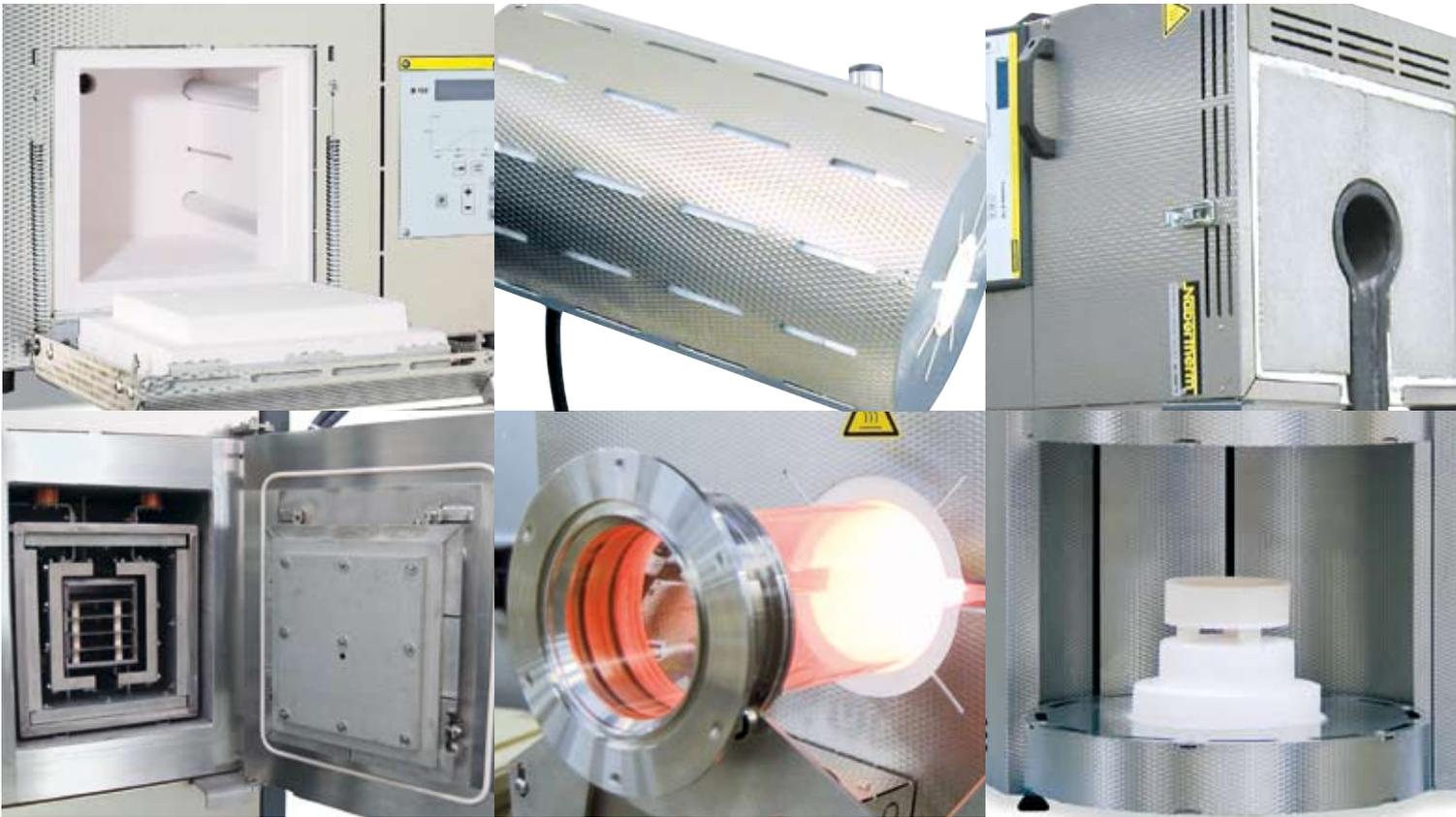


# Laboratory



**Muffle Furnaces**  
**Preheating Furnaces**  
**Ashing Furnaces**  
**Tube Furnaces**  
**Ovens**  
**High-Temperature Ovens**  
**Air Circulation Furnaces**  
**Chamber Furnaces**  
**Melting Furnaces**  
**High-Temperature Furnaces**  
**Retort Furnaces**  
**Vacuum Furnaces**  
**Brazing Furnaces**

[www.nabertherm.com](http://www.nabertherm.com)

■ Made  
■ in  
■ Germany



### **Made in Germany**

Nabertherm with more than 350 employees worldwide have been developing and producing industrial furnaces for many different applications for over 60 years. 150,000 satisfied customers in 100 countries offer proof of our commitment to build quality equipment cost-effectively. Short delivery times are ensured due to our complete inhouse production and our wide variety of standard furnaces.

### **Setting Standards in Quality and Reliability**

Our products range from standard furnaces to flexible, state-of-the-art fully automatic systems and plants with material handling technology. Your complete heat treatment production process can be realized through our customized solutions.

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

### **Global Sales and Service Network – Close to you**

With our global sales network, we can offer on-site customer service wherever you choose to produce. Long term sales and distribution partners in all important world markets ensure individual on-site customer service and consultation. There are various reference customers in your neighborhood who have similar furnaces or systems.

### **Customer Service and Spare Parts**

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

### **More Than Heat – Experience in Many Fields of Thermal Processing**

In addition to furnaces for laboratory, Nabertherm offers a wide range of standard furnaces and systems for many other thermal processing applications. The modular design of our products allows us to customize a solution to your individual needs without expensive modifications. Our large and state-of-the-art test and research center provides for a representative selection of furnaces. Our practice-oriented R&D department will be pleased to carry out tests for you in order to verify the process suitability of the given furnace model.

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## Professional Furnaces: L 3/11 - LT 40/12 with Flap Door or Lift Door



L 9/11



L 5/12

### L 3/11 - LT 40/12

Our L 3/11 - LT 40/12 series is the right choice for daily laboratory use. These models stand out for their excellent workmanship, advanced and attractive design, and high level of reliability. The furnaces come equipped with either a flap door or lift door at no extra charge.

- Tmax 1100 °C or 1200 °C
- Heating from two sides by ceramic heating plates (heating from three sides for models L 24/11 - LT 40/12)
- Ceramic heating plates with integral heating element which is safeguarded against fumes and splashing, and easy to replace
- Highly durable cured vacuum fibre module lining
- Housing made of sheets of textured stainless steel
- Double-walled housing for low external temperatures and high stability
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Adjustable air inlet integrated in door (see illustration)
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for low-noise operation
- Description of the control system see page 54



Over-temperature limit controller

#### Additional equipment

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



LT 15/12



LT 24/11

Model	Flap door	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
			w	d	h		W	D	H				
L	3/11	1100	160	140	100	3	380	370	420	1,2	single-phase	20	60
L	5/11	1100	200	170	130	5	440	470	520	2,4	single-phase	35	60
L	9/11	1100	230	240	170	9	480	550	570	3,0	single-phase	45	75
L	15/11	1100	230	340	170	15	480	650	570	3,6	single-phase	55	90
L	24/11	1100	280	340	250	24	560	660	650	4,5	3-phase	75	95
L	40/11	1100	320	490	250	40	600	790	650	6,0	3-phase	95	95
L	3/12	1200	160	140	100	3	380	370	420	1,2	single-phase	20	75
L	5/12	1200	200	170	130	5	440	470	520	2,4	single-phase	35	75
L	9/12	1200	230	240	170	9	480	550	570	3,0	single-phase	45	90
L	15/12	1200	230	340	170	15	480	650	570	3,6	single-phase	55	105
L	24/12	1200	280	340	250	24	560	660	650	4,5	3-phase	75	110
L	40/12	1200	320	490	250	40	600	790	650	6,0	3-phase	95	110



L 5/11 with gas supply system

Model	Lift door	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
			w	d	h		W	D	H <sup>1</sup>				
LT	3/11	1100	160	140	100	3	380	370	420+165	1,2	single-phase	20	60
LT	5/11	1100	200	170	130	5	440	470	520+220	2,4	single-phase	35	60
LT	9/11	1100	230	240	170	9	480	550	570+290	3,0	single-phase	45	75
LT	15/11	1100	230	340	170	15	480	650	570+290	3,6	single-phase	55	90
LT	24/11	1100	280	340	250	24	560	660	650+335	4,5	3-phase	75	95
LT	40/11	1100	320	490	250	40	600	790	650+335	6,0	3-phase	95	95
LT	3/12	1200	160	140	100	3	380	370	420+165	1,2	single-phase	20	75
LT	5/12	1200	200	170	130	5	440	470	520+220	2,4	single-phase	35	75
LT	9/12	1200	230	240	170	9	480	550	570+290	3,0	single-phase	45	90
LT	15/12	1200	230	340	170	15	480	650	570+290	3,6	single-phase	55	105
LT	24/12	1200	280	340	250	24	560	660	650+335	4,5	3-phase	75	110
LT	40/12	1200	320	490	250	40	600	790	650+335	6,0	3-phase	95	110

<sup>1</sup>Including opened lift door

\*Please see page 54 for more information about mains voltage



Adjustable air inlet integrated in the door

## Compact Muffle Furnaces LE 2/11 - LE 14/11



LE 4/11



LE 6/11

### LE 2/11 - LE 14/11

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

- Tmax 1100 °C, working temperature 1050 °C
- Heating from two sides from heating elements in quartz glass tubes
- Maintenance-friendly replacement of heating elements and insulation
- Multilayered insulation with fibre plates in the furnace chamber
- Housing made of sheets of textured stainless steel
- Double-walled housing for low external temperatures and high stability
- Flap door which can also be used as a work platform
- Exhaust air outlet in rear wall
- Solid state relays provide for low-noise operation
- Compact dimensions and light weight
- Controller mounted in side space (under the door on the LE 2/11 and LE 4/11 to save space)
- Description of the control system see page 54



Over-temperature limit controller

### Additional equipment

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

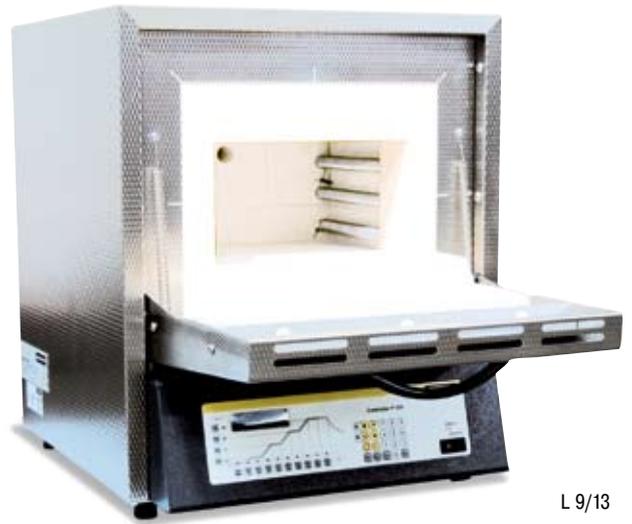
Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H				
LE 2/11	1100	110	180	110	2	275	380	350	1,8	single-phase	10	25
LE 4/11	1100	170	200	170	4	335	400	410	1,8	single-phase	15	35
LE 6/11	1100	170	200	170	6	510	400	320	1,8	single-phase	18	35
LE 14/11	1100	220	300	220	14	555	500	370	2,9	single-phase	25	40

\*Please see page 54 for more information about mains voltage

## Muffle Furnaces L 5/13 - LT 15/13 with Brick Insulation and Flap Door or Lift Door



LT 15/13



L 9/13

### L 5/13 - LT 15/13

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

- Tmax 1300 °C
- Heating from two sides from heating elements
- Heating elements on support tubes ensure free heat radiation and a long service life
- Multilayer insulation with robust lightweight refractory bricks in the furnace chamber
- Housing made of sheets of textured stainless steel
- Double-walled housing for low external temperatures and stability
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Adjustable air inlet in the furnace door
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for low-noise operation
- Description of the control system see page 54



Furnace lining with high-quality lightweight refractory brick insulation

### Additional equipment

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



Over-temperature limit controller

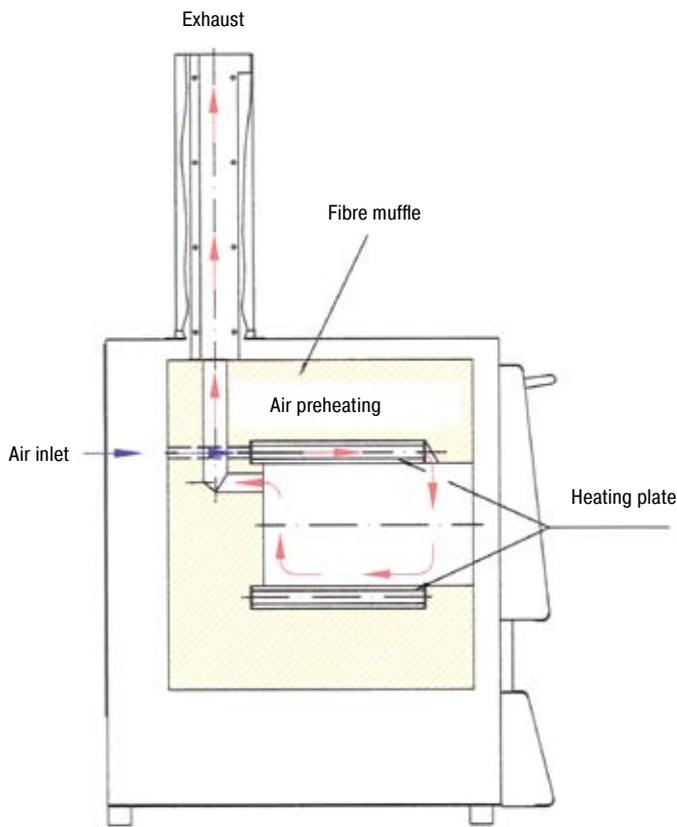
Model Flap door	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H				
L 5/13	1300	200	170	130	5	440	470	520	2,4	single-phase	42	45
L 9/13	1300	230	240	170	9	480	550	570	3,0	single-phase	60	50
L 15/13	1300	230	340	170	15	480	650	570	3,6	single-phase	70	60

Model Lift door	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H <sup>1</sup>				
LT 5/13	1300	200	170	130	5	440	470	520+220	2,4	single-phase	42	45
LT 9/13	1300	230	240	170	9	480	550	570+290	3,0	single-phase	60	50
LT 15/13	1300	230	340	170	15	480	650	570+290	3,6	single-phase	70	60

<sup>1</sup>Including opened lift door

\*Please see page 54 for more information about mains voltage

## Ashing Furnaces LV 3/11 - LVT 15/11 with Flap Door or Lift Door



Air intake and exhaust flow principle



LV 3/11

### LV 3/11 - LVT 15/11

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

- Tmax 1100 °C
- Heating from two sides by ceramic heating plates
- Ceramic heating plates with integral heating element which is safeguarded against fumes and splashing, and easy to replace
- Highly durable, high-performance cured vacuum fibre module lining
- Housing made of sheets of textured stainless steel
- Double-walled housing for low external temperatures and stability
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Solid state relays provide for lownoise operation
- Air exchange of more than 6 times per minute
- Good temperature uniformity due to preheating of incoming air
- Description of the control system see page 54



LVT 9/11



LVT 15/11

### Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Please see page 13 for more accessories



