FURNACES FOR FOUNDRY

www.nabertherm.com

Made in Germany
Facts
- Production of Arts & Crafts furnaces, laboratory furnaces, dental furnaces and industrial furnaces since 1947
- Production site in Lilienthal/Bremen - Made in Germany
- 500 employees worldwide
- 150,000 customers in more than 100 countries
- Very wide product range of furnaces
- One of the biggest R&D departments in the furnace industry
- High vertical integration

Global Sales and Service Network
- Manufacturing only in Germany
- Decentralized sales and service close to the customer
- Own sales organization and long term sales partners in all important world markets
- Individual on-site customer service and consultation
- Fast remote maintenance options for complex furnaces
- Reference customers with similar furnaces or systems close to you
- Secured spare parts supply, many spare parts available from stock
- Further information see page 54

Setting Standards in Quality and Reliability
- Project planning and construction of tailormade thermal process plants incl. material handling and charging systems
- Innovative controls and automation technology, adapted to customer needs
- Very reliable and durable furnace systems
- Customer test center for process assurance

Experience in Thermal Processing
- Thermal Process Technology
- Additive Manufacturing
- Advanced Materials
- Fiber Optics/Glass
- Foundry
- Laboratory
- Dental
- Arts & Crafts
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<td>26</td>
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<td>Wax burnout</td>
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<th>Type</th>
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<tr>
<td>Tempering plants for aluminum and steel</td>
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Which Furnace for which Process?

Melt

- Electrically heated tilting furnaces to 1300 °C
  page 10
- Gas-fired tilting furnaces
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- Gas-fired tilting furnaces with recuperative burner
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- Tilting furnaces (SiC-rod-heated) to 1450 °C
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Melting and Holding

- Electrically heated tilting furnaces to 1300 °C
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- Gas-fired tilting furnaces with recuperative burner
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- Electrically heated bale-out furnaces
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- Electrically heated laboratory tilting furnaces
  page 31
- Rotary table system for continuous pouring
  page 32
- Melting furnaces for heavy metals or magnesium
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Holding, Transporting

- Electrically heated bale-out furnaces
  page 20
- Transportable electrically heated bale-out furnaces
  page 25
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  page 30

Transportable bale-out furnace TM 150/10
Heat Treatment of Forms and Cast Pieces

Artificial Ageing, Tempering, Quenching, Annealing and Hardening
- Drop-bottom furnaces page 46
- Tempering plants page 46
- Continuous furnaces page 48
- Forced convection chamber furnaces see catalogs below
- Forced convection bogie hearth furnaces see catalogs below
- Electrically heated bogie hearth furnaces see catalogs below
- Gas-fired bogie hearth furnaces see catalogs below

For detailed product description, see catalogs Thermal Process Technology I and II:

Pre-Heating, Drying
- Rotary hearth furnaces page 48
- Continuous furnaces page 48
- Forced convection chamber furnaces see catalogs below
- Forced convection bogie-hearth furnaces see catalogs below

For detailed product description, see catalog Thermal Process Technology:

Dewaxing, Thermal Decoring/Cleaning
- Electrically heated cleaning furnaces for riser tubes page 33
- Dewaxing furnaces page 50
- Chamber furnaces for heat cleaning see catalogs below

For detailed product description, see catalog Advanced Materials:

Additive Manufacturing
- Chamber furnaces with gas-supply boxes page 52
- Retort furnaces page 52
- High-temperature furnaces for debinding and sintering page 52
- Chamber ovens page 52

For detailed product description, see catalog Additive Manufacturing:
Available Heating Concepts and Exhaust Gas Systems for Melting Furnaces

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 melting 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 melting 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 melting 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 melting 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 emissions 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. For demanding copper alloys up to a melting temperature of 1320 °C, the TC/KC models with heating via SiC rods are recommended.

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 compared to 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

<table>
<thead>
<tr>
<th>Use</th>
<th>Melting Material</th>
<th>Max. Melt Temperature</th>
<th>Productivity</th>
<th>Melt Quality</th>
<th>Energy Consumption</th>
<th>Noise Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models TB/KB (not for Models TB ../12) Exhaust gas discharge over the crucible edge</td>
<td>Melting</td>
<td>Al + Cu</td>
<td>++</td>
<td>++</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Models TB/KB Side exhaust gas discharge</td>
<td>Melting + Holding</td>
<td>Al + Zn</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Models TBR/KBR Side exhaust gas discharge with recuperator</td>
<td>Melting + Holding</td>
<td>Al</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Models T/K Electrically heated with bath control</td>
<td>Melting + Holding</td>
<td>Al + Zn</td>
<td>0</td>
<td>0</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>Models T/K Electrically heated without bath control</td>
<td>Melting + Holding</td>
<td>Al + Zn + Cu</td>
<td>+</td>
<td>0</td>
<td>++</td>
<td>++</td>
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<tr>
<td>Modell T/TM ../10 Electrically heated with bath control</td>
<td>Holding</td>
<td>Al</td>
<td>-</td>
<td>-</td>
<td>+++</td>
<td>+++</td>
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<tr>
<td>Models TC/KC Electrically heated via SiC rods</td>
<td>Melting + Holding</td>
<td>Cu</td>
<td>+++</td>
<td>+</td>
<td>++</td>
<td>+</td>
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</table>
Tilting furnaces are characterized by very good melt quality and high melting performance with optimum energy efficiency. Depending on the model, for aluminum, zinc or copper alloys.

- Incl. crucible
- Electro-hydraulic tilting device with safe two-hand operation on the furnace
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- Uniform and precise pouring due to optimum pivot point
- Defined application within the constraints of the operating instructions
- As additional equipment: Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control
<table>
<thead>
<tr>
<th>Furnace Group</th>
<th>Model</th>
<th>Page</th>
</tr>
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<tr>
<td>Tilting furnaces K</td>
<td>K</td>
<td>10</td>
</tr>
<tr>
<td>Tilting furnaces KB</td>
<td>KB</td>
<td>12</td>
</tr>
<tr>
<td>Tilting furnaces KBR with recuperative burner</td>
<td>KBR</td>
<td>14</td>
</tr>
<tr>
<td>Product videos melting furnaces</td>
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<td>15</td>
</tr>
<tr>
<td>Tilting furnaces KC</td>
<td>KC</td>
<td>16</td>
</tr>
</tbody>
</table>
Tilting Furnaces K
Electricaly Heated, for Melting and Holding

The electrically heated tilting furnaces are characterized by very good melt quality and high melting performance with optimum energy efficiency. They are ideal as a flexible solution for pre-melting but also for direct pouring into large moulds.

