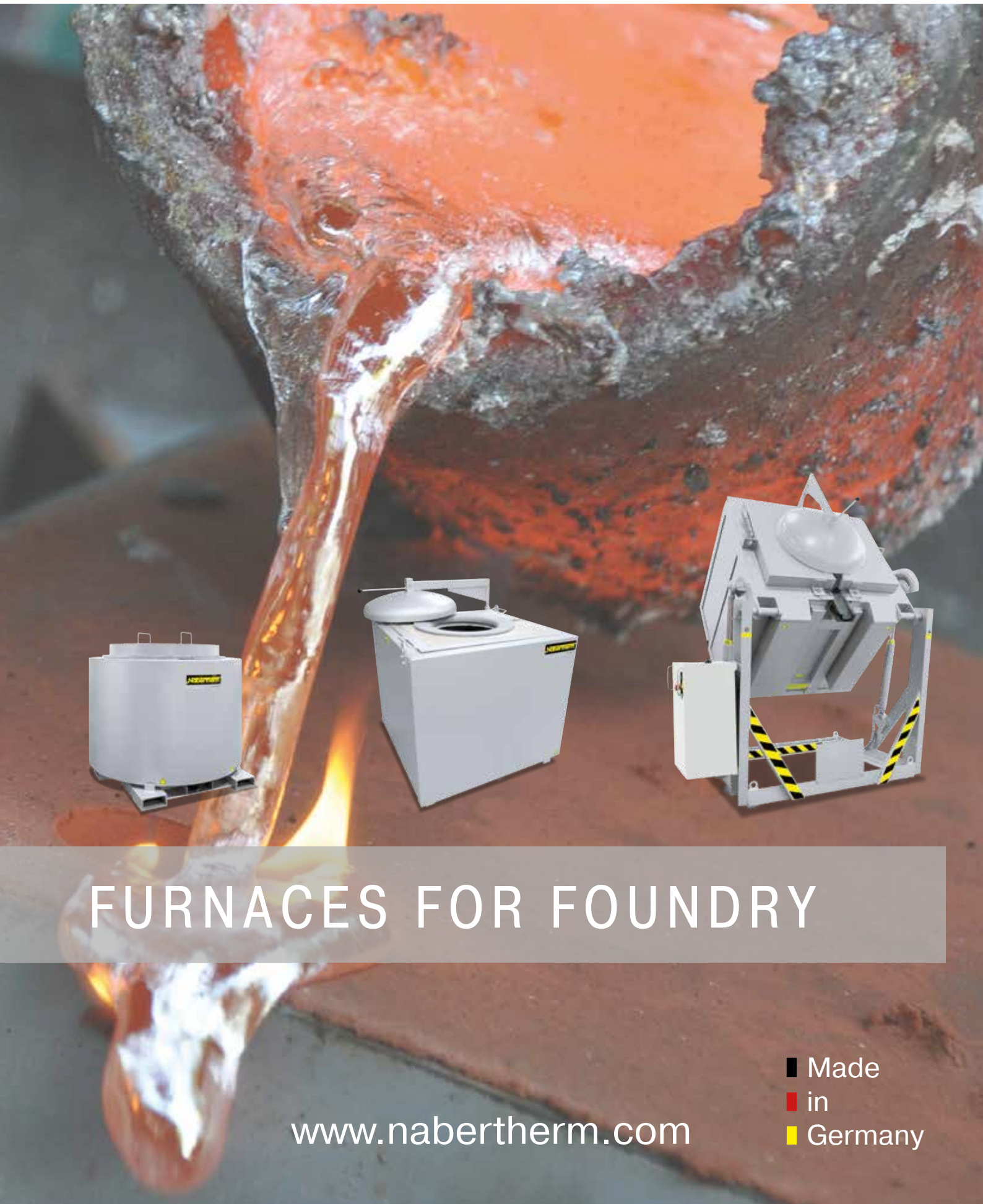
Nabertherm

MORE THAN HEAT **30 - 3000 °C**



FURNACES FOR FOUNDRY

Made
in
Germany

www.nabertherm.com

Facts

- Production of Arts & Crafts furnaces, laboratory furnaces, dental furnaces and industrial furnaces since 1947
- Production site in Lilienthal/Bremen - Made in Germany
- 600 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 informarion see page 50

