Which Furnace for Which Process?

Chamber furnace N 300/G with controlled cooling

Annealing/Cooling Glass

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

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

Forced convection chamber furnace NAT 30/85 as tabletop model

Sterilizing Laboratory Glassware

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

Bogie hearth furnace W 7500

Tempering Quartz Glass

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

Drying and Curing Coatings

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

Chamber oven KTR 1500

Fusing

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

Fusing furnace GF 240

Bending and Curving

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

Tub furnace GW 2200

High-temperature furnace LHT 01/17 D

Melting Small Samples

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

Chamber furnace N 7/H as tabletop model

Preheating Molds and Tools

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

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

Systems for Manufacturing Fiber Optics

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

Salt-bath furnace TS 4/50

Chemical Strengthening of Glass

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

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