Foundry

Furnaces and Heat Treatment Plants

Melting
Holding
Core Drying
Thermal Decoring
Dewaxing
Heat Treatment
Additive Manufacturing
Annealing/Tempering
Preheating
Quenching
Energy Efficiency Technology
AMS 2750 E, NADCAP, CQI-9

Made in Germany

www.nabertherm.com
Made in Germany
Nabertherm with 500 employees worldwide have been developing and producing industrial furnaces for many different applications for 70 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 in house manufacturing provide for individual project planning and construction of tailor-made thermal process plants 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
Nabertherm’s strength is one of the biggest R&D departments in the furnace industry. In combination with central manufacturing in Germany and decentralized sales and service close to the customer we can provide for a competitive edge to live up to your needs. Long term sales and partners in all important world markets ensure individual on-site customer service and consultation. There are certainly reference customers who are using similar furnaces or systems close to you.

Large Customer Test Center
Which 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 worldwide. 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 Foundry, Nabertherm offers a wide range of standard furnaces and plants 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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Please order our "Advanced Materials" catalog which contains a large number of solutions for debinding and sintering!
Alternative Melting Furnace Concepts

Alternative Heating Technologies

The application of alternative heating technologies depends on the requirements for melt quality, productivity and energy efficiency. In principle either electrically or gas-fired furnaces can be used. In this context, with respect to costs the local pricing for the alternative energy play a decisive role.

Gas-Fired

Gas-fired furnaces are ideal for melting, particularly if equipped with exhaust gas discharge over the crucible edge. Side exhaust gas discharge is best if a high melt quality is required. However, a higher melt quality means a lower energy efficiency since a fuel-fired furnace with side exhaust gas discharge consumes approx. 20-25 % more energy than a furnace with an exhaust gas discharge over the crucible edge.

Fuel-fired furnaces provide for optimal energy efficiency in combination with highest melt quality due to their burner system that includes heat recovery via recuperator. The hot exhaust gases from the furnace preheat the combustion air for the burner via a heat exchanger. This system leads to savings of up to 25 % compared to conventional fuel-fired furnaces with a side exhaust gas discharge.

Electric Heating

If the melt quality and energy efficiency take priority, an electrically heated furnace is the best choice. The heating is controlled very steadily and precisely. The melt is not polluted through immissions from a fuel-fired heating. Electrically heated furnaces can achieve up to 85 % of the melting performance of fuel-fired furnaces with a side exhaust gas discharge. If the furnaces are used only for holding, we recommend the T.../10 models, which are very energy efficient due to their very good insulation and reduced connected load.

Alternative Exhaust Gas Systems

Exhaust Gas Discharge over the Crucible Edge

Exhaust gas discharge over the crucible edge is the standard design for our gas and oil-fired crucible furnaces, except for the TB models for furnace temperatures of 1200 °C, since these furnaces are normally used as holding furnaces. Due to the high melting performance, the furnaces are perfectly suited for melting. This type of exhaust gas discharge is characterised as follows:

+ Very high melting performance, ideal for use as a melting furnace
+ Low power consumption since the crucible is not just heated from the outside but part of the heat also enters the crucible from above. Energy savings of up to 20 % compared to furnaces with a side exhaust gas discharge

- Limitations on the melt quality due to higher burn-off and increased hydrogen absorption by the melt from the exhaust gases
- Bath control not recommended
Side Exhaust Gas Discharge

a) without Recuperator Technology
The side exhaust gas discharge is available for all fuel-fired crucible furnaces. Although the melting performance is not as high as with an exhaust gas discharge over the crucible edge, it provides for better melt quality and, in combination with a bath control, is highly recommended for holding operation.

+ High melt quality due to low burn-off and reduced hydrogen inclusions in the melt
+ Swing lid-reduction of power consumption up to 50% during holding with a closed swing lid
+ Operator exposed to less heat in the area above the crucible
+ Best melt quality if a bath control for precise temperature control is used

- Lower melting performance compared to furnaces with exhaust gas discharge over the crucible edge
- Power consumption during melting around 25% higher compared to furnaces with exhaust gas discharge over the crucible edge

b) with Recuperator Technology
Fuel-fired furnaces with burner systems that include heat recovery via a recuperator provide for optimum energy efficiency in connection with a top melt quality. The combustion air for the burner is pre-heated with the hot exhaust gases from the furnace via heat exchanger. The system results in savings of up to 25% compared to conventional fuel-fired furnaces with side exhaust gas discharge.

Depending on the utilisation the relatively higher acquisition costs pay off already after a short period of time.

+ Burner systems with a recuperator system save around 25% of the power compared to furnaces with a side exhaust gas discharge
+ High melt quality due to low burn-off and reduced hydrogen absorption in the melt
+ Reduced power consumption by up to 50% during holding with a closed swing lid
+ Operator exposed to less heat in the area above the crucible
+ Best melt quality if a bath control for a precise temperature control is used

- Lower melting performance than furnaces with exhaust gas discharge over the crucible edge
- Power consumption during melting around 20-25% higher than furnaces with exhaust gas discharge over the crucible edge

Decision Aid for Melting Furnaces

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<th>Melt Quality</th>
<th>Energy Consumption</th>
<th>Noise Emissions</th>
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<td>Melting</td>
<td>++</td>
<td>-</td>
<td>0</td>
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<tr>
<td>Models TB/KB Side exhaust gas discharge</td>
<td>Melting +</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Models TBR/KBR Side exhaust gas discharge with recuperator</td>
<td>Melting +</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Models T/K Electrically heated with bath control</td>
<td>Melting +</td>
<td>0</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Models T/K Electrically heated without bath control</td>
<td>Melting +</td>
<td>0</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Modelle T../10 Electrically heated with bath control</td>
<td>Holding</td>
<td>-</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Models TC/KC Electrically heated via SiC rods</td>
<td>Melting +</td>
<td>+</td>
<td>+</td>
<td>0</td>
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</table>
The gas-fired or oil-heated tilting furnaces in the KB product lines provide for high melting performance, making them ideal for melting operations. The use of high-quality insulation materials results in very low energy consumption. The two-stage burner can be configured for either gas or oil operation. Designed with an exhaust vent over the crucible edge, these tilting furnaces achieve very high melting rates and optimum energy efficiency.

Models KB ../12 reach a max. furnace temperature of 1200 °C resulting in melting temperatures of up to 1050 °C. These tilting furnaces are mainly used for aluminum and Zinc alloys.

Models KB ../14 reach a max. furnace temperature of 1400 °C resulting in melting temperatures of up to 1250 °C. These tilting furnaces are mainly used for copper alloys in small foundries.

**Standard Design for all Tilting Furnaces**

- Two-stage output control: High load for melting operation, low load for holding operation with automatic switching between both modes
- Modern burner system with optimized flame guide: High efficiency provided by over-pressure operation to keep out entrained air
- Gas system consisting of pressure regulator, gas filter, manometer and solenoid valves
- Safe flame monitoring
- Burner technology with easy-to-service design, e.g. flame head can be removed from the rear when the burner is swung out
- Burner technology compliant with DIN 746, Part 2
- Designed for natural gas or liquid natural gas with 8.8 kWh/m³ - 25.9 kWh/m³
- Required min. gas pressure with full load: 50 mbar
- Operation with other fuels and/or with another gas input pressure possible
- High melting performance powered by high-performance burners and high-quality insulation
- Incl. crucible
- Electro-hydraulic tilting system with flame resistant HFC hydraulic fluid

**Tilting Furnaces KB**

Gas-Fired, for Melting and Holding
Melting furnace plant consisting of two tilting furnaces KB 360/12 with side exhaust gas discharge and one work platform

- Safe, uniform and precise pouring enabled by the optimum pivot point of the furnace and the manual operation of the slider valve
- Multi-layered insulation with lightweight refractory bricks
- Exhaust gas discharge over the crucible edge see page 6 - 7
- Emergency outlet for safe discharge of the melt in case of a crucible break
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Over-temperature limiter for the furnace chamber with automatic reset to protect against over-temperature. 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.
- Furnace chamber control with temperature measurement behind the crucible, recommended when using as pre-melt furnace
- Information about temperature control see page 27 - 29
- Defined application within the constraints of the operating instructions

Standard Design for Tilting Furnaces KB ..../14
- Insulation with an additional wear-and-tear layer made of copper-resistant refractory concrete

Additional Equipment for all Tilting Furnaces
- Work platform or platform for easier charging
- Collecting pan under the emergency outlet see page 26
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 27
- Information on other accessories see page 25 - 26
### Additional Equipment for Tilting Furnaces KB ..../12

- Side exhaust gas discharge see pages 6 - 7
- Swing lid (only when equipped with side exhaust gas discharge)
- Crucible breakage monitoring with optical and acoustic signal
- Insulated connecting piece (exhaust flue) for side-wall exhaust gas vent to a connected customer suction system
- SMS-alarm message to one or more mobile phones, e.g. in case of crucible breakage
- Bath control system (only when equipped with side exhaust gas discharge) see page 28
  - Furnace control via the bath temperature
  - Thermocouples in the furnace chamber and the melt
  - Improved melt quality ensured by a reduction in temperature overshoots
  - Integrated safety controller system that, in case of bath thermocouple breakage, continues to operate the furnace at a reduced output to prevent the melt from solidifying

### Model Specifications

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<th>Model</th>
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<th>Tmax melt bath °C</th>
<th>Crucible</th>
<th>Capacity</th>
<th>Burner output kW</th>
<th>Melting performance kWh/kg</th>
<th>Consumption Melting kWh/kg</th>
<th>Holding Consumption kWh/h</th>
<th>Outer dimensions in mm</th>
<th>Weight in kg</th>
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<tr>
<td>KB 80/12</td>
<td>1200 1050</td>
<td>TP 287 180 550</td>
<td>300</td>
<td>2201 1.3 - 1.5</td>
<td>10 2730 1530 1680 2100</td>
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<td>KB 150/12</td>
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<td>300</td>
<td>2401 1.0 - 1.3</td>
<td>11 2830 1630 1860 2500</td>
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<td>1200 1050</td>
<td>TP 412 H 370 1200</td>
<td>300</td>
<td>2601 1.0 - 1.3</td>
<td>13 2830 1630 1980 2800</td>
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<td>1200 1050</td>
<td>TBN 800 750 - 450</td>
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<td>1200 1050</td>
<td>TBN 1100 1000 - 450</td>
<td>4501 1.0 - 1.3</td>
<td>19 3170 1890 2150 3600</td>
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<td>1400 1250</td>
<td>R 400/TP 982 120 400</td>
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<tr>
<td>KB 60/14</td>
<td>1400 1250</td>
<td>R 500 150 500</td>
<td>400 - 3601 1.0 - 1.3</td>
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<tr>
<td>KB 80/14</td>
<td>1400 1250</td>
<td>R 600 180 600</td>
<td>400 - 3801 1.0 - 1.3</td>
<td>25 2140 1440 2110 2650</td>
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1\(^{\text{At 700 °C}}\)
2\(^{\text{At 1000 °C}}\)
3\(^{\text{The stated melting performances are maximum values. Daily operation comes up to roughly 80%}}\)
4\(^{\text{External dimensions vary when furnace is equipped with additional equipment. Dimensions on request}}\)
5\(^{\text{Incl. burner}}\)

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Tilting furnace KB 150/12 in production
Tilting Furnaces KBR with Recuperative Burner
Gas-Fired, for Melting and Holding of Aluminum

The fuel-heated tilting furnaces with the side exhaust gas discharge provide for optimum energy utilization combined with highest quality melt. Fitted with a burner system including heat-recovery system using a recuperative burner, the energy efficiency of fuel-heated tilting furnaces is significantly improved.

Depending on utilization the exhaust gases from the crucible furnace are guided through a heat exchanger in order to preheat the combustion air for the burner. The system provides for energy savings of up to 25 % compared to conventional fuel-heated tilting furnaces with side exhaust gas discharge. The higher purchase costs are amortized within a short time.

The KBR series is recommended when both high melt quality requirements and high energy efficiency are required, and the speed of the melting process is of secondary interest. If the fastest possible melting rate is important for the process and a particularly high quality of the melt is of secondary importance, a conventional tilting furnace KB with exhaust ducting over the edge of the crucible (see page 8) is recommended.

Technical Design as Models KB (See Page 8) but with the Following Features
- Heat exchanger in the exhaust gas duct to preheat the combustion air for the burners
- Energy savings of up to 25 % in comparison to other fuel-heated melting furnaces featuring side-wall exhaust gas vents
- Side exhaust gas discharge
  - Low burn-off provides for high quality melt
  - Low hydrogen absorption by the melt
  - Low heat exposure for the operator in the area above the crucible
- Max. furnace temperature of 1 100 °C for melt bath temperatures up to 950 °C
- Required minimum gas pressure at full load: 80 mbar

<table>
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<th>Model</th>
<th>Tmax furnace</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity kg Al</th>
<th>Burner output kW</th>
<th>Melting performance2 kg/h Al1</th>
<th>Consumption Melting kWh/kg Al</th>
<th>Consumption Holding kWh/h</th>
<th>Outer dimensions2 in mm</th>
<th>Weight in kg</th>
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<td>KBR 240/11</td>
<td>1100 °C</td>
<td>950 °C</td>
<td>TP 587</td>
<td>570</td>
<td>390</td>
<td>320</td>
<td>1,1 - 1,4</td>
<td>13</td>
<td>2580</td>
<td>2300</td>
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<td>KBR 360/11</td>
<td>1100 °C</td>
<td>950 °C</td>
<td>TBN 800</td>
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<td>450</td>
<td>340</td>
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<td>1100 °C</td>
<td>950 °C</td>
<td>TBN 1100</td>
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<td>450</td>
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<td>16</td>
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</table>

1At 700 °C
2The stated melting performances are maximum values. Daily operation comes up to roughly 80 %.
3External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

*incl. burner
The electrically heated tilting furnaces are characterized by high melting performance with very temperature uniformity in the melt. Aluminum and brass can be melted in the 1200 °C version. The 1300 °C version can also be used to melt bronze alloys.