Over-temperature limit controller

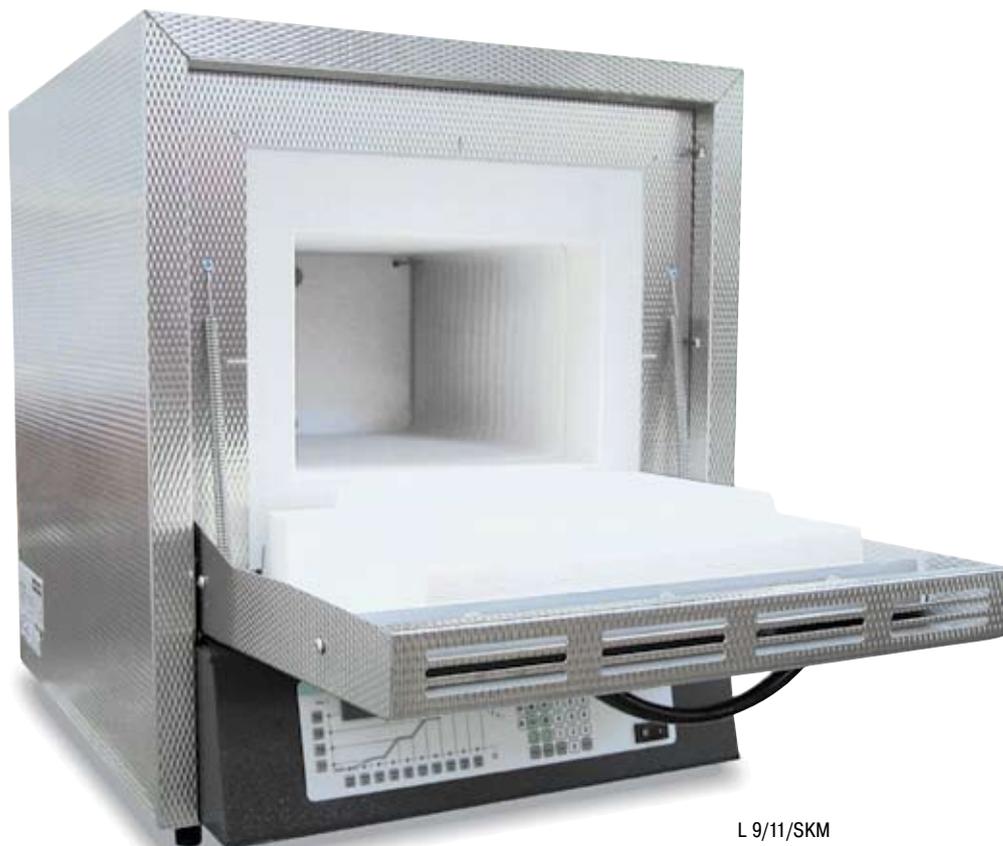
Model Flap door	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Supply kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H <sup>1</sup>				
LV 3/11	1100	160	140	100	3	380	370	750	1,2	single-phase	20	120
LV 5/11	1100	200	170	130	5	440	470	850	2,4	single-phase	35	120
LV 9/11	1100	230	240	170	9	480	550	900	3,0	single-phase	45	120
LV 15/11	1100	230	340	170	15	480	650	900	3,6	single-phase	55	120

Model Lift door	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H <sup>1</sup>				
LVT 3/11	1100	160	140	100	3	380	370	750	1,2	single-phase	20	120
LVT 5/11	1100	200	170	130	5	440	470	850	2,4	single-phase	35	120
LVT 9/11	1100	230	240	170	9	480	550	900	3,0	single-phase	45	120
LVT15/11	1100	230	340	170	15	480	650	900	3,6	single-phase	55	120

<sup>1</sup>Including exhaust tube (Ø 80 mm)

\*Please see page 54 for more information on mains voltage

## Muffle Furnaces L, LT 9/11/SKM with embedded Heating Elements in the Ceramic Muffle



L 9/11/SKM



Muffle heated from four sides

### L, LT 9/11/SKM

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

- Tmax 1100 °C
- Muffle heated from four sides
- Furnace chamber with embedded ceramic muffle, high resistance to aggressive gasses and vapours
- Housing made of sheets of textured stainless steel
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Adjustable working air inlet in the door
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for lownoise operation
- Description of the control system see page 54



Gas supply panel for nonflammable protective gas with shutoff valve and flow meter with regulator valve, piped and ready to connect

### Additional equipment

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



Over-temperature limit controller

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H				
L 9/11/SKM	1100	230	240	170	9	480	550	570	3,0	single-phase	50	90
LT 9/11/SKM	1100	230	240	170	9	480	550	570+290 <sup>1</sup>	3,0	single-phase	50	90

<sup>1</sup>Including opened lift door

\*Please see page 54 for more information about mains voltage

## Furnace Systems with Scale and Software for Determination of Combustion Loss

### L 9/11/SW - LT 9/12/SW

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

- Tmax 1100 °C or 1200 °C
- Heating from two sides by ceramic heating plates
- Ceramic heating plates with integral heating element which is safeguarded against fumes and splashing, and easy to replace
- Highly durable cured vacuum fibre module lining
- Housing made of sheets of textured stainless steel
- Optional flap door (L) which can be used as work platform or lift door (LT) with hot surface facing away from the operator
- Adjustable working air inlet in the door
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for lownoise operation
- Delivery includes base, ceramic plunger with base plate in the furnace lining, precision scale and software package
- 3 scales available for different maximum weights and scaling ranges
- Software for documentation of the temperature curve and combustion loss using a PC
- Description of the control system see page 54

### Additional equipment

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

Model flap door	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H				
L 9/11/SW	1100	230	240	170	9	480	550	800	3,0	single-phase	55	75
L 9/12/SW	1200	230	240	170	9	480	550	800	3,0	single-phase	55	90

Model Lift door	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H <sup>1</sup>				
LT 9/11/SW	1100	230	240	170	9	480	550	800+290	3,0	single-phase	55	75
LT 9/12/SW	1200	230	240	170	9	480	550	800+290	3,0	single-phase	55	90

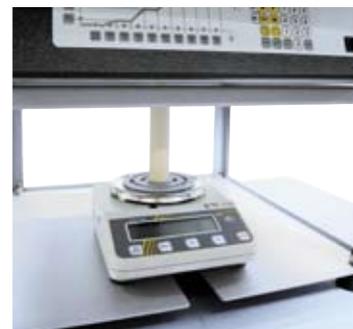
<sup>1</sup>Including opened lift door

\*Please see page 54 for more information about mains voltage

Scale type	Readability in g	Weight range in g	Weight of plunger in g	Calibration value in g	Minimum load in g
EW-1500	0,01	1500 incl. plunger	850	0,1	0,5
EW-3000	0,01	3000 incl. plunger	850	0,1	0,5
EW-6000	0,10	6000 incl. plunger	850	1,0	5,0



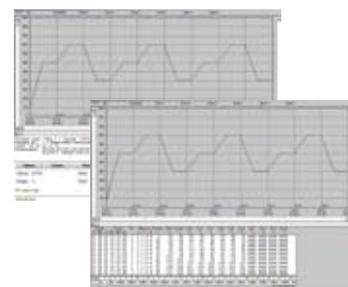
L 9/11/SW



3 scales available for different maximum weights and scaling areas



Over-temperature limit controller

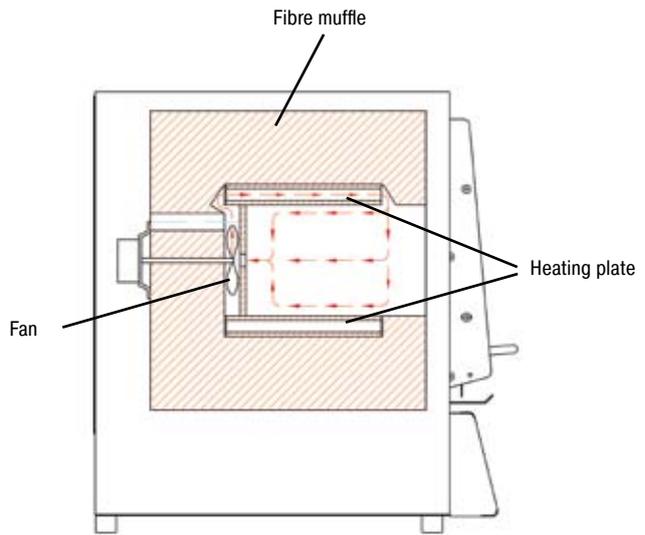


Software for documentation of the temperature curve and combustion loss using a PC

## Muffle Furnaces LT 5/11 HA - LT 15/11 HA with integrated Air Circulation



LT 5/11HA with air circulation



Air-circulation fan in rear wall of furnace

### LT 5/11 HA - LT 15/11 HA

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

- Tmax 1100 °C
- Heating from two sides by ceramic heating plates
- Ceramic heating plates with integral heating element which is safeguarded against splashing, and easy to replace
- Highly durable cured vacuum fibre module lining
- Housing made of sheets of textured stainless steel
- Double-walled housing for low external temperatures and stability
- With lift door (LT), whereby the hot side is away from the operator
- Exhaust air outlet in rear wall of furnace
- Solid state relays provide for lownoise operation
- Circulation fans for better heat transmission and distribution, particularly during heating and cooling
- Description of the control system see page 54



Over-temperature limit controller

### Additional equipment

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

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H <sup>1</sup>				
LT 5/11HA	1100	200	160	130	5	440	470	520+220	2,4	single-phase	36	60
LT 9/11HA	1100	230	230	170	9	480	550	570+290	3,0	single-phase	46	60
LT 15/11HA	1100	230	330	170	15	480	650	570+290	3,6	single-phase	56	75

<sup>1</sup>Including opened lift door

\*Please see page 54 for more information about mains voltage

## Accessories



Article No.:  
631000140

**Chimney** for connection to an exhaust pipe.



Article No.:  
631000141

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



Article No.:  
631000166

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



Article No.:  
699000279 (saggar)  
699000285 (lid)

**Square Sagger for Furnaces HTC and LHT, Tmax 1600 °C**

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



Article No.:  
699000270 (saggar)  
699000986 (lid)

**Round Sagger (Ø 115 mm x 35 mm) for Furnaces LHT/LB(R), Tmax 1600 °C**

These saggars are perfectly suited for furnaces LHT/LB and LHT/LBR. The load is placed in the saggars. Up to three saggars can be stacked on top of each other in order to use the overall furnace chamber.



Article No.:  
699000252

**Spacers, Tmax 1600 °C**

We recommend not to place the charge directly on the bottom of the furnace. Ceramic spacers can be put under the first saggar to provide for an optimal air flow under the charge with the result of an improved temperature uniformity.

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



**Ceramic ribbed plate, Tmax 1200 °C**

for models	Article No.
LE 2	691601097
L 3, LT 3, LV, LVT 3	691600507
LE 4, LE 6, L 5, LT 5, LV 5, LVT 5	691600508
L 9, LT 9, LV 9, LVT 9	691600509
LE 14	691601098
L 15, LT 15, LV 15, LVT 15	691600506
L 24, LT 24	691600874
L 40, LT 40	691600875



**Ceramic collecting pan, Tmax 1300 °C**

for models	Article No.
LE 2	691601099
L 3, LT 3, LV 3, LVT 3	691600510
LE 4, LE 6, L 5, LT 5, LV 5, LVT 5	691600511
L 9, LT 9, LV 9, LVT 9	691600512



**Steel collecting pan, Tmax 1100 °C**

for models	Article No.
LE 2	691402096
L 3, LT 3, LV 3, LVT 3	691400145
LE 4, LE 6, L 5, LT 5, LV 5, LVT 5	691400146
L 9, LT 9, LV 9, LVT 9	691400147
LE 14	691402097
L 15, LT 15, LV 15, LVT 15	691400149
L 24, LT 24	691400626
L 40, LT 40	691400627

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



Article No.:  
493000004

**Gloves, Tmax 650 °C.**



Article No.:  
491041101

**Gloves, Tmax 900 °C.**



Article No.:  
493000002 (300 mm)  
493000003 (500 mm)

Various **tongs** for easy loading and unloading of the furnace.

## Annealing, Hardening and Brazing Furnaces N 7/H - N 61/H



N 7/H as table-top model



N 41/H

### N 7/H - N 61/H

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

- Tmax 1280 °C
- Three-sided heating from both sides and the floor
- Heating elements on support tubes ensure free heat radiation and a long service life
- Floor heating protected by heat-resistant SiC plate
- Multilayer insulation with high-quality lightweight refractory bricks in the furnace chamber
- Exhaust opening in the side of the furnace, or on back wall of furnace in the N 31/H models and higher
- Models N 7/H - N 17/HR are designed as tabletop models
- Stand included with model N 31/H and up
- Parallel swinging door which opens downward, or upward upon request
- Description of the control system see page 54



Working with protective gas boxes for a protective gas atmosphere using a loading carriage

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H				
N 7/H	1280	250	250	120	7	720	640	510	3,0	single-phase	60	180
N 11/H	1280	250	350	140	11	720	740	510	3,6	single-phase	70	180
N 11/HR	1280	250	350	140	11	720	740	510	5,5	3-phase <sup>1</sup>	70	120
N 17/HR	1280	250	500	140	17	720	890	510	6,4	3-phase <sup>1</sup>	90	120
N 31/H	1280	350	350	250	31	840	1010	1320	15,0	3-phase	210	105
N 41/H	1280	350	500	250	41	840	1160	1320	15,0	3-phase	260	120
N 61/H	1280	350	750	250	61	840	1410	1320	20,0	3-phase	400	120

<sup>1</sup>Heating only between two phases

\*Please see page 54 for information on mains voltage

## Accessories for Hardening and Brazing

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

### Hardening and Annealing Boxes

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

### Annealing Tray with Holder

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

### Hearth Plates

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

### Hardening Tongs

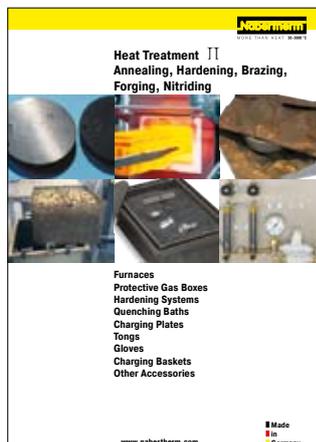
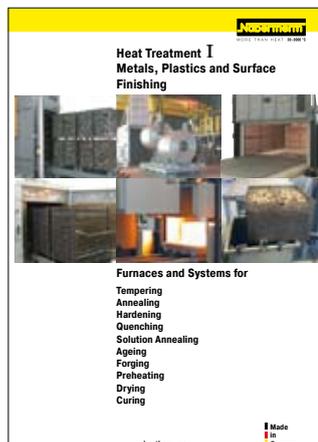
- Hardening tongs in various sizes and forms for use in annealing and hardening

### Heat Treating Foil

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

### Gloves

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



Please ask for our separate catalogues for hardening furnaces and hardening accessories!

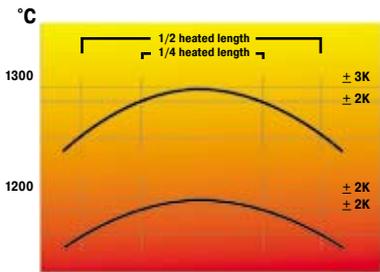
# Compact Tube Furnaces R



R 50/250/12 single-zoned



R 100/750/13, three-zone control with H100



Temperature uniformity, single-zoned tube furnaces



Over-temperature limit controller

## R 50/250/12 - R 120/1000/13

These compact tabletop tube furnaces with integrated control systems can be used universally for many processes. Equipped with a standard working tube of C 530 ceramic and two fibre plugs, these furnaces have an unbeatable price/performance ratio.