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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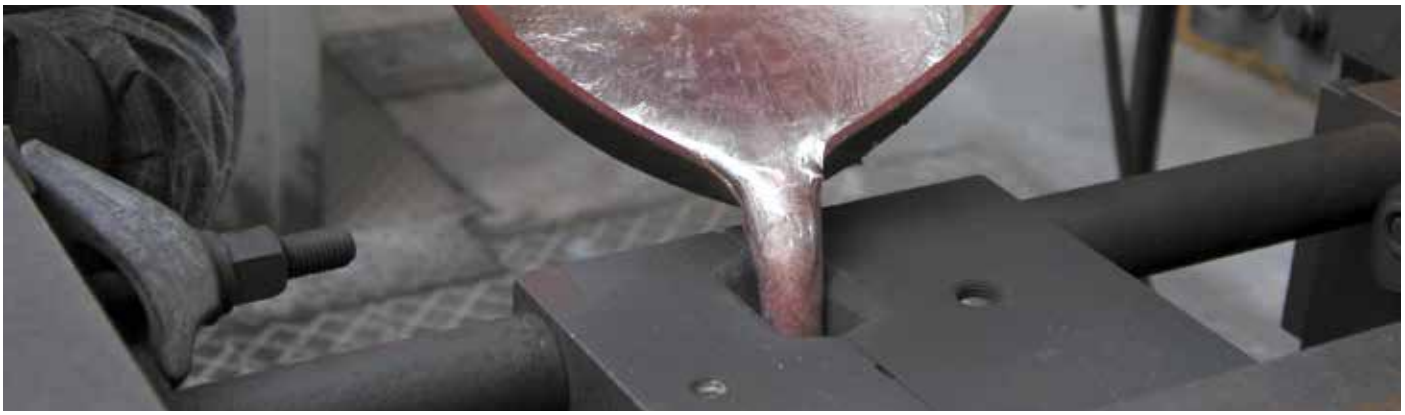

Which Furnace for which Process?

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For detailed product description, see catalog Thermal Process Technology:

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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 gas-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.

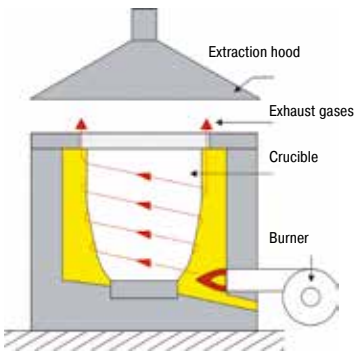
Gas-fired furnaces provide for optimal energy efficiency in combination with highest melt quality due to their burner system that includes heat recovery via recuperator. The hot exhaust gases from the melting furnace preheat the combustion air for the burner via a heat exchanger. This system leads to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

Electric Heating

If the melt quality and energy efficiency take priority, an electrically heated furnace is the best choice. The heating is controlled very steadily and precisely. The melt is not polluted through immissions from a gas-fired heating. Electrically heated furnaces can achieve up to 85 % of the melting performance of gas-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



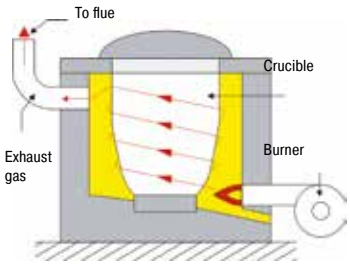
Exhaust gas discharge over the crucible edge

Exhaust gas discharge over the crucible edge is the standard design for our gas-fired cruicible furnaces, 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



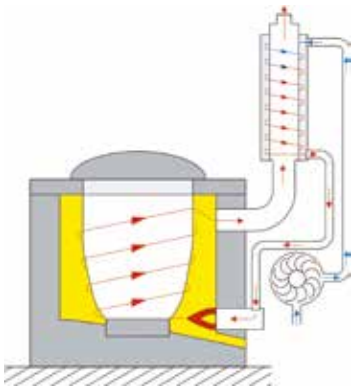
Side exhaust gas discharge

a) without Recuperator Technology

The side exhaust gas discharge is available for all gas-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


Side exhaust gas discharge with recuperator technology

b) with Recuperator Technology

Gas-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 gas-fired furnaces with side exhaust gas discharge.

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

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

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

Decision Aid for Melting Furnaces

	Use	Melting Material	Max. Melt Temperature	Productivity	Melt Quality	Energy Consumption	Noise Emissions
Models KB Exhaust gas discharge over the crucible edge	Melting	Al + Cu	++	++	-	o	-
Models KB Side exhaust gas discharge	Melting + Holding	Al + Zn	o	+	+	-	-
Models KBR Side exhaust gas discharge with recuperator	Melting + Holding	Al	o	+	+	+	-
Models T/K Electrically heated with bath control	Melting + Holding	Al + Zn	o	o	+++	++	+
Models T/K Electrically heated without bath control	Melting + Holding	Al + Zn + Cu	+	o	++	++	+
Modelle T/TM../10 Electrically heated with bath control	Holding	Al	–	-	+++	+++	+
Models TC/KC Electrically heated via SiC rods	Melting + Holding	Cu	+++	+	++	+	+

Tilting Furnaces

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

Furnace Group	Model	Page
Tilting furnaces K	K	10
Tilting furnaces KB	KB	12
Tilting furnaces KBR with recuperative burner	KBR	14
Product videos melting furnaces		15
Tilting furnaces KC	KC	16

Tilting Furnaces K
electrically 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.

