimization of temperature uniformity
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load
- Working tubes made from various materials, such as ceramic, quartz glass, or metal
- Gas supply system packages for protective gas and vacuum operation
- Vacuum components, such as pumps, connection kits, and sensors
- Safety package for processes in a hydrogen atmosphere
- Process control and documentation with VCD software package or Nabertherm Control Center NCC for monitoring, documentation, and control

Rotary tube furnace RSRC 80/500/11 with feeding system and gas supply system 26 for processes under protective gas

Special Tube Furnaces for the Production of Glass Fiber Material
for Heat Treatment of Glass Powder/Granules and Preforms

Tube furnace RSV 220/1800/16S

Rotary tube furnace RSR 250/3500/15S

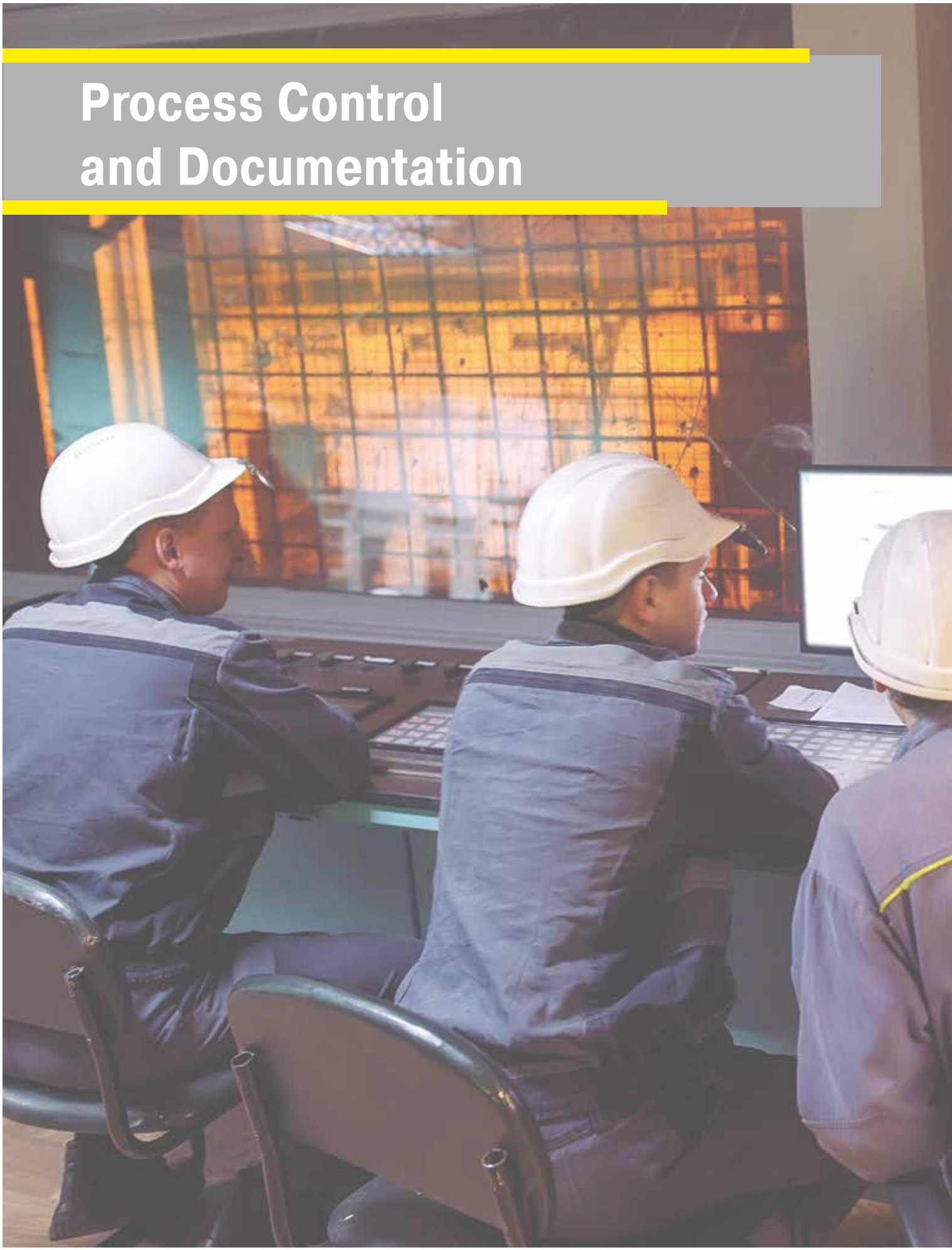
Split-type tube furnace RSV 460/1000/16S for vertical operation