- K../12 with Tmax of 1200 °C also suitable for aluminum or brass, with a maximum melt bath temperature, depending on the condition of the crucible, of 1050 °C
- K../13 with Tmax of 1300 °C also suitable for bronze alloys or brass, with a maximum melt bath temperature of 1150 °C
- Heating from three sides using electric heating elements, radiating freely on support tubes, simple exchange of individual heating elements
- Multi-step wiring of the heating elements for furnaces with more than 50 kW electrical rating
- Heating of furnaces up to 60 kW power rating controlled using long-lasting, noiseless solid-state-relays
- Heating of furnaces beyond 60 kW with contactors
- High melting performance with temperature uniformity in the melt
- Insulation constructed in multiple layers with lightweight refractory bricks on the hot face
- Incl. crucible
- Electro-hydraulic tilting system with flame resistant HFC hydraulic fluid
- Safe, even, and precise pouring thanks to optimum pivot point in the furnace and manual throttling valve operation
- Emergency outlet for safe draining of the melt in case of crucible breakage
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- No exhaust gas discharge needed
- Integrated safety system which continues to operate the furnace at reduced power in case of malfunction in the bath thermocouple, in order to prevent the freezing of the melt
- Over-temperature limiter in furnace chamber for protection against overheating. The limiter switches the heating off when the set limit temperature is reached, and only switches it back on after the temperature has fallen again
- Furnace chamber control with temperature measurement behind the crucible, recommended for melting
- Information on temperature regulation see page 27 - 29
- Defined application within the constraints of the operating instructions
### Additional equipment

- Work platform for easy charging
- Collecting pan under the emergency outlet see page 26
- Crucible breakage monitor with visual and audible signal (only for models K../12)
- SMS-message to one or more mobile phones in case of crucible breakage. One or more furnaces can be connected to the messaging device in parallel
- Bath control with thermocouples in the furnace chamber and in the melt. The furnace temperature is controlled through the melt. Temperature overshoots are reduced, thus the quality of the melt is improved
- Heating system operated through thyristors in phase-angle mode provides for even load on the heating elements and results in longer service life
- Multi-step switching of the furnace heat (see page 27). In holding mode, a switch or the controller is used to turn off one heating section in order to reduce the electrical rating
- Higher electrical ratings to increase melting performance
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 27
- For information on other accessories see page 25 - 26

---

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Crucible</th>
<th>Capacity</th>
<th>Heating power</th>
<th>Melting performance</th>
<th>Consumption</th>
<th>Outer dimensions mm</th>
<th>Weight kg</th>
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<td>1050</td>
<td>A 70</td>
<td>20/70</td>
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<td>3/7</td>
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<td>1050</td>
<td>A 150</td>
<td>45/150</td>
<td>20</td>
<td>42/63</td>
<td>3/7</td>
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<td>3/7</td>
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<td>TP 287</td>
<td>180/550</td>
<td>50</td>
<td>126/190</td>
<td>4/10</td>
<td>2050</td>
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<td>60</td>
<td>147/220</td>
<td>5/12</td>
<td>2120</td>
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<td>1200</td>
<td>1050</td>
<td>TP 412H</td>
<td>370/1200</td>
<td>60</td>
<td>160/240</td>
<td>5/12</td>
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<td>5/17</td>
<td>2260</td>
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<td>1050</td>
<td>TP 587H</td>
<td>650</td>
<td>80</td>
<td>210</td>
<td>9/18</td>
<td>2370</td>
<td>1810</td>
</tr>
<tr>
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<td>1050</td>
<td>BUK 800</td>
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<td>BUK 1100</td>
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<td>126</td>
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<td>12/22</td>
<td>2370</td>
<td>2100</td>
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<tr>
<td>K 10/13</td>
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<td>1150</td>
<td>A 70</td>
<td>20/70</td>
<td>16</td>
<td>32/47</td>
<td>5/8</td>
<td>1890</td>
<td>1240</td>
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<td>1300</td>
<td>1150</td>
<td>A 150</td>
<td>45/150</td>
<td>20</td>
<td>42/63</td>
<td>5/8</td>
<td>1890</td>
<td>1400</td>
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<tr>
<td>K 40/13</td>
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<td>1150</td>
<td>A 300</td>
<td>90/300</td>
<td>26</td>
<td>58/84</td>
<td>5/8</td>
<td>2000</td>
<td>1450</td>
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<tr>
<td>K 80/13</td>
<td>1300</td>
<td>1150</td>
<td>TP 287</td>
<td>180/550</td>
<td>50</td>
<td>126/190</td>
<td>6/11</td>
<td>2050</td>
<td>1520</td>
</tr>
</tbody>
</table>

1 At 700 °C
2 At 1000 °C
3 The specified melting performances are maximum values. In practice, approx. 80 % are achieved.
4 Depending on furnace design connected load might be higher
5 External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
Bale-Out Furnaces TB
Gas-Fired, for Melting and Holding

The gas-fired or oil-heated bale-out furnaces of the TB product lines provide for high melting performance. The use of modern burner systems, optimized pressures and flame guide in the furnace as well as the processing of high-quality insulation materials result in very low energy consumption.

The TB../12 reach a max. furnace chamber temperature of 1200 °C resulting in melting temperatures up to 1050 °C. These bale-out furnaces are mainly used for melting and holding of aluminum and zinc alloys, for example in die-cast foundries. The side exhaust gas discharge provides for a high quality melt.

The TB../14 models reach a max. furnace chamber temperature of 1400 °C resulting in max. melting temperatures of up to 1250 °C. These bale-out furnaces are mostly used for melting copper alloys in small foundries. This is why these bale-out furnaces are standardly equipped with an exhaust gas vent over the crucible edge for high melting rates. Models TB 10/14 and TB 20/14 are standardly equipped with a collar plate that can be swung aside for crucible pulling.

Standard Design for all Bale-Out Furnaces
- Two-stage output control: High load for melting operation, low load for holding operation with automatic switching between both modes
- Modern burner system with optimized flame guide: High efficiency provided by over-pressure operation to keep out entrained air
- Gas system consisting of pressure regulator, gas filter, manometer and solenoid valves
- Safe flame monitoring
- Burner technology with easy-to-service design, e.g. flame head can be removed from the rear when the burner is swung out
- Burner technology compliant with DIN 746, Part 2
- Designed for natural gas or liquid natural gas with 8.8 kWh/m³ - 25.9 kWh/m³
- Required min. gas pressure with full load: 50 mbar
- Operation with other fuels and/or with another gas input pressure possible
- High melting performance powered by high-performance burners and high-quality insulation
- Multi-layered insulation with lightweight refractory bricks
- Emergency outlet for safe discharge of the melt in case of a crucible break
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Over-temperature limiter for the furnace chamber with automatic reset to protect against over-temperature. 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.
- Furnace chamber control with temperature measurement behind the crucible, recommended when using as pre-melt furnace
- Information about temperature control see page 27 - 29
- Defined application within the constraints of the operating instructions
Standard Design for Bale-Out Furnaces TB ../12
- Side exhaust gas discharge see pages 6 - 7
- Swing lid

Standard Design for Bale-Out Furnaces TB ../14
- Insulation with an additional wear-and-tear layer made of copper-resistant refractory concrete
- Exhaust gas discharge over the crucible edge see page 6 - 7
- Swinging collar plate for crucible pulling for bale-out furnaces to TB 10/14 - TB 20/14 (not possible for larger models)

Additional Equipment for All Bale-Out Furnaces
- Work platform or platform for easier charging
- Collecting pan under the emergency outlet see page 26
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 27
- Information on other accessories see page 25 - 26

Additional Equipment for Bale-Out Furnaces TB ../12
- Crucible breakage monitoring with optical and acoustic signal
- SMS-alarm message to one or more mobile phones, e.g. in case of crucible breakage
- Equipped with recuperator technology see page 16
- Bath control system see page 28

- Furnace control via the bath temperature
- Thermocouples in the furnace chamber and the melt
- Improved melt quality ensured by a reduction in temperature overshoots
- Integrated safety controller system that, in case of bath thermocouple breakage, continues to operate the furnace at a reduced output to prevent the melt from solidifying

Table: Bale-out furnace TB 20/14 for bronze melting with side exhaust gas discharge and swiveling collar plate for crucible pulling

Bale-out furnace TB 20/14 in a pit with exhaust gas discharge over the crucible rim and swiveling collar plate for crucible pulling

**Additional Equipment for Bale-Out Furnaces TB ../12**

- Furnace control via the bath temperature
- Thermocouples in the furnace chamber and the melt
- Improved melt quality ensured by a reduction in temperature overshoots
- Integrated safety controller system that, in case of bath thermocouple breakage, continues to operate the furnace at a reduced output to prevent the melt from solidifying

**Additional Equipment for Bale-Out Furnaces TB ../14**
- Furnace control via the bath temperature
- Work platform or platform for easier charging
- Collecting pan under the emergency outlet see page 26
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 27
- Information on other accessories see page 25 - 26

**Model | Tmorfurnace | Tmaxmelt bath | Crucible | Capacity | Burner output | Melting performance | Consumption melting energy kwh/kg | Consumption holding energy kWh/h | Outer dimensions | Weight in kg**

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Crucible</th>
<th>Capacity</th>
<th>Burner output kW</th>
<th>Melting performance kWh/kg</th>
<th>Consumption melting energy kWh/kg</th>
<th>Consumption Holding energy kWh/h</th>
<th>Outer dimensions mm</th>
<th>Weight kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB 80/12</td>
<td>1200</td>
<td>1050</td>
<td>BU 200</td>
<td>200</td>
<td>650</td>
<td>180</td>
<td>140 kWh/kg</td>
<td>1.3 kWh/kg</td>
<td>10</td>
<td>1200</td>
</tr>
<tr>
<td>TB 100/12</td>
<td>1200</td>
<td>1050</td>
<td>BU 250</td>
<td>200</td>
<td>650</td>
<td>140 kWh/kg</td>
<td>1.3 kWh/kg</td>
<td>11</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>TB 110/12</td>
<td>1200</td>
<td>1050</td>
<td>BU 300</td>
<td>300</td>
<td>1000</td>
<td>210</td>
<td>150 kWh/kg</td>
<td>1.3 kWh/kg</td>
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<td>1310</td>
</tr>
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<td>BU 350</td>
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<td>1150</td>
<td>300</td>
<td>220 kWh/kg</td>
<td>1.3 kWh/kg</td>
<td>15</td>
<td>1310</td>
</tr>
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<td>1050</td>
<td>BU 500</td>
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<td>300</td>
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<td>1050</td>
<td>BU 800</td>
<td>800</td>
<td>-</td>
<td>400</td>
<td>350 kWh/kg</td>
<td>1.3 kWh/kg</td>
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<td>1050</td>
<td>BU 900</td>
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<td>350 kWh/kg</td>
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<td>BU 1400</td>
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<td>440 kWh/kg</td>
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<td>1250</td>
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<td>A 150</td>
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<td>100 kWh/kg</td>
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<td>1080</td>
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<td>320</td>
<td>320 kWh/kg</td>
<td>1.0 kWh/kg</td>
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<td>1260</td>
</tr>
</tbody>
</table>

1At 700 °C

2At 1000 °C

3The stated melting performances are maximum values. Daily operation comes up to roughly 80 %.

4External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
Bale-Out Furnaces TBR with Recuperative Burner
Gas-Fired, for Melting and Holding

The fuel-heated crucible furnaces in the TBR product line fitted with the side exhaust gas discharge provide for optimum energy utilization combined with highest quality melt. Fitted with a burner system including heat-recovery system using a recuperative burner, the energy efficiency of ordinary fuel-heated melting furnaces is significantly improved.

Depending on utilization the hot exhaust gases from the crucible furnace are guided through a heat exchanger in order to preheat the combustion air for the burner. The system provides for energy savings of up to 25 % compared to ordinary fuel-heated furnaces with side exhaust gas discharge. The higher purchase costs are amortized within a short time.

- Tmax 1 100 °C for aluminum and zinc alloys
- Two-stage output control: High load for melting operation, low load for holding operation with automatic switching between both modes
- Modern burner system with optimized flame guide: High efficiency provided by over-pressure operation to keep out entrained air
- Heat exchanger in the exhaust gas duct to preheat the combustion air for the burners
- Energy savings of up to 25 % in comparison to other fuel-heated melting furnaces featuring side-wall exhaust gas vents
- Gas system consisting of pressure regulator, gas filter, manometer and solenoid valves
- Safe flame monitoring
- Burner technology with easy-to-service design, compliant with DIN 746, Part 2
- Designed for natural gas or liquid natural gas with 8.8 kWh/m³ - 25.9 kWh/m³
- Required min. gas pressure with full load: 70 mbar
- Operation with other fuels and/or with another gas input pressure possible
- High melting performance powered by high-performance burners and high-quality insulation
- Multi-layered insulation with lightweight refractory bricks provide the furnace chamber lining

2 crucible furnaces TBR 100/11 in production
Emergency outlet for safe discharge of the melt in case of a crucible break
Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
Side exhaust gas discharge
- Low burn-off provides for high quality melt
- Low hydrogen absorption by the melt
- Low heat exposure for the operator in the area above the crucible
Over-temperature limiter for the furnace chamber with automatic reset to protect against over-temperature. 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.
Furnace chamber control with temperature measurement behind the crucible
Information about temperature control see page 27 - 29
Defined application within the constraints of the operating instructions

Additional equipment
- Crucible made of clay graphite or SiC with higher heat conductivity
- Information about exhaust venting see page 6 - 7
- Collecting pan under the emergency outlet see page 26
- Work platform or platform for easier charging
- Crucible break monitoring with optical and acoustic signal
- SMS-alarm message to one or more mobile phones, e.g. in case of crucible breakage
- Bath control system
  - Furnace control via the bath temperature
  - Thermocouples in the furnace chamber and the melt
  - Improved melt quality ensured by a reduction in temperature overshoots
  - Integrated safety controller system that, in case of bath thermocouple breakage, continues to operate the furnace at a reduced output to prevent the melt from solidifying
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 27
- Information on other accessories see page 25 - 26

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity</th>
<th>Burner output</th>
<th>Melting performance2</th>
<th>Consumption Melting</th>
<th>Consumption holding lid closed kWh/kg Al kWh/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBR 80/11</td>
<td>1100 °C</td>
<td>950 °C</td>
<td>BU 200</td>
<td>210 kg Al</td>
<td>650 kg Cu</td>
<td>180 kW</td>
<td>140 kg/h Al</td>
<td>1.0 - 1.1</td>
</tr>
<tr>
<td>TBR 100/11</td>
<td>1100 °C</td>
<td>950 °C</td>
<td>BU 250</td>
<td>250 kg Al</td>
<td>830 kg Cu</td>
<td>180 kW</td>
<td>150 kg/h Al</td>
<td>1.0 - 1.1</td>
</tr>
<tr>
<td>TBR 110/11</td>
<td>1100 °C</td>
<td>950 °C</td>
<td>BU 300</td>
<td>300 kg Al</td>
<td>1000 kg Cu</td>
<td>210 kW</td>
<td>220 kg/h Al</td>
<td>1.0 - 1.1</td>
</tr>
<tr>
<td>TBR 150/11</td>
<td>1100 °C</td>
<td>950 °C</td>
<td>BU 350</td>
<td>350 kg Al</td>
<td>1150 kg Cu</td>
<td>240 kW</td>
<td>270 kg/h Al</td>
<td>1.0 - 1.1</td>
</tr>
<tr>
<td>TBR 180/11</td>
<td>1100 °C</td>
<td>950 °C</td>
<td>BU 500</td>
<td>500 kg Al</td>
<td>1650 kg Cu</td>
<td>300 kW</td>
<td>330 kg/h Al</td>
<td>1.0 - 1.1</td>
</tr>
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<td>TBR 240/11</td>
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<td>950 °C</td>
<td>BU 600</td>
<td>600 kg Al</td>
<td>2000 kg Cu</td>
<td>320 kW</td>
<td>330 kg/h Al</td>
<td>1.0 - 1.1</td>
</tr>
<tr>
<td>TBR 360/11</td>
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<td>950 °C</td>
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<td>320 kg Cu</td>
<td>350 kW</td>
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</table>

1At 700 °C
2The stated melting performances are maximum values. Daily operation comes up to roughly 80 %.
Due to their high-grade insulation and optimized connected loads the bale-out furnaces can be used both for melting and holding. They feature good melting performance together with outstanding temperature uniformity in the melt. The 1100 °C version can be used for melting aluminum, the 1200 °C version for brass as well. The 1300 °C version can also be used for melting bronze alloys. The bale-out furnaces are fitted with multi-layer insulation.

