Laboratory

Muffle Furnaces
Preheating Furnaces
Ashing Furnaces
Tube Furnaces
Ovens
High-Temperature Ovens
Chamber Furnaces
Melting Furnaces
High-Temperature Furnaces
Retort Furnaces
Vacuum Furnaces
Brazing Furnaces
Clean Room Furnaces

Made in Germany

www.nabertherm.com
Made in Germany
Nabertherm with 350 employees worldwide have been developing and producing industrial furnaces for many different applications for over 60 years. As a manufacturer, Nabertherm offers the widest and deepest range of furnaces worldwide. 150,000 satisfied customers in more than 100 countries offer proof of our commitment to excellent design, quality and cost efficiency. Short delivery times are ensured due to our complete inhouse production and our wide variety of standard furnaces.

Setting Standards in Quality and Reliability
Nabertherm does not only offer the widest range of standard furnaces. Professional engineering in combination with inhouse manufacturing provide for individual project planning and construction of tailor-made thermal process systems with material handling and charging systems. Complete thermal processes are realized by customized system solutions.

Innovative Nabertherm control technology provides for precise control as well as full documentation and remote monitoring of your processes. Our engineers apply state-of-the-art technology to improve the temperature uniformity, energy efficiency, reliability and durability of our systems with the goal of enhancing your competitive edge.

Global Sales and Service Network – Close to you
Centralized engineering and manufacturing and decentralized sales and service define our strategy to live up to your needs. Long term sales and distribution partners in all important world markets ensure individual on-site customer service and consultation. There are various reference customers in your neighborhood who have similar furnaces or systems.

Large Customer Test Center
What furnace is the right choice for this specific process? This question cannot always be answered easily. Therefore, we have set up our modern test center which is unique in respect to size and variety. A representative number of furnaces is available for tests for our customers.

Customer Service and Spare Parts
Our professional service engineers are available for you world-wide. Due to our complete inhouse production, we can despatch most spare parts from stock over night or produce with short delivery time.

Experience in Many Fields of Thermal Processing
In addition to furnaces for laboratory, Nabertherm offers a wide range of standard furnaces and systems for many other thermal processing applications. The modular design of our products provides for customized solutions to your individual needs without expensive modifications.
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Professional Furnaces with Flap Door or Lift Door

L 1/12 - LT 40/12

Our L 1/12 - LT 40/12 series is the right choice for daily laboratory use. These models stand out for their excellent workmanship, advanced and attractive design, and high level of reliability. The furnaces come equipped with either a flap door or lift door at no extra charge.

- Tmax 1100 °C or 1200 °C
- Heating from two sides by ceramic heating plates (heating from three sides for models L 24/11 - LT 40/12)
- Ceramic heating plates with integral heating element which is safeguarded against fumes and splashing, and easy to replace
- Highly durable cured vacuum fiber module lining
- Housing made of sheets of textured stainless steel
- Dual shell housing for low external temperatures and high stability
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Adjustable air inlet integrated in door (see illustration)
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for low-noise operation
- Controls description see page 60

Additional equipment

- Chimney, chimney with fan or catalytic converter
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Protective gas connection on the rear wall of furnace
- Manual or automatic gas supply system
- Please see page 13 for more accessories
- Process control and documentation with Controltherm MV software package see page 61
Adjustable air inlet integrated in the door

### Model Tmax

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Minutes to Tmax²</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>3/11</td>
<td>110 160 140 100</td>
<td>3</td>
<td>380 370 420</td>
<td>1.2</td>
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<tr>
<td>L</td>
<td>5/11</td>
<td>110 200 170 130</td>
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<td>L</td>
<td>9/11</td>
<td>110 230 240 170</td>
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<td>75</td>
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<td>L</td>
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<td>110 230 340 170</td>
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<td>3.6</td>
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<td>90</td>
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<tr>
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<td>3-phase</td>
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<tr>
<td>L</td>
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<td>1200 90 115 110</td>
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<td>250 265 340</td>
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<td>10</td>
<td>25</td>
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<tr>
<td>L</td>
<td>3/12</td>
<td>1200 160 140 100</td>
<td>3</td>
<td>380 370 420</td>
<td>1.2</td>
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<td>9</td>
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<td>single-phase</td>
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<td>90</td>
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<tr>
<td>L</td>
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<td>600 790 650</td>
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</tbody>
</table>

¹Including opened lift door
²If connected at 230 V 1/N/PE rsp. 400 V 3/N/PE

*Please see page 60 for more information about supply voltage
Compact Muffle Furnaces

With their unbeatable price/performance ratio, these compact muffle furnaces are perfect for many applications in the laboratory. Quality features like the dual shell furnace housing of rust-free stainless steel, their compact, lightweight constructions, or the heating elements encased in quartz glass tubes make these models reliable partners for your application.

- Tmax 1100 °C, working temperature 1050 °C
- Heating from two sides from heating elements in quartz glass tubes
- Maintenance-friendly replacement of heating elements and insulation
- Multilayered insulation with fiber plates in the furnace chamber
- Housing made of sheets of textured stainless steel
- Dual shell housing for low external temperatures and high stability
- Flap door which can also be used as a work platform
- Exhaust air outlet in rear wall
- Solid state relays provide for low-noise operation
- Compact dimensions and light weight
- Controller mounted in side space (under the door on the LE 1/11, LE 2/11 and LE 4/11 to save space)
- Controls description see page 60

Additional equipment
- Chimney, chimney with fan or catalytic converter
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Protective gas connection on the rear wall of furnace
- Manual gas supply system
- Please see page 13 for more accessories
- Process control and documentation with Controltherm MV software package see page 61

<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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Minutes to Tmax¹</th>
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</thead>
<tbody>
<tr>
<td>LE 1/11</td>
<td>1100</td>
<td>90 115 110</td>
<td>1</td>
<td>250 265 340</td>
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<td>10 10</td>
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<td>LE 2/11</td>
<td>1100</td>
<td>110 180 110</td>
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<td>275 380 350</td>
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<td>single-phase 15</td>
<td>35 35</td>
<td></td>
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<td>170 200 170</td>
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<td>510 400 320</td>
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<td>35 35</td>
<td></td>
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<tr>
<td>LE 14/11</td>
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<td>220 300 220</td>
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<td>555 500 370</td>
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<td>single-phase 25</td>
<td>40 40</td>
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</tbody>
</table>

¹If connected at 230 V 1/N/PE rtp. 400 V 3/N/PE
*Please see page 60 for more information about supply voltage
L 5/13 - LT 15/13

Heating elements on support tubes radiating freely into the furnace chamber provide for particularly short heating times for these models. Thanks to their robust lightweight refractory brick insulation, they can reach a maximum working temperature of 1300 °C. These models thus represent an interesting alternative to the familiar L(T) 3/11 models, when you need particularly short heating times or a higher application temperature.

- Tmax 1300 °C
- Heating from two sides from heating elements
- Heating elements on support tubes ensure free heat radiation and a long service life
- Multilayer insulation with robust lightweight refractory bricks in the furnace chamber
- Housing made of sheets of textured stainless steel
- Dual shell housing for low external temperatures and stability
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Adjustable air inlet in the furnace door
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for low-noise operation
- Controls description see page 60

Additional equipment
- Chimney, chimney with fan or catalytic converter
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Protective gas connection on the rear wall of furnace
- Manual or automatic gas supply system
- Please see page 13 for more accessories

### Table

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<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Minutes to Tmax²</th>
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</thead>
<tbody>
<tr>
<td>L 5/13</td>
<td>1300</td>
<td>200</td>
<td>170</td>
<td>130</td>
<td>5</td>
<td>440</td>
<td>470</td>
<td>520</td>
</tr>
<tr>
<td>L 9/13</td>
<td>1300</td>
<td>230</td>
<td>240</td>
<td>170</td>
<td>9</td>
<td>480</td>
<td>550</td>
<td>570</td>
</tr>
<tr>
<td>L 15/13</td>
<td>1300</td>
<td>230</td>
<td>340</td>
<td>170</td>
<td>15</td>
<td>480</td>
<td>650</td>
<td>570</td>
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<th>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Minutes to Tmax²</th>
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<tr>
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<td>1300</td>
<td>200</td>
<td>170</td>
<td>130</td>
<td>5</td>
<td>440</td>
<td>470</td>
<td>520</td>
</tr>
<tr>
<td>LT 9/13</td>
<td>1300</td>
<td>230</td>
<td>240</td>
<td>170</td>
<td>9</td>
<td>480</td>
<td>550</td>
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<td>170</td>
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<td>480</td>
<td>650</td>
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</tbody>
</table>

¹Including opened lift door
²If connected at 230 V 1/N/PE rbp. 400 V 3/N/PE

*Please see page 60 for more information about supply voltage
Ashing Furnaces with Flap Door or Lift Door

LV 3/11 - LVT 15/11
The models LV 3/11 - LVT 15/11 are especially designed for ashing in the laboratory. A special air intake and exhaust system allows air exchange of more than 6 times per minute. Incoming air is preheated to ensure a good temperature uniformity.

- Tmax 1100 °C
- Heating from two sides by ceramic heating plates
- Ceramic heating plates with integral heating element which is safeguarded against fumes and splashing, and easy to replace
- Highly durable, high-performance cured vacuum fiber module lining
- Housing made of sheets of textured stainless steel
- Dual shell housing for low external temperatures and stability
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Solid state relays provide for low noise operation
- Air exchange of more than 6 times per minute
- Good temperature uniformity due to preheating of incoming air
- Controls description see page 60
Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Please see page 13 for more accessories
- Process control and documentation with Controltherm MV software package see page 61

<table>
<thead>
<tr>
<th>Model</th>
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<th>Connected load kW</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
<th>Minutes to Tmax</th>
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<td>160 140 100</td>
<td>3</td>
<td>380 370 750</td>
<td>1.2</td>
<td>single-phase</td>
<td>20</td>
<td>120</td>
</tr>
<tr>
<td>LV 5/1</td>
<td>1100</td>
<td>200 170 130</td>
<td>5</td>
<td>440 470 850</td>
<td>2.4</td>
<td>single-phase</td>
<td>35</td>
<td>120</td>
</tr>
<tr>
<td>LV 9/1</td>
<td>1100</td>
<td>230 240 170</td>
<td>9</td>
<td>480 550 900</td>
<td>3.0</td>
<td>single-phase</td>
<td>45</td>
<td>120</td>
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<tr>
<td>LV 15/1</td>
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<td>480 650 900</td>
<td>3.6</td>
<td>single-phase</td>
<td>55</td>
<td>120</td>
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</tbody>
</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>Connected load kW</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
<th>Minutes to Tmax</th>
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<tr>
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<td>480 650 900</td>
<td>3.6</td>
<td>single-phase</td>
<td>55</td>
<td>120</td>
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</tbody>
</table>

¹Including exhaust tube (Ø 80 mm)
²If connected at 230 V 1/N/PE resp. 400 V 3/N/PE

*Please see page 60 for more information about supply voltage
Muffle Furnaces with Embedded Heating Elements in the Ceramic Muffle

We particularly recommend the L 9/11/SKM model if your application involves aggressive substances. The furnace has a ceramic muffle with embedded heating from four sides. The furnace thus combines a very good temperature uniformity with excellent protection of the heating elements from aggressive atmospheres. Another aspect is the smooth, nearly particle free muffle (furnace door made of fiber insulation), an important quality feature for some ashing processes.

- Tmax 1100 °C
- Muffle heated from four sides
- Furnace chamber with embedded ceramic muffle, high resistance to aggressive gasses and vapours
- Housing made of sheets of textured stainless steel
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Adjustable working air inlet in the door
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for low noise operation
- Controls description see page 60

Additional equipment

- Chimney, chimney with fan or catalytic converter
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Protective gas connection on the rear wall of furnace
- Manual or automation gas supply system
- Please see page 13 for more accessories

<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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Minutes to Tmax²</th>
</tr>
</thead>
<tbody>
<tr>
<td>L 9/11/SKM</td>
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<td>480 x 550 x 570</td>
<td>3.0</td>
<td>single-phase</td>
<td>50</td>
<td>90</td>
</tr>
</tbody>
</table>

¹Including opened lift door
²If connected at 230 V 1/N/PE resp. 400 V 3/N/PE

*Please see page 60 for more information about supply voltage
Furnace Systems with Scale and Software for Determination of Combustion Loss

L 9/11/SW - LT 9/12/SW
This complete system, with a furnace, integrated precision scale, and software, was designed especially for combustion loss determination in the laboratory. The determination of combustion loss is necessary, for instance, when analyzing sludges and household garbage, and is also used in a variety of technical processes for the evaluation of results. The difference between the initial total mass and the combustion residue is the combustion loss. During the process, the software included records both the temperature and the weight loss.

- Tmax 1100 °C or 1200 °C
- Heating from two sides by ceramic heating plates
- Ceramic heating plates with integral heating element which is safeguarded against fumes and splashing, and easy to replace
- Highly durable cured vacuum fiber module lining
- Housing made of sheets of textured stainless steel
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Adjustable working air inlet in the door
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for low noise operation
- Delivery includes base, ceramic plunger with base plate in the furnace lining, precision scale and software package
- 3 scales available for different maximum weights and scaling ranges
- Software for documentation of the temperature curve and combustion loss using a PC
- Controls description see page 60

Additional equipment
- Chimney, chimney with fan or catalytic converter
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Please see page 13 for more accessories
- Process control and documentation with Controltherm MV software package see page 61

<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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Minutes to Tmax²</th>
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</thead>
<tbody>
<tr>
<td>L 9/11/SW</td>
<td>1100</td>
<td>230 x 240 x 170</td>
<td>9 x 480</td>
<td>550 x 800</td>
<td>3.0</td>
<td>single-phase</td>
<td>55</td>
<td>75</td>
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<tr>
<td>L 9/12/SW</td>
<td>1200</td>
<td>230 x 240 x 170</td>
<td>9 x 480</td>
<td>550 x 800</td>
<td>3.0</td>
<td>single-phase</td>
<td>55</td>
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<td>LT 9/11/SW</td>
<td>1100</td>
<td>230 x 240 x 170</td>
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<td>550 x 800+290</td>
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<td>single-phase</td>
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<td>230 x 240 x 170</td>
<td>9 x 480</td>
<td>550 x 800+290</td>
<td>3.0</td>
<td>single-phase</td>
<td>55</td>
<td>90</td>
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¹Including opened lift door
²If connected at 230 V 1/N/PE rps. 400 V 3/N/PE

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<th>Weight range in g</th>
<th>Weight of plunger in g</th>
<th>Calibration value in g</th>
<th>Minimum load in g</th>
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<td>850</td>
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<tr>
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<td>0.10</td>
<td>6000 incl. plunger</td>
<td>850</td>
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Muffle Furnaces with Integrated Air Circulation

LT 5/1 1HA - LT 15/1 1HA

The LT 5/11HA - LT 15/11HA muffle ovens with integrated air circulation provide an optimum temperature uniformity in the furnace chamber and heat transmission to your batch. This advantageous effect not only increases the precision of the results of your work, it is also a true quality factor, particularly when you need good uniformity in the lower temperature range.

