FURNACES FOR FIBER OPTICS AND GLASS

www.nabertherm.com
Facts
- Production of Arts & Crafts furnaces, laboratory furnaces, dental furnaces and industrial furnaces since 1947
- Production site in Lilienthal/Bremen - Made in Germany
- 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
- 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

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 information see page 86

Setting Standards in Quality and Reliability
- Thermal Process Technology
- Additive Manufacturing
- Advanced Materials
- Fiber Optics/Glass
- Foundry
- Laboratory
- Dental
- Arts & Crafts

Experience in Thermal Processing
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Which Furnace for Which Process?

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 manufacturing. 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.

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.

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.

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**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).

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**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 suit the customer’s processes.
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.

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.

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.

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).
### Furnace group

<table>
<thead>
<tr>
<th>Model</th>
<th>Drying and curing coatings</th>
<th>Preheating molds and tools</th>
<th>Stabilization</th>
<th>Stress relief/cooling</th>
<th>Fusing</th>
<th>Bending and curing</th>
<th>Tempering quartz glass</th>
<th>Melting small samples</th>
<th>Research and development</th>
<th>Fiber optic production</th>
<th>Chemical strengthening</th>
</tr>
</thead>
</table>

### 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
<table>
<thead>
<tr>
<th>Furnace Group</th>
<th>Model</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating cabinets up to 150 °C</td>
<td>WK</td>
<td>10</td>
</tr>
<tr>
<td>Ovens up to 300 °C</td>
<td>TR</td>
<td>12</td>
</tr>
<tr>
<td>Chamber ovens up to 260 °C</td>
<td>KTR</td>
<td>14</td>
</tr>
</tbody>
</table>
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 Cabinets**

**Electrically Heated**

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
<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
<th>Connected load in kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>WK 4500</td>
<td>150</td>
<td>1500 x 1500 x 2000</td>
<td>4500</td>
<td>W: 1980, D: 3110, H: 2500</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>WK 6000</td>
<td>150</td>
<td>2000 x 1500 x 2000</td>
<td>6000</td>
<td>W: 2480, D: 3110, H: 2500</td>
<td>18</td>
<td>21</td>
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<td>WK 7500</td>
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<td>2500 x 1500 x 2000</td>
<td>7500</td>
<td>W: 2980, D: 3110, H: 2500</td>
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<td>30</td>
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<td>WK 10000</td>
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<td>2000 x 2500 x 2000</td>
<td>10000</td>
<td>W: 2460, D: 4070, H: 2500</td>
<td>45</td>
<td>50</td>
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<tr>
<td>WK 10001</td>
<td>150</td>
<td>2500 x 2000 x 2000</td>
<td>10000</td>
<td>W: 2960, D: 3570, H: 2500</td>
<td>45</td>
<td>50</td>
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<tr>
<td>WK 12000</td>
<td>150</td>
<td>2000 x 3000 x 2000</td>
<td>12000</td>
<td>W: 2460, D: 4570, H: 2500</td>
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<td>50</td>
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<td>WK 15000</td>
<td>150</td>
<td>2500 x 3000 x 2000</td>
<td>15000</td>
<td>W: 2900, D: 4720, H: 2500</td>
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<td>62</td>
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<tr>
<td>WK 17500</td>
<td>150</td>
<td>2500 x 3500 x 2000</td>
<td>17500</td>
<td>W: 2900, D: 5220, H: 2500</td>
<td>54</td>
<td>62</td>
</tr>
</tbody>
</table>

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

*Please see page 81 for more information about supply voltage.
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.

### 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 removable grids (number of removable 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 removable 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

- **Model**: TR 420
- **Configuration**: LS
- **Dimensions (mm)**: 750 x 530 x 1100
- **Personal Volume (l)**: 450
- **Connected Load (kW)**: 6.3
- **Electrical Connection**: 3-phase
- **Weight (kg)**: 250
- **Supplied with**: 150

### Oven TR 1050 with Double Door

- **Model**: TR 1050
- **Configuration**: LS
- **Dimensions (mm)**: 1200 x 670 x 1100
- **Personal Volume (l)**: 1050
- **Connected Load (kW)**: 9.3
- **Electrical Connection**: 3-phase
- **Weight (kg)**: 450
- **Supplied with**: 1450

### Table: Oven Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax in °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions¹ in mm</th>
<th>Connected load in kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Connected Electrical</th>
<th>Min to Tmax²</th>
<th>Grids included</th>
<th>Grids max.</th>
<th>Max. total load³</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR 30</td>
<td>300</td>
<td>360 x 300 x 300</td>
<td>30</td>
<td>610 x 570 x 665</td>
<td>2.1</td>
<td>1-phase</td>
<td>45</td>
<td>25</td>
<td>1</td>
<td>4</td>
<td>80</td>
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<tr>
<td>TR 60</td>
<td>300</td>
<td>450 x 390 x 350</td>
<td>60</td>
<td>700 x 610 x 710</td>
<td>3.1</td>
<td>1-phase</td>
<td>90</td>
<td>25</td>
<td>1</td>
<td>4</td>
<td>120</td>
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<tr>
<td>TR 60 LS</td>
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<td>450 x 390 x 350</td>
<td>60</td>
<td>700 x 620 x 870</td>
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<td>1</td>
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<td>650 x 390 x 500</td>
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<td>900 x 610 x 860</td>
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<td>2</td>
<td>7</td>
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<tr>
<td>TR 120 LS</td>
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<td>650 x 390 x 500</td>
<td>120</td>
<td>900 x 820 x 870</td>
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<td>TR 240</td>
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<td>240</td>
<td>1000 x 780 x 970</td>
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<td>1-phase</td>
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<td>2</td>
<td>8</td>
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<tr>
<td>TR 240 LS</td>
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<td>750 x 530 x 600</td>
<td>240</td>
<td>1000 x 990 x 970</td>
<td>6.3</td>
<td>3-phase</td>
<td>180</td>
<td>60</td>
<td>2</td>
<td>8</td>
<td>150</td>
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<td>TR 420</td>
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<td>1300 x 550 x 600</td>
<td>420</td>
<td>1550 x 915 x 970</td>
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<td>3-phase</td>
<td>250</td>
<td>60</td>
<td>2</td>
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<td>200</td>
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<tr>
<td>TR 450</td>
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<td>750 x 550 x 1100</td>
<td>450</td>
<td>1000 x 780 x 1470</td>
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<td>TR 450 LS</td>
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<td>1000 x 990 x 1470</td>
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<td>1200 x 670 x 1000</td>
<td>800</td>
<td>1470 x 970 x 1520</td>
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<td>1050</td>
<td>1470 x 970 x 1920</td>
<td>9.3</td>
<td>3-phase</td>
<td>450</td>
<td>80</td>
<td>4</td>
<td>14</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

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

*Please see page 81 for more information about supply voltage*
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.

