

# Nabertherm

MORE THAN HEAT 30-3000 °C



## THERMAL PROCESS TECHNOLOGY 2

Furnaces and Heat Treatment Plants for Processes under Protective or Reactive Gases or Vacuum

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

■ Made  
■ in  
■ Germany



## Facts

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

## Global Sales and Service Network

- Manufacturing only in Germany
- Decentralized sales and service close to the customer
- Own sales organization and long term sales partners in all important world markets
- Individual on-site customer service and consultation
- Fast remote maintenance options for complex furnaces
- Reference customers with similar furnaces or systems close to you
- Secured spare parts supply, many spare parts available from stock
- Further information see page 118

## Setting Standards in Quality and Reliability

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

## Experience in Thermal Processing

- Thermal Process Technology
- Additive Manufacturing
- Advanced Materials
- Fiber Optics/Glass
- Foundry
- Laboratory
- Dental
- Arts & Crafts



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# Furnaces and Accessories for Heat Treatment of Metals



Generally, metals are heat treated under protective or reaction gases or in vacuum to prevent or minimize oxidation of the components.

Nabertherm offers an extensive range of graduated solutions for the heat treatment of metals. This catalog provides a description of the different furnace concepts and the accessories that are available for the different processes.

## Which Furnace is Suitable for Which Application?

Essentially, the requirements with respect to the furnace type depend on following factors:

- Required temperature range
- Charge dimensions
- Type of protective or reaction gas
- Required leak rate of the work space/required surface quality of the charge
- Safety requirements, i. e. when working under flammable gases
- Required heating and cooling times

Depending on the process requirements, adapted solutions can be offered for heat treatment, including quenching.

## Sealed Furnace

Sealed furnaces are standard furnaces with a protective gas connection in which the housing is sealed and the door design is adapted. These furnaces are suitable for processes without high requirements with respect to residual oxygen, or for heat treatment of components that are to be processed afterwards.

## Furnaces with Protective Gas Boxes, Protective Gas Boxes with an Evacuation Lid, or Annealing Bags

Heat treatment furnaces with protective gas boxes or annealing bags offer a good price/performance ratio and can be used for many processes that have to be carried out in a non-flammable protective or reaction gas atmosphere.



Chamber furnace N 7/H



Chamber furnace N 41/H





Forced convection chamber furnace N 250/85 HA with protective gas box

By using a protective gas box with the corresponding process gas supply, a standard furnace can be upgraded to a protective gas furnace. Depending on the type of process gas, the preflushing rate, the process flushing rate, and the condition of the box, it is possible to achieve residual oxygen concentrations in the low ppm range.

Depending on the application, the protective gas boxes are removable, remain in the furnace, or are especially designed for heat treatment of bulk materials. Annealing bags are another gassing variant.

For charges with complex shapes or drilled holes, bulk materials, or sensitive materials, such as titanium, it is recommended to use a protective gas box with an additional evacuation lid for cold stage evacuation.

Protective gas boxes can be used in forced convection furnaces at temperatures up to 850 °C and in radiation heated furnaces for working temperatures up to 1100 °C. This catalog describes in detail the different furnace ranges and the associated accessories.



Hot-Wall Retort furnace NR 80/11

### Hot-Wall Retort Furnaces

Retort furnaces are the perfect solution if the process requires a furnace chamber with a pure atmosphere. The retort is not water cooled and is therefore restricted in maximum temperature. Water cooling is used only for the door seal. Hot-wall retort furnaces can be used for maximum working temperatures of 1100 °C, and with special retort material, up to 1150 °C.

These gas tight retort furnaces are ideal for heat treatment processes that require a defined protective or reaction gas atmosphere. The compact models can also be designed for heat treatment in vacuum up to 600 °C. Equipped with corresponding safety technology, retort furnaces are also suitable for applications under reaction gases such as hydrogen.

### Cold-Wall Retort Furnaces

Cold-wall retort furnaces can be used for heat treatment processes in defined protective or reaction gas atmospheres or high temperature processes under vacuum. The VHT retort furnaces are designed as electrically heated chamber furnaces with graphite, molybdenum, tungsten, or MoSi<sub>2</sub> heating.

The vacuum-tight retort is completely water-cooled and allows for heat treatment processes either in protective or reaction gas atmospheres or under vacuum up to 10<sup>-5</sup> mbar.

This furnace series can also be equipped with suitable safety packages for flammable gases.

### Furnaces for Continuous Processes

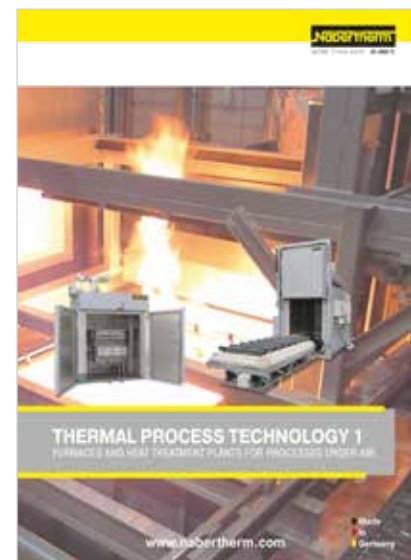
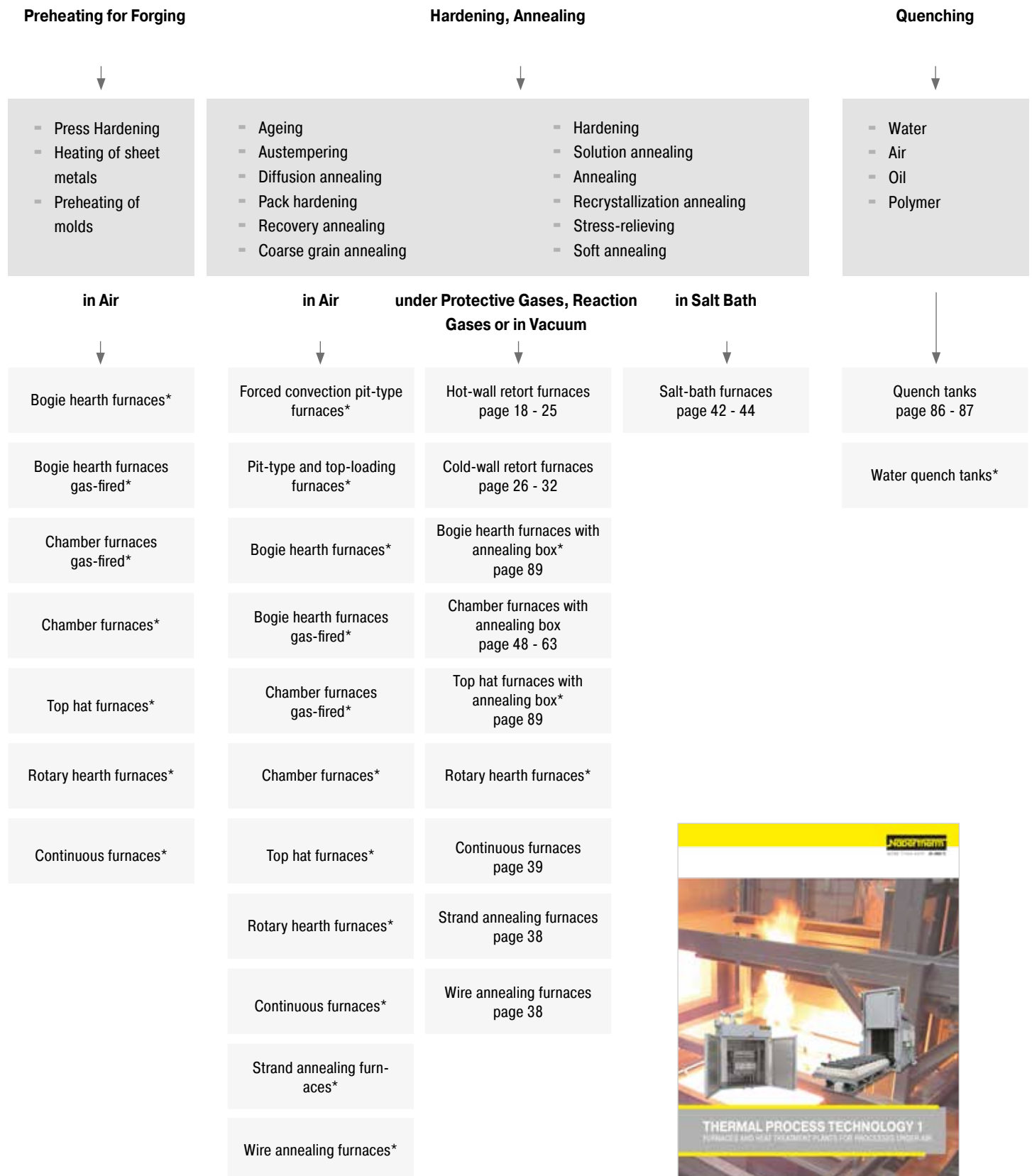
Nabertherm also has compact furnaces for continuous processes that require a protective or reaction gas atmosphere.



Cold-Wall Retort furnace VHT 100/16-MO

# Which Furnace for Which Process?

This catalog describes furnaces working under non-flammable or flammable gases or under vacuum. For furnaces working under air please see our catalog „Thermal Process Technology 1“.



\* See also catalog Thermal Process Technology 1



## Tempering, Annealing

## Tempering Plants

- Tempering
- Precipitation annealing
- Ageing annealing
- Recovery annealing
- Solution annealing
- Preheating
- Reduced hydrogen annealing

- Solution annealing
- Quenching
- Artificial ageing

### in Air

### under Protective Gases, Reaction Gases or in Vacuum

### in Salt Bath

Chamber dryers\*

Hot-wall retort furnaces  
page 18 - 25

Martempering furnaces  
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Tool shop hardening  
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Forced convection chamber  
furnaces > 560 liters\*

Forced convection chamber  
furnaces with annealing  
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Protective gas hardening  
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Forced convection chamber  
furnaces < 675 liters\*  
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Forced convection chamber  
furnaces with clean room  
technology\*

Hot-wall retort protective  
gas hardening system  
page 21

Forced convection chamber  
furnaces with clean room  
technology\*

Sealed forced convection  
chamber furnaces  
page 73

Fully automatic tempering  
plant\*

Forced convection bogie  
hearth furnaces\*

Forced convection bogie  
hearth furnaces with an-  
nealing box\*, page 89

Manual tempering plant\*

Forced convection pit-type  
furnaces  
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Forced convection pit-type  
furnaces with annealing\*  
box, page 74 - 76

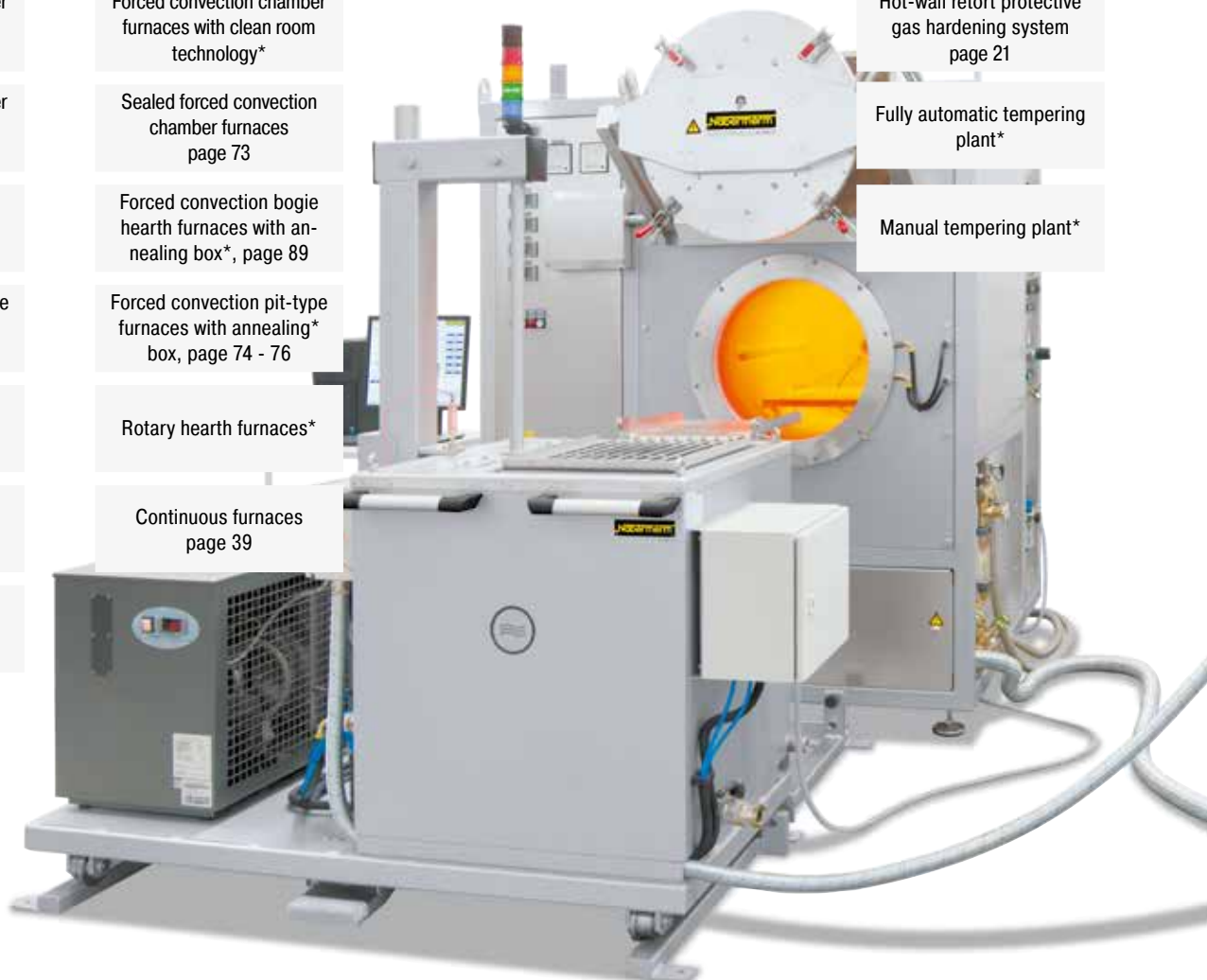
Pit-type and top-loading  
furnaces\*

Rotary hearth furnaces\*

Rotary hearth furnaces\*

Continuous furnaces  
page 39

Continuous furnaces\*



Semi-automatic tempering plant with retort furnace NR 50/11 and water quenching

# Which Furnace for Which Process?

## Brazing/Soldering

- Soft soldering
- Brazing
- High-temperature brazing
- Dip brazing of steel

## Curing, Tempering, Drying

- Composites
- Molds
- Adhesive
- Plastics
- Lacquers
- PTFE
- Silicone
- Surface Drying
- Preheating
- Vulcanizing
- Conditioning

### in Salt Bath

Salt-bath furnaces  
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### in Vacuum

Hot-wall retort furnaces  
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Cold-wall retort furnaces  
page 26 - 32

Tube furnaces\*\*  
page 34 - 35

### under Protective Gases

Hot-wall retort furnaces  
page 18 - 25

Cold-wall retort furnaces  
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Tube furnaces\*\*  
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Forced convection chamber  
furnaces with annealing  
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Chamber furnaces with  
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Forced convection pit-type  
furnaces with annealing  
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### Solvent Based

Hot-wall retort furnaces  
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Chamber dryers\*

Forced convection chamber  
furnaces NA .. LS\*

### Water Based

Chamber dryers\*

Forced convection cham-  
ber furnaces\*  
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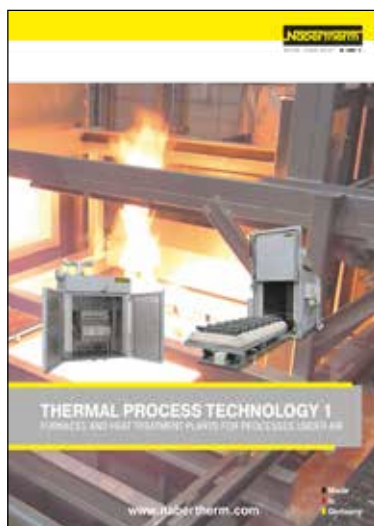
Ovens\*

Forced convection bogie  
hearth furnaces\*

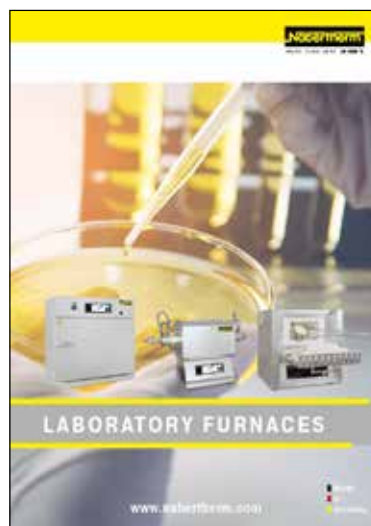
Forced convection pit-type  
furnaces\*  
page 74 - 76

Rotary hearth furnaces\*

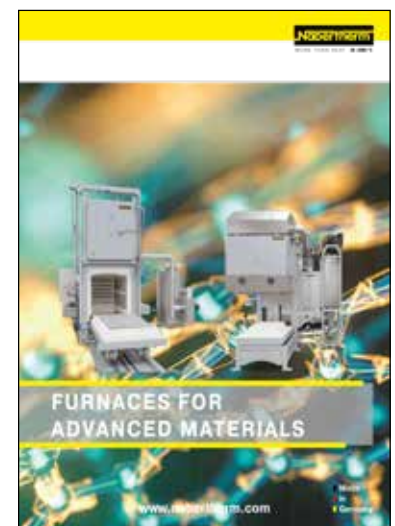
Continuous furnaces\*



\* See also catalog Thermal Process Technology 1



\*\* See also catalog Laboratory



\*\*\* See also catalog Advanced Materials



## Thermal/Thermo-Chemical Processes Surface Treatment, Cleaning

- Carburizing
- Blueing (e.g. with water steam)
- Nitriding/nitrocarborizing
- Boriding
- Deoxidizing under hydrogen
- Pyrolysis
- Heat cleaning
- Oxidizing
- Siliconizing

## Sintering & Debinding

- Additive manufacturing\*\*\*\*
- Debinding
- MIM
- CIM
- Sintering

### in Powders

### under Protective Gases, Reaction Gases

### in Salt Bath

### in Air

### under Protective Gases, Reaction Gases or in Vacuum

Hot-wall retort furnaces  
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Hot-wall retort furnaces  
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Salt-bath furnaces  
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Chamber furnaces\*\*\*

Hot-wall retort furnaces  
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Cold-wall retort furnaces  
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Cold-wall retort furnaces  
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Chamber furnaces  
gas-fired\*\*\*

Cold-wall retort furnaces  
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Forced convection chamber  
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Forced convection chamber  
furnaces with annealing  
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Forced convection chamber  
furnaces NA .. LS\*

Retort furnaces for catalytic  
debinding  
page 22

Bogie hearth furnaces  
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Forced convection bogie  
hearth furnaces with an-  
nealing box\*, page 89

Forced convection  
chamber furnaces with  
annealing box\*\*\*

Chamber furnaces\*  
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Bogie hearth furnaces with  
annealing box\*  
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Top hat furnaces\*  
page 89

Chamber furnaces with  
annealing box  
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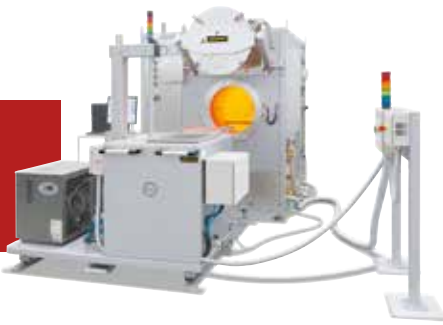
## Thermal Separation Processes

Process	..DB.. Debinding and sintering in oxidising atmosphere	..LS Debinding and sintering in inert atmosphere	..IDB.. Debinding and sintering in inert atmosphere	NB..CL Heat Cleaning in inert atmosphere	..BO Heat Cleaning in oxidising atmosphere	NB..BOWAX Dewaxing and burn off
Avoid igniting						
Provoke igniting						
Diluted atmosphere						
Inerted atmosphere						
Open combustion						
O <sub>2</sub> content	≥ 20 %	≥ 20 %	≤ 1 %	≤ 3 %	<> 20 % varies	<> 20 % varies
Vaporisation speed	slow	fast	slow	slow - fast	slow - fast	very fast
Loading / unloading	cold/cold	cold/cold hot/hot	cold/cold	cold/cold	cold/cold	> 750 °C/ > 750 °C
Tmax	1800 °C	450 °C	850 °C	500 °C	1400 °C	850 °C
Electrically heated						
Gas-fired						
External TNV		(✓)				
Internal TNV						
External KNV		(✓)	(✓)			



\*\*\*\* See also catalog Additive Manufacturing

# Hardening, Carburizing, Nitriding, Brazing, MIM



Hot-wall retort furnace NR 50/11 with semi-automatic quenching device for hardening of steel or titanium

## Hardening

Hardening is one of the most common forms of heat treatment of metallic materials, with the aim of increasing mechanical resistance by converting the microstructure.

The hardness and strength increase resulting from the hardening are the main reasons for the increased resistance against wear, tension, pressure and bending.

Hardening is generally understood to mean the transformation hardening, i.e. austenitization of the material followed by quenching. When quenching, the critical cooling rate of the respective material must be exceeded in order to obtain a martensitic structure. The quenching is carried out in different quenching media (water, air, oil or gas).

Depending on the application, the material is allowed to quench, for example to obtain the desired toughness, and the hardness is again reduced.



Protective gas hardening system SHS 41

## Carburizing

Steels with a low content of carbon can usually be poorly cured. By increasing the carbon content to a certain percentage, the hardenability can be significantly improved. This property is used for carburizing. The edge layer is enriched with carbon so that this carburized part of the material can subsequently be cured. The non-edge, non-carburized area of the material remains tough and soft. A known example of this process is the carburizing and subsequent hardening and tempering (case hardening) of gears wheels for all types of gearing. The toothings has the necessary hardness after the hardening in order to minimize wear, but the core of the gear wheel remains ductile and machinable.

## Nitriding

As in carburizing, nitriding is also a thermochemical treatment. During nitriding, nitrogen diffuses into the edge layer. Depending on the steel or cast alloy, an increase in hardness can be achieved. A greater advantage of nitriding is the achievement of a wear-resistant edge layer. For low-alloy steels the corrosion resistance can be significantly increased by nitriding.

Carburizing and nitriding can be carried out with solid, gaseous or liquid media.

The following furnace concepts are suitable for curing, carburizing and nitriding:

### Hardening

- Hardening in the protective gas box/protective gas annealing bag or annealing box in chamber furnaces with or without protective gas atmosphere. The quenching can take place in different media like oil, water or air.
- Hardening in the hot-wall retort furnace with protective gas or reaction gas up to 1150 °C. The quenching is done manually or semi-automatically in oil, water or air.

### Carburizing/Nitriding

- Carburizing/nitriding in the annealing box with appropriate granulates
- Controlled or uncontrolled nitriding/carburizing in the hot-wall retort furnace with combustible reaction gases. The quenching is done manually or semi-automatically in oil, water or air.

### Annealing

- Annealing in a forced convection chamber furnace with or without a protective gas atmosphere
- Annealing in the protective gas box in a forced convection chamber furnace under protective gas atmosphere

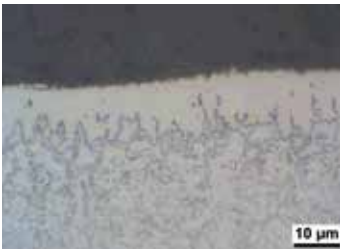


Forced convection furnace N 250/85 HA with annealing box



Retort furnace NRA 50/09 H<sub>2</sub>





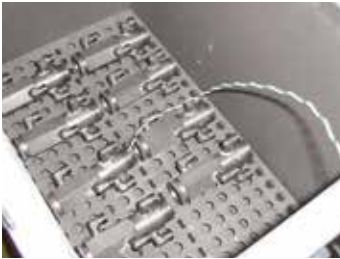
Close-up of a metallographic section of a powder-borated hot-work steel

### Powder-Pack Annealing Processes

As a cost-effective alternative to the thermochemical processes which take place in a gas atmosphere, the powder packing annealing is suitable for certain processes.

With this method, the parts, which are appropriately prepared, are charged into an annealing box together with the process powder. The annealing boxes are then closed with a cover.

Possible application examples are carburizing, neutralizing, nitriding or boriding.



Brazing in annealing box

### Brazing

In general, when speaking of brazing it has to be distinguished between soft-soldering, brazing and high-temperature brazing. This involves a thermal process for forming substance-to-substance bonds and material coatings during which a liquid phase is generated by the melting of the solder. Based on their melting temperatures, the solder processes are classified as follows:

Soft-solders:  $T_{liq} < 450\text{ °C}$

Brazing:  $T_{liq} > 450\text{ °C} < 900\text{ °C}$

High-temperature brazing:  $T_{liq} > 900\text{ °C}$

Beside the right selection of the solder, the flux if necessary, and ensuring that the surfaces are clean, the choice of the right brazing furnace is also key to the process. In addition to the actual brazing process, Nabertherm has furnaces for the preparation process in their range such as for metallizing ceramics in preparation for brazing ceramic-to-metal bonds.

The following furnace concepts are available for brazing:

- Brazing in an annealing box in the forced convection chamber furnace up to  $850\text{ °C}$  in a protective gas atmosphere
- Brazing in an annealing box in a chamber furnace up to  $1100\text{ °C}$  under a protective gas atmosphere
- Brazing in a hot-wall retort furnace NR/NRA product line under protective gases or reaction gas up to  $1100\text{ °C}$
- Brazing in a cold-wall retort furnace VHT product line under protective gases, reaction gases or under vacuum up to  $2200\text{ °C}$
- Brazing in a salt bath up to  $1000\text{ °C}$  salt bath temperature
- Brazing or metallizing in a tube furnace up to  $1800\text{ °C}$  under protective gases, reaction gases or in a vacuum up to  $1400\text{ °C}$



Retort furnace NRA 40/02 with cupboard for the acid pump

In the Nabertherm Test Center in Lilienthal, Germany, a range of sample furnaces is available for customers testing applications which is the best approach to define the right furnace for a specific application.

### MIM - Metal Powder Injection Molding

The metal powder injection molding is based on the same principle as the plastic injection molding. At MIM, a metallic feedstock, i.e. a metallic powder with a binder system, is produced by means of an injection molding machine and an injection mold. The result is a so-called green part, which does not yet have its final size and density.

In the subsequent debinding process, which takes place under metallic conditions either under an inert atmosphere, under hydrogen or else catalytically under a nitric acid-nitrogen atmosphere, the green part loses a large proportion of the binder.

In the subsequent sintering process, which is also carried out again in a protective gas or reaction gas atmosphere or in a vacuum, the brown part is sintered to the finished component, which in most cases does not have to be further processed.