- Tmax 1100 °C
- Heating from two sides by ceramic heating plates
- Ceramic heating plates with integral heating element which is safeguarded against splashing, and easy to replace
- Highly durable cured vacuum fiber module lining
- Housing made of sheets of textured stainless steel
- Dual shell housing for low external temperatures and stability
- With lift door (LT), whereby the hot side is away from the operator
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for low-noise operation
- Circulation fans for better heat transmission and distribution, particularly during heating and cooling
- Controls description see page 60

Additional equipment
- Chimney, chimney with fan or catalytic converter
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Please see page 13 for more accessories

<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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Minutes to Tmax²</th>
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</thead>
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<td>LT 5/11HA</td>
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<td>1100</td>
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<td>480 x 550 x 570+290</td>
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<tr>
<td>LT 15/11HA</td>
<td>1100</td>
<td>230 x 330 x 170</td>
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<td>480 x 650 x 570+290</td>
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<td>75</td>
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</table>

¹Including opened lift door
²If connected at 230 V 1/N/PE rfp. 400 V 3/N/PE

*Please see page 60 for more information about supply voltage
Exhaust systems/Accessories

Chimney for connection to an exhaust pipe.

Chimney with fan, to remove exhaust gas from the furnace better. The P 330 controller can be used to activate the fan automatically.

Catalytic converter with fan for removal of organic components from the exhaust air. Organic components are catalytically oxidized at about 600 °C, broken into carbon dioxide and water vapour. Irritating odors are thus largely eliminated. The P 330 controller can be used to switch the catalytic converter automatically.

Exhaust torch to burn exhaust gases which are generated during the process. The torch is gas heated and will be operated with propane gas. If a catalytic afterburner cannot be used for the process this torch is recommended.

Round saggar (Ø 115 mm x 35 mm) for furnaces LHT/LB, Tmax 1650 °C
These saggars are perfectly suited for furnaces LHT/LB. The load is placed in the saggars. Up to three saggars can be stacked on top of each other in order to use the overall furnace chamber.

Square saggar for furnaces HTC and LHT, Tmax 1600 °C
The load is placed in ceramic saggars for optimal utilization of the furnace space. Up to three saggars can be stacked on top of each other in the furnace. Each saggar has cut-outs for better ventilation. The top saggar should be closed with a lid made of ceramics also.

Select between different base plates and collecting pans for protection of the furnace and easy loading (for models L, LT, LE, LV and LVT on pages 4 - 12).

Ceramic ribbed plate, Tmax 1200 °C

Ceramic collecting pan, Tmax 1300 °C

Steel collecting pan, Tmax 1100 °C

For models

<table>
<thead>
<tr>
<th>Ceramic ribbed plate</th>
<th>Ceramic collecting pan</th>
<th>Steel collecting pan (Material 1.4828)</th>
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<tr>
<td><strong>Article No.</strong></td>
<td><strong>Dimensions in mm</strong></td>
<td><strong>Article No.</strong></td>
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<td>L 1, LE 1</td>
<td>110 x 90 x 12.7</td>
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<tr>
<td>LE 2</td>
<td>170 x 110 x 12.7</td>
<td>100 x 160 x 10</td>
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<tr>
<td>L 3, LT 3, LV 3, LVT 3</td>
<td>150 x 140 x 12.7</td>
<td>150 x 140 x 20</td>
</tr>
<tr>
<td>LE 4, LE 6, L 5, L 5, LV 5, LVT 5</td>
<td>190 x 170 x 12.7</td>
<td>190 x 170 x 20</td>
</tr>
<tr>
<td>L 9, LT 9, LV 9, LV 9, N 7</td>
<td>240 x 220 x 12.7</td>
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<tr>
<td>LE 14</td>
<td>210 x 290 x 12.7</td>
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</tr>
<tr>
<td>L 15, LT 15, LV 15, LVT 15, N 11</td>
<td>340 x 220 x 12.7</td>
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</tr>
<tr>
<td>L 24, LT 24</td>
<td>340 x 270 x 12.7</td>
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</tr>
<tr>
<td>L 40, LT 40</td>
<td>490 x 310 x 12.7</td>
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</tr>
</tbody>
</table>

Heat-resistant gloves for protection of the operator when loading or removing hot materials, resistant to 650 °C or 900 °C.

Gloves, Tmax 650 °C.

Gloves, Tmax 900 °C.

Various tongs for easy loading and unloading of the furnace.
Annealing, Hardening and Brazing Furnaces

N 7/H - N 61/H
To withstand harsh use in the laboratory, e.g. when heat-treating metals, robust insulation with light refractory bricks is necessary. The N 7/H - N 61/H models are a perfect fit to solve this problem. The furnaces can be extended with a variety of accessories, like annealing boxes for operation under protective gas, roller guides, or a cooling station with a quenching bath. Even high-performance applications like the annealing of titanium in medical applications can be implemented without the use of expensive and complicated annealing systems.

- Tmax 1280 °C
- Three-sided heating from both sides and the floor
- Heating elements on support tubes ensure free heat radiation and a long service life
- Floor heating protected by heat-resistant SiC plate
- Multilayer insulation with high-quality lightweight refractory bricks in the furnace chamber
- Exhaust opening in the side of the furnace, or on back wall of furnace in the N 31/H models and higher
- Models N 7/H - N 17/HR are designed as tabletop models
- Stand included with model N 31/H and up
- Parallel swinging door which opens downward, or upward upon request
- Controls description see page 60

<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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Minutes to Tmax²</th>
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</thead>
<tbody>
<tr>
<td>N 7/H</td>
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<tr>
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<td>105</td>
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</table>

¹Heating only between two phases
²If connected at 230 V 1/N/PE rsp. 400 V 3/N/PE
*Please see page 60 for more information about supply voltage
Accessories for Hardening and Brazing

Our wide selection of annealing, hardening and brazing furnaces can be extended with a variety of accessories for hardening and brazing to suit your application. The accessories shown below represent only a small fraction of the products available. For further details, please see our separate catalogues for heat-treatment furnaces and hardening accessories.

**Hardening and Annealing Boxes**
- Hardening and annealing boxes with or without protective gas connectors, up to 1100 °C, also in a tailor-made variant for cold evacuation, for instance for the annealing of small parts and bulk goods

**Annealing Tray with Holder**
- Annealing tram with alloy bag and holder with protective gas connection for models N 7/H to N 61/H for annealing and hardening under protective gas and quenching in air

**Hearth Plates**
- Hearth plates for up to 1100 °C for protection of the furnace floor for models N 7/H to N 61/H, edged on three sides

**Hardening Tongs**
- Hardening tongs in various sizes and forms for use in annealing and hardening

**Heat Treating Foil**
- Heat treating foil for wrapping of samples for oxidation-free annealing and hardening of steels up to 1200 °C

**Gloves**
- Heat-resistant gloves to 600 °C or 900 °C for protection of operator during loading see page 13

Please ask for our separate catalogues for hardening furnaces and hardening accessories!
Professional Chamber Furnaces with Brick Insulation or Fiber Insulation

LH 15/12 - LF 120/14

The LH 15/12 - LF 120/14 laboratory furnaces have been trusted for many years as professional chamber furnaces for the laboratory. These furnaces 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 models can be optimally adapted to your processes.

- T<sub>max</sub> 1200 °C, 1300 °C, or 1400 °C
- Five-sided heating for very good temperature uniformity
- Heating elements on support tubes ensure free heat radiation and a long service life
- Protection of floor heating and flat stacking surface provided by embedded SiC plate in the floor
- LH models: multilayered, fiber-free insulation of light refractory bricks and special backup insulation
- LF models: high-quality fiber insulation with corner bricks for shorter heating and cooling times
- Door with brick-on-brick seal, hand fitted
- Short heating times due to high installed power
- Side vent with bypass connection for exhaust pipe
- Self-supporting arch for high stability and greatest possible protection against dust
- Quick lock on door
- Freely adjustable air slide intake in furnace floor
- Stand included
- Controls description see page 60
**Parallel swinging door** for opening when hot

- Lift door with electro-mechanic linear drive
- Separate wall-mounting or floor standing cabinet for switchgear
- Motor-driven exhaust-air flap
- Cooling fan for shorter cycle times
- Protective gas connector, sealed housing
- Inner process box made of quartz glass for very clean atmosphere, quartz glass covered door with lid function
- Manual or automatic gas supply system
- Scale to measure weight reduction during annealing

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### Additional equipment

- **LH 216/12SW** with scale to measure weight reduction during annealing
- **LH 60/12** with manual lift door and gas supply box for non-flammable protective gases

---

### Model Overview

<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>Connected load kW</th>
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<th>Weight in kg</th>
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<tbody>
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<td>820 1110 1420</td>
<td>18.0</td>
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</tr>
</tbody>
</table>

¹Heating only between two phases

*Please see page 60 for more information about supply voltage
High-Temperature Chamber Furnaces with SiC Rod Heating

These powerful laboratory muffle furnaces are available for temperatures up to 1400 °C, 1500 °C, or 1600 °C. The durability of the SiC rods in periodic use, in combination with their high heating speed, make these furnaces to all-rounders in the laboratory. Heating times of 40 minutes to 1400 °C can be achieved, depending on the furnace model and the conditions of use.

- Tmax 1400 °C, 1500 °C, or 1600 °C
- Working Temperature 1550 °C (for models HTC../16), increased wear and tear of heating elements must be expected in case of working at higher temperatures
- Model HTCT 01/16 with single phase connection
- High-quality fiber material, selected for the working temperature
- Housing made of sheets of textured stainless steel
- Dual shell housing for low external temperatures and high stability
- Optional flap door (HTC) which can be used as work platform or lift door (HTCT) with hot surface facing away from the operator (HTCT 01/.. only with lift door)
- Switching system with solid-state-relays, power tuned to the SiC rods
- Easy replacement of heating rods
- Controls description see page 60

### Additional equipment
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Square saggar for charging of up to three layers see page 13
- Lid for top saggar
- Manual or automatic gas supply system
- Adjustable air intake opening in the furnace door, exhaust air opening in the roof

### Over-temperature limit controller

### Furnace chamber with high-quality fiber materials and SiC heating rods on both sides of the furnace

### Saggars with top lid

### Additional equipment
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Square saggar for charging of up to three layers see page 13
- Lid for top saggar
- Manual or automatic gas supply system
- Adjustable air intake opening in the furnace door, exhaust air opening in the roof

<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>Connected load kW</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
<th>Minutes to Tmax</th>
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<tbody>
<tr>
<td>HTC, HTCT 01/14</td>
<td>1400</td>
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<td>400 x 355 x 530 mm</td>
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¹Heating only between two phases
²Plus maximum 270 mm for models HTCT when open
³If connected at 230 V 1/N/PE resp. 400 V 3/N/PE

*Please see page 60 for more information about supply voltage
High-Temperature Chamber Furnaces with MoSi₂ Heating Elements as Table-Top Model

LHT 02/16 - LHT 08/18

Designed as tabletop models, these compact high-temperature chamber 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 and the laboratory. These furnaces are also perfectly suited for the sintering of technical ceramics, such as zirconium oxide dental bridges.

- Tmax 1600 °C, 1750 °C, or 1800 °C
- High-quality molybdenum disilicide heating elements
- Furnace chamber lined with first-class, durable fiber material
- Housing made of sheets of textured stainless steel
- Dual shell housing with additional fan cooling for low surface temperature
- Furnace sizes of 2, 4, or 8 liters
- Compact design with lift-door, opening upwards
- Adjustable air inlet
- Exhaust air opening in the roof
- Type B thermocouple
- Switching system with phase-angle firing thyristors (SCRs)
- Controls description see page 60

Additional equipment
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Square saggars for charging of up to three layers see page 13
- Process control and documentation with Controltherm MV software package see page 61
- Protective gas connection
- Manual or automatic gas supply system

<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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
<th>Minutes to Tmax²</th>
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<td>90 150 150 150</td>
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<td>2</td>
<td>470 700 750+350</td>
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</table>

¹Heating only between two phases
²If connected at 230 V 1/N/PE or 400 V 3/N/PE
*Please see page 60 for more information about supply voltage
*Including opened lift door

Over-temperature limit controller

Additional equipment
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Square saggars for charging of up to three layers see page 13
- Process control and documentation with Controltherm MV software package see page 61
- Protective gas connection
- Manual or automatic gas supply system
High-Temperature Lift-Bottom Furnace

LHT/LB
The electrically driven lift-bottom considerably allows for proper charging of the LHT/LB furnaces. The heating all around the cylindrical furnace chamber provides for an optimal temperature uniformity. For model LHT 02/17 LB the charge can be placed in charge saggars made of technical ceramics. Up to three charge saggars can be stacked on top of each other resulting in a high productivity. Due to its volume model LHT 16/17 LB can also be used for applications in production.