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

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

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 shelf 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
Charging cart with pull-out trays

---

### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
<th>Electrical connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>KTR 1000 (LS)</td>
<td>260</td>
<td>1000 1000 1000</td>
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<td>KTR 2000 (LS)</td>
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<td>KTR 6250 (LS)</td>
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<td>21300</td>
<td>3600 4195 3380</td>
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<td>KTR 22500 (LS)</td>
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<td>22500</td>
<td>3140 5400 3500</td>
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<td>2-phase</td>
</tr>
</tbody>
</table>

1Depending on furnace design connected load might be higher

2External 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**

---

*Please see page 81 for more information about supply voltage*
Motor-driven rotary track with baskets for moving the charge during heat treatment.

Adjustable plate shutters to adapt the air guide to the charge.

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.

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.

Max. amount of silicone per charge at a fresh air amount of 120 l/min/kg
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
<table>
<thead>
<tr>
<th>Furnace Group</th>
<th>Model</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forced convection chamber furnaces</td>
<td>NA</td>
<td>20</td>
</tr>
<tr>
<td>Forced convection chamber furnaces from 1000 liter</td>
<td>NAT</td>
<td></td>
</tr>
<tr>
<td>Forced convection bogie hearth furnaces</td>
<td>N . . H</td>
<td>22</td>
</tr>
<tr>
<td>Brick-insulated chamber furnaces for cooling/relieving stresses in glass</td>
<td>W . . A</td>
<td>26</td>
</tr>
<tr>
<td>Brick-insulated chamber furnaces for cooling/relieving stresses in glass</td>
<td>N . . G</td>
<td>28</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax (°C)</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA 30/45 (LS)</td>
<td>450</td>
<td>290 420 260</td>
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<td>1040 1290 1385</td>
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<td>NA 250/45 (LS)</td>
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<td>1350 1650 1680</td>
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<td>3-phase</td>
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<td>NA 675/45 (LS)</td>
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<tr>
<td>NAT 15/65</td>
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<tr>
<td>NA 30/65</td>
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<tr>
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<td>350 500 350</td>
<td>60</td>
<td>910 1390 1475</td>
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<tr>
<td>NA 120/65</td>
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<td>120</td>
<td>990 1470 1550</td>
<td>12.0</td>
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<tr>
<td>NA 250/65</td>
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<td>600 750 600</td>
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<td>1170 1650 1680</td>
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<td>3-phase</td>
<td>730</td>
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<tr>
<td>NA 500/65</td>
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<td>750 1000 750</td>
<td>500</td>
<td>1290 1890 1825</td>
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<tr>
<td>NA 675/65</td>
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<td>675</td>
<td>1290 2100 1825</td>
<td>27.0</td>
<td>3-phase</td>
<td>1050</td>
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<tr>
<td>NAT 15/85</td>
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<td>1-phase</td>
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<td>750 1000 750</td>
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<td>675</td>
<td>1270 2190 1960</td>
<td>30.0</td>
<td>3-phase</td>
<td>1360</td>
</tr>
</tbody>
</table>

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

---

Temperature curve with additional equipment „controlled cooling“ switched on.

- **Port for thermocouple**
- **Tray**
- **Roller conveyor in furnace chamber**

---

*Please see page 81 for more information about supply voltage*
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 Furnaces from 1000 Liter**

**Electrically Heated or Gas-Fired**

Forced convection furnace NA 3240/45S

<table>
<thead>
<tr>
<th>Standard Equipment for Models up to 600 °C (850 °C Models See Page 23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Tmax 450 °C or 600 °C</td>
</tr>
<tr>
<td>- Electrically heated or gas-fired</td>
</tr>
<tr>
<td>- Electric heating by means of heater coils</td>
</tr>
<tr>
<td>- Direct gas heating or upon request with indirect gas heating with radiation tube, e. g. for heat treatment of aluminum</td>
</tr>
<tr>
<td>- Horizontal air circulation (type ../HA)</td>
</tr>
<tr>
<td>- High air exchange for perfect heat transfer</td>
</tr>
<tr>
<td>- Temperature uniformity up to +/- 5 °C according to DIN 17052-1 see page 85</td>
</tr>
<tr>
<td>- Furnace chamber lined with alloy 1.4301 (DIN)</td>
</tr>
<tr>
<td>- High quality mineral wool insulation provides for low outer temperatures</td>
</tr>
<tr>
<td>- Inside unlocking device for furnaces with walk-in work space</td>
</tr>
<tr>
<td>- Furnace sizes suitable for common charging systems, such as pallets, baskets, etc.</td>
</tr>
<tr>
<td>- 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.</td>
</tr>
<tr>
<td>- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load</td>
</tr>
</tbody>
</table>

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

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

Forced convection chamber furnace NA 4000/45
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

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
<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions¹ in mm</th>
<th>Circulation rate m³/h</th>
<th>Heating power in kW²</th>
<th>Electrical connection*</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1000</td>
<td>W=2015 D=2150 H=1700</td>
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<td>1500</td>
<td>W=2015 D=2650 H=1700</td>
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<td>36</td>
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</tr>
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<td>2000</td>
<td>W=2015 D=2200 H=2670</td>
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<td>3-phase</td>
</tr>
<tr>
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<td>2000</td>
<td>W=2215 D=2400 H=2670</td>
<td>9000</td>
<td>60</td>
<td>3-phase</td>
</tr>
<tr>
<td>NA 4000/45</td>
<td>450</td>
<td>w=2200 d=1500 h=1200</td>
<td>4000</td>
<td>W=3315 D=2650 H=1870</td>
<td>6400</td>
<td>60</td>
<td>3-phase</td>
</tr>
<tr>
<td>NA 4010/45</td>
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<td>W=2015 D=3200 H=2670</td>
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<td>7200</td>
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<tr>
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<tr>
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<tr>
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<td>W=2550 D=2750 H=2670</td>
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<td>3-phase</td>
</tr>
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<td>1000</td>
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<td>1500</td>
<td>W=2600 D=2000 H=1900</td>
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<tr>
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<tr>
<td>N 2000/85HA</td>
<td>850</td>
<td>w=1500 d=1100 h=1200</td>
<td>2000</td>
<td>W=2700 D=2320 H=2100</td>
<td>9000</td>
<td>60</td>
<td>3-phase</td>
</tr>
<tr>
<td>N 2000/85HA1</td>
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</table>

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

²Depending on furnace design connected load might be higher.