Retort furnace VHT 40/16-MO  $H_2$  with hydrogen extension package and process box

# Additive Manufacturing



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



Oven TR 240 for drying of powders



Chamber oven KTR 2000 for curing after 3D-printing

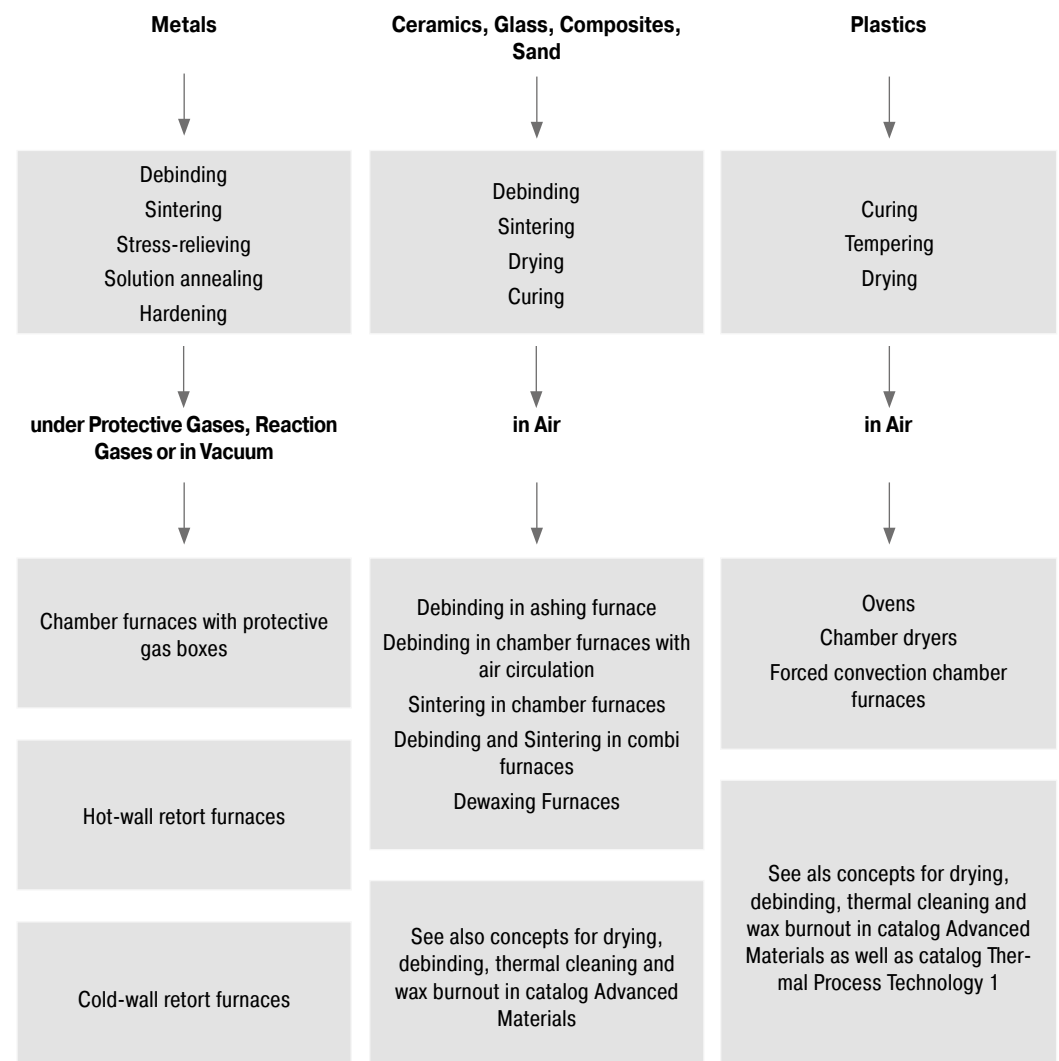


Retort furnace NR 150/11 for annealing of metal parts of 3D-printing



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

In additive manufacturing, a distinction is made between printing with and without binder. Depending on the manufacturing process, different furnace types are used for the subsequent heat treatment.





# Binder-Free Systems



Printed aluminum part, heat treated in model N 250/85 HA (Manufacturer CETIM CERTEC on SUPCHAD platform)

In binder-free additive manufacturing, in most cases, the components are produced with the powder-based laser melting process on a printing platform. In the meantime, other manufacturing processes have also become established on the market, which likewise require a corresponding heat treatment after the production process.

The tables below show typical materials and construction platform sizes of laser-based systems that are available on the market with suggestions with respect to furnace sizes, required temperature and atmosphere in the furnace.

## Aluminum Components

Generally, aluminum is heat treated in air at temperatures between 150 °C and 450 °C.

Due to the very good temperature uniformity, forced convection chamber furnaces are suitable for processes such as tempering, aging, stress-relieving or preheating.



Forced convection chamber furnace NA 250/45 for heat treatment in air

Examples for max platform sizes	Forced convection chamber furnaces, see page 68 up to 650 °C
210 x 210 mm	NA 60/65
280 x 280 mm	NA 60/65
360 x 360 mm	NA 120/45
480 x 480 mm	NA 250/45
600 x 600 mm	NA 500/45

## Stainless Steel and Titanium Components

In many cases, certain stainless steels and titanium are heat treated in a protective gas atmosphere at temperatures below 850 °C.

By using a protective gas box with the corresponding process gas supply, a standard furnace can be upgraded to a protective gas furnace. Depending on the type of process gas, the preflushing rate, the process flushing rate, and the condition of the box, it is possible to achieve residual oxygen concentrations of up to 100 ppm.

The forced convection chamber furnaces with protective gas boxes described below have a working temperature range between 150 °C and 850 °C. If the protective gas boxes are removed from the furnace, aluminum or steel components can also be heat treated in air.



Forced convection chamber furnace NA 250/85 with protective gas box for heat treatment in a protective gas atmosphere

Examples for platform sizes	Forced convection chamber furnaces, see page 68 up to 850 °C with protective gas box
100 x 100 mm	NA 60/85
200 x 200 mm	NA 60/85
280 x 280 mm	NA 120/85
400 x 400 mm	NA 250/85
550 x 550 mm	NA 500/85

The models listed in the table above are just a few examples.



Hot-wall retort furnace NRA 150/09 for heat treatment in a protective gas atmosphere

With sensitive materials, such as titanium, the component may still oxidize due to the residual oxygen concentration in the protective gas box.

In these cases, hot-wall retort furnaces with a maximum temperature of 900 °C or 1100 °C are used. These gas tight retort furnaces are ideal for heat treatment processes that require a defined protective or reaction gas atmosphere. The compact models can also be designed for heat treatment under vacuum up to 600 °C. The risk of oxidation on the component is considerably reduced with these furnaces.

Examples for platform sizes	Hot-wall retort furnaces see page 18
200 x 200 mm	NR 20/11
300 x 300 mm	NR 80/11
300 x 500 mm	NR 80/11
400 x 400 mm	NR 160/11
400 x 800 mm	NR 160/11 and NR(A) 300/..



Titanium rods after heat treatment in NR 50/11 in argon atmosphere



Cold-wall retort furnace VHT 100/12-MO for processes in high vacuum

Cold-wall retort furnaces are used for processes in protective gas at temperatures above 1100 °C or under vacuum above 600 °C.

Examples for platform sizes	Cold-wall retort furnaces <sup>1</sup> see page 26
100 x 100 mm	VHT 8/..
250 x 250 mm	VHT 40/..
350 x 350 mm	VHT 70/..
400 x 400 mm	VHT 100/..

<sup>1</sup>Available with different heater materials and for different max. temperatures



LH 216/12 with controlled cooling, gassing system and charging device

### Inconel or Cobalt-Chromium Components

Materials such as Inconel and cobalt-chromium are generally heat treated at temperatures from 850 °C up to between 1100 °C and 1150 °C. Various furnace families are used for these processes. In many cases, the chamber furnaces of the LH .. or NW .. series with protective gas boxes are sufficient to provide an outstanding price/performance ratio. Both furnace groups are suitable for temperatures between 800 °C and 1100 °C.

Examples for platform sizes	Chamber furnaces see page 58 up to 1100 °C with protective gas box
100 x 100 mm	LH 30/12
250 x 250 mm	LH 120/12
400 x 400 mm	LH 216/12
420 x 520 mm	NW 440
400 x 800 mm	NW 660

## Systems with Binder



Muffle furnace L 40/11 BO with passive safety system and integrated post combustion for thermal debinding in air



High-temperature furnace HT 64/17 DB100 with passive safety system for debinding and sintering in air



Retort furnace NRA 40/02 with cupboard for the acid pump

In 3D printing, organic binders, which evaporate during heat treatment, are used to build-up the part. The printed parts can be made of ceramic, metal, glass or sand. Depending on the evaporation volume, furnaces with graduated safety systems for debinding and sintering are used.

On pages 10 and 11 the different concepts are presented in a decision matrix and explained on the following pages.

Printing dimensions up to (w x d x h)	Debinding furnaces <sup>1</sup> see catalog Advanced Materials	Sintering furnaces <sup>2</sup> see catalog Advanced Materials
100 x 100 x 100 mm	L 9/11 BO	LHT 4/16
200 x 200 x 150 mm	L 9/11 BO	HT 40/16
300 x 400 x 150 mm	L 40/11 BO	HT 64/17

<sup>1</sup> Values for debinding like max. organic content, or evaporation rate have to be considered

<sup>2</sup> The furnaces are available with different max. furnace chamber temperatures

### Debinding and Sintering in Protective or Reaction Gas or under Vacuum

To protect metal components that were printed using a binder-based system against oxidation, two process steps, debinding and sintering, are carried out in an oxygen-free atmosphere.

Depending on the material and the binder system, debinding is carried out either in a non-flammable protective gas (IDB), under hydrogen (H<sub>2</sub>), or catalytically in a mixture of nitric acid and nitrogen. Adapted safety systems are used to ensure the safety of these processes.

The table contains examples of furnaces which can be equipped with suitable safety technology. Hot-wall retort furnaces are used as debinding furnaces and cold-wall retort furnaces as sintering furnaces. Under certain circumstances, depending on the application, it is possible to use the same furnace for both processes.

Printing dimensions up to (w x d x h)	Cold-wall retort furnaces <sup>1, 2</sup> see page 26
100 x 180 x 120 mm	VHT 8/..
180 x 320 x 170 mm	VHT 25/..
230 x 400 x 220 mm	VHT 40/..
300 x 450 x 300 mm	VHT 70/..
400 x 480 x 400 mm	VHT 100/..

<sup>1</sup> Available with different heater materials and for different max. temperatures

<sup>2</sup> With inner process chamber for the residual debinding



# Retort Furnaces and Tube Furnaces



Retort furnaces for processes with a defined process gas atmosphere or under vacuum, for example stress relief annealing.



Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that aluminosilicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.



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



Defined application within the constraints of the operating instructions



As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control



Furnace Group	Model	Page
Hot-wall retort furnaces up to 1100 °C	NR(A) ..	18
Cold-wall retort furnaces up to 2400 °C	VHT ..	26
Retort furnace cooling systems		33
Tube Furnaces for Processes under Flammable or Non-Flammable Protective or Reaction Gases or under Vacuum		34



# Hot-Wall Retort Furnaces up to 1100 °C


These gas tight 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 with a slight overpressure. These compact models can also be laid out for heat treatment under vacuum up to 600 °C. The furnace chamber consists of a gas tight retort with water cooling around the door to protect the special sealing. 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:



Retort furnace NR 80/11

## Models NRA ../06 with Tmax 600 °C

- Heating elements located inside the retort
- Retort made of 1.4571 (X6CrNiMoTi 17-12-2)
- Air circulation fan  and baffle for directed gas flow
- Insulation made of mineral wool
- Furnace temperature control with measurement inside the retort


## Models NRA ../09 with Tmax 900 °C

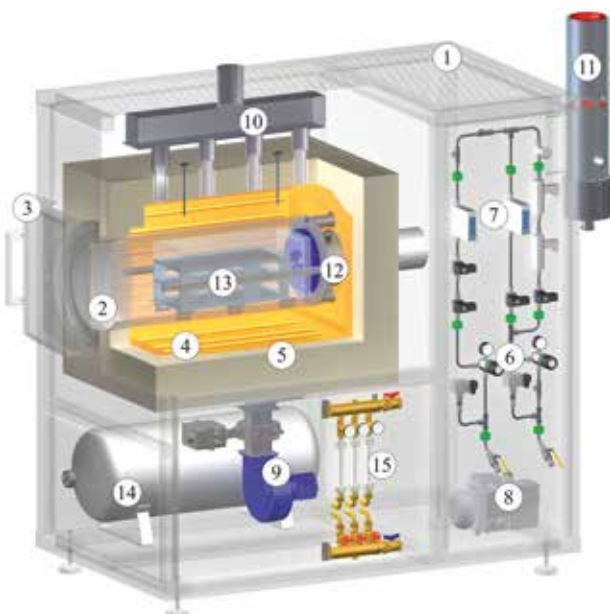
Design like models NRA ../06 with following differences:

- Outside heating with heating elements around the retort
- Retort made of 1.4828 (X15CrNiSi 20-12)
- Multi-layer refractory insulation and micro-porous panel material
- Furnace temperature control with measurement outside the retort

## Models NR ../11 with Tmax 1100 °C

Design like models NRA ../09 with following differences:

- Retort made of 1.4841 (X15CrNiSi 25-21)
- Without gas-circulation  and baffles
- Welded support brackets



## Schematic Presentation of a Hot-Wall Retort Furnace NRA 40/09 H<sub>2</sub> with additional Equipment

- 1 Housing with integrated switchgear
- 2 Retort
- 3 Door with bayonet catch (additional equipment)
- 4 Heating
- 5 Insulation
- 6 Gas management system
- 7 Mass flow controller MFC (additional equipment)
- 8 Vacuum pump (additional equipment)
- 9 Fan for indirect cooling (additional equipment)
- 10 Outlet indirect cooling (additional equipment)
- 11 Exhaust torch (additional equipment - H<sub>2</sub>-safety package)
- 12 Fan for gas circulation (NRA models)
- 13 Charging frame (on request)
- 14 Emergency flushing container (additional equipment - H<sub>2</sub>-safety package)
- 15 Open cooling water system



Retort furnace NRA 40/09



Retort furnace NR 20/11 with parallel swing door

## Standard Equipment

- Compact design with integrated control and gas supply (up to retort furnace NR(A) 700/..)
- Swivel door hinged on right side
- Open cooling water system
- Control divided into several heating zones
- Temperature uniformity up to  $\pm 8^\circ\text{C}$  according to DIN 17052-1 in the empty work space see page 72
- Gas supply system for one non-flammable protective or reaction gas with flow meter and magnetic valve
- Controller with touch operation P570

## Additional Equipment

- Upgrade for other non-flammable gases
- Mass flow controller MFC
- Process controls H3700, H1700 (PLC) including remote maintenance module
- Temperature control as charge control with temperature measurement inside and outside the retort
- Indirect and/or direct cooling
- Heat exchanger with closed-loop cooling water circuit for door cooling
- Oxygen sensor and dew point sensor
- Parallel swing door or electric bayonet catch
- Retort, made of 2.4633 for  $T_{\text{max}} 1150^\circ\text{C}$
- External switchgear with or without cabinet cooling
- Charge support or custom-built charging trolley
- Temperature uniformity optimized according to DIN 17052 or AMS2750H to  $\pm 5^\circ\text{C}$  in empty work space see page 102

	NRA ../06	NRA ../09	NR ../11
Tmax in °C	600	900	1100 <sup>1</sup>
Atmosphere circulation	✓	✓	–
Operation with non-flammable protective gas	✓	✓	✓
Operation with air/oxygen <sup>2</sup>	✓	✓	✓
Operation with flammable gas <sup>3</sup>	✓ <sup>5</sup>	✓	✓
Inert debinding IDB <sup>3</sup>	✓	✓	✓
Low vacuum $\leq 10\text{ mbar}^4$	✓	✓	✓
Fine vacuum $> 10^{-3}\text{ mbar}^4$	✓	✓	✓
High vacuum $< 10^{-4}\text{ mbar}^4$	✓ <sup>5</sup>	✓	✓
Retort Heating	outside/inside <sup>6</sup>	outside	outside

<sup>1</sup>Up to  $1150^\circ\text{C}$  with 2.4633 as retort material without a circulation fan

<sup>2</sup>Increased wear on the retort and the attachments

<sup>3</sup>Only in connection with the corresponding safety package

<sup>4</sup>Up to  $600^\circ\text{C}$  vacuum operation;  $650^\circ\text{C}$  with 2.4633 as retort material without a circulation fan

<sup>5</sup>Only if heated from the outside

<sup>6</sup>Only available from size NRA 300/06 on

Model	Work space dimensions in mm			Outer dimensions <sup>1</sup> in mm			Useful volume in l	Connected <sup>1</sup> load in kW*
	w	d	h	W	D	H		
NR(A) 20/..	225	400	225	1100 <sup>2</sup>	1600	1700	20	34
NR(A) 40/..	325	400	325	1200 <sup>2</sup>	1600	1900	40	34
NR(A) 80/..	325	750	325	1200 <sup>2</sup>	2000	1900	80	44
NR(A) 100/..	450	500	450	1400 <sup>2</sup>	1800	2100	100	64
NR(A) 160/..	450	800	450	1400 <sup>2</sup>	2100	2100	160	74
NR(A) 300/..	590	900	590	2200	3100	2600	300	157
NR(A) 400/..	590	1200	590	2200	3400	2600	400	187
NR(A) 500/..	720	1000	720	2300 <sup>3</sup>	3300	2700	500	217
NR(A) 700/..	720	1350	720	2300 <sup>3</sup>	3500	2700	700	287
NR(A) 1000/..	870	1350	870	2300 <sup>3</sup>	3600	2800	1000	307

<sup>1</sup>Outer dimensions and connected load of models NR ../11

<sup>2</sup>Outer dimensions plus separate switchgear with gas supply package for flammable gases or PLC control

\*Please see page 110 for more information about supply voltage

<sup>3</sup>Outer dimensions plus separate switchgear



# Hot-Wall Retort Furnaces for Thermal Debinding



Retort furnace NRA 80/11 IDB

## Hot-Wall Retort Furnaces for Thermal Debinding in Non-Flammable Process Gases (IDB) and for Presintering

In the IDB version, the retort furnaces are equipped with a safety concept in which the furnace chamber is inerted with a protective gas. Exhaust gases are incinerated in a thermal afterburner. Both the purging and the torch function are monitored to ensure safe operation.

### Standard Design IDB

- Safety package for handling flammable gas releases
- Process carried out with monitored overpressure of 10-50 mbar relative
- PLC process control with safety monitoring (F-PLC) and graphic touch panel
- Monitoring of all process gas input pressures
- Bypass for safe purging of the furnace chamber with inert gas
- Thermal post combustion of the exhaust gases



Thermal post combustion with optional condensate trap

## Hot-Wall Retort Furnaces for Thermal Debinding in Hydrogen (H<sub>2</sub>) and for Presintering

If flammable process gases, such as hydrogen, are used, the retort furnace is also equipped with the required safety technology.

### Standard Design H<sub>2</sub>

- Safety package for operation in hydrogen
- Flammable process gases with controlled overpressure of 10-50 mbar relative
- PLC process control with safety monitoring (F-PLC) and graphic touch panel
- Redundant gas inlet valves for hydrogen
- Monitoring of all process gas input pressures
- Hydrogen sensor/hydrogen gas warning sensors in the furnace housing
- Bypass for safe purging of the furnace chamber with inert gas
- Torch for thermal post combustion of the exhaust gases
- Protective gas emergency flood container for purging the furnace in case of malfunction

### Additional Equipment

- Condensate trap (for IDB and H<sub>2</sub> models), which is dependent on the quantity and condensation behavior of the type of binder that is used



Retort furnace NRA 300/09 H<sub>2</sub> for heat treatment in hydrogen



Hot-wall retort furnaces NR 1000/11 in production



Hot-wall retort furnace NRA 3300/06 with automatic door opening for the integration in a fully automatic quench & temper plant

## Solutions for Customer-Specific Applications

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 also 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 retort furnaces – we will find the appropriate solution for a suitable process optimization.



Semi-automatic annealing plant with retort furnace NR 50/11 and water quenching bath on rails



Hot-wall retort furnace NRA 1700/06 with charging frame. For grey room/clean room installation for heat treatment of glass under protective gases.



Electric bayonet catch



Charging support and TUS measuring frame for retort furnace NR 20/11



Gas supply system with mass flow controller

# Hot-Wall Retort Furnaces for Catalytic Debinding

The hot-wall retort furnaces are ideal for heat treatment processes that require a defined process gas atmosphere. The furnace chamber consists of a gas tight retort.

Equipped with the corresponding safety technology, these retort furnaces are suitable for catalytic (CDB) and also thermal (IDB, H<sub>2</sub>) debinding of MIM components.



Retort furnace NRA 40/02 CDB with separate cabinet for the acid pump

## Hot-Wall Retort Furnace for Catalytic Debinding (CDB)

The hot-wall retort furnaces NRA .. CDB were developed especially for catalytic debinding of ceramic and metal powder injection molding components. They are equipped with an internally-heated gas tight retort.

The catalytic debinding furnaces are designed and built so that the nitric acid is fed into the furnace by means of an acid pump where it evaporates and is distributed evenly throughout the furnace chamber through the atmosphere circulation. The evaporated nitric acid debinds the components by chemically decomposing the polyoxymethylene-based binder (POM) to form formaldehyde. To minimize emissions to the atmosphere, the furnace is equipped with a thermal post-combustion system. Formation of explosive gas mixtures is prevented with monitored flow of the nitric acid and a constant, monitored flow of nitrogen. The design and construction of the furnace with gas tight retort ensures that no oxygen can enter. The door is kept closed during the entire debinding process.



Heating program input screen of the CDB furnace

## Standard Design

- Safety package for safe operation with nitric acid
- PLC process control with safety monitoring (F-PLC) and graphic touch panel
- Retort made of acid-resistant stainless steel 1.4571 with swing door
- Heating inside the retort via chrome steel tubular heating elements
- Horizontal circulation for even distribution of the process atmosphere
- Acid pump in separate cabinet
- Gas-fired exhaust gas torch with flame monitoring

Model	Volume in l	Work space in mm			Quantity Levels	Number of Shelves 170 x 250 mm total (level)	Shelves Work space in m <sup>2</sup>	Outer dimensions in mm			Weight in kg	Heating power in kW
		w	d	h				W	D	H <sup>1</sup>		
NRA 40 CDB	40	340	500	240	6	24 (2x2)	1	1400	1700	2400	1000	2
NRA 80 CDB	80	340	750	320	8	48 (2x3)	2	1600	2000	2500	1200	13
NRA 160 CDB	160	500	680	480	12	96 (2x4)	4	1800	2200	2600	1600	20
NRA 320 CDB	320	680	750	640	16	192 (4x3)	8	2300	2400	2800	2800	35

<sup>1</sup>Including exhaust gas torch

# Bottom Loading Retort Furnaces up to 1100 °C

The bottom loading retort furnaces of the LBR series are suitable for production processes that are carried out in protective/reaction gas atmosphere. With regard to the basic performance data, these models are constructed like the SR models. Their size and design with electro-hydraulically driven lifting bottom make it easier to load heavy duties. The retort furnaces are available in different sizes and designs.



Bottom loading retort furnace LBR 300/11 H<sub>2</sub> with safety technology for operation with Hydrogen as process gas

## Standard Equipment

- Tmax 650 °C, 900 °C or 1100 °C
- Frame-mounted housing with stainless steel sheets
- Charging from the front
- Electro-hydraulically driven furnace bottom
- Gas supply system for a non-flammable protective gas or reaction gas with flow meter and solenoid valve
- Temperature control designed as furnace chamber control, see control alternative page 104
- Connection possibility for an optional vacuum pump (cold evacuation or operation up to 600 °C under vacuum)

## Additional equipment

- H<sub>2</sub> version and IDB version see models NR and NRA



Bottom loading retort furnace LBR 300/11 H<sub>2</sub> with charge table



Gas management system at bottom loading retort furnace LBR 300/11 H<sub>2</sub>



LBR 300/11 H<sub>2</sub> with charging baskets



# Pit-Type Retort Furnaces up to 1100 °C

The retort furnaces SR and SRA (with gas circulation) are designed for operation under non-flammable or flammable protective or reaction gases. The hot-wall retort furnaces are loaded from above by crane or other lifting equipment provided by the customer. In this way, even large charge weights can be loaded into the furnace chamber.

Depending on the temperature range in which the furnace be used, the following models are available:

## Models SRA ../06 with Tmax 650 °C

- Heating inside the retort
- Gas-circulation with powerful fan in the furnace lid
- Temperature uniformity up to +/- 5 °C inside the work space see page 102
- Retort made of 1.4571

## Models SRA ../09 with Tmax 900 °C

Design like models SR../06 with following differences:

- All-around heating from outside of the retort
- Retort made of 1.4828

## Models SR ../11 with Tmax 1100 °C

Design like models SR../09 with following differences:

- Without gas-circulation
- Retort made of 1.4841



Retort furnace SRA 300/06 with charging basket



Retort furnace SRA 200/09

## Standard Equipment

Design like standard equipment of models NR and NRA with following differences:

- Compact housing in frame construction with inserted stainless steel sheets
- Charging from above with crane or other lifting equipment from customer
- Hinged lid with opening to the side
- Welded charging frame resp. gas-guiding box for furnaces with circulation
- Gas-supply system for one non-flammable protective or reactive gas with flowmeter and magnetic valve
- Furnace temperature control see control alternative page 104
- Possible connection of an optional vacuum pump (for cold evacuation or for processes up to 600 °C under vacuum)

## Additional equipment

- H<sub>2</sub> version and IDB version see models NR and NRA

Model	Tmax °C	Inner dimensions of alloy retort		Volume in l	Outer dimensions <sup>1</sup> in mm			Electrical connection*	Weight in kg
		ø in mm	h in mm		W	D	H		
SR(A) 200/..	650, 900 or 1100	600	700	200	1600	2200	2200	3-phase	2100
SR(A) 300/..		600	1000	300	1600	2200	2500	3-phase	2400
SR(A) 500/..		800	1000	500	1800	2400	2700	3-phase	2800
SR(A) 600/..		800	1200	600	1800	2400	2900	3-phase	3000
SR(A) 800/..		1000	1000	800	2000	2600	2800	3-phase	3100
SR(A) 1000/..		1000	1300	1000	2000	2600	3100	3-phase	3300
SR(A) 1500/..		1200	1300	1500	2200	2800	3300	3-phase	3500

<sup>1</sup>External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

\*Please see page 110 for more information about supply voltage

## Pit-Type Furnace with Exchangeable Retort

Main advantage of the pit-type furnace design is that the retort can be taken out of the furnace by crane, in order to cool down outside the furnace while the inert gas flushing is still switched on. Cooling can be carried out naturally outside the furnace on a separate cooling station or forced in a cooling station with powerful cooling fan. The throughput can be increased by using a second exchangeable retort, which is loaded and inertised before the first retort is removed.



Pit-type furnace SRA 450/06 with exchangeable retort



Exchangeable retorts with supply and measuring lines



Retort furnace SR 170/1000/11 with changeable retort and cooling station

# Cold-Wall Retort Furnaces up to 2400 °C

The compact retort furnaces of the VHT product line are available as electrically heated chamber furnaces with graphite, molybdenum, tungsten or MoSi<sub>2</sub> heating. A wide variety of heating designs as well as a complete range of accessories provide for optimal retort 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<sup>-5</sup> mbar. The basic furnace is suited for operation with non-flammable protective or reactive 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.