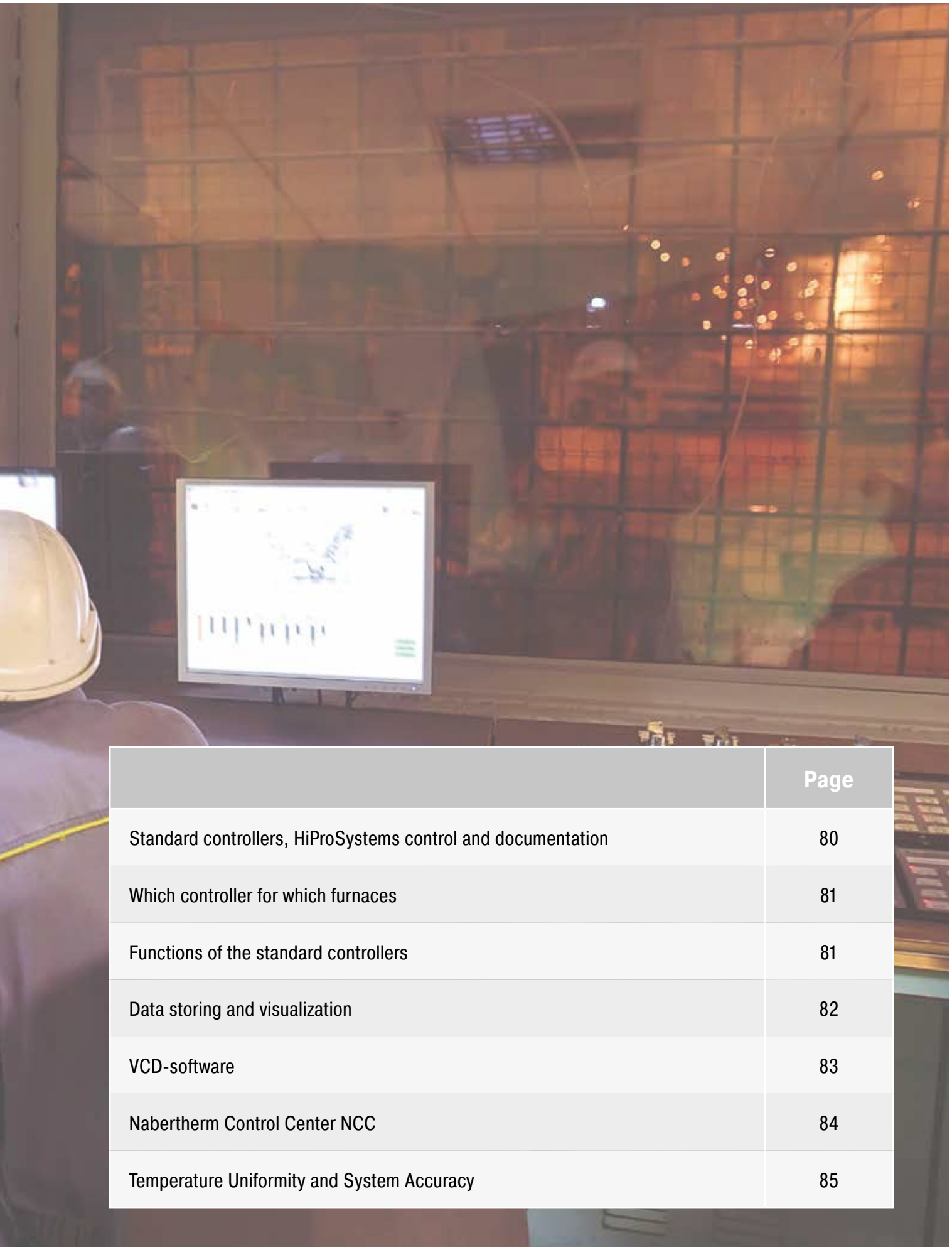
Custom-built furnaces, such as for cleaning glass powder/granules, for sintering or for degassing preforms.