**Standard Equipment**

- K.../12 for aluminum and zinc alloys
- K.../13 for copper alloys such as bronze or brass
- Free-radiating heating elements on support tubes for long service life and simple replacement
- Twelve months warranty on heating elements
- Multi-layer insulation for optimum energy efficiency and low external wall temperatures
- Incl. crucible
- Electro-hydraulic tilting device with safe two-hand operation on the furnace
- Uniform and precise pouring due to optimum pivot point
- Emergency outlet for safe draining of the melt in case of crucible breakage
- No exhaust gas discharge needed
- Integrated safety system which continues to operate the furnace at reduced power in case of malfunction in the 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.
- Low-maintenance furnace chamber control with temperature measurement behind the crucible

**Additional Equipment**

- Safety fence
- Work platform for easy charging
- Collecting pan under the emergency outlet see page 39
- Crucible breakage monitor with visual and audible signal (only for models K.../12)
- 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
- Multi-step switching of the furnace heat (see page 43)
- Models with increased heating power
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 42
Three tilting furnaces with work platform for melting of aluminum

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity in kg</th>
<th>Heating power in kW</th>
<th>Melting performance(^3) in kg/h</th>
<th>Consumption melting in kWh/kg Al</th>
<th>Consumption holding in kWh/h</th>
<th>Lid closed/open</th>
<th>Outer dimensions in mm</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>°C</td>
<td>°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>1520 1580 1750</td>
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<td></td>
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<tr>
<td>K</td>
<td>150/12</td>
<td>1200</td>
<td>TP 412</td>
<td>320 870</td>
<td>60</td>
<td>147 0.4</td>
<td>5/12</td>
<td>2120</td>
<td>1680 1860 2350</td>
<td></td>
<td></td>
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<tr>
<td>K</td>
<td>180/12</td>
<td>1200</td>
<td>TP 412H</td>
<td>370 980</td>
<td>60</td>
<td>160' 0.4</td>
<td>5/12</td>
<td>2120</td>
<td>1680 1860 2450</td>
<td></td>
<td></td>
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<tr>
<td>K</td>
<td>240/12</td>
<td>1200</td>
<td>TP 587</td>
<td>570 1500</td>
<td>80</td>
<td>180' 0.4</td>
<td>8/12</td>
<td>2280</td>
<td>1760 1860 2800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>360/12</td>
<td>1200</td>
<td>TBN 800</td>
<td>750</td>
<td>90</td>
<td>260' 0.4</td>
<td>11/20</td>
<td>2370</td>
<td>1810 1950 3500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>400/12</td>
<td>1200</td>
<td>TBN 1100</td>
<td>1050</td>
<td>126</td>
<td>295' 0.4</td>
<td>12/22</td>
<td>2370</td>
<td>1930 2100 3700</td>
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</table>

| K    | 10/13        | 1300           | A 70     | 20 50 70       | 16                  | 47' 0.3                  | 5/8'                            | 1890          | 1240 1440 1000 |             |
| K    | 20/13        | 1300           | A 150    | 45 120 150    | 20                  | 63' 0.3                   | 5/8'                            | 1890          | 1400 1460 1300 |             |
| K    | 40/13        | 1300           | A 200    | 90 240 300    | 26                  | 84' 0.3                   | 5/8'                            | 2000          | 1450 1540 1650 |             |
| K    | 80/13        | 1300           | TP 287   | 180 470 550   | 50                  | 190' 0.3                  | 6/11'                           | 2050          | 1520 1580 1950 |             |

\(^1\) Al at 700 °C
\(^2\) CuZn 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.
\(^6\) Values for other materials, e.g. zinc, on request.

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Charging of transport ladle with tilting furnace K 360/12
Tilting furnace K 40/13 with extended spout (sculpture foundry Knaak)
Filling a mould with liquid bronze (photographer Andrea Künstle)
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. Designed with an exhaust vent over the crucible edge, these tilting furnaces achieve very high melting rates and optimum energy efficiency.

**Standard Equipment for all Tilting Furnaces**
- KB ..../12 for aluminum and zinc alloys
- KB ..../14 for copper alloys such as bronze or brass
- Modern and powerful two-stage burner for high melting capacity and low maintenance operation
- Fuel heating with either gas or oil
- Exhaust gas discharge over the crucible edge see page 6
- Multi-layer insulation for optimum energy efficiency and low external wall temperatures
- Incl. crucible
- Electro-hydraulic tilting device with safe two-hand operation on the furnace
- Uniform and precise pouring due to optimum pivot point
- Emergency outlet for safe discharge of the melt in case of a crucible break
- Integrated safety system which continues to operate the furnace at reduced power in case of malfunction in the thermocouple, in order to prevent the freezing of the melt
- 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.
- Low-maintenance furnace chamber control with temperature measurement behind the crucible

**Standard Equipment 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**
- Safety fence
- Work platform or platform for easier charging
- Collecting pan under the emergency outlet see page 39
- Information on other accessories see page 38 - 39

**Additional Equipment for Tilting Furnaces KB ..../12**
- Side exhaust gas discharge including cover see pages 7
- Insulated exhaust gas diverter connecting piece (exhaust flue) for side-wall exhaust gas vent to a connected customer suction system
- Crucible breakage monitoring with optical and acoustic signal
- SMS-alarm message in case of crucible breakage
- Bath control system (only when equipped with side exhaust gas discharge) see page 40
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 42
Hydraulic system with flame resistant hydraulic fluid

Two-stage burner, mounted on furnace frame

Cast copper alloy

### Tilting furnace KB 150/12 in production

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity in kg</th>
<th>Burner output</th>
<th>Melting performance in kg/h</th>
<th>Melting performance in kWh/kg</th>
<th>Consumption melting</th>
<th>Consumption holding</th>
<th>Outer dimensions in mm</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>KB 80/12</td>
<td>1200</td>
<td>1050</td>
<td>TP 287</td>
<td>180</td>
<td>300</td>
<td>220°</td>
<td>1.3 - 1.5°</td>
<td>10</td>
<td>2730</td>
<td>1530 1680</td>
<td>2100</td>
</tr>
<tr>
<td>KB 150/12</td>
<td>1200</td>
<td>1050</td>
<td>TP 412</td>
<td>330</td>
<td>300</td>
<td>240°</td>
<td>1.0 - 1.3°</td>
<td>11</td>
<td>2830</td>
<td>1630 1880</td>
<td>2600</td>
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<tr>
<td>KB 180/12</td>
<td>1200</td>
<td>1050</td>
<td>TP 412 H</td>
<td>370</td>
<td>300</td>
<td>260°</td>
<td>1.0 - 1.3°</td>
<td>13</td>
<td>2830</td>
<td>1630 1980</td>
<td>2800</td>
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<tr>
<td>KB 240/12</td>
<td>1200</td>
<td>1050</td>
<td>TP 587</td>
<td>570</td>
<td>390</td>
<td>400°</td>
<td>1.0 - 1.3°</td>
<td>15</td>
<td>3120</td>
<td>1840 1980</td>
<td>3100</td>
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<tr>
<td>KB 360/12</td>
<td>1200</td>
<td>1050</td>
<td>TBN 800</td>
<td>750</td>
<td>450</td>
<td>420°</td>
<td>1.0 - 1.3°</td>
<td>17</td>
<td>3170</td>
<td>1890 2080</td>
<td>3300</td>
</tr>
<tr>
<td>KB 400/12</td>
<td>1200</td>
<td>1050</td>
<td>TBN 1100</td>
<td>1800</td>
<td>450</td>
<td>450°</td>
<td>1.0 - 1.3°</td>
<td>19</td>
<td>3170</td>
<td>1890 2150</td>
<td>3600</td>
</tr>
</tbody>
</table>