- T 80/11 with Tmax of 1100 °C for aluminum or zinc, with a maximum melt bath temperature, depending on the condition of the crucible, of 950 °C
- T 80/12 with Tmax of 1200 °C also suitable for brass, with a maximum melt bath temperature, depending on the condition of the crucible, of 1050 °C
- T 80/13 with Tmax of 1300 °C, also suitable for bronze alloys, with a maximum melt bath temperature, depending on the condition of the crucible, of 1150 °C
- Four-side heating using electric heating elements, freely radiating on support tubes
- Simple replacement of individual heating elements. In case of crucible breakage, only the defective heating elements on each level need to be replaced
- Heating of furnaces up to 60 kW power rating controlled using long-lasting, noiseless solid-state-relays
- Heating of furnaces beyond 60 kW with contactors
- High melting performance with temperature uniformity in the melt
- Insulation constructed in multiple layers with lightweight refractory bricks on the hot face
- Emergency outlet for safe draining of the melt in case of crucible breakage
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- No exhaust gas discharge needed
- Integrated safety system which continues to operate the furnace at reduced power in case of malfunction in the bath thermocouple, in order to prevent the freezing of the melt
- Over-temperature limiter in furnace chamber for protection against overheating. The limiter switches the heating off when the set limit temperature is reached, and only switches it back on after the temperature has fallen again
- Furnace chamber control with temperature measurement behind the crucible, recommended for melting
- Crucible not included in the standard version
- For Information on temperature regulation see pages 27 - 29
- Defined application within the constraints of the operating instructions

Additional equipment
- Crucible of clay-graphite or SiC
- Work platform
- Collecting pan under the emergency outlet see page 26
- Crucible breakage monitor with visual and audible signal (not for 1300 °C models)
- SMS-alarm message to one or more mobile phones, e.g. in case of crucible breakage
<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity</th>
<th>Heating power</th>
<th>Melting performance(^3)</th>
<th>Consumption Holding</th>
<th>Outer dimensions(^5) in mm</th>
<th>Weight in kg</th>
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</table>

1°At 700 °C  
2The specified melting performances are maximum values. In practice, approx. 80 % are achieved.  
3Depending on furnace design connected load might be higher  
4External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
Tilting Furnace KC and Bale-Out Furnace TC
SiC-Rod-Heated, for Melting

The electrically heated tilting furnaces and bale-out furnaces of the KC and TC product lines are characterized by a higher melting performance than achievable with wire heated melting furnaces. These furnaces are designed for permanent operation at working temperatures.

- Tmax 1450 °C also suitable for bronze alloys, with a maximum melting of 1320 °C, depending on the crucible condition
- Heating from two sides by generously dimensioned SiC rods, temperature uniformity
- Simple exchange of individual heating elements
- Heat operation by thyistors in phase-angle mode with performance control: The resistance of the SiC rods changes with temperature and age. Performance control ensures constant power of heating irrespective to the condition of the heating elements.
- High melting performance with temperature uniformity
- Insulation constructed in multiple layers with lightweight refractory bricks on the hot face
- SiC-Crucible
- Electro-hydraulic tilting system with flame resistant HFC hydraulic fluid (KC models)
- Safe, even, and precise pouring thanks to optimum pivot point in the furnace and manual throttling valve operation (KC models)
- Emergency outlet for safe draining of the melt in case of crucible breakage
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- No exhaust gas discharge needed
- Over-temperature limiter in furnace chamber for protection against overheating. The limiter switches the heating off when the set limit temperature is reached, and only switches it back on after the temperature has fallen again
- Furnace chamber control with temperature measurement behind the crucible
For information on temperature regulation see page 27 - 29

Defined application within the constraints of the operating instructions

Additional equipment

- Work platform for simplified loading
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 27
- For information on other accessories see page 25 - 26

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Crucible</th>
<th>Capacity kg Al</th>
<th>Capacity kg Cu</th>
<th>Heating power in kW</th>
<th>Connected load in kW</th>
<th>Melting performance¹ kg/h Al</th>
<th>Melting performance¹ kg/h Cu</th>
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<th>Outer dimensions² in mm</th>
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¹At 700 °C
²At 1000 °C
³The specified melting performances are maximum values. In practice, approx. 80 % are achieved.
⁴Depending on furnace design connected load might be higher
⁵External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
**Bale-Out Furnaces T ../10**

**Electrically Heated, for Holding**

The perfect insulation and the reduced electric connected loads provide for perfect energy efficiency and make the bale-out furnaces T ../10 optimally suitable for holding operation. Due to the reduced connected load these bale-out furnaces are only suitable for melting to a limited extent. This is why they are mostly used in foundries with central pre-melting furnaces followed by transportation of the melt to the holding furnace.

- Tmax 1000 °C, ideally suited for the holding of aluminum
- Four-side heating using electric heating elements, freely radiating on support tubes
- Simple replacement of individual heating elements. In case of crucible breakage, only the defective heating elements on each level need to be replaced
- Heating of furnaces up to 60 kW power rating controlled using long-lasting, noiseless solid-state-relays
- Heating of furnaces beyond 60 kW with contactors
- Particularly good insulation constructed in multiple layers with lightweight refractory bricks on the hot face

Additional equipment, see T furnaces, page 18

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity</th>
<th>Heating power (W)</th>
<th>Consumption Holding (kWh/h)</th>
<th>Outer dimensions (cm)</th>
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1At 700 °C  
2External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

3Depending on furnace design connected load might be higher
**Transportable Bale-Out Furnaces TM**

Electrically Heated, for Holding Aluminum

The bale-out furnaces of the TM product lines were developed especially for use at different pouring locations. The cylindrical, very stable furnace housing, the very high-quality insulation and the meandering heating elements are the special features of this furnace family. The furnaces are designed to be transported by forklift truck and come with a plug-in connection to the control gear. With a forklift truck the furnace can be transported to the pre-melt furnace for filling. When additional switchgear and control boxes are used, the bale-out furnace can also be optionally used at different pouring locations.

- Tmax 1000 °C, ideal for holding of aluminum
- Cylindrical, highly stable furnace housing
- Damper slots under the furnace for safe forklift transportation of the furnace inside the foundry
- All-round heating provided by resistant meandering heating elements
- Switchgear and control box for plug-in connection
- Heating of furnaces up to 60 kW power rating controlled using long-lasting, noiseless solid-state-relays
- Insulation constructed in multiple layers with lightweight refractory bricks on the hot face
- Emergency outlet for safe discharge of the melt in case of a crucible break
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- No exhaust gas vent necessary
- Crucible in standard design not included
- Furnace chamber control with temperature measurement behind the crucible
- Over-temperature limiter in the furnace chamber to protect against over-temperature. The limit controller switches off the heating when the pre-set limit temperature setting has been reached and does not switch it on again until the temperature falls below the setting again.

For Information on temperature regulation see page 27 - 29

Defined application within the constraints of the operating instructions

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Additional equipment, see T furnaces, page 18

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### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax holding furnaces</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity</th>
<th>Heating power</th>
<th>Consumption Holding Lid closed/open kWh/h</th>
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<td>8/17 kW</td>
<td>1650 x 1730 x 1200</td>
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</table>

1At 700 °C  
2External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.  
3Depending on furnace design connected load might be higher
Bath Furnaces B
Electrically Heated, for Holding of Aluminum

The B 120 - B 500 bath furnaces (without crucibles) have been especially developed for stationary holding operation in die-cast foundries with removal of the melt by a bale-out robot. The tub of the bath furnaces is lined with special long-life brick. The multi-layered backing insulation is designed for lowest electric connected load. The furnace tub is divided into three interconnected chambers. The heating proceeds from the lid into the center chamber. The bale-out openings are dimensioned to enable the robot to be optimally used. In holding operation bath furnaces, when used properly, provide better energy efficiency than bale-out furnaces.

- Tmax 1000 °C, perfectly suited for holding of aluminum at about 720 °C
- Heating mounted in the lid, freely radiating from carrier tubes
- Particularly low energy consumption due to generously dimensioned, multi-layer insulation
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- High melt quality due to very low corundum formation on the surface
- Heating switched by solid-state-relays
- No exhaust gas discharge needed
- Temperature control with measurement in the melt and in the furnace chamber
- Plug for connection with separate switchgear cabinet
- For information on temperature control see page 27 - 29
- Useful only for holding, not for melting
- Defined application within the constraints of the operating instructions

Additional Equipment
- Adaptation to dosing pump
- Automated lid opening for ladling operation
- Ladle opening adapted to size of ladle

Bath Furnaces B
- Inlet opening for filling with liquid aluminum
- Melting thermocouple in the bath of the outlet opening
- Heating mounted in the lid, simple replacement of the heating elements

### Table: Bath Furnaces B Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Capacity kg Al</th>
<th>Heating power in kW²</th>
<th>Consumption Holding kW h/h</th>
<th>Bale-out opening mm</th>
<th>Outer dimensions in mm</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 120</td>
<td>1000</td>
<td>750</td>
<td>300</td>
<td>11</td>
<td>2</td>
<td>300 x 300</td>
<td>1900  1150  1160</td>
<td>1900</td>
</tr>
<tr>
<td>B 250</td>
<td>1000</td>
<td>750</td>
<td>600</td>
<td>14</td>
<td>3</td>
<td>380 x 380</td>
<td>2030  1280  1200</td>
<td>2450</td>
</tr>
<tr>
<td>B 500</td>
<td>1000</td>
<td>750</td>
<td>1200</td>
<td>20</td>
<td>5</td>
<td>430 x 430</td>
<td>2350  1450  1240</td>
<td>3700</td>
</tr>
</tbody>
</table>

¹Depending on furnace design connected load might be higher
²External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
Accessories for Bale-Out and Tilting Furnaces

Crucible Pulling Feature with Swinging Collar Plate
In standard version, Nabertherm crucible furnaces are built with a collar plate fixed to the furnace. The bale-out is done manually or by robot. As additional equipment, the smaller models up to T 40 can be equipped with a swinging collar plate which allows crucible pulling. To pull the crucible, the collar plate is swung to the side, so that the operator has free access to the crucible from above.

Pneumatic Lid Opener for Bale-Out Furnaces for Holding
The crucible furnaces of the T. product lines can be equipped with an optional pneumatic lid opener. The pneumatic lid opener is activated by depressing a foot pedal. Optionally, the pneumatic lid opener can be controlled and triggered by an external signal to fully automate the ladling process. The furnace lid swings to the side and the operator has free access to the crucible. This practical feature increases energy efficiency because the furnace is only open during charging and bale-out. Over 50% energy savings can be realized with the pneumatic lid opener vs. an always open furnace (see tables for energy consumption for each model of melting furnace, page 7).

Charging Funnel for Ingots
The charging funnel made of stainless steel 1.4301 (304) makes charging the furnace much easier, especially when melting ingots. Long ingots can also be charged extending over the crucible edge, and then sink, guided, into the crucible. Furnaces which are designed with a control system with night-time reduction can, for example, be filled in the evening and, on the following morning a complete melt is ready for use. The funnel is suitable for all melting furnaces, electrically heated or gas- with a side exhaust gas discharge.

Work Platform for Loading for Bale-Out and Tilting Furnaces
For bale-out and tilting furnaces, customized work platforms for charging and servicing can be provided as additional equipment. This feature is used to simplify access to the furnace, particularly for larger furnace models. The operator has access to the top of the furnace to charge ingots or clean the melt.
Crucible Breakage Alarm Device (up to $T(B).../12$)
Nabertherm melting furnaces are equipped with emergency outlet. In case of crucible breakage or leaking melt the crucible breakage alarm device will provide for a warning as soon as fluid metal emerges from the emergency outlet. The warning signal of the alarm is both optical, with a signal lamp, and acoustic, using a horn. As additional equipment it is possible to send an alarm as SMS-message to one or more mobile phones. One or more furnaces can be connected to the messaging device in parallel.

Collecting Pan under the Emergency Outlet
The bale-out furnaces are standardly equipped with an inclined bottom and an emergency outlet for liquid metal in case of a crucible breakage. To collect the liquid melt in case of an emergency the models T..., TB..., K... and KB... can be delivered with a small base frame and a collecting pan. The pan can safely receive full crucible volume and is equipped with a pull-out handle. Unnecessary foundation works can be avoided.

Filling Level Measurement by means of Optical Detection or Weight Loss
When crucible furnaces are used in continuous operation, it can be necessary to monitor the filling level of the crucible and provide for a signal when defined levels are reached. The signal can be either optical, acoustic, or a signal for automatic filling of the crucible. When the minimum level is reached, a signal to fill a crucible is given. On reaching the maximum level this process is stopped. The measurement of fill level can either be done by using a scale under the furnace or by using a measurement probe to detect the fill level and which records the data very precisely independent from external influences.

Separate Bath Temperature Measurement Device
For melting furnaces with only furnace chamber temperature control, a separate bath temperature measurement device can be used to check the bath temperature. The measurement device is suitable for a temperature range from 0 °C to 1300 °C, and can be delivered with different dip pipe lengths (200 mm, 380 mm, 610 mm). Temperature measurement is carried out using a NiCr-Ni thermocouple. The submersion length of the pipe should be 2/3 of the element length to achieve the most ideal reaction time. The average reaction time is 40 seconds. The thermocouple is suitable for all nonferrous metals except phosphor bronze.
Control and Documentation Alternatives for Melting Furnaces

Band Alarm under/over Temperature
A band alarm displays the working range for casting. If the temperature is within the range, a green signal lamp is lit and the melt can be processed. In this range, the controller additionally provides for a signal that the customer can evaluate. Example: Release for the foundry robot.