The furnaces are designed according to our customers' specifications. The customer integrates them into its production system. Furnace model, temperature, size, and interfaces to higher-level systems are agreed individually for each project.

For detailed information, please also see our catalog „Laboratory Furnaces".

Process Control and Documentation





Process Control and Documentation

Nabertherm has many years of experience in the design and construction of both standard and custom control alternatives. All controls are remarkable for their ease of use and even in the basic version have a wide variety of functions

B400/C440/P470

B410/C450/P480

H1700 with colored, tabular depiction

H3700 with colored graphic presentation

Standard Controllers

Our extensive line of standard controllers satisfies most customer requirements. D60Based on the specific furnace model, the controller regulates the furnace temperature reliably and is equipped with an integrated USB-interface for documentation of process data (NTLog/NTGraph).

The standard controllers are developed and fabricated within the Nabertherm group. When developing controllers, our focus is on ease of use. The user can choose between 23 languages. From a technical standpoint, these devices are custom-fit for each furnace model or the associated application. From the simple controller with an adjustable temperature to the control unit with freely configurable control parameters, stored programs and PID microprocessor control with self-diagnosis system, we have a solution to meet your requirements.

Optionally available: Communication module with Ethernet connection for Series 400 controllers with the following functions: Connection to higher-level systems with setpoint setting and display via a web server

HiProSystems Control and Documentation

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/H700
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 (not available for all H700).

Process control H1700
Customized versions can be realized in addition to the scope of services of the H500/H700. Display of basic data as online trend.

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

For more information on operating of the Nabertherm controllers, here are some tutorials:

Which controller for which furnaces	WK	TR	TR .. LS	KTR	NA	NAT	NA .. LS	NA > 1000 l, N .. HA	W .. A	N ..G	GF, GFM	GW	HG	N 7/H - N 87 ../H ../HR	N 81(/13) - N 641(/13)	LH	N 100 - N 2200 ../(G, H, 14)	S, S .. /G	W, W .. /H, W ../14	H ../LB oder LT	LHT, LHT .. D	LHT .. LB Speed	HT	HTC 16/16 - HTC 450/16	HFL	HT ../LB oder LT	TS	NRA 17/06 - NRA 1000/11	NR, NRA .. H_2	NR, NRA .. IDB
Catalog page	10	12	12	14	20	20	20	22	26	28	32	36	38	42	42	44	46	48	50	52	56	57	58	60	61	62	71	72	74	74
Controller																														
R7		●																												
B400	●			●	●			●	●					●	●	●														
B410		○				●																								
C440	○			○	○			○	○		●			○	○	○		●												
C450		○	●			○																								
P470	○			○	○		●	○	○	●	○		●[3]	○	○	○	●		●	●	●	●	●[3]	●[3]	●[3]	●[3]	●	●		
P480		○				○																								
3208/C6				○	○																									
3504		○		○	○																							○		
H500/PLC					○								●[3]		○	○			○				●[3]	●[3]	●[3]	●[3]				
H700/PLC													○						○				○		○	○	○			
H1700/PLC				○	○			○		○		●	○		○		○		○	○			○	○	○	○				●
H3700/PLC				○	○			○				○	○		○				○	○			○	○	○	○	○	○	●	
NCC				○	○			○	○	○		○	○		○	○	○		○	○			○	○	○	○	○	○	○	○