1° Al at 700 °C
2° CuZn at 1000 °C
3° The stated melting performances are maximum values. Daily operation comes up to roughly 80 %.
4° External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
5° Incl. burner and hydraulic system
6° Values for other materials, e.g. zinc, on request
The fuel-heated tilting furnaces with recuperative burner provide for optimum energy utilization combined with very high melt quality. Fitted with a burner system including heat-recovery system the energy efficiency of fuel-heated tilting furnaces with the side exhaust gas discharge 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 6) is recommended.

### Standard Equipment as KB Models, but

- 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 1100 °C for melt bath temperatures up to 950 °C
- Required minimum gas pressure at full load: 80 mbar

### Tilting Furnaces KBR with Recuperative Burner
Gas-Fired, for Melting and Holding of Aluminum

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**Tilting furnace KBR 240/11**

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity in kg</th>
<th>Burner output</th>
<th>Melting performance in kg/h</th>
<th>Consumption melting in kWh/kg</th>
<th>Consumption holding in kWh/h</th>
<th>Outer dimensions in mm</th>
<th>Weight in kg</th>
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<tbody>
<tr>
<td>KBR 240/11</td>
<td>1100</td>
<td>950</td>
<td>TP 587</td>
<td>570</td>
<td>390</td>
<td>320&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.1 - 1.4&lt;sup&gt;1&lt;/sup&gt;</td>
<td>13</td>
<td>2580</td>
<td>2300</td>
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<tr>
<td>KBR 360/11</td>
<td>1100</td>
<td>950</td>
<td>TBN 800</td>
<td>750</td>
<td>450</td>
<td>340&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.1 - 1.4&lt;sup&gt;1&lt;/sup&gt;</td>
<td>15</td>
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<td>2350</td>
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<tr>
<td>KBR 400/11</td>
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<td>TBN 1100</td>
<td>1000</td>
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<td>360&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.1 - 1.4&lt;sup&gt;1&lt;/sup&gt;</td>
<td>16</td>
<td>2580</td>
<td>2350</td>
</tr>
</tbody>
</table>

<sup>1</sup>Al at 700 °C

<sup>2</sup>The stated melting performances are maximum values. Daily operation comes up to roughly 80 %.

<sup>3</sup>External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

<sup>4</sup>Incl. burner

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**Tilting furnace KBR 240/11 during filling of a transport ladle**

**Melting thermocouple**

**Insulated connecting piece for side-wall exhaust gas vent to a connected customer suction system**
Product Videos Melting Furnaces

**Tilting Furnace for Aluminum**

Typical solution for flexible premelting. Several electric tilting furnaces, for melting of partly different alloys, and subsequent transfer of the melt to the casting location by means of a crane transport ladle. For further information on this furnace series, also see page 10.

**Tilting Furnace and Transportable Holding Furnace**

Fast melting in the gas-fired tilting furnace and subsequent filling of transportable holding furnaces. By filling the holding furnace directly at the premelter, the number of refilling operations can be kept low. This has a positive effect on both energy efficiency and melt quality. For more information on these furnaces, also see page 12 and page 25.

**SiC Rod Heated Tilting Furnace/Cupola Melting Furnace**

The SiC rod-heated furnace of the KC/TC series shown here is characterized by its high maximum temperature and thus also enables the melting of alloys with particularly high casting temperatures, such as aluminum bronze or certain precious metals.

Charging of transport ladle with tilting furnace K 360/12

Scan for product video „Tilting furnace for aluminum“

Scan for product video „Tilting furnace KB 360/12 and transportable holding furnace TM 150/11“

Tilting furnace KB 360/12 and transportable holding furnace TM 150/11

Tilting furnace KC 80/14

Scan for product video „Tilting furnace for precious metals“
Tilting Furnace KC
SiC-Rod-Heated, for Melting

The electrically heated tilting furnaces of the KC product lines are characterized by a higher maximal temperature than achievable with wire heated melting furnaces. This allows for processing of demanding copper alloys such as aluminum bronze. These furnaces are designed for permanent operation at working temperatures.

**Standard Equipment**

- Melt temperatures up to 1320 °C
- Symmetrical heating via powerful SiC rods
- SiC-Crucible
- Simple exchange of individual heating elements
- Heat operation by thyristors 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.
- Multi-layer insulation for optimum energy efficiency and low external wall temperatures
- Electro-hydraulic tilting device with safe two-hand operation on the furnace
- Uniform and precise pouring due to optimum pivot point
- Emergency outlet for safe draining of the melt in case of crucible breakage
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- 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.
- Low-maintenance furnace chamber control with temperature measurement behind the crucible

**Additional Equipment**

- Additional heating transformers provide for significant reduction of the connected load
- Safety fence
- Work platform for simplified loading
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 42
- For information on other accessories see page 38 - 39
Heated on both sides by high performance SiC rods

Switchgear with thyristors in phase angle operation for economic power consumption

Swing lid with good sealing to collar plate to avoid heat loss over the crucible opening

### Tilting furnace KC 80/14 during casting

### Table: Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Crucible</th>
<th>Capacity in kg Cu</th>
<th>Heating power in kW</th>
<th>Connected load in kW</th>
<th>Melting performance in kg/h Cu</th>
<th>Outer dimensions in mm</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>KC 20/14</td>
<td>1450</td>
<td>1320</td>
<td>A 150</td>
<td>150</td>
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<td>120²</td>
<td>1710</td>
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<td>KC 40/14</td>
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<td>1320</td>
<td>A 300</td>
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<td>36</td>
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<td>1320</td>
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<td>112</td>
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<td>1320</td>
<td>TPC 412H</td>
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<td>230²</td>
<td>2000</td>
<td>2070</td>
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</tbody>
</table>

¹Reduction of connected load by optional heating transformers
²CuZn at 1000 °C
³The specified melting performances are maximum values. In practice, approx. 80 % are achieved.
⁴External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
Bale-out furnaces are suitable for melting and holding and are characterized by good energy efficiency. Depending on the model, for aluminum, zinc or copper alloys.