- Tmax 1650 °C
- High-quality molybdenum disilicide heating elements
- Furnace chamber lined with first-class, durable fiber materials
- Outstanding temperature uniformity due to all-round furnace chamber heating
- Furnace chamber with a volume of 2 or 16 liters, table with large footprint
- Spacers to lift-up the saggars already installed in the table
- Precise, electric spindle drive with push button operation
- Housing made of sheets of textured stainless steel
- Exhaust air vent in the roof
- Type S thermocouple
- Switchgear with thyristor
- Controls description see page 60
Addional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Saggar for charging of up to three layers see page 13
- Protective gas connection
- Manual or automatic gas supply system
- Adjustable air inlet through the floor
- Process control and documentation with Controltherm MV software package see page 61

<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>
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<th>Electrical connection*</th>
<th>Weight in kg</th>
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<tbody>
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<td>740</td>
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<tr>
<td>LHT 16/17 LB</td>
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<td>Ø 260</td>
<td>260</td>
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<td>650</td>
<td>1250</td>
<td>1980</td>
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</tbody>
</table>

*Please see page 60 for more information about supply voltage

**High-Temperature Furnaces with Scale for Determination of Combustion Loss and Thermogravimetric Analysis (TGA)**

Customized LHT 04/16 SW with scale for measuring weight reduction during annealing and with gas supply system

**LHT 04/16 SW and LHT 04/17 SW**

These furnaces were specially developed to determine combustion loss during annealing and for thermogravimetric analysis (TGA) in the lab. The complete system consists of the high-temperature furnace for 1600°C or 1750°C, a table frame, precision scale with feedthroughs into the furnace and powerful software for recording both the temperature curve and the weight loss over time.

- Technical description of the furnaces: see models LHT 04/16 and LHT 04/17 page 19
- Description of the weighing system: see models L 9/... SW page 11

Software for documentation of the temperature curve and combustion loss using a PC

*Please see page 60 for more information about supply voltage

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
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<th>Connected load kW</th>
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<td>655</td>
<td>370</td>
<td>890</td>
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</table>

¹Heating only between two phases
²If connected at 230 V 1/N/PE resp. 400 V 3/N/PE
Chamber High-Temperature Furnaces with Fiber Insulation up to 1800 °C

HT 04/16 - HT 450/18
Due to their solid construction and compact stand-alone design, these high-temperature furnaces are perfect for processes in the laboratory where the highest precision is needed. Outstanding temperature uniformity and practical details set unbeatable quality benchmarks. For configuration for your processes, these furnaces can be extended with extras from our extensive option list.

- Tmax 1600 °C, 1750 °C, or 1800 °C
- Furnace sizes from 4 to 450 liters
- High-quality molybdenum disilicide (MoSi2) heating elements
- Parallel swivel door, chain-guided, enabling safe opening and closing without damage to the fiber insulation in the collar area, protection of user from radiation from the furnace
- Door labyrinth sealing provides for optimum energy efficiency and temperature uniformity
- Door area armored with stainless steel to avoid burn damages
- Reinforced floor as protection for bottom insulation as standard from models HT 16/16 upwards
- Over-temperature limit controller with manual reset for product and furnace protection
- Furnace chamber lined with first-class, durable fiber material
- Special ceiling construction with high durability
- Thermocouple, PtRh-Pt, Type B or Type S
- Vapor vent in the furnace roof
- Controls description see page 60
**Additional equipment**

- **Cooling fan**
  For cycle time acceleration furnace sized specific fans are installed. The fan speed is preselected per segment. The controller is automatically switched on and off. Hence, different speeds can be applied e.g. for binder removal or cooling. With HiProSystems-Controllers, linear cooling is possible.

- **Furnace in HDB design featuring fresh air pre-heating, exhaust gas ventilation and an extensive safety package for debinding and sintering in one process, i.e. without transferring the material from the debinding furnace to the sintering furnace.**

- **Motor-driven exhaust-air flap control**
- **Stainless steel exhaust gas hoods**
- **Catalytic or thermal afterburners**
- **Kiln furniture tailored to customer specifications**
- **Lift door**
- **Special heating elements for zirconia sintering provide for longer service life with respect to chemical interaction between charge and heating elements**
- **Protective gas connector and seal of furnace casing to allow purging of furnace with protective gasses**
- **Manual or automatic gas supply system**
- **Inner process box to improve the gastightness and to protect the furnace chamber against contamination**

---

### Table: 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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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</table>

¹Only heating between two phases

*Please see page 60 for more information about supply voltage

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**HT 276/17 customized with pneumatically driven and parallel lift-door**

**Parallely guided door provides for heat protection of the operator**
High-Temperature Chamber Furnaces with SiC Rod Heating

HTC 16/16 - HTC 450/16

The high-temperature chamber 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 absence of interactivity between the charge and the SiC rods, these models are more suitable than the alternatives heated with molybdenum-disilicide elements. The basic construction of these furnaces make them comparable with the already familiar models in the HT series and they can be upgraded with the same additional equipment.

- Tmax 1550 °C
- Dual shell housing with fan cooling for low shell temperatures
- Heating from both sides via vertically mounted SiC rods
- High-quality fiber insulation backed by special insulation
- Side insulation constructed with tongue and groove blocks provides for low heat loss to the outside
- Long-life roof insulation with special suspension
- Chain-guided parallel swivel door for defined opening and closing of the door without destroying the insulation
- Labyrinth sealing ensures the least possible temperature loss in the door area
- Specially reinforced furnace floor for accommodating high charge weights for model HTC 16 and above
- Exhaust air opening in the furnace roof
- Heating elements switched via SCR’s
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Controls description see page 60

For additional equipment see models HT 04/16 - HT 450/18

<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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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<td>1200 x 1620 x 2060</td>
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<td>3-phase</td>
<td>1500</td>
</tr>
</tbody>
</table>

*Heating only between two phases

*Please see page 60 for more information about supply voltage
Chamber Furnaces with Refractory Insulation up to 1700 °C

HFL 16/16 - HFL 160/17

Model range HFL 16/16 HFL 160/17 is characterized by its lining with robust light refractory bricks. This version is recommended for processes producing aggressive gases or acids, such as under glass melting.

- Tmax 1600 °C or 1700 °C
- High-quality molybdenum disilicide (MoSi₂) heating elements
- Insulation with light refractory bricks and special backup insulation
- Type B thermocouple
- Furnace sizes of 16 to 160 liters
- For the release of vapours, a 30 mm large exhaust hole is integrated into the roof of the furnace
- Over-temperature limit controller with manual reset for protection of material
- Controls description see page 60

Additional equipment
- Exhaust-air flap, manually or motor-driven for improved venting of the furnace chamber
- Fan for better ventilation of combustion chamber and for fast cooling of the furnace
- Protective gas connector and seal of furnace housing to allow purging of furnace with protective gases
- Manual or automatic gas supply system

<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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
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<tr>
<td>HFL 16/16</td>
<td>1600</td>
<td>200 300 260</td>
<td>16</td>
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<tr>
<td>HFL 40/16</td>
<td>1600</td>
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<td>880 880 1710</td>
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<tr>
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<td>1090 1080 2030</td>
<td>21</td>
<td>3-phase</td>
<td>1190</td>
</tr>
</tbody>
</table>

¹ Heating only between two phases
* Please see page 60 for more information about supply voltage

Protective screen in front of heating elements for protection against mechanical damage
Ovens, also with Safety Technology according to EN 1539

TR 60 - TR 1050
With their maximum working temperature of up to 300 °C and forced air circulation, the ovens achieve a perfect temperature uniformity which is much better than in ovens of most competitors. They can be used for various applications such as e.g. drying, sterilizing or warm storing. Ample warehousing of standard models provides for short delivery times.

- Tmax 300 °C
- Working range: + 5 °C above room temperature up to 300 °C
- Models TR 60 - TR 240 designed as tabletop models
- Models TR 450 and TR 1050 designed as floor standing models
- Horizontal, forced air circulation results in temperature uniformity better than ΔT 8 K see page 63
- Stainless steel chamber, alloy 304 (AISI)/(DIN material no. 1.4301), rust-resistant and easy to clean
- Large handle to open and close the door
- Charging in multiple layers possible using removeable grids (number of removeable grids included, see table to the right)
- Large, wide-opening swing door, hinged on the right with quick release for models TR 60 - TR 450
- Double swing door with quick release for TR 1050
- TR 1050 equipped transport rollers
- Infinitely adjustable exhaust at the rear wall with operation from the front
- PID microprocessor control with self-diagnosis system
- Solid state relays provide for low noise operation
- Controls description see page 60

Electrical rotating device as additional equipment

Extricable metal grids to load the oven in different layers
Additional equipment
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Infinitely adjustable fan speed of the air circulation fan
- Window for charge observing
- Further removable grids with rails
- Side inlet
- Stainless steel collecting pan to protect the furnace chamber
- Safety Technology according to EN 1539 for charges containing liquid solvents up to model TR 240, achievable temperature uniformity $\Delta T$ 16 K
- Transport castors for model TR 450
- Various modifications available for individual needs
- Upgrading available to meet the quality requirements of AMS 2750 D or FDA
- Process control and documentation with Controltherm MV software package see page 61

TR 60 with observation window

<table>
<thead>
<tr>
<th>Model</th>
<th>$T_{\text{max}}$</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Connected load kW</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
<th>Grids included</th>
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<td>4</td>
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</tbody>
</table>

¹Max load per layer 30 kg
²If EN 1539 is ordered power rating will increase

*Please see page 60 for more information about supply voltage
These chamber furnaces with air circulation are characterized by their extremely high temperature uniformity. Hence, they are especially suitable for processes such as cooling, crystalizing, pre-heating, curing, but also for numerous processes in tool making. Due to the modular concept, the furnaces can be adjusted to the process requirements by adding suitable equipment.

- Tmax 450 °C, 650 °C, or 850 °C
- Horizontal air circulation
- Swing door hinged on the right
- Temperature uniformity up to ΔT 8 K according to DIN 17052-1 see page 63
- Heating from bottom, sides and top
- Optimum air flow and temperature uniformity through high circulation rates
- One shelf and rails for two additional shelves included (N 15/65 HA without removable tray)
- Air baffle box of stainless steel inside the furnace chamber for optimum air circulation
- Base frame included in the delivery, N 15/65 HA designed as table-top model
- Switchgear with solid-state relays
- Controls description see page 60

### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Outer dimensions in mm</th>
<th>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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<td>1000</td>
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<td>470</td>
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<td>N 30/65 HA</td>
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<td>290</td>
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<td>260</td>
<td>30</td>
<td>667 × 255</td>
</tr>
<tr>
<td>N 60/65 HA</td>
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<td>350</td>
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<td>750</td>
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<td>500</td>
<td>1152 × 255</td>
</tr>
<tr>
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<tr>
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<td>667 × 255</td>
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<tr>
<td>N 120/85 HA</td>
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<td>600</td>
<td>450</td>
<td>120</td>
<td>767 × 255</td>
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<tr>
<td>N 250/85 HA</td>
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<td>750</td>
<td>600</td>
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<td>1002 × 255</td>
</tr>
<tr>
<td>N 500/85 HA</td>
<td>850</td>
<td>750</td>
<td>1000</td>
<td>750</td>
<td>500</td>
<td>1152 × 255</td>
</tr>
</tbody>
</table>

¹Table-top model
²Heating only between two phases

*Please see page 60 for more information about supply voltage
Air Circulation Chamber Furnaces for Clean Room Processes

NAC 120/65 - NAC 500/65
Specific heat treatment processes require the reduction of particle contamination in the furnace chamber and on the work floor down to a minimum. For these applications the NAC air circulation chamber furnaces are recommended. The inner chamber is made of stainless steel and offers best possible protection against impurities from the insulation. Depending on design and required clean room class these furnaces can be equipped accordingly.

- Tmax 650 °C
- Standard sizes between 120 and 500 liters furnace volume
- Customized dimensions, also available as production-scale furnaces up to 10000 l (KTR models)
- Dual shell housing provides for low surface temperatures
- Insulation made of mineral wool with aluminum protection cover provides for low emissions to the outside
- Welded inner housing made of stainless steel 1.4301
- Door with silicone sealing
- Horizontal airflow incl. air-guiding box provides for optimum temperature uniformity
- Tubular heating elements positioned behind the air-guiding box
- One shelf included in the delivery

Additional equipment
- Silicone-free design with door sealing made of Viton
- Electro-polished inner box
- Electrically driven air inlet and air outlet flaps
- Cooling system for reduction of process times
- Observation window in the door
- Manual or automatic gas supply systems
- Speed control for air-circulation fan
- Additional shelves
- Process control and documentation with Controltherm MV software package see page 61

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Outer dimensions in mm</th>
<th>Connected load/kW</th>
<th>Electrical connection*</th>
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<tbody>
<tr>
<td>NAC 120/65</td>
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<td>450 600 450 900 + 255 1600 1600</td>
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<td>600 750 600 1050 + 255 1750 1750</td>
<td>18.6 3-phase</td>
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<tr>
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<td>650</td>
<td>750 900 750 1120 + 255 1900 1900</td>
<td>27.6 3-phase</td>
<td></td>
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</tr>
</tbody>
</table>

Rights to change technical data, especially with respect to outer dimensions reserved
*Please see page 60 for more information about supply voltage
### Compact Tube Furnaces

**RD 15/150/13 - RD 30/200/13**

The RD product line furnaces convince with their unbeatable price-performance ratio, very compact outer dimensions and their low weight. These all-rounders are equipped with a working tube which also serves as support for the heating wires. Thus, the working tube is part of the furnace heating which has the advantage that the furnaces achieve very high heat-up rates. The furnaces can be supplied for 1100 °C or 1300 °C.

All models are designed for horizontal application. If the customer requires protective gas atmosphere, a separate working tube, e.g. made of quartz glass, must be inserted in the working tube.