Tilting furnace K 150/12

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

Tilting furnace K 150/12 and bale-out furnace T 180/11 as premelting and holding system

Additional Equipment

- Safety fence
- Work platform for easy charging
- Collecting pan under the emergency outlet see page 35
- 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 39)
- Models with increased heating power
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 38

Three tilting furnaces with work platform for melting of aluminum

Model	Tmax furnace °C	Tmax melt bath °C	Crucible	Capacity in kg Al	Zn	Cu	Heating power in kW[4]	Melting performance[3,6] in kg/h Al	Consumption melting[6] kWh/kg Al	Consumption holding Lid closed/open kWh/h	Outer dimensions[5] in mm W	D	H	Weight in kg
K 80/12	1200	1050	TP 287	180	470	-	50	126[1]	0.4[1]	4/10[1]	2050	1520	1580	1750
K 150/12	1200	1050	TP 412	330	870	-	60	147[1]	0.4[1]	5/12[1]	2120	1600	1860	2250
K 180/12	1200	1050	TP 412H	370	980	-	60	160[1]	0.4[1]	5/12[1]	2120	1600	1860	2450
K 240/12	1200	1050	TP 587	570	1500	-	80	180[1]	0.4[1]	8/17[1]	2260	1760	1860	3000
K 360/12	1200	1050	TBN 800	750	-	-	100	260[1]	0.4[1]	11/20[1]	2370	1810	1950	3500
K 400/12	1200	1050	TBN 1100	1050	-	-	126	295[1]	0.4[1]	12/22[1]	2370	1930	2100	3700
								Cu	Cu					
K 10/13	1300	1150	A 70	20	50	70	16	47[2]	0.3[2]	5/8[2]	1890	1240	1440	1000
K 20/13	1300	1150	A 150	45	120	150	20	63[2]	0.3[2]	5/8[2]	1890	1400	1460	1300
K 40/13	1300	1150	A 300	90	240	300	26	84[2]	0.3[2]	5/8[2]	2000	1450	1540	1650
K 80/13	1300	1150	TP 287	180	470	550	50	190[2]	0.3[2]	6/11[2]	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

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)

Tilting Furnaces KB
gas-fired, for melting and holding

The gas-fired 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.

Tilting furnace KB 400/12 with exhaust gas discharge over the crucible edge

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
- 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

Melting furnace plant consisting of two tilting furnaces KB 360/12 with side exhaust gas discharge and one work platform

Additional Equipment for all Tilting Furnaces

- Safety fence
- Work platform or platform for easier charging
- Collecting pan under the emergency outlet see page 35
- Information on other accessories see page 34 - 35

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 36
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 38

Tilting furnace KB 150/12 in production

Model	Tmax furnace °C	Tmax melt bath °C	Crucible	Capacity in kg Al	Zn	Cu	Burner output kW	Melting performance[3,6] in kg/h Al	Consumption melting[6] kWh/kg Al	Consumption holding Lid closed kWh/h	Outer dimensions[4] in mm W[5]	D	H	Weight in kg
KB 80/12	1200	1050	TP 287	180	470	-	300	220[1]	1.3 - 1.5[1]	10	2730	1530	1680	2100
KB 150/12	1200	1050	TP 412	330	870	-	300	240[1]	1.0 - 1.3[1]	11	2830	1630	1880	2600
KB 180/12	1200	1050	TP 412 H	370	970	-	300	260[1]	1.0 - 1.3[1]	13	2830	1630	1980	2800
KB 240/12	1200	1050	TP 587	570	1500	-	390	400[1]	1.0 - 1.3[1]	15	3120	1840	1980	3100
KB 360/12	1200	1050	TBN 800	750	-	-	450	420[1]	1.0 - 1.3[1]	17	3170	1890	2080	3300
KB 400/12	1200	1050	TBN 1100	1000	-	-	450	450[1]	1.0 - 1.3[1]	19	3170	1890	2150	3600
								Cu	Cu					
KB 40/14	1400	1250	R 400/TP 982	-	-	400	400	330[2]	1.0 - 1.3[2]	22	2710	1530	1550	2400
KB 60/14	1400	1250	R 500	-	-	500	400	360[2]	1.0 - 1.3[2]	25	2710	1530	1550	2700
KB 80/14	1400	1250	R 600	-	-	600	400	380[2]	1.0 - 1.3[2]	25	2710	1530	1710	3400

[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

Hydraulic system with flame resistant hydraulic fluid

Two-stage burner, mounted on furnace frame

Cast copper alloy

Tilting Furnaces KBR with Recuperative Burner

gas-fired, for melting and holding of aluminum

The gas-fired 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 gas-fired 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 gas-fired 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.

Tilting furnace KBR 240/11

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 gas-fired 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

Model	Tmax furnace °C	Tmax melt bath °C	Crucible	Capacity in kg Al	Burner output kW	Melting performance[2] in kg/h Al	Consumption melting in kWh/kg Al	Consumption holding Lid closed kWh/h	Outer dimensions[3] in mm W[4]	D	H	Weight in kg
KBR 240/11	1100	950	TP 587	570	390	320[1]	1.1 - 1.4[1]	13	2580	2300	1980	3600
KBR 360/11	1100	950	TBN 800	750	450	340[1]	1.1 - 1.4[1]	15	2580	2350	2080	3800
KBR 400/11	1100	950	TBN 1100	1000	450	360[1]	1.1 - 1.4[1]	16	2580	2350	2150	4100

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

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

Charging of transport ladle with tilting furnace K 360/12

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.

Scan for product video „Tilting furnace for aluminum“

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 22.

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

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.

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.