- Low-maintenance furnace chamber control with temperature measurement behind the crucible
- Multi-layer insulation for optimum energy efficiency and low external wall temperatures
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- 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.
- Defined application within the constraints of the operating instructions
- As additional equipment: Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control
<table>
<thead>
<tr>
<th>Furnace Group</th>
<th>Model</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bale-out furnaces T</td>
<td>T</td>
<td>20</td>
</tr>
<tr>
<td>Bale-out furnaces TB</td>
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<tr>
<td>Bale-out furnaces TBR with recuperative burner</td>
<td>TBR</td>
<td>24</td>
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<tr>
<td>Transportable bale-out furnaces TM</td>
<td>TM</td>
<td>25</td>
</tr>
<tr>
<td>Bale-out furnaces TC</td>
<td>TC</td>
<td>26</td>
</tr>
</tbody>
</table>
Bale-Out Furnaces T
Electrically Heated, for Melting and Holding

Whether in manual pouring operation or integrated in an automated casting cell, the electrically heated tilting furnaces are characterized by very good melt quality, optimum energy efficiency and low-maintenance operation. These furnaces are available with reduced connected load for only holding of aluminum alloys or with increased power for holding and melting as allrounders.

**Standard Equipment**

- T ../10 for holding aluminum alloys
- T ../11 for melting and holding aluminum and zinc alloys
- T ../13 for melting and holding copper alloys such as bronze or brass
- Free radiating heating elements arranged on four sides on support tubes provide for long service life and easy replacement
- Twelve months warranty on heating elements
- High melting performance with temperature uniformity in the melt
- Multi-layer insulation for optimum energy efficiency and low external wall temperatures
- Emergency outlet for safe draining of the melt in case of crucible breakage
- No exhaust gas discharge needed
- Integrated safety system which continues to operate the furnace at reduced power in case of malfunction in the 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.
- Low-maintenance furnace chamber control with temperature measurement behind the crucible

**Additional Equipment**

- Crucible of clay-graphite or SiC
- Collecting pan under the emergency outlet see page 39
- Crucible breakage monitor with visual and audible signal (not for T ../13)
- Bath control with thermocouples in the furnace chamber and in the melt (not for T ../13). 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
- Multi-step switching of the furnace heat (see page 43)
- Higher electrical ratings to increase melting performance
- Work platform for ease of charging
- Alarm message via SMS, e.g. in the event of crucible breakage
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 42
- For information on other accessories see page 38 - 39
## Bale-out furnace T 80/13 for gunmetal in a sand foundry shop

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity in kg</th>
<th>Heating power in kW</th>
<th>Melting performance</th>
<th>Consumption melting kWh/kg</th>
<th>Consumption holding kWh/h</th>
<th>Outer dimensions in mm</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 80/10</td>
<td>1000 800</td>
<td>BU 200</td>
<td>200</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>4/3</td>
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</tr>
<tr>
<td>T 110/10</td>
<td>1000 800</td>
<td>BU 300</td>
<td>300</td>
<td>-</td>
<td>-</td>
<td>26</td>
<td>-</td>
<td>-</td>
<td>5/10</td>
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<tr>
<td>T 150/10</td>
<td>1000 800</td>
<td>BU 350</td>
<td>350</td>
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<td>38</td>
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<td>T 180/10</td>
<td>1000 800</td>
<td>BU 500</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td>42</td>
<td>-</td>
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<td>7/15</td>
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</tr>
<tr>
<td>T 240/10</td>
<td>1000 800</td>
<td>BU 600</td>
<td>600</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>7/15</td>
<td>1370 1370 1350 1530</td>
</tr>
<tr>
<td>T 360/10</td>
<td>1000 800</td>
<td>BN 800</td>
<td>800</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>8/17</td>
<td>1510 1510 1490 2000</td>
</tr>
<tr>
<td>T 450/10</td>
<td>1000 800</td>
<td>BU 1800 H 830</td>
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<td>-</td>
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<td>50</td>
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<td>12/20</td>
<td>1685 1685 1360 2400</td>
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<td>T 560/10</td>
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<td>BU 1800 H 1000</td>
<td>1400</td>
<td>-</td>
<td>-</td>
<td>50</td>
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<td>-</td>
<td>13/23</td>
<td>1685 1685 1530 2550</td>
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<tr>
<td>T 800/10</td>
<td>1000 800</td>
<td>BU 1800</td>
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<td>-</td>
<td>-</td>
<td>15/25</td>
<td>1685 1685 1830 2800</td>
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</tbody>
</table>

Al at 700 °C
CuZn at 1000 °C

1Al at 700 °C
2The specified melting performances are maximum values. In practice, approx. 80 % are achieved. Values for other materials, e. g. zinc, on request.
2Depending on furnace design connected load might be higher
3External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
4Values for other materials, e. g. zinc, on request

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1. Bale-out of bale-out furnace with robot
2. Four side heating for excellent temperature uniformity
3. Manual ladling from a bale-out furnace T 80/10
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.

### Bale-out furnace TB 20/14

- Standard Equipment for all Bale-Out Furnaces
  - TB ../12 for aluminum and zinc alloys
  - TB ../14 for copper alloys such as bronze or brass
  - Modern and powerful two-stage burner for high melting capacity and low maintenance operation
  - Fuel heating with either gas or oil
  - Multi-layer insulation for optimum energy efficiency and low external wall temperatures
  - Emergency outlet for safe discharge of the melt in case of a crucible break
  - Integrated safety system which continues to operate the furnace at reduced power in case of malfunction in the 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.
  - Low-maintenance furnace chamber control with temperature measurement behind the crucible

- Standard Equipment for Bale-Out Furnaces TB ../12
  - Side exhaust gas discharge results in a high quality of the melt
  - Swing lid

- Standard Equipment 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 provides for high melting capacity
  - 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 Bale-Out Furnaces TB ../12
  - Crucible breakage monitoring with optical and acoustic signal
  - SMS-alarm message in case of crucible breakage
  - Bath control system
Thermocouple for melt bath control
Emergency outlet for safe melt discharge in case of crucible break
Bale-out furnace TB 240/12 with lateral exhaust gas discharge