- Tmax 1100 °C or 1300 °C
- Housing made of sheets of textured stainless steel
- Outer diameter of the tube: 15mm or 30mm, heated length: 150mm or 200mm
- Working tube made of C530 material including two fiber plugs as standard
- Thermocouple type K (1100 °C) or type S (1300 °C)
- Solid state relays provide for low-noise operation of the heating
- Heating wires wound directly around the working tube resulting in very fast heat-up rates
- Controls description see page 60

#### Additional equipment

- Over-temperature limit controller with adjustable shut-off temperature for thermal protection class 2 according to EN 60519-2 as over-temperature protection for furnace and load
- Additional working tube, inserted in the integrated tube, e.g. for protective gas operation
- Gas supply package for protective gas or vacuum operation
- Version as thermocouple test furnace see page 42

#### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Outer dimensions in mm</th>
<th>Inner tube Ø mm</th>
<th>Heated length/mm</th>
<th>Length constant temperature ΔT 10 K</th>
<th>Connected load/kW</th>
<th>Minutes to Tmax²</th>
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<th>Weight in kg</th>
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<td>RD 30/200/11</td>
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<td>350 200 350 30</td>
<td>300 150</td>
<td>350 85</td>
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<td>20 single-phase</td>
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<td>300 170 320 15</td>
<td>150 50</td>
<td>200 65</td>
<td>1.0</td>
<td>25 single-phase</td>
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</tr>
<tr>
<td>RD 30/200/13</td>
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<td>350 200 350 30</td>
<td>300 150</td>
<td>350 85</td>
<td>1.5</td>
<td>25 single-phase</td>
<td>12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹Tmax is reached outside the tube. Realistic working temperature inside the tube is approx. 50 °C lower.
²If connected at 230 V 1/N/PE rsp. 400 V 3/N/PE

*Please see page 60 for more information about supply voltage
These compact tabletop tube furnaces with integrated control systems can be used universally for many processes. Equipped with a standard working tube of C 530 ceramic and two fiber plugs, these furnaces have an unbeatable price/performance ratio.

- Tmax 1200 °C or 1300 °C
- Housing made of sheets of textured stainless steel
- Outer tube diameter of 50 to 120 mm, heated length from 250 to 1000 mm
- Working tube of C 530 ceramic including two fiber plugs as standard equipment
- Type S thermocouple
- Solid state relays provide for low noise operation
- Standard working tube see chart on page 47
- Controls description see page 60

Additional equipment
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Charge control with temperature measurement in the working tube and in the oven chamber behind the tube see page 43
- Three-zoned design with HiProSystem control (heated length from 750 mm, for 1300 °C models)
- Alternative working tubes see chart on page 47
- Please see page 44 for additional equipment
- Alternative gas supply systems for protective gas or vacuum operation see page 44
- Process control and documentation with Controltherm MV software package see page 61

### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Outer dimensions in mm</th>
<th>Outer tube Ø in mm</th>
<th>Heated length mm</th>
<th>Length constant temperature ΔT 10 K</th>
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<th>Connected load kW</th>
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<td>750</td>
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<td>1070</td>
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<td>730</td>
<td>120</td>
<td>1000</td>
<td>330</td>
<td>1400</td>
<td>6.5</td>
</tr>
</tbody>
</table>

¹These models also available with three-zones
²Heating only between two phases
³Tmax is reached outside the tube. Realistic working temperature inside the tube is approx. 50 °C lower.

*Please see page 60 for more information about supply voltage
Universal Tube Furnaces with Stand for Horizontal or Vertical Operation

RT 50-250/11 - RT 30-200/15

These compact tube furnaces are used when laboratory experiments must be performed horizontally, vertically, or at specific angles. The ability to configure the angle of tilt and the working height, and their compact design, also make these furnaces suitable for integration into existing process systems.

- Tmax 1100 °C, 1300 °C, or 1500 °C
- Compact design
- Vertical or horizontal operation freely adjustable
- Working height freely adjustable
- Working tube made of C 530 ceramic
- Type S thermocouple
- Operation also possible separate from stand if safety guidelines are observed
- Control system integrated in furnace base
- Please see page 44 for additional equipment
- Controls description see page 60

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>W</th>
<th>D</th>
<th>H</th>
<th>Inner tube Ø</th>
<th>Heated length mm</th>
<th>Length constant temperature ΔT 10 K</th>
<th>Tube length in mm</th>
<th>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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*Please see page 60 for more information about supply voltage
Universal High-Temperature Tube Furnaces with Silicon Carbide Rod Heating
Gas Atmosphere or Vacuum

RHTC 80-230/15 - RHTC 80-710/15
These compact tube furnaces with SiC rod heating and integrated switchgear and controller can be used universally for many processes. With an easy to replace working tube as well as additional standard equipment options, these furnaces are flexible and can be used for a wide range of applications. The high-quality fiber insulation ensures fast heating and cooling times. The SiC heating rods installed parallel to the working tube ensure excellent temperature uniformity. The price-performance ratio for this temperature range is unbeatable.

- Tmax 1500 °C
- Housing made of sheets of textured stainless steel
- High-quality fiber insulation
- Active cooling of housing for low surface temperatures
- Type S thermocouple
- Solid state relays provide for low-noise operation
- Prepared for assembly of working tubes with water-cooled flanges
- Ceramic tube, C 799 quality
- Standard working tube see chart on page 47
- Controls description see page 60

Additional equipment
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect furnace and load
- Charge control with temperature measurement in the working tube and in the oven chamber behind the tube see page 43
- Fiber plugs
- Check valve at gas outlet avoids intrusion of false air
- Working tubes for operation with water-cooled flanges
- Display of inner tube temperature with additional thermocouple
- Alternative gas supply systems for protective gas or vacuum operation see page 44
- Alternative working tubes see chart on page 47

### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Outer dimensions in mm</th>
<th>Outer tube Ø /mm</th>
<th>Heated length /mm</th>
<th>Length constant temperature ΔT 10 K</th>
<th>Tube length in mm</th>
<th>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
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¹Heating only between two phases
²Heating only on one phase
³Tmax is reached outside the tube. Realistic working temperature inside the tube is approx. 50 °C lower.

*Please see page 60 for more information about supply voltage
Hinged Tube Furnaces for Horizontal or Vertical Operation up to 1300 °C
Gas Atmosphere or Vacuum

The RS tube furnaces can be used for either horizontal or vertical operation. Using a variety of accessories, these professional tube furnaces can be optimally laid out for your process. By using different available gas supply packages, operations can be performed under a protective gas atmosphere, vacuum, or even with flammable gases.

- **Tmax 1100 °C or 1300 °C**
- **Housing made of sheets of textured stainless steel**
- **Tmax 1100 °C: Type K thermocouple**
- **Tmax 1300 °C: Type S thermocouple**
- **Frame for vertical operation, which can also be retrofitted as additional equipment**
- **Hinged design for simple insertion of the working tube**
- **Working tube made of ceramic C 530 for operation in air included in scope of delivery**
- **Switchgear and control unit separate from furnace in own wall or standing cabinet**
- **Standard working tube see chart on page 47**
- **Controls description see page 60**

### Model and Specifications

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1 Heating only between two phases
2 Heating only on one phase
3 Heating only on one phase
5 Watch size for single-zone version

¹Heating only between two phases
²Without tube
³Outer dimensions for vertical operation upon request
⁴Tmax is reached outside the tube. Realistic working temperature inside the tube is approx. 50 °C lower.
⁵Only valid for single-zone version

*Please see page 60 for more information about supply voltage.
The RS tube furnace line can be custom-fit to your needs with a variety of extras. Starting with various working tubes of different materials to protective gas or vacuum operation. For optimum temperature uniformity, all RS furnaces are also available as three-zone tube furnaces with modern PLC controls. The heat loss at the ends of the tube is compensated using this three-zoned control, and a longer uniform zone is the result. An overview of the complete line of accessories can be found starting on page 44.

Additional equipment
- Charge control with temperature measurement in the working tube and in the oven chamber behind the tube see page 43
- Working tubes designed for process requirements
- Display of inner tube temperature with additional thermocouple
- Different gas supply packages (page 44) for protective gas and vacuum operation
- Three-zone control for optimization of temperature uniformity
- Check valve at gas outlet avoids intrusion of false air
- Ceramic half pipe for heating elements and/or as support surface for the load
- Optical temperature measurement for the use as continuously working furnace
- Stand for vertical operation
- Base frame with integrated switchgear and controller
- Alternative working tubes see chart on page 47
- Please see page 44 for more additional equipment
Rotary Tube Furnaces for Continuous Processes and/or Batch Operation

If, for example, the focus lies on maintaining the individual grain characteristics of the material such as in drying or calcination, rotary tube furnaces of the RSR product line are the optimal solution. The permanently rotating working tube allows for the continuous movement of the charge.

These models can basically be designed for continuous processes and/or batch operation. Depending on process, charge and required maximum temperature, different working tubes made of silica glass, ceramics or metals are used.

Depending on the application, these models can be upgraded with additional accessories such as charging funnel, electric screw-conveyor for materials supply, or gas supply systems into a small production plant. Rotary tube furnaces can be operated at ambient air, under protective gas and even in vacuum. The necessary features can also be supplied as additional equipment.

Standard design of all models
- Housing made of textured stainless steel sheets
- Beltless drive and hinged furnace housing provide for very easy removal of working tube or reactor
- Adjustable drive of approx. 1-20 rpm
- Controls description see page 60

Additional equipment for all models
- Different tube diameters or heated lengths
- Manual or automatic gas supply systems
- Gas-tight rotary device for the connection to gas supply systems
- Check valve at gas outlet avoids intrusion of false air
- Three-zone control for the optimization of temperature uniformity
- Temperature display unit in the working tube with measurement by means of an additional thermocouple
- Charge control by means of an additional thermocouple in the working tube
Standard design for batch operation
- Tmax 1100 °C
- Thermocouple type K
- Furnace designed as tabletop model with quartz glass reactor open at both sides
- Reactor is removed from the furnace for discharging

Additional equipment for batch operation
- Different gas supply systems
- Vacuum design, up to $10^{-2}$ mbar depending on the applied pump
- Reactor made of quartz glass, open at both sides, with burling for better conveyance of the charge in the tube
- Information on the different working tubes see page 39
- Package for improved charging and discharging of the working tube in the following design:
  - Reactor made of quartz glass or stainless steel 1.4841, closed at one side, with integrated blade for a better mixing of the charge
  - Tilting mechanism to the left/to the right. For charging and heat treatment, the furnace is tilted towards the right side until the stop so that the load is charged into the furnace. For discharge, the furnace is tilted towards the other side to discharge the powder from the reactor.
  - Removal of reactor not necessary
  - Furnace mounted on the base
  - Base running on casters
- Base with manual spindle for tilting angle adjustment for charging, during heat treatment and for discharging the tube
- Digital display for the tilting angle of the furnace

Standard design for continuous processes
- Tmax 1100 °C
  - Thermocouple type K
  - Working tube made of quartz glass open at both sides

RSR 120/1000/13 with charging funnel and collection bottle at the outlet
Screw-conveyor with adjustable speed
Screw-conveyors with different pitches for the adaption to the charge
Vibration generator at the charging funnel for improved powder supply

package for improved charging and discharging of the working tube in the following design:
Tmax 1300 °C
- Thermocouple type S
- Working tube made of C530 ceramics, open at both sides, not gas-tight
- Compact design with switchgear and controller, mounted in the base, including transport casters
- Furnace mounted on base, including manual spindle drive with crank for pre-adjustment of the tilting angle
- Base running on casters

Additional equipment for continuous processes
- Working tube made of quartz glass with burling for optimized transportation of the charge up to Tmax 1100 °C
- Gas-tight working tube made of C610 ceramics up to Tmax 1300 °C
- Information on the different working tubes see page 39
- Different gas supply systems which cause process gas to flow around the charge due to inlet on the one and outlet on the other side of the tube (only in combination with an electrically driven screw-conveyor, see below)
- Charging funnel made of stainless steel with lockable powder outlet, as additional equipment also available as gas-tight funnel
- Electric vibration generator at the charging funnel for the optimization of material supply into the working tube
- Electrically driven screw-conveyor at the inlet of the working tube with 20mm pitch and adjustable speed between 0.28 and 6 revolutions per minute
- Screw-conveyor with adjusted pitch for adjustment to the charge as requested
- Different gear transmissions for other speeds on request
- Discharge blade at the outlet of the working tube
- Collecting bottle made of laboratory glass at the outlet of the working tube
- Digital display unit for the tilting angle of the furnace
- Electric linear drive for the adjustment of the tilting angle
- Alternating design for continuous processes or batch operation. The furnace can be tilted on the frame towards both sides. The customer can mount a working tube open at both sides for flow processes as well as a process reactor (Tmax 1100 °C) closed at one side for batch operation.
- PLC controls for temperature control and the control of connected aggregates such as gearshift and speed of the screw-conveyor, speed of the working tube, switching of the vibration generator, etc.
<table>
<thead>
<tr>
<th>Model</th>
<th>T max °C</th>
<th>Outer dimensions in mm</th>
<th>Temperature constant</th>
<th>Length working zone</th>
<th>Ø Outer</th>
<th>Ø Terminal end</th>
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¹Heating only between two phases
²Heating only between phase 1 and neutral
³Tmax is reached outside the tube. Realistic working temperature inside the tube is approx. 50 °C lower.
⁴Without tube

Working Tubes for Rotary Tube Furnaces: Standard (*) and Options (○)

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<th>Batch operation</th>
<th>Universal operation</th>
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<td>601404553</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>106 x 100 x 2040 mm</td>
<td>601404723</td>
<td>601404554</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Quartz glas reactor</td>
<td>601402746</td>
<td>601402548</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>76 x 70 x 1140 mm</td>
<td>601402747</td>
<td>601402547</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>106 x 100 x 1140 mm</td>
<td>601402748</td>
<td>601402546</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>106 x 100 x 1390 mm</td>
<td>601402749</td>
<td>601402638</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Quartz glass reactor with pimples</td>
<td>601404724</td>
<td>6014042804</td>
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<td>○</td>
</tr>
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<td>76 x 70 x 1140 mm</td>
<td>601404725</td>
<td>601404355</td>
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<td>○</td>
</tr>
<tr>
<td>106 x 100 x 1140 mm</td>
<td>601404726</td>
<td>6014043296</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

○ Working tube available as an option

¹Tubes/reactors incl. mounted sleeves for connection to the rotary drive. Spare tubes come without sleeves.