Functions of the standard controllers	R7	3216	3208	B400/ B410	C440/ C450	P470/ P480	3504	H500	H700	H1700	H3700	NCC
Number of programs	1	1		5	10	50	25	20	1/10[3]	20	20	100
Segments	1	8		4	20	40	500[3]	20	20	20	20	20
Extra functions (e. g. fan or autom. flaps) maximum				2	2	2-6	2-8[3]	3[3]	○[3]	6/2[3]	8/2[3]	16/4[3]
Maximum number of control zones	1	1	1	1	1	3	2[1,2]	1-3[3]	○[3]	8	8	8
Drive of manual zone regulation				●	●	●						
Charge control/bath control						●	○	○	○	○	○	○
Auto tune		●	●	●	●	●	●					
Real-time clock				●	●	●		●	●	●	●	●
Plain, blue-white LC-display				●	●	●						
Graphic color display								4"	7"	7"	12"	22"
Status messages in clear text			●	●	●	●	●	●	●	●	●	●
Data entry via touchpanel								●	●	●	●	
Data input via jog dial and buttons				●	●	●						
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.	●	●	●	●	●	●	●	●	●	●	●	●
Start time configurable (e. g. to use night power rates)				●	●	●		●	●	●	●	●
Switch-over °C/°F	○	○	○	●	●	●	○	●	●[3]	●[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				23	23	23						

[1] Not for melt bath control
[2] Control of additional separate slave regulators possible
[3] Depending on the design

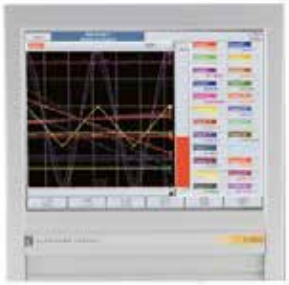
● Standard
○ Option

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).

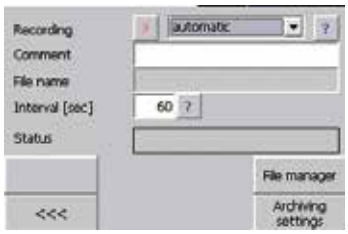


Temperature recorder

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 AMS2750F			x



NTLog Comfort

Data Storing of Nabertherm Controllers with NTLog Basic

NTLog Basic allows for recording of process data of the connected Nabertherm Controller (B400, B410, C440, C450, P470, P480) on a USB stick.

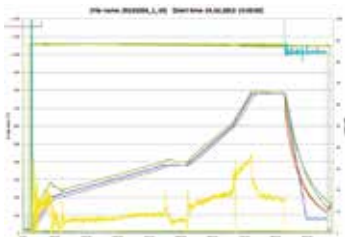
The process documentation with NTLog Basic requires no additional thermocouples or sensors. Only data recorded which are available in the controller. The data stored on the USB stick (up to 80,000 data records, format CSV) can afterwards be evaluated on the PC either via NTGraph or a spreadsheet software used by the customer (e. g. MS Excel).

For protection against accidental data manipulation the generated data records contain checksums.

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 (not available for all H700 systems). 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.

NTLog Comfort for data recording of a Siemens PLC



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

Visualization with NTGraph for Single-Zone Controlled Furnaces

The process data from NTLog can be visualized either using the customer‘s own spreadsheet program (e. g. MS-Excel) or NTGraph (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 MS-Excel for 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 seven languages (DE/EN/FR/ES/IT/CN/RU). In addition, selected texts can be generated in other languages.

Software NTEdit for Entering Programs on the PC

By using the software NTEdit (Freeware) the input of the programs becomes clearer and thus easier. The program can be enttered on customers PC and then be imported into the controller (B400, B410, C440, C450, P470, P480) 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 MS-Excel for Windows (from version 2007). NTEdit is available in eight languages (DE/EN/FR/ES/IT/CN/RU/PT).

Example lay-out with 3 furnaces

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 from the controllers B400/B410, C440/C450 and P470/P480. 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 MS Excel (.csv format *) or the generation of reports in PDF format is possible.