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace</th>
<th>Tmax melt bath</th>
<th>Crucible</th>
<th>Capacity in kg</th>
<th>Burner output</th>
<th>Melting performance⁴,⁵</th>
<th>Consumption melting⁶ kWh/kg</th>
<th>Consumption holding kWh/h</th>
<th>Outer dimensions in mm</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB 80/12</td>
<td>1200</td>
<td>1050</td>
<td>BU 200</td>
<td>200 525</td>
<td>180 140¹</td>
<td>1.3 - 1.5⁴</td>
<td>10</td>
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<td>240</td>
<td>900</td>
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<td>TB 100/12</td>
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<td>1050</td>
<td>BU 250</td>
<td>250 660</td>
<td>180 140¹</td>
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<td>1310</td>
<td>260</td>
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<td>BU 300</td>
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<td>210 150¹</td>
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<td>1310</td>
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<tr>
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<td>BU 350</td>
<td>350 920</td>
<td>300 220¹</td>
<td>1.3 - 1.5⁴</td>
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<tr>
<td>TB 180/12</td>
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<td>1050</td>
<td>BU 500</td>
<td>500 1320</td>
<td>300 270¹</td>
<td>1.3 - 1.5⁴</td>
<td>17</td>
<td>1450</td>
<td>320</td>
<td>1800</td>
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<td>BU 600</td>
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<td>BU 1210</td>
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<td>1200</td>
<td>1050</td>
<td>BU 1310</td>
<td>1300 3430</td>
<td>500 420¹</td>
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<td>1050</td>
<td>BP 1000</td>
<td>1400 3690</td>
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<td>1.3 - 1.5⁴</td>
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<td>1760</td>
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<td>1050</td>
<td>BU 1510</td>
<td>1500 3960</td>
<td>500 420¹</td>
<td>1.3 - 1.5⁴</td>
<td>28</td>
<td>1690</td>
<td>550</td>
<td>4500</td>
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<tr>
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<td>1050</td>
<td>BU 1800</td>
<td>1800 4750</td>
<td>500 440¹</td>
<td>1.3 - 1.5⁴</td>
<td>30</td>
<td>1760</td>
<td>590</td>
<td>4900</td>
</tr>
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</table>

¹ Al at 700 °C
² CuZn at 1000 °C
³ The stated melting performances are maximum values. Daily operation comes up to roughly 80 %.
⁴ External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
⁵ Values for other materials, e.g. zinc, on request.
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.

**Standard Equipment as TB Models, but**

- 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
- Maximum furnace chamber temperature 1100 °C, for melt bath temperatures up to 950 °C
- Required min. gas pressure with full load: 70 mbar
- Only gas firing possible, no oil
- 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.
- Low-maintenance furnace chamber control with temperature measurement behind the crucible

**Crucible furnace TBR 110/11**

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Crucible</th>
<th>Capacity in kg</th>
<th>Burner output kW</th>
<th>Melting performance kg/h</th>
<th>Consumption melting kWh/kg</th>
<th>Consumption holding lid closed kWh/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBR 80/11</td>
<td>1100</td>
<td>950</td>
<td>BU 200</td>
<td>200</td>
<td>180</td>
<td>140(^1)</td>
<td>1.0 - 1.1</td>
<td>8.0</td>
</tr>
<tr>
<td>TBR 100/11</td>
<td>1100</td>
<td>950</td>
<td>BU 250</td>
<td>250</td>
<td>180</td>
<td>140(^1)</td>
<td>1.0 - 1.1</td>
<td>8.8</td>
</tr>
<tr>
<td>TBR 110/11</td>
<td>1100</td>
<td>950</td>
<td>BU 300</td>
<td>300</td>
<td>210</td>
<td>150(^1)</td>
<td>1.0 - 1.1</td>
<td>10.4</td>
</tr>
<tr>
<td>TBR 150/11</td>
<td>1100</td>
<td>950</td>
<td>BU 350</td>
<td>350</td>
<td>240</td>
<td>220(^1)</td>
<td>1.0 - 1.1</td>
<td>12.0</td>
</tr>
<tr>
<td>TBR 180/11</td>
<td>1100</td>
<td>950</td>
<td>BU 500</td>
<td>500</td>
<td>300</td>
<td>270(^1)</td>
<td>1.0 - 1.1</td>
<td>13.6</td>
</tr>
<tr>
<td>TBR 240/11</td>
<td>1100</td>
<td>950</td>
<td>BU 600</td>
<td>600</td>
<td>320</td>
<td>330(^1)</td>
<td>1.0 - 1.1</td>
<td>15.2</td>
</tr>
<tr>
<td>TBR 360/11</td>
<td>1100</td>
<td>950</td>
<td>BU 800</td>
<td>800</td>
<td>320</td>
<td>350(^1)</td>
<td>1.0 - 1.1</td>
<td>16.0</td>
</tr>
</tbody>
</table>

\(^1\) Al at 700 °C

\(^2\) The stated melting performances are maximum values. Daily operation comes up to roughly 80 %.
Transportable Bale-Out Furnaces TM
Electrically Heated, for Holding and Transport Aluminum

The transportable 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 meander-shape 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. Due to the filling of the bale-out furnace directly at the premelting furnace, the otherwise necessary intermediate transport by means of a transport ladle and an additional filling process can be omitted. This has a positive effect on both energy efficiency and melt quality.

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Crucible</th>
<th>Capacity in kg</th>
<th>Heating power holding lid closed/open kWh/h</th>
<th>Outer dimensions in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM 80/10</td>
<td>1000</td>
<td>800</td>
<td>BU 200</td>
<td>200</td>
<td>21/4</td>
<td>1000/1100/1150</td>
</tr>
<tr>
<td>TM 150/10</td>
<td>1000</td>
<td>800</td>
<td>875/600</td>
<td>350</td>
<td>36/5/10</td>
<td>1320/1440/1150</td>
</tr>
<tr>
<td>TM 240/10</td>
<td>1000</td>
<td>800</td>
<td>BU 600</td>
<td>600</td>
<td>42/7/15</td>
<td>1220/1340/1450</td>
</tr>
<tr>
<td>TM 310/10</td>
<td>1000</td>
<td>800</td>
<td>1170/580</td>
<td>770</td>
<td>42/8/17</td>
<td>1650/1730/1200</td>
</tr>
</tbody>
</table>

- Tmax 1000 °C, ideal for holding of aluminum alloys
- Cylindrical, highly stable furnace housing
- Damper slots under the furnace for safe forklift transportation of the furnace with the melt inside the foundry
- All-round heating provided by meander-shape heating elements
- Plug connection on the furnace for easy disconnection of the connecting cable to the switchgear
- Heating controlled using long-lasting 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
- No exhaust gas vent necessary
- Crucible in standard design not included
- 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.
- Low-maintenance furnace chamber control with temperature measurement behind the crucible

Additional equipment like models T see page 20

1Al at 700 °C
2Depending on furnace design connected load might be higher
3External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

Forklift entry with dampers
Meander heating elements
Plug socket on the furnace for the cable connection to the switchgear and control box
Bale-Out Furnace TC
SiC-Rod-Heated, for Melting

The electrically heated bale-out furnaces of the TC product lines are characterized by a higher maximal temperature than achievable with wire heated melting furnaces. This allows for processing of demanding copper alloys such as aluminum bronze. These furnaces are designed for permanent operation at working temperatures.