---

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.

External dimensions vary when furnace is equipped with additional equipment. Dimensions on request. *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.

### 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 programs with each 4 segments), alternative controllers see page 81

### 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

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Max. charging weight in kg</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
<th>Electrical connection</th>
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<tbody>
<tr>
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<td>800 1600 800</td>
<td>1000</td>
<td>800 1780 2450 2350</td>
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</tr>
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<td>1600</td>
<td>1000 1920 2450 2510</td>
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</tr>
<tr>
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<td>1500 1980 3100 2560</td>
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</tr>
<tr>
<td>W 3300/.. A</td>
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<td>1200 2250 1200</td>
<td>3300</td>
<td>1900 2180 3100 2750</td>
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<tr>
<td>W 4400/.. A</td>
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<td>1500 2250 1200</td>
<td>4000</td>
<td>2400 2480 3100 2800</td>
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<tr>
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<td>1200 3300 1200</td>
<td>4800</td>
<td>2800 2180 4380 2850</td>
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</tr>
<tr>
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</tr>
</tbody>
</table>

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 bogie 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.

### 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

### 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

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in L</th>
<th>Outer dimensions1 in mm</th>
<th>Heating power in kW2</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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<tbody>
<tr>
<td>N 100/G</td>
<td>900</td>
<td>400 x 530 x 460</td>
<td>100</td>
<td>720 x 1130 x 1440</td>
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<td>N 150/G</td>
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<td>450 x 530 x 590</td>
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<td>770 x 1130 x 1570</td>
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<td>N 200/G</td>
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<td>470 x 530 x 780</td>
<td>200</td>
<td>790 x 1130 x 1760</td>
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<td>N 200/GS</td>
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<td>400 x 1000 x 500</td>
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<td>795 x 1710 x 1605</td>
<td>16</td>
<td>3-phase</td>
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<tr>
<td>N 250/GS</td>
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<td>N 300/G</td>
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<td>870 x 1300 x 1760</td>
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<td>995 x 1710 x 1705</td>
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<td>995 x 2110 x 1705</td>
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<td>660</td>
<td>1000 x 1750 x 1830</td>
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1External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
2Depending on furnace design connected load might be higher

---

### Charging trolley for model1

<table>
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<th>W</th>
<th>D</th>
<th>H</th>
<th>W</th>
<th>D</th>
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<td>315</td>
<td>470</td>
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<td>N 150/G</td>
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<td>505</td>
<td>540</td>
<td>375</td>
<td>470</td>
<td>22</td>
<td>12</td>
<td>40</td>
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<td>505</td>
<td>730</td>
<td>395</td>
<td>470</td>
<td>22</td>
<td>17</td>
<td>40</td>
</tr>
<tr>
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<td>675</td>
<td>730</td>
<td>478</td>
<td>640</td>
<td>22</td>
<td>17</td>
<td>40</td>
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</table>

1Charging 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)
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
<table>
<thead>
<tr>
<th>Furnace Group</th>
<th>Model</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fusing furnaces with fixed table</td>
<td>GF</td>
<td>32</td>
</tr>
<tr>
<td>Fusing furnaces with movable table</td>
<td>GFM</td>
<td>34</td>
</tr>
<tr>
<td>Tub furnaces with wire heating</td>
<td>GW</td>
<td>36</td>
</tr>
<tr>
<td>Top hat furnaces with wire heating with table</td>
<td>HG</td>
<td>38</td>
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</table>
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.

### Standard Equipment

- **Tmax 950 ºC**, GF 75: Tmax 900 ºC
- 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
<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Floor space in m²</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
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<td>GF 75</td>
<td>950</td>
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<td>620 620 310</td>
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<td>1170 950 1370</td>
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<td>3-phase</td>
<td>210</td>
</tr>
<tr>
<td>GF 240</td>
<td>950</td>
<td>1010 810 400</td>
<td>0.81</td>
<td>1460 1140 1460</td>
<td>11.0</td>
<td>3-phase</td>
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</tr>
<tr>
<td>GF 380</td>
<td>950</td>
<td>1210 1100 400</td>
<td>1.33</td>
<td>1660 1460 1460</td>
<td>15.0</td>
<td>3-phase</td>
<td>450</td>
</tr>
<tr>
<td>GF 420</td>
<td>950</td>
<td>1660 950 400</td>
<td>1.57</td>
<td>2110 1310 1460</td>
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<td>3-phase</td>
<td>500</td>
</tr>
<tr>
<td>GF 520</td>
<td>950</td>
<td>1210 1160 400</td>
<td>1.40</td>
<td>1660 1520 1460</td>
<td>15.0</td>
<td>3-phase</td>
<td>550</td>
</tr>
<tr>
<td>GF 600</td>
<td>950</td>
<td>2010 1010 400</td>
<td>2.03</td>
<td>2460 1370 1460</td>
<td>22.0</td>
<td>3-phase</td>
<td>600</td>
</tr>
<tr>
<td>GF 920</td>
<td>950</td>
<td>2110 1160 400</td>
<td>2.44</td>
<td>2560 1520 1460</td>
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<td>3-phase</td>
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<td>GF 1050</td>
<td>950</td>
<td>2310 1210 400</td>
<td>2.79</td>
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<td>32.0</td>
<td>3-phase</td>
<td>1050</td>
</tr>
<tr>
<td>GF 1425</td>
<td>950</td>
<td>2510 1510 400</td>
<td>3.79</td>
<td>2960 1870 1460</td>
<td>32.0</td>
<td>3-phase</td>
<td>1250</td>
</tr>
</tbody>
</table>

1*Heating only between two phases
2*Fusing of 32 A if connected to 230 V
3* Depending on furnace design connected load might be higher
4*External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

*Please see page 81 for more information about supply voltage
*Base included

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.