Tilting furnace KC 150/14

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 thyistors in phase-angle mode with performance control: The resistance of the SiC rods changes with temperature and age. Performance control ensures constant power of heating irrespective to the condition of the heating elements.
- 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

Tilting furnace KC 180/14

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 38
- For information on other accessories see page 34 - 35

Tilting furnace KC 80/14 during casting

Model	Tmax furnace °C	Tmax melt bath °C	Crucible	Capacity in kg Cu	Heating power in kW[1]	Connected load in kW	Melting performance[3] in kg/h Cu	Outer dimensions[4] in mm W	D	H	Weight in kg
KC 20/14	1450	1320	A 150	150	36	69	120[2]	1710	1900	1050	1500
KC 40/14	1450	1320	A 300	300	36	69	120[2]	1770	1900	1100	1600
KC 80/14	1450	1320	TPC 287	550	48	94	180[2]	1880	1970	1160	1900
KC 150/14	1450	1320	TPC 412	1000	66	112	220[2]	2000	2070	1300	2700
KC 180/14	1450	1320	TPC 412H	1150	99	187	230[2]	2000	2070	1500	3000

[1]Reduction of connected load by optional heating transformers
[2]CuZn at 1000 °C
[3]The specified melting performances are maximum values. In practice, approx. 80 % are achieved.
[4]External 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

Bale-Out Furnaces

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

Furnace Group	Model	Page
Bale-out furnaces T	T	20
Transportable bale-out furnaces TM	TM	22
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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 bale-out 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.

Bale-out furnace T 110/11

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

Bale-out furnace T 800/11

Additional Equipment

- Crucible of clay-graphite or SiC
- Collecting pan under the emergency outlet see page 35
- 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 39)
- 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 38
- For information on other accessories see page 34 - 35

Bale-out furnace T 80/13 for gunmetal in a sand foundry shop

Model	Tmax furnace	Tmax melt bath	Crucible	Capacity in kg			Heating power	Melting performance[3,6]	Consumption melting[6]	Consumption holding Lid closed/open	Outer dimensions[5] in mm			Weight
	°C	°C		Al	Zn	Cu	in kW[4]	in kg/h	kWh/kg	kWh/h	W	D	H[7]	in kg
T 80/10	1000	800	BU 200	200	-	-	20	-	-	4/9[1]	1230	1160	930	1050
T 110/10	1000	800	BU 300	300	-	-	26	-	-	5/10[1]	1310	1250	1030	1250
T 150/10	1000	800	BU 350	350	-	-	38	-	-	5/10[1]	1330	1250	1130	1330
T 180/10	1000	800	BU 500	500	-	-	42	-	-	7/15[1]	1480	1430	1190	1400
T 240/10	1000	800	BU 600	600	-	-	50	-	-	7/15[1]	1480	1430	1340	1530
T 360/10	1000	800	BN 800	800	-	-	50	-	-	8/17[1]	1590	1540	1450	2000
T 450/10	1000	800	BU 1800 H 830	970	-	-	50	-	-	13/20[1]	1840	1760	1380	2400
T 560/10	1000	800	BU 1800 H 1000	1230	-	-	50	-	-	13/23[1]	1840	1760	1550	2550
T 800/10	1000	800	BU 1800	1800	-	-	70	-	-	15/25[1]	1840	1760	1850	2800
								Al	Al					
T 10/11	1100	950	A 70	20	50	-	16	32[1]	0.4[1]	3/5[1]	970	910	790	550
T 20/11	1100	950	A 150	45	110	-	20	42[1]	0.4[1]	3/6[1]	1050	990	780	650
T 40/11	1100	950	A 300	90	230	-	26	58[1]	0.4[1]	3/7[1]	1130	1080	870	750
T 80/11	1100	950	BU 200	200	520		50	126[1]	0.4[1]	4/9[1]	1230	1160	930	1050
T 110/11	1100	950	BU 300	200	790	-	60	136[1]	0.4[1]	5/10[1]	1310	1250	1030	1250
T 150/11	1100	950	BU 350	350	920	-	60	147[1]	0.4[1]	5/10[1]	1330	1250	1130	1330
T 180/11	1100	950	BU 500	500	1320	-	70	168[1]	0.4[1]	7/15[1]	1480	1430	1190	1400
T 240/11	1100	950	BU 600	600	1580	-	80	180[1]	0.4[1]	7/15[1]	1480	1430	1340	1530
T 360/11	1100	950	BN 800	800	2110	-	110	200[1]	0.4[1]	8/17[1]	1590	1540	1450	2000
T 450/11	1100	950	BU 1800 H 830	970	2570	-	110	200[1]	0.4[1]	13/20[1]	1840	1760	1380	2400
T 560/11	1100	950	BU 1800 H 1000	1230	3250	-	110	220[1]	0.4[1]	13/23[1]	1840	1760	1550	2550
T 800/11	1100	950	BU 1800	1800	4750	-	140	240[1]	0.4[1]	15/25[1]	1840	1760	1850	2800
								Cu	Cu					
T 10/13	1300	1150	A 70	20	-	70	16	47[2]	0.3[2]	5/8[2]	1020	950	890	650
T 20/13	1300	1150	A 150	45	-	150	20	63[2]	0.3[2]	5/10[2]	1100	1030	870	780
T 40/13	1300	1150	A 300	90	-	300	26	84[2]	0.3[2]	5/12[2]	1170	1100	970	960
T 80/13	1300	1150	BU 200	200	-	650	50	190[2]	0.3[2]	5/15[2]	1270	1200	1030	1200

[1]Al at 700 °C

[2]CuZn at 1000 °C

[3]The specified melting performances are maximum values. In practice, approx. 80 % are achieved. Values for other materials, e. g. zinc, on request.