### Standard Equipment

- Melt temperatures up to 1320 °C
- Symmetrical heating via powerful SiC rods
- Simple exchange of individual heating elements
- Heat operation by thyristors 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.
- Multi-layer insulation for optimum energy efficiency and low external wall temperatures
- Emergency outlet for safe draining of the melt in case of crucible breakage
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that aluminosilicate wool, also known as "refractory ceramic fiber" (RCF), which is classified and possibly carcinogenic, is not used.
- 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.
- Low-maintenance furnace chamber control with temperature measurement behind the crucible

### Additional Equipment

- Additional heating transformers provide for significant reduction of the connected load
- Work platform for simplified loading
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 42
- For information on other accessories see page 38 - 39

### Bale-out furnace TC 80/14

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Crucible</th>
<th>Capacity in kg</th>
<th>Heating power in kW</th>
<th>Connected load in kW</th>
<th>Melting performance in kg/h Cu</th>
<th>Outer dimensions in mm</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC 20/14</td>
<td>1450</td>
<td>1320</td>
<td>A 150</td>
<td>150</td>
<td>36</td>
<td>69</td>
<td>120°</td>
<td>1200 1250 930</td>
<td>830</td>
</tr>
<tr>
<td>TC 40/14</td>
<td>1450</td>
<td>1320</td>
<td>A 300</td>
<td>300</td>
<td>36</td>
<td>69</td>
<td>120°</td>
<td>1250 1020 950</td>
<td>950</td>
</tr>
<tr>
<td>TC 80/14</td>
<td>1450</td>
<td>1320</td>
<td>BU 200</td>
<td>650</td>
<td>48</td>
<td>94</td>
<td>180°</td>
<td>1360 1350 1080</td>
<td>1050</td>
</tr>
<tr>
<td>TC 150/14</td>
<td>1450</td>
<td>1320</td>
<td>BU 300</td>
<td>1000</td>
<td>66</td>
<td>112</td>
<td>220°</td>
<td>1450 1320 1300</td>
<td>1300</td>
</tr>
</tbody>
</table>

1Reduction of connected load by optional heating transformers
2CuZn at 1000 °C
3The specified melting performances are maximum values. In practice, approx. 80 % are achieved.
4External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

- Switchgear with thyristors in phase angle operation for economic power consumption
- Heated on both sides by high performance SiC rods
- Swing lid with good sealing to collar plate to avoid heat loss over the crucible opening
<table>
<thead>
<tr>
<th>Furnace Group</th>
<th>Model</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath furnaces B</td>
<td>B</td>
<td>30</td>
</tr>
<tr>
<td>Laboratory tilting furnace K/KC</td>
<td>K/KC</td>
<td>31</td>
</tr>
<tr>
<td>Melting furnaces in customized dimensions</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>Cleaning furnace for riser tubes SRO</td>
<td>SRO</td>
<td>35</td>
</tr>
</tbody>
</table>
Bath Furnaces B
Electrically Heated, for Holding of Aluminum

The 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.

### Standard Equipment
- Perfectly suited for holding of aluminum
- Heating mounted in the lid, freely radiating from carrier tubes
- Particularly low energy consumption due to generously dimensioned, multi-layer insulation
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- Very high melt quality, among other things because the extraction basin is connected to the heated main basin only below the bath surface.
- Heating switched by low-maintenance solid-state-relays
- No exhaust gas discharge needed
- Temperature control/measurement in the melt and in the furnace chamber
- Useful only for holding, not for melting

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

### Table

<table>
<thead>
<tr>
<th>Model</th>
<th>Tmax furnace °C</th>
<th>Tmax melt bath °C</th>
<th>Capacity in kg</th>
<th>Heating power in kW</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.

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
Laboratory Tilting Furnaces K/KC
Electrically Heated

These compact tilting 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 4/14) 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 °C, 1300 °C, or 1400 °C.

### Standard Equipment
- Tmax 1000 °C, 1300 °C, or 1400 °C
- Crucible sizes of 0.75 liters, 1.5 liters or 3 liters
- Crucible with integrated pouring spout of clay-graphite included with delivery
- Additional spout (not for KC 4/14), mounted at the furnace for exact pouring
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.
- 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
- Controller R7 (resp. 3508 for KC)

### 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

### Model Specifications

<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>Connected load kW</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>K 1/10</td>
<td>1000</td>
<td>850</td>
<td>A6</td>
<td>1.5</td>
<td>0.75</td>
<td>600</td>
<td>710</td>
</tr>
<tr>
<td>K 2/10</td>
<td>1000</td>
<td>850</td>
<td>A10</td>
<td>3</td>
<td>1.50</td>
<td>600</td>
<td>710</td>
</tr>
<tr>
<td>K 4/10</td>
<td>1000</td>
<td>850</td>
<td>A25</td>
<td>7</td>
<td>3.00</td>
<td>670</td>
<td>800</td>
</tr>
<tr>
<td>K 1/13¹</td>
<td>1300</td>
<td>1150</td>
<td>A6</td>
<td>1.5</td>
<td>0.75</td>
<td>600</td>
<td>710</td>
</tr>
<tr>
<td>K 2/13¹</td>
<td>1300</td>
<td>1150</td>
<td>A10</td>
<td>3</td>
<td>1.50</td>
<td>600</td>
<td>710</td>
</tr>
<tr>
<td>K 4/13¹</td>
<td>1300</td>
<td>1150</td>
<td>A25</td>
<td>7</td>
<td>3.00</td>
<td>670</td>
<td>800</td>
</tr>
<tr>
<td>KC 1/14²</td>
<td>1400</td>
<td>1250</td>
<td>A6</td>
<td>6</td>
<td>0.75</td>
<td>570</td>
<td>630</td>
</tr>
<tr>
<td>KC 2/14²</td>
<td>1400</td>
<td>1250</td>
<td>A10</td>
<td>10</td>
<td>1.50</td>
<td>570</td>
<td>630</td>
</tr>
<tr>
<td>KC 4/14²</td>
<td>1400</td>
<td>1250</td>
<td>A25</td>
<td>25</td>
<td>3.00</td>
<td>670</td>
<td>870</td>
</tr>
</tbody>
</table>

¹Outer dimensions of furnace, transformer in separate housing (500 x 570 x 300 mm)
²Switchgear and controller mounted in a floor standing cabinet
³External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
Tilting furnace K 240/12 with lifting platform for charging and pouring at different levels

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.