### 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

### 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
<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Outer dimensions(^2) in mm</th>
<th>Heating power in kW(^1)</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
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<tbody>
<tr>
<td>GFM 420</td>
<td>950</td>
<td>1660 x 950 x 400</td>
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<td>GFM 600</td>
<td>950</td>
<td>2010 x 1010 x 400</td>
<td>2580 x 1450 x 1460</td>
<td>22</td>
<td>3-phase</td>
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<tr>
<td>GFM 920</td>
<td>950</td>
<td>2110 x 1160 x 400</td>
<td>2680 x 1600 x 1460</td>
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<td>3-phase</td>
<td>990</td>
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<td>GFM 1050</td>
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<td>2310 x 1210 x 400</td>
<td>2880 x 1650 x 1460</td>
<td>32</td>
<td>3-phase</td>
<td>1190</td>
</tr>
<tr>
<td>GFM 1425</td>
<td>950</td>
<td>2510 x 1510 x 400</td>
<td>3080 x 1950 x 1460</td>
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<td>3-phase</td>
<td>1390</td>
</tr>
</tbody>
</table>

\(^1\)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.

GFM 1425 fusing furnace with motorized lid opening

- 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.

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

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.
Bottom heating covered by SiC tiles to create level stacking support

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions² in mm</th>
<th>Heating power in kW¹</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
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<tr>
<td>GW 830</td>
<td>900</td>
<td>1200 1150 600</td>
<td>830 2140 1980 1250</td>
<td>36 3-phase 820</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>GW 840</td>
<td>900</td>
<td>1650 850 600</td>
<td>840 2590 1680 1250</td>
<td>36 3-phase 980</td>
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<td></td>
<td></td>
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<tr>
<td>GW 1200</td>
<td>900</td>
<td>2000 1000 600</td>
<td>1200 2940 1830 1250</td>
<td>40 3-phase 1210</td>
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<td>2100 1150 600</td>
<td>1450 3040 1980 1250</td>
<td>70 3-phase 1420</td>
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<td>900</td>
<td>2300 1200 600</td>
<td>1660 3240 2030 1250</td>
<td>80 3-phase 1780</td>
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<tr>
<td>GW 2200</td>
<td>900</td>
<td>2300 1200 800</td>
<td>2200 3240 2030 1400</td>
<td>90 3-phase 2160</td>
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<td>8000 4640 3530 1400</td>
<td>180 3-phase 2980</td>
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</tbody>
</table>

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

Automatic lid opening via electromechanical spindle
Motorized exhaust air flaps as additional equipment
Bottom heating covered by SiC tiles to create level stacking support

*Please see page 81 for more information about supply voltage
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.

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

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG 750</td>
<td>900</td>
<td>w: 2100 d: 1200 h: 300</td>
<td>W: 2550 D: 1800 H: 1350</td>
<td>35</td>
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<td>HG 1000</td>
<td>900</td>
<td>w: 1750 d: 1000 h: 550</td>
<td>W: 2200 D: 1450 H: 1600</td>
<td>33</td>
<td>3-phase</td>
<td>1500</td>
</tr>
<tr>
<td>HG 1800</td>
<td>900</td>
<td>w: 2450 d: 1850 h: 400</td>
<td>W: 2950 D: 2350 H: 1600</td>
<td>45</td>
<td>3-phase</td>
<td>2500</td>
</tr>
<tr>
<td>HG 2640</td>
<td>900</td>
<td>w: 3000 d: 2200 h: 400</td>
<td>W: 3500 D: 2700 H: 1450</td>
<td>75</td>
<td>3-phase</td>
<td>3400</td>
</tr>
<tr>
<td>HG 3000</td>
<td>900</td>
<td>w: 3500 d: 2200 h: 400</td>
<td>W: 4000 D: 2800 H: 1600</td>
<td>75</td>
<td>3-phase</td>
<td>3800</td>
</tr>
<tr>
<td>HG 4800</td>
<td>900</td>
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<td>W: 6000 D: 2700 H: 1600</td>
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<td>3-phase</td>
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</tr>
<tr>
<td>HG 5208/S</td>
<td>900</td>
<td>w: 3100 d: 2100 h: 800</td>
<td>W: 3990 D: 2590 H: 3140</td>
<td>110</td>
<td>3-phase</td>
<td>5000</td>
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<tr>
<td>HG 7608/S</td>
<td>900</td>
<td>w: 3800 d: 2500 h: 800</td>
<td>W: 4690 D: 2990 H: 3140</td>
<td>143</td>
<td>3-phase</td>
<td>7000</td>
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</tbody>
</table>

1Depending on furnace design connected load might be higher
2External 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
<table>
<thead>
<tr>
<th>Furnace Group</th>
<th>Model</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamber furnaces to preheat molds and tools</td>
<td>N/N .. H</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>N .. 13</td>
<td></td>
</tr>
<tr>
<td>Chamber furnaces with wire heating up to 1400 °C</td>
<td>LH</td>
<td>44</td>
</tr>
<tr>
<td>Chamber furnaces with wire heating up to 1400 °C</td>
<td>N/N .. H</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>N .. 14</td>
<td></td>
</tr>
<tr>
<td>Top loading furnaces</td>
<td>S/S .. /G</td>
<td>48</td>
</tr>
<tr>
<td>Bogie hearth furnaces with wire heating up to 1400 °C</td>
<td>W/W .. H</td>
<td>50</td>
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<td></td>
<td>W .. 14</td>
<td></td>
</tr>
<tr>
<td>Top hat furnaces or bottom loading furnaces with wire heating up to 1400 °C</td>
<td>H .. LB</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>H .. LT</td>
<td></td>
</tr>
</tbody>
</table>
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 $+/- 10 \, ^\circ C$ 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

**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

### Table of Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax in °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions¹ in mm</th>
<th>Heating power in kW²</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
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<td>250 x 250 x 140</td>
<td>9</td>
<td>800 x 650 x 600</td>
<td>3.0</td>
<td>1-phase</td>
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<td>N 11/H</td>
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<td>800 x 750 x 600</td>
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<td>1-phase</td>
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<td>250 x 350 x 140</td>
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<td>3-phase³</td>
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<td>17</td>
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<td>6.4</td>
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<td>350 x 350 x 250</td>
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<td>3-phase</td>
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</tr>
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<td>N 161</td>
<td>1200</td>
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<td>160</td>
<td>1350 x 2085 x 2300</td>
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<td>1575 x 2400 x 2345</td>
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<td>1850 x 2850 x 2650</td>
<td>80.0</td>
<td>3-phase</td>
<td>2500</td>
</tr>
</tbody>
</table>

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

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*Please see page 81 for more information about supply voltage*
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.

### 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 programs with each 4 segments), alternative controllers see page 81

### 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
<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax in °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions¹ in mm</th>
<th>Connected load in kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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<tbody>
<tr>
<td>LH 15/12</td>
<td>1200</td>
<td>250 250 250</td>
<td>15</td>
<td>680 860 1230</td>
<td>5.0</td>
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<td>LH 30/12</td>
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<td>320 320 320</td>
<td>30</td>
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<td>18.0</td>
<td>3-phase²</td>
<td>370</td>
</tr>
</tbody>
</table>

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

*Please see page 81 for more information about supply voltage.
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.