Manual Program Intervention
If the current program is to be prolonged and the controller should not go to the next segment (e.g. continuation of melting operation in case of overtime), a key switch can be used to change over from program operation to controller operation. The controller continues working with the previously set temperature until the switch is activated again in order to continue with the program.

Documentation with NTLog
For process documentation, the H500-controls can be equipped with NTLog. For detailed description see page 28 - 29.

Documentation with NCC
The H700-controls can be supplemented with the Nabertherm Control Center Software (NCC) including PC. The NCC-controls provide for a convenient documentation of the melting operation with the following documentation options:

- All relevant data, such as furnace temperature, melt bath temperature, messages, etc. are always saved as a file each day.
- The furnace is equipped with an additional start and stop button in a separate housing. When the button is pressed, the melt bath temperature is recorded separately and saved as a file. This enables customer charges to be analyzed and archived separately.
- The PC can also be used as a user interface with all the benefits of a computer.
- NCC AA (Aviation and Automotive) for applications according to CQI9, AMS or NADCAP.

Additional Equipment for All Electrically Heated Melting Furnaces

Multi-Step Switch for Reduction of Connected Rating
A multi-step switch switches off a part of the heating depending on the power of the corresponding furnace model. Generally, the furnace can be operated at full load for melting. If the furnace is only used in holding mode the connected rating of the furnace can be reduced by turning off a defined part of the heating capacity, resulting in a significant cost advantage. As an option, this function can be automatically switched depending on temperature.

Power Management for Reduction of the Electrical Connection Value
If several crucible furnaces are used the installation of an intelligent power management can be the right choice. Monitoring all furnaces the power management is continuously reconciling the switch-on times of the heating. This effectively prevents all furnaces from switching-on at the same time. The positive impact is that the total connected rating provided by the energy provider can be significantly reduced.

Switchgear Cooling with Fans or Air-Conditioning
The switchgear of our furnaces is designed for environment temperatures of up to 40 °C. To secure a failure-free and long lasting operation of the switchgear in case of higher temperatures they can be equipped with active fan cooling or even with an air-conditioner.
Furnace Control with Eurotherm 3208 or 3508 and Optional Weekly Timer

In the basic design, Nabertherm melting furnaces are equipped with Eurotherm 3208 or 3508 controllers. The temperature is measured inside the furnace behind the crucible. Two setpoints and one heating ramp can be set. For example, the setpoints could be the working temperature and the lower temperature for night setback. A digital weekly timer can also be used as an accessory which automatically switches between the two temperatures and the on/off function of the furnace. The switching times can be chosen for each working day.

Melt Bath Control (cascade control) via PLC and H500 or H700 Touch Panel for BaleOut and Tilting Furnaces

In the basic design, the bale out and tilting furnaces are controlled with a thermocouple inside the furnace chamber behind the crucible. For fast heat-up times, the operator usually sets a temperature that is higher than the desired melt bath temperature. This control enables fast heating times but also results in temperature overshoots in the melt due to the indirect temperature measurement.

As in option the bale out and tilting furnaces can be equipped with a melt bath control. In addition to the furnace thermocouple, the temperature is also measured with a thermocouple in the melt. Both temperatures are permanently reconciled to achieve the exact melt bath temperature. If the melt bath thermocouple fails, the system automatically switches over to furnace control. This control considerably improves the quality of the melt because overshoots are effectively prevented. This type of temperature control is especially recommended for holding in order to control the melt bath temperature as precisely as possible. It is also the best choice for a quick and automatic melting process without any need for the operator to intervene in the temperature control during melting.

As an alternative to a thermocouple in the melt, a thermocouple in a pocket inside the crucible wall can also be used (special crucible with pocket required) which measures the temperature of the crucible wall. This indirect measurement is not as precise as measuring directly in the melt and automatic melting is slightly slower. However, the thermocouple is in a more protected position. This simplifies charging of the crucible and increases the thermocouple life time.

**Controller Type**

<table>
<thead>
<tr>
<th>Functions</th>
<th>Eurotherm 3208</th>
<th>Eurotherm 3508</th>
<th>H500</th>
<th>H700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available for furnace type</td>
<td>TM/T/K</td>
<td>TB/TBR/KB/KBR</td>
<td>TC/KC</td>
<td>TC/TM/T/K/KC</td>
</tr>
<tr>
<td>Furnace control</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Melt bath control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly timer</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Bridging the melt bath controller</td>
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<td></td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Preparation program with 20 segments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation program with a ramp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection to an overriding system</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation with reduced power</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating hour counter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documentation with NTLog</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Documentation with NCC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual intervention in the program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Standard
- Option
The melt bath is controlled via the H500 PLC-controls (electrically heated furnaces) with a 4 inch (optional 7 inch) touch panel and 4 operating buttons or the H700-controls (gas fired furnaces) with a 7 inch touch panel. It combines simple operation, precise control, and extensive user options. Presentation and program entry are done directly by a very simple to operate touch panel. The functions are displayed in plain text.

- Operation with furnace chamber control or melt bath control alternatively with cascade
- Display on a graphic color screen with overview of all temperatures
- Very easy data entry directly on the operating screen (touch panel)
- Weekly timer for changing temperatures, entries in real time
- A program with 12 segments can be set for each weekday
- Separate, freely programmable preparation program, password protected, e.g. to dry the crucible
- Band alarm with over and/or under temperature monitoring
- Operating hour counter
- Integrated safety system that continues furnace operation at reduced power in case of a fractured melt bath thermocouple to prevent the melt from solidifying
- Trend display of the furnace temperatures in the past 72 hours
- Language choice

Furnaces already in use can be retrofitted with a melt bath controller.

**Bridging the Melt Bath Controls to Increase Melting Performance and Reduce Melting Times**

If a completely empty crucible is to be refilled, the values measured by the melt bath thermocouple do not correspond to the actual temperature of the cold metals because the charge is not yet melted. A pushbutton is used to temporarily specify a higher furnace temperature than the program would adjust. The operator selects the desired time (max. 120 minutes) and the furnace temperature. When the time has expired, the controller automatically switches back to melt bath control.

**Operation with Reduced Power**

Operation with reduced power can be used to temporarily reduce the connected load of the furnace when the working temperature is reached. If reduced power is activated and the temperature in the furnace is within or above the set temperature band, part of the heating is switched off to operate the furnace with reduced power.
Melting Furnaces in Customized Dimensions

Tilting Furnaces with Electrohydraulic Lifting Platforms

Depending on the material flow and space requirements in a foundry, the charging height and pouring height may need to be different for a tilting furnace. For instance, if loading is performed at ground level and the metal is poured into a machine at a higher level, then an optional electro-hydraulic lifting platform can adjust for the difference. The operation of the lifting platform is by means of a 2 hand operation with a manual throttling valve. It can also be interlocked with other machinery and be motor driven operated.

Melting Furnaces for Heavy Metals

Our melting furnaces in the K and T product lines can be upgraded with adapted electrical heating for melting of heavy metals like lead and zinc. The melting furnace is equipped with a special crucible, in most cases a steel crucible. The melting power is tailored to the type of metal to ensure optimum utilization of the melting furnace.

Tilting furnace K 240/12 with lifting platform for charging and pouring at different levels

Steel crucible with special suspension brackets for high charge weight
Rotary Table System for Continuous Pouring

For continuous processes, multiple crucible furnaces can be combined on a rotary table system. For example, when using three furnaces with a rotation in 120° steps, loading takes place at the first space, de-gassing at the second space, and bale-out at the third. This ensures a continuous supply of liquid metal at the pouring location. The rotary table is designed with an emergency drain below in case of crucible breakage.

Magnesium Melting Furnaces

For a variety of projects, Nabertherm has supplied melting furnaces to be upgraded by the customer for the melting of magnesium. Nabertherm supplied the furnace with all necessary control systems and the steel crucible. The furnaces were completed by the customer with the safety devices, pump systems for bale-out, and gas supply systems. We are capable of implementing furnace systems to provide for a crucible volume of 1500 liters of magnesium.
Laboratory Melting Furnaces

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 melting furnaces are available for furnace chamber temperatures of 1000, 1300, or 1500 °C. This corresponds to melt temperatures of about 80 °C - 110 °C lower.

- Tmax 1000 °C, 1300 °C, or 1500 °C
- Crucible sizes of 0.75, 1.5 or 3 liters
- Crucible with integrated pouring spout of iso-graphite included with delivery
- Additional spout (not for KC), mounted at the furnace for exact pouring
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Compact bench-top design, simple emptying of crucible by tilting system with gas damper
- Crucible for heating up of melting furnace insulated with a hinged lid, lid opened when pouring
- Defined application within the constraints of the operating instructions
- Controls description see page 78

Additional equipment
- Other crucible types available, e.g. steel
- Design as bale-out furnace without tilting device, e.g. for lead melting
- Over-temperature limiter 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 furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Crucible</th>
<th>Volume in l</th>
<th>Outer dimensions* in mm</th>
<th>Heating power in kW</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>1000</td>
<td>850</td>
<td>A 6</td>
<td>0.75</td>
<td>520 680 660</td>
<td>3.0</td>
<td>85</td>
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<td>K</td>
<td>2/10</td>
<td>1000</td>
<td>A10</td>
<td>1.50</td>
<td>520 680 660</td>
<td>3.0</td>
<td>90</td>
</tr>
<tr>
<td>K</td>
<td>4/10</td>
<td>1000</td>
<td>A25</td>
<td>3.00</td>
<td>570 755 705</td>
<td>3.6</td>
<td>110</td>
</tr>
<tr>
<td>K</td>
<td>1/13'</td>
<td>1300</td>
<td>A 6</td>
<td>0.75</td>
<td>520 680 660</td>
<td>3.0</td>
<td>120</td>
</tr>
<tr>
<td>K</td>
<td>2/13'</td>
<td>1300</td>
<td>A10</td>
<td>1.50</td>
<td>520 680 660</td>
<td>3.0</td>
<td>125</td>
</tr>
<tr>
<td>K</td>
<td>4/13'</td>
<td>1300</td>
<td>A25</td>
<td>3.00</td>
<td>570 755 705</td>
<td>5.5</td>
<td>170</td>
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<tr>
<td>KC</td>
<td>1/15²</td>
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<td>A6</td>
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<td>580 630 580</td>
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<td>170</td>
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<tr>
<td>KC</td>
<td>2/15²</td>
<td>1500</td>
<td>A10</td>
<td>1.50</td>
<td>580 630 580</td>
<td>10.5</td>
<td>170</td>
</tr>
</tbody>
</table>

*Outer dimensions of furnace, transformer in separate housing (500 x 570 x 300 mm)
+Switchgear and controller mounted in a floor standing cabinet

Depending on furnace design, connected load might be higher.

External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
Cleaning Furnace for Riser Tubes
Electrically Heated

Riser tubes for low-pressure melting furnaces must be cleaned in regular intervals. To remove deposits the pipe must be removed from the furnace and heated. In comparison to applying an open flame to heat the pipe, the SRO 170/1000/11 furnace offers the advantages of very uniform tube heating. The quality of the heat treatment is clearly better and the lifetime of the risers can be extended when cleaned regularly. The heated rising tube can be removed from the furnace hot and returned to the low-pressure melting furnace.

The furnace is charged from above using a crane provided by the customer. Located in the lower section of the furnace is a steel catch drawer which is filled with sand or sizing compound. The rising tube hangs in the receptacle with a crane eye and the deposits drip into the drawer. Designed as a drawer, it can be easily pulled out, emptied and filled again.

- Tmax. 1100 °C
- Charging opening with collar plate and swing lid on the furnace. Charging of the rising tube using the customer crane
- Max. dimensions of the rising tube: L: 1000 mm, outer dimension 90 mm with single-side flange with an outer diameter of 115 mm
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Heated length: 1000 mm
- Charge receptacle with crane eye for holding smaller risers
- Steel catch draw, filled by the customer with sand, which collects deposits
- Steel collector designed as a drawer
- Furnace on rollers
- Switchgear and control equipment fastened directly to the furnace
- Defined application within the constraints of the operating instructions
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Controls description see page 78

Additional equipment
- Design for other riser dimensions on request
- Switchgear on rollers
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78

<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>Heating power in kW</th>
<th>Electrical connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRO 170/1000/11</td>
<td>1100</td>
<td>590 640 1700</td>
<td>90 1000</td>
<td>12,0</td>
<td>3-phase</td>
<td></td>
</tr>
</tbody>
</table>

1 Depending on furnace design connected load might be higher.
*Please see page 79 for more information about supply voltage.
2 External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
Chamber Ovens
Electrically Heated or Gas-Fired

The chamber ovens of the KTR range can be used for complex drying processes and heat treatment of charges to an application temperature of 260 °C. The high-performance air circulation enables optimum temperature uniformity throughout the work space. A wide range of accessories allow the chamber ovens to be modified to meet specific process requirements. The design for the heat treatment of flammable materials in conformance with EN 1539 (NFPA 86) is available for all sizes.

- Tmax 260 °C
- Electrically heated (via a heating register with integrated chrome steel heating elements) or gas-fired (direct or indirect gas-fired including injection of the hot air into the intake duct)
- Temperature uniformity up to +/- 3 °C according to DIN 17052-1 (for design without track cutouts) see page 74
- High-quality mineral wool insulation provides for outer temperatures of < 25 °C above room temperature
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- High air exchange for fast drying processes
- Double-wing door for furnaces KTR 3100 and larger

Chamber oven KTR 1500
Chamber oven KTR 4500
Chamber oven KTR 6125
Chamber oven KTR 1500 with charging cart

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Over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Incl. floor insulation
- Defined application within the constraints of the operating instructions
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Controls description see page 78

Additional equipment
- Track cutouts for level drive-in of charging cart
- Base frame to charge the oven via a charging forklift
- Additional door in the back for charging from both sides or to use the oven as lock between two rooms
- Fan system for faster cooling with manual or motor-driven control of the exhaust flaps
- Programmed opening and closing of exhaust air flaps
- Air circulation with speed control, recommendable for processes with light or sensitive charge
- Observation window and furnace chamber lighting
- Safety technology according to EN 1539 (NFPA 86) (models KTR .. LS) for charges containing solvents see page 55
- Charging cart with or without rack system
- Design for clean room heat treatment processes
- Rotating systems for tempering processes
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78
Chamber Ovens
Electrically Heated or Gas-Fired

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm²</th>
<th>Heating power in kW⁠¹</th>
<th>Electrical connection¹</th>
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<tbody>
<tr>
<td>KTR 1000 (LS)</td>
<td>260</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>18/10 request</td>
<td>3-phase</td>
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<td>18/13 request</td>
<td>3-phase</td>
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<td>KTR 3100 (LS)</td>
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<td>1250</td>
<td>2000</td>
<td>25/15 request</td>
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<tr>
<td>KTR 4500 (LS)</td>
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</table>

¹Depending on furnace design connected load might be higher
²External dimensions vary when furnace is equipped with additional equipment. Dimensions on request. Outer dimensions from chamber ovens KTR .. LS are different

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

All KTR-models are also available with Tmax 300 °C.
To ensure safe operation of the oven when tempering silicone, the fresh air supply of the oven must be monitored. A fresh air volume flow of 100 - 120 l/min/kg silicone (6-7.2 m³/h/kg silicone) has to be considered. The graph shows the maximum amount of silicone depending on the operating temperature for various KTR models at a fresh air supply of 120 l/min/kg silicone. The oven will be carried out in accordance with the requirements of the standard EN 1539 (NFPA 86).
Forced Convection Chamber Furnaces < 675 Liters
Electrically Heated

The very good temperature uniformity of these chamber furnaces with air circulation provides for ideal process conditions for annealing, curing, solution annealing, artificial ageing, preheating, or soft annealing and brazing. The forced convection chamber furnaces are equipped with a suitable annealing box for soft annealing of copper or tempering of titanium, and also for annealing of steel under non-flammable protective or reaction gases. The modular forced convection chamber furnace design allows for adaptation to specific process requirements with appropriate accessories.