[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

[7]Ladling height without lid

Bale-out of bale-out furnace with robot

Four side heating for excellent temperature uniformity

Manual ladling from a bale-out furnace T 80/10

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.

Transportable bale-out furnace TM 150/10

Standard Equipment

- 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

Model	Tmax furnace	Tmax melt bath	Crucible		Capacity in kg	Heating power	Consumption holding Lid closed/open	Outer dimensions[3] in mm		
	°C	°C	Ø	H	Al	in kW[2]	kWh/h[1]	W	D	H
TM 80/10	1000	800	BU 200		200	21	4/9	1000	1100	1000
TM 150/10	1000	800	875	600	350	36	5/10	1320	1440	1000
TM 240/10	1000	800	BU 600		600	42	7/15	1220	1340	1300
TM 310/10	1000	800	1170	580	770	42	8/17	1650	1730	1050

[1]Al at 700 °C
[2]Depending on furnace design connected load might be higher
[3]External 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.

Bale-out furnace TC 80/14

Standard Equipment

- Melt temperatures up to 1320 °C
- Symmetrical heating via powerful SiC rods
- Simple exchange of individual heating elements
- Heat operation by thyistors in phase-angle mode with performance control: The resistance of the SiC rods changes with temperature and age. Performance control ensures constant power of heating irrespective to the condition of the heating elements.
- 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 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
- Work platform for simplified loading
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 38
- For information on other accessories see page 34 - 35

Model	Tmax furnace °C	Tmax melt bath °C	Crucible	Capacity in kg Cu	Heating power in kW[1]	Connected load in kW	Melting performance[3] in kg/h Cu	Outer dimensions[4] in mm W	D	H	Weight in kg
TC 20/14	1450	1320	A 150	150	36	69	120[2]	1200	1250	930	830
TC 40/14	1450	1320	A 300	300	36	69	120[2]	1260	1250	1020	950
TC 80/14	1450	1320	BU 200	650	48	94	180[2]	1360	1350	1080	1050
TC 150/14	1450	1320	BU 300	1000	66	112	220[2]	1450	1320	1300	1300

[1]Reduction of connected load by optional heating transformers
[2]CuZn at 1000 °C
[3]The specified melting performances are maximum values. In practice, approx. 80 % are achieved.
[4]External 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

Furnaces for Special Applications

Furnace Group	Model	Page
Laboratory tilting furnace K/KC	K/KC	26
Melting furnaces in customized dimensions		28
Cleaning furnace for riser tubes SRO	SRO	31

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.

Tilting furnace KC 1/14

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 tiltiing 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)

Tilting furnace KC 4/14

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	Tmax furnace	Tmax melt bath	Crucible	in kg		Volume	Outer dimensions[3] in mm			Connected load	Weight
	°C	°C		Al	Cu	in l	W	D	H	kW	in kg
K 1/10	1000	850	A6	1.5	-	0.75	600	710	670	3.0	85
K 2/10	1000	850	A10	3.0	-	1.50	600	710	670	3.0	90
K 4/10	1000	850	A25	7.0	-	3.00	670	800	710	3.5	110
K 1/13[1]	1300	1150	A6	1.5	6.0	0.75	600	710	670	3.0	85
K 2/13[1]	1300	1150	A10	3.0	10.0	1.50	600	710	670	3.0	90
K 4/13[1]	1300	1150	A25	7.0	25.0	3.00	670	800	710	5.5	110
KC 1/14[2]	1400	1250	A6	-	6.0	0.75	570	630	580	11.0	90
KC 2/14[2]	1400	1250	A10	-	10.0	1.50	570	630	580	11.0	95
KC 4/14[2]	1400	1250	A25	-	25.0	3.00	670	870	590	22.0	110

[1]Outer dimensions of furnace, transformer in separate housing (500 x 570 x 300 mm)
[2]Switchgear and controller mounted in a floor standing cabinet
[3]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

Tilting-aid with dampers

Tilting furnace K 4/10 with steel crucible, e. g. for tin melting

Crucible sizes of 0.75 liters, 1.5 liters or 3 liters

Melting Furnaces in Customized Dimensions

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 with three bale-out furnaces T 150/11

Rotary Table System for Continuous Pouring

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

Electrically heated bale-out furnace with steel crucible and swivel lid for tin or lead

Electrically heated bale-out furnace for tin or lead with rim suction ring and melting bath thermocouple

Tilting furnace K 240/11 for melting of lead

Melting Furnaces for Heavy Metals

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.

Rim suction ring for connection to customer‘s exhaust air system

Tilting furnace for heavy metals with bath control

Steel crucible with special suspension brackets for high charge weight

Tilting furnace K 1500/75 S for magnesium with 1500 liters crucible volume

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.