**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

**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
### Chamber Furnaces N 1680/S for Long Parts

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
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<th>Volume in l</th>
<th>Outer dimensions1 in mm</th>
<th>Heating power in kW2</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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<td>1150 1440</td>
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<td>430 530 620 150 790</td>
<td>1150 1600</td>
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<td>550 700 780 300 910</td>
<td>1320 1760</td>
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<tr>
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<td>2160 2350</td>
<td>140 3-phase 3600</td>
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</tbody>
</table>

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.
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.

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

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

<table>
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<th>Model</th>
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<th>Volume</th>
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<th>Heating power ²</th>
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<tr>
<td></td>
<td>°C</td>
<td>w d h in mm</td>
<td>in l</td>
<td>W D H in mm</td>
<td>in kW</td>
<td>in kg</td>
<td>in kg</td>
</tr>
<tr>
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<td>220</td>
<td>3000 1000 2000</td>
<td>18</td>
<td>3-phase</td>
<td>1000</td>
</tr>
<tr>
<td>S 430/G</td>
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<td>1200 600 600</td>
<td>432</td>
<td>1900 1300 2200</td>
<td>24</td>
<td>3-phase</td>
<td>1100</td>
</tr>
<tr>
<td>S 500/G</td>
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<td>500</td>
<td>3000 1100 2000</td>
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<td>750</td>
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<td>1240</td>
<td>1200 600 600</td>
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<td>1900 1300 2200</td>
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<tr>
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</table>

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

*Please see page 81 for more information about supply voltage
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.

**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

**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

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions¹ in mm</th>
<th>Heating power in kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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<td>1000</td>
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<table>
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<th>Tmax °C</th>
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<th>Heating power in kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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<td>10300</td>
</tr>
</tbody>
</table>

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

---

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

---

**Notes:**
- Thermocouple inlets (Ø 40 mm) in the front corners of the bogie.
- Bogie hearth furnace for tempering quartz rods.
- Electro-hydraulic lift door.

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*Please see page 81 for more information about supply voltage.*
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, 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.

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

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.
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

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions¹ in mm</th>
<th>Heating power in kW²</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 125/LB, LT</td>
<td>1280</td>
<td>800 400 400</td>
<td>125 1550</td>
<td>1500 2200</td>
<td>12 3-phase</td>
<td>1250</td>
<td></td>
</tr>
<tr>
<td>H 250/LB, LT</td>
<td>1280</td>
<td>1000 500 500</td>
<td>250 1530</td>
<td>1700 2300</td>
<td>18 3-phase</td>
<td>1400</td>
<td></td>
</tr>
<tr>
<td>H 500/LB, LT</td>
<td>1280</td>
<td>1200 600 600</td>
<td>500 2020</td>
<td>1800 2500</td>
<td>36 3-phase</td>
<td>1800</td>
<td></td>
</tr>
<tr>
<td>H 1000/LB, LT</td>
<td>1280</td>
<td>1600 800 800</td>
<td>1000 2200</td>
<td>2000 2900</td>
<td>48 3-phase</td>
<td>2800</td>
<td></td>
</tr>
<tr>
<td>H 1350/LB, LT</td>
<td>1280</td>
<td>2800 620 780</td>
<td>1360 3750</td>
<td>2050 3050</td>
<td>75 3-phase</td>
<td>3500</td>
<td></td>
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<tr>
<td>H 3000/LB, LT</td>
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<td>3000 1000 1000</td>
<td>3000 4000</td>
<td>2100 3200</td>
<td>140 3-phase</td>
<td>6200</td>
<td></td>
</tr>
</tbody>
</table>

¹External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
²Depending 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

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

### Standard Equipment
- T\textsuperscript{max} 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

<table>
<thead>
<tr>
<th>Model</th>
<th>T\textsuperscript{max} in °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions\textsuperscript{1} in mm</th>
<th>Connected load in kW</th>
<th>Electrical connection\textsuperscript{*}</th>
<th>Weight in kg</th>
<th>Heating time in min\textsuperscript{2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHT 02/16</td>
<td>1600</td>
<td>90 150 150</td>
<td>2</td>
<td>470 630 760+260</td>
<td>3.0</td>
<td>1-phase</td>
<td>75</td>
<td>30</td>
</tr>
<tr>
<td>LHT 04/16</td>
<td>1600</td>
<td>150 150 150</td>
<td>4</td>
<td>470 630 760+260</td>
<td>5.2</td>
<td>3-phase\textsuperscript{4}</td>
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<td>25</td>
</tr>
<tr>
<td>LHT 08/16</td>
<td>1600</td>
<td>150 300 150</td>
<td>8</td>
<td>470 810 760+260</td>
<td>8.0</td>
<td>3-phase\textsuperscript{4}</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>LHT 01/17 D</td>
<td>1650</td>
<td>110 120 120</td>
<td>1</td>
<td>385 425 525+195</td>
<td>2.9</td>
<td>1-phase</td>
<td>28</td>
<td>35</td>
</tr>
<tr>
<td>LHT 03/17 D</td>
<td>1650</td>
<td>135 155 200</td>
<td>4</td>
<td>470 630 760+260</td>
<td>3.0</td>
<td>1-phase</td>
<td>75</td>
<td>30</td>
</tr>
<tr>
<td>LHT 02/17</td>
<td>1750</td>
<td>90 150 150</td>
<td>2</td>
<td>470 630 760+260</td>
<td>3.0</td>
<td>1-phase</td>
<td>75</td>
<td>35</td>
</tr>
<tr>
<td>LHT 04/17</td>
<td>1750</td>
<td>150 150 150</td>
<td>4</td>
<td>470 630 760+260</td>
<td>5.2</td>
<td>3-phase\textsuperscript{4}</td>
<td>85</td>
<td>30</td>
</tr>
<tr>
<td>LHT 08/17</td>
<td>1750</td>
<td>150 300 150</td>
<td>8</td>
<td>470 810 760+260</td>
<td>8.0</td>
<td>3-phase\textsuperscript{4}</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
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<td>90 150 150</td>
<td>2</td>
<td>470 630 760+260</td>
<td>3.6</td>
<td>1-phase</td>
<td>75</td>
<td>60</td>
</tr>
<tr>
<td>LHT 04/18</td>
<td>1800</td>
<td>150 150 150</td>
<td>4</td>
<td>470 630 760+260</td>
<td>5.2</td>
<td>3-phase\textsuperscript{4}</td>
<td>85</td>
<td>40</td>
</tr>
<tr>
<td>LHT 08/18</td>
<td>1800</td>
<td>150 300 150</td>
<td>8</td>
<td>470 810 760+260</td>
<td>9.0</td>
<td>3-phase\textsuperscript{4}</td>
<td>100</td>
<td>40</td>
</tr>
</tbody>
</table>

\textsuperscript{1}External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

\textsuperscript{2}Including opened lift door

\textsuperscript{4}Heating time of the empty and closed furnace up to T\textsuperscript{max} − 100 K (connected to 230 V 1/N/PE resp. 400 V 3/N/PE)

\textsuperscript{*}Please see page 81 for more information about supply voltage

\textsuperscript{4}Heating only between two phases
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 optimal temperature uniformity.