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, degassing 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.
The 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.
Melting Furnaces for Magnesium

For a variety of projects, Nabertherm has supplied melting furnaces to be upgraded by the customer for the melting of magnesium. Nabertherm supplied the tilting furnace with all necessary control systems and the steel crucible. The melting furnaces were completed by the customer with the safety devices, the pump systems for bale-out, and gas supply systems.
Cleaning Furnace for Riser Tubes SRO 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 life-time 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.

**Standard Equipment**

- 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: Length: 1000 mm, outer dimension 90 mm with single-side flange with an outer diameter of 115 mm
- Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as "refractory ceramic fiber" (RCF), which is classified and possibly carcinogenic, is not used.
- 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
- NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive

**Additional Equipment**

- Design for other riser dimensions on request
- Switchgear on rollers

**Model | Tmax °C | Outer dimensions* in mm | Outer tube-Ø/ mm | Heated length/mm | Heating power in kW** | Electrical connection**
--- | --- | --- | --- | --- | --- | ---
SRO 170/1000/11 | 1100 | 590 | 640 | 1700 | 90 | 1000 | 12.0 | 3-phase

*Depending on furnace design connected load might be higher
*External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
*Please see page 43 for more information about supply voltage

Cleaning furnace SRO 170/1000/11 with suspended pipe

To be pulled with crane eye for riser tubes with flange

Cleaning furnace SRO 170/1000/11

Steel collector designed as a drawer
Accessories and Process Control and Documentation
<table>
<thead>
<tr>
<th>Table Entry</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories for bale-out and tilting furnaces</td>
<td>38</td>
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<tr>
<td>Control and documentation alternatives for melting furnaces</td>
<td>40</td>
</tr>
<tr>
<td>Standard controllers, HiProSystems control and documentation</td>
<td>40</td>
</tr>
<tr>
<td>Data storing and visualization</td>
<td>42</td>
</tr>
<tr>
<td>Functions of the standard controller</td>
<td>43</td>
</tr>
</tbody>
</table>
Accessories for Bale-Out and Tilting Furnaces

Our wide range of furnaces for the foundry can be extended individually for your application processes by our extensive range of accessories. For detailed information or for special requests, please contact us. With our long term experience and one of the largest engineering departments in the furnace industry, we would be very pleased to work with you and find a solution tailored to your needs.

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.

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.

Crucible Breakage Alarm Device for T(B)../12 Models

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 an 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.

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.

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).
Control and Documentation Alternatives for Melting Furnaces

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.

Furnace Control with Eurotherm 3208 or Eurotherm 3508 and Optional Weekly Timer

In the basic design, Nabertherm melting furnaces are equipped with Eurotherm 3208 or Eurotherm 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 Touch Panel or H700 Touch Panel for Bale-Out 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 baleout 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.

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 (gasfired 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.
Other Possible Additional Functions

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 NTLogComfort

With this extension, the process data can be stored in real time on a USB stick. No additional thermocouples or sensors are required. Only the data that is available in the controller is recorded. The CSV data can then be analyzed on a PC, either via NTGraph or via a customer-supplied spreadsheet program (e.g. MS Excel). In addition, a computer in the same local network can be connected via an Ethernet connection so that data can be written directly to this computer.

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 and comprehensive 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.
- In addition, the PC can also be used as an operator interface for several furnaces simultaneously
- NCC AA (Aviation and Automotive) for applications according to CQI9, AMS or NADCAP

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

<table>
<thead>
<tr>
<th>Controller Type</th>
<th>Eurotherm 3208</th>
<th>Eurotherm 3508</th>
<th>H500</th>
<th>H700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available for models</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>Functions</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Furnace control</td>
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<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Melt bath control</td>
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<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Weekly timer</td>
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<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<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>
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<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>Band alarm under/over temperature</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>
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<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Documentation with NTLogComfort</td>
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<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Documentation with NCC</td>
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<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

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).
Heat Treatment before and after Casting
<table>
<thead>
<tr>
<th>Topic</th>
<th>Seite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tempering plants for aluminum and steel</td>
<td>46</td>
</tr>
<tr>
<td>Furnaces for continuous processes</td>
<td>48</td>
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<tr>
<td>Wax burnout</td>
<td>50</td>
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<tr>
<td>Additive manufacturing</td>
<td>52</td>
</tr>
<tr>
<td>Energy efficiency concepts</td>
<td>53</td>
</tr>
</tbody>
</table>
Tempering Plants for Aluminum and Steel

After casting, multi-stage heat treatment is often necessary. For processes such as the T6 heat treatment of aluminum (solution annealing, quenching and ageing) or the hardening of steel, quenching and tempering plants are used. Due to the design consisting of one or more furnaces in combination with a quenching tank or a cooling station, the quenching and tempering process can be carried out manually, semi-automatically or even fully automatically.

General Properties

- Multi-stage heat treatment of aluminum alloys and steel
- Manual, semi-automated or even fully automated
- Concepts for horizontal or vertical movement of the charge
- Quenching delay times from start of door opening of only 5 seconds possible
- Standard sizes and customized solutions available
- Process data acquisition and consideration of common automotive and aerospace standards such as CQI-9, AMS2750F

Horizontal Quenching and Tempering Plants

In horizontal quenching and tempering plants, the quench tank is positioned in front of the chamber furnace. The charge is transferred horizontally into the furnace by a 2-axis manipulator and, after heat treatment, is removed hot and quenched. As the movement technology in this plant concept is only in the hot furnace chamber for a short time, temperatures of up to 1300 °C are possible.

Drop-Bottom Furnace Plants

Drop-bottom furnaces are used for solution annealing and subsequent rapid quenching of aluminum alloys. Especially for thin-walled aluminum components, quenching delay times of only 5 seconds from the start of door opening to complete immersion in the quenching bath can be realized.
The modular design of our systems enables a wide range of design options for the plant and, with appropriate planning, also the possibility of later expansion.

Customized Solutions

Mobile drop-bottom furnace for solution annealing with pit-type furnace for artificial ageing with four parking places

For detailed information, please also see our catalog Thermal Process Technology.
Furnaces for Continuous Processes

For continuous processes with fixed cycle times, such as core or mold drying or for preheating molds in investment casting, continuous furnaces or rotary hearth furnaces are often the right choice. Depending on the process, different working temperatures, conveying concepts and heating concepts can be used here.

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

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

Heating Systems
- Electric heating, radiation or convection
- Direct or indirect gas-fired
- Infrared heating
- Heating with the use of external heat sources
Cycle push-through plant for artificial ageing of aluminum castings

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

For detailed information, please also see our catalog Thermal Process Technology.
Wax Burnout

For casting with lost patterns, among other things, furnaces are needed to get the pattern material out of the mold in a safe way and to fire the mold. Nabertherm also offers different solutions for this.