- Tmax 450 °C, 650 °C, or 850 °C
- Stainless steel air-baffles in the furnace for optimum air circulation
- Swing door hinged on the right side
- Base frame included in the delivery, NA 15/65 designed as table-top model
- Horizontal air circulation
- Temperature uniformity up to +/- 4 °C according to DIN 17052-1 (model NA 15/65 up to +/- 5 °C) see page 74
- Optimum air distribution enabled by high flow speeds
- One frame sheet and rails for two additional trays included in the scope of delivery (NA 15/65 without frame sheet)
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Defined application within the constraints of the operating instructions
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Controls description see page 78

Additional equipment (not for model NA 15/65)
- Optimization of the temperature uniformity up to +/- 3 °C according to DIN 17052-1 see page 74
- Air inlet and exhaust air flaps when used for drying
- Controlled cooling with fan
- Manual lift door (up to model N(A) 120/.. (HA))
- Pneumatic lift door
- Air circulation with speed control, recommendable for processes with light or sensitive charge
- Additional frame sheet
- Roller conveyor in furnace chamber for heavy charges
Forced convection chamber furnace NA 120/45 with fresh-air cooling

- Annealing boxes
- Feed and charging aids
- Safety technology according to EN 1539 (NFPA 86) (models NA .. LS) for charges containing solvents
- Inlets, measuring frames and thermocouples for TUS measurements charge or comparative measurements
- Charge control
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78

### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>T_max</th>
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<th>Volume</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW²</th>
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<th>Weight in kg</th>
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</tbody>
</table>

*Please see page 79 for more information about supply voltage

1*Table-top model see page 38
2*Heating only between two phases
3*Depending on furnace design connected load might be higher
4*Additional equipment

Forced convection chamber furnace NA 500/45S with four compartments, each with roller conveyor and individual door
Forced Convection Chamber Furnaces > 1000 Liters
Electrically Heated or Gas-Fired

These forced convection chamber furnaces are available for maximum operating temperatures of 260 °C, 450 °C, 600 °C or 850 °C and are perfectly suited for demanding processes. Due to their robust and solid design even heavy loads can be heat treated. These furnaces are suited for use with baskets, pallets, and mobile furnace racks. The charging can be carried out with fork lift, pallet truck, or charging trolley. The basic forced convection chamber furnaces are standing on the shop floor without bottom insulation. Charging can be simplified by roller conveyors, if necessary also motorized. All furnaces are available with electric heating or gas heating.

Standard version for models up to 600 °C (850 °C models see page 42)
- Tmax 260 °C, 450 °C or 600 °C
- Electrically heated or gas-fired
- Electric heating by means of heater coils
- Direct gas heating or upon request with indirect gas heating with radiation tube, e.g. for heat treatment of aluminum
- Optimal air circulation for your charge by means of adjustable air outlets
- Horizontal air circulation (type ../HA)
- High air exchange for perfect heat transfer
- Ground level charging without bottom insulation for 260 °C models
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Temperature uniformity up to +/- 5 °C according to DIN 17052-1 see page 74
- Furnace chamber lined with alloy 1.4301 (DIN)
- High quality mineral wool insulation provides for low outer temperatures
- Inside unlocking device for furnaces with walk-in work space
- Furnace sizes suitable for common charging systems, such as pallets, baskets, etc.
Double-wing door for furnaces with an internal width of more than 1500 mm (260 °C and 450 °C models). Furnaces for higher temperatures and with smaller sizes are equipped with a single-wing door.

Over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load.

Defined application within the constraints of the operating instructions.

NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive.

Controls description see page 78.

Additional equipment for models up to 600 °C
- Optional floor insulation provides for improved temperature uniformity for 260 °C models.
- Entry ramps or track cutouts for floor-level charging cart of models with bottom insulation (not for 600 °C models).
- Furnace positioned on base frame provides for ergonomic charging height.
- Electro-hydraulic lift door.
- Fan system for faster cooling with manual or motor-driven control.
- Motor-driven control of air inlet and exhaust air flaps for better ventilation of the furnace chamber.
- Observation window and/or furnace chamber lighting (not for 600 °C models).
- Optimization of the temperature uniformity up to +/- 3 °C according to DIN 17052-1 see page 74.
- Safety technology according to EN 1539 for charges containing solvents (not for 600 °C models) see page 55.
- Charging systems or roller conveyors, also electrically driven provide for easy charging.
- Catalytic or thermal exhaust gas cleaning systems.
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78.
Forced Convection Chamber Furnaces > 1000 Liters
Electrically Heated or Gas-Fired

Standard version for models 850 °C
- Tmax 850 °C
- Electrically heated or gas-fired
- Electric heating with heating elements on supports tubes
- Direct gas heating into the outlet of the air circulation fan
- Optimal air circulation for your charge by means of adjustable air outlets
- Horizontal air circulation (type ../HA)
- High air exchange provides for perfect heat transfer
- Base frame with 500 mm charging height
- Temperature uniformity up to +/- 5 °C according to DIN 17052-1 see page 74
- Air baffles made of 1.4828 (DIN)
- Multi-layer insulation with fiber plates provides for low outer temperatures. Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2.
- Furnaces sizes perfectly suited to accommodate common charging systems, e.g. like pallets or pallet boxes
- Over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Defined application within the constraints of the operating instructions
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Controls description see page 78

Additional equipment for models 850 °C
- Electro-hydraulic lift door
- Fan system for faster cooling with manual or motor-driven control
- Motor-driven air inlet and control of exhaust air flaps for better ventilation of the furnace chamber
- Optimization of the temperature uniformity up to +/- 3 °C according to DIN 17052-1 see page 74
- Base frame for customized charging height
- Charging systems or roller conveyors, also electrically driven provide for easy charging
- Designed for Tmax 950 °C
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78
<table>
<thead>
<tr>
<th>Model</th>
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<th>Outer dimensions in mm</th>
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<th>Heating power in kW</th>
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</table>

1 Reduced connected power for plastics applications
2 Depending on furnace design connected load might be higher
3 External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

Forced convection chamber furnace N 24800/45AS with two lift-doors and rails for interchangeable charging

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

Forced convection furnace N 4010/45HA with track cutouts, chamber lighting and observation window
Forced Convection Bogie Hearth Furnaces
Electrically Heated or Gas-Fired

The forced convection bogie hearth furnaces W 1000/60A - W 8300/85A are used when heavy charges weighing up to more than 25 t have to be heat-treated. They are ideal for processes such as solution annealing, artificial ageing, annealing or soft annealing, for which a high degree of temperature uniformity is crucial. The high-performance air circulation assures that the temperature uniformity achieved throughout the work space is outstanding. A broad selection of additional equipment enables these bogie hearth furnaces to be optimally adapted to suit specific processes.

- Tmax 600 °C or 850 °C
- Dual shell housing with rear ventilation provides for low shell temperatures for the 850 °C models
- Swing door hinged on the right side
- Heating from chrome steel heating elements for the 600 °C models
- Heating from three sides (both side walls and the trolley) for the 850 °C models
- High-performance air circulation fan with vertical circulation
- Temperature uniformity up to +/- 5 °C according to DIN 17052-1 see page 74
- Bottom heating protected by SiC tiles on the bogie providing level stacking surface for the 850 °C models
- Furnace chamber fitted with inner sheets made of stainless steel 1.4301 for 600 °C models and of 1.4828 for 850 °C models
- Insulation structured with high-quality mineral wool for 600 °C models
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Bogies with flanged wheels running on rails for easy and precise movement of heavy loads
- Electric chain-driven bogie in combination with rail operation for smooth movement of heavy loads from model W 4800
- Over-temperature limiter with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Defined application within the constraints of the operating instructions
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Controls description see page 78

Forced convection bogie hearth furnace W 12500/85AS with grid for heavy loads

Forced convection bogie hearth furnace W 5920/85 AS with annealing box for heat treatment of coils under protective gas

Cooling fan for accelerated cooling
Additional equipment
- Direct gas heating or upon request with indirect gas heating with radiation tube
- Electric chain-driven bogie in combination with rail operation for smooth movement of heavy loads up to Model W 4000
- Optimization of the temperature uniformity up +/- 3 °C according to DIN 17052-1 see page 74
- Bogie running on steel wheels with gear rack drive, no rails in front of the furnace necessary
- Different possibilities for an extension to a bogie hearth furnace plant:
  - Additional bogies
  - Bogie transfer system with parking rails to exchange bogies running on rails or to connect multiples furnaces
  - Motor-driven bogies and cross-traversing system
  - Fully automatic control of the bogie exchange
- Electro-hydraulic lift door
- Motor-driven exhaust air flaps, adjustable via the program
- Uncontrolled or controlled cooling system with frequency-controlled cooling fan and motor-driven exhaust air flap
- Multi-zone control adapted to the particular furnace model provides for optimum temperature uniformity in the 850 °C models
- Commissioning of the furnace with test firing and temperature uniformity measurement (also with load) for the purpose of process optimization
- Designed for Tmax 950 °C, fan blade driven indirectly via a belt to protect the air recirculation motor against over-heating
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78

### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
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<tr>
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</tbody>
</table>

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

Forced convection bogie hearth furnace
W 3900/85AS

Forced convection bogie hearth furnace
W 24750/60AS

Charge support made of perforated sheet metal
Forced Convection Pit-Type Furnaces
Electrically Heated or Gas-Fired

Due to their robust design, these pit-type furnaces with air circulation are particularly useful for a professional heat treatment demanding optimum temperature uniformity. Production processes such as tempering, solution annealing, artificial ageing, and soft annealing can be realized with these pit-type furnaces.

- Tmax 600 °C or 850 °C
- Useful for heavy charge weights
- Air circulation fans in the furnace lid, high circulation rate

- Heating chamber with air baffle cylinder
- Heating elements on all wall surfaces
- Distribution of air flow through grid at the furnace bottom
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Pneumatic or hydraulic lid lifting device
- Temperature uniformity up to +/- 3 °C according to DIN 17052-1 see page 74
- Defined application within the constraints of the operating instructions
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Controls description see page 78

Additional equipment
- Integral fan for fast cooling
- Optimization of the temperature uniformity up to +/- 2 °C according to DIN 17052-1 see page 74
- Variable rpm converter control of the air circulation velocity for sensitive parts
- Multiple zone control or special air circulation system for optimum temperature uniformity tailored to the charge
- Charge weights up to 7 tons
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78

Model | Tmax | Inner dimensions | Volume | Max. charging weight | Outer dimensions | Heating power | Electrical connection
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tr>
<td></td>
<td>°C</td>
<td>cond. cylinder</td>
<td>in l</td>
<td>in kg</td>
<td>in mm</td>
<td>in kW</td>
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<td>5000</td>
<td>2700 3000 3900</td>
<td>120</td>
<td>3-phase</td>
<td></td>
</tr>
</tbody>
</table>

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

Motor-driven fresh-air and exhaust air flaps

Forced Convection Pit-Type Furnace
SAH 1790/80S

Forced Convection Pit-Type Furnace
SAH 1790/80S with rolling lid

Forced Convection Pit-Type Furnace
SAH 1700/60S with rolling lid

Forced Convection Pit-Type Furnace
SAH 1700/60S

Forced Convection Pit-Type Furnace
SAH 5600/75 S

Motor-driven fresh-air and exhaust air flaps

Forced Convection Pit-Type Furnace
SAH 1780/60S

Forced Convection Pit-Type Furnace
SAH 1700/60S with rolling lid

Forced Convection Pit-Type Furnace
SAH 1780/60S

Forced convection pit-type furnaces
S 10400/75 AS in production

Forced convection pit-type furnaces
SAH 5600/75 S in production

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Pit-Type and Top-Loading Furnaces with or without Air Circulation
Electrically Heated or Gas-Fired

Our top-loading furnaces are perfectly suited for the heat treatment of longer or heavier components. The furnace is usually charged with a factory crane. Due to their high-performance air circulation, the furnaces provide for excellent temperature uniformity up to a maximum temperature of 850 °C. The top-loading furnaces for the temperature range up to 1280 °C provide for very good temperature uniformity due to their five-side heating. Alternatively, these furnaces can also be provided with gas heating. Customized dimensions are designed and produced to accommodate the size and weight of the components to be treated.

- Tmax 260 °C, 450 °C, 600 °C or 850 °C for furnaces with air circulation
- Tmax 900 °C or 1280 °C for furnaces with radiation heating
- Electrically heated or gas-fired
- Heating from both long sides for furnaces with air circulation
- Heating from all four sides and the bottom with SiC plates in the bottom as level stacking support for models to 900 °C or 1280 °C
- High-quality insulation, adapted to the specific maximum temperature. Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2.
- Electrohydraulic opening system of the lid with two-hand operation
- Closable air supply vents in the lower area of the furnace chamber
- Closable exhaust air flaps in the lid
- Over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Defined application within the constraints of the operating instructions

Additional equipment
- Motor-driven exhaust air flaps for faster cooling
- Controlled fan cooling with motor-driven exhaust air flaps
- Multi-zone control of the heating provides for optimum temperature uniformity
- Furnace chamber can be divided in length for short workparts, partitions can be controlled separately
- Designed for Tmax 950 °C, fan blade driven indirectly via a belt to protect the air recirculation motor against overheating
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78
Drop-bottom furnaces are used for solution annealing and subsequent rapid quenching of aluminum alloys. In particular, with thin-walled aluminum components quench delay times of just 5 seconds from when the door begins to open until complete immersion in the quench tank are required. Generally, these requirements can be met only with this furnace design. The drop-bottom furnace stands on a base so that a quench tank can be positioned directly below the furnace. For the quenching process, the furnace bottom moves horizontally to the side. The loaded basket drops out of the furnace into the quench tank guided by wire cables. The lifting system can be controlled automatically or semi-automatically. Because of the broad working temperature range, drop-bottom furnace plants allow complete T6 heat treatments, consisting of solution annealing, quenching, and artificial aging in just one furnace.