**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

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

*External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
*Corresponds to charge saggars with spacer.

---

Electrically driven lift-bottom

Saggar

Furnace chamber heated on four sides for model LHT 01/17 LB Speed
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 Furnaces with Molybdenum Disilicide Heating Elements with Fiber Insulation up to 1800 °C**

**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/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**

- 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**

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

---

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

---

**Model** | Tmax in °C | Inner dimensions in mm | Volume in l | Outer dimensions¹ in mm | Heating power in kW² | Electrical connection | Weight in kg
---|---|---|---|---|---|---|---
HT 08/16 | 1600 | 150 300 150 | 8 | 740 640 1755 | 8.0 | 3-phase² | 215
HT 16/16 | 1600 | 200 300 260 | 16 | 820 690 1860 | 12.0 | 3-phase² | 300
HT 29/16 | 1600 | 275 300 350 | 29 | 985 740 1990 | 9.3 | 3-phase² | 340
HT 40/16 | 1600 | 300 350 350 | 40 | 1010 800 1990 | 12.0 | 3-phase² | 420
HT 64/16 | 1600 | 400 400 400 | 64 | 1140 890 2040 | 18.0 | 3-phase² | 555
HT 128/16 | 1600 | 400 800 400 | 128 | 1140 1280 2040 | 26.0 | 3-phase² | 820
HT 160/16 | 1600 | 500 550 550 | 160 | 1250 1040 2240 | 21.0 | 3-phase² | 880
HT 276/16 | 1600 | 500 1000 550 | 276 | 1310 1600 2290 | 42.0 | 3-phase² | 1300
HT 450/16 | 1600 | 500 1150 780 | 450 | 1360 1800 2570 | 57.0 | 3-phase² | 1450
HT 08/17 | 1750 | 150 300 150 | 8 | 740 640 1755 | 8.0 | 3-phase² | 215
HT 16/17 | 1750 | 200 300 260 | 16 | 820 690 1860 | 12.0 | 3-phase² | 300
HT 29/17 | 1750 | 275 300 350 | 29 | 985 740 1990 | 9.3 | 3-phase² | 340
HT 40/17 | 1750 | 300 350 350 | 40 | 1010 800 1990 | 12.0 | 3-phase² | 420
HT 64/17 | 1750 | 400 400 400 | 64 | 1140 890 2040 | 18.0 | 3-phase² | 555
HT 128/17 | 1750 | 400 800 400 | 128 | 1140 1280 2040 | 26.0 | 3-phase² | 820
HT 160/17 | 1750 | 500 550 550 | 160 | 1250 1040 2240 | 21.0 | 3-phase² | 880
HT 276/17 | 1750 | 500 1000 550 | 276 | 1310 1600 2290 | 43.0 | 3-phase² | 1300
HT 450/17 | 1750 | 500 1150 780 | 450 | 1360 1800 2570 | 57.0 | 3-phase² | 1450
HT 08/18 | 1800 | 150 300 150 | 8 | 740 640 1755 | 8.0 | 3-phase² | 215
HT 16/18 | 1800 | 200 300 260 | 16 | 820 690 1860 | 12.0 | 3-phase² | 300
HT 29/18 | 1800 | 275 300 350 | 29 | 985 740 1990 | 9.3 | 3-phase² | 340
HT 40/18 | 1800 | 300 350 350 | 40 | 1010 800 1990 | 12.0 | 3-phase² | 420
HT 64/18 | 1800 | 400 400 400 | 64 | 1140 890 2040 | 18.0 | 3-phase² | 555
HT 128/18 | 1800 | 400 800 400 | 128 | 1140 1280 2040 | 26.0 | 3-phase² | 820
HT 160/18 | 1800 | 500 550 550 | 160 | 1250 1040 2240 | 21.0 | 3-phase² | 880
HT 276/18 | 1800 | 500 1000 550 | 276 | 1310 1600 2290 | 42.0 | 3-phase² | 1300
HT 450/18 | 1800 | 500 1150 780 | 450 | 1360 1800 2570 | 64.0 | 3-phase² | 1450

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

*Please see page 81 for more information about supply voltage*
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 makes them comparable with the already familiar models in the HT product line and they can be upgraded with the same additional equipment.

### 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 Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax in °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Heating Power in kW</th>
<th>Connected load in kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTC 16/16</td>
<td>1550</td>
<td>200 300 260</td>
<td>16</td>
<td>810 700 1500</td>
<td>12.0</td>
<td>16.0</td>
<td>3-phase*</td>
<td>270</td>
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<tr>
<td>HTC 40/16</td>
<td>1550</td>
<td>300 350 350</td>
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<td>1000 800 1620</td>
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<tr>
<td>HTC 64/16</td>
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<td>400 400 400</td>
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<td>1130 900 1670</td>
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<td>HTC 128/16</td>
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<td>128</td>
<td>1130 1290 1670</td>
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<td>HTC 160/16</td>
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<td>HTC 450/16</td>
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<td>500 1150 780</td>
<td>450</td>
<td>1350 1740 2120</td>
<td>64.0</td>
<td>118.0</td>
<td>3-phase</td>
<td>1500</td>
</tr>
</tbody>
</table>

*External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

*Heating only between two phases

*Please see page 81 for more information about supply voltage
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.