Dewaxing Furnaces, Electrically Heated

These furnaces are specially designed for lost wax melting with subsequent firing of the ceramic mold. The electrically heated models are operated below the flash point of the wax for lost wax melting. The furnaces have a heated outlet in the bottom of the furnace chamber, which tapers to the center in a funnel shape. Below the furnace is a sealed stainless steel container with a removable drawer in which the wax is collected. After completion of the melting out process, the furnace continues to heat up to fire the molds.

Dewaxing Furnaces, Gas-Fired

The chamber furnaces of the NB .. BOWAX are suitable for flash-fire processes in which the hot furnace is loaded with casting screws. For fast loading and unloading, the furnace is equipped with a pneumatic lift door. After loading, the wax liquefies in a very short time. The first part of the outflowing wax runs via the integrated pan directly into a collecting basin under the furnace and is safely collected in a water basin. The remaining part of the wax evaporates in the furnace chamber and is safely burned in the downstream thermal afterburning.
Burnout of Residual Wax or 3D-Printed Plastic Models

The chamber furnaces of the series N(B) .. BO are used for processes with high organic quantities or high evaporation rates. For safety reasons, they have an integrated pilot burner for ignition of the flammable components in mixed gases. An accumulation of ignitable components is avoided and safe burning is ensured. These furnaces can be used for residual dewaxing of casting screws or burnout of 3D-printed plastic models with subsequent sintering of the mold.

For detailed information, please also see our catalog Advanced Materials.
Additive manufacturing allows for the direct conversion of design construction files fully functional objects. With 3D-printing objects from metals, plastics, ceramics, glass, sand or other materials are 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.

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Retort furnace NR 150/11 for annealing of metal parts of 3D-printing

Oven TR 240 for drying of powders

Chamber oven KTR 2000 for curing after 3D-printing

Compact tube furnace for sintering or annealing under protective gases or in a vacuum after 3D-printing

HT 160/17 DB200 for debinding and sintering of ceramics after 3D-printing

<table>
<thead>
<tr>
<th>Metals</th>
<th>Ceramics, Glass, Composites, Sand</th>
<th>Plastics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debinding</td>
<td>Sintering</td>
<td>Curing</td>
</tr>
<tr>
<td>Stress-relieving</td>
<td>Solution annealing</td>
<td>Tempering</td>
</tr>
<tr>
<td>Hardening</td>
<td>Drying</td>
<td>Drying</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>under Protective Gases, Reaction Gases or in Vacuum</th>
<th>in Air</th>
<th>in Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamber furnaces with gas-supply boxes</td>
<td>Debinding in chamber furnaces with air circulation</td>
<td>Ovens</td>
</tr>
<tr>
<td>Hot-wall retort furnaces</td>
<td>Sintering in chamber furnaces</td>
<td>Forced convection chamber furnaces</td>
</tr>
<tr>
<td>Cold-wall retort furnaces</td>
<td>Debinding and Sintering in combi furnaces</td>
<td>See also concepts for drying, debinding, thermal cleaning and wax burnout in catalog Advanced Materials</td>
</tr>
<tr>
<td>See also catalog Thermal Process Technology</td>
<td>Dewaxing Furnaces</td>
<td>See also catalog Advanced Materials as well as catalog Thermal Process Technology</td>
</tr>
</tbody>
</table>

Also, concomitant or upstream processes of additive manufacturing require the use of a furnace in order to achieve the desired product properties, such as heat treatment or drying the powder.
Energy Efficiency Concepts

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.
Spare Parts and Customer Service — Our Service Makes the Difference

For many years the name Nabertherm has been standing for top quality and durability in furnace manufacturing. To secure this position for the future as well, Nabertherm offers not only a first-class spare parts service, but also excellent customer service for our customers. Benefit from more than 70 years of experience in furnace construction.

In addition to our highly qualified service technicians on site, our service specialists in Lilienthal are also available to answer your questions about your furnace. We take care of your service needs to keep your furnace always up and running. In addition to spare parts and repairs, maintenance and safety checks as well as temperature uniformity measurements are part of our service portfolio. Our range of services also includes the modernization of older furnace systems or new linings.

The needs of our customers always have highest priority!

- Very fast spare parts supply, many standard spare parts in stock
- Worldwide customer service on site with its own service points in the largest markets
- International service network with long-term partners
- Highly qualified customer service team for quick and reliable repair of your furnace
- Commissioning of complex furnace systems
- Customer training in function and operation of the system
- Temperature uniformity measurements, also according to standards like AMS2750F (NADCAP)
- Competent service team for fast help on the phone
- Safe teleservice for systems with PLC controls via modem, ISDN or a secured VPN line
- Preventive maintenance to ensure that your furnace is ready for use
- Modernization or relining of older furnace systems

Contact us:

Spares: spares@nabertherm.de +49 (4298) 922-474

Customer Service: service@nabertherm.de +49 (4298) 922-333
Please visit our website www.nabertherm.com and find out all you want to know about us - and especially about our products.

In addition to current information and exhibition dates, there is of course the possibility of direct contact or an authorized dealer from our worldwide dealer network.

Professional Solutions for:

- Thermal Process Technology
- Additive Manufacturing
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- Fiber Optics/Glass
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- Dental
- Arts & Crafts
Headquarters:

Nabertherm GmbH
Bahnhofstr. 20
28865 Lilienthal, Germany
Fon +49 4298 922 0
contact@nabertherm.de

Sales Organisation

China
Nabertherm Ltd. (Shanghai)
No. 158, Lane 150, Pingbei Road, Minhang District
201109 Shanghai, China
Fon +86 21 64902960
contact@nabertherm-cn.com

France
Nabertherm SARL
20, Rue du Cap Vert
21800 Quetigny, France
Fon +33 6 08318554
contact@nabertherm.fr

Spain
Nabertherm España
c/Marti i Julia, 8 Bajos 7º
08940 Cornellà de Llobregat, Spain
Fon +34 93 4744716
contact@nabertherm.es

Great Britain
Nabertherm Ltd., United Kingdom
Fon +44 7508 015919
contact@nabertherm.com

Italy
Nabertherm Italia
via Trento N° 17
50139 Florence, Italy
Fon +39 348 3820278
contact@nabertherm.it

Benelux
Nabertherm Benelux, The Netherlands
Fon +31 6 284 00080
contact@nabertherm.com

USA
Nabertherm Inc.
64 Reads Way
New Castle, DE 19720, USA
Fon +1 302 322 3665
contact@nabertherm.com

All other Countries: Follow
https://www.nabertherm.com/contacts

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