- Tmax 1200 °C or 1300 °C
- Housing made of sheets of textured stainless steel
- Outer tube diameter of 50 to 120 mm, heated length from 250 to 1000 mm
- Working tube of C 530 ceramic including two fibre plugs as standard equipment
- Type S thermocouple
- Solid state relays provide for lownoise operation
- Standard working tube see chart on page 29
- Description of the control system see page 54

### Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Charge control with temperature measurement in the working tube and in the oven chamber behind the tube, please see page 25
- Three-zoned design with HiProSystem control (heated length from 750 mm, for 1300 °C models)
- Alternative working tubes see chart on page 29
- Please see page 26 for additional equipment

Model	Tmax °C <sup>3</sup>	Outer dimensions in mm			Outer tube Ø /mm	Heated length mm	Length constant temperature ΔT 10K	Tube length in mm	Power kW	Electrical connection*	Weight in kg
		W	D	H							
R 50/250/12	1200	400	240	490	50	250	80	450	1,2	single-phase	20
R 50/500/12	1200	650	240	490	50	500	170	700	1,8	single-phase	25
R 100/750/12	1200	1000	360	640	90	750	250	1070	3,6	single-phase	80
R 120/1000/12	1200	1300	420	730	120	1000	330	1400	6,0	3-phase <sup>2</sup>	170
R 50/250/13	1300	400	240	490	50	250	80	450	1,3	single-phase	35
R 50/500/13	1300	650	240	490	50	500	170	700	1,9	single-phase	48
R 100/750/13 <sup>1</sup>	1300	1000	360	640	90	750	250	1070	4,4	3-phase <sup>2</sup>	120
R 120/1000/13 <sup>1</sup>	1300	1300	420	730	120	1000	330	1400	6,5	3-phase <sup>2</sup>	230

<sup>1</sup>These models also available with three-zones

<sup>2</sup>Heating only between two phases

\*Please see page 54 for information about mains voltage

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

## Universal Tube Furnaces RT with Stand for horizontal or vertical Operation



RT 50-250/11 with gas supply system for nitrogen



RT 50-250/13

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

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

- Tmax 1100 °C, 1300 °C, or 1500 °C
- Compact design
- Vertical or horizontal operation freely adjustable
- Working height freely adjustable
- Working tube made of C 530 ceramic
- Type S thermocouple
- Operation also possible separate from stand if safety guidelines are observed
- Control system integrated in furnace base
- Please see page 26 for additional equipment
- Description of the control system see page 54



RT 50-250/11

Model	Tmax °C	Outer dimensions in mm			Inner tube Ø /mm	Heated length mm	Length constant temperature ΔT 10K	Tube length in mm	Power kW	Electrical connection*	Weight in kg
		W	D	H							
RT 50-250/11	1100	350	380	740	50	250	80	360	1,8	single-phase	25
RT 50-250/13	1300	350	380	740	50	250	80	360	1,8	single-phase	25
RT 30-200/15	1500	445	475	740	30	200	70	360	1,8	single-phase	45

\*Please see page 54 for more information about mains voltage

## Hinged Tube Furnaces RS for horizontal or vertical Operation up to 1300 °C, Gas Atmosphere or Vacuum



RS 80/300/11 for horizontal operation



RS 80/750/13 with stand as additional equipment for vertical operation

### RS 80/300/11 - RS 170/1000/13

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



Gas supply panel for nonflammable protective gas with shutoff valve and flow meter with regulator valve, piped and ready to connect

- Tmax 1100 °C or 1300 °C
- Housing made of sheets of textured stainless steel
- Tmax 1100 °C: Type K thermocouple
- Tmax 1300 °C: Type S thermocouple
- Frame for vertical operation, which can also be retrofitted as additional equipment
- Hinged design for simple insertion of the working tube
- Working tube made of ceramic C 530 for operation in air included in scope of delivery
- Switchgear and control unit separate from furnace in own wall or standing cabinet
- Standard working tube see chart on page 29
- Description of the control system see page 54

Model	Tmax °C <sup>5</sup>	Exterior dimensions <sup>3</sup> in mm			Max. outer tube Ø /mm	Heated length mm	Length constant temperature ΔT 10K	Tube length in mm	Power kW	Electrical connection*	Weight in kg
		W <sup>2</sup>	D	H							
RS 80/300/11	1100	555	475	390	80	300	100	650	1,8	single-phase	80
RS 80/500/11	1100	755	475	390	80	500	170	850	3,4	single-phase	90
RS 80/750/11	1100	1005	475	390	80	750	250	1100	4,6	3-phase <sup>4</sup>	105
RS 120/500/11	1100	755	525	440	120	500	170	850	4,8	3-phase <sup>4</sup>	95
RS 120/750/11	1100	1005	525	440	120	750	250	1100	6,3	3-phase <sup>4</sup>	110
RS 120/1000/11	1100	1255	525	440	120	1000	330	1350	9,0	3-phase <sup>4</sup>	125
RS 170/750/11	1100	1005	575	490	170	750	250	1100	7,0 <sup>7</sup>	3-phase <sup>4</sup>	115
RS 170/1000/11	1100	1255	575	490	170	1000	330	1350	9,0 <sup>7</sup>	3-phase <sup>4</sup>	130
RS 80/300/13	1300	555	475	390	80	300	100	650	3,6	single-phase	80
RS 80/500/13	1300	755	475	390	80	500	170	850	6,0	3-phase <sup>4</sup>	90
RS 80/750/13	1300	1005	475	390	80	750	250	1100	9,3	3-phase <sup>4</sup>	105
RS 120/500/13	1300	755	525	440	120	500	170	850	7,8	3-phase <sup>4</sup>	95
RS 120/750/13	1300	1005	525	440	120	750	250	1100	12,6	3-phase <sup>4</sup>	110
RS 120/1000/13	1300	1255	525	440	120	1000	330	1350	12,6	3-phase <sup>4</sup>	125
RS 170/750/13	1300	1005	575	490	170	750	250	1100	12,6	3-phase <sup>4</sup>	115
RS 170/1000/13	1300	1255	575	490	170	1000	330	1350	12,6	3-phase <sup>4</sup>	130

<sup>1</sup>Heating only between two phases

<sup>2</sup>Without tube

<sup>3</sup>Exterior dimensions for vertical operation upon request

<sup>5</sup>Tmax. is reached outside the tube. Realistic working temperature inside the tube is approx. 50 °C lower.

<sup>7</sup>Only valid for single-zone version

\*Please see page 54 for more information about mains voltage



The RS tube furnace line can be custom-fit to your needs with a variety of extras. Starting with various working tubes of different materials to protective gas or vacuum operation. For optimum temperature uniformity, all RS furnaces are also available as three-zone tube furnaces with modern PLC controls. The heat loss at the ends of the tube is compensated using this three-zoned control, and a longer uniform zone is the result. An overview of the complete line of accessories can be found starting on page 26.

RS 120/1000/13S with gastight tube, charge control and check valve at gas outlet

#### Additional equipment

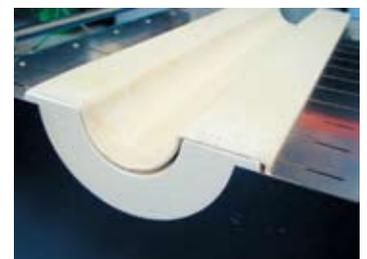
- Charge control with temperature measurement in the working tube and in the oven chamber behind the tube, please see page 28
- Working tubes designed for process requirements
- Display of inner tube temperature with additional thermocouple
- Different gas supply packages (starting on page 26) for protective gas and vacuum operation
- Three-zone control for optimization of temperature uniformity
- Check valve at gas outlet avoids intrusion of false air
- Ceramic half pipe for heating elements and/or as support surface for the load
- Stand for vertical operation
- Base frame with integrated switchgear and controller
- Alternative working tubes see chart on page 29
- Please see page 26 for more additional equipment



Quartz glass and flanges for protective gas operation as optional equipment



RS 120/750/13 with gas supply system 4, hydrogen applications

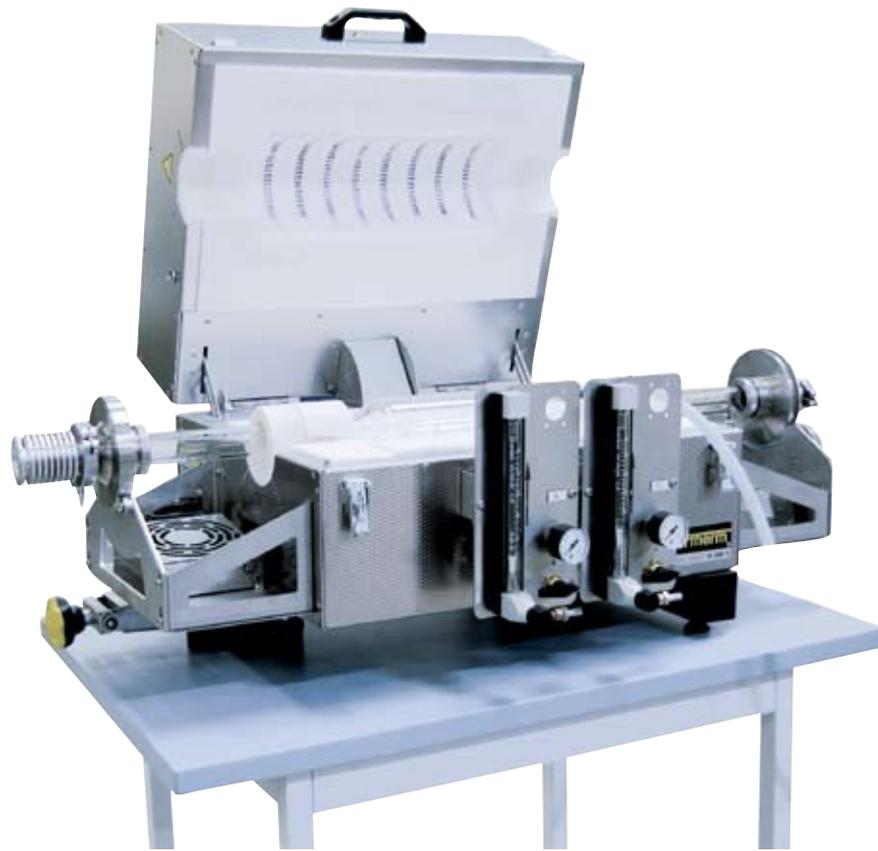


Ceramic half pipe for heating elements and/or as support surface for the load

## Rotary Tube Furnaces RSR



RSR 80-500/11 with tilting frame for continuous operation



RSR 80-300/11 in tiltable version with glass tube and protective gas operation



Adapters for alternative operation with working tube or process reactor

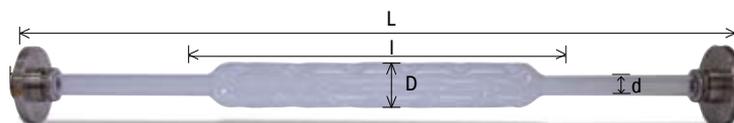


Connection set for vacuum operation

### RSR 80-500/11 - RSR 120-750/11

When the retention of the granular characteristics of the material is important, as in drying or calcining, the rotary tube furnaces of the RSR series provide for the optimal solution. The permanent rotation of the working tube in one direction makes sure that the charge is constantly in motion. The furnaces may be operated either horizontally with a quartz glass reactor or in a preset tilting angle with a quartz glass tube for continuous conveying of the charge through the tube. Equipment like the filling funnel, electrically driven feeder and outlet with conveying paddles in the tube can be added to upscale these continuous furnaces into a small production plant.

- Design like RS models, see page 18
- T<sub>max</sub> 1100 °C
- Type K thermocouple
- Compact unit, designed as tabletop model
- Optionally supplied with quartz glass process reactor or quartz glass tube
- Easy working tube or process reactor removal through beltless drive and hinged housing
- Infinitely variable drive (approx. 1-20 rpm)
- Good flooding of load with process gas due to inlet on one side and outlet on other side of tube
- Description of the control system see page 54



Quartz glass reactor, flat or dimpled with flange KF 40 according to DIN 28403



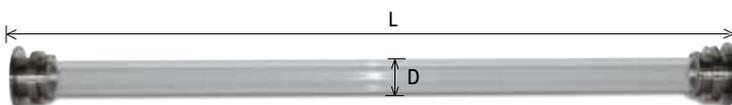
RSR 120/750/11 with filling funnel and conveying technology

### Additional equipment

- Gas-tight rotary feedthrough for connection to gas supply systems (suitable for operation in rough vacuum)
- Display of inner tube temperature with additional thermocouple
- Different gas supply systems
- Gas cooler at tube outlet
- Check valve at gas outlet avoids intrusion of false air
- Three-zone control
- Tube adaptor for alternative operation either with glass reactor or ceramic tube
- Tilting frame with adjustable tilting angle for conveying the powder through the tube
- Feeder with electrically driven screw conveyor and adjustable rotational speed
- Filling funnel with closable powder outlet
- Powder outlet with conveying paddles in the working tube at the tube end



Screw conveyor with adjustable rotational speed



Quartz glass tube for through-put operation in combination with tilting device



Protective gas inlet at tube exit

Model	Tmax °C <sup>3</sup>	Outer dimensions in mm			Length constant Temperature ΔT 10K	Tube dimensions in mm				Supply power/kW	Electrical connection*	Weight in kg
		W <sup>2</sup>	D	H		L	l	D	d			
RSR 80-500/11	1100	1075	475	390	170	1140	500	76	34	3,4	single-phase	100
RSR 80-750/11	1100	1325	475	390	250	1390	750	76	34	4,6	3-phase <sup>1</sup>	115
RSR 120-500/11	1100	1075	525	440	170	1140	500	106	34	4,8	3-phase <sup>1</sup>	105
RSR 120-750/11	1100	1325	525	440	250	1390	750	106	34	6,3	3-phase	120

<sup>1</sup>Heating only between two phases

<sup>2</sup>Without tube

\*Please see page 54 for information on mains voltage

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

## High-temperature Tube Furnaces RHTH for horizontal Operation and RHTV for vertical Operation up to 1800 °C, Gas Atmosphere or Vacuum



Horizontal tube furnace RHTH 120/300/16 with vacuum flanges as additional equipment

### RHTH 120/150/.. - RHTH 120/600/.., RHTV 120/150/.. - RHTV 120/600/..

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



Gas supply panel for nonflammable protective gas with shutoff valve and flow meter with regulator valve, piped and ready to connect

- Tmax 1600 °C, 1700 °C, or 1800 °C
- MoSi<sub>2</sub> heating elements, mounted vertically for easy replacement
- Insulation with vacuum-formed ceramic fibre plates
- Rectangular outer housing with slots for convection cooling
- Models RHTV with hinges for wall mounting
- Housing made of sheets of textured stainless steel
- Ceramic working tube made of material C 799 incl. fibre plugs operation under air
- Type B thermocouple
- Power unit with low-voltage transformer and thyristor
- Switchgear and control unit separate from furnace in separate floor standing cabinet
- Standard working tube see chart on page 29
- Description of the control system see page 54

#### Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Charge control with temperature measurement in the working tube and in the oven chamber behind the tube, please see page 28
- Working tubes designed for process requirements
- Display of inner tube temperature with additional thermocouple
- Gas-tight flanges for protective gas and vacuum operation
- Manual or automatic gas supply system
- Three- or five-zone control for optimization of temperature uniformity
- Check valve at gas outlet avoids intrusion of false air
- Stand for vertical operation
- Alternative working tubes see chart on page 29
- Please see page 26 for more additional equipment



Over-temperature limit controller



RHTH 120/600/16 with upstream furnace RT 50-250/11 to preheat the process gas



RHTV 120/150/17 vertical tube furnace with stand and gas supply system 2 as additional equipment