39
High-Temperature Tube Furnaces for Horizontal and Vertical Operation up to 1800 °C
Gas Atmosphere or Vacuum

The high-temperature tube furnaces are available in either horizontal (type RHTH) or vertical (type RHTV) designs. High-quality insulation materials made of vacuum-formed fiber plates enable energy-saving operation and a fast heating time due to low heat storage and heat conductivity. By using different gas supply systems, operations can be performed under a protective gas atmosphere, vacuum, or even with flammable gasses.

- Tmax 1600 °C, 1700 °C, or 1800 °C
- MoSi2 heating elements, mounted vertically for easy replacement
- Insulation with vacuum-formed ceramic fiber plates
- Rectangular outer housing with slots for convection cooling
- Models RHTV with hinges for wall mounting
- Housing made of sheets of textured stainless steel
- Ceramic working tube made of material C 799 incl. fiber plugs operation under air
- Type B thermocouple
- Power unit with low-voltage transformer and thyristor
- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load and with selectable maximum temperature gradient as tube protection
- Switchgear and control unit separate from furnace in separate floor standing cabinet
- Standard working tube see chart on page 47
- Controls description see page 60

Additional equipment
- Charge control with temperature measurement in the working tube and in the oven chamber behind the tube see page 43
- Working tubes designed for process requirements
- Display of inner tube temperature with additional thermocouple
- Gas-tight flanges for protective gas and vacuum operation
- Manual or automatic gas supply system
- Three- or five-zone control for optimization of temperature uniformity
- Check valve at gas outlet avoids intrusion of false air
- Stand for vertical operation
- Alternative working tubes see chart on page 47
- Please see page 44 for more additional equipment
**RHTV 120/150/17 vertical tube furnace with stand and gas supply system 2 as additional equipment**

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax</th>
<th>Outer dimensions in mm</th>
<th>Max. outer tube Ø /mm</th>
<th>Heated length mm</th>
<th>Length constant temperature ΔT 10 K in mm</th>
<th>Tube length in mm</th>
<th>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RHTH 120/150/..</td>
<td>1600 or</td>
<td>470 550 640</td>
<td>50 150</td>
<td>50</td>
<td>50</td>
<td>380</td>
<td>5.4</td>
<td>3-phase¹</td>
<td>70</td>
</tr>
<tr>
<td>RHTH 120/300/..</td>
<td>1700 or</td>
<td>620 550 640</td>
<td>80 300</td>
<td>100</td>
<td>530</td>
<td>9.0</td>
<td>3-phase¹</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>RHTH 120/600/..</td>
<td>1800</td>
<td>920 550 640</td>
<td>120 600</td>
<td>200</td>
<td>830</td>
<td>14.4</td>
<td>3-phase¹</td>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>

¹Heating only between two phases

²Without tube

³Tmax is reached outside the tube. Realistic working temperature inside the tube is approx. 50 °C lower.

---

**RHTV 120/480/16 LB in customer-specific design with working tube closed at one side, protective gas and vacuum option as well as with electric screw drive of the lift table**

**RHTV 120/300/15 integrated in a tensile strength testing machine**
Thermocouple Calibration Set

For heat treatment processes, continuous quality can only be ensured by the regular calibration of control or charge thermocouples. The illustrated calibration set can be used with every tube furnace for the professional calibration of thermocouples.

The thermocouple calibration set is mounted in a compact housing and consists of a temperature display unit for two thermocouples, a reference thermocouple with compensation wire and a plug connection for different types of thermocouples. Both the display unit and the whole measuring circuit to the reference thermocouple are calibrated ex works and are supplied with a calibration certificate.

The set is used with a tube furnace, e.g. model RD 30/200/11. For calibration, the furnace is set for one temperature. From one side, the reference thermocouple is inserted into the working tube. From the other side, the thermocouple to be tested is positioned in the tube. The measuring points of both thermocouples must face as close as possible to each another. Depending on the furnace model, a ceramic temperature compensation block can be offered for the positioning of both thermocouples. After a defined period of time, the temperature of both thermocouples can be read off from the display unit of the thermocouple calibration set and be compared.

- Compact housing
- Single-phase connection see page 60
- Digital display unit for the test thermocouple and the reference thermocouple, with calibration certificate in steps of 100 °C
- Reference thermocouple, type N, with calibration certificate (for 3 temperatures)
- Thermocouple inputs type K, S, N for test thermocouples. Only one input per measurement is possible.
- Furnace (RD or R model) has to be ordered separately

Additional equipment
- Reference thermocouple type K or type S
- Further thermocouple inputs for specimen, e.g. type B, type J or type R
- Fiber plug with passages and ceramic temperature compensation block for the support of the thermocouples in the test furnace
Control Alternatives for Tube Furnaces

Furnace Chamber Control
with temperature measurement in furnace chamber outside the working tube.
- Advantages: Thermocouple protected against damage and aggressive load, very even control, attractive price
- Disadvantage: Process-dependent temperature difference between displayed temperature on the controller and inside the tube

Extension Package for Furnace Chamber Control
with additional temperature measurement in the working tube and display of the measured temperature

Charge Control
with temperature measurement both in the furnace chamber outside the working tube as well as in the working tube.
- Advantages: Very precise and rapid control adjustment
- Disadvantage: Costs

Furnace Chamber vs. Charge Control Comparison

Furnace Chamber Control
Only the furnace chamber temperature is measured and controlled. Regulation is carried out slowly to avoid out-of-range values. As the charge temperature is not measured and controlled, it may vary a few degrees from the chamber temperature.

Charge Control
If the charge control is switched on, both the charge temperature and furnace chamber temperature are measured. By setting different parameters the heat-up and cooling processes can be individually adapted. This results in a more precise temperature control at the charge.

Thermocouple for charge control in the RHTH 120/600/18 furnace

Sintering under hydrogen in a tube furnace of RHTH product line
When equipped with various equipment packages, the tube furnace series RS, RHTC, RHTH, and RHTV can be adapted for operation with nonflammable or flammable gasses or for vacuum operation. The different equipment packages can be delivered together with the furnace, or later as needed.

**Gas Supply System 1** for simple protective gas applications (no vacuum operation)

This package represents a basic version sufficient for many applications, for operation with nonflammable protective gasses. The standard working tube made of ceramic C 530 delivered with the furnace can still be used.

- Standard working tube can be used
- 2 plugs of ceramic fiber with protective gas connections
- Gas supply system for nonflammable protective gas (Ar, N₂, forming gas) with shutoff valve and flow meter with control valve (volume 50-500 l/hr), piped and ready to connect (gas intake pressure at 300 mbar to be provided by customer)

**Additional equipment**

- Extension of gas supply system with a second or third nonflammable type of gas
- Bottle pressure regulator for use with bottled gas
- Automatically controlled gas supply with solenoid valves on the gas supply system, which can be switched on and off through a controller with programmable extra functions (e.g. P 330)

**Gas Supply System 2** for protective gas applications with nonflammable gases/vacuum operation

For increased atmospheric purity requirements in the working tube, we recommend this gas supply system. The standard working tube is replaced by a dense working tube of ceramic C 610 or C 799 in a gas-tight design. Besides the longer working tube, the scope of delivery also includes gas-tight flanges and a corresponding bracket system in the furnace. The system can also be equipped for vacuum operation.

- Longer, gas-tight working tube of ceramic C 610 for furnaces to 1300 °C or of C 799 for temperatures above 1300 °C
- 2 vacuum-tight, water-cooled stainless steel flanges with fittings on the outlet side (cooling water supply with NW9 hose connector to be provided by the customer)
- Mounting system on furnace for the flanges
- Gas supply system for nonflammable protective gas (Ar, N₂, forming gas) with shutoff valve and flow meter with control valve (volume 50-500 l/hr), gas outlet valve, piped and ready to connect (gas intake pressure at 300 mbar to be provided by customer)

**Additional equipment**

- Extension of gas supply system with a second or third nonflammable type of gas
- Bottle pressure regulator for use with bottled gas
- Automatically controlled gas supply with solenoid valves on the gas supply system, which can be switched on and off through a controller with programmable extra functions (e.g. P 330)
- Water-cooled end flange with quick connectors
- Cooling unit for closed loop water circuit
- Window for charge observation in combination with gastight flanges

**Vacuum Operation**

- Vacuum package for evacuation of the working tube, consisting of connector for the gas outlet, 1 ball valve, manometer, 1-stage manually operated rotary vane vacuum pump with corrugated stainless steel hose connected to the gas outlet, max. attainable end pressure in working tube about 10⁻² mbar
- Alternative pumps for max. final pressure of up to 10⁻⁵ mbar on request see page 45
Gas Supply System 3 for hydrogen applications, manual operation in supervised mode
Adding gas supply system 3 to the tube furnace allows operation under a hydrogen atmosphere. During hydrogen operation, a safety pressure of approx. 30 mbar is ensured in the working tube. Surplus hydrogen is burnt off in an exhaust gas torch. The operator manually takes care of inerting the working chamber before process start, after process end, and in case of default.

- Safety system for operation with flammable gases including torch function and tube breakage monitoring (checking overpressure)
- Longer, gas-tight working tube
- 2 vacuum-tight, water-cooled stainless steel flanges (cooling water supply to be provided by customer via hose connector)
- Exhaust gas torch
- Pressure switch for monitoring the safety pressure
- Gas supply system for \( \text{H}_2 \) and \( \text{N}_2 \). Volume adjustment is carried out by hand (the customer provides an \( \text{H}_2 \) supply at 1 bar, an \( \text{N}_2 \) supply at 10 bar, an \( \text{O}_2 \) supply at 6-8 bar and a propan supply at 300 mbar)

Gas Supply System 4 for hydrogen applications, fully-automatic, unattended operation
With extended safety logic and an integrated nitrogen purge container, the system can be used for fully-automatic, unattended operation. Equipped with a Safety-PLC control system, pre-purging, hydrogen inlet, operation, fault monitoring and purging at the end of the process are carried out automatically. In case of default, the tube is immediately purged with nitrogen and the system is automatically switched to a safe status.

Equipment in Addition to System 3
- Extended safety control system with emergency tube purging in case of default
- Emergency purge container
- Safety-PLC control system with touchpanel for data input

Additional equipment for systems 3 - 4
- Simplified safety package for operation when purging with hydrogen above 800 °C
  - Tube can be opened at working temperature above 800 °C
  - Pilot flame at tube outlet
  - Purging with hydrogen below 800 °C not possible, locked
  - Available for models RS
- Gas supply system extension for additional nonflammable gas types
- Bottle pressure reducer for use with bottled gas
- Cooling unit for closed loop water circuit
- Vacuum packages (with hydrogen operation, this package can only be used for pre-evacuation)
- PLC control system (as standard with gas supply system 4)
- Gas supply via program-dependent, controllable mass flow controllers (with PLC control system only)

Vacuum Pumps
With respect to the final pressure different pumps are available see page 58:
- Single-step rotary piston pump for a max. final pressure of approx. 20 mbar.
- Two-step rotary piston pump for a max. final pressure of approx. \( 10^{-2} \) mbar.
- Pump system PT70 Dry (rotary vane pump with following turbomolecular pump for a max. final pressure of \( 10^{-6} \) mbar.

Information:
For protection of the vacuum pump only cold stage evacuation is allowed. The reduction of working tube strengthness limits the max. possible working temperature under vacuum see page 46.
Tube Furnaces for Integration into Customized Systems

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 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 tube furnace systems – we will find the appropriate solution for a suitable process optimization.

Working Tubes

There are various working tubes available, depending on application and temperatures. The technical specifications of the different working tubes are presented in the following table:

<table>
<thead>
<tr>
<th>Material</th>
<th>Tube outside Ø mm</th>
<th>Max. heat-up ramp K/h</th>
<th>Tmax in air* °C</th>
<th>Tmax in vacuum operation °C</th>
<th>Gas-tight</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 530 (Sillimanite)</td>
<td>&lt; 120</td>
<td>unlimited</td>
<td>1300</td>
<td>not possible</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>from 120</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 610 (Pythagoras)</td>
<td>&lt; 120</td>
<td>300</td>
<td>1400</td>
<td>1200</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>from 120</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C 799 (99.7% Al₂O₃)</td>
<td>&lt; 120</td>
<td>300</td>
<td>1800</td>
<td>1400</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>from 120</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quartz glass</td>
<td>all</td>
<td>unlimited</td>
<td>1100</td>
<td>950</td>
<td>yes</td>
</tr>
<tr>
<td>CrFeAl-Alloy</td>
<td>all</td>
<td>unlimited</td>
<td>1300</td>
<td>1100</td>
<td>yes</td>
</tr>
</tbody>
</table>

*The max. allowed temperature might be reduced operating under aggressive atmospheres.
## Working Tubes: Standard (●) and Options (○)