Drop-bottom design alternatives
- Drop-bottom furnace with stationary quench tank as a cost-effective, space saving variant
- Drop-bottom furnace with movable quench tank, including holding position for charging and optional unloading crane
- Customized designs with several furnaces, several tanks and several holding positions for fully automatic processing of several charges

System details
- Working temperature range between 80 °C and 600 °C
- Working temperature can be extended to 650 °C
- Heating generally electric; direct or indirect gas heating is also possible
- Air flow, depending on space conditions and charge geometry, horizontal or vertical
- Compliance with relevant aircraft and automobile standards, such as AMS 2750 E, AMS 2770/2771, or CQI-9 as an option
Quench Tanks

Water or polymer quench tanks have a single stainless steel wall and have an integrated circulation system of the quenching medium for effective removal of energy from the charge. Temperature and level are monitored. All tanks have connections for water feed and drainage and a heat exchanger. On request, the quench tank can be equipped with a controlled heating to preheat the quenching medium and/or a heat exchanger for cooling. If the quenching medium is to be kept continuously at a high temperature, a tank insulation with or without cover is recommended.

Based on Siemens PLC technology the system is operated conveniently with PC-based Nabertherm Control Center software. Components can also be moved manually via a Mobile Panel.

Customized drop-bottom designs are tailored and manufactured to customer needs.

<table>
<thead>
<tr>
<th>Size examples</th>
<th>Tmax</th>
<th>Work space dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
<th>Electrical connection</th>
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<tbody>
<tr>
<td>Model</td>
<td>°C</td>
<td>w</td>
<td>d</td>
<td>h</td>
<td>H</td>
<td>kW</td>
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<td>600</td>
<td>1000</td>
<td>1200</td>
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<td>1400</td>
<td>1400</td>
<td>1100</td>
<td>5600</td>
<td>5700**</td>
</tr>
</tbody>
</table>

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

*Please see page 79 for more information about supply voltage
**With quench tank on cart
***Quench tank mounted on the floor
To temper steel, after annealing the furnace is opened at working temperatures of more than 1000 °C. The lift door opens and the manipulator places the charge into the quenching medium. After quenching the charge is placed into the forced convection chamber furnace for tempering. Good temperature uniformity is important.

Oil or water is used as a quenching medium. Depending on the steel grade and the required cooling rate, the charge can also be force-cooled or quenched in an air quenching chamber.

Alternative plant designs are tailored to process requirements. For lighter charge weights a manual tempering plant can be used, consisting of an annealing furnace, quench tank and manual manipulator. Semi-automatic or fully automatic plants are used for heavy loads and high throughput rates. The charge is placed into the hot furnace and subsequently into the quench tank by a manipulator.

The customer specifies the needed quenching delay time for the individual process counting from opening the furnace door until the charge is completely immersed in the quenching medium. Fast delay times are only possible with a powered manipulator. If the quenching delay time is not so critical, for example for heavy and thick-walled parts, bogie hearth furnaces can also be used. The bogie is driven out of the furnace electrically and the components can be transferred and quenched by a crane.
Tempering plant with top hat furnace H 4263/12S and water bath

Top hat furnaces are suitable for long components or for processes with no need for short quenching delay times. The top hat is opened while the furnace is hot and the charge is then transferred and quenched by the customer’s crane with a C-hook.

Annealing Furnace Design Alternatives
- Chamber furnace with radiation heating and a lift door for charging with a manipulator
- Bogie hearth furnace with powered bogie for charging with a crane for low quenching delay time requirements
- Top hat furnace for long components, such as rod material for charging with a crane and C-hook

Quenching Design Alternatives
- Quench tanks with water, oil or polymer as a quenching medium
- Cooling station with powerful fan cooling for air quenching.

Charge Transfer Alternatives
- Manual manipulator for manual tempering plants
- Electric manipulator for manual tempering plants
- Rail-mounted 2-axle manipulator, semi-automatic for charging, unloading and quenching the charge in a liquid medium
- Rail-mounted 2-axle manipulator, semi-automatic or fully automatic for charging, unloading, quenching, subsequent tempering in forced convection furnace or transferring to a holding position

The charge is placed in the hot furnace by a manipulator and is also removed and transferred to the quenching medium while it is hot.
Quench Tanks
Subject to process, charge size and weight a customized quench bath will be designed and delivered. Standard sizes are also available. Water, oil or polymer are available as quenching medium.

Available quenching mediums:
- Water
- Oil
- Polymer

Design Specifications
- Powerful circulation of the quenching medium
- Controlled heating systems
- Lowering devices for the charge
- Fill-level control
- Automatic refill system in case of water as quenching medium
- Connection port for customer’s cooling system
- Cooling system of the quenching medium via heat exchanger
- Oil separator for quench tanks with water
- Protective gas supply on the surface of oil quench tanks as fire protection
- Integration of bath temperature in the process control and documentation

Oil quenching bath OAB 67000 with heat exchanger and a volume of 67,000 liters oil

Combined oil quenching and cleaning bath with immersable tables, protection cover, oil separator and exhaust system

Oil separator for quench tanks with water

Powerful circulation of quenching medium
Certain heat treatment processes require a gas-fired chamber furnace. Short heating times due to the high power are a convincing argument. The chamber furnaces with powerful atmospheric gas burners cover a wide variety of these processes. In the basic version the burners are manually ignited once at the start of the process. The automatic control system then takes over control of the temperature curve. At program end, the burners are automatically switched off. Depending on the process, the furnaces can be equipped with automatically controlled fan burners and safety technology for debinding. Depending on the model, these furnaces can be upgraded with fully automatic fan burners and additional accessories.

- Tmax 1300 °C
- Powerful, atmospheric burners for operation with liquified gas or natural gas
- Depending on the application, special positioning of the gas burners with flame guidance provides for optimal temperature uniformity
- Fully automatic temperature control
- Gas fittings with flame control and safety valve in accordance with DVGW (German Technical and Scientific Association for Gas and Water)
- Multi-layer, reduction-proof insulation with light-weight refractory bricks and special back-up insulation result in low gas consumption
- Self-supporting and rugged ceiling, bricks laid in arched construction. Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2.
- Exhaust hood
- Over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Defined application within the constraints of the operating instructions
- Controls description see page 78

Additional equipment
- Fan burner with fully automatic control
- Indirect gas firing with radiation tubes for flame protection of the charge
- Exhaust air and exhaust gas piping
- Thermal or catalytic exhaust cleaning systems
- Recuperator technology for heat recovery see page 83
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78
Safety Technology for Forced Convection Chamber Furnaces

Certain processes release and vaporize solvents or other flammable vapors. The concentration of these vapors must be kept below a certain limit to prevent ignition. European Norm EN 1539 and NFPA 86 in the USA prescribe the required safety equipment for these processes.

For these applications and processes, all forced convection furnaces of the KTR and forced convection chamber furnaces < 450 °C product lines are suited with safety technology for protection of a potential ignition in the furnace chamber.

To avoid an ignition in the furnace, flammable vapors must be diluted with air. Special care must be taken so high concentrations of flammable materials do not accumulate in "dead" areas within the furnace. For this purpose, the furnaces are equipped with an exhaust gas fan providing for a defined underpressure. A measurement system monitors this flow, while fresh air is simultaneously resupplied. In parallel, the furnace atmosphere is diluted by the inflow of fresh air. The air circulation is also monitored by the measurement system.

- Furnace sizes between 120 and 10,000 liters
- Powerful exhaust fan capable of maintaining underpressure in the furnace
- Defined and monitored air circulation flow and exhaust air
- Visual and audible emergency signals
- Over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
The chamber furnaces in the model series NB . CL are used for heat cleaning of components. An optimum temperature uniformity is not a priority for these processes. Examples are heat cleaning of electric motors, coated surfaces of steel components or the nozzles of plastic injection molding machines.

The furnaces are gas-fired and have an integrated thermal post combustion system which is also gas-fired. The pre-set, low-oxygen respectively reducing atmosphere in the chamber furnace effectively prevents spontaneous combustion at the workpiece and subsequent damage as a result of over-temperature.

For safe operation, the furnace door locks after program start and cannot be opened again until the temperature has dropped below 180 °C at the process end. In case of a burner flame malfunction or gas shortage the process is aborted. In addition, the control system is equipped with an over-temperature limiter with manual reset that is set by the customer at a safe cut-off temperature to switch off the chamber furnace if the limit is exceeded.

The chamber furnaces are not suitable for components and coatings that contain solvents or a high concentration of water. These models must also not be used for charges with low flash points such as wood, paper or wax.

- Tmax 500 °C
- Furnace chamber size dimensioned to hold standard lattice boxes
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2, bottom and rear wall insulated with lightweight refractory bricks
- High performance, atmospheric burner fueled by liquified gas or natural gas
- Completely automated temperature controls
- Integrated thermal post combustion for exhaust gas cleaning
- Defined application within the constraints of the operating instructions
- Controls description see page 78

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax</th>
<th>Inner dimensions in mm</th>
<th>Outer dimensions1 in mm</th>
<th>Burner rating furnace chamber in kW</th>
<th>Burner rating TNV in kW</th>
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<td>3000</td>
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</table>

1External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
Chamber Furnaces for Processes with High Vaporization Rates of Organic Matter or for Thermal Cleaning by Ashing
Electrically Heated or Gas-Fired

The chamber furnaces of the model series N(B) .. BO are used for processes with large amounts of organic matters or high vaporization rates. These models can be used for products which are insensitive against temporarily uncontrolled temperature increases. Processes in which the product or contaminations on the product are ashed by ignition can be also carried out safely in this type of chamber furnace. Examples include residual wax removal of pouring clusters followed by sintering, or thermal cleaning of oxide catalytic honey combs from soot or fuel residues. The electrically heated N .. BO furnaces can be used for processes with exact temperature control and uniformity. For safety reasons, they are equipped with an integrated gas torch for igniting the flammable components in the gas mixture. The accumulation of flammable components is avoided and their safe combustion is ensured.

The gas-fired NB .. BO furnaces are designed for processes which require a heat-up time to temperatures > 500 °C. The burning of unwanted organic ingredients can take place at temperatures > 500 °C. Following this, a subsequent process can take place up to max. 1400 °C (electrically) or up to 1000 °C (gas-fired).

For safety, the furnace door locks after the program was started and cannot be opened again until the temperature has dropped below a defined value. In case of burner malfunction or gas shortage the process is aborted.

Chamber furnaces N 100 BO - N 650/14 BO, electrically heated and gas-fired ignition flame
- Tmax 1000 °C or 1400 °C
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Standard sizes up to 650 liters furnace chamber, additional sizes on request
- Exhaust hood
- Fully automatic temperature control
- Optional thermal post combustion
- Ignition flame using natural gas or liquid gas (LPG)
- Defined application within the constraints of the operating instructions
- Controls description see page 78

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Outer dimensions in mm</th>
<th>Heating power in kW</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1000</td>
<td>400 530 460</td>
<td>1200 1300 2100</td>
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<tr>
<td>N 300 BO</td>
<td>1000</td>
<td>550 700 780</td>
<td>1500 1450 2200</td>
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<td>N 650/14 BO</td>
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<td>700 850 1100</td>
<td>1700 1900 2700</td>
<td>62</td>
</tr>
</tbody>
</table>

*Depending on furnace design connected load might be higher

Chamber furnaces models NB 300 BO and NB 650 BO, gas-fired
- Tmax 1000 °C
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Standard sizes up to 650 liters furnace chamber, additional sizes on request
- Integrated thermal post combustion
- Gas burners operating with natural gas or liquid gas (LPG)
- Defined application within the constraints of the operating instructions
- Controls description see page 78

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Outer dimensions in mm</th>
<th>Output burner in kW</th>
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</thead>
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<td>1250 1650 3000</td>
<td>100</td>
</tr>
<tr>
<td>NB 650 BO</td>
<td>1000</td>
<td>700 850 1100</td>
<td>1600 2100 3150</td>
<td>200</td>
</tr>
</tbody>
</table>

*External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
These dewaxing furnaces are especially designed for dewaxing and subsequent firing of the ceramic form. The electrically heated models are operated below the ignition point of the wax during dewaxing. The dewaxing furnaces have a heated stainless steel drain in the bottom of the furnace chamber, formed as a funnel with the discharge near the center of the furnace. The stainless steel grids in the bottom can be removed for cleaning. There is a tight stainless steel container under the dewaxing furnace with a removable drawer for wax collection. After the dewaxing process is finished, the furnace continues heating in order to sinter the molds.

- Tmax 850 °C
- Chamber furnace with wide-opening swinging door
- Four side heating with freely radiating heating elements on ceramic support tubes
- Heated drainage in floor, controlled by a separate controller up to a maximum of 200 °C, to reliably prevent freezing of the draining wax - Release of furnace heating only possible after drain temperature is reached, to prevent clogging
- Stainless steel floor pan with grid bottom for level loading
- Rugged self-supporting, vaulted arch construction
- Exhaust gas vent in furnace ceiling for connection with ductwork
- Air inlet openings for reliable air exchange
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Dual shell furnace housing for low exterior temperatures
- Removable base included in delivery (fixed base for models N 440 and larger)
- First over-temperature limiter which must be set below the ignition point of the wax and prevents the wax from igniting during dewaxing. It is customers responsibility to set the required time interval for dewaxing. After this time has elapsed the over-temperature limiter will be deactivated to make sure that the furnace can continue with the sintering process.
- Second over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Defined application within the constraints of the operating instructions
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Controls description see page 78

<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>Max. drain-off volume in l</th>
<th>Heating power in kW*</th>
<th>Electrical connection*</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>N 100/WAX</td>
<td>850</td>
<td>400 530 460</td>
<td>100</td>
<td>720 1130 1440</td>
<td>5</td>
<td>7.5</td>
<td>3-phase</td>
<td>340</td>
</tr>
<tr>
<td>N 150/WAX</td>
<td>850</td>
<td>450 530 590</td>
<td>150</td>
<td>770 1130 1570</td>
<td>8</td>
<td>9.5</td>
<td>3-phase</td>
<td>360</td>
</tr>
<tr>
<td>N 200/WAX</td>
<td>850</td>
<td>500 530 720</td>
<td>200</td>
<td>820 1130 1700</td>
<td>10</td>
<td>11.5</td>
<td>3-phase</td>
<td>440</td>
</tr>
<tr>
<td>N 300/WAX</td>
<td>850</td>
<td>550 700 780</td>
<td>300</td>
<td>870 1300 1760</td>
<td>15</td>
<td>15.5</td>
<td>3-phase</td>
<td>480</td>
</tr>
<tr>
<td>N 440/WAX</td>
<td>850</td>
<td>600 750 1000</td>
<td>450</td>
<td>1020 1460 1875</td>
<td>17</td>
<td>20.5</td>
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<td>885</td>
</tr>
<tr>
<td>N 660/WAX</td>
<td>850</td>
<td>700 850 1100</td>
<td>650</td>
<td>1120 1560 1975</td>
<td>20</td>
<td>26.5</td>
<td>3-phase</td>
<td>1000</td>
</tr>
<tr>
<td>N 1000/WAX</td>
<td>850</td>
<td>800 1000 1250</td>
<td>1000</td>
<td>1580 1800 2400</td>
<td>25</td>
<td>40.5</td>
<td>3-phase</td>
<td>1870</td>
</tr>
<tr>
<td>N 1500/WAX</td>
<td>850</td>
<td>900 1200 1400</td>
<td>1500</td>
<td>1680 2000 2550</td>
<td>35</td>
<td>57.5</td>
<td>3-phase</td>
<td>2570</td>
</tr>
<tr>
<td>N 2200/WAX</td>
<td>850</td>
<td>1000 1400 1600</td>
<td>2200</td>
<td>1780 2200 2750</td>
<td>50</td>
<td>75.5</td>
<td>3-phase</td>
<td>3170</td>
</tr>
</tbody>
</table>

*Depending on furnace design connected load might be higher
*Please see page 79 for more information about supply voltage
*External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
The chamber furnace of NB ... BOWAX series is suitable for Flash Fire processes in which the hot furnace is charged with raping castings.