RHTV 120/300/15 integrated in a tensile strength testing machine

Model	Tmax °C <sup>3</sup>	Outer dimensions in mm			Max. outer tube Ø /mm	Heated length mm	Length constant temperature ΔT 10K	Tube length in mm	Power kW	Electrical connection*	Weight in kg
		W <sup>2</sup>	D	H							
Horizontal design											
RHTH 120/150/..	1600 or	470	550	640	50	150	50	470	5,4	3-phase <sup>1</sup>	70
RHTH 120/300/..	1700 or	620	550	640	80	300	100	620	9,0	3-phase <sup>1</sup>	90
RHTH 120/600/..	1800	920	550	640	120	600	200	920	14,4	3-phase <sup>1</sup>	110

Model	Tmax °C <sup>3</sup>	Outer dimensions in mm			Max. outer tube Ø /mm	Heated length mm	Length constant temperature ΔT 10K	Tube length in mm	Power kW	Electrical connection*	Weight in kg
		W	D	H <sup>2</sup>							
Vertical design											
RHTV 120/150/..	1600 or	570	650	510	50	150	30	480	5,4	3-phase <sup>1</sup>	70
RHTV 120/300/..	1700 or	570	650	660	80	300	80	630	10,3	3-phase <sup>1</sup>	90
RHTV 120/600/..	1800	570	650	960	120	600	170	880	19,0	3-phase <sup>1</sup>	110

<sup>1</sup>Heating only between two phases

<sup>2</sup>Without tube

<sup>\*</sup>Please see page 54 for information on mains voltage

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

## Universal High-Temperature Tube Furnaces RHTC with Silicon Carbide Rod Heating, Gas Atmosphere or Vacuum



RHTC 80-230



RHTC 80-450/15 with manual gas supply system

### RHTC 80-230/15 - RHTC 80-710/15

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

- Tmax 1500 °C
- Housing made of sheets of textured stainless steel
- High-quality fiber insulation
- Active cooling of housing for low surface temperatures
- Type S thermocouple
- Solid state relays provide for low-noise operation
- Prepared for assembly of working tubes with water-cooled flanges
- Ceramic tube, C 799 quality
- Standard working tube see chart on page 29
- Description of the control system see page 54



SiC rod heating

### Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect furnace and load
- Charge control with temperature measurement in the working tube and in the oven chamber behind the tube, please see page 28
- Fiber plugs
- Check valve at gas outlet avoids intrusion of false air
- Working tubes for operation with water-cooled flanges
- Display of inner tube temperature with additional thermocouple
- Alternative gas supply systems for protective gas or vacuum operation, starting on page 26
- Alternative working tubes see chart on page 29

Model	Tmax °C <sup>3</sup>	Outer dimensions in mm			Outer tube Ø /mm	Heated length/mm	Length constant temperature ΔT 10K	Tube length in mm	Supply power/kW	Electrical connection*	Weight in kg
		W	D	H							
RHTC 80-230/15	1500	600	430	580	80	230	80	600	6,3	3-phase <sup>2</sup>	50
RHTC 80-450/15	1500	820	430	580	80	450	150	830	9,5	3-phase <sup>1</sup>	70
RHTC 80-710/15	1500	1070	430	580	80	710	235	1080	11,7	3-phase <sup>1</sup>	90

<sup>1</sup>Heating only between two phases

<sup>2</sup>Heating only on one phase

\*Please see page 54 for more information about mains voltage

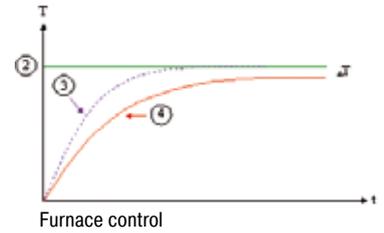
<sup>3</sup>Tmax. is reached outside the tube. Realistic working temperature inside the tube is approx. 50 °C lower.

## Control Alternatives for Tube Furnaces

### Furnace Chamber Control

with temperature measurement in furnace chamber outside the working tube.

- Advantages: Thermocouple protected against damage and aggressive load, very even control, attractive price
- Disadvantage: Process-dependent temperature difference between displayed temperature on the controller and inside the tube



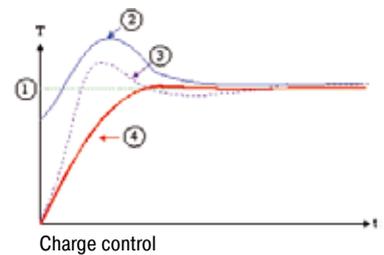
### Extension Package for Furnace Chamber Control

with additional temperature measurement in the working tube and display of the measured temperature

### Charge Control

with temperature measurement both in the furnace chamber outside the working tube as well as in the working tube.

- Advantages: Very precise and rapid control adjustment
- Disadvantage: Costs



## Furnace Chamber vs. Charge Control Comparison

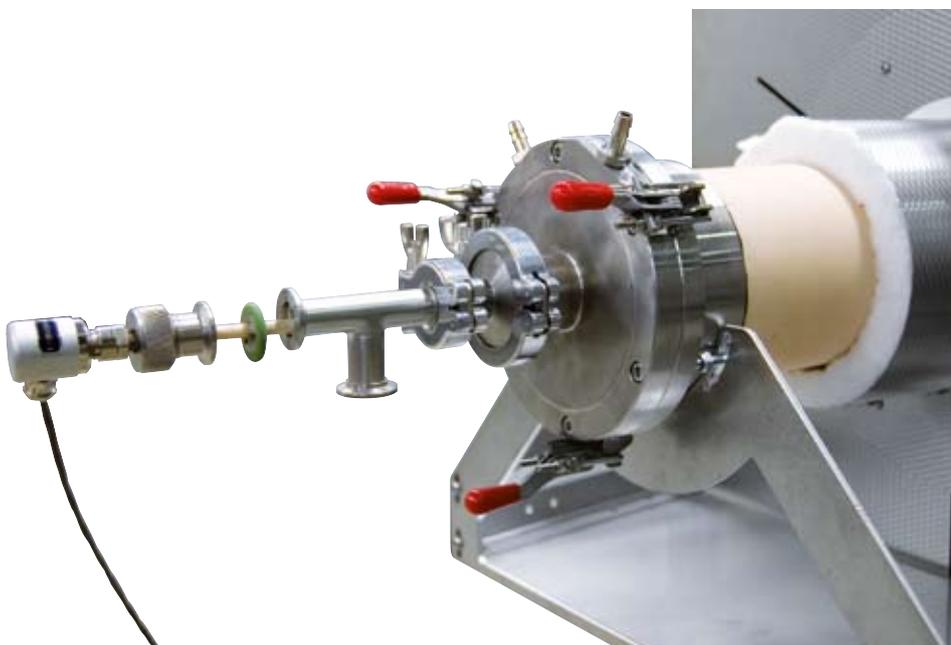
### Furnace Chamber Control

Only the furnace chamber temperature is measured and controlled. Regulation is carried out slowly to avoid out-of-range values. Because the charge temperature is not measured during this process, the furnace chamber temperature deviates from the charge temperature by several degrees.

1. Charge setpoint value
2. Furnace setpoint value
3. Actual value furnace chamber
4. Actual value load/bath/muffle/retort

### Charge Control

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



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

## Gas Supply Systems/Vacuum Operation for Tube Furnaces R, RT, RS, RHTC, RHTH and RHTV

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

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

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



Gas supply system 1:  
Fibre plugs with protective gas connection,  
suitable for many laboratory applications

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

#### Additional equipment

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



Gas supply panel for nonflammable  
protective gas with shutoff valve and flow  
meter with regulator valve, piped and ready  
to connect

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

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

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

#### Additional equipment

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



Observation window as additional equip-  
ment for gastight flanges

### Vacuum Operation

- Vacuum package for evacuation of the working tube, consisting of connector for the gas outlet, 1 ball valve, manometer, 1-stage manually operated rotary vane vacuum pump with corrugated stainless steel hose connected to the gas outlet, max. attainable end pressure in working tube about 10<sup>-2</sup> mbar
- Alternative pumps for max. final pressure of up to 10<sup>-5</sup> mbar on request (see page 27)

**Gas Supply System 3** for hydrogen applications, manual operation in supervised mode

Adding gas supply system 3 to the tube furnace allows operation under a hydrogen atmosphere. During hydrogen operation, a safety pressure of approx. 30 mbar is ensured in the working tube. Surplus hydrogen is burnt off in an exhaust gas torch. The operator manually takes care of inerting the working chamber before process start, after process end, and in case of default.

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



RHTH 120-600/18 with gas supply system 4 for hydrogen operation

**Gas Supply System 4** for hydrogen applications, fully-automatic, unattended operation

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

**Equipment in Addition to System 3**

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

**Additional equipment for systems 3 - 4**

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



Gas-tight design with water-cooled flanges



Water-cooled end flange with quick connectors as additional equipment

**Vacuum Pumps**

With respect to the final pressure different pumps are available (see also page 48):

- Single-step rotary piston pump for a max. final pressure of approx. 20 mbar.
- Two-step rotary piston pump for a max. final pressure of approx. 10<sup>-2</sup> mbar.
- Pump system PT70 Dry (rotary vane pump with following turbomolecular pump for a max. final pressure of 10<sup>-5</sup> mbar.

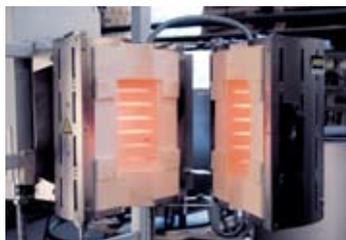
**Information:**

For protection of the vacuum pump only cold stage evacuation is allowed. The reduction of working tube strength limits the max. possible working temperature under vacuum (see page 28).



Vacuum pump stand for operation up to 10<sup>-5</sup> mbar

## Tube Furnaces for Integration into Customized Systems



RS 100-250/11S in split-type design for integration into a test stand



Tube furnace with five-zone control for optimal temperature uniformity



RS 120/1000/11-S in divided version. Both half furnaces are manufactured identically and will be integrated in an existing gas-heating system with space-saving design

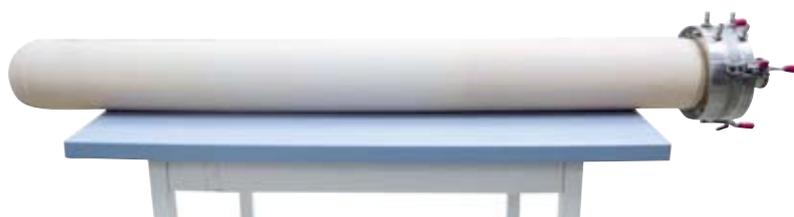


Bolts for connection of two separated half furnaces

With their high level of flexibility and innovation, Nabertherm offers the optimal solution for customer-specific applications.

Based on our standard models, we develop individual solutions for integration in overriding process systems. The solutions shown on this page are just a few examples of what is feasible. From working under vacuum or protective gas via innovative control and automation technology for a wide selection of temperatures, sizes, lengths and other properties of tube furnace systems – we will find the appropriate solution for a suitable process optimization.

## Working Tubes



Working tube closed at one end with gastight flanges as additional equipment

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

Material	Tube outside Ø mm	Max. heat-up ramp K/h	Tmax in air* °C	Tmax in vacuum operation °C	Gas-tight
C 530 (Sillimantín)	< 120	unlimited	1300	not possible	no
	from 120	200			
C 610 (Pytagoras)	< 120	300	1400	1200	yes
	from 120	200			
C 799 (99.7 % Al <sub>2</sub> O <sub>3</sub> )	< 120	300	1800	1400	yes
	from 120	200			
Quartz glass	all	unlimited	1100	950	yes
CrFeAl-Alloy	all	unlimited	1300	1100	yes

\*the max. allowed temperature might be reduced operating under aggressive atmospheres



Various working tubes as option

## Working Tubes: Standard (●) and Options (○)

Working tube outer Ø x inner Ø x length	Article No.	Model																									
		R				RS						RHTC			RHTH			RHTV			RSR						
		50-250	50-500	100-750	120-1000	80-300	80-500	80-750	120-500	120-750	120-1000	170-750	170-1000	80-230	80-450	80-710	120-150	120-300	120-600	120-150	120-300	120-600	80-500	80-750	120-500	120-750	
<b>C 530</b>																											
40 x 30 x 450 mm	692070274	○																									
40 x 30 x 700 mm	692070276		○				○																				
50 x 40 x 450 mm	692070275	●																									
50 x 40 x 700 mm	692070277		●																								
60 x 50 x 650 mm	692070106						○																				
60 x 50 x 850 mm	692070305						○																				
60 x 50 x 1100 mm	692070101			○				○																			
70 x 60 x 1070 mm	692070048			○				○																			
80 x 70 x 650 mm	692070036					●																					
80 x 70 x 850 mm	692070108						●		○																		
80 x 70 x 1100 mm	692070109			○			●		○																		
95 x 80 x 1070 mm	692070049			●					○																		
120 x 100 x 850 mm	692070110						●																				
120 x 100 x 1100 mm	692070111							●								○											
120 x 100 x 1350 mm	692070131									●					○												
120 x 100 x 1400 mm	692070279				●																						
170 x 150 x 1100 mm	692071659										●																
170 x 150 x 1350 mm	692071660										●																
<b>Vacuum tube<sup>1</sup> C 610</b>																											
60 x 50 x 1030 mm	692070179					○																					
60 x 50 x 1230 mm	692070180						○																				
60 x 50 x 1480 mm	692070181							○																			
80 x 70 x 1230 mm	692070182							○		○																	
80 x 70 x 1480 mm	692070183							○		○																	
120 x 100 x 1230 mm	692070184							○																			
120 x 100 x 1480 mm	692070185								○																		
120 x 100 x 1730 mm	692070186									○					○												
170 x 150 x 1480 mm	692070187										○																
170 x 150 x 1730 mm	692070188										○																
<b>C 799</b>																											
50 x 40 x 380 mm	692071664															●				●							
50 x 40 x 530 mm	692071665																○				○						
50 x 40 x 830 mm	692070163																○					○					
80 x 70 x 600 mm	692070600											●															
80 x 70 x 830 mm	692071670												●														
80 x 70 x 530 mm	692071669																●				●						
80 x 70 x 1080 mm	692071647																	●				●					
120 x 105 x 830 mm	692071713																						●				
<b>Vacuum tube<sup>1</sup> C 799</b>																											
50 x 40 x 990 mm	692070149															○				○							
50 x 40 x 1140 mm	692070176																○				○						
50 x 40 x 1440 mm	692070177																	○				○					
80 x 70 x 990 mm	692070190											○											○				
80 x 70 x 1140 mm	692070148																						○				
80 x 70 x 1210 mm	692070191												○										○				
80 x 70 x 1470 mm	692070192																							○			
80 x 70 x 1440 mm	692070178																							○			
120 x 105 x 1440 mm	692070147																							○			
<b>Vacuum tube<sup>2</sup> APM</b>																											
75 x 66 x 1090 mm	691402564					○																					
75 x 66 x 1290 mm	691402565						○																				
75 x 66 x 1540 mm	691400835							○																			
115 x 104 x 1290 mm	691402566								○																		
115 x 104 x 1540 mm	691402567									○																	
115 x 104 x 1790 mm	691402568										○																
164 x 152 x 1540 mm	691402569											○															
164 x 152 x 1790 mm	691402570												○														
<b>Quartz glass tubes<sup>3</sup></b>																											
76 x 70 x 1140 mm	601402750																						●		○		
Spare tube	691402556																						●		○		
76 x 70 x 1390 mm	601402751																							●		○	
Spare tube	691402636																							●		○	
106 x 100 x 1140 mm	601402752																							●		○	
Spare tube	691402637																							●		○	
106 x 100 x 1390 mm	601402753																								●		○
Spare tube	691402635																								●		○
<b>Quartz glass tube<sup>3</sup></b>																											
76 x 70 x 1140 mm	601402746																						○		○		
Spare tube	691402548																							○		○	
76 x 70 x 1390 mm	601402747																							○		○	
Spare tube	691402272																							○		○	
106 x 100 x 1140 mm	601402748																							○		○	
Spare tube	691402629																							○		○	
106 x 100 x 1390 mm	601402749																								○		○
Spare tube	691402638																								○		○

<sup>1</sup>With grinded tube ends for the use with water-cooled end flanges

<sup>2</sup>With attached holder for gas tight flange

<sup>3</sup>Tubes/reactors incl. mounted sleeves for connection to the rotary drive. Spare tubes come without sleeves.