Cleaning furnace SRO 170/1000/11 with suspended pipe

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 dimesions on request
- Switchgear on rollers

Model	Tmax	Outer dimensions[2] in mm			Outer tube-Ø/	Heated	Heating	Electrical
	°C	W	D	H	mm	length/mm	power in kW[1]	connection*
SRO 170/1000/11	1100	590	640	1700	90	1000	12,0	3-phase

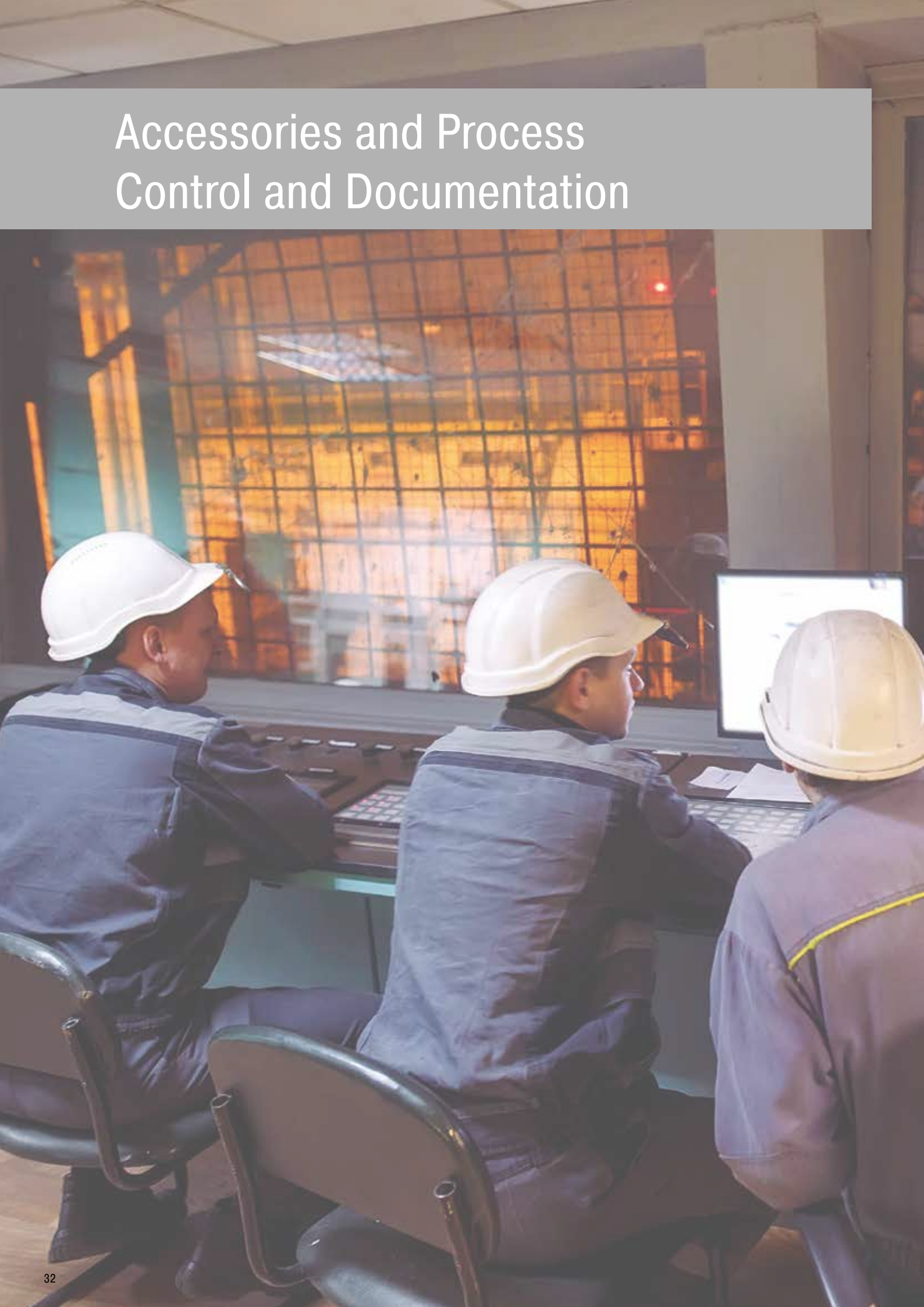
[1]Depending on furnace design connected load might be higher
[2]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.
*Please see page 39 for more information about supply voltage

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



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

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 20/.. 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

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 under the emergency outlet of a melting furnace

Crucible Breakage Alarm Device for T ../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

Collecting Pan under the Emergency Outlet

The bale-out furnaces are standardly euipped 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 emergancy the models T .., 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. Unncecessary foundation works can be avoided.

Work platform for tilting furnace K 240/12

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

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

Eurotherm 3208 furnace controller

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 onoff function of the furnace. The switching times can be chosen for each working day.

Weekly timer to switch between melting temperature and lower temperature

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 baleout 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.

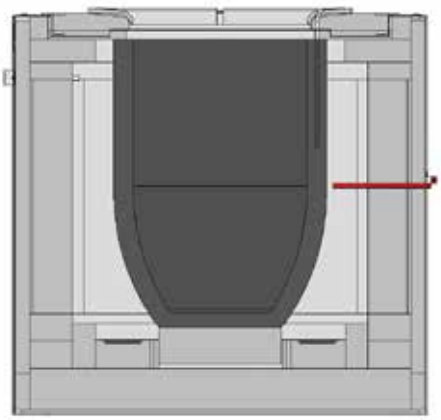
As in option the baleout and tilting furnaces can be equipped with a melt bath control. In addition to the furnace thermocouple, the temperature is also measured with a thermocouple in the melt. Both temperatures are permanently reconciled to achieve the exact melt bath temperature. If the melt bath 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.