<table>
<thead>
<tr>
<th>Working tube</th>
<th>Article No.</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>outer Ø x inner Ø x length</td>
<td></td>
<td>R</td>
</tr>
<tr>
<td>40 x 30 x 450 mm</td>
<td>692070274</td>
<td>○</td>
</tr>
<tr>
<td>40 x 30 x 700 mm</td>
<td>692070276</td>
<td>o</td>
</tr>
<tr>
<td>50 x 40 x 450 mm</td>
<td>692070275</td>
<td>●</td>
</tr>
<tr>
<td>50 x 40 x 700 mm</td>
<td>692070277</td>
<td>○</td>
</tr>
<tr>
<td>60 x 50 x 650 mm</td>
<td>692070106</td>
<td>○</td>
</tr>
<tr>
<td>60 x 50 x 850 mm</td>
<td>692070005</td>
<td>○</td>
</tr>
<tr>
<td>60 x 50 x 1100 mm</td>
<td>692070101</td>
<td>○</td>
</tr>
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<td>70 x 60 x 1070 mm</td>
<td>692070048</td>
<td>○</td>
</tr>
<tr>
<td>80 x 70 x 650 mm</td>
<td>692070006</td>
<td>○</td>
</tr>
<tr>
<td>80 x 70 x 850 mm</td>
<td>692070008</td>
<td>○</td>
</tr>
<tr>
<td>80 x 70 x 1100 mm</td>
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<td>○</td>
</tr>
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<td>95 x 80 x 1070 mm</td>
<td>692070049</td>
<td>○</td>
</tr>
<tr>
<td>120 x 100 x 650 mm</td>
<td>692070110</td>
<td>○</td>
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<tr>
<td>120 x 100 x 1100 mm</td>
<td>692070111</td>
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<td>170 x 150 x 1350 mm</td>
<td>692071660</td>
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</tr>
<tr>
<td>Vacuum tube¹ C 610</td>
<td>60 x 50 x 1030 mm</td>
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</tr>
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<td>692070180</td>
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</tr>
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<td>80 x 70 x 1230 mm</td>
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</tr>
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<td>170 x 150 x 1730 mm</td>
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</tr>
<tr>
<td>C 799</td>
<td>50 x 40 x 380 mm</td>
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</tr>
<tr>
<td>C 799</td>
<td>50 x 40 x 530 mm</td>
<td>692071665</td>
</tr>
<tr>
<td>50 x 40 x 830 mm</td>
<td>692070163</td>
<td>○</td>
</tr>
<tr>
<td>80 x 70 x 600 mm</td>
<td>692070000</td>
<td>○</td>
</tr>
<tr>
<td>80 x 70 x 830 mm</td>
<td>692071670</td>
<td>●</td>
</tr>
<tr>
<td>80 x 70 x 530 mm</td>
<td>692071669</td>
<td>●</td>
</tr>
<tr>
<td>80 x 70 x 1080 mm</td>
<td>692071667</td>
<td>●</td>
</tr>
<tr>
<td>120 x 105 x 830 mm</td>
<td>692071713</td>
<td>●</td>
</tr>
<tr>
<td>Vacuum tube¹ C 799</td>
<td>50 x 40 x 990 mm</td>
<td>692070149</td>
</tr>
<tr>
<td>50 x 40 x 1140 mm</td>
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<td>○</td>
</tr>
<tr>
<td>80 x 70 x 1140 mm</td>
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<td>○</td>
</tr>
<tr>
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<td>○</td>
</tr>
<tr>
<td>80 x 70 x 1470 mm</td>
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<td>○</td>
</tr>
<tr>
<td>120 x 105 x 1440 mm</td>
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<td>○</td>
</tr>
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<td>Vacuum tube² APM</td>
<td>75 x 66 x 1090 mm</td>
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</tr>
<tr>
<td>75 x 66 x 1290 mm</td>
<td>691402565</td>
<td>○</td>
</tr>
<tr>
<td>75 x 66 x 1540 mm</td>
<td>691400835</td>
<td>○</td>
</tr>
<tr>
<td>115 x 104 x 1290 mm</td>
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<td>○</td>
</tr>
<tr>
<td>115 x 104 x 1540 mm</td>
<td>691402567</td>
<td>○</td>
</tr>
<tr>
<td>115 x 104 x 1790 mm</td>
<td>691402568</td>
<td>○</td>
</tr>
<tr>
<td>164 x 152 x 1540 mm</td>
<td>691402569</td>
<td>○</td>
</tr>
<tr>
<td>Vacuum quartz glass tube</td>
<td>164 x 152 x 1790 mm</td>
<td>691402570</td>
</tr>
<tr>
<td>60 x 54 x 1030 mm</td>
<td>691404422</td>
<td>○</td>
</tr>
<tr>
<td>60 x 54 x 1230 mm</td>
<td>691404423</td>
<td>○</td>
</tr>
<tr>
<td>60 x 54 x 1480 mm</td>
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<td>80 x 74 x 1230 mm</td>
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</tr>
<tr>
<td>120 x 114 x 1480 mm</td>
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<td>○</td>
</tr>
<tr>
<td>120 x 114 x 1730 mm</td>
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<td>○</td>
</tr>
<tr>
<td>170 x 162 x 1480 mm</td>
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<td>○</td>
</tr>
<tr>
<td>170 x 162 x 1730 mm</td>
<td>691404431</td>
<td>○</td>
</tr>
</tbody>
</table>

¹With grinded tube ends for the use with water-cooled end flanges
²With attached holder for gas tight flange
³Tubes/reactors incl. mounted sleeves for connection to the rotary drive. Spare tubes come without sleeves.

*Standard working tube
Working tube available as an option
Laboratory Melting Furnaces

K 1/10 - K 4/13, KC 1/15 + KC 2/15

These compact melting furnaces for the melting of non-ferrous metals and alloys are one of a kind and have a number of technical advantages. Designed as tabletop models, they can be used for many laboratory applications. The practical counter balanced hinge with shock absorbers and the spout (not for KC) on the front of the furnace make exact dosing easy when pouring the melt. The furnaces are available for furnace chamber temperatures of 1000, 1300, or 1500 °C. This corresponds to melt temperatures of about 80-110 °C lower.

- Tmax 1000 °C, 1300 °C, or 1500 °C, with melt temperature about 80 - 110 °C lower
- Crucible sizes of 1, 2, or 4 liters
- Crucible with integrated pouring spout of iso-graphite included with delivery
- Spout (not for KC), mounted at the furnace for exact pouring
- Compact bench-top design, simple emptying of crucible by tilting system with gas damper
- Crucible for heating of furnace insulated with a hinged lid, lid opened when pouring
- Controls description see page 60

Additional equipment
- Other crucible types available, e.g. steel or SiC
- Design as crucible furnace without tilting device, e.g. for lead melting
- Over-temperature limit controller for the furnace chamber with automatic reset to protect against overtemperature. The limit controller switches off the heating when the pre-set limit temperature has been reached and does not switch it on again until the temperature falls below the setting again.
- Observation hole for melt

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Crucible</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>K 1/10</td>
<td>1000</td>
<td>A 6</td>
<td>1.0</td>
<td>520 680 660</td>
<td>3.0</td>
<td>single-phase</td>
<td>85</td>
</tr>
<tr>
<td>K 2/10</td>
<td>1000</td>
<td>A10</td>
<td>2.0</td>
<td>520 680 660</td>
<td>3.0</td>
<td>single-phase</td>
<td>90</td>
</tr>
<tr>
<td>K 4/10</td>
<td>1000</td>
<td>A25</td>
<td>4.0</td>
<td>570 755 705</td>
<td>3.6</td>
<td>single-phase</td>
<td>110</td>
</tr>
<tr>
<td>K 1/13²</td>
<td>1300</td>
<td>A 6</td>
<td>1.0</td>
<td>520 680 660</td>
<td>3.0</td>
<td>single-phase</td>
<td>120</td>
</tr>
<tr>
<td>K 2/13²</td>
<td>1300</td>
<td>A10</td>
<td>2.0</td>
<td>520 680 660</td>
<td>3.0</td>
<td>single-phase</td>
<td>125</td>
</tr>
<tr>
<td>K 4/13²</td>
<td>1300</td>
<td>A25</td>
<td>4.0</td>
<td>570 755 705</td>
<td>5.5</td>
<td>3-phase¹</td>
<td>170</td>
</tr>
<tr>
<td>KC 1/15³</td>
<td>1500</td>
<td>A6</td>
<td>1.0</td>
<td>580 630 580</td>
<td>10.5</td>
<td>3-phase</td>
<td>170</td>
</tr>
<tr>
<td>KC 2/15³</td>
<td>1500</td>
<td>A10</td>
<td>2.0</td>
<td>580 630 580</td>
<td>10.5</td>
<td>3-phase</td>
<td>170</td>
</tr>
</tbody>
</table>

¹Heating only between two phases
²Outer dimensions of furnace, transformer in separate housing (500 x 570 x 300 mm)
³Switchgear and controller mounted in a floor standing cabinet

*Please see page 60 for more information about supply voltage
Fast-Firing Kilns

LS 12/13 and LS 25/13
These models are ideal for simulation of typical fast-firing processes up to a maximum firing temperature of 1300 °C. The combination of high performance, low thermal mass and powerful cooling fans provides for cycle times from cold to cold of under 35 minutes.

- Tmax 1300 °C
- Very compact design
- Ceramic grid tubes as charge support
- Floor and lid heating
- Two-zone control, bottom and lid
- Integrated cooling fans, programmable to speed up charge cooling including housing cooling
- Programmable lid opening of approximately 20 mm for faster cooling without activating the fan
- Thermocouple PtRh-Pt, type S for top and bottom zone
- Castors for easy furnace moving
- Controls description see page 60

<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>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 12/13</td>
<td>1300</td>
<td>350 350 40 12</td>
<td>600 800 985</td>
<td>15 3-phase 130</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LS 25/13</td>
<td>1300</td>
<td>500 500 100 25</td>
<td>750 985 1150</td>
<td>22 3-phase 160</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Please see page 60 for more information about supply voltage

Gradient or Lab Strand Annealing Furnaces

GR 1300/13
The furnace chamber of the gradient furnace GR 1300/13 is divided in six control zones of equal length. The temperature in each of the six heating zones is separately controlled. The furnace is usually charged from the side through the parallel swivel door. A maximum temperature gradient of 400 °C can then be stabilized over the heated length of 1300 mm. On request the furnace also is designed as a strand furnace with a second door on the opposite side. Other available additional equipment consists of fiber chamber separators dividing the furnace chamber into six equally sized chambers. Charging then occurs from above by opening the large lid.

- Tmax 1300 °C
- Heated length: 1300 mm
- Heating elements on support tubes providing for free heat radiation in the kiln chamber
- Charging from the top or through the right side door
- Gas damper suspension of the lid
- 6-zone control
- Separate control of heating zones (each 160 mm long)
- Temperature gradient of 400 °C over the entire length of the kiln chamber, each zone can individually be controlled
- Controls description see page 60

Additional equipment
- Up to ten control zones
- Fiber separators dividing the chamber in six equally sized chambers
- Second parallel swivel door for use as strand furnace
- Vertical instead of horizontal strand furnace

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Outer dimensions in mm</th>
<th>Connected load kW</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR 1300/13</td>
<td>1300</td>
<td>1300 100 60</td>
<td>1660 740 1345</td>
<td>18</td>
<td>3-phase 220</td>
<td>300</td>
</tr>
</tbody>
</table>

*Please see page 60 for more information about supply voltage
The N 110/HS furnace is especially used for the assay of precious metals where the insulation and heating must be protected from emerging gasses and vapours. The furnace chamber forms a ceramic muffle which can easily be replaced. In the standard design, the muffle is closed with a firebrick plug. A lift door can be installed instead upon request.

- **T**<sub>max</sub> 1300 °C
- Muffle heated from four sides
- Heating elements and insulation protected by ceramic muffle
- Simple replacement of muffle
- Manual lift door
- Tool holder on furnace
- Stainless steel exhaust chimney above the door opening for connection of an exhaust system
- Work platform with embedded ceramic plate in front of the muffle opening to place load
- Front side with large service door for easy access to the furnace chamber behind the muffle
- Dual shell housing with fan cooling to reduce exterior temperatures
- Base frame with integrated switchgear and controller
- Controls description see page 60

### Additional equipment
- Electrical lift door drive with 2-hand button operation
- Second work platform with embedded ceramic plate below the standard platform

<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>Connected load kW</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>N 110/HS</td>
<td>1300</td>
<td>260 340 95</td>
<td>8.0</td>
<td>760 790 1435</td>
<td>22 3-phase</td>
<td>510</td>
<td></td>
</tr>
<tr>
<td>S 73/HS</td>
<td>1200</td>
<td>530 380 360</td>
<td>73.0</td>
<td>1050 1530 900</td>
<td>26 3-phase</td>
<td>890</td>
<td></td>
</tr>
<tr>
<td>N 7/HS</td>
<td>1150</td>
<td>180 240 80</td>
<td>3.5</td>
<td>750 640 580¹</td>
<td>3 single-phase</td>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>

¹Plus 100 mm for exhaust hood

*Please see page 60 for more information about supply voltage*
Catalytic and Thermal Afterburning Systems, Exhaust Gas Washer

**Catalytic and Thermal Afterburning Systems (KNV and TNV), Exhaust Gas Washer**

For exhaust gas cleaning, in particular in debinding, Nabertherm offers exhaust gas cleaning systems tailored to the process. The afterburning system is permanently connected to the exhaust gas fitting of the furnace and accordingly integral part of the control system and the safety matrix of the furnace. For existing furnaces, independent exhaust gas cleaning systems are also available that can be separately controlled and operated.

Catalytic exhaust cleaning is especially recommended due to energetic reasons when only pure hydrocarbon compounds must be cleaned during the debinding process in air. Thermal afterburning systems are used if large volumes of exhaust gas from the debinding process in air must be cleaned and/or if there is a risk that the exhaust gases might damage the catalyst. Thermal afterburning is also used for debinding applications under protective gas or under hydrogen.

An exhaust gas washer is often used if large amounts of exhaust gases are generated respectively, if the gases cannot be treated with a thermal afterburner system or with a torch. The gases will be lead through a water shower and fall out as condensate.