● Standard working tube

○ Working tube available as an option

## Customized Tube Furnaces

Besides our extensive selection of standard tube furnaces, we can also provide you with a tube furnace custom-designed for your application. Some examples of tube furnace systems we have supplied to other customers are listed below. From modified standard furnaces to fully-customized tube furnace systems – we will find a solution for your needs!



- RS 100/1500/13S tube furnace for integration in the customer's production plant
- Operates horizontally, vertically, or at a defined angle
- Tmax 1300 °C
- Heated length: 1500 mm
- Tube interior diameter: 100 mm
- Three-zoned control system for optimization of temperature uniformity



- R 100/1000/11S tube furnace for vacuum operation for annealing of metals under vacuum or protective gas atmospheres
- Working tube closed on one side made of highly heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Load carrier made of alloy 314 (AISI)/(DIN material no. 1.4841)
- 1-stage rotary vane pump for vacuum down to  $10^{-1}$  mbar
- Tmax 1100 °C
- Heated length: 1000 mm
- Tube interior diameter: 100 mm



- RS 100/1000/11 hinged tube furnace for debinding under protective gas atmospheres
- Gas-tight flanges, water-cooled for working under protective gas
- Binder cold trap with condensate separator on the right side of the tube
- Tmax 1100 °C
- Heated length: 1000 mm
- Tube interior diameter: 100 mm



- Vertical tube furnace R 50/5000/13S for drop-down experiments under temperature
- Steel tube assembled vertically
- Furnace consists of 6 modules, each hinged separately
- Each furnace module equipped with a controller for zone control
- Tmax 1300 °C
- Overall tube length approx. 6000 mm
- Heated length 6 x 800 mm
- Tube interior diameter 50 mm



RS 80/2350/11S with tube made of quartz glass in special length for protective gas and vacuum operation

## Fast-Firing Kilns LS 12/13 and LS 25/13

### LS 12/13 and LS 25/13

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

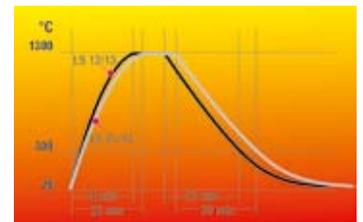
- Tmax 1300 °C
- Very compact design
- Ceramic grid tubes as charge support
- Floor and lid heating
- Two-zone control, bottom and lid
- Integrated cooling fans, automatically programmable to speed up charge cooling including housing cooling
- Programmable lid opening of approximately 20 mm for faster cooling without activating the fan
- Thermocouple PtRh-Pt, type S for top and bottom zone
- Castors for easy furnace moving
- Description of the control system see page 54



LS 12/13

Model	Tmax °C	Interior dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
LS 12/13	1300	350	350	40	12	600	800	985	15	3-phase	130
LS 25/13	1300	500	500	100	25	750	985	1150	22	3-phase	160

\*Please see page 54 for more information about mains voltage



Firing curves LS 12/13 and LS 25/13

## Gradient Kilns GR 1300/13

### GR 1300/13

The kiln chamber is divided into six equal control sections over its heated length of 1300 mm. Each of these zones is individually controlled. For temperatures up to 1300 °C a gradient of up to 400 °C can be achieved.

- Tmax 1300 °C
- Heated length: 1300 mm
- Heating elements on support tubes providing for free heat radiation in the kiln chamber
- Charging from the top or through the right side door
- Gas damper suspension of the lid
- 6-zone control
- Separate control of heating zones (each 160 mm long)
- Temperature gradient of 400 °C over the entire length of the kiln chamber, each zone can individually be controlled
- Fibre blocks to separate the individual chambers as additional equipment
- Description of the control system see page 54



GR 1300/13



Furnace chamber of the GR 1300/13 with second door as additional equipment

Model	Tmax °C	Interior dimensions in mm			Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg
		w	d	h	W	D	H			
GR 1300/13	1300	1300	100	60	1660	740	1345	18	3-phase	300

\*Please see page 54 for more information about mains voltage

## Professional Chamber Furnaces with Brick Insulation LH or Fibre Insulation LF



LH 15/12 with brick insulation

LH 60/12 with scale to measure weight reduction during annealing



Interior of low heat storage fibre material for fast cooling times in LF models



Cooling fan connected to automatic vent flap for shorter cooling time

### LH 15/12 - LF 120/14

The LH 15/12 - LF 120/14 laboratory furnaces have been trusted for many years as professional chamber furnaces for the laboratory. These furnaces are available with either a robust insulation of light refractory bricks (LH models) or with a combination insulation of refractory bricks in the corners and low heat storage, quickly cooling fibre material (LF models). With a wide variety of optional equipment, these models can be optimally adapted to your processes.

- Tmax 1200 °C, 1300 °C, or 1400 °C
- Five-sided heating for very good temperature uniformity
- Heating elements on support tubes ensure free heat radiation and a long service life
- Protection of floor heating and flat stacking surface provided by embedded SiC plate in the floor
- LH models: multilayered, fibre-free insulation of light refractory bricks and special backup insulation
- LF models: high-quality fibre insulation with corner bricks for shorter heating and cooling times
- Door with brick-on-brick seal, hand fitted
- Short heating times due to high installed power
- Side vent with bypass connection for exhaust pipe
- Self-supporting arch for high stability and greatest possible protection against dust
- Quick lock on door
- Freely adjustable air slide intake in furnace floor
- Stand included
- Description of the control system see page 54



LF 120/12 with fibre insulation

### Additional equipment

- Parallel swinging door, pivots away from operator, for opening when hot
- Lift door with electro-mechanic linear drive
- Separate wall-mounting or floor standing cabinet for switchgear
- Automatic vent flap
- Cooling fan for shorter cycle times
- Protective gas connector, sealed housing
- Retort made of quartz glass for very clean atmosphere, quartz glass covered door with lid function
- Manual or automatic gas supply system
- Scale to measure weight reduction during annealing



LH 120/12S with quartz glass retort

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
LH 15/12	1200	250	250	250	15	570	790	1170	5,0	3-phase <sup>1</sup>	150
LH 30/12	1200	320	320	320	30	640	860	1240	7,0	3-phase <sup>1</sup>	170
LH 60/12	1200	400	400	400	60	720	1010	1320	8,0	3-phase	260
LH 120/12	1200	500	500	500	120	820	1110	1420	12,0	3-phase	340
LH 15/13	1300	250	250	250	15	570	790	1170	7,0	3-phase <sup>1</sup>	150
LH 30/13	1300	320	320	320	30	640	860	1240	8,0	3-phase <sup>1</sup>	170
LH 60/13	1300	400	400	400	60	720	1010	1320	11,0	3-phase	260
LH 120/13	1300	500	500	500	120	820	1110	1420	15,0	3-phase	340
LH 15/14	1400	250	250	250	15	570	790	1170	8,0	3-phase <sup>1</sup>	150
LH 30/14	1400	320	320	320	30	640	860	1240	10,0	3-phase <sup>1</sup>	170
LH 60/14	1400	400	400	400	60	720	1010	1320	12,0	3-phase	260
LH 120/14	1400	500	500	500	120	820	1110	1420	18,0	3-phase	340



Parallel swinging door for opening when hot

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
LF 15/13	1300	250	250	250	15	570	790	1170	7,0	3-phase <sup>1</sup>	130
LF 30/13	1300	320	320	320	30	640	860	1240	8,0	3-phase <sup>1</sup>	150
LF 60/13	1300	400	400	400	60	720	1010	1320	11,0	3-phase	230
LF 120/13	1300	500	500	500	120	820	1110	1420	15,0	3-phase	300
LF 15/14	1400	250	250	250	15	570	790	1170	8,0	3-phase <sup>1</sup>	130
LF 30/14	1400	320	320	320	30	640	860	1240	10,0	3-phase <sup>1</sup>	150
LF 60/14	1400	400	400	400	60	720	1010	1320	12,0	3-phase	230
LF 120/14	1400	500	500	500	120	820	1110	1420	18,0	3-phase	300



Gas panel

<sup>1</sup>Heating only between two phases

\*Please see page 54 for information on mains voltage

## Ovens TR 60 - TR 1050 up to 300 °C



TR 60



TR 240



Over-temperature limit controller

### TR 60 - TR 1050

With their maximum working temperature of 300 °C and forced air circulation, the TR series ovens achieve very good temperature uniformity. They can be used for various applications such as e.g. drying, sterilizing or warm storing. The stainless steel interior chamber is easy to clean and resistant to rust.

- Tmax 300 °C
- Operating range, room temperature + 5 °C to 300 °C
- Models TR 60 - TR 240 designed as tabletop models
- Models TR 420 and TR 1050 designed as floor standing models
- Horizontal, forced air circulation results in temperature uniformity better than  $\Delta T$  8 K
- Stainless steel chamber, alloy 304 (AISI)/(DIN material no. 1.4301), rust-resistant and easy to clean
- Large handle to open and close the door
- Charging in multiple layers possible using removeable trays (number of removeable trays included, see table below)
- Large, wide-opening swing door, hinged on the right with quick release for models TR 60 - TR 420
- Door hinge for models TR 60 - TR 420 can be simply changed from the right to the left side
- Double swing door with quick release for TR 1050
- Infinitely adjustable exhaust at the rear wall with operation from the front
- PID microprocessor control with self-diagnosis system
- Solid state relays provide for lownoise operation
- Description of the control system see page 54



Extricable metal sheets to load the oven



TR 420



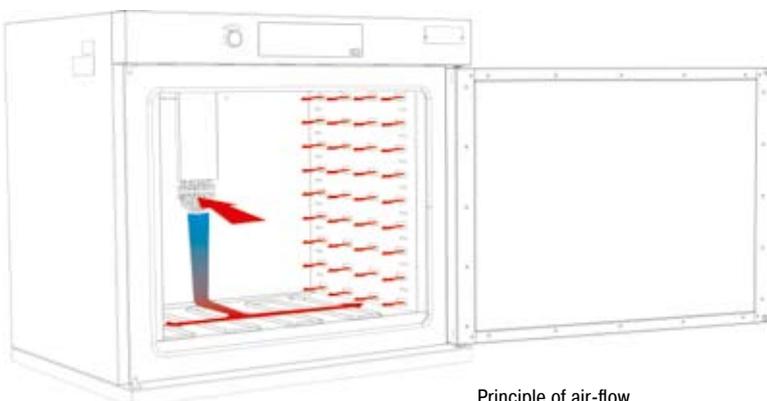
TR 1050 with double door

### Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Infinitely adjustable fan speed of the air-circulation
- Window for charge observing
- Further removeable trays with rails



Infinitely adjustable fan speed of the air-circulation as additional equipment



Principle of air-flow

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Trays in- cluded	Trays max.	Max. total load <sup>1</sup>
		w	d	h		W	D	H						
TR 60	300	450	380	350	60	700	650	690	2,1	single-phase	90	1	4	120
TR 120	300	650	380	500	120	900	650	840	2,1	single-phase	150	2	7	150
TR 240	300	750	550	600	240	1000	820	940	3,1	single-phase	190	2	8	150
TR 420	300	710	550	1080	420	860	830	1370	6,3	3-phase	120	3	17	150
TR 1050	300	1240	570	1510	1050	1430	860	1920	9,3	3-phase	380	4	22	170

<sup>1</sup>Max load per layer 30 kg

\*Please see page 54 for information on mains voltage

## High-Temperature Ovens, Chamber Furnaces with Air Circulation



N 120/65 HA



N 250/65HA with pneumatic lift-door as additional equipment

### N 15/65HA, N 30/45HA - N 500/85HA

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



N 1680/45 AS with roller conveyor implemented in a production line

- Tmax 450 °C, 650 °C, or 850 °C
- Horizontal air circulation
- Swing door hinged on the right
- Optimum temperature uniformity (according to DIN 17052-1) up to  $\Delta T$  6 K
- Heating from bottom, sides and top
- Optimum air flow and temperature uniformity through high circulation rates
- One shelf and rails for two additional shelves included
- Air baffle box of stainless steel inside the furnace chamber for optimum air circulation
- Switchgear with solid-state relays
- Description of the control system see page 54

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Supply power/kW	Electrical connections*	Weight in kg
		w	d	h		W	D	H			
N 30/45 HA	450	290	420	260	30	607 + 255	1175	1315	3,6	1-phase	195
N 60/45 HA	450	350	500	350	60	667 + 255	1250	1400	6,6	3-phase	240
N 120/45 HA	450	450	600	450	120	767 + 255	1350	1500	9,6	3-phase	310
N 250/45 HA	450	600	750	600	250	1002 + 255	1636	1860	19,0	3-phase	610
N 500/45 HA	450	750	1000	750	500	1152 + 255	1886	2010	28,0	3-phase	1030
N 15/65 HA <sup>1</sup>	650	295	340	170	15	470	845	460	2,7	1-phase	55
N 30/65 HA	650	290	420	260	30	607 + 255	1175	1315	6,0	3-phase <sup>2</sup>	195
N 60/65 HA	650	350	500	350	60	667 + 255	1250	1400	9,6	3-phase	240
N 120/65 HA	650	450	600	450	120	767 + 255	1350	1500	13,6	3-phase	310
N 250/65 HA	650	600	750	600	250	1002 + 255	1636	1860	21,0	3-phase	610
N 500/65 HA	650	750	1000	750	500	1152 + 255	1886	2010	31,0	3-phase	1030
N 30/85 HA	850	290	420	260	30	607 + 255	1175	1315	6,0	3-phase <sup>2</sup>	195
N 60/85 HA	850	350	500	350	60	667 + 255	1250	1400	9,6	3-phase	240
N 120/85 HA	850	450	600	450	120	767 + 255	1350	1500	13,6	3-phase	310
N 250/85 HA	850	600	750	600	250	1002 + 255	1636	1860	21,0	3-phase	610
N 500/85 HA	850	750	1000	750	500	1152 + 255	1886	2010	31,0	3-phase	1030

<sup>1</sup>Table-top model

<sup>2</sup>Heating only between two phases

\*Please see page 54 for more information about supply voltage

Additional equipment N 30/45HA - N 500/85HA

- Cooling system with fan for fast cooling
- Automatic control of air inlet and exhaust air vents for better ventilation and faster cooling of the furnace
- Pneumatic lift-door
- Atmosphere boxes for protective gas operation
- Additional shelves
- Variable frequency control of air circulation velocity for sensitive parts
- Charging aids, roller conveyors

## Air-Circulation Chamber Furnaces with Cleanroom Technology



N 2380/55 HAC air circulation furnace in customized version with charging cart and shelves made of 1.4828 stainless steel



N 500/65 HAC with cleanroom technology

### N 120/65 HAC - N 500/65 HAC

For some heat treatment processes it is important to reduce the particle disposal in the furnace chamber to a minimum. To achieve highest protection for these applications these specific chamber furnaces with welded inner box and insulation fully covered with stainless steel sheets are recommended. The ovens are perfectly suitable for heat treatment processes of glass with an emphasis on a clean surface of the product.