Molybdenumdisilicide heater and fiber insulation



Molybdenum or tungsten heating chamber



Graphite heating chamber

## Alternative Heating Specifications

In general the following variants are available with respect to the process requirements:

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

- Suitable for processes under protective and reaction gases or under vacuum
- Tmax 1800 °C, 2200 °C or 2400 °C (VHT 40/.. - VHT 100/..)
- Max. vacuum up to 10<sup>-4</sup> mbar depending on pump type used
- Graphite felt insulation

### VHT ../..-MO or VHT ../..-W with Molybdenum or Tungsten Heating

- Suitable for high-purity processes under protective and reaction gases or under high vacuum
- Tmax 1200 °C, 1600 °C or 1800 °C (see table)
- Max. vacuum up to 10<sup>-5</sup> mbar depending on pump type used
- Insulation made of molybdenum resp. tungsten radiation sheets

### 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<sup>-2</sup> mbar (up to 1300 °C) depending on pump type
- Insulation made of high purity aluminum oxide fiber

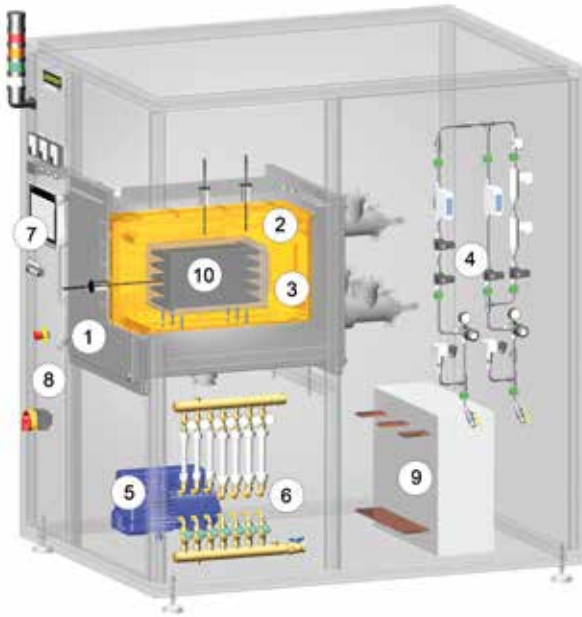
	VHT ../..-GR	VHT ../..-MO	VHT ../..-W	VHT ../..-KE
Tmax	1800 °C, 2200 °C or 2400 °C	1200 °C or 1600 °C	1800 °C	1800 °C
Inert gas	✓	✓	✓	✓
Air/Oxygen	-	-	-	✓
Hydrogen	✓ <sup>3,4</sup>	✓ <sup>3</sup>	✓ <sup>3</sup>	✓ <sup>1,3</sup>
Rough vacuum and fine vacuum (>10 <sup>-3</sup> mbar)	✓	✓	✓	✓ <sup>2</sup>
High vacuum (<10 <sup>-3</sup> mbar)	✓ <sup>4</sup>	✓	✓	✓ <sup>2</sup>
Material of heater	Graphite	Molybdenum	Tungsten	MoSi <sub>2</sub>
Material of insulation	Graphite felt	Molybdenum	Tungsten/Molybdenum	Ceramic fiber

<sup>1</sup>Tmax reduces to 1400 °C

<sup>2</sup>Depending on the temperature

<sup>3</sup>Only with safety package for flammable gases

<sup>4</sup>Up to 1800 °C



Schematic presentation of a cold-wall retort furnace with additional equipment

- 1 Retort
- 2 Heating
- 3 Insulation
- 4 Gas management system
- 5 Vacuum pump
- 6 Cooling water distribution
- 7 Controls
- 8 Integrated switchgear
- 9 Heating transformer
- 10 Charging frame inside the inner process chamber



Retort furnace VHT 100/16-MO with automation package

#### Standard Equipment

- Standard furnace sizes 8 - 500 liters
- Water-cooled retort made of stainless steel
- 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 tap, automatic flow monitoring, open-loop cooling water system
- Adjustable cooling water circuits with flowmeter and temperature indicator and overtemperature protection
- Switchgear and controller integrated in furnace housing
- Process control with controller with touch operation P570
- Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the oven and load
- Manual operation of the process gas and vacuum functions
- Manual gas supply for one process gas ( $N_2$ , Ar or non-flammable forming gas) with adjustable flow
- Bypass with manual valve for rapid filling or flooding of furnace chamber
- Manual gas outlet with overflow valve (20 mbar relative) for over-pressure operation
- 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





Retort furnace VHT 8/16-MO with automation package



Heat treatment of copper bars under hydrogen in retort furnace VHT 8/16-MO



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



Turbo-molecular pump

#### Additional Equipment Gas Management System

- Manual gas supply for second process gas ( $N_2$ , Ar or non-flammable forming gas) with adjustable flow and bypass
- Mass flow controller for alternating volume flow and generation of gas mixtures with second process gas (only with automation package)
- Inner process box made of molybdenum, tungsten, graphite or CFC, especially recommended for debinding processes. The box is installed in the furnace with direct gas inlet and outlet and provides for better temperature uniformity. Generated exhaust gases will be directly lead out the inner process chamber during debinding. The change of gas inlet pathes after debinding results in a clean process gas atmosphere during sintering.

#### Additional Equipment Vacuum

- Two-stage rotary vane pump with ball valve for pre-evacuating and heat-treating in a fine vacuum (up to  $10^{-2}$  mbar) incl. electronic pressure sensor
- Turbo molecular pump with slide valve for pre-evacuation and for heat treatment in a high vacuum (up to  $10^{-5}$  mbar) including electronic pressure sensor and booster pump
- Other vacuum pumps on request
- Partial pressure operation: protective gas flushing at controlled underpressure (only with automation package)

#### Additional Equipment Cooling

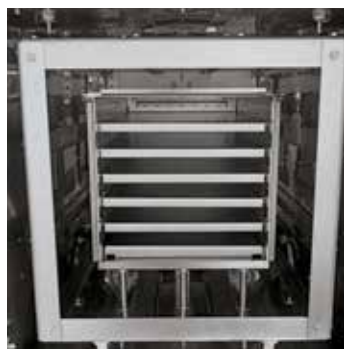
- Heat exchanger with closed-loop cooling water circuit
- Direct cooling see page 33

#### Additional Equipment for Controls and Documentation

- Charge thermocouple with display
- Temperature measurement at 2200 °C models with pyrometer in the upper temperature range and thermocouple, type C with automatic pull-out device for precise control results in the low temperature range (VHT 40/..-GR and larger)
- Automation package with process control H3700
  - 12" graphic touch panel
  - Input of all process data like temperatures, heating rates, gas injection, vacuum at the touch panel
  - Display of all process-relevant data on a process control diagram
  - Automatic gas supply for one process gas ( $N_2$ , argon or non-flammable forming gas) with adjustable flow
  - Bypass for flooding and filling the chamber with process gas controlled by the program
  - Automatic pre- and post programs, including leak test for safe furnace operation
  - Automatic gas outlet with bellows valve and overflow valve (20 mbar relative) for over-pressure operation
  - Transducer for absolute and relative pressure
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 112



Graphite inner process chamber incl. charge holder



Molybdenum inner process chamber incl. six charge supports

### Process Box for Debinding in Inert Gas

Certain processes require charges to be debinded in non-flammable protective or reactive gases. For these processes we fundamentally recommend a hot-wall retort furnace (see models NR .. or SR ..). These retort furnaces can ensure that the formation of condensation will be avoided as thoroughly as possible.

If there is no way to avoid the escape of small amounts of residual binder during the process, even in the VHT furnace, the retort furnace should be designed to meet this contingency.

The furnace chamber is equipped with an additional process box that has a direct outlet to the exhaust gas torch through which the exhaust gas can be directly vented. This system enables a substantial reduction in the amount of furnace chamber contamination caused by the exhaust gases generated during debinding.

Depending on the exhaust gas composition the exhaust gas line can be designed to include various options.

- Exhaust gas torch for burning off the exhaust gas
- Condensation trap for separating out binding agents
- Exhaust gas post-treatment, depending on the process, via exhaust gas washers
- Heated exhaust gas outlet to avoid condensation deposits in the exhaust gas line

Model	Inner dimensions of process box in mm			Volume in l
	w	d	h	
VHT 8/..	120	210	150	3.5
VHT 25/..	200	350	200	14.0
VHT 40/..	250	430	250	25.0
VHT 70/..	325	475	325	50.0
VHT 100/..	425	500	425	90.0
VHT 250/..	575	700	575	230.0
VHT 500/..	725	850	725	445.0

Model	Work space in mm			Volume in l	Max. charge weight/kg	Outer dimensions <sup>6</sup> in mm			Heating power in kW <sup>4</sup>			
	w	d	h			W	D	H	Graphite	Molybdenum	Tungsten	Ceramic fiber
VHT 8/..	170	240	200	8	5	1250 (800) <sup>1</sup>	1100	2700 <sup>5</sup>	27/27/- <sup>2</sup>	19/34 <sup>3</sup>	50	12
VHT 25/..	250	400	250	25	20	1500	2500	2200	70/90/- <sup>2</sup>	45/65 <sup>3</sup>	85	25
VHT 40/..	300	450	300	40	30	1600	2600 <sup>5</sup>	2300	83/103/125 <sup>2</sup>	54/90 <sup>3</sup>	110	30
VHT 70/..	375	500	375	70	50	1800 <sup>5</sup>	3300 <sup>5</sup>	2400	105/125/150 <sup>2</sup>	70/110 <sup>3</sup>	130	55
VHT 100/..	450	550	450	100	75	1900	3500 <sup>5</sup>	2500	131/155/175 <sup>2</sup>	90/140 <sup>3</sup>	on request	85
VHT 250/..	600	750	600	250	175	3000 <sup>1</sup>	4300	3100	180/210/- <sup>2</sup>	on request	on request	on request
VHT 500/..	750	900	750	500	350	3200 <sup>1</sup>	4500	3300	220/260/- <sup>2</sup>	on request	on request	on request

<sup>1</sup>With separated switching system unit

<sup>2</sup>1800 °C/2200 °C

<sup>3</sup>1200 °C/1600 °C

<sup>4</sup>Depending on furnace design connected load might be higher

<sup>5</sup>Dimensions may be smaller depending on the heater type

<sup>6</sup>External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.



Single-stage rotary vane pump for heat treatment in a rough vacuum to 5 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



Retort furnace VHT 40/16-MO H<sub>2</sub> with hydrogen extension package and process box



Retort furnace VHT 100/15-KE H<sub>2</sub> with fiber insulation and extension package for operation under hydrogen, 1400 °C

### H<sub>2</sub> Version for Operation with Hydrogen or other Reaction Gases

In the H<sub>2</sub> version the retort furnaces 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 retort furnaces are controlled by a fail-safe PLC control system (Siemens S7 safety controller).

#### Standard Equipment

- Certified safety concept
- Automation package (additional equipment see page 26)
- 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 retort 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 retort starting from 750 °C furnace chamber temperature
- Inner process hood in the retort for debinding under hydrogen
- Process control and documentation via Nabertherm Control Center (NCC) for monitoring, documentation and control see page 112



Gas management system

# Bottom Loading Retort Furnace up to 2400 °C

The LBVHT model series with bottom loading specification are especially suitable for production processes which require either protective or reaction gas atmosphere or a vacuum. The basic performance specifications of these models are similar to the VHT models. Their size and design with electro-hydraulically driven table facilitate charging during production. The retort furnaces are available in various sizes and designs. Similar like the VHT models, these furnaces can be equipped with different heating concepts.



Retort furnace LBVHT 250/20-W with tungsten heating chamber

## Standard Equipment

- Standard furnace sizes between 100 and 600 liters
- Designed as bottom loading retort furnace with electro-hydraulically driven table for easy and well-arranged charging
- Prepared to carry heavy charge weights
- Different heating concepts using
  - Graphite heating chamber up to Tmax 2400 °C
  - Molybdenum heating chamber up to Tmax 1600 °C
  - Tungsten heating chamber up to Tmax 2000 °C
- Frame structure filled with textured stainless steel sheets
- Standard design with gassing system for non-flammable protective or reaction gases
- Automatic gas supply system which also allows for operation with several process gases as additional equipment
- Gas supply systems for operating with hydrogen or other combustible reaction gases incl. safety package as additional equipment
- Switchgear and control box as well as gassing system integrated into the furnace housing
- Further product characteristics of the standard furnace as well as possible additional equipment can be found in the description of the VHT furnaces from Page 26

Model	Tmax °C	Model	Tmax °C	Model	Tmax °C	Inner dimensions in mm		Volume in l	Electrical connection*
LBVHT 100/16-MO	1600	LBVHT 100/20-W	2000	LBVHT 100/24-GR	2400	450	700	100	3-phase
LBVHT 250/16-MO	1600	LBVHT 250/20-W	2000	LBVHT 250/24-GR	2400	600	900	250	3-phase
LBVHT 600/16-MO	1600	LBVHT 600/20-W	2000	LBVHT 600/24-GR	2400	800	1200	600	3-phase

\*Please see page 110 for more information about supply voltage



Retort furnace LBVHT with graphite heating chamber



Retort furnace LBVHT 540/16-MO H<sub>2</sub>



Retort furnace LBVHT 540/16-MO H<sub>2</sub> with measuring frame



# Cold-Wall Retort Furnaces up to 2400 °C or up to 3000 °C

Compared with the VHT models (page 26 ff), the retort furnaces of the SVHT product line offer improved performance data with regard to achievable vacuum and maximum temperature. Due to the design as pit-type furnace with tungsten heating, processes up to max. 2400 °C even in high vacuum can be implemented with retort furnaces of the SVHT...-W product line. Retort furnaces of the SVHT...-GR product line with graphite heating, also in pit-type design, can be operated in an inert gas atmosphere even up to max. 3000 °C.



Retort furnace SVHT 9/24-W with tungsten heating



Graphite heating module



Cylindrical retort with tungsten heating



Cooling water distribution

## Standard Equipment

- Standard sizes with a furnace chamber of 2 or 9 liters
- Designed as pit-type furnace, charged from above
- Frame construction with inserted sheets of textured stainless steel
- Dual shell water-cooled stainless steel container
- Manual operation of process gas and vacuum functions
- Manual gas supply for non-combustible process gas
- A step in front of the retort furnace for an ergonomic charging height
- Retort lid with gas-charged shock absorbers
- Controls and switchgear as well as gas supply integrated in furnace housing
- Further standard product characteristics see description for standard design of VHT models page 26

## SVHT ...-GR

- Applicable for processes:
  - Under protective or reaction gases or in the vacuum up to 2200 °C under consideration of relevant max. temperature limits
  - Under inert gas argon up to 3000 °C
- Max. vacuum up to  $10^{-4}$  mbar depending on the type of pump used
- Heating: graphite heating elements in cylindrical arrangement
- Insulation: graphite felt insulation
- Temperature measurement by means of an optical pyrometer

## SVHT ...-W

- Applicable for processes under protective or reaction gases or in vacuum up to 2400 °C
- Max. vacuum up to  $10^{-5}$  mbar depending on the type of pump used
- Heating: cylindrical tungsten heating module
- Insulation: tungsten and molybdenum radiant plates
- Optical temperature measurement with pyrometer

## Additional equipment

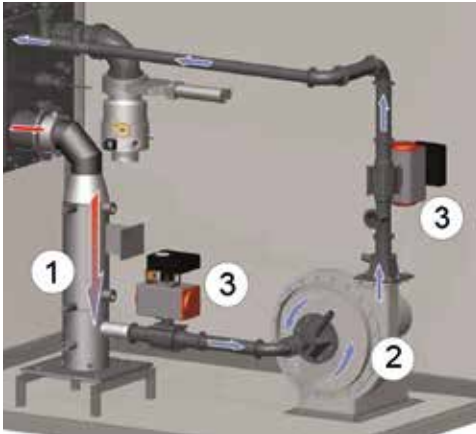
- Additional equipment such as automatic process gas control or design for the operation with flammable gases incl. safety system see VHT models page 26

Model	Tmax °C	Work space dimensions Ø x h in mm	Useful volume in l	Outer dimensions in mm			Heating power in KW <sup>1</sup>	Electrical connection*
				W	D	H		
SVHT 2/24-W	2400	150 x 150	2,5	1300	2500	2000	55	3-phase
SVHT 9/24-W	2400	230 x 230	9,5	1400	2900	2100	95	3-phase
SVHT 2/30-GR	3000	150 x 150	2,5	1400	2750	2100	65	3-phase
SVHT 9/30-GR	3000	230 x 230	9,5	1500	2900	2100	90	3-phase

<sup>1</sup>Depending on furnace design connected load might be higher

\*Please see page 110 for more information about supply voltage

# Retort Furnace Cooling Systems



Schematic presentation of rapid gas cooling  
1 Gas heat exchanger  
2 Radial fan  
3 Shut-off valves



Fan cooling, hot-wall retort furnace NRA 400/03



Rapid gas cooling, cold-wall retort furnace VHT 8/16-MO

## Indirect cooling (hot-wall retort furnaces)

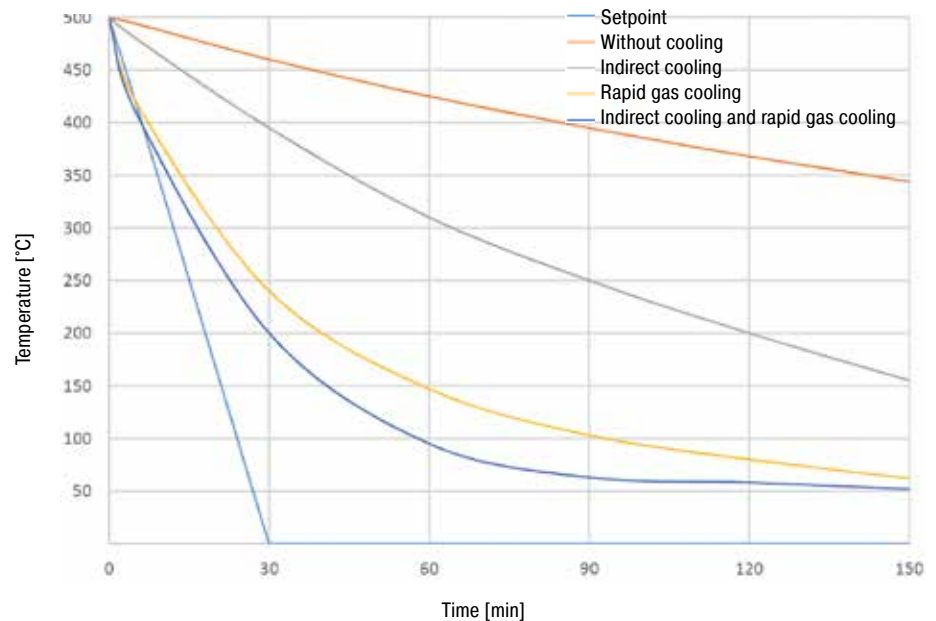
- Ambient air is blown onto the outer retorte surface to cool it down. The waste heat is removed via the exhaust air outlet of the furnace.
- The charge is cooled indirectly, which means that the atmosphere in the retort is not affected by the cooling
- The charge cannot be quenched with the cooling system

## Direct cooling (cold-wall and hot-wall retort furnaces)

- Rapid gas cooling in the retort. For this purpose, the furnace atmosphere is circulated through a heat exchanger.
- The system pressure is not increased by the cooling; there is no gas quenching at high pressure
- Not available for processes with flammable furnace atmospheres

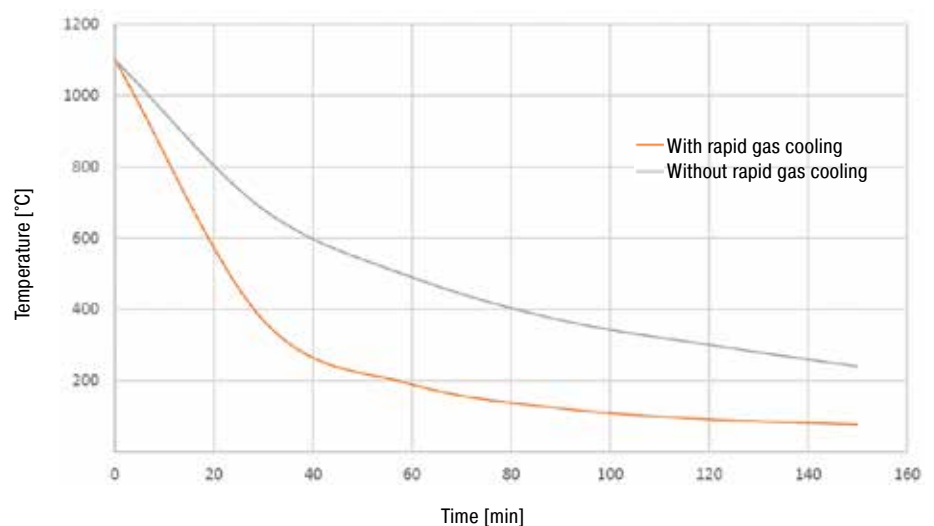
## Cooling Behavior of Hot-Wall Retort Furnace with Charge

(Example: NRA 50/09 with charge of 40 kg)



## Cooling Behavior of Cold-Wall Retort Furnace with Charge

(Example: VHT 8/06-MO with charge of 10 kg)



# Tube Furnaces for Processes under Flammable or Non-Flammable Protective or Reaction Gases or under Vacuum

With the wide range of available accessories, our professional tube furnaces can be designed optimally to suit various processes. By upgrading with different gas supply systems, processes can be carried out in a protective gas atmosphere, in vacuum, or under flammable protective or reaction gases. In addition to the convenient standard controllers, modern PLC controls can be used also.



Vertical tube furnace RHTV 50/150/17 with stand and gas supply system 2 as additional equipment

## Standard Equipment

- Tube furnaces (static) with Tmax 1100 °C to 1800 °C (max. 1400 °C in vacuum) for horizontal or vertical operation
- Rotary tube furnaces for batch or continuous processes with Tmax 1100 °C or 1300 °C
- Different working tube materials designed for various process requirements

## Additional equipment

- Different gas supply system packages for flammable or non-flammable protective or reaction gases
- Vacuum operation
- Multiple zone design to optimize temperature uniformity
- Charge control with temperature measurement in the working tube and in the furnace chamber outside the tube
- Display of temperature in the working tube with additional thermocouple
- Cooling systems for accelerated cooling of the working tube and the charge
- Individual solutions for process optimization available Rotary Tube Furnace RSR 250/3500/15S



Rotary Tube Furnace RSR 250/3500/15S



Sintering under hydrogen in a tube furnace of RHTH product line



High-temperature tube furnace for four different protective gases



Compact laboratory tube furnace with manual gas supply system

# Customized Tube Furnaces

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

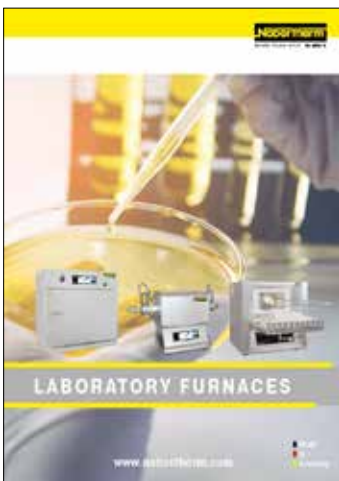
Based on our standard models, we develop individual solutions also for integration in overriding process systems. The solutions shown on this page are just a few examples of what is feasible. From working under vacuum or protective gas via innovative control and automation technology for a wide selection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



Tube furnace RHTV 120/480/16 LBS with working tube closed at one side, protective gas and vacuum option as well as with electric screw drive of the lift table



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



Please ask for our laboratory catalog to get further information about our extensive range of tube furnaces and other laboratory furnaces!



Tube furnace RS 200/4500/08 with lift door for heat treatment of bars



RS 250/2500/11S, five-zone controlled, for wire annealing in high-vacuum or under protective gases, incl. forced cooling and exhaust hood



# Furnaces for Continuous Processes

Continuous furnaces with a conveyor system through the furnace are used in particular when the same processes are repeated, large quantities have to be heat treated or automation is required. When designing the right flow system, parameters such as working temperature, charge dimensions, weight and throughput play an important role.

The following pages of this chapter describe options based on different conveying concepts and types of heating for continuously implementing heat treatment processes.

The following equipment applies to all furnaces in this chapter:



Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load



Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.



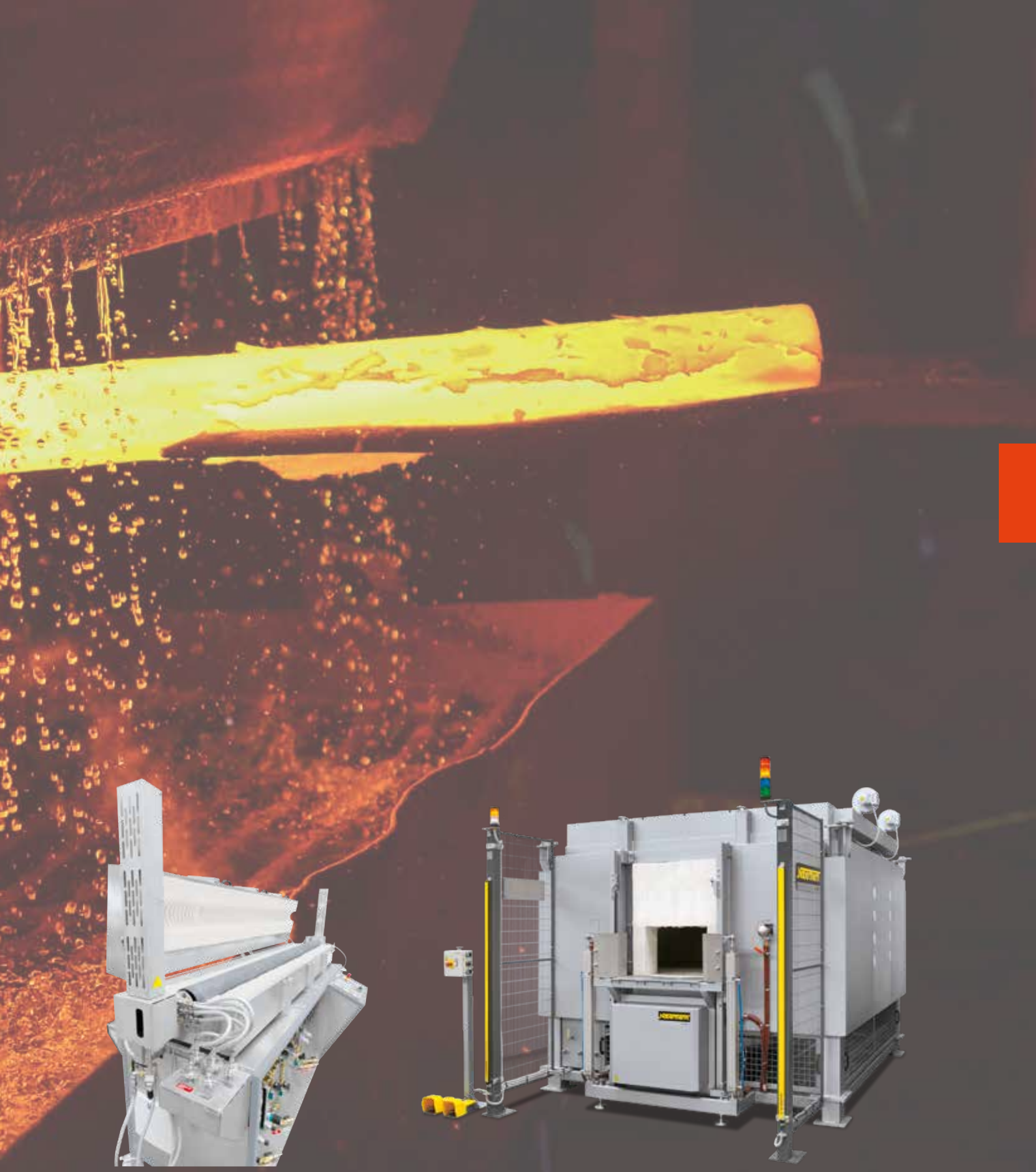
Defined application within the constraints of the operating instructions



Controller with intuitive touch operation



As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control



Furnace Group	Model	Page
Wire and Strand Annealing Furnaces	D	38
Continuous Plants for Protective or Reaction Gas Atmospheres		39

# Wire and Strand Annealing Furnaces

These models are particularly suitable for continuous heat treatment at operation temperatures up to 1200 °C. The modular design allows adjustment to different length and width requirements. The heating elements are mounted on only one side of the furnace and can be changed individually during operation. Optimum temperature uniformity is achieved by means of a multiple zone control system tailored to the furnace dimensions.