### 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

### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax in °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Connected load in kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFL 16/16</td>
<td>1600</td>
<td>200 300 300 260</td>
<td>16</td>
<td>1000 890 1620</td>
<td>12</td>
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<td>500</td>
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<td>300 350 350 350</td>
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<td>500 550 550 550</td>
<td>160</td>
<td>1400 1250 2100</td>
<td>21</td>
<td>3-phase</td>
<td>1140</td>
</tr>
<tr>
<td>HFL 16/17</td>
<td>1700</td>
<td>200 300 300 260</td>
<td>16</td>
<td>1000 890 1620</td>
<td>12</td>
<td>3-phase^2</td>
<td>530</td>
</tr>
<tr>
<td>HFL 40/17</td>
<td>1700</td>
<td>300 350 350 350</td>
<td>40</td>
<td>1130 915 1890</td>
<td>12</td>
<td>3-phase</td>
<td>690</td>
</tr>
<tr>
<td>HFL 64/17</td>
<td>1700</td>
<td>400 400 400 400</td>
<td>64</td>
<td>1230 980 1940</td>
<td>18</td>
<td>3-phase</td>
<td>920</td>
</tr>
<tr>
<td>HFL 160/17</td>
<td>1700</td>
<td>500 550 550 550</td>
<td>160</td>
<td>1400 1250 2100</td>
<td>21</td>
<td>3-phase</td>
<td>1190</td>
</tr>
</tbody>
</table>

^1External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
^2Heating 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.

<table>
<thead>
<tr>
<th>Standard Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Tmax 1600 °C, 1750 °C or 1800 °C</td>
</tr>
<tr>
<td>- Recommended maximum working temperature approx. 50 °C below Tmax of the furnace. Higher working temperatures will increase wear and tear.</td>
</tr>
<tr>
<td>- Dual shell housing with fan cooling provides for low shell temperatures</td>
</tr>
<tr>
<td>- Top hat furnaces: electrohydraulically driven top hat with fixed table</td>
</tr>
<tr>
<td>- Bottom loading furnaces: driven table and fixed top hat</td>
</tr>
<tr>
<td>- Gently running, low-vibration spindle drive or electrohydraulic drive for larger models</td>
</tr>
<tr>
<td>- Safe and tight closing of the furnace by means of labyrinth seal</td>
</tr>
<tr>
<td>- Heating from all four sides provides for good temperature uniformity</td>
</tr>
<tr>
<td>- High-quality fiber insulation backed by special insulation</td>
</tr>
<tr>
<td>- Side insulation constructed with tongue and groove blocks provides for low heat dissipation to the outside</td>
</tr>
<tr>
<td>- Long-life, robust roof insulation with special suspension</td>
</tr>
<tr>
<td>- Furnace table with special bottom reinforcement to accommodate high charge weights (distributed load 5 kg/dm²)</td>
</tr>
<tr>
<td>- Motorized exhaust air flap in the furnace roof, controlled via the extra function of the controller</td>
</tr>
<tr>
<td>- Heating elements switched via SCR’s</td>
</tr>
<tr>
<td>- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load</td>
</tr>
<tr>
<td>- Controller P470 (50 programs with each 40 segments), controls description see page 80</td>
</tr>
</tbody>
</table>
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
<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>HT 64/16 LB, LT</td>
<td>1600</td>
<td>400 400 400</td>
<td>64</td>
<td>1100 1750</td>
<td>2400</td>
<td>36</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 166/16 LB, LT</td>
<td>1600</td>
<td>550 550 550</td>
<td>166</td>
<td>1350 2060</td>
<td>2600</td>
<td>42</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 276/16 LB, LT</td>
<td>1600</td>
<td>1000 500 550</td>
<td>276</td>
<td>1800 2100</td>
<td>2600</td>
<td>69</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 400/16 LB, LT</td>
<td>1600</td>
<td>1200 600 550</td>
<td>400</td>
<td>1900 2200</td>
<td>2680</td>
<td>69</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 500/16 LB, LT</td>
<td>1600</td>
<td>1550 600 550</td>
<td>500</td>
<td>2000 2200</td>
<td>2680</td>
<td>69</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 1000/16 LB, LT</td>
<td>1600</td>
<td>1000 600 1000</td>
<td>1000</td>
<td>1800 2900</td>
<td>3450</td>
<td>140</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 1030/16 LB, LT</td>
<td>1600</td>
<td>2200 600 780</td>
<td>1030</td>
<td>2950 2500</td>
<td>3050</td>
<td>160</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 64/17 LB, LT</td>
<td>1750</td>
<td>400 400 400</td>
<td>64</td>
<td>1100 1750</td>
<td>2400</td>
<td>36</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 166/17 LB, LT</td>
<td>1750</td>
<td>550 550 550</td>
<td>166</td>
<td>1350 2060</td>
<td>2600</td>
<td>42</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 276/17 LB, LT</td>
<td>1750</td>
<td>1000 600 550</td>
<td>276</td>
<td>1800 2100</td>
<td>2600</td>
<td>69</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 400/17 LB, LT</td>
<td>1750</td>
<td>1200 600 550</td>
<td>400</td>
<td>1900 2200</td>
<td>2680</td>
<td>69</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 500/17 LB, LT</td>
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<td>500</td>
<td>2000 2200</td>
<td>2680</td>
<td>69</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 1000/17 LB, LT</td>
<td>1750</td>
<td>1000 1000 1000</td>
<td>1000</td>
<td>1800 2900</td>
<td>3450</td>
<td>140</td>
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</tr>
<tr>
<td>HT 1030/17 LB, LT</td>
<td>1750</td>
<td>2200 600 780</td>
<td>1030</td>
<td>2950 2500</td>
<td>3050</td>
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<td>3-phase</td>
</tr>
<tr>
<td>HT 64/18 LB, LT</td>
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<td>64</td>
<td>1100 1750</td>
<td>2400</td>
<td>36</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 166/18 LB, LT</td>
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<td>166</td>
<td>1350 2060</td>
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<td>3-phase</td>
</tr>
<tr>
<td>HT 276/18 LB, LT</td>
<td>1800</td>
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<td>69</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 400/18 LB, LT</td>
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<td>1900 2200</td>
<td>2680</td>
<td>69</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 500/18 LB, LT</td>
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<td>1550 600 550</td>
<td>500</td>
<td>2000 2200</td>
<td>2680</td>
<td>69</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 1000/18 LB, LT</td>
<td>1800</td>
<td>1000 1000 1000</td>
<td>1000</td>
<td>1800 2900</td>
<td>3450</td>
<td>140</td>
<td>3-phase</td>
</tr>
<tr>
<td>HT 1030/18 LB, LT</td>
<td>1800</td>
<td>2200 600 780</td>
<td>1030</td>
<td>2950 2500</td>
<td>3050</td>
<td>160</td>
<td>3-phase</td>
</tr>
</tbody>
</table>

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

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

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

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

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

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 for bulk materials in baskets.