- Design of models N ../HA plus:
- Horizontal airflow
- Special sealing of the housing
- Insulation covered with stainless steel sheets
- Optimum temperature uniformity at 250 °C - 650 °C of up to  $\Delta T$  6 K in accordance to DIN 17052-1
- Operation under protective gases as an option

Model	Tmax °C	Inner dimensions in mm			Outer dimensions in mm			Supply power/ kW	Electrical connections*
		w	d	h	W	D	H		
N 120/65 HAC	650	450	600	450	900 + 255	1600	1600	9,6	3-phase
N 250/65 HAC	650	600	750	600	1050 + 255	1750	1750	18,6	3-phase
N 500/65 HAC	650	750	900	750	1120 + 255	1900	1900	27,6	3-phase

\*Please see page 54 for more information about supply voltage



Industrial oven N 250/65 HAC with particle-free oven chamber. For charging, furnace door is located in cleanroom, class 100, furnace chamber in greyroom behind.

## Melting Furnaces K 1/10 - K 4/13, KC Models



K 1/10



KC 2/15

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

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



K 2/10 with steel crucible for lead melting

- Tmax 1000 °C, 1300 °C, or 1500 °C, with melt temperature about 80 - 110 °C lower
- Crucible sizes of 1, 2, or 4 liters
- Crucible with integrated pouring spout of iso-graphite included with delivery
- Spout (not for KC), mounted at the furnace for exact pouring
- Compact bench-top design, simple emptying of crucible by tilting system with gas damper
- Crucible for heating of furnace insulated with a hinged lid, lid opened when pouring
- Description of the control system see page 54

### Additional equipment

- Other crucible types available, e.g. steel or SiC
- Over-temperature limit controller with automatic reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and melt The furnace shuts off upon overtemperature and switches back on when the temperature falls below the critical level.
- Observation hole for melt



Observation hole for the melt

Model	Tmax °C	Crucible	Volume in L	Outer dimensions in mm			Supply power/kW	Electrical connection*	Weight in kg
				W	D	H			
K 1/10	1000	A 6	1,0	520	680	660	3,0	single-phase	85
K 2/10	1000	A10	2,0	520	680	660	3,0	single-phase	90
K 4/10	1000	A25	4,0	570	755	705	3,6	single-phase	110
K 1/13 <sup>2</sup>	1300	A 6	1,0	520	680	660	3,0	single-phase	120
K 2/13 <sup>2</sup>	1300	A10	2,0	520	680	660	3,0	single-phase	125
K 4/13 <sup>2</sup>	1300	A25	4,0	570	755	705	5,5	3-phase <sup>1</sup>	170
KC 1/15 <sup>3</sup>	1500	A6	1,0	580	630	580	10,5	3-phase	170
KC 2/15 <sup>3</sup>	1500	A10	2,0	580	630	580	10,5	3-phase	170

<sup>1</sup>Heating only between two phases

\*Please see page 54 for information on mains voltage

<sup>2</sup>External dimensions of furnace, transformer in separate housing (500 x 570 x 300 mm)

<sup>3</sup>Switchgear and controller mounted in a floor standing cabinet

## High-Temperature Furnaces with SiC Rod Heating HTC 01/14 - HTCT 08/16, Optionally with Flap Door or Lift Door



HTCT 08/15 with lift door

HTC 08/14 with flap door and gas supply system

### HTC 01/14 - HTCT 08/16

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

- Tmax 1400 °C, 1500 °C, or 1600 °C
- High-quality fibre material, selected for the working temperature
- Housing made of sheets of textured stainless steel
- Double-walled housing for low external temperatures and high stability
- Optional flap door (HTC) which can be used as work platform or lift door (HTCT) with hot surface facing away from the operator
- Adjustable air intake opening in the furnace door, exhaust air opening in the back wall
- Switching system with solid-state-relays, power tuned to the SiC rods
- Easy replacement of heating rods
- Description of the control system see page 54

### Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Square saggars for charging of up to three layers see page 13
- Spacer recommended to be placed under the bottom saggars for better temperature uniformity
- Manual or automatic gas supply system

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H <sup>2</sup>				
HTC, HTCT 01/14	1400	90	150	130	1	470	700	750	2,2	single-phase	55	40
HTC, HTCT 03/14	1400	120	210	120	3	400	535	530	9,0	3-phase <sup>1</sup>	30	40
HTC, HTCT 08/14	1400	170	290	170	8	450	620	570	13,0	3-phase	40	40
HTC, HTCT 01/15	1500	90	150	130	1	470	700	750	2,2	single-phase	55	50
HTC, HTCT 03/15	1500	120	210	120	3	400	535	530	9,0	3-phase <sup>1</sup>	30	50
HTC, HTCT 08/15	1500	170	290	170	8	450	620	570	13,0	3-phase	40	50
HTC, HTCT 01/16	1600	90	150	130	1	470	700	750	2,2	single-phase	55	60
HTC, HTCT 03/16	1600	120	210	120	3	400	535	530	9,0	3-phase <sup>1</sup>	30	60
HTC, HTCT 08/16	1600	170	290	170	8	450	620	570	13,0	3-phase	40	60

<sup>1</sup>Heating only between two phases

\*Please see page 54 for more information about mains voltage

<sup>2</sup>Plus maximum 270 mm for models HTCT when open



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



Saggars with top lid



Spacers



Over-temperature limit controller

## High-temperature Lift-bottom Furnace LHT/LB without and LHT/LBR with Retort



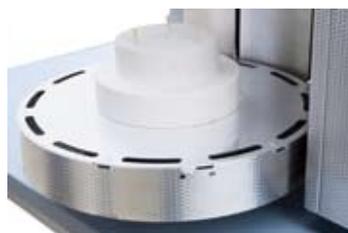
LHT 02/16 LB with a set of saggars



LHT 16/17 LBR

### LHT/LB and LHT/LBR

The electrically driven lift-bottom considerably facilitates charging of the LHT/LB(R) furnaces. With their all-round heating of the cylindrical chamber, these furnaces achieve outstanding temperature uniformity. Model LHT 02/16 LBR is specifically recommend when possible contamination is an issue. A ceramic retort between the charge and the heating elements optimally protects the furnace against chemical contamination. The load can be placed in saggars made of technical ceramics. Up to three saggars can be charged and provide for high output. As additional equipment these furnaces can be furnished with a cooling system using compressed air which is induced to shorten the process cycle.



Lift-bottom with adjustable air inlet

- Tmax 1600 °C or 1700 °C
- High-quality molybdenum disilicide heating elements
- Furnace chamber lined with first-class, durable fiber materials
- Outstanding temperature uniformity due to all-round furnace chamber heating
- Tubular plasma ceramic retort for the LBR version to prevent a certain level of contamination and to improve temperature uniformity
- Furnace chamber with a volume of 2 or 16 liters, table with large footprint
- Spacers to lift-up the saggars already installed in the table
- Precise, electric spindle drive with push button operation
- Housing made of sheets of textured stainless steel
- Adjustable air inlet through the floor
- Exhaust air vent in the roof
- Type B thermocouple
- Switchgear with thyristor
- Description of the control system see page 54

## Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the furnace and load
- Square sagger for charging of up to three layers see page 13
- Protective gas connection
- Manual or automatic gas supply system, particularly effective in the LBR version with retort
- Forced-Air Cooling Package for model LHT 02/LBR for shorter process cycles

The forced-air cooling package can be installed in models LHT 02/16 LBR and LHT 02/17 LBR. The furnace will be equipped with a quick lock for compressed air and a valve which can be activated by means of the extra function in the controller. To protect the charge, the cooling air will be injected behind the ceramic retort in the furnace chamber. Cooling times can be cut by about 45 minutes.



Plasma ceramic retort for protection of the heating elements and to avoid charge continuation [in the LHT 02/16 LBR]

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		∅	h			W	D	H				
LHT 02/16 LB, LBR	1600	∅ 120	130		2	540	610	740	3,0	single-phase	85	85
LHT 02/17 LB, LBR	1700	∅ 120	130		2	540	610	740	3,0	single-phase	85	85
LHT 16/16 LB, LBR	1600	∅ 260	260		16	650	1250	1980	12,0	3-phase	410	120
LHT 16/17 LB, LBR	1700	∅ 260	260		16	650	1250	1980	12,0	3-phase	410	120

\*Please see page 54 for more information about mains voltage

## High-Temperature LHT/SW Furnaces with Scale and Software for Determination of Combustion Loss during Annealing and for Thermographic Analyses (TGA)



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

### LHT 04/16 SW and LHT 04/17 SW

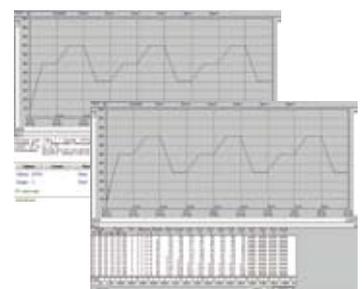
These furnaces were specially developed to determine combustion loss during annealing and for thermographic analysis (TGA) in the lab. The complete system consists of the high-temperature furnace for 1600°C or 1750°C, a table frame, precision scale with feedthroughs into the furnace and powerful software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

- Technical description of the furnaces: see models LHT 04/16 and LHT 04/17, page 42
- Description of the weighing system: see models L 9/... SW, page 11

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H				
LHT 04/16 SW	1600	150	150	150	4	655	370	890	5,0	3-phase <sup>1</sup>	85	25
LHT 04/17 SW	1750	150	150	150	4	655	370	890	5,0	3-phase <sup>1</sup>	85	40

<sup>1</sup>Heating only between two phases

\*Please see page 54 for more information about mains voltage



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

## High-Temperature Furnaces LHT with MoSi<sub>2</sub> Heating Elements as Table-Top Model



LHT 08/17



LHT 02/17

### LHT 02/16 - LHT 08/18

Designed as tabletop models, these compact high-temperature furnaces have a variety of advantages. The first-class workmanship using high-quality materials, combined with ease of operation, make these furnaces all-rounders in research and the laboratory. These furnaces are also perfectly suited for the sintering of technical ceramics, such as zirconium oxide dental bridges.



Saggars with top lid



Spacers



Over-temperature limit controller

- Tmax 1600 °C, 1750 °C, or 1800 °C
- High-quality molybdenum disilicide heating elements
- Furnace chamber lined with first-class, durable fibre material
- Housing made of sheets of textured stainless steel
- Double-walled housing with additional fan cooling for low surface temperature
- Furnace sizes of 2, 4, or 8 liters
- With lift door, whereby the hot side is away from the operator
- Adjustable air inlet
- Exhaust air opening in the roof
- Type B thermocouple
- Switching system with phase-angle firing thyristors (SCRs)
- Description of the control system see page 54

#### Additional equipment

- Over-temperature limit controller with manual reset for thermal protection class 2 in accordance with EN 60519-2 as temperature limiter to protect the oven and load
- Square saggars for charging of up to three layers see page 13
- Spacer recommended to be placed under the bottom saggars for better temperature uniformity
- Protective gas connection
- Manual or automatic gas supply system

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H				
LHT 02/16	1600	90	150	150	2	470	700	750+350	3,0	single-phase	75	30
LHT 04/16	1600	150	150	150	4	470	700	750+350	5,2	3-phase <sup>1</sup>	85	25
LHT 08/16	1600	150	300	150	8	470	850	750+350	8,0	3-phase <sup>1</sup>	100	25
LHT 02/17	1750	90	150	150	2	470	700	750+350	3,0	single-phase	75	60
LHT 04/17	1750	150	150	150	4	470	700	750+350	5,2	3-phase <sup>1</sup>	85	40
LHT 08/17	1750	150	300	150	8	470	850	750+350	8,0	3-phase <sup>1</sup>	100	40
LHT 02/18	1800	90	150	150	2	470	700	750+350	3,6	single-phase	75	75
LHT 04/18	1800	150	150	150	4	470	700	750+350	5,2	3-phase <sup>1</sup>	85	60
LHT 08/18	1800	150	300	150	8	470	850	750+350	9,0	3-phase <sup>1</sup>	100	60

<sup>1</sup>Heating only between two phases

\*Please see page 54 for more information about mains voltage

## High-Temperature Furnaces HT with MoSi<sub>2</sub> Heating Elements as Floor Models



HT 16/16



HT 32/17 with automatic vapour vent flap and fresh air fan with dimmer

### HT 04/16 - HT 16/18

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

- Tmax 1600 °C, 1750 °C, or 1800 °C
- High-quality molybdenum disilicide (MoSi<sub>2</sub>) heating elements
- Furnace chamber lined with first-class, durable fibre material
- Parallel swinging doors, chain-guided, allowing safe opening and closing without destruction of the fibre insulation. Positive closing of the door with a cam latch
- Type B thermocouple
- Furnace sizes from 4 to 450 liters, special sizes on request
- Over-temperature limit controller with manual reset for product and furnace protection
- Description of the control system see page 54

### Additional equipment

- Floor reinforcement for support of heavy loads
- Exhaust air flap controlled manually or automatically for better ventilation of furnace chamber
- Fan for better ventilation of combustion chamber and for fast cooling of the furnace
- Protective gas connector and seal of furnace housing to allow purging of furnace with protective gasses
- Manual or automatic gas supply system
- Retort to improve the gastightness and to protect the furnace chamber against contamination

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg	Minutes to Tmax
		w	d	h		W	D	H				
HT 04/16	1600	150	150	150	4	610	470	1400	5,2	3-phase <sup>1</sup>	150	40
HT 08/16	1600	150	300	150	8	610	610	1400	8,0	3-phase <sup>1</sup>	200	35
HT 16/16	1600	200	300	260	16	710	650	1500	12,0	3-phase <sup>1</sup>	270	30
HT 04/17	1750	150	150	150	4	610	470	1400	5,2	3-phase <sup>1</sup>	150	40
HT 08/17	1750	150	300	150	8	610	610	1400	8,0	3-phase <sup>1</sup>	200	35
HT 16/17	1750	200	300	260	16	710	650	1500	12,0	3-phase <sup>1</sup>	270	30
HT 04/18	1800	150	150	150	4	610	470	1400	5,2	3-phase <sup>1</sup>	150	40
HT 08/18	1800	150	300	150	8	610	610	1400	9,0	3-phase <sup>1</sup>	200	35
HT 16/18	1800	200	300	260	16	710	650	1500	12,0	3-phase <sup>1</sup>	270	30

<sup>1</sup>Heating only between two phases

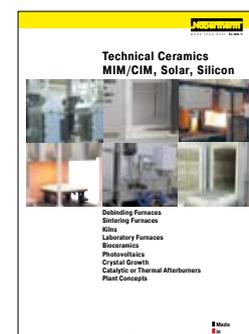
\*Please see page 54 for more information about mains voltage



Gas supply panel for nonflammable protective gas with shutoff valve and flow meter with regulator valve, piped and ready to connect



Gastight retort with gas injection through the furnace floor



Ask for our "Ceramics" catalog for more information on our high-temperature furnaces!