## Standard Equipment

- Tmax 1200 °C
- Modular design, variable length
- Small outer dimensions due to efficient microporous silica insulation
- Special heating elements that can be changed during operation
- Heating from the ceiling
- Optimum temperature uniformity by means of multiple zone control
- Controls description see page 104

## Additional equipment

- Gas supply systems for the working tubes for non-flammable or flammable protective or reaction gases including hydrogen, with burn off torch and safety technology
- Process and charge documentation
- Double chamber furnace system with parallel chambers for simultaneous operation at different temperatures
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 112



Strand annealing furnace D 390/S

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Heating power in kW <sup>1</sup>	Electrical connection*
		w	d	h		W	D	H		
D 20/S	1200	400	1000	50	20	900	1200	1350	9	3-phase
D 30/S	1200	600	1000	50	30	1100	1200	1350	12	3-phase
D 50/S	1200	200	3600	50	50	700	4000	1150	15	3-phase
D 60/S	1200	200	5600	50	60	700	6000	1350	36	3-phase
D 70/S	1200	350	3600	50	70	850	4000	1100	36	3-phase
D 110/S	1200	480	4600	50	110	980	5000	1450	36	3-phase
D 130/S	1200	650	3600	50	130	1150	4000	1150	60	3-phase
D 180/S	1200	480	7600	50	180	980	8000	1350	80	3-phase
D 250/S	1200	950	5600	50	250	1400	6000	1350	80	3-phase
D 320/S	1200	850	7600	100	320	1400	8000	1350	160	3-phase

<sup>1</sup>Depending on furnace design connected load might be higher

\*Please see page 110 for more information about supply voltage



D 250/S in production



Strand annealing furnaces based on a tube furnace with a length of 6 meters



Wire annealing furnace based on a tube furnace with safety package for hydrogen as process gas



# Continuous Plants for Protective or Reaction Gas Atmospheres

Continuously operating furnaces are ideal for heat treatment of large numbers of small parts in a protective or reaction gas atmosphere, such as brazing, hardening, or annealing.

Controlled protective gas atmospheres are generated in the furnace by using a gas tight retort. If hydrogen or cracked gas is used for the process, the furnace is equipped with the corresponding safety technology.

Parameters such as maximum working temperature, exposure, and geometry of the charge all play a role in the choice of the conveying system. Established conveyor concepts include metal belts or rollers. Wire and strand annealing furnaces are used to anneal wires or strands; in this case, the charge is unwound in front of the furnace, drawn through the furnace and is then wound again behind the furnace.

To cool the components faster, a water-cooled dual shell is installed directly behind the heating zone; the length of this is determined by the required unloading temperature.



Modular strand annealing furnace for operation in a hydrogen atmosphere with electrically heated torches at the ends



Manual pusher-type furnace with cooling tunnel for hydrogen up to 1250 °C



Pusher-type furnace system D 520/2600/55-04 S to sinter teflon coatings under protective atmosphere



# Salt-Bath Furnaces

Salt-bath furnaces have a very good temperature uniformity and ensure very good heat transfer to the work piece. Our TS salt baths are used for steel applications, for example, while the QS martempering furnaces are for example used for the heat treatment of nitinol.

The following equipment applies to all furnaces in this chapter:



Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load



Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.



Defined application within the constraints of the operating instructions



Controller with intuitive touch operation



As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control



Furnace Group	Model	Page
Salt-Bath Furnaces for Heat Treatment of Steel or Light Metals	TS	42
Martempering Furnaces using Neutral Salts	QS	45

# Salt-Bath Furnaces for Heat Treatment of Steel

electrically heated

Salt-bath furnaces have an excellent temperature uniformity and ensure very good heat transfer to the work piece. Generally, heat treatment can be carried out with shorter dwell times than in chamber furnaces. Since the charge is heat treated with the exclusion of oxygen, scale and discoloration on the surface of the parts are kept to a minimum.

The salt-bath furnaces TS 20/15 can be used for heat treatment of metals in neutral and active salt baths. They are used for processes such as nitriding according to Tenifer up to 600 °C, carburization to 950 °C or bright annealing to 1000 °C.

The crucible is inserted so that it is suspended in the salt-bath furnace and can be replaced easily if necessary. Two crucible types are available:

- Type P: low carbon steel and CrNi plated for carburizing, neutral salt and annealing baths up to 850 °C
- Type C: high alloy CrNi steel for neutral salt and annealing baths up to 1000 °C

Crucibles are wearing parts because they are exposed to thermal stress during the heating and cooling process and corrosive salt. The following parameters influence wear of the crucible:

- Working temperature
- Number of heating and cooling cycles
- Salt
- Charge material
- Charge quantity
- Contamination of the charge

The crucible must be checked regularly for wear and damage. We recommend to order a replacement crucible together with the furnace.



Salt-bath furnace TS 30/30, electrically heated

## Features for heat treatment of steel:

- Tmax in salt: 750 °C or 1000 °C
- Safety technology according to EN 60519-2
- Melt-bath control: the temperature is measured in the salt as well as inside the furnace behind the crucible
- Removable collar plate made of steel
- Insulated swing-away lid
- Temperature uniformity up to  $\pm 2$  °C according to DIN 17052-1 in the salt bath see page 102
- Over-temperature limiter in the furnace chamber to protect persons and the furnace
- Crucible can be easily replaced
- Controls description see page 104





Salt-bath furnaces can be delivered electrically heated or gas-fired

- Electrically heated (TS models):
  - Freely radiating, high quality heating elements on ceramic support tubes
  - Crucible heated from four sides
  - If a heating element is defective, the furnace can be heated with the remaining heating elements
- Gas-fired (TSB models on request):
  - Burner system with optimized flame management: high level of efficiency with overpressure operation to prevent false air entering
  - Burner technology according to DIN EN 7462, part 2
  - Lateral exhaust gas feed around the crucible

Salt-bath furnace TS 30/18 with preheating chamber above the salt bath and charging aid for immersion of the charge

Model	Tmax °C <sup>2</sup>	Inner dimensions salt-bath crucible		Volume in l	Outer dimensions in mm			Heating power in kW <sup>1</sup>	Electrical connection*	Weight in kg
		Ø in mm	h in mm		W	D	H			
TS 20/15	750 <sup>3</sup>	230	500	20	850	850	800	16	3-phase	650
TS 30/18	750 <sup>3</sup>	300	500	30	950	950	800	20	3-phase	700
TS 40/30	750 <sup>3</sup>	400	500	60	1050	1050	800	33	3-phase	750
TS 50/48	750 <sup>3</sup>	500	600	110	1150	1150	970	58	3-phase	1000
TS 60/63	750 <sup>3</sup>	610	800	220	1250	1250	970	70	3-phase	1200
TS 70/72	750 <sup>3</sup>	700	1000	370	1350	1350	1370	80	3-phase	1500
TS 90/80	750 <sup>3</sup>	900	1000	500	1600	1600	1400	100	3-phase	1700

<sup>1</sup>Depending on furnace design connected load might be higher

<sup>2</sup>Salt bath temperature

<sup>3</sup>Tmax for heat treatment of aluminum 550 °C

\*Please see page 110 for more information about supply voltage



Salt-bath furnace TSB 30/30, gas-fired



Salt-bath furnace TS 90/80 with a salt bath thermocouple for heat treatment of steel



Salt-bath furnace TS 30/18 with two salt bath thermocouples for heat treatment of aluminum



# Salt-Bath Furnaces for Heat Treatment of Steel

electrically heated or gas-fired



Salt-bath furnace TS 40/30 with exhaust gas collection at crucible rim and manual lid

## Additional equipment

- Exhaust gas collection at crucible rim
  - For the direct extraction of vapors and exhaust gases
  - Flange on the back to connect the customer's exhaust gas system
  - Only in combination with a lid that is manually placed on top
- Pneumatic lid opening
- Pneumatic lateral movement of the swivel lid
- Manual lowering and raising of the lid with a lever
- Foot pedal control
- Not available in combination with exhaust gas collection at crucible rim
- Charging basket for bulk materials
  - Possible lid closing over the salt bath with inserted charging basket
  - For manual charging of small martempering and salt baths
  - Charging with a crane or charging aid for large martempering and salt baths



Salt-bath furnace TS 40/30 with pneumatic lid opening



Charging basket for salt-bath furnaces

## Process Examples with Petrofer and Durferri Salts

TS models up to 750 °C	
Nitriding	Nitrogen 420, Nitrogen 460, Nitrogen 500
Annealing and blackening	SFS 240
Hardening, Tempering, Annealing, Quenching	GS 185, GS 230, GS 250, GS 345, GS 405, GS 406, GS 430, GS 520
Preheating, annealing of gold, silver or brass	GS 560, HS 545
TS models up to 1000 °C	
Carbonitriding, carburizing	Carbogen VC, Carbogen OK
Annealing, hardening, preheating	HS 535, HS 545, HS 535, GS 560, GS 660
	Carbogen Universal, Carborapid + GS-ZS, Carbomax +GS-ZS, Carbogen 800/800 ST, Carbogen 1000/ 1000 ST, CECON-
Carburizing	TROL 50H, CECONTROL 80B,
	CECONTROL 110B, CECONSTANT 80, CECONSTANT 100
Preheating of high-speed steel, annealing	GS 540, GS 660, GS 670, GS 750, HS 550, HS 635, HS 760
Preheating, annealing of gold, silver or brass	GS 560, HS 545

# Martempering Furnaces using Neutral Salts

## electrically heated

QS 20 - QS 400 martempering furnaces are filled with neutral salt and offer remarkably rapid and intensive heat transmission to the workpiece while ensuring optimum temperature uniformity. Since the batch is heat treated with the exclusion of oxygen, scale and discoloration on the surface of the parts are reduced to a minimum. For working temperatures at between 180 °C and 550 °C these martempering furnaces are useful for quenching or cooling with minimal workpiece distortion, retempering, austempering for optimal toughness, recrystallization annealing after electrical discharge machining (EDM) and for blueing.

The quenching or cooling process is applied in order to achieve an even temperature uniformity throughout the workpiece's entire cross-section before the formation of martensite and to avoid distortion and formation of cracks in complex mechanical components during the subsequent hardening process.

Tempering in a martempering bath is the same as the tempering process in forced convection furnace and is used to reduce a previously hardened workpiece to a desired hardness, to increase toughness and reduce stress within the workpiece.

Austempering is a good choice to achieve a high level of toughness and dimensional accuracy in oil hardened low-alloy steels. Workpieces subject to austempering have high tensile strength and good elasticity.



Mart empering furnace QS 70 with charging aid



Heating element in the crucible

### Standard Equipment

- Tmax 550 °C
- Very good temperature uniformity
- Martemper bath temperature control
- Heating with immersion heating elements
- Rectangular crucible, integrated in the housing
- Charging basket
- Crucible made of 1.4828
- Controls description see page 104

### Additional equipment

- Charging aid with hand crank and cable winch, mounted on side of furnace
- Exhaust gas collection at crucible rim

### Process Examples with Petrofer and Durferit Salts

#### QS-baths (steel/Nitinol)

Hardening, isothermal treatment of steels up to 950 °C, stress relieving, annealing, blueing, bainitization

AS 135, AS 140, AS 220, AS 225, AS 200, AS 235, GS 230

Homogenization annealing, recrystallization annealing; warm-bath curing, tempering, banitizing, blueing

AS 300

Model	Tmax	Work space dimensions in the charging basket in mm			min. amount of salt in l	max. charge weight in kg	Outer dimensions in mm			Heating power in kW <sup>1</sup>	Electrical connection*	Weight in kg
	°C	w	d	h			W	D	H			
QS 20	550	300	210	460	20	3	800	600	1020	2,6	1-phase	150
QS 30	550	300	210	580	30	5	800	600	1020	3,2	1-phase	170
QS 70	550	400	300	680	70	10	1000	700	1020	8,0	3-phase	260
QS 200	550	540	520	880	200	30	1100	920	1240	18,5	3-phase	670
QS 400	550	730	720	980	400	50	1300	1120	1340	24,5	3-phase	1160

<sup>1</sup>Depending on furnace design connected load might be higher

\*Please see page 110 for more information about supply voltage

# Chamber Furnaces with Brick Insulation or Fiber Insulation

Furnaces with robust insulation made of light-weight refractory bricks for rough industrial use.



Solid state relays provide for low noise operation



Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.



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



Defined application within the constraints of the operating instructions



As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control





Furnace Group	Model	Page
Chamber Furnaces for Annealing and Hardening	N 7/H - N 641/13	48
Annealing and Protective Gas Boxes, Additional Equipment for Models N 7/H - N 641/13	N 7/H - N 641/13	50
Stainless Steel Heat Treating Foil to avoid Surface Reactions		56
Annealing and Heat Treating Foils		56
Accessory Equipment for Processing Bags, Envelopes and Foils		56
Annealing Envelopes		57
Annealing Bags		57
Chamber Furnaces with Brick Insulation or Fiber Insulation	LH 15/.. - LH 216/..	58
Protective Gas Boxes, Additional Equipment for Models LH 15/.. - LH 216/..	LH 15/.. - LH 216/..	60
Chamber Furnaces with Drawer Bottom or as a Bogie	NW 150 - NW 1000	62
Protective Gas Boxes and Hoods for Chamber Furnaces NW 150 - NW 1000	NW 150 - NW 1000	63



# Chamber Furnaces

electrically heated

These universal chamber furnaces with radiation heating have been specifically designed to withstand heavy-duty use in the tool shop and industry. They are particularly useful for processes such as tool making or for hardening jobs, e.g. annealing, hardening and forging. With help of various accessories, these furnaces can be customized to every application requirements.



Annealing furnace N 7/H, as table-top model with optional protective gas box



Chamber furnace N 41/H with optional protective gas box

## Standard Equipment

- Compact, robust design construction with double-walled housing
- Door can be opened when furnace is hot
- Deep furnace chamber with three-sides heating: from both side walls and bottom
- Heating elements on support tubes ensure free heat radiation and a long service life
- Bottom heating protected by heat-resistant SiC plate (models N 81/.. - N 641/.. also with side SiC plates)
- Stainless steel upper door jamb protects furnace structure when furnace is opened hot up to model N 87/H. Models N 81/... - N 641/.. with compact stainless steel door.
- Temperature uniformity up to  $\pm 10^\circ\text{C}$  according to DIN 17052-1 see page 102
- Low energy consumption due to multi-layer insulation
- Base frame included in the delivery, N 7/H - N 17/HR designed as table-top model
- Exhaust opening in the side of the furnace, or on rear wall of chamber furnace in the N 31/H models and higher
- Parallel swinging door (user protected from heat radiation) up to N 87/H guided downwards, from N 81 guided upwards
- Door movement cushioned with gas dampers/struts
- Heat resistant zinc paint for protection of door and door frame (for model N 81 and larger)
- Controller with touch operation B500 (5 programs with 4 segments each), controls description see page 106
- Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC
- Freeware NTGraph for evaluation and documentation of firings using Excel™ for Windows™ on the PC
- MyNabertherm App for online monitoring of the firing on mobile devices for free download

## Additional Equipment

- Side heating elements protected with SiC tiles (Models N 7/H – N 87/H)
- Port with 18 mm ceramic tube including screw cap (Models N 7/H – N 87/H)
- Pneumatic door opening, controlled by foot pedal (Models N 31/H – N 641/13)
- Protective gas boxes for heat treatment under non-flammable protective and reaction gases
- Gas feed fittings
- Charging devices
- Charge control



Chamber furnace N 87/H



Chamber furnace N 81/13 with pneumatic lift door

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions <sup>4</sup> in mm			Heating power in kW <sup>3</sup>	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
N 7/H <sup>1</sup>	1280	250	250	140	9	800	650	600	3.0	1-phase	60
N 11/H <sup>1</sup>	1280	250	350	140	11	800	750	600	3.5	1-phase	70
N 11/HR <sup>1</sup>	1280	250	350	140	11	800	900	600	5.5	3-phase <sup>2</sup>	70
N 17/HR <sup>1</sup>	1280	250	500	140	17	800	900	600	6.4	3-phase <sup>2</sup>	90
N 31/H	1280	350	350	250	30	1040	1030	1340	15.0	3-phase	210
N 41/H	1280	350	500	250	40	1040	1180	1340	15.0	3-phase	260
N 61/H	1280	350	750	250	60	1040	1430	1340	20.0	3-phase	400
N 87/H	1280	350	1000	250	87	1040	1680	1340	25.0	3-phase	480
N 81	1200	500	750	250	80	1300	2000	2000	20.0	3-phase	950
N 161	1200	550	750	400	160	1350	2085	2300	30.0	3-phase	1160
N 321	1200	750	1100	400	320	1575	2400	2345	47.0	3-phase	1570
N 641	1200	1000	1300	500	640	1850	2850	2650	70.0	3-phase	2450
N 81/13	1300	500	750	250	80	1300	2000	2000	22.0	3-phase	970
N 161/13	1300	550	750	400	160	1350	2085	2300	35.0	3-phase	1180
N 321/13	1300	750	1100	400	320	1575	2400	2345	60.0	3-phase	1600
N 641/13	1300	1000	1300	500	640	1850	2850	2650	80.0	3-phase	2500

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

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

<sup>3</sup>Depending on furnace design connected load might be higher

<sup>4</sup>External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

\*Please see page 110 for more information about supply voltage



Working with protective gas boxes for a protective gas atmosphere using a charging cart



Chamber furnace N 7/H as table-top model



Deep furnace chamber with three-sides heating

## Charging Plates for Models N 7/H - N 641/13

We recommend these accessories for applications up to 1100 °C to protect the furnace floor, especially if a charging cart is used.

### Standard Equipment

- Tmax 1100 °C
- Three raised edges
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Larger plates and custom dimensions available upon request



Charging plate

Article no.	Furnace	Outer dimensions in mm		
		W	D	H
628000138	N 7/H	240	290	25
628000139	N 11/H, N 11/HR	240	390	25
628000141	N 17/HR	240	540	30
628000400	N 31/H	340	390	30
628000133	N 41/H	340	540	30
628000142	N 61/H	340	790	30
628001925	N 87/H	340	1040	30
628000143	N 81, N 81/13	480	790	30
628000144	N 161, N 161/13	530	790	30
628000145	N 321, N 321/13	720	1140	30
628000146	N 641, N 641/13	950	1330	30

## Annealing Boxes for Models N 7/H - N 161/13

### Working with Annealing Boxes

Annealing boxes are made of heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841) and also feature a lid for top charging. A ceramic fiber gasket is inserted in the circular seal profile on the upper edge of the box to seal it. To prevent oxidation during the process, neutral annealing coal is placed in the box. These bind the oxygen in the box. The oxygen inside the box is bound by the coal. After the heat treatment, the box is removed from the oven, the lid is opened using tongs and the workpiece removed. Our annealing boxes are also well suited for brazing.

The boxes can also be used with the appropriate granulate for carburizing (also referred to as case hardening or cementing) and for powder nitriding or powder boriding. The workpieces are placed in the box with carburizing granulate or nitriding powder or boriding powder and a suitable activator.



Annealing box with lid and granulate

### Standard Equipment

- Tmax 1100 °C
- Annealing box with lid and seal profile
- Lid sealing with ceramic fiber
- Also usable for carburizing and powder nitriding
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)

Article no.	Furnace	Inner dimensions in mm			Outer dimensions in mm			Charging method of the box
		w	d	h	W	D	H	
631000962	N 7/H	180	190	90	216	226	116	charging fork
631000967	N 11/H, N 11/HR	180	290	90	216	326	116	charging fork
631000972	N 17/HR	180	440	90	216	476	116	charging fork
631000977	N 31/H	280	230	200	316	304	226	draw hook
631000982	N 41/H	280	380	200	316	454	226	draw hook
631000986	N 61/H, N 87/H	280	500	200	316	574	226	draw hook

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each

Work space = box inner dimensions: - 30 mm to all sides

Larger boxes and custom dimensions available upon request

# Protective Gas Boxes for Models N 7/H - N 641/13

The annealing boxes for heat treatment under protective gas are equipped with a protective gas inlet and outlet. A box with protective gas is advisable for larger workpieces requiring defined heat treating. We would be pleased to carry out Trials at our technical center can be carried out on request. Up to furnace model N 61/H with downward door opening the gas ductway is laid through the upper section of the door collar, for larger furnaces with upward door opening the supply line is laid through the lower furnace collar.

The box is pressurized with non flammable protective and reactive gases such as argon, nitrogen or forming gas via the protective gas tube. There are manual and automatic systems available for protective gas. See pages 92 - 93. for more information about protective gases which can be used as well as manual and automatic protective gas systems.

After charging the box it is closed and preflushed outside the furnace. Afterwards the box is placed in the preheated furnace. The quantity of gas can be reduced to the process flush quantity. After the heat treatment the box is pulled out of the furnace, the charge taken from the box and placed in the quenching medium. We recommend using binding wire on the parts so that they can easily be grasped by tongs.

A flexible type K thermocouple is installed in the box for measuring the temperature; we recommend connecting it to a digital display device or to a temperature recorder.

The box can also be cooled down on a cooling platform while closed. Be sure that the protective gas flowrate is increased for this application.



Winch stacker with protective gas box and furnace



Box with protective gas connection

## Standard Equipment

- Tmax 1100 °C
- For non-combustible protective and reactive gases argon, nitrogen and forming gas (observe national regulations)
- Protective gas box with fiber sealing and lid, gas supply via a tube into the bottom of the box
- Protective gas connection via quick coupling with hose connector (inner diameter 9 mm)
- Piping for gas inlet and outlet through the furnace collar
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K for temperature display or charge control

## Additional equipment

- Starting from N 31/H a charging cart is recommended see page 96
- Digital temperature display see page 98
- Gas supply systems see page 92
- Charging forks see page 53
- Draw Hook see page 95

Article no.	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>			Preflush rate l/min	Process flush rate l/min	Charging method of the box
		w	d	h	W	D	H			
631000963	N 7/H	180	190	90	216	226	116	15 - 20	5 - 8	charging fork
631000968	N 11/H, N 11/HR	180	290	90	216	326	116	15 - 20	5 - 8	charging fork
631000973	N 17/HR	180	440	90	216	476	116	15 - 20	5 - 8	charging fork
631000978	N 31/H	280	230	200	316	304	226	20 - 25	10 - 15	draw hook
631000983	N 41/H	280	380	200	316	454	226	20 - 25	10 - 15	draw hook
631000987	N 61/H, N 87/H	280	500	200	316	574	226	20 - 25	10 - 15	draw hook
631000392	N 81, N 81/13	394	494	185	462	530	212	20 - 30	10 - 20	charging stacker
631000393	N 161, N 161/13	450	550	250	515	596	355	20 - 30	10 - 20	charging stacker
631000607	N 321, N 321/13	470	850	185	580	960	330	20 - 30	10 - 20	charging stacker
631000608	N 641, N 641/13	720	1050	270	830	1160	414	20 - 30	10 - 20	charging stacker

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each

Work space = box inner dimensions: - 30 mm to all sides

Larger boxes and custom dimensions available upon request

<sup>1</sup> Without piping



# Protective Gas Boxes with Evacuation Lid for Models N 7/H - N 161/13

For heat treatment of bulk goods and hollow parts under protective gas atmosphere we recommend the usage of protective gas boxes with an additional evacuation lid.

These boxes are equipped with a lid for top charging, protective gas inlet and outlet as well as a evacuation lid with rubber sealing gasket. Gas ductwork and handling while hot is the same as the protective gas boxes described on page 50. In addition, these boxes also feature a connection for a vacuum pump with a shut-off valve.

After charging the box in a cold state it is evacuated and afterwards flushed with protective gas. By repeating this process once or several times the results are considerably improved. After the box was flushed with protective gas the last time, the evacuation lid is removed and the box is placed into the preheated furnace. Protective gas is used for heat treatment. Thus traces of oxygen in the box can be reduced by a considerable amount which improves the quality of the components accordingly.

After the heat treatment the box is taken out of the furnace and can be cooled in air or be opened to remove the charge.

The box can also be force-cooled on a cooling platform while closed. Be sure that the protective gas flowrate is increased for this application.

## Standard Equipment

- Tmax 1100 °C
- For non-combustible protective and reactive gases argon, nitrogen and forming gas (observe national regulations)
- Protective gas box with fiber sealing and lid with locks, recess for evacuation lid, gas inlet via a pipe into the bottom of the box
- Evacuation lid with rubber sealing (Elastomer) and manometer
- Protective gas connection via three-way ball valve and quick coupling with hose connector (inner diameter 9 mm)
- Piping for gas inlet and outlet through the furnace collar
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K for temperature display or charge control

## Additional equipment

- Starting from N 31/H a charging cart is recommended see page 96
- Digital temperature display see page 98
- Vacuum pump see page 93
- Gas supply systems see page 92
- Charging forks see page 53
- Draw hook see page 95



Protective gas box for N 41/H furnace with additional evacuation lid

Article no.	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>			Preflush rate	Process flush rate	Charging method of the box
		w	d	h	W	D	H	l/min	l/min	
631000966	N 7/H	170	170	70	212	212	106	15 - 20	5 - 8	charging fork
631000971	N 11/H, N 11/HR	170	270	70	212	312	106	15 - 20	5 - 8	charging fork
631000976	N 17/HR	170	420	70	212	462	106	15 - 20	5 - 8	charging fork
631000981	N 31/H	250	200	150	292	242	178	20 - 25	10 - 15	draw hook
631000985	N 41/H	250	350	150	292	392	178	20 - 25	10 - 15	draw hook
631000989	N 61/H, N 87/H	250	500	150	292	542	178	20 - 25	10 - 15	draw hook
631000526	N 81, N 81/13	354	494	185	422	905	215	20 - 30	10 - 20	charging stacker
631000527	N 161, N 161/13	400	550	250	468	965	350	20 - 30	10 - 20	charging stacker

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each  
Work space = box inner dimensions: - 30 mm to all sides

<sup>1</sup> Without piping and evacuation lid  
Larger boxes and custom dimensions available upon request

## Charging Forks



Charging forks to charge and remove protective gas boxes up to model N 17/H

Article no.	Furnace
631001016	N 7/H, N 11/H(R)
631001017	N 17/HR

## Protective Gas Boxes with Hinged Lids for Fast Quenching for Models N 7/H - N 31/H

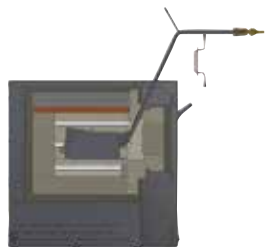
For heat treatment of small amounts of bulk material or small parts under protective gases with subsequent fast quenching in oil or water, we recommend to use protective gas boxes with a hinged lid. Boxes with an angled hinged lid on the front are equipped with a protective gas line on the rear wall. The supply line is run through the upper furnace collar.

After preflushing the box with non-flammable protective and reactive gases such as argon, nitrogen or forming gas 95/5, the box is placed with hinged lid first into the furnace. Due to a slight overpressure within the box the protective gas is vented off through the hinged lid.

After the heat treatment the box is taken out of the furnace and the charge is poured into quenching bath directly out of the box. By placing the box at an angle the hinged lid opens by itself. The contact with ambient air is reduced to a minimum.