For a quick loading and unloading, the dewaxing furnace is equipped with a pneumatic lift door, which is controlled via a footswitch.

After charging, the wax liquefies in short time. The first part of the wax flows-out through the integrated pan directly into a catch basin under the dewaxing furnace and is collected safely in a water tank.

The remainder of the wax evaporates in the furnace chamber and is burned safely in the downstream thermal post combustion. The resulting exhaust air is conducted via an exhaust chimney and a secondary customer side piping out of the hall.

In the event of a flame failure of the burner or gas shortage takes place a process termination.

- Tmax 1000 °C
- Standard size with 300 l furnace volume, other sizes on request
- Fully automatic temperature control
- Integrated thermal post combustion incl. Exhaust hood (250 mm)
- Gas burner for operation with natural or LPG gas with permanent monitoring via a PLC
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Pneumatic lift-door with foot-switch and electromagnetic locking
- Withdrawable wax collecting pan under the furnace
- Optical indication when charging temperature has been reached
- Defined application within the constraints of the operating instructions
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive
- Controls description see page 78

<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>Max. drain-off volume in l</th>
<th>Heating power in kW</th>
<th>Electrical connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB 300/BOWAX</td>
<td>1000</td>
<td>550 700 780 300</td>
<td>1010 1700 3030</td>
<td>2 50 100,0</td>
<td>3-phase</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Depending on furnace design connected load might be higher
2 Please see page 79 for more information about supply voltage
3 External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
For annealing and hardening of larger parts, for example heavy cast parts or tool steel dies to temperatures between 800 °C and 1100 °C, we recommend our bogie hearth furnaces with radiation heating. The bogie can be loaded outside the furnace. When the design includes an electro-hydraulic lift door and a motorized bogie, the furnace can be opened while hot and the load can be removed for cooling or quenching. When several bogies are used together with a second door or bogie transfer system, one bogie can be loaded outside the furnace while the other bogie is in the furnace. This shortens process times and the residual energy of the furnace can be used when the new charge is heated.

- Tmax 900 °C or 1280 °C
- Dual shell housing with rear ventilation, provides low shell temperatures
- Swing door hinged on the right side
- Heating from five sides (four sides and bogie) provides for a optimum temperature uniformity
- Bogie heating receives power via blade contacts when driven in
- Heating elements mounted on support tubes provide for free radiation and long service life
- Bottom heating protected by SiC tiles on the bogie providing level stacking surface
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Self-supporting and long-life ceiling construction with bricks laid in arched construction
- Bogies with flanged wheels running on rails for easy and precise movement of heavy loads
- Adjustable air inlet damper
- Manual exhaust air flap on the furnace roof
Over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load

Defined application within the constraints of the operating instructions

NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive

Controls description see page 78

Additional equipment

- Electric chain-driven bogie in combination with rail operation for smooth movement of heavy loads
- Bogie running on steel wheels with gear rack drive, no rails in front of the furnace necessary
- Different possibilities for an extension to a bogie hearth furnace plant:
  - Additional bogies
  - Bogie transfer system with parking rails to exchange bogies running on rails or to connect multiples furnaces
  - Motor-driven bogies and cross-traversal system
  - Fully automatic control of the bogie exchange
- Electro-hydraulic lift door
- Motor-driven exhaust air flap
- Uncontrolled or controlled cooling system with frequency-controlled cooling fan and motor-driven exhaust air flap
- Multi-zone control adapted to the particular furnace provides model for optimal the temperature uniformity
- Commissioning of the furnace with test firing and temperature uniformity measurement (also with load) for the purpose of process optimization
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78
### Bogie Hearth Furnaces
**Electrically Heated**

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax °C</th>
<th>Inner dimensions in mm</th>
<th>Volume in l</th>
<th>Outer dimensions(^2) in mm</th>
<th>Heating power in kW(^1)</th>
<th>Electrical connection</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 1000/G</td>
<td>900</td>
<td>800 1600 800 1000</td>
<td>1000</td>
<td>1470 2410 1915</td>
<td>40</td>
<td>3-phase</td>
<td>3000</td>
</tr>
<tr>
<td>W 1500/G</td>
<td>900</td>
<td>900 1900 900 1500</td>
<td>1500</td>
<td>1570 2710 2030</td>
<td>75</td>
<td>3-phase</td>
<td>3500</td>
</tr>
<tr>
<td>W 2200/G</td>
<td>900</td>
<td>1000 2200 1000</td>
<td>2200</td>
<td>1670 3010 2140</td>
<td>110</td>
<td>3-phase</td>
<td>4500</td>
</tr>
<tr>
<td>W 3300/G</td>
<td>900</td>
<td>1000 2800 1200</td>
<td>3300</td>
<td>1670 3610 2355</td>
<td>140</td>
<td>3-phase</td>
<td>5300</td>
</tr>
<tr>
<td>W 5000/G</td>
<td>900</td>
<td>1000 3600 1400</td>
<td>5000</td>
<td>1670 4410 2555</td>
<td>185</td>
<td>3-phase</td>
<td>7300</td>
</tr>
<tr>
<td>W 7500/G</td>
<td>900</td>
<td>1000 5400 1400</td>
<td>7500</td>
<td>1670 6210 2555</td>
<td>235</td>
<td>3-phase</td>
<td>10300</td>
</tr>
<tr>
<td>W 10000/G</td>
<td>900</td>
<td>1000 7100 1400</td>
<td>10000</td>
<td>1670 7910 2555</td>
<td>300</td>
<td>3-phase</td>
<td>12500</td>
</tr>
<tr>
<td>W 1000</td>
<td>1280</td>
<td>800 1600 800 1000</td>
<td>1000</td>
<td>1470 2410 1915</td>
<td>57</td>
<td>3-phase</td>
<td>3000</td>
</tr>
<tr>
<td>W 1500</td>
<td>1280</td>
<td>900 1900 900 1500</td>
<td>1500</td>
<td>1570 2710 2030</td>
<td>75</td>
<td>3-phase</td>
<td>3500</td>
</tr>
<tr>
<td>W 2200</td>
<td>1280</td>
<td>1000 2200 1000</td>
<td>2200</td>
<td>1670 3010 2140</td>
<td>110</td>
<td>3-phase</td>
<td>4500</td>
</tr>
<tr>
<td>W 3300</td>
<td>1280</td>
<td>1000 2800 1200</td>
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<td>1670 3610 2355</td>
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<td>3-phase</td>
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<td>W 5000</td>
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<td>1000 3600 1400</td>
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<td>7300</td>
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<tr>
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<td>1280</td>
<td>1000 5400 1400</td>
<td>7500</td>
<td>1670 6210 2555</td>
<td>235</td>
<td>3-phase</td>
<td>10300</td>
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<tr>
<td>W 10000</td>
<td>1280</td>
<td>1000 7100 1400</td>
<td>10000</td>
<td>1670 7910 2555</td>
<td>300</td>
<td>3-phase</td>
<td>12500</td>
</tr>
</tbody>
</table>

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

*Please see page 79 for more information about supply voltage.
Gas-Fired Bogie Hearth Furnaces up to 1400 °C
for Heat Treatment in Air or under Reducing Atmosphere

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

- Tmax up to 1400 °C, depending on furnace design
- Powerful, sturdy high-speed burner with pulse control and special flame control in the furnace chamber provide for optimum temperature uniformity
- Operation with city gas, natural gas or liquified gas
- Fully automatic PLC control of the temperature as well as monitoring of the burner function
- Reduction-resistant fiber insulation with low heat storage provides for short heating and cooling times. Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2.
- Dual shell housing provides for low outside temperatures
- Exhaust hood with fittings for further discharge of the exhaust gases
- Over-temperature limiter with adjustable cutout temperature for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Defined application within the constraints of the operating instructions
- Controls description see page 78

Additional equipment
- Automatic lambda control to set the furnace atmosphere
- Exhaust air and exhaust gas piping
- Recuperator burners utilizing part of the waste heat in the exhaust tract to preheat the combustion air and considerably contribute to energy saving
- Thermal exhaust cleaning systems
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78
- Other additional equipment for bogie hearth furnaces see pages 61
Catalytic and Thermal Post Combustion Systems, Exhaust Gas Washer

For exhaust gas cleaning, in particular in debinding, Nabertherm offers exhaust gas cleaning systems tailored to the process. The post combustion 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 post combustion systems (KNV)

Catalytic exhaust cleaning is recommended due to energetic reasons when only pure hydrocarbon compounds must be cleaned during the debinding process in air. They are recommended for small to medium exhaust gas amounts.

- Perfectly suited for debinding processes in air with only organic exhaust gases
- Decomposition of gases in carbon dioxide and water
- Integrated in a compact stainless steel housing
- Electric heating provides for preheating of the exhaust gas to the optimal reaction temperature for catalytic treatment
- Cleaning in different layers of catalytic honeycombs within the system
- Thermocouples for measuring the temperatures of raw gas, reaction honeycombs and discharge
- Over-temperature limiter with adjustable cutout temperature protects the catalyst
- Tight connection between the exhaust gas outlet of the debinding furnace and the exhaust gas fan with corresponding integration into the overall system with respect to control and safety technology
- Catalyst dimensioned in relation to the exhaust gas flow
- Measuring port for clean gas measurements (FID)
Thermal post combustion systems (TNV)
Thermal post combustion systems are used if large volumes of exhaust gas from the debinding process in air must be cleaned and/or if there is a risk that the exhaust gases might damage the catalyst. Thermal post combustion is also used for debinding applications under non-flammable or flammable protective or reaction gases.

- Optimally suited for debinding processes in air with large exhaust gas flow, erratic large exhaust gas volumes, large volume flow or for debinding processes under non-flammable or flammable protective or reaction gases
- Gas-fired to burn the exhaust gases
- Burn-off at temperatures up to 850 °C provides for thermal decomposition of the exhaust gases
- Heating with compact gas burner with automatic firing device

Exhaust Gas Washer
An exhaust gas washer will be often used if the generated gases cannot be effectively treated with a thermal post combustion system or with a torch. To clean, detox or decontaminate the exhaust gas stream a liquid is used to wash or neutralize unwanted pollutants. The scrubber can be adapted to the process by designing its liquid distribution and contact area and by selecting the most suitable washing liquid. Liquids may simply be water or special reagents or even suspensions to successfully remove unwanted gases, liquids or particles from the exhaust gas.
Rotary Hearth Furnaces up to 1300 °C with and without Air Circulation
Electrically Heated or Gas-Fired

Gas-fired rotary-hearth furnaces for preheating of ceramic moulds up to 1100 °C incl. thermal post combustion for exhaust gas cleaning
Rotary Hearth Furnaces up to 1300 °C with and without Air Circulation
Electrically Heated or Gas-Fired

The rotary hearth furnaces of the DH product line are optimally suited for continuous processes on a small floor space. They are designed for preheating processes such as the preheating of metal parts for forging or for preheating of moulds. Charging and discharging can be done at one position – either by a person or fully automatic. The hearth rotates in pre-set segments individually reconciled with the workpart geometry. The rotational speed and rotational intervals can be defined by the control system or by manual switching.

The rotary hearth furnaces are specifically designed for the required throughput and charge dimensions. They are heated electrically or alternatively gas-fired by means of powerful gas burners. Subject to the temperature range these rotary hearth furnaces are equipped with or without air circulation.

- Tmax > 850 °C up to 1300 °C with radiation heating
- Tmax up to 850 °C with powerful air-circulation for better heat transmission onto the charge and to optimize the temperature uniformity in the low-temperature range
- Electrically heated:
  - Wire heating elements in the furnaces ceiling
  - Heating via SiC rods installed in the furnace ceiling for furnaces up to 1300 °C
- Gas-fired:
  - Directly gas-fired: The burner fires directly in the furnace chamber
  - Indirectly gas-fired: The burner fires in a radiation tube to avoid a direct contact between the charge and the burner exhaust gases
- Very compact design compared with continuous furnaces
- Designed for continuous operation at one working temperature
- Table diameter up to 6000 mm
- Only fiber materials are used which are not classified as carcinogenic according to TRGS 905, class 1 or 2
- Additional water sealing between the rotary table and the housing for forced convection furnaces and directly gas-fired furnaces
Directly gas-fired rotary hearth furnaces

- Table drive under the furnace provides for movement in defined segments or continuously
- Low-vibration movement of the rotary hearth
- Charging through a lift-door
- Actuation of rotary drive via foot pedal or external contact in case of automatic operation
- Additional Service door on request
- Controls description see page 78

Additional equipment
- Exhaust hood above the door opening for discharge of the warm exhaust air when door is open
- Charging aids for ease of loading and unloading
- Multi-zone control for uniform thermal profile during the cycle
- Protective gas connections
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 78
- Visualization of loaded positions on the human machine interface (HMI)

Electrically heated rotary hearth furnaces with Tmax 450 °C, prepared for automatic operation
Continuous Furnaces
Electrically Heated or Gas-Fired

Continuous furnace plant for working temperatures up to 260 °C with integrated cooling station.
Continuous furnaces are the right choice for processes with fixed cycle times such as drying or preheating, curing, aging, vulcanisation or degassing. The furnaces are available for various temperatures up to a maximum of 1400 °C. The furnace design depends on the required throughput, the process requirements for heat treatment and the required cycle time.