## High-Temperature Furnaces HFL as floor Models with Brick Insulation for Melting Experiments



HFL 160/17 with gas supply system



HFL 295/13 with lift door and transformer in stand, with customer-specific design



Protective screen in front of heating elements for protection against mechanical damage

### HFL 16/16 - HFL 160/17

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

- Tmax 1600 °C or 1700 °C
- High-quality molybdenum disilicide (MoSi<sub>2</sub>) heating elements
- Insulation with light refractory bricks and special backup insulation
- Type B thermocouple
- Furnace sizes of 16 to 160 liters
- For the release of vapours, a 30 mm large exhaust hole is integrated into the roof of the furnace
- Over-temperature limit controller with manual reset for protection of material
- Description of the control system see page 54

#### Additional equipment

- Exhaust air flap controlled manually or automatically for better ventilation of furnace chamber
- Fan for better ventilation of combustion chamber and for fast cooling of the furnace
- Protective gas connector and seal of furnace housing to allow purging of furnace with protective gasses
- Manual or automatic gas supply system



Gas supply system for HFL 160/17

Model	Tmax °C	Inner dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
HFL 16/16	1600	200	300	260	16	770	830	1550	12	3-phase <sup>1</sup>	500
HFL 40/16	1600	300	350	350	40	880	880	1710	12	3-phase	660
HFL 64/16	1600	400	400	400	64	980	930	1830	18	3-phase	880
HFL 160/16	1600	500	550	550	160	1090	1080	2030	21	3-phase	1140
HFL 16/17	1700	200	300	260	16	770	830	1550	12	3-phase <sup>1</sup>	530
HFL 40/17	1700	300	350	350	40	880	880	1710	12	3-phase	690
HFL 64/17	1700	400	400	400	64	980	930	1830	18	3-phase	920
HFL 160/17	1700	500	550	550	160	1090	1080	2030	21	3-phase	1190

<sup>1</sup>Heating only between two phases

\*Please see page 54 for more information about mains voltage

## Chamber Retort Ovens for Catalytic Debinding

### NRA 40/02 CDB and NRA 150/02 CDB

The chamber ovens NRA 40/02 CDB and NRA 150/02 CDB are specially developed for debinding of ceramics and metallic powder injection molded parts according to the BASF CATAMOLD®-method. They are equipped with a gastight retort with inside heating and air circulation. During catalytic debinding, the polyacetal-containing (POM) binder chemically decomposes in the oven under nitric acid and is carried out of the oven by a nitrogen carrier gas and burned in an exhaust gas torch. Both furnaces have a comprehensive safety package to protect the operator and the surrounding.

Model NRA 40/02 CDB is very compact and excels with its excellent cost-performance ratio. This model is perfectly suited for repeating lab processes and in production. As a professional production furnace, model NRA 150/02 CDB is also designed for frequent charge changes. The furnace has an automatic torch control that detects the end of the process measuring the torch temperature.



NRA 40/02 CDB



NRA 150/02 CDB



Acid pump for nitric acid



Process chamber with internal heating

- Tmax 200 °C
- Process retort made of acid-resistant stainless steel 1.4571 with large swiveling door
- Four-side heating inside the retort through chromium steel tube heating elements for good temperature uniformity
- Horizontal air circulation for uniform distribution of the process gas
- Acid pump and acid vessel (to be provided by the customer) accommodated in the furnace frame
- Gas-heated exhaust gas torch with flame monitoring
- Non-wearing ceramic cup for uniform evaporation of the nitric acid

#### Version NRA 40/02 CDB

- Gas supply system with fixed values
- Safety package provides for safe shut-down and floods of the furnace with nitrogen in case of a failure
- Controller P 300 for setting the temperature curve

#### Version NRA 150/02 CDB

- Extensive safety package with redundantly operating safety PLC for safe operation with nitric acid
- Automatic gas supply system for nitrogen with mass flow controller
- Large, graphic touch panel H 3700 for entering data and for process visualization
- Adjustable acid volume and correspondingly adjusted gas supply volumes

#### Additional equipment

- Scale for the nitric acid vessel, connected to the PLC monitors the acid consumption and visualizes the fill level of the acid vessel (NRA 150/02 CDB)
- NCC software package for visualization, control and charge documentation of the process (NRA 150/02 CDB)
- Lift truck for easy loading of the furnace

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Supply power/kW	Electrical connection*	Weight in kg	Acidic quantity (HNO <sub>3</sub> )	Nitrogen (N <sub>2</sub> )
		w	d	h		W	D	H					
NRA 40/02 CDB	200	300	450	300	40	1100	1250	2450	5	three-phase <sup>1</sup>	350	30 ml/h	500 l/h
NRA 150/02 CDB	200	450	700	450	150	1650	1960	2850	23	three-phase <sup>1</sup>	1650	max. 180 ml/h	max. 4000 l/h

<sup>1</sup>Only heating between two phases

\*Please see page 70 for more information about mains voltage.

## High-Temperature Chamber Retort Furnaces up to 2400 °C



VHT 8/22-GR with graphite insulation and heating as well as automation package



VHT 40/22-GR with graphite insulation and heating

The compact furnaces of the VHT product line are available as electrically heated chamber furnaces with graphite, molybdenum or MoSi heating. A wide variety of heating designs as well as a complete range of accessories provide for optimal furnace configurations even for sophisticated applications.

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

The H<sub>2</sub> version provides for operation under hydrogen or other flammable gases. Key of the specification up is a certified safety package providing for a safe operation at all times and triggers an appropriate emergency program in case of failure.

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

### Alternative Heating Specifications

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

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

- Suitable for processes under protective and reaction gases or under vacuum
- Tmax 1800 °C or 2200 °C
- Max. vacuum up to  $10^{-2}$  mbar depending on pump type used
- Graphite felt insulation
- Temperature measurement using type B thermocouple (version to 1800 °C)
- Temperature measurement using optical pyrometer (version to 2200 °C)

## VHT ..../MO with Molybdenum Insulation and Heating

- Suitable for high-purity processes under protective and reaction gases or under high vacuum
- Tmax 1600 °C
- Max. vacuum up to  $5 \times 10^{-5}$  mbar depending on pump type used
- Insulation made of Molybdenum steel sheets
- Temperature measurement by thermocouple type B

## VHT ..../KE with Fiber Insulation and Heating through Molybdenum Disilicide Heating Elements

- Suitable for processes under protective and reaction gases, in air or under vacuum
- Tmax 1800 °C
- Max. vacuum up to  $10^{-2}$  mbar (up to 1300 °C) depending on pump type
- Insulation made of high purity aluminum oxide fiber
- Temperature measurement by thermocouple type B

	VHT ...-18/GR	VHT ...-16/MO	VHT ...-18/KE
Inert gas	✓	✓	✓
Air	to 400 °C	-	✓
Hydrogen	✓	✓	-
Rough vacuum and fine vacuum ( $>10^{-3}$ mbar)	✓	✓	✓
High vacuum ( $<10^{-5}$ mbar)	-	✓	-



Graphite heating chamber



Molybdenum heating chamber



Ceramic fiber heating chamber

## Standard Equipment for all Models

### Basic version

- Standard furnace sizes 8, 40 and 100 liters
- A water-cooled stainless steel process reactor sealed with temperature-resistant o-rings
- Frame made of stable steel profiles, easy to service due to easily removable stainless steel panels
- Housing of the VHT 8 model on castors for easy repositioning of furnace
- Cooling water manifold with manual stopcocks in supply and return lines, automatic flowmeter monitoring, openloop cooling water system
- Adjustable cooling water circuits with flowmeter and temperature indicator and overtemperature fuses
- Switchgear and controller integrated in furnace housing
- H 700 PLC control with clearly laid out 5.7" touchpanel control for program entry and display, 10 programs each with 20 segments
- Over-temperature limit controller with manual reset for thermal protection class in accordance with EN 60519-2
- Manual operation of the process gas and vacuum functions
- Manual gas supply for one process gas ( $N_2$  or Ar) with adjustable flow
- Bypass with manual valve for rapid filling or flooding of furnace chamber
- Manual gas outlet with overflow valve (20 mbar relative)
- Single-stage rotary vane pump with ball valve for pre-evacuating and heat treatment in a rough vacuum to 5 mbar
- Pressure gauge for visual pressure monitoring

### Additional equipment

- Tmax 2400 °C
- Housing, optionally divisible, for passing through narrow door frames (VHT 08)
- Manual gas supply for second process gas ( $N_2$  or Ar) with adjustable flow and bypass
- Molybdenum or carbon-fiber-carbon retort with direct gas supply for clean atmosphere and improved temperature uniformity in the furnace chamber
- Charge thermocouple with display
- Two-stage rotary vane pump with ball valve for pre-evacuating and heat-treating in a vacuum to  $10^{-2}$  mbar
- Temperature measurement at 2200 °C with pyrometer and thermocouple, type S with automatic pull-out device for precise control results in the low temperature range
- Turbo molecular pump with slide valve for pre-evacuation and for heat treatment in a vacuum to  $10^{-5}$  mbar including electric pressure transducer and booster pump (only VHT.../MO)

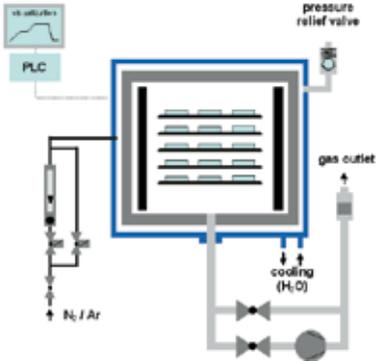


Thermocouple, type S with automatic pull-out device for precise control results in the low temperature range

Continued on next page



VHT 40/16MOH<sub>2</sub>



VHT gas supply diagram, automatic operation



Nitrogen emergency purging and exhaust gas torch for hydrogen version



Turbo-molecular pump

Continuation of additional equipment

- Heat exchanger with closed-loop cooling water circuit
- Automation package with graphic touch panel H 3700
  - 12" graphic touch panel H 3700
  - Input of all process data like temperatures, heating rates, gas injection, vacuum at the touch panel
  - Display of all process-relevant data on a process control diagram
  - Automatic gas supply for one process gas (N<sub>2</sub> or argon) with adjustable flow
  - Bypass for flooding and filling the chamber with process gas controlled by the program
  - Automatic pre- and post programs, including leak test for safe furnace operation
  - Automatic gas outlet with bellows valve and overflow valve (20 mbar)
  - Transducer for absolute and relative pressure
- MFC flow controller for alternating volume flow and generation of gas mixtures with second process gas (only with automation package)
- Partial pressure operation: protective gas flushing at controlled underpressure (only with automation package)
- PC control via NCC with corresponding optional documentation and connection to customer PC networks



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



Two-stage rotary vane pump for heat treatment in a vacuum to 10<sup>-2</sup> mbar



Turbo-molecular pump with booster pump for heat treatment in a vacuum to 10<sup>-5</sup> mbar

### H<sub>2</sub> Version VHT.../MO-H<sub>2</sub> or VHT.../GR-H<sub>2</sub> for Operation with Hydrogen or other Reaction Gases

In the H<sub>2</sub> version the furnaces of the VHT.../MO or VHT.../GR product line can be operated under hydrogen or other reaction gases. For these applications, the systems are additionally equipped with the required safety technology. Only certified and industry proven safety sensors are used. The furnaces are controlled by a fail-safe PLC control system (S7-300F/ safety controller).

- Certified safety concept
- Automation package (see additional equipment above)
- Redundant gas inlet valves for hydrogen
- Monitored pre-pressures of all process gases
- Bypass for safe purging of furnace chamber with inert gas
- Pressure-monitored emergency flooding with automated solenoid valve opening
- Electric or gas-heated exhaust gas torch for H<sub>2</sub> post-combustion
- Atmospheric operation: H<sub>2</sub>-purging of process reactor starting from room temperature at controlled over pressure (50 mbar relative)

#### Additional equipment

- Partial pressure operation: H<sub>2</sub> flushing at underpressure in the process reactor starting from 750 °C furnace chamber temperature
- Retort in the process chamber for debinding under hydrogen

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

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

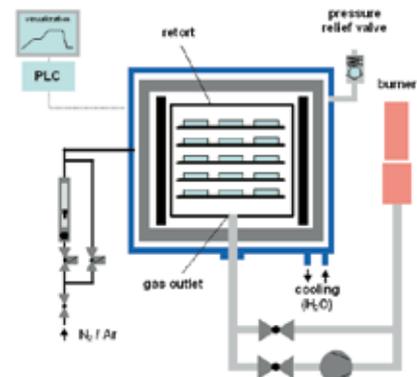
- Adapted safety concept for debinding
- Automation package (see additional equipment above)
- Exhaust gas torch for burning the exhaust gases
- Debinding retort in the furnace chamber with direct discharge of the exhaust gases into the exhaust gas torch
- Bypass for safe flushing of furnace chamber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

#### Additional equipment

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



VHT 08/16 MO with hydrogen extension package as automatic version



VHT gas supply diagram, debinding and sintering

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Supply power/kW	Electrical connection*	Weight in kg	Material insulation/heater
		w	d	h		W	D	H				
VHT 8/18-GR	1800	170	240	200	8	1250 (800) <sup>1</sup>	1100	2000	27.0	three-phase <sup>2</sup>	1200	Graphite/graphite felt
VHT 40/18-GR	1800	300	450	300	40	1500	2000	2300	83.0	three-phase	2000	Graphite/graphite felt
VHT 100/18-GR	1800	450	550	450	100	1750	2200	2600	On request	three-phase	2800	Graphite/graphite felt
VHT 8/22-GR	2200	170	240	200	8	1250 (800) <sup>1</sup>	1100	2000	27.0	three-phase <sup>2</sup>	1200	Graphite/graphite felt
VHT 40/22-GR	2200	300	450	300	40	1500	2000	2300	83.0	three-phase	2000	Graphite/graphite felt
VHT 100/22-GR	2200	450	550	450	100	1750	2200	2600	On request	three-phase	2800	Graphite/graphite felt
VHT 8/16-MO	1600	170	240	200	8	1250 (800) <sup>1</sup>	1100	2000	34.0	three-phase <sup>2</sup>	1200	Molybdenum
VHT 40/16-MO	1600	300	450	300	40	1500	2000	2300	122.0	three-phase	2000	Molybdenum
VHT 100/16-MO	1600	450	550	450	100	1750	2200	2600	On request	three-phase	2800	Molybdenum
VHT 8/18-KE	1800	170	240	200	8	1250 (800) <sup>1</sup>	1100	2000	12.5	three-phase <sup>2</sup>	1200	MoSi <sub>2</sub> /ceramic fiber
VHT 40/18-KE	1800	300	450	300	40	1500	2000	2300	45.0	three-phase	2000	MoSi <sub>2</sub> /ceramic fiber
VHT 100/18-KE	1800	450	550	450	100	1750	2200	2600	On request	three-phase	2800	MoSi <sub>2</sub> /ceramic fiber

<sup>1</sup>With the switching system unit removed

<sup>2</sup>Only heating between two phases

\*Please see page 70 for more information about mains voltage.

## Chamber Retort Furnaces up to 1100 °C



NRA 50/06 IDB for debinding under protective gas



NRA 75/06 as basic version with automatic gas injection and touch panel H 3700

### NRA 12/06 - NRA 430 /11

These gastight retort furnaces are equipped with direct or indirect heating depending on temperature. They are perfectly suited for various heat treatment processes requiring a defined protective or a reaction gas atmosphere. These compact models can also be laid out for heat treatment under vacuum up to 600 °C. The furnace chamber consists of a gastight retort with water cooling around the door to protect the special sealing. Equipped with the corresponding safety technology, retort furnaces are also suitable for applications under reaction gases, such as hydrogen or, in combination with the IDB package, for inert debinding or for pyrolysis processes.