Protective gas box with hinged lid



### Standard Equipment

- Tmax 1100 °C
- For non-combustible protective and reactive gases argon, nitrogen and forming gas (observe national regulations)
- Protective gas box with flap lid and gas supply from the rear wall
- Protective gas connection via quick coupling with hose connector (inner diameter 9 mm)
- Piping for gas inlet and outlet through the furnace collar
- Lid remains closed through its own weight
- Holder with hand handle
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K for temperature display or charge control

### Additional equipment

- Starting from N 31/H a charging cart is recommended see page 96
- Digital temperature display see page 98
- Gas supply systems see page 92

Article no.	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>			Preflush rate l/min	Process flush rate l/min
		w	d	h	W	D	H		
631000964	N 7/H	180	160	90	216	210	110	15 - 20	5 - 8
631000969	N 11/H, N 11/HR	180	260	90	216	310	110	15 - 20	5 - 8
631000974	N 17/HR	180	410	90	216	460	110	15 - 20	5 - 8
631000979	N 31/H	260	220	120	290	272	140	20 - 25	10 - 15

Work space = box inner dimensions: - 30 mm to all sides  
Larger boxes and custom dimensions available upon request

<sup>1</sup> Without piping

# Gas Feed Boxes with Hinged Lid for Models N 7/H - N 87/H which Remain in the Furnace

## Working with Protective Gas Boxes with Hinged Lid in continuous Operation

In the case of successive protective gas heat treatment of individual parts, a gassing box is recommended, which remains in the furnace. For charging, the box is equipped with a flap lid to the front. The lid closes without a sealing profile against the oblique position of the box opening. Larger gas losses in comparison with removable boxes can be expected. For the protective gas supply the pipe goes through a bore on the rear wall of the furnace.

For charging, the box is opened in the furnace using a draw hook and the workpieces are placed into the box. The box is continuously flushed with non-flammable protective and reactive gases such as argon, nitrogen or forming gas 95/5. Due to a slight overpressure within the box the protective gas is vented off through the hinged lid.

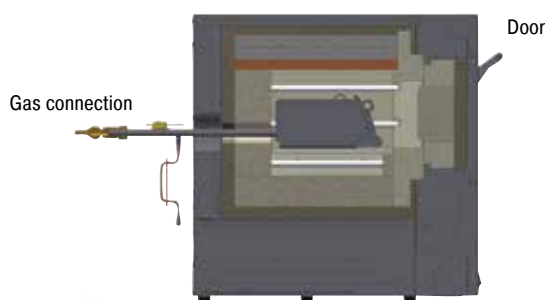
After the heat treatment the box is opened using a draw hook and the workpieces are removed.



Probes heat treated in different processes

## Standard Equipment

- Tmax 1100 °C
- For non-combustible protective and reactive gases argon, nitrogen and forming gas (observe national regulations)
- Protective gas box with flap lid and gas supply from the rear wall
- Protective gas connection via quick coupling with hose connector (inner diameter 9 mm)
- Piping for gas inlet and outlet through the rear wall
- Front flap lid which opens downwards
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K for temperature display or charge control
- The furnace will not be equipped with a charging plate (protective gas box is permanently installed)



Protective gas box with hinged lid for permanent operation

## Additional equipment

- Digital temperature display see page 98
- Gas supply systems see page 92



Article no.	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>			Preflush rate l/min	Process flush rate l/min
		w	d	h	W	D	H		
631000965	N 7/H	170	170	80	213	221	114	15 - 20	5 - 8
631000970	N 11/H, N 11/HR	170	270	80	213	321	114	15 - 20	5 - 8
631000975	N 17/HR	170	420	80	213	471	114	15 - 20	5 - 8
631000980	N 31/H	270	260	190	303	321	224	20 - 25	10 - 15
631000984	N 41/H	270	410	190	303	471	224	20 - 25	10 - 15
631000988	N 61/H	270	660	190	303	721	224	20 - 25	10 - 15
631000990	N 87/H	270	910	190	303	971	224	20 - 25	10 - 15

Work space = box inner dimensions: - 30 mm to all sides  
Larger boxes and custom dimensions available upon request

<sup>1</sup> Without piping

# Protective Gas Annealing Bag and Holder for Models N 7/H - N 87/H

When workpieces made of air-hardened steel must be heat treated under protective gas and quenched afterwards, the protective gas annealing bag with holder is an optimal solution. This system consists of a holder with charge carrier and protective gas tube as well as a bag made of stainless steel heat treating foil.

The charge is placed on the charge carrier and covered with the protective gas annealing bag. The bag is preflushed with non-flammable protective and reactive gases such as argon, nitrogen or forming gas 95/5 and placed together with the holder in the furnace. After the charge has been heated, the protective gas annealing bag and holder are removed from the furnace and cooled with the help of the forced cooling system or in still air. At the same time the workpiece remains in the bag in the protective gas atmosphere. This prevents oxidation from occurring. Due to thin-walled foil very rapid cooling times can be achieved.

The protective gas annealing bag is also suitable for quenching workpieces in oil or water. The protective gas annealing bag with holder is taken out of the hot furnace after the heating time. The bag is pulled off the holder above the quenching bath using a heat protection glove. After this the workpiece can slide directly into the quenching bath. The short exposure to ambient air while being pulled out normally has only minimum effect on the surface oxidation of workpieces.

The bags can be used multiple times. Our experience shows that at temperatures < 950 °C the stainless steel heat treating bag lasts for approx. 10 - 15 processes. At temperatures between 950 °C and 1050 °C, use for approx. 5 - 10 processes can be assumed.



## Standard Equipment

- Tmax 1100 °C
- For non-combustible protective and reactive gases argon, nitrogen and forming gas (observe national regulations)
- Holder with protective gas annealing bag
- Supplied with three protective gas annealing bags
- Protective gas supply with quick lock and hose connector (inner diameter 9 mm)
- Protective protective gas through notch in upper furnace collar
- Holder with hand handle
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K for temperature display or charge control



Protective gas annealing bag in operation

## Additional equipment

- Starting from N 31/H a charging cart is recommended see page 96
- Digital temperature display see page 98
- Gas supply systems see page 92

Article no.	Furnace	Useable inner dimensions in mm			Replacement bag (article no.)	Bag dimensions in mm			Preflush rate l/min	Process flush rate l/min
		w	d	h		w	d	h		
631000539	N 7/H	60	180	30	491040825	80	250	40	15 - 20	5 - 8
631000540	N 11/H, N 11/HR	100	180	50	491042225	120	250	60	15 - 20	5 - 8
631000541	N 17/HR	100	280	50	491042235	120	350	60	15 - 20	5 - 8
631000542	N 31/H	100	180	50	491042225	120	250	60	15 - 20	5 - 8
631000543	N 41/H	140	350	60	491043640	160	420	80	15 - 20	5 - 8
631000544	N 61/H, N 87/H	180	350	70	491045242	200	420	100	20 - 25	10 - 15



## Stainless Steel Heat Treating Foil to avoid Surface Reactions



Single parts requiring protection against decarburizing can be wrapped in a stainless steel heat treating foil off the roll or packed in prepared envelopes or bags. The rolls are available in various lengths and widths, the envelopes and bags are supplied in various dimensions.

Foil off the roll can be cut to size using gold plates scissors and the workpiece can be wrapped to requirements. See page 94 - 95 for more details about accessory supplies required, such as tongs and special gloves. The protected workpiece can now be loaded into the heated furnace. Due to the foil's thinness, it takes on the furnace temperature immediately and binds oxygen trapped in the foil packaging. There is then no oxygen present to oxidize the workpiece itself. The workpiece stays clean.

After the appropriate dwell time in the furnace, the wrapped workpiece is immersed in the quenching medium. After quenching the foil is removed and the part is then tempered.

Care should be taken to ensure that the foil is not too close to the workpiece as otherwise the foil may become damaged. If the workpiece should have several openings or gaps, and a large amount of oxygen can be wrapped up, these gaps can be filled in with foil pieces. This increases the foil surface area.

The foil has very sharp edges. Use gloves and tools.



Workpieces in foil heat treating

## Annealing and Heat Treating Foils



Stainless steel heat treating foil

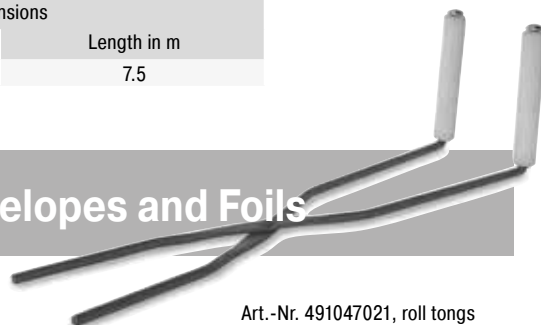
- Tmax 1200 °C
- Stainless steel heat treating foil for single use
- Ultra-thin stainless steel heat treating foil for bright annealing of workpieces in all shapes and sizes
- Foil is cut to the correct size
- Workpieces are packed into the foil as closely as possible
- Airtight lock by means of folds of a fold lock or suitable tools (see below)
- Rapid heating of the foil binds the oxygen in the packed piece, preventing virtually all oxidation and decarburizing
- Quenching takes place with a foil, so the workpiece remains protected
- Rapid quenching

Article no.	Dimensions	
	Width in mm	Length in m
491020615	610.0	7.5

## Accessory Equipment for Processing Bags, Envelopes and Foils



Art.-Nr. 491047010, fold lock



Art.-Nr. 491047021, roll tongs

We recommend using special protective gloves and tools for closing bags, envelopes and foils because the foil has very sharp edges and can be damaged if handled using conventional tools.

Article no.	Description
491047010	Fold lock with rotating handle
491047021	Roll tongs for annealing envelopes and bag
491041106	Hynit L finger protection gloves for foil use

## Annealing Envelopes



Annealing envelopes

- Annealing envelopes useful up to  $T_{max}$  1200 °C
- For hardening small parts
- Airtight lock by means of folds of a fold lock or suitable tools see page 56
- Rapid heating of the foil binds the oxygen in the annealing envelope preventing virtually all oxidation and decarburizing
- Rapid quenching in air, oil or water, ensuring high dimensional accuracy
- Workpieces are placed as tightly as possible in the annealing envelope
- Envelopes made of ultra-thin stainless steel heat treating foil, welded on three sides, for single use

Article no.	Dimensions in mm	
	Width	Length
491001000	63	127
491001501	63	203
491002000	101	152
491002501	101	228
491002999	152	203
491003500	152	304

Other dimensions available upon request

Article no.	Dimensions in mm	
	Width	Length
491004000	203	254
491004501	203	355
491005001	254	304
491005500	254	406
491006000	304	355
491006500	304	457

## Annealing Bags



Annealing bags

- Annealing bag suitable for powder nitriding, boriding and high speed steel hardening up to approx. 1050 °C - 1150 °C for cold work purposes
- Made of stainless steel heat treating foil for single use
- For hardening of blocks, stamps, cutting plates, etc.
- Rapid heating binds the oxygen in the annealing bag so that high-alloy and medium-alloy steel grades can be hardened
- Rapid quenching in air, oil or water, ensuring high dimensional accuracy
- Workpieces are placed as tightly as possible into the annealing bag
- Airtight lock by means of folds of a fold lock or suitable tools see page 56

Quadratic cross-section			
Article no.	Dimensions in mm		
	W	D	H
491063520	40	200	40
491063530	40	300	40
491064520	60	200	60
491064530	60	300	60
491065520	80	200	80
491065530	80	300	80
491066520	100	200	100
491066545	100	450	100

Other dimensions available upon request

Rectangular cross-section			
Article no.	Dimensions in mm		
	W	D	H
491041520	100	200	25
491041530	100	300	25
491043030	150	300	25
491043520	150	200	40
491043550	150	500	40
491045030	200	300	40
491045242	200	420	100
491046535	250	350	40

# Chamber Furnaces with Brick Insulation or Fiber Insulation

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



Chamber furnace LH 216/12 with fresh air fan to accelerate the cooling times

## Standard Equipment

- Tmax 1200 °C, 1300 °C, or 1400 °C
- Dual shell ventilated housing made of textured stainless steel sheets for low surface temperature and high stability
- High furnace chamber with five-sided heating for very good temperature uniformity
- Heating elements on support tubes ensure free heat radiation and a long service life
- Controller mounted on furnace door and removable for comfortable operation
- Protection of bottom heating and flat stacking surface provided by embedded SiC plate in the floor
- LH models: multi-layered insulation of light refractory bricks and special backup insulation
- LF models: high-quality fiber insulation with corner bricks for shorter heating and cooling times
- Motorized exhaust air flap
- Freely adjustable air inlet integrated in furnace floor
- Base included
- Controller with touch operation C540 (10 programs with each 20 segments), alternative controllers see page 80



LH 60/13 DB50 for debinding in air

## Additional Equipment

- Parallel swinging door (user protected from heat radiation)
- Lift door with electro-mechanic linear drive for opening when hot
- Cooling system to cool the furnace with a defined temperature gradient or with a preset fresh air volume. Both operating modes can be switched on and off for different segments by means of the extra function of the controller.
- Protective gas connection to purge with non-flammable process gases
- Manual or automatic gas supply system
- Stainless steel exhaust hood as interface to customer's exhaust system



Chamber furnace LH 30/12 with manual lift door



Chamber furnace LF 60/14

Model	Tmax in °C	Inner dimensions in mm			Volume in l	Outer dimensions <sup>1</sup> in mm			Connected load in kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
LH 15/12	1200	250	250	250	15	680	860	1230	5	3-phase <sup>2</sup>	170
LH 30/12	1200	320	320	320	30	710	930	1290	7	3-phase <sup>2</sup>	200
LH 60/12	1200	400	400	400	60	790	1180	1370	8	3-phase	300
LH 120/12	1200	500	500	500	120	890	1180	1470	12	3-phase	410
LH 216/12	1200	600	600	600	216	990	1280	1590	20	3-phase	470
LH 15/13	1300	250	250	250	15	680	860	1230	7	3-phase <sup>2</sup>	170
LH 30/13	1300	320	320	320	30	710	930	1290	8	3-phase <sup>2</sup>	200
LH 60/13	1300	400	400	400	60	790	1180	1370	11	3-phase	300
LH 120/13	1300	500	500	500	120	890	1180	1470	15	3-phase	410
LH 216/13	1300	600	600	600	216	990	1280	1590	22	3-phase	470
LH 15/14	1400	250	250	250	15	680	860	1230	8	3-phase <sup>2</sup>	170
LH 30/14	1400	320	320	320	30	710	930	1290	10	3-phase <sup>2</sup>	200
LH 60/14	1400	400	400	400	60	790	1180	1370	12	3-phase	300
LH 120/14	1400	500	500	500	120	890	1180	1470	18	3-phase	410
LH 216/14	1400	600	600	600	216	990	1280	1590	26	3-phase	470
LF 15/13	1300	250	250	250	15	680	860	1230	7	3-phase <sup>2</sup>	150
LF 30/13	1300	320	320	320	30	710	930	1290	8	3-phase <sup>2</sup>	180
LF 60/13	1300	400	400	400	60	790	1180	1370	11	3-phase	270
LF 120/13	1300	500	500	500	120	890	1180	1470	15	3-phase	370
LF 15/14	1400	250	250	250	15	680	860	1230	8	3-phase <sup>2</sup>	150
LF 30/14	1400	320	320	320	30	710	930	1290	10	3-phase <sup>2</sup>	180
LF 60/14	1400	400	400	400	60	790	1180	1370	12	3-phase	270
LF 120/14	1400	500	500	500	120	890	1180	1470	18	3-phase	370

<sup>1</sup>External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

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

\*Please see page 110 for more information about supply voltage



Parallel swinging door for opening when hot



Model with brick base



LF furnace design provides for shorter heating and cooling times



# Protective Gas Boxes for Models LH 15/.. - LH 216/..

Due to the cubic interior of the LH chamber furnaces and the corresponding protective gas boxes, these furnaces are ideally suited for higher batches. Gas-sing boxes for the LH models have a standard charge thermocouple, which can be used, for example, for charge control. The protective gas inlet and outlet is routed through the furnace collar in the case of a furnace with a swivel door on the left and through the lower furnace collar in the lift-door configuration. These boxes have a lid for charging from above, protective gas inlet and outlet.



Protective gas box for furnaces with hinged door

## Standard Equipment

- Tmax 1100 °C
- For non-combustible protective and reactive gases argon, nitrogen and forming gas (observe national regulations)
- Protective gas box with fiber seal and cover with locks, inert gas introduction via a pipe into the bottom of the box
- Protective gas connection via quick coupling with hose connector (inner diameter 9 mm)
- Piping for gas inlet and outlet through the furnace collar
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K for temperature display or charge control

## Additional Equipment

- Starting from LH 60/.. a charging cart is recommended see page 96
- Gas supply systems see page 92
- Extended gas piping for the use of smaller boxes in larger furnace models
- Draw hook
- Charging stacker see page 97

Article no.	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>			Charging method of the box
		w	d	h	W	D	H	
631001276	LH 15/..	100	100	100	165	182	166	draw hook
631001277	LH 30/..	170	170	170	235	252	236	draw hook
631001278	LH 60/..	250	250	250	315	332	316	draw hook
631001279	LH 120/..	350	350	350	415	411	441	draw hook
631001280	LH 216/..	450	450	400	514	535	554	charging stacker

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each  
 Work space = box inner dimensions: - 30 mm to all sides  
 Larger boxes and custom dimensions available upon request

<sup>1</sup> Without piping

## Protective Gas Boxes with Charging from the Front

Design as the described protective gas boxes, but with charging from the front. These protective gas boxes remain in the oven and are equipped with a lid that can be opened to the front. After the lid has been opened, the batch can be removed directly.



Protective gas box which stays in the furnace

Article no.	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>			Charging method of the box
		w	d	h	W	D	H	
631001310	LH 15/..	100	100	100	170	148	194	-
631001311	LH 30/..	170	170	170	240	218	264	-
631001312	LH 60/..	250	250	250	320	298	344	-
631001313	LH 120/..	350	350	350	420	398	444	-
631001327	LH 216/..	450	450	450	520	529	558	-

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each  
 Work space = box inner dimensions: - 30 mm to all sides  
 Larger boxes and custom dimensions available upon request

<sup>1</sup> Without piping

## Protective Gas Boxes with Evacuation Lid for Models LH 15/.. - LH 216/..

Design as the described protective gas boxes, but with an additional evacuation lid. In order to reduce the residual oxygen in the box, protective gas boxes with evacuation lids can be used. These boxes have a lid for top loading, a protective gas inlet and outlet, and an evacuation cover with rubber gasket. The gas piping and the handling in the warm state corresponds to the gassing boxes on page 60. In addition, a connection for a vacuum pump via three-way ball valve is provided.

In combination with a vacuum pump, the oxygen is evacuated from the box in cold state and afterwards flushed with protective gas. Repeating the process once or several times will significantly improve the results. After this process, the evacuation cover is removed and the actual heat treatment process is started under protective gas. After the heat treatment, the box is pulled out of the furnace and can be cooled in air or opened for batch removal.



Protective gas box with evacuation lid

### Standard Equipment

- Protective gas box with fiber sealing and lid with locks, recess for evacuation lid, gas inlet via a pipe into the bottom of the box
- Evacuation lid with rubber sealing (Elastomer) and manometer
- Protective gas connection via three-way ball valve and quick coupling with hose connector (inner diameter 9 mm)

### Additional Equipment

- Vacuum pump see page 93
- Gas supply systems see page 92
- Extended gas piping for the use of smaller boxes in larger furnace models
- Draw hook, starting from LH 30/.. a charging cart is recommended see page 96
- Charging stacker see page 97

Article no.	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>			Charging method of the box
		w	d	h	W	D	H	
631001281	LH 15/..	100	100	100	152	180	160	draw hook
631001282	LH 30/..	170	170	170	222	252	230	draw hook
631001283	LH 60/..	250	250	250	302	332	310	draw hook
631001284	LH 120/..	350	350	350	402	432	405	draw hook
631001285	LH 216/..	450	450	400	506	535	540	charging stacker

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each  
Work space = box inner dimensions: - 30 mm to all sides

<sup>1</sup> Without piping and evacuation lid

Larger boxes and custom dimensions available upon request

## Charging Plates for Models LH 15/.. - LH 216/..

Charging plates are recommended to protect the furnace floor. The charging plates are particularly suitable for heat treatment with protective gas boxes in order to minimize wear during charging.



Charging plate

### Standard Equipment

- Tmax 1100 °C
- Threeside upstand
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- With spacer on the rear heating elements

Article no.	Furnace	Outer dimensions in mm		
		W	D	H
628002013	LH 15/..	190	230	30
628002014	LH 30/..	260	300	30
628002015	LH 60/..	340	400	30
628002016	LH 120/..	440	500	30
628002017	LH 216/..	540	600	30

# Chamber Furnaces with Drawer Bottom or as a Bogie

The NW chamber furnaces enable simple charging for cold-cold processes. The heat treatment can take place under air or under non-flammable protective gases with a protective gas box or protective gas hood. With a drawer mechanism (NW 150 - NW 300/H) the furnace table can be easily pulled out of the chamber furnace. The larger models NW 440 - NW 1000/H are designed as shuttle furnace with completely free traversing bogie. Free access in front of the furnace allows for a simplified and clear charging.



Chamber kiln NW 300



Chamber kiln NW 440

## Standard Equipment

- Tmax 1300 °C, 1100 °C with protective gas box (additional equipment)
- Dual shell housing, galvanized steel sheets
- Double-walled door with front made of textured stainless steel
- Controller mounted on furnace door and removable for comfortable operation (up to model NW 440)
- Heating from five sides with special arrangement of heating elements for optimum temperature uniformity
- Heating elements of support tubes provide for free radiation of the heat
- Multi-layer insulation with light-weight refractory bricks and high-quality, energy-saving backing insulation
- Vaulted ceiling
- Furnace table can be pulled-out as drawer (NW 150 - NW 300)
- From chamber furnace NW 440 bogie on four castors (two with brakes) which can be pulled out completely. Accession assistance and removable drawbar for bogie
- SiC-floor plate protects floor elements and provides a level setting surface
- Door sealing grinded by hand (brick on brick); NW 150 - NW 300
- Semi-automatic air inlet flap closes the air inlet at a temperature which can be set in the controller for NW 150 - NW 300
- Exhaust air outlet in the ceiling, motorized exhaust air flap for chamber furnaces NW 440 - NW 1000
- Comfortable charging height with base of 800 mm (chamber furnaces NW 440 - NW 1000 = 500 mm)
- Controls description see page 104

## Additional Equipment

- Protective gas boxes and hoods
- Manual or automatic gas supply system
- Process control and documentation via VCD software package or Nabertherm Control Center (NCC) for monitoring, documentation and control see page 112

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions <sup>1</sup> in mm			Connected load kW	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
NW 150	1300	430	530	620	150	790	1150	1600	11	3-phase	400
NW 200	1300	500	530	720	200	860	1150	1700	15	3-phase	460
NW 300	1300	550	700	780	300	910	1320	1760	20	3-phase	560
NW 440	1300	600	750	1000	450	1000	1400	1830	30	3-phase	970
NW 660	1300	600	1100	1000	660	1000	1750	1830	40	3-phase	1180
NW 1000	1300	800	1000	1250	1000	1390	1760	2000	57	3-phase	1800

\*Please see page 110 for more information about supply voltage

<sup>1</sup>External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

# Protective Gas Boxes and Protective Gas Hoods for Chamber Furnaces NW 150 - NW 1000



Chamber furnace NW 200 with protective gas box



Protective gas box for similar furnace



Automatic gas supply system for two flushing quantities

## Protective Gas Boxes

These protective gas boxes have a cover with a sealing profile as well as a protective gas inlet and outlet. They are pulled out of the furnace in cold condition and charged from above.

### Standard Equipment

- Tmax 1100 °C
- For non-combustible protective and reactive gases argon, nitrogen and forming gas (observe national regulations)
- Protective gas box with fiber seal and cover with locks, inert gas introduction via a pipe into the bottom of the box
- Protective gas connection via quick coupling with hose connector (inner diameter 9 mm)
- Piping for gas inlet and outlet through the furnace collar
- Forklift receptive
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4841)
- Charge thermocouple type K for temperature display or charge control

## Protective Gas Hoods

Protective gas hoods consist of a top and a bottom with a sealing profile as well as protective gas inlet and outlet. After charging the bottom in front of the oven in cold condition, the hood is put on and the drawer or the car is pushed back into the oven.

### Design as Protective Gas Boxes, but

- Gassing hood with eye for raising the hood by crane
- Hood bottom with sealing
- Piping for gas inlet and outlet at the hood through the furnace collar

### Additional Equipment

- Gas supply systems see page 92

Furnace	Article no. Protective gas box	Inner dimensions in mm			Article no. Protective gas hood	Inner dimensions in mm			Charging the furnace
		w	d	h		w	d	h	
NW 150	631001329	330	420	400	631001334	300	360	400	drawer
NW 200	631001330	400	420	500	631001335	370	360	450	drawer
NW 300	631001331	450	550	550	631001336	420	530	500	drawer
NW 440	631001332	500	600	750	631001337	470	580	550	on a bogie
NW 660	631001333	500	750	750	631001338	470	750	550	on a bogie
NW 1000					on request				on a bogie

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each

Work space = box inner dimensions: - 30 mm to all sides

Larger boxes and custom dimensions available upon request



# Forced Convection Furnaces up to 850 °C

The forced convection furnaces presented in this chapter are ideal for processes such as tempering, aging, or others that take place at temperatures up to a maximum of 850 °C. Good heat transfer and temperature uniformity are important for these processes. The powerful air circulation and air flow are optimized for each individual model, which leads to very good temperature uniformity, even in the standard version.

The following equipment applies to all furnaces in this chapter:



Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load



Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.



Defined application within the constraints of the operating instructions



Controller with intuitive touch operation



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



Freeware NTEdit for convenient program input via Excel™ for Windows™ on the PC



Freeware NTGraph for evaluation and documentation of firings using Excel™ for Windows™ on the PC



MyNabertherm App for online monitoring of the firing on mobile devices for free download



As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control



Furnace Group	Model	Page
Forced Convection Chamber Furnaces – Tabletop Design	NAT	66
Forced Convection Chamber Furnaces < 675 Liters	NA 60/.. - NA 675/..	68
Protective Gas Boxes, Additional Equipment for Models NA 30/45 - N 500/85HA	NA 30/45 - N 500/85HA	70
Sealed Forced Convection Chamber Furnaces NA-I and NA-SI	NA 15/.. - NA 500/.. SI	73
Forced Convection Pit-Type Furnaces	SAL 120/85 - SAL 500/85	74
Protective Gas Boxes, Additional Equipment for Models SAL 120/85 - SAL 500/85	SAL 120/85 - SAL 500/85	75



# Forced Convection Chamber Furnaces – Tabletop Design

electrically heated

These forced convection chamber furnaces are characterized by their good temperature uniformity. Due to the compact tabletop design, this series is very well suited for installation in laboratories or rooms with limited space.

Applications include preheating of components for shrink-fit processes, heat treatment of metals in air such as aging, stress relieving, soft annealing or tempering, and heat treatment of glass.