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

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

Heating systems
- Electric heating, radiation or convection
- Direct or indirect gas-fired

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

Mesh belt drive in a continuous furnace

Continuous furnace D 700/10000/300/45S with chain conveyor for 950 °C, gas-fired
Temperature cycles
- Control of working temperature across the whole length of the furnace, such as for drying or preheating
- Automatic control of a process curve applying defined heat-up, dwell and cooling time
- Heat treatment including a final quenching of the charge

Process atmosphere
- In air
- For processes with organic outgassings incl. mandatory safety technology according to EN 1539 (NFPA 86)
- In non-flammable protective or reactive gases such as nitrogen, argon or forming gas
- In flammable protective or reactive gases such as hydrogen incl. the necessary safety technology

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

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

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

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

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

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

**Temperature Uniformity in the Work Space incl. Protocol**
In standard furnaces a temperature uniformity is guaranteed as +/- K without measurement of temperature uniformity. However, as additional feature, a temperature uniformity measurement at a reference temperature in the work space compliant with DIN 17052-1 can be ordered. Depending on the furnace model, a holding frame which is equivalent in size to the charge space is inserted into the furnace. This frame holds thermocouples at defined measurement positions (11 thermocouples with square cross-section, 9 thermocouple with circular cross-section). The temperature uniformity measurement 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.
Standards such as the AMS 2750 E (Aerospace Material Specifications) are applicable for the industrial processing of high-quality materials. They define industry-specific requirements for heat treatment. Today, the AMS 2750 E and derivative standards such as AMS 2770 for the heat treatment of aluminum are the guidelines for the aerospace industry. After the introduction of the CQI-9, the automotive industry has also committed to submit heat treatment processes to stricter rules. These standards describe in detail the requirements applicable to thermal processing plants.

- Temperature uniformity in the work space (TUS)
- Instrumentation (definition of measurement and control systems)
- Calibration of the measurement system (IT) from the controller via the measurement line to the thermocouple.
- Inspections of system accuracy (SAT)
- Documentation of the inspection cycles

Norm compliance is necessary to ensure that the required quality standard of the manufactured components can also be reproduced in series. For this reason, extensive and repeated inspections as well as controls of the instrumentation, including the relevant documentation, are required.

Furnace Class and Instrumentation Requirements of the AMS 2750 E

Depending on the quality requirements of heat treatment job the customer specifies instrumentation type and the temperature uniformity class. The instrumentation type describes the necessary combination of the applied control, recording media as well as thermocouples. The temperature uniformity of the furnace and the class of the selected instrumentation are defined based on the required furnace class. The higher the requirements are set for the furnace class the more precise the instrumentation must be.

<table>
<thead>
<tr>
<th>Instrumentation</th>
<th>Type</th>
<th>Furnace class</th>
<th>Temperature uniformity (°C / °F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each control zone has a thermocouple connected to the controller</td>
<td>A</td>
<td>1</td>
<td>+/- 3</td>
</tr>
<tr>
<td>Recording of the temperature measured by the control thermocouple</td>
<td>B</td>
<td>2</td>
<td>+/- 6</td>
</tr>
<tr>
<td>Sensors for recording the coldest and hottest spots</td>
<td>C</td>
<td>3</td>
<td>+/- 8</td>
</tr>
<tr>
<td>Each control zone has a charge thermocouple with recording system</td>
<td>D</td>
<td>4</td>
<td>+/- 10</td>
</tr>
<tr>
<td>Each control zone has an over-temperature protection unit</td>
<td>E</td>
<td>5</td>
<td>+/- 14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>+/- 24</td>
</tr>
</tbody>
</table>

Regular Inspections

The furnace or the heat treatment plant must be designed so that the requirements of the AMS 2750 E can be met and be reproduced. The standard also requires the inspection intervals for the instrumentation (SAT = System Accuracy Test) and the temperature uniformity of the furnace (TUS = Temperature Uniformity Survey). The SAT/TUS tests must be performed by the customer with measuring devices and sensors which operate independently of the furnace instrumentation.

Nabertherm Services

The suitable furnace model for the corresponding heat treatment can be designed based on the process, the charge, the required furnace class and the type of instrumentation. Depending on the required specs, alternative solutions can be offered.

- Furnace designs, which meet standards, following customer specifications regarding furnace class and instrumentation, incl. gauge connections for repeated customer inspections at regular intervals. No consideration of requirements with respect to documentation
- Data recording devices (e.g., temperature recorder) for TUS and/or SAT measurements see page 80
- Data recording, visualization, time management via the Nabertherm Control Center (NCC), based on Siemens WinCC software see page 78
- Commissioning at site, incl. the first TUS and SAT inspection
- Connection of existing furnace plant to meet norm requirements
- Documentation of the complete process chain in line with the corresponding norm
Implementation of AMS 2750 E

Basically, two different systems are available for control and documentation, a proven Nabertherm system solution or instrumentation using Eurotherm controllers/temperature recorders. The Nabertherm AMS package is a convenient solution that includes the Nabertherm Control Center for control, visualization, and documentation of the processes and test requirements based on PLC control.

Instrumentation with Nabertherm Control Center (NCC) for Control, Visualization, and Documentation based on a Siemens PLC Controls

The attractive feature of the instrumentation with Nabertherm Control Center in combination with PLC controls of the furnace is the convenient data input and visualization. The software programming is structured in a way that both the user and the auditor can navigate it without difficulty.

In daily use, the following product characteristics stand out:

- Very easy to navigate and straight-forward presentation of all the data in plain text on the PC
- Automatic saving of the charge documentation at the end of the program
- Administration of the calibration cycles in the NCC
- Results of the measurement distance calibration are entered in the NCC
- Schedule management of the required testing cycles including a reminder function. The testing cycles for TUS (Temperature Uniformity Survey) and SAT (System Accuracy Test) are entered in days and monitored by the system and the operator or tester is informed in time about up-coming tests. The measurements have to be done with separate calibrated measuring equipment.
- Option of transferring the measurement data to a customer’s server
The Nabertherm Control Center can be extended to enable a complete documentation of the heat treatment process apart from just the furnace data. For example, when heat-treating aluminum, in addition to the furnace, the temperatures in the quenching basin or a separate cooling medium can also be documented.

**Alternative Instrumentation with Temperature Controllers and Recorders from Eurotherm**

As an alternative to instrumentation with the Nabertherm Control Center (NCC) and PLC controls, instrumentation with controllers and temperature recorders is also available. The temperature recorder has a log function that must be configured manually. The data can be saved to a USB stick and be evaluated, formatted, and printed on a separate PC. Besides the temperature recorder, which is integrated into the standard instrumentation, a separate recorder for the TUS measurements is needed (see page 78).

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

**Standard Controllers**
Our extensive line of standard controllers satisfies most customer requirements. D60 Based on the specific furnace model, the controller regulates the furnace temperature reliably and is equipped with an integrated USB-interface for documentation of process data (NTLog/NTGraph).

The standard controllers are developed and fabricated within the Nabertherm group. When developing controllers, our focus is on ease of use. The user can choose between 17 languages. From a technical standpoint, these devices are custom-fit for each furnace model or the associated application. From the simple controller with an adjustable temperature to the control unit with freely configurable control parameters, stored programs and PID microprocessor control with self-diagnosis system, we have a solution to meet your requirements.

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

**Alternative User Interfaces for HiProSystems**
**Process control H500/H700**
This basic panel accommodates most basic needs and is very easy to use. Firing cycle data and the extra functions activated are clearly displayed in a table. Messages appear as text. Data can be stored on a USB stick using the „NTLog Comfort“ option (not available for all H700).

**Process control H1700**
Customized versions can be realized in addition to the scope of services of the H500/H700

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

**Control, Visualisation and Documentation with Nabertherm Control Center NCC**
Upgrading the HiProSystems-Control individually into a PC-based 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 extension can be used also in accordance with the AMS 2750 E (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 overriding systems
- Connection to mobile phone or stationary network for malfunction message transmission via SMS
- Control from various locations over the network
- Measurement range calibration up to 18 temperatures per measuring point for use at different temperatures. For norm-relevant applications a multilevel calibration is possible.
### Assignment of Standard Controllers to Furnace Families

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<th>Catalog page</th>
<th>KB</th>
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<th>XTR</th>
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<th>N 1000/280 HA - N 4800/550 HA</th>
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<th>SAH</th>
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### Functionality of the Standard Controllers

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<td>17</td>
</tr>
</tbody>
</table>

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

### Mains Voltages for Nabertherm Furnaces

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

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

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

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

<table>
<thead>
<tr>
<th></th>
<th>Model 600e</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>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 E</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

**Data storing of Nabertherm controllers with NTLog Basic**

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

The process documentation with NTLog Basic requires no additional thermocouples or sensors. Only data recorded which are available in the controller.

The data stored on the USB stick (up to 80,000 data records, format CSV) can afterwards be evaluated on the PC either via NTGraph or a spreadsheet software used by the customer (e.g. MS Excel).

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

**Data storing of HiProSystems with NTLog Comfort**

The extension module NTLog Comfort offers the same functionality of NTLog Basic module. Process data from a HiProSytems control are read out and stored in real time on a USB stick (not available for all H700 systems). The extension module NTLog Comfort can also be connected using an Ethernet connection to a computer in the same local network so that data can be written directly onto this computer.

**Visualization with NTGraph for Single-Furnace Control**

The process data from NTLog can be visualized either using the customer’s own spreadsheet program (e.g. MS-Excel) or NTGraph (Freeware). With NTGraph Nabertherm provides for an additional user-friendly tool free of charge for the visualization of the data generated by NTLog. Prerequisite for its use is the installation of the program MS-Excel for Windows (version 2003/2010/2013). After data import presentation as diagram, table or report can be chosen. The design (color, scaling, reference labels) can be adapted by using prepared sets. NTGraph is available in seven languages (DE/EN/FR/SP/IT/CH/RU). In addition, selected texts can be generated in other languages.

**Software NTEdit for Entering Programs on the PC**

By using the software NTEdit (Freeware) the input of the programs becomes clearer and thus easier. The program can be entered on customers PC and then be imported into the controller with a USB stick. The display of the set curve is tabular or graphical. The program import in NTEdit is also possible. With NTEdit Nabertherm provides a user-friendly free tool. A prerequisite for the use is the client installation of MS-Excel for Windows (2007/2010/2013). NTEdit is available in eight languages (DE/EN/FR/SP/IT/CH/RU/PT).
VCD-Software for Visualization, Control and Documentation

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

The VCD software is used to record process data from the controllers B400/B410, C440/C450 and P470/P480. Up to 400 different heat treatment programs can be stored. The controllers are started and stopped via the software at a PC. The process is documented and archived accordingly. The data display can be carried-out in a diagram or as data table. Even a transfer of process data to MS Excel (.csv format *) or the generation of reports in PDF format is possible.

Features
- Available for controllers B400/B410/C440/C450/P470/P480
- Suitable for operating systems Microsoft Windows 7 or 8/8.1 or 10 (32/64 Bit)
- Simple installation
- Setting, Archiving and print of programs and graphics
- Operation of controllers via PC
- Archiving of process curves from up to 16 furnaces (also multi-zone controlled)
- Redundant saving of archives on a server drive
- Higher security level due to binary data storage
- Free input of charge date with comfortable search function
- Possibility to evaluate data, files can be converted to Excel
- Generation of a PDF-report
- 17 languages selectable

Extension package 1 for display of an additional temperature measuring point, independant of the furnace controls
- Connection of an independant thermocouple, type S, N or K with temperature display on controller C6D, e. g. for documentation of charge temperature
- Conversion and transmission of measured values to the VCD software
- For data evaluation, please see VCD-software features
- Display of measured temperature directly on the extension package

Extension package 2 for the connection of up to three, six or nine measuring point, independant of the furnace controls
- Connection of three thermocouples, type K, S, N or B to the included connecting box
- Possible extension of up to two or three connecting boxes with up to nine measuring points
- Conversion and transmission of measured values to the VCD software
- Data evaluation, see VCD features
Additive manufacturing allows for the direct conversion of design construction files into fully functional objects. With 3D-printing objects from metals, plastics, ceramics, glass, sand or other materials being built up in layers until they have reached their final shape.

Depending on the material, the layers are interconnected by means of a binder system or by laser technology.

Many methods of additive manufacturing require subsequent heat treatment of the manufactured components. The requirements for the furnaces for heat treatment depend on the component material, the working temperature, the atmosphere in the furnace and, of course, the additive production process.

Nabertherm offers solutions from curing for conservation of the green strength up to sintering in vacuum furnaces in which the objects of metal are annealed or sintered.

Additive Manufacturing

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Energy Efficiency Technology

In face of rising energy prices and stricter environmental regulations there is increasing demand for heat treatment plants with greater energy efficiency.

Depending on the furnace size and the process there is always a certain amount of potential energy which can be recovered from the waste heat and re-used. This is especially true for large furnace systems or long process times which allow for huge energy savings that the additional investment has a short pay-back time. The thermal energy from finished charges can also be used to pre-heat cold charges which is also an efficient way of saving energy.

The following examples outline engineering alternatives for heat recovery:

Heat Exchangers
The principle of the counterflow heat exchanger is to use the hot exhaust gas coming from the furnace to pre-heat the cold fresh air channelled into the furnace. In many cases, there is no need anymore for a separate fresh air preheating unit. Such a system is recommended if the process requires continuous air exchange in the furnace chamber, such as when tempering silicone, or during drying processes that are covered by the EN 1539 industrial standard.

Recuperator Burners
Large gas-heated heat-treatment furnaces are especially advantageous for the installation of recuperator burners. Recuperator burners also use hot exhaust gas; to pre-heat the combustion air. Depending on the furnace model and the process, substantial energy savings of as much as 25% can be realized by using recuperator burners so that there is a short pay-back time for the additional purchase costs.

Heat Transfer Chambers
Heat transfer chambers, which can also be described as cooling/heating chambers, offer two enormous advantages. For one, they help save energy, and for another, using a heat transfer chamber increases productivity.

The load is removed from the furnace while it is still hot and placed in the heat transfer chamber. The chamber also has room for a new, cold charge. Circulating the air cools the hot charge and, at the same time, preheats the cold charge before it is put into the furnace. Consequently, the furnace heating does not have to provide the thermal energy and through-put capacity of the furnace is increased of the same time.

The above systems for enhancing energy efficiency are only a few examples of technical alternatives. We would be happy to advise you on whether an additional heat recovery module would also be a sensible add-on to your furnace or system.
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.

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- Thermal Process Technology for Metals, Plastics and Surface Finishing
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