**Catalytic afterburning systems (KNV)**
- Perfectly suited for debinding processes in air with only organic exhaust gases
- Catalytic conversion of the unburned hydrocarbons to their nontoxic, natural components
- Integrated in a compact stainless steel housing
- Electric heating provides for preheating of the exhaust gas to the optimal reaction temperature for catalytic treatment
- Cleaning in different layers of catalytic honeycombs within the system
- Thermocouples for measuring the temperatures of raw gas, reaction honeycombs and discharge
- Over-temperature limit controller with adjustable cutout temperature protects the catalyst
- Tight connection between the exhaust gas outlet of the debinding furnace and the exhaust gas fan with corresponding integration into the overall system with respect to control and safety technology
- Catalyst dimensioned in relation to the exhaust gas flow
- Measuring port for clean gas measurements (FID), see additional equipment

**Thermal afterburning systems (TNV)**
- Optimaly suited for debinding processes in air with large exhaust gas flow, erratic large exhaust gas volumes, large volume flow or for debinding processes under protective gases, hydrogen or in vacuum
- Burn-off at temperatures up to 850 °C provides for thermal decomposition of the exhaust gases
- Heating with compact gas burner with automatic firing device
- Thermocouples in the combustion chamber and in the raw gas inlet
- Over-temperature limit controller for protecting the thermal afterburning
- Design depending on the exhaust gas flow
- Measuring port for clean gas measurements (FID), see additional equipment
Hot-Wall Retort Furnaces up to 1100 °C

NRA 17/06 - NRA 1000/11
These gastight 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. These compact models can also be laid out for heat treatment under vacuum up to 600 °C. The furnace chamber consists of a gastight retort with water cooling around the door to protect the special sealing. Equipped 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 required for the process:

Models NRA ../06 with Tmax 650 °C
- Heating elements located inside the retort
- Temperature uniformity up to ΔT 6 K inside the working chamber from 100 °C - 600 °C see page 63
- Retort made of 1.4571
- Gas circulation fan in the back of the retort provides for optimal temperature uniformity

Models NRA ../09 with Tmax 950 °C
- Outside heating with heating elements surrounding the retort as well as an additional door heater
- Temperature uniformity up to ΔT 6 K inside the working chamber from 200 °C - 900 °C see page 63
- Retort made of 1.4841
- Fan in the back of the retort provides for optimal temperature uniformity

Models NR ../11 with Tmax 1100 °C
- Outside heating with heating elements surrounding the retort as well as an additional door heater
- Temperature uniformity up to ΔT 10 K inside the working chamber from 200 °C - 1050 °C see page 63
- Retort made of 1.4841
Standard Equipment for all models

Basic version
- Compact housing in frame design with removable stainless steel sheets
- Controls and gas supply integrated in the furnace housing
- Welded charging supports in the retort or air-baffle box in the furnace with air circulation
- Swivel door hinged on right side with open cooling water system
- Multi-zone control for 950 °C and 1100 °C version, separated by furnace chamber and door. Depending on furnace chamber additionally subdivided into one or several heating zones
- Temperature control as charge control with temperature measurement inside and outside the retort
- Gas supply system for one nonflammable protective gas with flow meter and solenoid valve, switchable via the control system
- Operation under vacuum up to 600 °C with optional single-stage rotary vane pump
- Port for vacuum pump for cold evacuation
- PLC controls with touch panel H 700 for data input (resp. P 300 for 650 °C-version) see page 60

Additional equipment
- Upgrade for other nonflammable gases
- Automatic gas injection, including MFC flow controller for alternating volume flow, PLC controlled with touch panel H 3700
- Vacuum pump for evacuating of the retort up to 600 °C, attainable vacuum up to 10⁻⁵ mbar subject to selected pump
- Cooling system for shortening process times
- Heat exchanger with closed-loop cooling water circuit for door cooling
- Measuring device for residual oxygen content

Customized Furnace NRA 480/04

Customized gas supply system for reactive gases

Vacuum pump for cold evacuation of the retort

Touchpanel H 3700 for automatic version
Bayonet quick-lock for the retort, also with electric drive as additional equipment

---

**H₂ Version for Operation under Hydrogen**

When hydrogen is used as a process gas, the furnace is additionally equipped with the required safety technology. Only certified and industry proven safety sensors are used. The furnace is controlled by a fail-safe PLC control system (S7- 300F/safety controller).

- H₂ supply at controlled overpressure of 50 mbar relative
- Certified safety concept
- PLC controls with graphic touch panel H 3700 for data input
- Redundant gas inlet valves for hydrogen
- Monitored pre-pressures of all process gases
- Bypass for safe flushing of furnace chamber with inert gas
- Torch for thermal afterburning of exhaust gases
- Emergency flood container for purging the furnace in case of failure

---

**IDB Version for Debinding under Protective Gas or for Pyrolysis Processes**

The retort furnaces of the NR and NRA product line are perfectly suited for debinding under protective gases or for pyrolysis processes. The IDB version of the furnaces implements a safety concept by controlled purging the furnace chamber with a protective gas. Exhaust gases are burned in an exhaust torch. Both the purging and the torch function are monitored to ensure a safe operation.

- Process control under monitored and controlled overpressure of 50 mbar relative
- Certified safety concept
- PLC controls with graphic touch panel H 1700 for data input
- Monitored gas pre-pressure of the process gas
- Bypass for safe flushing of furnace chamber with inert gas
- Torch for thermal afterburning of exhaust gases

---

### Table: Working chamber dimensions and useful volume

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Working Chamber Dimensions in mm</th>
<th>Useful Volume in l</th>
<th>Electrical connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRA 17/..</td>
<td>650 or 950</td>
<td>w 225 d 500 h 225</td>
<td>17</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 25/..</td>
<td>650 or 950</td>
<td>w 325 d 475 h 325</td>
<td>25</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 50/..</td>
<td>650 or 950</td>
<td>w 325 d 700 h 325</td>
<td>75</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 75/..</td>
<td>650 or 950</td>
<td>w 450 d 750 h 450</td>
<td>150</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 150/..</td>
<td>650 or 950</td>
<td>w 450 d 1000 h 450</td>
<td>200</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 200/..</td>
<td>650 or 950</td>
<td>w 570 d 900 h 570</td>
<td>300</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 300/..</td>
<td>650 or 950</td>
<td>w 570 d 1250 h 570</td>
<td>400</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 400/..</td>
<td>650 or 950</td>
<td>w 720 d 1000 h 720</td>
<td>500</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 500/..</td>
<td>650 or 950</td>
<td>w 720 d 1350 h 720</td>
<td>700</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 700/..</td>
<td>650 or 950</td>
<td>w 870 d 1350 h 870</td>
<td>1000</td>
<td>3-phase</td>
</tr>
<tr>
<td>NRA 1000/..</td>
<td>650 or 950</td>
<td>w 870 d 1350 h 870</td>
<td>1000</td>
<td>3-phase</td>
</tr>
</tbody>
</table>

*Please see page 60 for more information about mains voltage*
Pit-Type Cold-Wall Retort Furnaces up to 2400 °C or up to 3000 °C

SVHT 2/24-W - SVHT 9/30-GR
Compared with the VHT models (page 56 ff), the furnaces of the SVHT product line offer improved performance data with regard to achievable vacuum and maximum temperature. Due to the design as pit-type furnace with tungsten heating, processes up to max. 2400 °C even in high vacuum can be implemented with models of the SVHT...-W product line. Models of the SVHT..-GR product line with graphite heating, also in pit-type design, can be operated in an inert gas atmosphere even up to max. 3000 °C.

- Standard sizes with a furnace chamber of 2 or 9 liters
- Designed as pit-type furnace, charged from above
- Frame construction with inserted sheets of textured stainless steel
- Double-walled water-cooled stainless steel container
- Manual operation of process gas and vacuum functions
- Manual gas supply for non-combustible process gas
- A step in front of the furnace for an ergonomic charging height
- Retort lid with gas-charged shock absorbers
- Controls and switchgear as well as gas supply integrated in furnace housing
- Further standard product characteristics see description for standard design of VHT models page 56

Heating options

SVHT ..-GR
- Applicable for processes:
  - under protective or reaction gases or in the vacuum up to 2200 °C
  - under inert gases (argon, helium) up to 3000 °C
- Max. vacuum up to 10⁻³ mbar depending on the type of pump used
- Heating: graphite heating elements in cylindrical arrangement
- Insulation: graphite felt insulation
- Temperature measurement by means of an optical pyrometer

SVHT ..-W
- Applicable for processes under protective or reaction gases or in vacuum up to 2400 °C
- Max. vacuum up to 10⁻⁵ mbar depending on the type of pump used
- Heating: cylindrical tungsten heating module
- Insulation: tungsten and molybdenum radiant plates
- Temperature measurement with optical pyrometer

Additional equipment such as automatic process gas control or design for the operation with flammable gases incl. safety system see VHT models page 56.

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Working chamber dimensions Ø x h in mm</th>
<th>Useful volume in L</th>
<th>Outer dimensions in mm</th>
<th>Connected load KW</th>
<th>Electrical connection*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVHT 2/24-W</td>
<td>2400</td>
<td>150 x 150</td>
<td>2,5</td>
<td>1400 2500 2100</td>
<td>55</td>
<td>3-phase</td>
</tr>
<tr>
<td>SVHT 9/24-W</td>
<td>2400</td>
<td>230 x 230</td>
<td>9,5</td>
<td>1500 2750 2100</td>
<td>95</td>
<td>3-phase</td>
</tr>
<tr>
<td>SVHT 2/30-GR</td>
<td>3000</td>
<td>150 x 150</td>
<td>2,5</td>
<td>1400 2500 2100</td>
<td>55</td>
<td>3-phase</td>
</tr>
<tr>
<td>SVHT 9/30-GR</td>
<td>3000</td>
<td>230 x 230</td>
<td>9,5</td>
<td>1500 2750 2100</td>
<td>95</td>
<td>3-phase</td>
</tr>
</tbody>
</table>

*Please see page 60 for more information about mains voltage
The compact furnaces of the VHT product line are available as electrically heated chamber furnaces with graphite, molybdenum or MoSi₂ heating. A wide variety of heating designs as well as a complete range of accessories provide for optimal furnace configurations even for sophisticated applications.

The vacuum-tight retort allows heat treatment processes either in protective and reaction gas atmospheres or in a vacuum, subject to the individual furnace specs to 10⁻⁵ mbar. The basic furnace is suited for operation with nonflammable protective gases or under vacuum.

The H₂ version provides for operation under hydrogen or other flammable gases. Key of the specification up is a certified safety package providing for a safe operation at all times and triggers an appropriate emergency program in case of failure.

For debinding applications under vacuum, we recommend the VDB version, which besides the corresponding safety technology has an additional debinding retort in the heating chamber and prevents the exhaust gases from contaminating the furnace chamber. The exhaust gases are channelled from the debinding retort into the exhaust gas torch.

**Alternative Heating Specifications**

The following heating systems are available for the different application temperatures:

**VHT ../GR with Graphite Insulation and Heating**

- Suitable for processes under protective and reaction gases or under vacuum
- Tmax 1800 °C or 2200 °C
- Max. vacuum up to 10⁻³ mbar depending on pump type used
- Graphite felt insulation
- Temperature measurement using type B thermocouple (version to 1800 °C)
- Temperature measurement using optical pyrometer (version to 2200 °C)
VHT ../MO or ../W with molybdenum or tungsten heating
- Suitable for high-purity processes under protective and reaction gases or under high vacuum
- Tmax 1200 °C, 1600 °C or 1800 °C (see table)
- Max. vacuum up to 5 x 10⁻³ mbar depending on pump type used
- Insulation made of Molybdenum steel sheets
- Temperature measurement with thermocouple, type S for models with 1200 °C
- Temperature measurement with thermocouple, type B for models with 1600 °C and 1800 °C

VHT ../KE with Fiber Insulation and Heating through Molybdenum Disilicide Heating Elements
- Suitable for processes under protective and reaction gases, in air or under vacuum
- Tmax 1800 °C
- Max. vacuum up to 10⁻² mbar (up to 1300 °C) depending on pump type
- Insulation made of high purity aluminum oxide fiber
- Temperature measurement by thermocouple type B

<table>
<thead>
<tr>
<th>Inert gas</th>
<th>VHT ../-../GR</th>
<th>VHT ../-16/MO</th>
<th>VHT ../-18/W</th>
<th>VHT ../-18/KE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rough vacuum and fine vacuum (≥10⁻³ mbar)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>High vacuum (≤10⁻² mbar)</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Oxygen</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1 up to 1400 °C
2 depending on Tmax

Standard Equipment for all Models

Basic version
- Standard furnace sizes 8, 40 and 100 liters
- A water-cooled stainless steel process reactor sealed with temperature-resistant o-rings
- Frame made of stable steel profiles, easy to service due to easily removable stainless steel panels
- Housing of the VHT 8 model on castors for easy repositioning of furnace
- Cooling water manifold with manual stopcocks in supply and return lines, automatic flowmeter monitoring, openloop cooling water system
- Adjustable cooling water circuits with flowmeter and temperature indicator and overtemperature fuses
- Switchgear and controller integrated in furnace housing
- H 700 PLC control with clearly laid out 5.7” touchscreen control for program entry and display, 10 programs each with 20 segments
- Over-temperature limit controller with manual reset for thermal protection class in accordance with EN 60519-2
- Manual operation of the process gas and vacuum functions
- Manual gas supply for one process gas (N₂ or Ar) with adjustable flow
- Bypass with manual valve for rapid filling or flooding of furnace chamber
- Manual gas outlet with overflow valve (20 mbar relative)
- Single-stage rotary vane pump with ball valve for pre-evacuating and heat treatment in a rough vacuum to 5 mbar
- Pressure gauge for visual pressure monitoring

Additional equipment
- Tmax 2400 °C
- Housing, optionally divisible, for passing through narrow door frames (VHT 08)
- Manual gas supply for second process gas (N₂ or Ar) with adjustable flow and bypass
- Inner process box made of molybdenum or CFC, especially recommended for debinding processes. The box is installed in the furnace with direct gas inlet and outlet and provides for better temperature uniformity. Due to a change in gas supply direction after debinding a clean process atmosphere for sintering is achieved.