Forced convection chamber furnace NAT 15/85 with base frame as additional equipment

## Standard Equipment

- Tmax 650 °C or 850 °C
- Horizontal air circulation with optimum distribution through stainless steel baffles
- Integrated control unit
- Swing door hinged on the right side, door opening temperatures up to 400 °C
- Temperature uniformity up to  $\pm 6$  °C according to DIN 17052-1 (model NAT 15/65 up to  $\pm 5$  °C) see page 102
- Optimum air distribution enabled by high flow speeds
- Air inlet in the rear wall of the furnace
- Adjustable exhaust port in the furnace ceiling (not for model NAT 15/65)
- 15 mm port in the furnace ceiling (not for model NAT 15/65)
- Controller with touch operation B500/B510 (5 programs with 4 segments each), controls description see page 106



Forced convection chamber furnace NAT 30/65

## Additional Equipment (not for NAT 15/65)

- Base frame
- Charging racks for loading on several levels
- Equipment package with batch control and process control and documentation via VCD software package



Forced convection chamber furnace NAT 30/85



Forced convection chamber furnace NAT 50/85

Model	Tmax	Inner dimensions in mm			Volume in l	Outer dimensions <sup>1</sup> in mm			Heating power in kW <sup>2</sup>	Electrical connection*	Weight in kg	Heat-up time <sup>3</sup> to Tmax in minutes
	°C	w	d	h		W	D	H				
NAT 15/65	650	295	340	170	15	470	790	460	2.8	1-phase	60	35
NAT 30/65	650	320	320	300	30	810	620	620	3.0	1-phase	90	80
NAT 60/65	650	400	400	400	60	890	700	720	3.0	1-phase	110	100
NAT 15/85	850	320	320	150	15	690	880	570	3.0	1-phase	85	190
NAT 30/85	850	320	320	300	30	690	880	720	3.0	1-phase	100	230
NAT 50/85	850	400	320	400	50	770	880	820	4.5	3-phase	130	230

<sup>1</sup>External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

<sup>2</sup>Depending on furnace design connected load might be higher

<sup>3</sup>Approx. information in empty furnace

\*Please see page 110 for more information about supply voltage



Adjustable exhaust port in the furnace ceiling



Forced convection chamber furnace NAT 15/85



Interior made of stainless steel sheet 1.4828



# Forced Convection Chamber Furnaces up to 675 Liter

electrically heated

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



Forced convection chamber furnace NA 500/45 with signal tower

## Standard Equipment

- Tmax 450 °C, 650 °C, or 850 °C
- Horizontal air circulation with optimum distribution through stainless steel baffles
- Swing door hinged on the right side
- Base frame included in the delivery
- Temperature uniformity up to  $\pm 4$  °C according to DIN 17052-1 see page 102
- Optimum air distribution enabled by high flow speeds
- One frame sheet and rails for two additional trays included in the scope of delivery
- Controller with touch operation B500 (5 programs with 4 segments each), controls description see page 106
- Automatic switch-off of air circulating fan for two minutes after door opening
- Side port and additional 3 mm thermocouple entry port

## Additional Equipment for Models Tmax up to 450 °C

- Air inlet and exhaust air flaps when used for drying
- Controlled cooling via controlled flap and fan
- Additional frame sheet
- Gas supply boxes for different charging methods
- Gas feed fittings
- Charge control with documentation of the charge thermocouple
- Signal tower
- Charging systems



Forced convection chamber furnace NA 500/65

## Further Additional Equipment for Models Tmax up to 650 °C and 850 °C

- Optimization of the temperature uniformity up to  $\pm 3$  °C according to DIN 17052-1 see page 102
- Measuring frames and thermocouples for TUS measurements charge or comparative measurements
- Version according to AMS2750H or CQI-9
- Manual lift door for forced convection chamber furnace NA 120/65 and NA 120/85
- Pneumatic lift door from forced convection chamber furnace NA 250/65 upwards
- Manual roller conveyor in furnace chamber for high charge weights



Forced convection chamber furnace NA 60/65



Forced convection chamber furnace NA 60/85 with manual lift door and protective gas box for front loading

Model	Tmax	Inner dimensions in mm			Volume in l	Outer dimensions <sup>1</sup> in mm			Heating power in kW <sup>2</sup>	Electrical connection <sup>*</sup>	Weight in kg	Heat-up time <sup>3</sup> to Tmax in minutes	Cool-down time <sup>3</sup> from Tmax to 150 °C in minutes	
	°C	w	d	h		W	D	H					Flaps <sup>4</sup>	Fan cooling <sup>4</sup>
NA 120/45	450	450	600	450	120	1075	1475	1500	9.0	3-phase	280	60	90	30
NA 250/45	450	600	750	600	250	1250	1660	1670	12.0	3-phase	650	60	120	30
NA 500/45	450	750	1000	750	500	1400	1910	1810	18.0	3-phase	800	90	240	45
NA 60/65	650	350	500	350	60	930	1310	1435	9.0	3-phase	240	90	210	30
NA 120/65	650	450	600	450	120	1030	1410	1535	12.0	3-phase	280	90	240	60
NA 250/65	650	600	750	600	250	1250	1700	1750	20.0	3-phase	650	90	480	60
NA 500/65	650	750	1000	750	500	1400	1950	1900	27.0	3-phase	850	90	600	90
NA 60/85	850	350	500	350	60	930	1310	1435	9.0	3-phase	315	150	900	120
NA 120/85	850	450	600	450	120	1030	1410	1535	12.0	3-phase	390	150	900	120
NA 250/85	850	600	750	600	250	1260	1700	1810	20.0	3-phase	840	180	900	180
NA 500/85	850	750	1000	750	500	1410	1950	1960	30.0	3-phase	1150	180	900	210
NA 675/85	850	750	1200	750	675	1410	2150	1960	30.0	3-phase	1360	210	900	210

<sup>1</sup>External dimensions vary when furnace is equipped with additional equipment. Dimensions on request.

<sup>2</sup>Depending on furnace design connected load might be higher

<sup>3</sup>Approx. information in empty furnace

<sup>4</sup>Additional equipment

\*Please see page 110 for more information about supply voltage



Port for thermocouple



Tray



Roller conveyor in furnace chamber

# Protective Gas Boxes for Models NA 60/.. - NA 500/85

For the heat treatment, workpieces are placed in the box, the lid is locked using the sealing locks and flushed with protective gas outside the furnace for some time and then placed in the furnace. Depending on the weight, a charging cart (page 30) is recommended.



Forced convection chamber furnace NA 250/85 with protective gas box

## Standard Equipment

- For non-combustible protective and reactive gases argon, nitrogen and forming gas (observe national regulations)
- Protective gas box with fiber seal and cover with locks, inert gas introduction via a pipe into the bottom of the box
- Protective gas connection via quick coupling with hose connector (inner diameter 9 mm)
- Piping for gas inlet and outlet through the furnace collar
- Models NA 250/.. and NA 500/.. will be delivered without bootom frame sheet
- Heat-resistant alloy: 309 (AISI)/(DIN material no. 1.4828)
- Charge thermocouple type K for temperature display or charge control


## Additional Equipment

- Gas supply systems see page 92
- Extended gas piping for the use of smaller boxes in larger furnace models
- Draw hook
- Charging cart see page 96


Article no. (Furnace with hinged door)	(Furnace with lift door)	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>			Charging method of the box
			w	d	h	W	D	H	
631000411	631000764	NA 60/..	270	420	260	336	460	340	draw hook
631000412	631000765	NA 120/..	350	520	340	436	560	430	draw hook
631000413	631000766	NA 250/..	480	630	460	546	680	600	charging stacker
631000414	631000767	NA 500/..	630	780	610	696	836	760	charging stacker

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each  
Work space = box inner dimensions: - 30 mm to all sides  
Larger boxes and custom dimensions available upon request


<sup>1</sup> Without piping



Automatic gas supply system



Protective gas box which stays in the furnace



Protective gas box with extended piping for usage in a large furnace model

# Protective Gas Boxes with Evacuation Lid for Models NA 60/.. - NA 500/85

Design as the boxes described above, but with additional evacuation lid and connection. Before the box is placed in the furnace, in a cold state an evacuation and protective gas atmosphere are alternately generated to force out the oxygen and achieve a pure atmosphere.



Protective gas box with evacuation lid

## Standard Equipment

- Protective gas box with fiber sealing and lid with locks, recess for evacuation lid, gas inlet via a pipe into the bottom of the box
- Evacuation lid with rubber sealing (Elastomer) and manometer
- Protective gas connection via threeway ball valve and quick coupling with hose connector (inner diameter 9 mm)
- Piping for gas inlet and outlet through the furnace collar

## Additional Equipment

- Vacuum pump see page 93
- Gas supply systems see page 92
- Extended gas piping for the use of smaller boxes in larger furnace models
- Draw hook
- Charging cart see page 96

Article no. (Furnace with hinged door)	(Furnace with lift door)	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>			Charging method of the box
			w	d	h	W	D	H	
631000560	631000807	NA 60/..	230	380	220	318	468	297	draw hook
631000561	631000808	NA 120/..	330	480	320	418	568	412	draw hook
631000562	631000809	NA 250/..	430	580	370	518	668	532	charging stacker
631000563	631000810	NA 500/..	560	810	530	648	898	692	charging stacker

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each  
Work space = box inner dimensions: - 30 mm to all sides  
Larger boxes and custom dimensions available upon request

<sup>1</sup> Without piping and evacuation lid



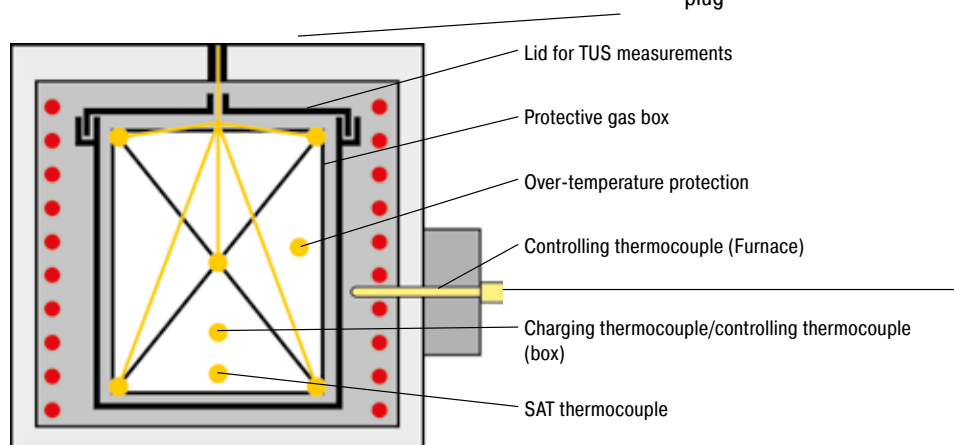
# Protective Gas Boxes for Automotive (CQI-9) and Aeronautic (AMS/NADCAP) Norms

## Protective Gas Boxes According to AMS2750H, Instrumentation Type D for Forced Convection Furnaces

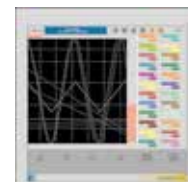
These boxes are based on the standard protective gas boxes for furnaces with hinged door. To fulfill AMS2750H, instrumentation, type D requirements the boxes are equipped with necessary measuring ports.

### Standard Equipment

- Temperature uniformity class 2:  $\pm 5$  °C in useful space
- Additional port for customers flexible SAT thermocouple with max. 1,5 mm diameter
- Thermocouple, overtemperature protection, metal clad thermocouple, type N with plug



Controller



TUS recorder

Article no. (Furnace with swinging door)	(Furnace with lift door)	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>		
			w	d	h	W	D	H
631001021	631001026	NA 60/..	270	420	260	336	460	340
631001022	631001027	NA 120/..	350	520	340	436	560	430
631001023	631001028	NA 250/..	480	630	460	546	680	600
631001024	631001029	NA 500/..	630	780	610	696	836	760

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each

Work space = box inner dimensions: - 30 mm to all sides

Larger boxes and custom dimensions available upon request

<sup>1</sup> Without piping

## Protective Gas Boxes with Evacuation Lid According to AMS2750H, Instrumentation type D

These boxes are based on the standard protective gas boxes with evacuation lid for furnaces with hinged door. Before the box is placed in the furnace, in a cold state an evacuation and protective gas atmosphere are alternately generated to force out the oxygen and achieve a pure atmosphere.



Protective gas box with evacuation lid according to AMS2750H

### Standard Equipment

- Temperature uniformity class 2:  $\pm 5$  °C in useful space
- Additional port for customers flexible SAT thermocouple with max. 1,5 mm diameter
- Thermocouple, overtemperature protection, metal clad thermocouple, type N with plug

Article no. (Furnace with hinged door)	(Furnace with lift door)	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>		
			w	d	h	W	D	H
631001052	631001057	NA 60/..	230	380	220	318	468	297
631001053	631001056	NA 120/..	330	480	320	418	568	412
631001054	631001055	NA 250/..	430	580	370	518	668	532
631001049	631001054	NA 500/..	560	810	530	648	898	692

Article no. 601655055, 1 set of fiber insulation cord, 5 strips of 610 mm each

Work space = box inner dimensions: - 30 mm to all sides

Larger boxes and custom dimensions available upon request

<sup>1</sup> Without piping

# Sealed Forced Convection Chamber Furnaces NA-I and NA-SI

Sealed forced convection chamber furnaces are suitable if a heat treatment process up to 850 °C requires a protective gas atmosphere that does not have to be completely oxygen free.

The difference between the two variants is that the I-model only has a sealed outer housing while the SI-model has a welded inner box, which further reduces the residual oxygen concentration.



Forced convection chamber furnace NA 120/65 I

## Standard Equipment

### NA(T)-I design

Like forced convection chamber furnaces < 675 l (page 60) with the following changes

- Tmax 650 °C and 850 °C
- Silicone door seal
- Furnace housing sealed with silicone
- Protective gas connection in the back wall
- Residual oxygen concentration < 1 % depending on the volume and type of protective gas
- For non-flammable protective and reaction gases such as argon, nitrogen, and forming gas (national regulations must be considered)



Forced convection chamber furnace NAT 15/65 I as tabletop model with manual gas supply system

## Standard Equipment

### NA-SI design

#### Additional features

- Tmax 650 °C
- Welded inner housing
- 2-sided heating and air circulation
- Door sealed with seal gas
- Sealed connection to circulation motor
- Gas inlet via circulator shaft
- Residual oxygen concentration to 0.1 % depending on the volume and type of protective gas
- For non-flammable protective and reaction gases such as argon, nitrogen, and forming gas (national regulations must be considered)

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions <sup>3</sup> in mm			Heating power in kW <sup>2</sup>	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
NAT 15/65 I <sup>1</sup>	650	295	340	170	15	470	790	460	2.8	1-phase	60
NA 60/85 I	850	350	500	350	60	930	1310	1435	9.0	3-phase	315
NA 120/85 I	850	450	600	450	120	1030	1410	1535	12.0	3-phase	390
NA 250/85 I	850	600	750	600	270	1260	1700	1810	20.0	3-phase	840
NA 500/85 I	850	750	1000	750	560	1410	1950	1960	30.0	3-phase	1150
NA 675/85 I	850	750	1200	750	675	1410	2150	1960	30.0	3-phase	1360
NA 100/65 SI	650	400	600	400	49	1100	1400	2000	20.0	3-phase	450
NA 230/65 SI	650	550	750	550	116	1350	1700	2000	33.0	3-phase	800
NA 500/65 SI	650	700	1000	700	250	1500	1900	2000	42.0	3-phase	1200

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

<sup>2</sup>Depending on furnace design connected load might be higher

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

\*Please see page 110 for more information about supply voltage

Forced Convection Pit-Type Furnaces SAL 120/85 - SAL 500/85

electrically heated

Forced convection pit-type furnaces offer the advantage of easy charging, for heat treatment of heavy parts or loads in charge baskets. With maximum application temperatures available from 850 °C, these compact pit-type furnaces are particularly useful for processes such as tempering, solution annealing, artificial ageing, and soft annealing.



SAL 250/85

Standard Equipment

- Tmax 850 °C
- Air circulation fans in the furnace bottom, high circulation rate
- Vertical air circulation with square air heating chamber
- Temperature uniformity up to +/- 4 °C according to DIN 17052-1 see page 102
- Interior walls from stainless steel
- Switchgear with solid-state relays
- Controls description see page 104

Additional Equipment

- Charging hoist with swivel arm and charge basket
- Optimization of the temperature uniformity up to +/- 2 °C according to DIN 17052-1 see page 102
- Integrated fan for rapid cool down or separate cooling station for annealing box cooling outside of the furnace
- Annealing box with protective gas inlet and outlet for production in a defined atmosphere
- Manual or automatic gas supply systems for non-flammable protective or reaction gases
- Process control and documentation via VCD software package for monitoring, documentation and control see page 112

Model	Tmax	Inner dimensions in mm			Volume in l	Max. charging weight in kg	Outer dimensions in mm			Heating power in kW <sup>1</sup>	Electrical connection*	Weight in kg
	°C	w	d	h			W	D	H			
SAL 120/85	850	450	450	600	120	80	900	1050	1450	13.0	3-phase	280
SAL 250/85	850	600	600	750	250	250	1050	1200	1600	20.0	3-phase	750
SAL 500/85	850	750	750	900	500	250	1200	1350	1750	30.0	3-phase	980

<sup>1</sup>Depending on furnace design connected load might be higher

\*Please see page 110 for more information about supply voltage

Pit-type furnace SAL 120/85 with protective gas retort box and cooling station next to the furnace

Basket system for charging in different layers

Protective gas box, AMS2750H design

## Charging Aid for Models SAL 120/85 - SAL 500/85

A charging aid, fastened to the furnace consisting of a swivel arm and winch is recommended for charging series SAL 120/85 - SAL 250/85 forced convection pit-type furnaces with protective gas boxes or baskets. This allows easy and safe furnace charging.



Swivel arm mounted on furnace

### Standard Equipment

- Swivel arm, mounted on side of furnace
- For ease of charging and removal of Nabertherm charging baskets and protective gas boxes
- Winch with hand crank
- Max. charging weight 140 kg

Furnace	Total height in mm
SAL 120/..	2400
SAL 250/..	2600
SAL 500/..	3010

## Protective Gas Boxes for Models SAL 120/85 - SAL 500/85

For tempering and bright annealing, workpieces are laid in the box, the lid is pressed firmly shut using the sealing locks and flushed with protective gas outside the box for some time and then placed in the furnace. Due to weight reasons we recommend to use a charging aid for charging.



Protective gas box with sealing lock

### Standard Equipment

- For non-combustible protective and reactive gases argon, nitrogen and forming gas (observe national regulations)
- Protective gas box with fiber seal and cover with locks, inert gas introduction via a pipe into the bottom of the box
- Protective gas connection via quick coupling with hose connector (inner diameter 9 mm)
- Piping for gas inlet and outlet through the furnace collar
- Heat-resistant alloy: 850 °C - 309 (AISI)/(DIN material no. 1.4828)
- Charging aid lifting eyes
- Charge thermocouple type K for temperature display or charge control

### Additional Equipment

- Digital temperature display see page 98
- Gas supply systems see page 92

Article no. with charge thermocouple	Furnace	Inner dimensions in mm			Outer dimensions in mm <sup>1</sup>		
		w	d	h	W	D	H
631000512	SAL 120/85	365	365	477	431	431	554
631000513	SAL 250/85	515	515	627	581	561	704
631000514	SAL 500/85	665	665	727	731	731	804

Article no. 601655055, 1 sales unit of fiber insulation cord, 5 strips of 610 mm each

<sup>1</sup> Without piping



# Charging Baskets for Models SAL 120/85 - SAL 500/85

The workpieces are placed in basket for tempering. We recommend the use of a charging aid for charging.



Charging basket for top charging

## Standard Equipment

- Heat-resistant charging basket for small parts and bulk materials, incl. handle or crane lifting eyes
- Filling from above
- Hole size 12 mm
- Heat-resistant alloy: 850 °C - 309 (AISI)/(DIN material no. 1.4828)

Article no.	Furnace	Inner dimensions in mm		
		w	d	h
631000484	SAL 120/85	360	380	550
631000485	SAL 250/85	510	530	650
631000486	SAL 500/85	570	570	750



Special charging basket with 3 drawers (4 levels) for side charging

The workpieces are placed on different levels for tempering. We recommend the use of a charging aid for charging.

## Standard Equipment

- Heat-resistant charging basket, incl. handle/crane lifting eyes
- Charged from side via 2 drawers (3 levels)
- Hole size 12 mm
- Heat-resistant alloy: 850 °C - 309 (AISI)/(DIN material no. 1.4828)

Article no.	Furnace	Inner dimensions in mm		
		w	d	h
631006047	SAL 120/85	344	344	500
631006048	SAL 250/85	490	490	720
631006049	SAL 500/85	660	660	770



Basket for charging in different floors

The workpieces are placed on different levels for tempering. We recommend the use of a charging aid for charging.

## Standard Equipment

- Heat-resistant charging basket for small parts and bulk materials, incl. handle/crane lifting eyes
- Charged in different floors
- Hole size 12 mm
- Heat-resistant alloy: 450 °C - 304 (AISI)/(DIN material no. 1.4301), 650 °C - 321 (AISI)/(DIN material no. 1.4541) or 850 °C - 309 (AISI)/(DIN material no. 1.4828)

Article no.	Furnace	No. of baskets	Max. charge weight per basket	Inner dimensions in mm		
				w	d	h
631006106	SAL 250/85	7	10 kg	530	530	100



# Hardening Systems

The toolshop hardening systems are an assembly of furnaces and accessories from our standard range. All components can also be ordered separately.

The following equipment applies to all furnaces in this chapter:



Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load



Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.



Defined application within the constraints of the operating instructions



Controller with intuitive touch operation



As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control



Furnace Group	Model	Page
Tool Shop Hardening Systems	KHS, MHS	80
Protective Gas Hardening System SHS 41	SHS	83



# Tool Shop Hardening System KHS 17

The work platform of the system is designed to carry an N 7/H - N 17/H series hardening furnace and NA 15/65 annealing furnace. Suitable protective gas boxes can be used. A movable oil/water bath for quenching and subsequent cleaning is positioned below the furnaces. This compact system is a practical solution if space is an issue.



After heat treatment in the hardening furnace, the parts are removed from the furnace or the gas feed box and quenched in an oil quench bath or water bath. The charging basket can be used to move the part within the bath so that it cools more evenly. After quenching in oil the workpiece should be cleaned in the water bath, dried and immediately tempered in a forced convection furnace in order to optimally fix the mechanical components with regard to their strength behavior for the required conditions, minimize distortion and prevent potential flaws.

## Additional Equipment

- Protective gas boxes see page 51 - 54
- Protective gas annealing bag and holder see page 55
- Gas supply systems see page 92
- Charging forks see page 53

Tool shop hardening system KHS 17

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Heating power in kW <sup>2</sup>	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
N 7/H	1280	250	250	120	7	720	640	510	3.0	1-phase	60
N 11/H	1280	250	350	140	11	720	740	510	3.6	1-phase	70
N 11/HR	1280	250	350	140	11	720	740	510	5.5	3-phase <sup>1</sup>	70
N 17/HR	1280	250	500	140	17	720	890	510	6.4	3-phase <sup>1</sup>	90
NAT 15/65	650	295	340	170	15	470	790	460	2.8	1-phase	60

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

<sup>2</sup>Depending on furnace design connected load might be higher

\*Please see page 110 for more information about supply voltage

Article no.	Article	Outer dimensions in mm			Charging floor grid dimensions	
		W	D	H	Width in mm	length in mm
401000104	Work table with quenching and cleaning bath	735	850	1155	-	-
401000102	Charging basket for quenching and cleaning bath	-	-	-	215	635

# Tool Shop Hardening System MHS 17

The MHS 17 hardening system has a modular design and consists of a work platform for the heat treating furnaces, an oil bath for quenching and water bath for cleaning parts. As an option both baths can be delivered incl. heating. The baths are mounted to the left and right of the work platform and have charging baskets in order to induce even cooling of the parts in the bath. All parts may be ordered separately meaning the hardening system can be retrofitted or equipment added individually depending on the materials processed.

The MHS 17 can have an air quenching system added to it for air-hardened steels. This platform has a powerful cooling fan to force cool the parts requiring hardening and also the gas feed annealing bag and holder. A refractory brick base is for placing hot boxes and workpieces on them. The quenching baths can also be fastened onto the forced cooling system.

An additional storage platform can be integrated within the system for holding accessory equipment and/or optional charging accessories.

Additional equipment see page 80.



MHS 17

Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Heating power in kW <sup>2</sup>	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
for MHS 17											
N 7/H	1280	250	250	120	7	720	640	510	3.0	1-phase	
N 11/H	1280	250	350	140	11	720	740	510	3.6	1-phase	70
N 11/HR	1280	250	350	140	11	720	740	510	5.5	3-phase <sup>1</sup>	70
N 17/HR	1280	250	500	140	17	720	890	510	6.4	3-phase <sup>1</sup>	90
NAT 15/65	650	295	340	170	15	470	790	460	2.8	1-phase	60

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

<sup>2</sup>Depending on furnace design connected load might be higher

\*Please see page 110 for more information about supply voltage

Article no.	Article	Outer dimensions in mm			Volume in l	Charging floor grid dimensions		Connected load kW	Supply voltage
		W	D	H		Width in mm	length in mm		
631006421	Work platform	1000	850	760	-	-	-	-	-
631006407	Oil bath	280	510	510	50	400	200	-	-
631006408	Water bath	280	510	510	50	400	200	-	-
631001011	Heating element (oil bath)	-	-	-	-	-	-	3,0	230 V
631001012	Heating element (water bath)	-	-	-	-	-	-	3,0	230 V
631000429	Forced cooling system (cooling platform)	560	610	760	-	400	200	0,2	230 V
631000442	Side platform	560	610	760	-	-	-	-	-

# Tool Shop Hardening Systems MHS 31, MHS 41 and MHS 61

These toolshop hardening systems are suitable for hardening larger components in air or under a protective gas atmosphere. The systems can be assembled from a chamber furnace, a forced convection furnace, a protective gas box with a gas supply via a solenoid valve, a charging plate to protect the furnace floor, and a quenching bath with heating element. During the heat treatment under protective gas, the process starts with the flushing of the batch in the protective gas box by means of protective gas. Subsequently, annealing is carried out in the chamber furnace at a lower process flushing rate. The chamber furnace is opened after the annealing process and the batch is removed from the protective gas box to be quenched in the preheated quench bath. The final annealing process takes place in the forced convection furnace. For easier charging, we recommend the use of optional charging aids such as pull hooks and charging trolleys.

The toolshop hardening systems are an assembly of furnaces and accessories from our standard range. All components can also be ordered separately.



Tool Shop Hardening Systems MHS 31

## Additional Equipment

- Draw hook see page 95
- Charging cart see page 96

	Model	Tmax °C	Inner dimensions in mm			Charging height in mm	Outer dimensions in mm			Heating power in kW <sup>2</sup>	Electrical connection*	Weight in kg
			w	d	h		W	D	H			
MHS 31	N 31/H	1280	350	350	250	900	1040	1100	1340	15	3-phase	210
	NA 30/65	650	320	320	300	900	810	620	620	3	1-phase <sup>1</sup>	90
	Quenching bath Q 50	-	200	170	250	700	350	350	700	-	-	-
	Heating element	-	-	-	-	-	-	-	-	3	1-phase	-
MHS 41	N 41/H	1280	350	500	250	900	1040	1250	1340	15	3-phase	260
	NA 60/65	650	400	400	400	900	890	700	720	3	1-phase	110
	Quenching bath Q 50	-	200	170	250	700	350	350	700	-	-	-
	Heating element	-	-	-	-	-	-	-	-	3	1-phase	-
MHS 61	N 61/H	1280	350	750	250	900	1040	1500	1350	20	3-phase	400
	NA 60/65	650	400	400	400	900	890	700	720	3	1-phase	110
	Quenching bath Q 50	-	200	170	250	700	350	350	700	-	-	-
	Heating element	-	-	-	-	-	-	-	-	3	1-phase	-
Accessories	Charging cart CW1	-	-	-	-	880 - 920	330	1100	880 - 920	-	-	-
	Charging cart CWK1	-	-	-	-	880 - 920	330	1100	880 - 920	0,2	1-phase	-
	Side platform	-	600	600	-	900	600	600	900	-	-	-
	Protective gas box N 31/H	1100	280	230	200	-	316	304	226	-	-	-
	Protective gas box N 41/H	1100	280	380	200	-	316	454	226	-	-	-

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

<sup>2</sup>Depending on furnace design connected load might be higher

\*Please see page 110 for more information about supply voltage

# Protective Gas Hardening System SHS 41

This compact, semi-automatic system is suitable for hardening in a protective gas atmosphere followed by quenching of the workpiece in oil. In this way, even larger parts can be annealed under a protective gas and quenched. It consists of a chamber furnace N 41/H hardening furnace with a pneumatic door opening and charging plates as well as an oil quench bath on rollers with an integrated pneumatic lowering unit, a floor grid with gas hood, a holding unit for the gas hood as well as a rim exhaust with flame trap.