VCD Software for Control, Visualisation and Documentation

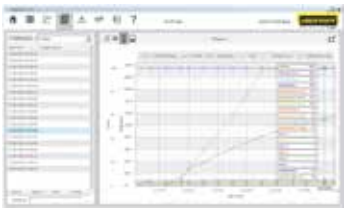
Features

- Available for controllers B400/B410/C440/C450/P470/P480
- Suitable for operating system Microsoft Windows 10 (32/64 Bit)
- 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 can be converted to Excel
- Generation of a PDF-report
- 17 languages selectable

Graphic display of main overview (version with 4 furnaces)

Extension Package 1 for Display of an Additional Temperature Measuring Point, Independant of the Furnace Controls

- Connection of an independant thermocouple, type S, N or K with temperature display on controller C6D, 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



Graphic display of process curve

Extension Package 2 for the Connection of up to Three, Six or Nine Measuring Point, Independant of the Furnace Controls

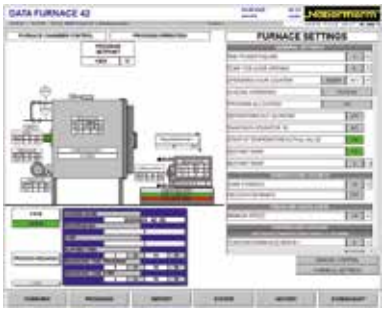
- Connection of three thermocouples, tpye K, S, N or B to the included connecting box
- Possible extension of up to two or three connecting boxes with up to nine measuring points
- Conversion and transmission of measured values to the VCD software
- Data evaluation, see VCD features

Nabertherm Control Center NCC

PC-Based Control, Process Visualization and Process Documentation Software

The Nabertherm Control Center as PC-supported furnace controls offers an ideal extension for furnaces with PLC based HiProSystem controls. 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 have been working successfully with this powerful software.

System overview



Furnace overview

Input of charge data and online trend

Measurement range calibration

Standard Equipment

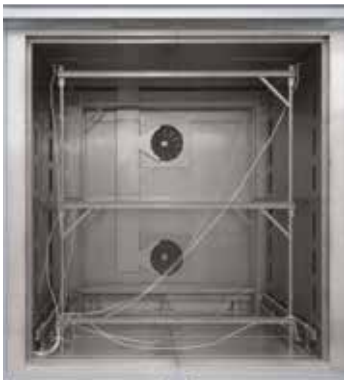
- Central furnace management
- Graphical furnace overview of up to 8 furnaces
- Tabular, clear program entry (100 program locations)
- Charge administration (article, quantity, additional information)
- Connection to the company network
- Adjustable access rights
- Online monitoring of the heat treatment
- Tamper-proof documentation
- Malfunction message list, adapted to the furnace model
- Archive function
- Delivery incl. PC and printer
- Measuring range calibration of up to 18 temperatures per measurement point. Multi-stage calibration is possible for applications with normative requirements.

Additional Equipment

- Reading in charge data via barcode
  - Simple data acquisition, ideal for frequently changing charges
  - Defined charge data ensures data quality
- Recipe storage with charge comparison
  - Comparison of charge and recipe to increase process reliability
- Adaptable access rights or access rights via employee cards
- Software extension to fulfill documentation requirements according to norms like AMS2750F (NADCAP), CQI9 or Food and Drug Administration (FDA), Part 11, EGV 1642/03
- Interface for connection to overriding systems
- SQL connection
- Redundant data storage
- Cellular connection or network connection for notification via SMS, e. g. in the event of malfunctions
- Control from different PC workstations
- Configuaration as industrial PC or virtual machine
- PC cabinet
- UPS for PC
- Customization according to individual requirements

Temperature Uniformity and System Accuracy

Holding frame for measurement of temperature uniformity



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

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.

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.

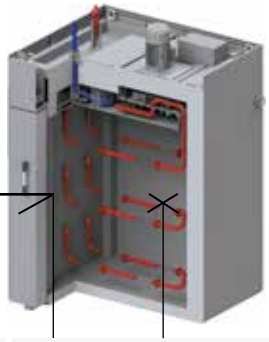
System Accuracy

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.



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 70 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 AMS2750F (NADCAP)
- Competent service team for fast help on the phone
- Safe teleservice for systems with PLC controls via modem, ISDN or a secured VPN line
- Preventive maintenance to ensure that your furnace is ready for use
- Modernization or relining of older furnace systems

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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.

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