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 D 1000/1250/200/26AS for tempering of injection molded parts.
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 Furnaces for Chemical Hardening of Glass

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 high-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

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions crucible in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW*</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS 8/50</td>
<td>500</td>
<td>300 100 100</td>
<td>8</td>
<td>1600 1050 2400</td>
<td>2</td>
<td>3-phase</td>
<td>650</td>
</tr>
<tr>
<td>TS 90/50</td>
<td>500</td>
<td>650 300 450</td>
<td>90</td>
<td>1600 1050 2400</td>
<td>20</td>
<td>3-phase</td>
<td>700</td>
</tr>
</tbody>
</table>

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

*Please see page 81 for more information about supply voltage
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:

**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 H₂ 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 - H₂-safety package)
12. Fan for gas circulation (NRA models)
13. Charging frame (on request)
14. Emergency flushing container (additional equipment - H₂-safety package)
15. Open cooling water system
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

### Retort furnace NR(A) 20/11 with parallel swing door

### Retort furnace NRA 40/09

<table>
<thead>
<tr>
<th>Model</th>
<th>Outer dimensions in mm</th>
<th>Work space dimensions in mm</th>
<th>Useful volume in l</th>
<th>Connected load in kW*</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRA (A) 20/..</td>
<td>W 1100</td>
<td>D 1600</td>
<td>H 1700</td>
<td>w 225</td>
</tr>
<tr>
<td>NRA (A) 40/..</td>
<td>W 1200</td>
<td>D 1600</td>
<td>H 1900</td>
<td>w 325</td>
</tr>
<tr>
<td>NRA (A) 80/..</td>
<td>W 1200</td>
<td>D 2000</td>
<td>H 1900</td>
<td>w 325</td>
</tr>
<tr>
<td>NRA (A) 100/..</td>
<td>W 1400</td>
<td>D 1800</td>
<td>H 2100</td>
<td>w 450</td>
</tr>
<tr>
<td>NRA (A) 160/..</td>
<td>W 1400</td>
<td>D 2100</td>
<td>H 2100</td>
<td>w 450</td>
</tr>
<tr>
<td>NRA (A) 300/..</td>
<td>W 2200</td>
<td>D 3100</td>
<td>H 2600</td>
<td>w 590</td>
</tr>
<tr>
<td>NRA (A) 400/..</td>
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<td>D 3400</td>
<td>H 2600</td>
<td>w 590</td>
</tr>
<tr>
<td>NRA (A) 500/..</td>
<td>W 2300</td>
<td>D 3300</td>
<td>H 2700</td>
<td>w 720</td>
</tr>
<tr>
<td>NRA (A) 700/..</td>
<td>W 2300</td>
<td>D 3500</td>
<td>H 2700</td>
<td>w 720</td>
</tr>
<tr>
<td>NRA (A) 1000/..</td>
<td>W 2300</td>
<td>D 3600</td>
<td>H 2800</td>
<td>w 870</td>
</tr>
</tbody>
</table>

*Please see page 81 for more information about supply voltage

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
3 Only available from size NRA 300/06 on

Tmax in °C

- Up to 1150 °C with 2.4633 as retort material without a circulation fan
- Up to 600 °C vacuum operation; 650 °C with 2.4633 as retort material without a circulation fan
- Only if heated from the outside
- Only if heated from the outside
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 failure

**H₂ Version for Operation with Flammable Process 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

**IDB Version for Debinding under Non-Flammable Protective Gases**

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

**Vacuum Version for Operation in High Vacuum**
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, lengths and other properties of retort furnaces – we will find the appropriate solution for a suitable process optimization.
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".

<table>
<thead>
<tr>
<th>Furnace group</th>
<th>Model</th>
<th>Tube diameter in mm from to</th>
<th>Heated length in mm from to</th>
<th>Tmax in °C from to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact tube furnaces</td>
<td>R, RD</td>
<td>30 170</td>
<td>200 1000</td>
<td>1200 1300</td>
</tr>
<tr>
<td>Tube furnaces with stand for horizontal and vertical operation</td>
<td>RT</td>
<td>30 50</td>
<td>200 250</td>
<td>1100 1500</td>
</tr>
<tr>
<td>High-temperature tube furnaces with SiC rod heating</td>
<td>RHTC</td>
<td>80 80</td>
<td>230 710</td>
<td>1500 1500</td>
</tr>
<tr>
<td>High-temperature tube furnaces with MoSi₂-heating for horizontal or vertical operation</td>
<td>RHTH, RHTV</td>
<td>50 120</td>
<td>150 600</td>
<td>1600 1800</td>
</tr>
<tr>
<td>Split-type tube furnaces for horizontal or vertical operation</td>
<td>RSH, RSV</td>
<td>50 170</td>
<td>250 1000</td>
<td>1100 1300</td>
</tr>
<tr>
<td>Rotary tube furnaces for batch operation</td>
<td>RSRB</td>
<td>80 120</td>
<td>500 1000</td>
<td>1100 1100</td>
</tr>
<tr>
<td>Rotary tube furnaces for processes with continuous movement</td>
<td>RSRC</td>
<td>80 120</td>
<td>500 1000</td>
<td>1100 1300</td>
</tr>
</tbody>
</table>

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

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

Rotary tube furnace RSRB 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

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
| Standard controllers, HiProSystems control and documentation | 80 |
| Which controller for which furnaces | 81 |
| Functions of the standard controllers | 81 |
| Data storing and visualization | 82 |
| VCD-software | 83 |
| Nabertherm Control Center NCC | 84 |
| Temperature Uniformity and System Accuracy | 85 |
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.

**Standard Controllers**

Our extensive line of standard controllers satisfies most customer requirements. D60 Based 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:
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

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.

<table>
<thead>
<tr>
<th>Model 6100e</th>
<th>Model 6100a</th>
<th>Model 6180a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data input using touch panel</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Size of colour display in inch</td>
<td>5.5&quot;</td>
<td>5.5&quot;</td>
</tr>
<tr>
<td>Number of thermocouple inputs</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Data read-out via USB-stick</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Input of charge data</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Evaluation software included</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

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.

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 entered 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).
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 charge 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 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.

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

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

Extension Package 2 for the Connection of up to Three, Six or Nine Measuring Point, Independant of the Furnace Controls
- Connection of three thermocouples, type 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
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.

**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
- Configuration as industrial PC or virtual machine
- PC cabinet
- UPS for PC
- Customization according to individual requirements
Temperature Uniformity and System Accuracy

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

**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.
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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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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