The workpiece is placed on the floor grid and covered with the gas hood. After preflushing with protective gas, the gas hood is pushed with the floor grid into the chamber furnace. After the heat treatment is completed, the workload is pulled out of the furnace onto the lowering unit. The hood remains above the quenching bath while the charging floor grid is lowered pneumatically. In order to obtain best quenching results, the pneumatic lowering unit is moved up and down in the oil quench bath. After completion, the workload is moved into unloading position.

This low cost system can be used for hardening processes which otherwise could only be handled in complex furnace systems.



Protective gas hardening system with furnace N 41/H



## Standard Equipment

- Chamber furnace N 41/H
- Pneumatic pedal switch operated door opening
- Charging plate
- Oil quench bath on rollers
- Pneumatic lowering unit
- Heating of oil quench bath
- Oil temperature display
- Charging floor grid and gas hood
- Holding unit for gas hood
- Manual protective gas unit see page 93
- Draw hook see page 95
- Safety equipment consisting of rim exhaust with flame trap and oil steam separator

## Additional Equipment

- Suction hood
- Water bath

Furnace Model	Tmax °C	Inner dimensions in mm			Volume in l	Outer dimensions in mm			Heating power in kW <sup>2</sup>	Electrical connection*	Weight in kg
		w	d	h		W	D	H			
N 41/H <sup>1</sup>	1280	350	500	250	40	1040	1250	1340	15.0	3-phase	260

<sup>1</sup>Furnace description see page 42

<sup>2</sup>Depending on furnace design connected load might be higher

\*Please see page 110 for more information about supply voltage

Article no.	Protective gas hardening system	hood size in mm			Oil quench bath size in liters	max. load Weight	max. quench yield/h	Preflush rate	Process flush rate	Heating power oil bath/kW	Electrical connection*
		W	D	H							
-	SHS 41	260	360	180	400	25 kg	20 kg	20 - 25	10 - 15	6.0	3-phase
631006104	Gas hood (spare part)										

\*Please see page 110 for more information about supply voltage



# Quenching and Cleaning Baths

Many heat treatment processes for steel and aluminum include a quenching process after heat treatment in order to achieve a certain microstructure or material properties. Depending on the material, water, oil or a polymer solution is used as a quenching medium. Some materials require the medium to be preheated to a certain temperature before the component is quenched or the medium must not exceed a certain temperature during the quenching process, in which case it may need to be actively cooled. If quenching is carried out in oil or polymer it is advisable to integrate a cleaning tank in the overall plant.

The following equipment applies to all furnaces in this chapter:



Over-temperature limiter with adjustable cutout temperature as temperature limiter to protect the furnace and load



Exclusive use of insulation materials without categorization according to EC Regulation No 1272/2008 (CLP). This explicitly means that alumino silicate wool, also known as “refractory ceramic fiber” (RCF), which is classified and possibly carcinogenic, is not used.



Defined application within the constraints of the operating instructions



As additional equipment: Process control and documentation via VCD software package for monitoring, documentation and control



Furnace Group	Model	Page
Quenching and Cleaning Baths	Q 200 - Q 600 D	86
Hardening Oil, Quench Water Additive, Detergent, Insulating Materials		88
Tailor-Made Furnace Plants		89

# Quenching and Cleaning Baths



Quenching bath Q 200 for quenching in oil or water

Baths for quenching in oil or water as well as for cleaning and degreasing are available as single or double baths and are made of stainless steel. Oil quench bath assure highly even cooling of workpieces and are equipped with a lid to immediately extinguish ignited oil. For optimal results, pre-tempering water baths for cleaning workpieces should have an appropriate degreasing additive mixed in to the water bath. An optional heating allows for a bath temperature of approx. 70 °C. All baths come with a charge carrier, supply and drain line.

Article no.	Bath	Inner dimensions in mm			Outer dimensions in mm			Volume in l	Quenchant performance in kg/h	max. load weight in kg
		w	d	h	W	D	H			
101300060	Q 50	200	170	250	350	350	700	50	5 - 10	10
101300080	Q 200	380	340	450	550	550	900	190	25 - 30	20

Article no.	Heating element (optional)	Connected load kW	Supply voltage*
631001013	Q 50	3	230 V
631001014	Q 200	6	400 V

\*Article no. for other possible supply voltages on request

The oil and water quench baths are combined within a single housing and separated by a sheet metal wall in the Q 200 D, Q 400 D and Q 600 D combination baths. Charging aids are available as additional equipment. The Q 200 D combination bath comes with a charge carrier, for models Q 400 D and Q 600 D must be ordered extra. For greater quenchant performance, the baths can be equipped with oil coolers.

Article no.	Bath	Inner dimensions in mm			Outer dimensions in mm			Volume in l Oil/water	max. load weight in kg
		w	d	h	W	D	H		
101300100	Q 200 D	380	340	400	1200	650	900	180/180	20
101300200	Q 400 D	480	480	330	1750	870	900	400/300	40
101300300	Q 600 D	580	580	330	2100	970	900	585/400	60

Charging aid manual + electric	Total height in mm	Max. load weight in kg	Compressed air in bar	Connected load kW	Electrical connection <sup>1</sup>
Q 200 D	1800	20	6 - 9	-	-
Q 400 D	2480	40	-	0.3	1-phase
Q 600 D	2480	60	-	0.3	1-phase

Oil cooler	max. quenchant performance in kg/h	Connected load kW	Electrical connection <sup>1</sup>
Q 200 D	approx. 100	0.55	3-phase
Q 400 D	approx. 200	2.20	3-phase
Q 600 D	approx. 300	2.20	3-phase

<sup>1</sup>Please see page 92 for more information about supply voltage

Heating element	Connected load kW	Supply voltage*
Q 200 D	6	400 V
Q 400 D	9	400 V
Q 600 D	15	400 V

\*Other supply voltages possible on request



Quenching bath Q 400 D with manual charging aid



Oil cooler as additional equipment

# Quench Tanks



Water quench tank WAB 24000 with forced circulation

Standard water or polymer quench tanks have a single stainless steel wall and incorporate a quenching medium circulation system for effective removal of energy from the component. Temperature and level are monitored. All tanks have connections for water feed and drainage. The tank can be cooled and the level topped up with the customer's fresh water supply.

The quench tanks are controlled with a Siemens PLC controls. The system is operated conveniently with a touchpanel or the PC-based Nabertherm Control Center software.



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

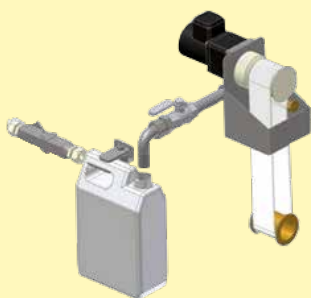
## Additional equipment

- Quench tank in customer's pit
- Quench tank heating
- Quench tank with insulation for improved energy efficiency at higher working temperatures
- Automatic level control
- Rolling lid for the quench tank in automatic operation at higher working temperatures of the quench medium
- Active cooling system

If quenching is carried out in oil or polymer it is advisable to integrate a cleaning tank in the overall plant. Especially if the next step in the process involves tempering in a forced convection chamber furnace, the components should be clean when they are transferred to the furnace.

For heat treatment where flammable substances are released or introduced, the furnaces can be equipped with a corresponding safety system in accordance with EN 1539.

Depending on the material and the required cooling rate, the charge can also be force-cooled or quenched in an air quenching chamber.



Oil separator for quench tanks with water



Oil quench tank OAB 2500/S



Powerful circulation of quenching medium



## Hardening Oil



Hardening oil

- Suitable for most tooling steels
- Thermo-chemically stabile and low misting
- Unlimited service life under normal use
- For mild quenching in critical martensite range
- Durixol W 25 w, can be cleaned using water

Article no.	Description	Container
491000140	Durixol W 25	50 l barrel
491000240	Durixol W 25 w	50 l barrel

## Quench Water Additive



Quench water additive

- For even and rapid water hardening
- For water temperatures to 70 °C, thus reducing risk of cracks and deformation

Article no.	Description	Container
491050200	Hydrodur GF	25 kg sack

## Detergent



Detergent in canister

- Cleaning additives increase the was time of the water and reduce costs
- Minimizes oil traces on workpieces and fumes during tempering

Article no.	Description	Container
493000016	Feroclean N-SF	10 kg canister

## Insulating Materials



Insulating Materials

- Formable ceramic-based paste to seal annealing boxes
- Also suitable for covering workpiece parts not requiring hardening

Article no.	Description	Container
491000120	Lenit heat-resistant putty	19 kg

# Tailor-Made Furnace Plants

Various furnace families can be upgraded with protective gas boxes for processes under non-flammable protection or reaction gases.



Bogie hearth furnace with protective gas box

Forced convection bogie hearth furnace W 5290/85 AS with annealing box for heat treatment of coils under protective gas



Top hat furnace plant with three exchangeable tables and protective gas boxes for heat treatment with non-flammable protective or reaction gases

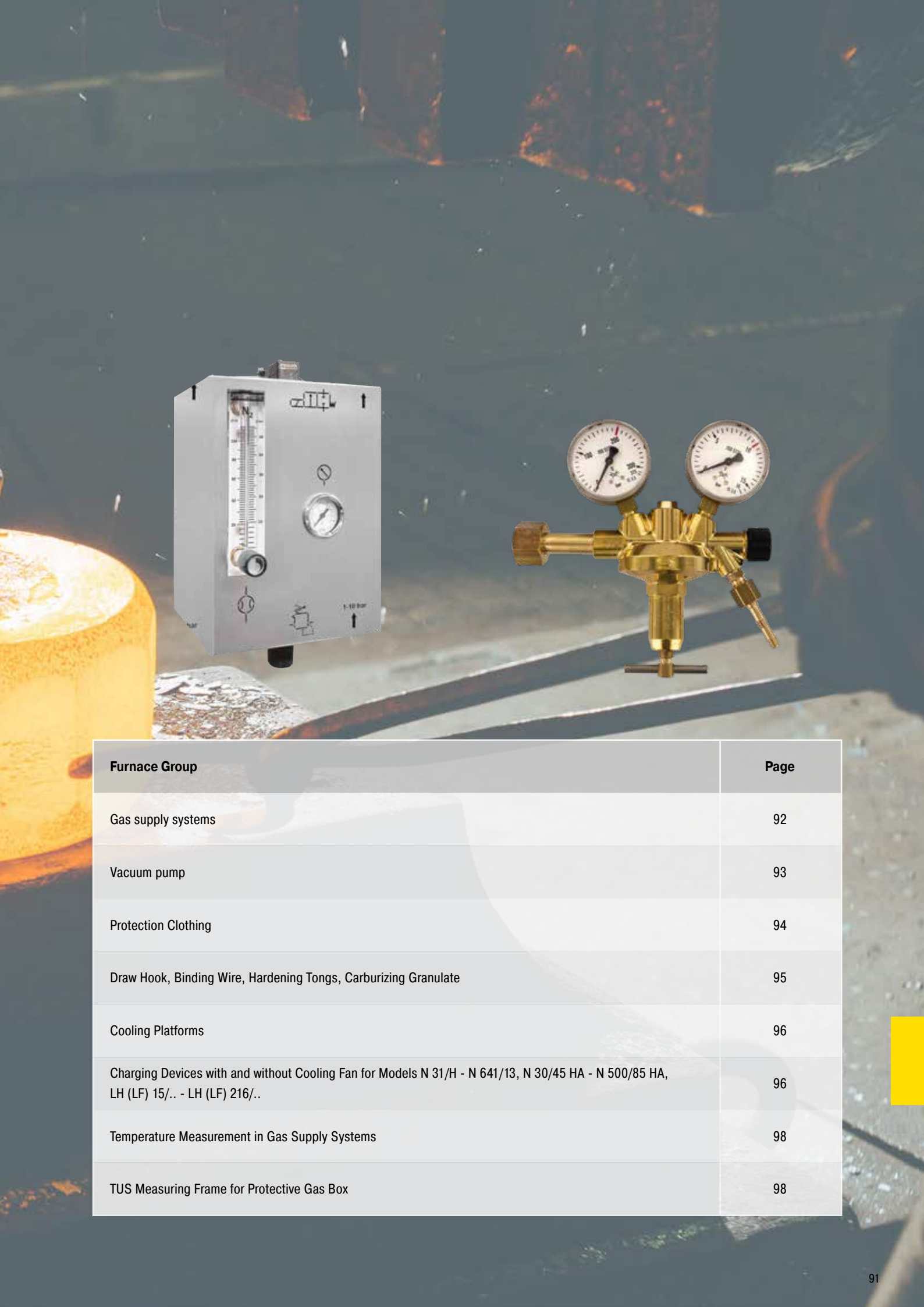


Air circulation chamber furnace N 250/65 HA IDB with protective gas box for inert debinding under protective gases incl thermal post combustion (TNV). Please also see catalog Advanced Materials.

# Additional equipment



Additional equipment such as gas supply systems for different non-combustible process gases, adapted to the gas supply boxes for the chamber and convection furnaces. Charging stackers and charging carts support loading and unloading.



Furnace Group	Page
Gas supply systems	92
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Charging Devices with and without Cooling Fan for Models N 31/H - N 641/13, N 30/45 HA - N 500/85 HA, LH (LF) 15/.. - LH (LF) 216/..	96
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# Gas Supply Systems

## Protective Gases

Protective gases are used to force oxygen out of the gas feed boxes mentioned above. Make sure to use protective gases behaving neutrally toward the heat treated part. The protective gases should be inert, meaning no chemical bonding should occur with the workpiece or the furnace and no reactions should be induced.

In many cases, nitrogen is used as protective gas (lighter than air). Our experience shows that nitrogen does not always lead to sufficient results. A longer preflush time must also be used.

Better results are achieved by adding a mixture of nitrogen and adding some hydrogen. Hydrogen acts as a reducing constituent and reacts with the oxygen. This gas mixture is known as forming gas and available in stores. Experience has shown that adding 5 % hydrogen to the nitrogen leads to good results. According to the EU material safety data sheet this mixture is considered as not flammable. National regulations, however, must be observed. This gas can be obtained in premixed form. No measures must be taken in advance to prevent explosions.

If the workpiece has an affinity to hydrogen, argon used as protective gas can lead to good results.

Argon is a gas which is heavier than air. This makes it relatively easy to fill the protective gas containers. Forming gas with added hydrogen (depending on the country law up to a ration of 98/2) is lighter, but it has the advantage of burning at higher temperatures and therefore binds with the oxygen. Even in a cold state, the leaking hydrogen transports the oxygen very easily out of the container.

For gas mixtures with hydrogen or other combustible gases, the valid safety regulations must always be observed. If the mixture is declared as combustible, the furnace, provided it is a gas tight version, can be fitted with a corresponding safety system.

Always make sure that the room is properly ventilated when working with protective gases. Country-specific safety regulations must also be followed.



Automatic gas supply system

### Automatic gas supply system for flow rates of 4 l - 50 l/min

- Gas supply system mounted at the furnace in a compact stainless steel housing
- Gas flow can be activated in each segment by solenoid valve via the controller; Flow rate preset manually
- Gas inlet: 1 bar - 10 bar, hose connection:  $\varnothing i = 9 \text{ mm}$
- Gas outlet: hose connection:  $\varnothing i = 9 \text{ mm}$
- System includes:
  - Solenoid valve with connection to the controller
  - Flow meter (scale as sticker)
  - Flow rate adjustment manually by screw and needle valve
  - Pressure reducer for setting the supply pressure
  - Pressure gauge for reading the supply pressure
  - Connection set for furnace
  - 5 m connection hose 9 mm
  - Quick fitting (G1/4) for gas inlet

Article no.	Type of gas	Flow rate l/min
6000085544	gas independent	4 - 50

## Automatic gas supply system for two flow rates 2 x 4 l - 50 l/min



Automatic gas supply system for two flushing quantities

- Gas supply systems mounted at the furnace in compact stainless steel housings
- Two combined gas supply systems depending on the connection for 2 gas quantities, 2 gas types or large gas quantity
- The gas supply can be activated in each segment by 2 solenoid valves, which can be selected independently via the controller. Gas flow rates pre-set manually
- Gas inlet: 1 bar - 10 bar, hose connection Øi = 9 mm
- Gas outlet: hose connection Øi = 9 mm
- System includes 2 combined systems, each with:
  - Solenoid valve with connection to the controller
  - Flow meter (scale as sticker)
  - Flow rate adjustment manually by screw and needle valve
  - Pressure reducer for setting the supply pressure
  - Pressure gauge for reading the supply pressure
  - Connection set for furnace
  - 5 m connection hose 9 mm
  - Quick fitting (G1/4) for gas inlet

Article no.	Type of gas	Flow rate l/min
6000085545	gas independent	2 x 4 - 50 or 4 - 100



Gas bottle connection

## Gas bottle connection

- With this option, the gas supply systems can be connected to common gas bottles
- Bottle connection with:
  - Pressure reducer
  - Pressure gauge for inlet pressure
  - Pressure gauge for outlet pressure

Article no.	Type of gas	Gas- cylinder thread
6000085489	Argon	W21,8x1/14" (EU)
6000085490	Nitrogen	W24.32x1/14"RH (EU)
6000085491	Forming gas (95/5 and 98/2)	W21,8x1/14"LH(EU)
6000085492	Argon	W21.8x1/14"R (ES, FR, PT)
6000085493	Nitrogen	W21.8x1/14"R (ES, FR, PT)
6000085494	Forming gas (95/5 and 98/2)	W21.8L (ES, FR, PT)

## Vacuum Pump

Oil sealed rotary vane vacuum pump for universal use within the low vacuum range. Highly compact and low noise construction. Manometer included in delivery.



Vacuum pump

- Sliding vane rotary pump with sucking capacity of max. 16 m³/h
- 0,5 mbar absolute
- Connection hose made of stainless steel 2000 mm
- Connector KF16
- Manometer (-1/0.6 bar)

Article no.	Outer dimensions in mm			Connections on suction side		Connected load	Supply voltage*	Nominal suction power m³ h	Suction capacity m³ h-l
	W	D	H						
601403057	280	315	200	3/4"	1/2" inner thread	0.55 kW	230 V	16	15

\*Article no. for other possible supply voltages on request

# Gloves



Article no.: 491041101 491041104



491041103 493000004

## Standard Equipment

- Specially insulated gloves for working with hot mechanical components and working near furnace

Article no.	Description	Short-time contact temperature in °C
491041101	Fiberglass finger glove, 380 mm long	approx. 700
491041103	Finger glove, 300 mm long	approx. 400
491041104	Fiberglass mitten, 380 mm long	approx. 700
493000004	Carbon-fiber finger glove, knitted	approx. 650

# Heat-Resistant Face Mask



## Standard Equipment

- Light design with adjustable hat size
- Plastic window, folds up

Article no.	Description
491037105	Heat-resistant face mask

# Frontal Protection Coat



## Standard Equipment

- Frontal heat protection
- Open back
- Velcro fastener on the back
- Material Preox-Aramid-Aluminium
- For radiated heat up to 1000 °C, max. 95 sec.
- C3-classification according to EN 11612-C
- Length 1300 mm

Article no.	Description
699000325	Frontal Protection Coat, Size 54 (D), 1300 mm

## Draw Hook

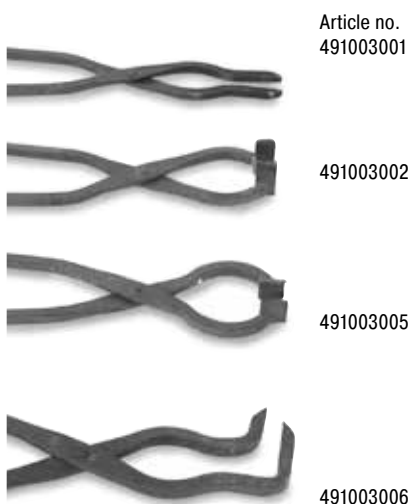


### Standard Equipment

- For charging protective gas annealing bags with holder, annealing and protective gas boxes
- Large handle, also easy to handle with glove

Article no.	Length in mm
631000663	500
631000593	750
631000594	1000

## Hardening Tongs



Article no.  
491003001

491003002

491003005

491003006

### Standard Equipment

- Various shapes and sizes for different applications and workpiece geometries
- Handle length 600 mm, assuring sufficient distance from hot furnace chamber and for deep immersion length into quench bath

Article no.	Description
491003001	Tongs with flat jaw suitable for hand forming
491003002	Tongs with vertical mouth for lifting off floor
491003003	Tongs with bent mouth, universal use
491003004	Tongs with double-curve jaw, universal use
491003005	Half round tongs, for round rod materials
491003006	Knee tongs for larger rings with thick wall
491003008	Handy universal tongs for small parts (handle length 500 mm)

## Carburizing Granulate



Carburizing granulate

### Standard Equipment

- Workpieces are placed into an annealing box with carburizing granulate and the lid is closed and sealed
- At approx. 900 °C the steel reacts with the carbon and forms an approx. 0.2 - 2 mm thick layer
- The thickness of the layer depends on the length of the process, approx. 0.1 mm/hr, a process time of approx. 6 - 8 hrs achieves good average results
- Powder for alloyed and non-alloyed steels as well as granulate for multiple use with approx. 20 % new granulate added
- Supplied in 25 kg sacks

Article no.	Description
491070250	KG 6 - granulate for alloyed steels and multiple re-use
491070275	KG 30 - granulate for non-alloyed steels and multiple re-use



## Cooling Platform

Storage platforms are used for forced cooling of mechanical components or annealing boxes outside of the furnace. The platform can also be used for charging the box in front of the furnace.



Picture shows cooling platform 6000043858

Article no.	Furnace	Outer dimensions in mm			Supply voltage*	Comments
		W	D	H		
631000429	up to N 17/HR	550	610	760	230 V	The same as forced cooling system MHS 17 see page 71
6000043858	up to N 161 up to NA 250/..	700	800	900	230 V	

\*Article no. for other possible supply voltages on request

## Charging Devices with and without Cooling Fan

### Charging Cart CW(K) 1, CW(K) 15 and CW(K) 16

For charging of larger workpieces, protective gas boxes and hardening boxes.

- Two movable and two fixed castors
- Equipped with a rack at working height for temporary storage
- CWK version with cooling fan



Charging cart CWK1

Article no.	Designation	Furnace	Outer dimensions in mm		
			W	D	H
631000528	CW 1	N 31/H, N 41..., NA 60/.. <sup>2</sup>	370	1100	880 - 920
631001320	CW 15	LH(LF) 15/.. - LH(LF) 30/..	370	1100	760 - 800
631001321	CW 16	LH(LF) 60/.. - LH(LF) 216/..	500	1100	760 - 800
631000529	CWK 1	N 31/H, N 41..., NA 60/.. <sup>2</sup>	400 + 100 <sup>1</sup>	1100	880 - 920
631001322	CWK 15	LH(LF) 15/.. - LH(LF) 30/..	330 + 100 <sup>1</sup>	1100	760 - 800
631001323	CWK 16	LH(LF) 60/.. - LH(LF) 216/..	470 + 100 <sup>1</sup>	1100	760 - 800

<sup>1</sup> Side switch

<sup>2</sup> From model 2022

### Charging Cart CW 2 - CW 4 and CWK 2 - CWK 4

For charging of larger workpieces, protective gas boxes and hardening boxes.

- CW(K) 2: two movable and two fixed castors
- CW(K) 3-4: 2 castors with brakes, 2 fixed rollers for heavy loads
- Equipped with a grid at working height for temporary storage
- Furnace locking via pedal lever
- CWK version with cooling fan



Charging cart CW 2

Article no.	Designation	Furnace	Outer dimensions in mm		
			W	D	H
631000530	CW 2	N 81..., N 161..., NA 120/..	500	1120	880 - 920
631000531	CW 3	N 321..	800	1490	880 - 920 <sup>2</sup>
631000468	CW 4	N 641..	1040	1950	880 - 920 <sup>2</sup>
6000135666	CWK 2	NA 120/..., N 81/..., N 161/..	500 + 80 <sup>1</sup>	1120	880 - 920
631000470	CWK 3	N 321..	800 + 80 <sup>1</sup>	1490	880 - 920 <sup>2</sup>
631000471	CWK 4	N 641..	1040 + 80 <sup>1</sup>	1950	880 - 920 <sup>2</sup>

<sup>1</sup> Side switch

<sup>2</sup> Without holding grip



Charging Stacker WS 1



Guiding track at the base frame



WS 2 charging stacker



Guiding track at the base frame

## Charging Cart WS 1

For charging of protective gas and annealing boxes.

- 2 casters with brakes, 2 fixed rollers for heavy loads
- With parallel guided lifting mechanism
- Only for boxes with preparation for charging device (standard since 07.2018)
- Will be delivered with drive-in aid for the relevant furnace model
- Guiding track and charging cart can be also ordered separately

Article no.	Designation	Furnace
6000004965	WS 1	N 61/H, N 87/H, N 81, NA 60, NA 120, LH 60, LH 120

Article no. guiding track	Furnace
6000006118	NA 60/..
6000006101	NA 120/..
6000005811	LH 60/..
6000005372	LH 120/..
6000006155	N 61/H
6000151799	N 81
6000151457	N 87/H

## Charging Stacker WS 2

- Lifting device with hand winch
- Compact construction with push bar and manual lifting device for easy and safe lifting
- 2 casters with brakes, 2 fixed rollers
- Adjustable loading fork width
- Max. load 500 kg
- Guiding track, mounted at the furnace base frame
- Guiding track and forklift can be also ordered separately

Article no.	Designation	Furnace
699000062	WS 2	N 161, LH 216, NA 250/.., NA 500/.., NA 675/..

Article no. guiding track	Furnace
6000158935	N 161
6000128381	NA 250/..
6000110018	NA 500/..
6000158936	NA 675/..
6000002842	LH 216/..

# TUS Measuring Frame for Protective Gas Box



TUS Measuring Frame for Protective Gas Box

To carry out the temperature uniformity measurement (TUS) the protective gas box will be equipped with a second lid. The TUS measuring frame is fixed to the lid and it is equipped with measuring port for thermocouples.

## Standard Equipment

- Tmax 1100 °C
- Useful for all relevant TUS norms
- Under the assumption that the furnace is equipped with a measuring port for themocouples
- Heat-resistant alloy 314 (AISI)/(DIN material no. 1.4828)
- Thermocouples not included

# Temperature Measurement in Gas Supply Systems



Thermostat (manual device)

The use of a temperature measuring device is recommended for measuring the exact heat treatment temperature in gas supply boxes or annealing bags with holders. Thermocouples are fitted as standard in Nabertherm gas boxes or annealing bags holders. A simple hand-held measuring device with LCD display is available for temperature measurement. The device is equipped with a 2-pin connector for connecting the thermocouple. The temperature can thus be determined and readjusted on the controller if necessary.

Article no.	Description
542100028	Temperature indicator with digital display, battery-operated, manual device
V000801	Connecting cable between heat treatment with charge thermocouple and Article no. 542100028, 3 m





# Process Control and Documentation





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Process data storage	114
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# Temperature Uniformity and System Accuracy

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

## Specification of Temperature Uniformity in $\pm$ K in the Standard Furnace

In the standard design the temperature uniformity is specified in  $\pm$  K at a defined set-temperature with the work space of the empty furnace during the dwell time. In order to make a temperature uniformity survey the furnace should be calibrated accordingly. As standard our furnaces are not calibrated upon delivery.