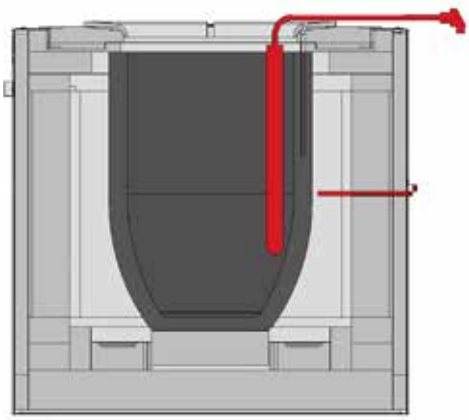
The melt bath is controlled via the H500 PLC-controls (electrically heated furnaces) with a 4 inch (optional 7 inch) touch panel and 4 operating buttons or the H700-controls (gasfired furnaces) with a 7 inch touch panel. It combines simple operation, precise control, and extensive user options. Presentation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

H500

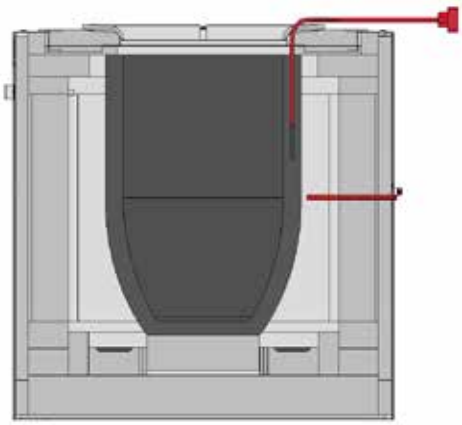
- Operation with furnace chamber control or melt bath control alternatively with cascade
- Display on a graphic color screen with overview of all temperatures
- Very easy data entry directly on the operating screen (touch panel)
- Weekly timer for changing temperatures, entries in real time
- A program 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



Furnace control



Melt bath control thermocouple in the melt



Melt bath control thermocouple in the pocket of the crucible wall

Entry of temperature/time programs in tabular format in several segments

- 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.

Melt bath control with a thermocouple in the melt

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.

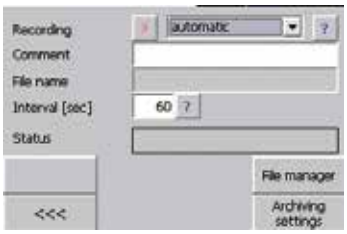
Other Possible Additional Functions

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.



NTLog Comfort

NTLog Comfort for data recording of a Siemens PLC

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. Excel™ for MS Windows™). 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

User interface Control Center NCC based on PC

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

Multi-Step Switch

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.

Controller Type	Eurotherm 3208		Eurotherm 3508	H500	H700	
Available for models	TM/T/K	TB/TBR/KB/KBR	TC/KC	TC/TM/T/K/KC	TM/T/K	TB/TBR/KB/KBR
Functions						
Furnace control	●	●	●	●	●	●
Melt bath control				●	●	●
Weekly timer	○	○	○	●	●	●
Bridging the melt bath controller				○	○	○
Preparation program with 20 segments				●	●	●
Preparation program with a ramp	●	●	●			
Band alarm under/over temperature	○	○	○	●	●	●
Connection to an overriding system	○	○	○	○	○	○
Operation with reduced power	○			○	○	○
Operating hour counter	○	○	○	●	●	●
Documentation with NTLogComfort				○		
Documentation with NCC					○	○
Manual intervention in the program					○	○

● 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

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.

Drop-bottom furnace with fixed quenching bath

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, AMS2750H

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

Fully automatic drop-bottom furnace plant, consisting of two drop-bottom furnaces, movable water bath and several loading and unloading positions

Automatic quenching and tempering plant N 644/S

Customized Solutions

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.

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

Continuous furnaces are the right choice for processes with fixed cycle times such as drying or preheating, curing, aging, vulcanisation or degassing. The furnaces are available for various temperatures up to a maximum of 1100 °C. The continuous furnaces of the DF model series are also specially designed for ceramic thick-film processes for burning out (Burn-Out) and firing/sintering (Fire) functional layers for example in LTCC applications. The furnace design depends on the required throughput, the process requirements for heat treatment and the required cycle time.

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

Gas-fired rotary-hearth furnaces for preheating of ceramic moulds up to 1100 °C incl. thermal post combustion for exhaust gas cleaning

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

Continuous belt furnace D 1000/4000/140/35 AS for black wash drying on sand cores

Continuous pilgrim step furnace system NBI 70000/15HAS for black wash drying on sand cores

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.

Dewaxing Furnaces
electrically heated

The electrically heated N ../WAX furnaces are particularly suitable for dewaxing of ceramic molds below the flash point of the wax and subsequent firing. The electrically heated chamber furnaces have a heated outlet in the bottom of the furnace chamber, formed as a funnel with the discharge near the center of the furnace. The drain pan on the furnace bottom is covered with stainless steel grids, which provide for an even charging surface for the molds and can be removed for cleaning. The molten wax is collected in a sealed stainless steel container with a removable drawer below the furnace. After the dewaxing process is completed, the furnace continues heating to sinter the molds. Fresh air inlets in the bottom area and a motorized exhaust air flap ensure good ventilation of the furnace chamber during the process. The resulting exhaust air is discharged via the exhaust hood and further customer-provided piping.