<table>
<thead>
<tr>
<th>Model</th>
<th>Inner dimensions of retort in mm</th>
<th>Volume in l</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHT 8/..</td>
<td>120 210 150</td>
<td>4</td>
</tr>
<tr>
<td>VHT 40/..</td>
<td>280 430 250</td>
<td>30</td>
</tr>
<tr>
<td>VHT 70/..</td>
<td>355 480 355</td>
<td>60</td>
</tr>
<tr>
<td>VHT 100/..</td>
<td>430 530 400</td>
<td>91</td>
</tr>
</tbody>
</table>
Continuation of additional equipment

- Charge thermocouple with display
- Two-stage rotary vane pump with ball valve for pre-evacuating and heat-treating in a vacuum to $10^{-2}$ mbar
- Temperature measurement at 2200 °C with pyrometer and thermocouple, type S with automatic pull-out device for precise control results in the low temperature range (VHT 40 and larger)
- Turbo molecular pump with slide valve for pre-evacuation and for heat treatment in a vacuum to $10^{-5}$ mbar including electric pressure transducer and booster pump (only VHT.../MO)
- Heat exchanger with closed-loop cooling water circuit
- Automation package with graphic touch panel H 3700
  - 12” graphic touch panel H 3700
  - Input of all process data like temperatures, heating rates, gas injection, vacuum at the touch panel
  - Display of all process-relevant data on a process control diagram
  - Automatic gas supply for one process gas (N$_2$, argon or forming gas) with adjustable flow
  - Bypass for flooding and filling the chamber with process gas controlled by the program
  - Automatic pre- and post programs, including leak test for safe furnace operation
  - Automatic gas outlet with bellows valve and overflow valve (20 mbar)
  - Transducer for absolute and relative pressure
- MFC flow controller for alternating volume flow and generation of gas mixtures with second process gas (only with automation package)
- Partial pressure operation: protective gas flushing at controlled underpressure (only with automation package)
- PC control via NCC with corresponding optional documentation and connection to customer PC networks

Single-stage rotary vane pump for heat treatment in a rough vacuum to 20 mbar

Two-stage rotary vane pump for heat treatment in a vacuum to $10^{-2}$ mbar

Turbo-molecular pump with booster pump for heat treatment in a vacuum to $10^{-5}$ mbar
H₂ Version VHT.../MO-H₂ or VHT.../GR-H₂ for Operation with Hydrogen or other Reaction Gases

In the H₂ version the furnaces of the VHT.../MO or VHT.../GR product line can be operated under hydrogen or other reaction gases. For these applications, the systems are additionally equipped with the required safety technology. Only certified and industry proven safety sensors are used. The furnaces are controlled by a fail-safe PLC control system (S7-300F/safety controller).

- Certified safety concept
- Automation package (see additional equipment above)
- Redundant gas inlet valves for hydrogen
- Monitored pre-pressures of all process gases
- Bypass for safe purging of furnace chamber with inert gas
- Pressure-monitored emergency flooding with automated solenoid valve opening
- Electric or gas-heated exhaust gas torch for H₂ post-combustion
- Atmospheric operation: H₂-purging of process reactor starting from room temperature at controlled over pressure (50 mbar relative)

Additional equipment
- Partial pressure operation: H₂ flushing at underpressure in the process reactor starting from 750 °C furnace chamber temperature
- Retort in the process chamber for debinding under hydrogen

VDB Version VHT.../MO-VDB or VHT.../GR-VDB for Debinding under Protective Gas, Hydrogen or in Vacuum

Certain processes require debinding under protective gases or in vacuum. For these processes the models VHT.../MO-VDB or VHT.../GR-VDB are perfectly suited. They are equipped with the necessary safety technology for debinding. The furnace chamber has an additional debinding retort with a direct discharge into the exhaust gas torch. This system ensures that exhaust gases during debinding do not get into and contaminate the furnace chamber.

- Adapted safety concept for debinding
- Automation package (see additional equipment above)
- Exhaust gas torch for burning the exhaust gases
- Debinding retort in the furnace chamber with direct discharge of the exhaust gases into the exhaust gas torch
- Bypass for safe flushing of furnace chamber with inert gas
- Dry-running vacuum pump

Additional equipment
- Condensate trap for separation of large binder volumes during vacuum debinding
- Heated exhaust gas discharge to prevent condensate deposits in the exhaust gas section
- Exhaust gas treatment depending on the process with binder trap, washer or exhaust gas torch

---

Model | Tmax °C | Inner dimensions in mm | Volume in l | Outer dimensions in mm | Connected load kW¹ | Electrical connection² | Weight in kg | Material heater/insulation
---|---|---|---|---|---|---|---|---
VHT 8/...-GR | 1800 | 170 | 240 | 200 | 8 | 1250 (800)¹ | 1100 | 2000 | 27 | 3-phase² | 1200 | Graphite/graphite felt
VHT 40/...-GR or 300 | 1800 | 450 | 300 | 40 | 1600 | 2100 | 2300 | 83/103³ | 3-phase² | 2800 | Graphite/graphite felt
VHT 100/...-GR | 1800 | 450 | 550 | 450 | 100 | 1900 | 2600 | 2500 | 105/125³ | 3-phase² | 2800 | Graphite/graphite felt
VHT 8/...-MO | 1200 | 170 | 240 | 200 | 8 | 1250 (800)¹ | 1100 | 2700 | 15/34³ | 3-phase² | 1200 | Molybdenum
VHT 40/...-MO or 300 | 1800 | 450 | 300 | 40 | 1600 | 2300 | 2600 | 50/1³ | 3-phase² | 2800 | Molybdenum
VHT 100/...-MO | 1800 | 450 | 550 | 450 | 100 | 1900 | 2500 | 2400 | 70/140³ | 3-phase² | 2800 | Molybdenum
VHT 8/18-W or 300 | 1800 | 450 | 300 | 40 | 1600 | 2300 | 2600 | 130³ | 3-phase² | 2800 | Molybdenum
VHT 10/18-W | 1800 | 450 | 375 | 450 | 70 | 1700 | 2500 | 2400 | 160³ | 3-phase² | 2800 | Molybdenum
VHT 70/18-W | 1800 | 450 | 550 | 450 | 100 | 1900 | 2800 | 2400 | 180³ | 3-phase² | 2800 | Molybdenum

¹With the switching system unit removed
²Only heating between two phases
³For operation under hydrogen a higher power rating has to be considered

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Process Control and Documentation

Nabertherm has many years of experience in the design and construction of both standard and custom control systems. 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. Based on the specific furnace model, the controller regulates the furnace temperature reliably. The standard controllers are developed and fabricated within the Nabertherm group. When developing controllers, our focus is on ease of use. 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, PID microprocessor control with self-diagnosis system and a computer interface, we have a solution to meet your requirements.

Assignment of Standard Controllers to Furnace Families

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<td>B 330</td>
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<tr>
<td>H 3700/PLC</td>
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Functionality of the Standard Controllers

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<th>R 6</th>
<th>B 150</th>
<th>C 40</th>
<th>C 42</th>
<th>B 180</th>
<th>P 300</th>
<th>P 310</th>
<th>P 330</th>
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<th>3504</th>
<th>H 700</th>
<th>H 1700</th>
<th>H 3700</th>
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<tr>
<td>Number of programs</td>
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<td>8</td>
<td>99</td>
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<td>Extra functions (e.g. fan or autom. flaps)</td>
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<td>5</td>
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<td>Graphic color display</td>
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<td>Status messages in clear text</td>
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<td>Start time configurable (e.g. to use night power rates)</td>
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<td>Operating hour counter</td>
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<td>Auto tune</td>
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<tr>
<td>Program entry in steps of 1 °C or 1 min.</td>
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<td>Keypad lock</td>
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<td>Skip-button for segment jump</td>
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<td>Drive of manual zone regulation</td>
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<tr>
<td>USB-Interface for data read-out via USB stick and visualisation via NT Log see page 62</td>
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<td>Programmable power outlet</td>
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<td>Real-time clock</td>
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<td>Bath control/Charge control</td>
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</table>

1 Not for model L(T)15...
2 Not for melt bath control
3 Control of additional separate slave regulators possible
4 As an extra feature in ovens with air circulation

Mains Voltages for Nabertherm Furnaces

- **Single-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.
Controltherm MV Software for Control, Visualisation and Documentation

Documentation and reproducibility gain increased attention with steadily rising quality standards. The powerful Nabertherm software Controltherm MV provides for an optimum solution for the control and documentation of one or more furnaces as well as charge data on basis of Nabertherm controllers.

In the basic version one furnace can be connected to the MV-software. The system can be extended to four, eight or even 16 multi-zone controlled furnaces. Up to 400 different heat treatment programs can be stored. The process will be documented and filed. Process data can be read-out graphically or in table format. A data transfer to MS-Excel is also possible.

For furnaces which are not controlled via a Nabertherm controller, the furnace temperature can be documented with the MV-software. We deliver an extension package as optional equipment. With respect to the individual version, three, six or even nine independent thermocouples can be connected. Independent of the control system, the values of each thermocouple will be read-out and evaluated by the MV-software.

Features
- Simple installation without specific knowledge
- All Nabertherm controllers with interface connectable
- Manipulation protected storage of temperature curves of up to one, four, eight or 16 furnaces (also multizone-controlled), depending on the version of MV-software
- Redundant storage on a network server possible
- Programming, archiving and printing of programs and graphics
- Free input of descriptive charge data text with comfortable search function
- Data exportable into Excel format for further evaluation
- Start/stop of the controller from the local PC (only with Nabertherm controllers mit interface)
- Selectable languages: German, English, French, Italian or Spanish
- 400 additional programs storable (only with Nabertherm controllers with interface)

Extension Package II for Connection of one Additional Temperature Measuring Point, Independent of the Controller
- Connection of an independent thermocouple, type K or S with display of the measured temperature on the included controller C 6 D, e.g. for documentation of charge temperature
- Conversion and transmission of measured data to the MV-software
- For data evaluation see MV-software features

Extension Package II for Connection Three, Six or Nine Temperature Measuring Points, Independent of the Controller
- Connection of three thermocouples, type K, S, N or B to the supplied connection box
- Extensible to two or three connection boxes for up to nine temperature measuring points
- Conversion and transmission of measured data to the MV-software
- For data evaluation, please see MV-software features
HiProSystems Control and Documentation

This professional control system for single and multi-zone furnaces is based on Siemens hardware and can be adapted and upgraded extensively. HiProSystems control is used when more than two process-dependent functions, such as exhaust dampers, 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 telediagnostic service is required. It is flexible and is easily tailored to your process or documentation needs.

Alternative User Interfaces

**Touch panel H 700**
This basic panel accommodates most basic needs and is very easy to use.

**Touch panel H 1700**
Firing cycle data and the extra functions activated are clearly displayed in a table. Messages appear as text.

**Touch panel H 3700**
All functions and process data are stored and displayed in easy to read charts. The data can be exported through various interfaces (Ethernet TCP/IP, MPI, Profibus) to a local PC or your company network for further processing. A CF card also gives the opportunity for data storage and transfer to a PC with a card reader.

For Control, Visualisation and Documentation

**Nabertherm Control Center NCC**
Upgrading the HiProSystems-Control individually into an NCC provides for additional interfaces, operating documentation, and service benefits in particular for controlling furnace groups including charge beyond the furnace itself (quenching tank, cooling station etc.):

- Recommended for heat treatment processes with extensive requirements in respect to documentation e.g. for metals, technical ceramics or in the medicine field
- Software can be used also in accordance with the AMS 2750 D (NADCAP)
- Documentation according to the requirements of Food and Drug Administration (FDA), Part 11, EGV 1642/03 possible
- Charge data can be read in via barcodes
- Interface for connection to existing Enterprise Database systems (e.g. SAP, Oracle)
- Connection to mobile phone network for alarm message transmission via SMS
- Control from various locations over the network
- Calibration of each measuring point for a specific temperature possible
- Extendable for calibration of a polygonal line with up to 18 temperatures per measuring point for use at different temperatures e.g. for AMS 2750 D applications

For Documentation

**Nabertherm Documentation Center NDC and data recording via NT Log**
If the process data of the HiProSystems control unit only need to be recorded, this can be done using a personal computer (PC) with the high-performance NDC software. The data are documented, forgery-proof, and can be evaluated both in the form of a table or a chart. Individual charge data can be entered by the customer and are archived together with the process data. A low-cost alternative which can be used is the NT Log package. The data is recorded on a USB stick during the firing. After the heat treatment has been completed, the recorded value can be read out on the PC with the free analysis software.

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></th>
<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>
<td>x</td>
</tr>
<tr>
<td>Size of colour display in inch</td>
<td>5.5</td>
<td>5.5</td>
<td>12.1</td>
</tr>
<tr>
<td>Number of thermocouple inputs</td>
<td>3</td>
<td>18</td>
<td>48</td>
</tr>
<tr>
<td>Data read-out via USB-stick</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Input of charge data</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Evaluation software included</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Applicable for TUS-measurements acc. to AMS 2750 D</td>
<td>x</td>
<td>x</td>
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</tr>
</tbody>
</table>
Temperature Uniformity and System Accuracy

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

Specification of Temperature Uniformity in $\Delta K$ in the Standard Furnace
In the standard design the temperature uniformity is specified as the relative, maximum deviation from a defined reference temperature within the useful space in the empty furnace at dwell time. Temperature uniformity is defined as $\Delta T$ in K. If, for example, a standard temperature uniformity of $\Delta T$ 10 K at 750 °C is specified, it means that the actual temperature in the furnace can vary between 740 °C and 750 °C or between 750 °C and 760 °C.

Specification of the Temperature Uniformity in +/- °C as Additional Feature
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 °C 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 760 °C in the useful space.

System Accuracy
Tolerances may occur not only in the useful space, they also exist with respect to the thermocouple and in the controls. If an absolute temperature uniformity in +/- °C at a defined set temperature or within a defined reference 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 useful 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 Useful Space incl. Protocol
In standard furnaces a temperature uniformity is guaranteed as $\Delta T$ without measurement of temperature uniformity. However, as additional feature, a temperature uniformity measurement at a reference temperature in the useful space compliant with DIN 17052-1 can be ordered. Depending on the furnace model, a holding frame which is equivalent in size to the charge space is inserted into the furnace. This frame holds thermocouples at 11 defined measurement positions. The measurement of the temperature uniformity is performed at a reference temperature specified by the customer at a pre-defined dwell time. If necessary, different reference temperatures or a defined reference working temperature range can also be calibrated.
Please visit our website www.nabertherm.com and find out all you want to know about us - and especially about our products.

Besides news and our current calendar of trade fairs, there is also the opportunity to get in touch directly with your local sales office or nearest dealer worldwide.

Professional Solutions for:
- Arts & Crafts
- Glass
- Advanced Materials
- Laboratory/Dental
- Thermal Process Technology for Metals, Plastics and Surface Finishing
- Foundry

Headquarters:

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28865 Lilienthal, Germany

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