Different model versions are available depending on the temperature range required for the process:

#### Models NRA .../06 with Tmax 650 °C

- Heating elements located inside the retort
- Temperature uniformity up to  $\Delta T$  6 K inside the working chamber from 100 °C - 600 °C
- Retort made of 1.4571
- Gas circulation fan in the back of the retort provides for optimal temperature uniformity



Inside heating in models NRA .../06

#### Models NRA .../09 with Tmax 950 °C

- Outside heating with heating elements surrounding the retort as well as an additional door heater
- Temperature uniformity up to  $\Delta T$  6 K inside the working chamber from 200 °C - 900 °C
- Retort made of 1.4841
- Gas circulation fan in the back of the retort provides for optimal temperature uniformity



Heating from outside around the retort in models NRA .../09 and NR .../11

#### Models NR .../11 with Tmax 1100 °C

- Outside heating with heating elements surrounding the retort as well as an additional door heater
- Temperature uniformity up to  $\Delta T$  20 K inside the working chamber from 200 °C - 1050 °C
- Retort made of 1.4841



NRA 150/11 H<sub>2</sub> for operation with hydrogen

### Standard Equipment for all models

#### Basic version

- Compact housing in frame design with removable stainless steel sheets
- Controls and gas supply integrated in the furnace housing
- Welded charging supports in the retort
- Swivel door hinged on right side with open cooling water system
- Multi-zone control, divided between furnace chamber and door. Depending on furnace dimensions, chamber also divided into one or more heating zones
- Gas supply system for one nonflammable protective gas with flow meter and solenoid valve, switchable via the control system
- Operation under vacuum up to 600 °C with optional single-stage rotary vane pump (not for models NRA ../06)
- Port for vacuum pump for cold evacuation
- PLC controls with touch panel H 700 for data input, see page 70

#### Additional equipment

- Upgrade for other nonflammable gases
- Automatic gas injection, including MFC flow controller for alternating volume flow, PLC controlled with touch panel H 3700
- Temperature control as charge control with temperature measurement inside and outside the retort
- Vacuum pump for evacuating of the retort up to 600 °C, attainable vacuum up to 10<sup>-5</sup> mbar subject to selected pump
- Cooling system for shortening process times
- Heat exchanger with closed-loop cooling water circuit for door cooling



Gas supply system for hydrogen



Vacuum pump for cold evacuation of the retort



Touchpanel H 3700 for automatic version

## Chamber Retort Furnaces up to 1100 °C



Emergency flood container and exhaust gas torch for model NRA 150/11 H<sub>2</sub>



Pneumatic door lock for the H<sub>2</sub> version



Debinding under protective gas with a gas box in a chamber furnace



Debinding under protective with a gas box in a bogie hearth furnace

### H<sub>2</sub> Version for Operation under Hydrogen

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

- H<sub>2</sub> supply at controlled overpressure of 50 mbar relative
- Certified safety concept
- PLC controls with graphic touch panel H 3700 for data input
- Redundant gas inlet valves for hydrogen
- Monitored pre-pressures of all process gases
- Bypass for safe flushing of furnace chamber with inert gas
- Exhaust gas torch for H<sub>2</sub> afterburning
- Emergency flood container for purging the furnace in case of failure



NR 200/11 H<sub>2</sub> for heat treatment under hydrogen

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

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

- Process control under monitored and controlled overpressure of 50 mbar relative
- Certified safety concept
- PLC controls with graphic touch panel H 1700 for data input
- Monitored gas pre-pressure of the process gas
- Bypass for safe flushing of furnace chamber with inert gas
- Exhaust gas torch for H<sub>2</sub> afterburning

## Chamber and Bogie Hearth Furnaces with Gas Box for Debinding under Protective Gases

Certain debinding processes under protective gas can also be realized in a chamber or bogie hearth furnace with inserted gas box as a cost-effective alternative. In our state-of-the-art test center we would be glad to make tests in order to select the most suitable furnace model.

Model	Tmax °C	Model	Tmax °C	Working chamber dimensions in mm			Useful volume in l	Electrical connection*
				w	d	h		
NR, NRA 17/..	600 or 900	NR 17/11	1100	225	350	225	17	three-phase
NR, NRA 25/..	600 or 900	NR 25/11	1100	225	500	225	25	three-phase
NR, NRA 50/..	600 or 900	NR 50/11	1100	325	490	325	50	three-phase
NR, NRA 75/..	600 or 900	NR 75/11	1100	325	700	325	75	three-phase
NR, NRA 150/..	600 or 900	NR 150/11	1100	450	750	450	150	three-phase
NR, NRA 200/..	600 or 900	NR 200/11	1100	450	1000	450	200	three-phase
NR, NRA 300/..	600 or 900	NR 300/11	1100	570	900	570	300	three-phase
NR, NRA 400/..	600 or 900	NR 400/11	1100	570	1200	570	400	three-phase

\*Please see page 70 for more information about mains voltage

## Assay Furnace N 110/HS and S 73/HS



N 110/HS with manual lift door and integrated control cabinet



Customized pit-type furnace S 73/HS, with rolling lid for bigger charges in crucibles



Work platform in front of muffle to place load



Furnace chamber of S 73/HS with SiC-plates as muffle function

### N 110/HS

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

- Tmax 1300 °C
- Muffle heated from four sides
- Heating elements and insulation protected by ceramic muffle
- Simple replacement of muffle
- Manual lift door
- Tool holder on furnace
- Stainless steel exhaust chimney above the door opening for connection of an exhaust system
- Work platform with embedded ceramic plate in front of the muffle opening to place load
- Front side with large service door for easy access to the furnace chamber behind the muffle
- Double-walled housing with fan cooling to reduce exterior temperatures
- Base frame with integrated switchgear and controller
- Description of the control system see page 54

### Additional equipment

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

Model	Tmax °C	Interior dimensions in mm			Volume in L	Outer dimensions in mm			Power kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
N 110/HS	1300	260	340	95	8	760	790	1435	22	3-phase	510
S 73/HS	1200	530	380	360	73	1050	1530	900	26	3-phase	890

\*Please see page 54 for more information about mains voltage

## The Nabertherm Product Range – [www.nabertherm.com](http://www.nabertherm.com)

### Arts & Crafts

Art is the union of style and technical skill. Good tools are functional and efficient. Are Nabertherm's kilns for pottery, fused glass, painted porcelain, and enamel ware tools or art?



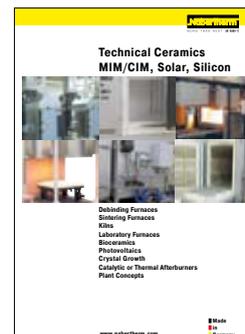
### Glass

Different furnace concepts for annealing, bending slumping, decorating and tempering make Nabertherm your strong partner for the heat treatment of glass and quartz.



### Technical Ceramics MIM/CIM, Solar, Silicon/BioCeramics

Wire-heated kilns for use up to 1400 C and MoSi<sub>2</sub> kilns for use up to 1800 C offer the best value and quality for sintering Technical Ceramics. All are available in sizes from bench-top to walk-in. To remove binders, we offer solutions from our Combi-Furnaces that debind and sinter in the same furnace to specialized systems for binder removal in a specialized atmosphere (e.g. BASF Catamold).



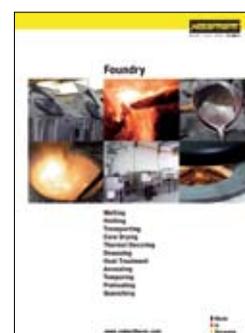
### Heat Treatment of Metals, Plastics and Surface Finishing

Tempering, annealing, hardening and quenching, solution annealing, forging, curing, preheating, drying, ageing – these are only some of the applications which are possible with our extensive program of furnaces and systems. From the compact hardening furnace to fully-automatic systems with conveying technology and process documentation – we certainly will find a solution tailored to your application.



### Foundry

Every furnace for the shop that casts metal, beginning with ovens to dry cores and dewax investments, to fuel-fired and electric resistance melting furnaces, to thermal decoring and heat treatment systems. All Nabertherm Foundry furnaces are designed for energy efficiency and integration with automation systems for low total cost of ownership.



# Process Control and Documentation



B 180

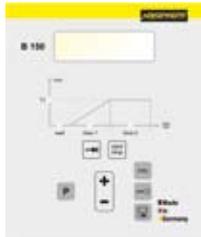
Nabertherm has many years of experience in the design and construction of both standard and custom control system. All controls are remarkable for their ease of use and even in the basic version have a wide variety of functions.



P 330

## Standard Controller

Our extensive line of standard controllers satisfies most customer requirements. Based on the specific furnace model, the controller regulates the furnace temperature reliably. The standard controllers are developed and fabricated within the Nabertherm group. When developing controllers, our focus is on ease of use. From a technical standpoint, these devices are custom-fit for each furnace model or the associated application. From the simple controller with an adjustable temperature to the control unit with freely configurable control parameters, stored programs, PID microprocessor control with self-diagnosis system and a computer interface, we have a solution to meet your requirements.

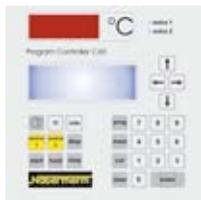


B 150

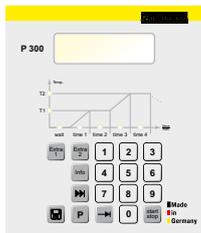
## Assignment of Standard Controllers to Furnace Families

	L 3 - LT 40	LE 2/11 + LE 4/11	LE 6/11 + LE 14/11	LV, LVT	L 9/11/SKM	L(T) 9././SW	N 7/H - N 61/H	R	RT	RS	RSR	RHTH/RHTV	RHTC	LS*	GR*	LH 15/12 - LF 120/14	TR	N 15././HA	N 30././HA - N 500././HA	N 120/65 HAC - N 500/65 HAC	K	KC	HTC 01/14 - HTCT 08/16	LHT/LB-LHT/LBR	LHT 04/16 SW + LHT 04/17 SW	LHT 02/16 - LHT 08/18	HT	HFL	NRA 150/02 CDB	VHT	NR... - NRA...	N 110/HS, S 73/HS			
Catalog page	4,7,12	6	6	8	10	11	14	16	17	18	20	22	24	31	31	32	34	36	36	37	38	38	39	40	41	42	43	44	45	46	50	52			
B 180	●			●	●	●		●	●				●				●	●				●	●												
P 330	○			○	○	○		○	○				○				○	○					○												
R 6		●																																	
C 6/2208e																																			
B 150			●				●			●	●					●		●	●													●			
P 300			○				○			○	○					○																		●	
P 310																										●									
C 40/C 42												●		●	●									○		●		●							
H 100										○	○	○				○											○								
H 700																																			
H 1700																																			
H 3700																																			

\*with additional slave controllers C6Z



C 40/C 42



P 300

## Functionality of the Standard Controllers

	R 6	B 150	C 40	C 42	B 180	P 300	P 310	P 330	H 100	H 700	H 1700	H 3700
Number of programs	1	1	9	9	1	9	9	9	50	10	10	10
Segments	1	2	18	18	2	40	40	40	99	20	20	20
Extra functions (e.g. fan or autom. flaps)			2	2		2 <sup>4</sup>	2 <sup>4</sup>	2	2	2	5	8
Maximum number of control zones			1 <sup>3</sup>		1	1	2	1	3 <sup>2</sup>	3	8	8
Graphic color display									●	5,7"	5,7"	12"
Status messages in clear text		●	●	●	●	●	●	●	●	●	●	●
Start time configurable (e.g. to use night power rates)		●	●	●	●	●	●	●	● <sup>2</sup>	●	●	●
Operating hour counter		●	●	●	●	●	●	●	●	●	●	●
Auto tune		●	●	●	●	●	●	●	●	●	●	●
Program entry in steps of 1 °C or 1 min.	●									●	●	●
Skip-button for segment jump		●	●	●	●	●	●	●	●	●	●	●
Drive of manual zone regulation			●				●					
Interface for MV software		○	●	●	○	○	○	●				
Programmable power outlet								● <sup>1</sup>				
kWh meter		●	●	●	●	●	●	●				
Real-time clock			●	●				●	●	●	●	●
Bath control/Charge control								○	○	●	●	●
Data entry via touchpanel										●	●	●
Data input via number pad			●	●	●	●	●	●				

● Standard

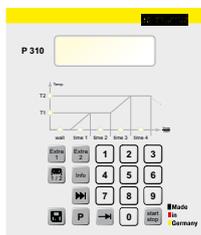
○ Option

<sup>1</sup> Not for model L(T)15..

<sup>2</sup> Not for melt bath control

<sup>3</sup> Control of additional separate slave regulators possible

<sup>4</sup> As an extra feature in ovens with air circulation



P 310



H 100

## Mains Voltages for Nabertherm Furnaces

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

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

## Professional Control and Documentation Alternatives

### HiProSystems Control and Documentation

This professional control system for single and multi-zone furnaces is based on Siemens hardware and can be adapted and upgraded extensively. HiProSystems control is used when more than two process-dependent functions, such as exhaust dampers, cooling fans, automatic movements, etc., have to be handled during a cycle; when furnaces with more than one zone have to be controlled; when special documentation of each batch is required and when remote telediagnostic service is required. The system is also perfectly suited for controlling multiple furnaces or furnace groups. It is flexible and is easily tailored to your process or documentation needs.

#### Alternative User Interfaces

##### Touch panel H 700

This basic panel accommodates most basic needs and is very easy to use.

##### Touch panel H 1700

Firing cycle data and the extra functions activated are clearly displayed in a table. Messages appear as text.

##### Touch panel H 3700

All functions and process data are stored and displayed in easy to read charts. The data can be exported through various interfaces (RS 232, RS 422 /485, USB, Ethernet TCP/IP, MPI, Profibus) to a local PC or your company network for further processing. A CF card also gives the opportunity for data storage and transfer to a PC with a card reader.

#### Extension Package, PC-based for Control, Visualisation and Documentation Nabertherm Control Center NCC

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

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

### Controltherm MV Software for Monitoring, Documentation and Control with Standard Controllers

Documentation and reproducibility gain increased attention with steadily rising quality standards. The powerful Nabertherm software Controltherm MV provides for an optimum solution for the control and documentation of one or more furnaces as well as charge data. This software is also perfectly suitable for retrofitting in order to comply with new norms and directives.

#### Features

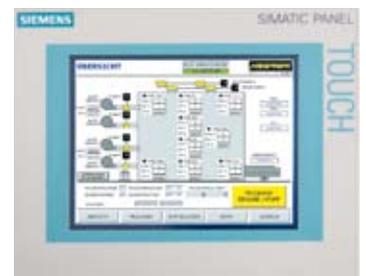
- Simple installation without specific knowledge
- All Nabertherm controllers with interface connectable
- Temperature cycles of up to 16 furnaces (also multi-zone controlled) can be archived in manipulation-safe files
- Redundant storage on a network server possible
- Programming, archiving and printing of programs and graphics
- Free input of descriptive charge data text with comfortable search function
- Data exportable into Excel format for further evaluation
- Start/stop of the controller from the local PC
- 400 additional programs storable (only with Nabertherm controllers)
- Connection of other furnaces/controllers by means of an additional temperature adapter possible and retrofittable
- Extension of additional measuring points for archiving possible and retrofittable

### Temperature Recorder

Reliable documentation method with a dot printer or continuous pen and up to six measuring points, also available with digitally storing graphic printer (e.g. CF card, USB-stick).



H 1700 with colored, tabular depiction of the data



H 3700 with colored graphic presentation of data



Controltherm MV software for the documentation, monitoring and control of the furnace



Temperature recorder

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- Ceramics
- Laboratory/Dental
- Heat Treatment of Metals, Plastics and Surface Finishing
- Foundry



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