Dewaxing furnace N 300/WAX

Standard Equipment

- Tmax 850 °C
- Chamber furnace with wide-opening swinging door
- Fresh air inlets in the bottom for continuous air exchange
- Motorized exhaust air flap in the furnace ceiling with exhaust hood for connection to customer provided ductwork
- Four side heating with freely radiating heating elements on ceramic support tubes
- Heated outlet in the furnace bottom, controlled and monitored by a separate controller with a temperature working range of min. 200 °C - max. 300 °C, to safely prevent the escaping wax from solidifying
- The furnace heating is released after a preset temperature has been reached in the drainage to protect the wax outlet from clogging
- Stainless steel floor pan with grid bottom for level loading
- Rugged self-supporting, vaulted arch construction
- Over-temperature limiter for the furnace chamber, which must be set below the flash point of the wax and prevents the wax from igniting during the melting process. The duration of the dewaxing process is specified by the customer. After this time, the over-temperature limiter is deactivated so that the furnace can continue with the sintering process.
- Controller with touch operation B500 (5 programs with each 4 segments)

Model	Tmax	Inner dimensions in mm			Volume in	Outer dimensions[2] in mm			Max. drain-off volume in	Heating power in	Electrical	Weight in
	°C	w	d	h	l	W	D	H	l	kW[1]	connection*	kg
N 100/WAX	850	400	530	460	100	720	1130	1440	5	7.5	3-phase	325
N 300/WAX	850	550	700	780	300	870	1300	1760	15	15.5	3-phase	550
N 440/WAX	850	600	750	1000	450	1000	1400	2000	17	20.5	3-phase	800

[1]Depending on furnace design connected load might be higher

[2]External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

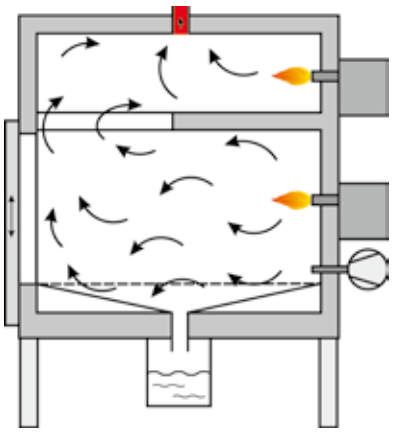
*Please see page 39 for more information about supply voltage

Grid bottom

Drain pan in floor

Drawer for collection of liquid wax

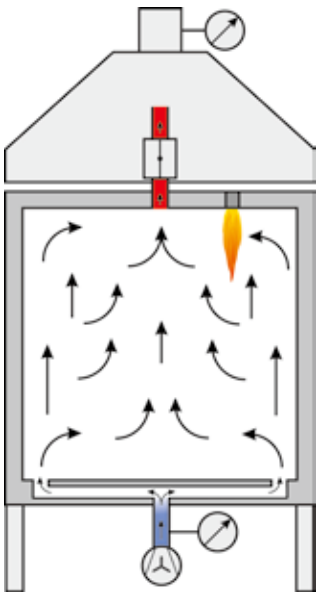
Dewaxing furnace NB 300/BOWAX



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.

Chamber furnace N 650/14 BO



Chamber furnace N 650/14 BO with ignition burner

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.

Additive Manufacturing

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

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.

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

Metals	Ceramics, Glass, Composites, Sand	Plastics
Debinding Sintering Stress-relieving Solution annealing Hardening	Debinding Sintering Drying Curing	Curing Tempering Drying
under Protective Gases, Reaction Gases or in Vacuum	**in Air**	**in Air**
Chamber furnaces with gas-supply boxes	Debinding in chamber furnaces with air circulation Sintering in chamber furnaces Debinding and Sintering in combi furnaces Dewaxing Furnaces	Ovens Chamber dryers Forced convection chamber furnaces
Hot-wall retort furnaces		
Cold-wall retort furnaces	See also concepts for drying, debinding, thermal cleaning and wax burnout in catalog Advanced Materials	See als concepts for drying, debinding, thermal cleaning and wax burnout in catalog Advanced Materials as well as catalog Thermal Process Technology 1
See also catalog Thermal Process Technology		

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

Counterflow heat exchanger for the forced convection chamber furnace N 2560/26 ACLS

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

Recuperator burner for aluminum melting furnace 16 x TBR 110/12 and 2 x TBR 180/12

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 between a hot and a cold charge

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.

Production system, consisting of four chamber furnaces for moving the load during heat treatment along with a three-stage heat exchanger to optimize energy efficiency

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 75 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 AMS2750H (NADCAP)
- Competent service team for fast help on the phone
- Safe teleservice for systems with PLC controls via a secured VPN line
- Preventive maintenance to ensure that your furnace is ready for use
- Modernization or relining of older furnace systems

Contact us:

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The whole World of Nabertherm: www.nabertherm.com

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
- Advanced Materials
- Fiber Optics/Glass
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