## Calibration of the Temperature Uniformity in $\pm$ K

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

## System Accuracy

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

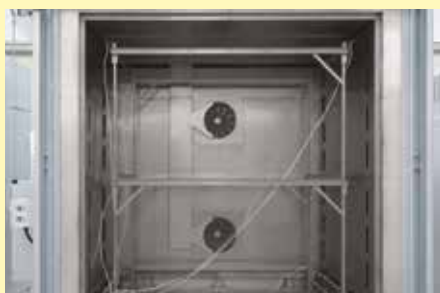
- Measurement of total temperature deviation of the measurement line from the controls to the thermocouple
- Measurement of temperature uniformity within the work space at the reference temperature or within the reference temperature range
- If necessary, an offset is set at the controls to adjust the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



Holding frame for measurement of temperature uniformity

## Temperature Uniformity in the Work Space incl. Protocol

In standard furnaces, temperature uniformity is guaranteed as  $\pm$  K without measurement of temperature uniformity. However, as an additional feature, a temperature uniformity measurement at a target temperature in the work space compliant with DIN 17052-1 can be ordered. Depending on the furnace model, a holding frame which is equivalent in size to the work space is inserted into the furnace. This frame holds thermocouples at up to 11 defined measurement positions. The measurement of the temperature uniformity is performed at a target temperature specified by the customer after a static condition has been reached. If necessary, different target temperatures or a defined target working temperature range can also be calibrated.



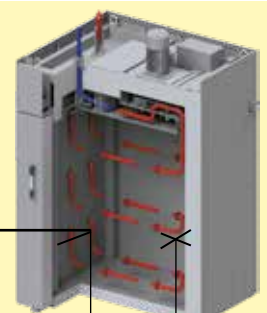
Pluggable frame for measurement for forced convection chamber furnace N 7920/45 HAS

The system accuracy is defined by adding the tolerances of the controls, the thermocouple and the work space



Precision of the controls, e. g.  $\pm 1$  K

Deviation of thermocouple, e. g.  $\pm 1.5$  K



Deviation from measuring point to the average temperature in the work space e. g.  $\pm 3$  K

# AMS2750H, NADCAP, CQI-9

Standards such as the AMS2750H (Aerospace Material Specifications) are applicable for the industrial processing of high-quality materials. They define industry-specific requirements for heat treatment. Today, the AMS2750H and derivative standards such as AMS2770 for the heat treatment of aluminum are the guidelines for the aerospace industry. After the introduction of the CQI-9, the automotive industry has also committed to submit heat treatment processes to stricter rules. These standards describe in detail the requirements applicable to thermal processing plants.



Measurement set-up in a high-temperature furnace

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

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

## Furnace Class and Instrumentation Requirements of the AMS2750H

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

## Regular Inspections

The furnace or the heat treatment plant must be designed so that the requirements of the AMS2750H can be met and be reproduced. The standard also requires the inspection intervals for the instrumentation (SAT = System Accuracy Test) and the temperature uniformity of the furnace (TUS = Temperature Uniformity Survey). The SAT/TUS tests must be performed by the customer with measuring devices and sensors which operate independently of the furnace instrumentation.

Instrumentation	Type						Furnace class	Temperature uniformity	
	A	B	C	D+	D	E		°C	°F
Each control zone has a thermocouple connected to the controller	x	x	x	x	x	x	1	+/- 3	+/- 5
Recording of the temperature measured by the control thermocouple	x	x	x	x	x		2	+/- 6	+/- 10
Sensors for recording the coldest and hottest spots	x		x				3	+/- 8	+/- 15
Each control zone has a charge thermocouple with recording system	x	x					4	+/- 10	+/- 20
One additional recording sensor, distance $\geq 76$ mm to control sensor, of a different sensor type				x			5	+/- 14	+/- 25
Each control zone has an over-temperature protection unit	x	x	x	x	x		6	+/- 28	+/- 50



Measurement set-up in an annealing furnace



Measuring protocol



Measurement range calibration



# AMS2750H, NADCAP, CQI-9

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



N 12012/26 HAS1 according to AMS2750H

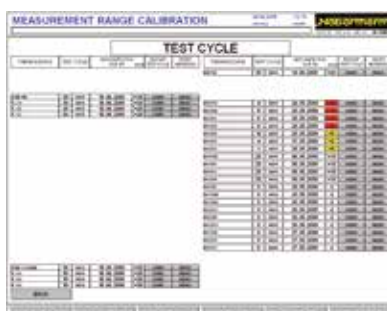
- Furnace designs, which meet standards, following customer specifications regarding furnace class and instrumentation, incl. gauge connections for repeated customer inspections at regular intervals. No consideration of requirements with respect to documentation
- Data recording devices (e.g., temperature recorder) for TUS and/or SAT measurements see page 103
- Data recording, visualization, time management via the Nabertherm Control Center (NCC), based on Siemens WinCC software see page 115
- Commissioning at site, incl. the first TUS and SAT inspection
- Connection of existing furnace plant to meet norm requirements
- Documentation of the complete process chain in line with the corresponding norm

## Implementation of AMS2750H

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

## Instrumentation with Nabertherm Control Center (NCC)

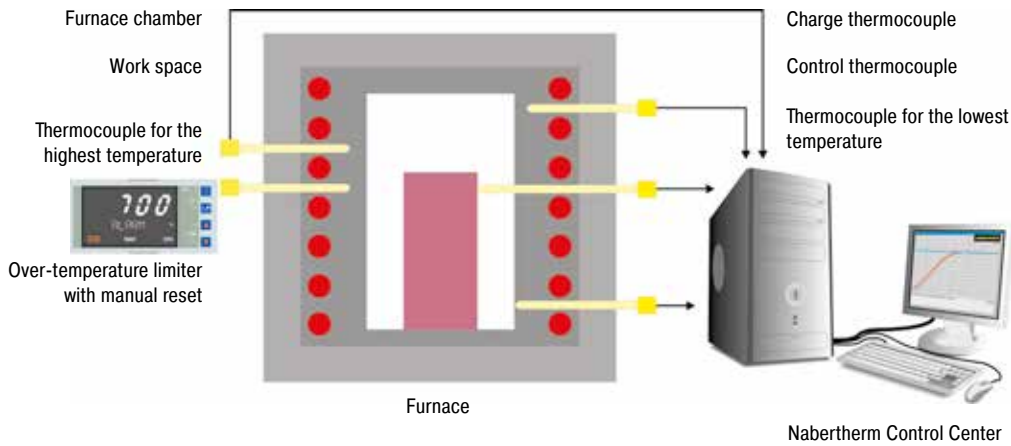
The attractive feature of the instrumentation with Nabertherm Control Center in combination with PLC controls of the furnace is the convenient data input and visualization. The software programming is structured in a way that both the user and the auditor can navigate it without difficulty.



In daily use, the following product characteristics stand out:

- Very easy to navigate and straight-forward presentation of all the data in plain text on the PC
- Automatic saving of the charge documentation at the end of the program
- Administration of the calibration cycles in the NCC
- Results of the measurement distance calibration are entered in the NCC
- Schedule management of the required testing cycles including a reminder function. The testing cycles for TUS (Temperature Uniformity Survey) and SAT (System Accuracy Test) are entered in days and monitored by the system and the operator or tester is informed in time about up-coming tests. The measurements have to be done with separate calibrated measuring equipment.
- Option of transferring the measurement data to a customer's server

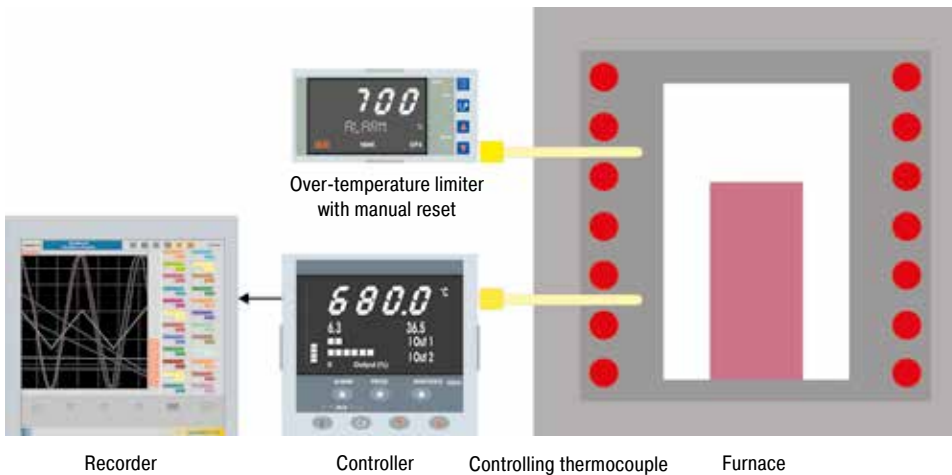
The Nabertherm Control Center can be extended to enable a complete documentation of the heat treatment process apart from just the furnace data. For example, when heat-treating aluminum, in addition to the furnace, the temperatures in the quenching basin or a separate cooling medium can also be documented.



Example of a design with Type A Nabertherm Control Center

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

As an alternative to instrumentation with the Nabertherm Control Center (NCC) and PLC controls, instrumentation with controllers and temperature recorders is also available. The temperature recorder has a log function that must be configured manually. The data can be saved to a USB stick and be evaluated, formatted, and printed on a separate PC. Besides the temperature recorder, which is integrated into the standard instrumentation, a separate recorder for the TUS measurements is needed (see page 103).



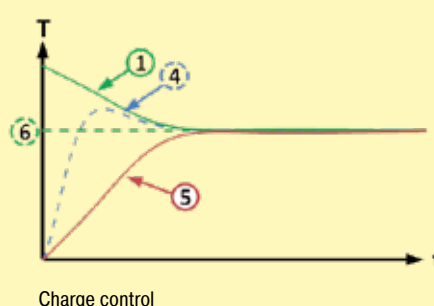
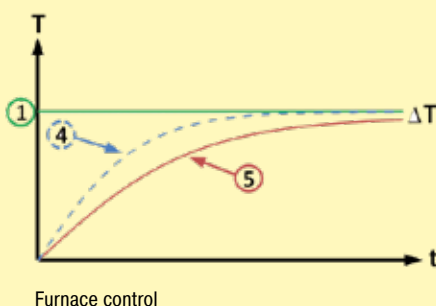
Example of a design containing Type D Eurotherm instrumentation

### Furnace Chamber Control

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

### Charge Control

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



1. Furnace setpoint value
2. Actual value furnace chamber, 1-zone
3. Actual value furnace chamber, 3-zone
4. Actual value furnace chamber
5. Actual value load/bath/muffle/retort
6. Charge setpoint value

# Nabertherm Controller Series 500

## I AM THE CONTROLLER

I'm the big brother of analog buttons and turning switches. I am the new generation of control and intuitive operation. My skills are highly complex, my operation is simple. I can be touched and speak 24 languages. I'll show you exactly which program is currently running and when it ends.



The controller series 500 impresses with its unique scope of performance and intuitive operation. In combination with the free "MyNabertherm" smartphone app, the monitoring of the furnace is even easier and more powerful than ever before. The operation and programming takes place via a high-contrast, large touch panel, which shows exactly the information that is relevant at the moment.



### Standard Equipment

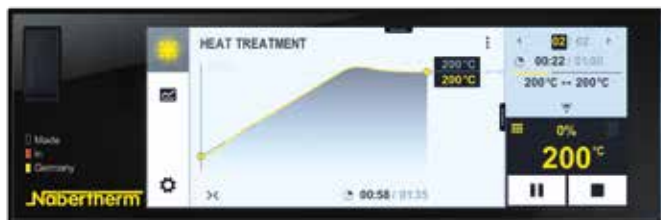


- Transparent, graphic display of the temperature curves
- Clear presentation of the process data
- 24 operating languages selectable
- Consistent, attractive design
- Easily understandable symbols for many functions
- Precise and accurate temperature control
- User levels
- Program status display with estimated end time and date
- Documentation of the process curves on USB storage medium in .csv file format
- Service information can be read out via USB stick
- Clear presentation
- Plain text display
- Configurable for all furnace families
- Can be parameterized for the different processes
- "Solar Mode" to utilize electricity from photovoltaic systems with and without a battery

## Highlights

In addition to the well-known and matured controller functions, the new generation offers you some individual highlights. Here is an overview of the most important ones for you:

### Modern Design



Colored display of temperature curves and process data

### Easy Programming



Simple and intuitive program entry via touch panel

### Integrated Help Function



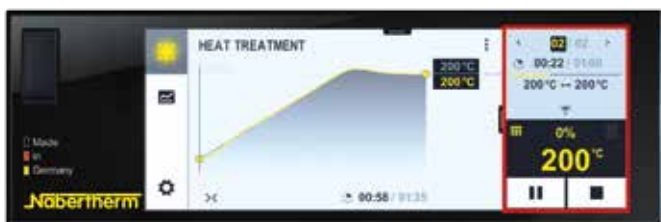
Information on various commands in plain text

### Program Management



Temperature programs can be saved as favorites and in categories

### Segment Player



Detailed overview of process information including setpoint, actual value and switched functions

### Wi-Fi-Capable



Connection with the MyNabertherm app



Intuitive touch screen



Easy program entry and control



Precise temperature control



User levels



Process documentation on USB

Further information on Nabertherm controllers, process documentation and tutorials on operation can be found on our website:  
<https://nabertherm.com/en/series-500>





# MyNabertherm App for Mobile Monitoring of Process Progress

MyNabertherm app – the powerful and free digital accessory for Nabertherm 500 Series Controllers. Use the app for convenient online progress monitoring of your Nabertherm furnaces – from your office, while on the way or from wherever you wish. The app always keeps you in the picture. Just like the controller itself, the app is also available in 24 languages.



Convenient monitoring of one or multiple Nabertherm furnaces simultaneously



Display of program progress for each furnace



Easy to contact

## App-Functions

- Convenient monitoring of one or multiple Nabertherm furnaces simultaneously
- Clear presentation as a dashboard
- Individual overview of a furnace
- Display of active/inactive furnaces
- Operating status
- Current process data

## Display of Program Progress for Each Furnace

- Graphical representation of the program progress
- Display of furnace name, program name, segment information
- Display of start time, program run time, remaining run time
- Display of additional functions such as fresh-air fan, exhaust air flap, gassing, etc.
- Operating modes as symbol

## Push Notifications in Case of Malfunctions and at Program End

- Push notification on the lock screen
- Display of malfunctions with an associated description in the individual overview and in a message list

## Contact with Service Possible

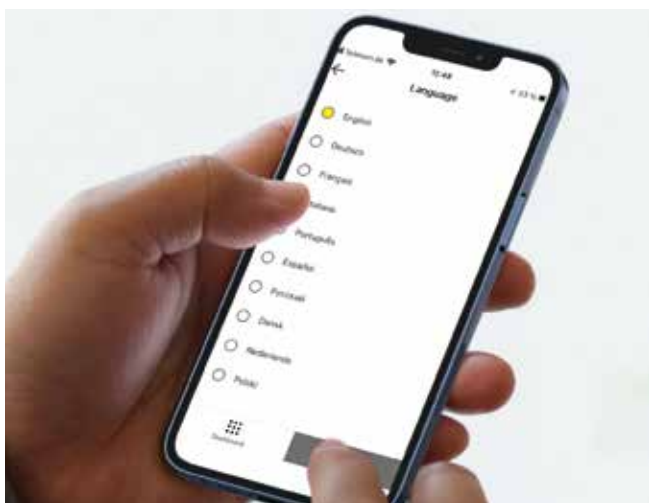
- Stored furnace data facilitate rapid support for you

## Requirements

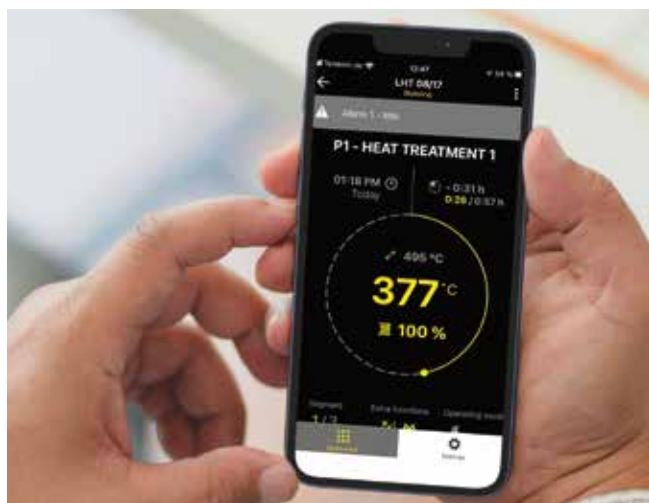
- Connection of the furnace to the Internet via the customer's Wi-Fi
- For mobile devices with Android (from version 9) or IOS (from version 13)



Monitoring of Nabertherm furnaces with 500 series touch panel controller for Arts & Crafts, laboratory, dental, thermal process technology, advanced materials and foundry applications.



Available in 24 languages



Push notifications in case of malfunctions



Clear contextual menu



Any addition of Nabertherm furnaces

Everything on display in the new Nabertherm app for the new controller series 500. Get the most out of your furnace with our app for iOS and Android. Don't hesitate to download it now.



# Functions of the Standard Controllers

	R7	3216	3208	B500/ B510	C540/ C550	P570/ P580	D580 <sup>4</sup>	3508	3504	H500	H1700	H3700	NCC
Number of programs	1	1	1	5	10	50	> 50	1/10/ 25/50 <sup>3</sup>	1/10/ 25/50 <sup>3</sup>	20	20	20	100
Segments	1	8	1	4	20	40	7	500 <sup>3</sup>	500 <sup>3</sup>	20	20	20	20
Extra functions (e. g. fan or autom. flaps) maximum				2	2	2-6		0-4 <sup>3</sup>	2-8 <sup>3</sup>	3 <sup>3</sup>	6/2 <sup>3</sup>	8/2 <sup>3</sup>	16/4 <sup>3</sup>
Maximum number of control zones	1	1	1	1	1	3	1	2 <sup>1,2</sup>	2 <sup>1,2</sup>	1-3 <sup>3</sup>	8	8	8
Drive of manual zone regulation				●	●	●		○	○	○	○	○	○
Charge control/bath control								○	○	○	○	○	○
Auto tune		●	●	●	●	●		●	●				
Real-time clock				●	●	●	●			●	●	●	●
Graphic color display				●	●	●	●			4" 7"	7"	12"	22"
Graphic display of temperature curves (program sequence)							●						
Status messages in clear text			●	●	●	●		●	●	●	●	●	●
Data entry via touchpanel				●	●	●	●			●	●	●	●
Entering program names (i.e. "Sintering")				●	●	●	●				●	●	●
Keypad lock				●	●	●	●	○	○				
User levels				●	●	●	●	●	●	○	○	○	●
Skip-button for segment jump				●	●	●	●						
Program entry in steps of 1 °C or 1 min.	●	●	●	●	●	●	1 sec.	●	●	●	●	●	●
Start time configurable (e. g. to use night power rates)				●	●	●				●	●	●	●
Switch-over °C/°F	○	○	○	●	●	●	●	○	○	●	● <sup>3</sup>	● <sup>3</sup>	● <sup>3</sup>
kWh meter				●	●	●	●						
Operating hour counter				●	●	●	●			●	●	●	●
Set point output			○	●	●	●		○	○		○	○	○
NTLog Comfort for HiProSystems: recording of process data on an external storage medium										○	○	○	
NTLog Basic for Nabertherm controller: recording of process data with USB-flash drive				●	●	●	●						
Interface for VCD software				○	○	○		○	○				
Malfunction memory										●	●	●	●
Number of selectable languages				24	24	24	24						
Wi-Fi-capable („MyNabertherm" app)				●	●	●	●						
Solar Mode				●	●	●	●						

<sup>1</sup> Not for melt bath control

<sup>2</sup> Control of additional separate slave regulators possible

<sup>3</sup> Depending on the design

<sup>4</sup>Controls description for D580 see chapter „Firing furnace and pressing furnace" in catalog „Dental Furnaces"

● Standard

○ Option

## Assignment of Standard Controllers to Furnace Families

	NR(A) 17/06 - NR(A) 1000/11	NR, NRA .. H <sub>2</sub>	NR, NRA .. IDB	NR, NRA 40/02 CDB	NR, NRA 150/02 CDB	SR(A) 17/06 - SR(A) 1500/11	VHT	VHT .. H <sub>2</sub>	LBVHT	SVHT	D 20/S - D 320/S	TS, TSB	QS	N 7/H - N 87/H	N 81(/..) - N 641(/..)	LH 15/12 - LF 120/14	NW	NAT 15/65 - 50/85	NA 120/45 - NA 500/85	NA-I, NA-SI	SAL 30/45 - SAL 500/85	Q	Q .. D
Catalog page	18	20	20	22	22	24	26	30	31	32	38	42	45	48	48	58	62	66	68	73	74	86	86
Controller											●				○				○		○	○	○
C6/3208																							
3216																							
3504	○					○							●		○				○		○	○	○
B500													●	●	●	●	●	●	●	●	●	●	●
B510																							
C540													○	○	○	○	○	○	○	○	○	○	○
C550																							
P570	●					●	● <sup>3</sup>		● <sup>3</sup>	● <sup>3</sup>				○	○	○	○	○	○	○	○	○	○
P580																							
H500/PLC																							
H700/PLC							● <sup>3</sup>		● <sup>3</sup>	● <sup>3</sup>		○	○						○	○	○	○	○
H1700/PLC			●	●		○		●	○	○	○	○			○	○			○	○	○	○	○
H3700/PLC	○	●			●	○	○	○	○	○	○	○			○	○			○	○	○	○	○
NCC	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○			○	○	○	○	○

## Mains Voltages for Nabertherm Furnaces

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

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

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

# Process Data Storage and Data Input via PC



There are various options for evaluation and data input the processes for optimal process documentation and data storage. The following options are suitable for data storage when using the standard controllers.

## Data Storing of Nabertherm Controllers with NTLog Basic

NTLog Basic allows for recording of process data of the connected Nabertherm Controller (B500, B510, C540, C550, P570, P580) on a USB stick. The process documentation with NTLog Basic requires no additional thermocouples or sensors. Only data recorded which are available in the controller. The data stored on the USB stick (up to 130,000 data records, format CSV) can afterwards be evaluated on the PC either via NTGraph or a spreadsheet software used by the customer (e.g. Excel™ for MS Windows™). For protection against accidental data manipulation the generated data records contain checksums.

## Visualization with NTGraph for MS Windows™ for Single-Zone Controlled Furnaces

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

## Software NTEdit for MS Windows™ for Entering Programs on the PC

By using the software NTEdit for MS Windows™ (Freeware) the input of the programs becomes clearer and thus easier. The program can be entered on customers PC and then be imported into the controller (B500, B510, C540, C550, P570, P580) with a USB stick. The display of the set curve is tabular or graphical. The program import in NTEdit is also possible. With NTEdit Nabertherm provides a user-friendly free tool. A prerequisite for the use is the client installation of Excel™ for MS Windows™ (from version 2007). NTEdit is available in eight languages (DE/EN/FR/ES/IT/CN/RU/PT).



NTGraph, a freeware for the easy-to-read analysis of recorded data using Excel™ for MS Windows™



Recording of process data of the connected controller via USB stick



Process input via the NTEdit software (freeware) for MS Windows™



# Process Data Storage

VCD-software for visualization, control and documentation

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

The VCD software is used to record process data of the series 500 and series 400 as well as various further Nabertherm controllers. Up to 400 different heat treatment programs can be stored. The controllers are started and stopped via the software at a PC. The process is documented and archived accordingly. The data display can be carried-out in a diagram or as data table. Even a transfer of process data to Excel™ for MS Windows™ (.csv format \*) or the generation of reports in PDF format is possible.



Example lay-out with 3 furnaces

## Features

- Available for controllers series 500 - B500/B510/C540/C550/P570/P580, series 400 - B400/B410/C440/C450/P470/P480, Eurotherm 3504 and various further Nabertherm controllers
- Suitable for operating systems Microsoft Windows 7/8/10/11
- Simple installation
- Setting, Archiving and print of programs and graphics
- Operation of controllers via PC
- Archiving of process curves from up to 16 furnaces (also multi-zone controlled)
- Redundant saving of archives on a server drive
- Higher security level due to binary data storage
- Free input of charge date with comfortable search function
- Possibility to evaluate data, files exportable to Excel™ for MS Windows™
- Generation of a PDF-report
- 24 languages selectable

## Extension Package 1 for display of an additional temperature measuring point, independent of the furnace controls

- Connection of an independent thermocouple, type S, N or K with temperature display on a supplied C6D display, e. g. for documentation of charge temperature
- Conversion and transmission of measured values to the VCD software
- For data evaluation, please see VCD-software features
- Display of measured temperature directly on the extension package

## Extension Package 2 for the connection of up to three, six or nine measuring point, independent of the furnace controls

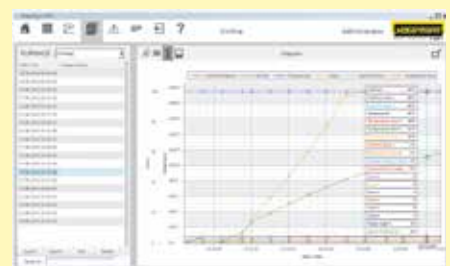
- Connection of three thermocouples, type K, S, N or B to the included connecting box
- Possible extension of up to two or three connecting boxes with up to nine measuring points
- Conversion and transmission of measured values to the VCD software
- Data evaluation, see VCD features



VCD Software for Control, Visualisation and Documentation



Graphic display of main overview (version with 4 furnaces)



Graphic display of process curve



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

## Alternative User Interfaces for HiProSystems

### Process Control H500

This basic panel accommodates most basic needs and is very easy to use. Firing cycle data and the extra functions activated are clearly displayed in a table. Messages appear as text. Data can be stored on a USB stick using the „NTLog Comfort“ option.

### Process Control H1700

Customized versions can be realized in addition to the scope of services of the H500. Display of basic data as online trend on a color 7" display with graphically structured interface.

### Process Control H3700

Display of functions on a large 12" display. Display of basic data as online trend or as a graphical system overview. Scope as H1700.

## Remote Maintenance Router – Fast Support in Case of a Malfunction

For fast failure diagnosis in case of a malfunction, remote maintenance systems are used for HiProSystems-plants (depending on the model). The plants are equipped with a router, which will be connected to the internet by the customer. In case of a malfunction, Nabertherm is able to get access to the furnace controls via a secured connection (VPN tunnel) and to perform a malfunction diagnosis. In most cases, the problem can be directly solved by a technician on site according with supervision from Nabertherm.

If no Internet connection can be provided, we offer optionally the remote maintenance via LTE network as additional equipment.



H1700 with colored, tabular depiction



H3700 with colored graphic presentation



Router for remote maintenance

# Process Data Storage



The following options are available for industrial process documentation and the recording of data from several furnaces. These can be used to document the process data for the PLC controls.

## Data Storing of HiProSystems with NTLog Comfort

The extension module NTLog Comfort offers the same functionality of NTLog Basic module. Process data from a HiProSystems control are read out and stored in real time on a USB stick. The extension module NTLog Comfort can also be connected using an Ethernet connection to a computer in the same local network so that data can be written directly onto this computer.

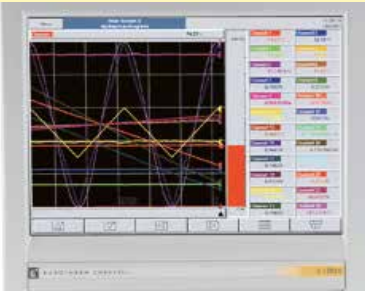


NTLog Comfort for data recording of a Siemens PLC via USB stick

## Temperature Recorder

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

	Model 6100e	Model 6100a	Model 6180a
Data input using touch panel	x	x	x
Size of colour display in inch	5.5"	5.5"	12.1"
Number of thermocouple inputs	3	18	48
Data read-out via USB-stick	x	x	x
Input of charge data		x	x
Evaluation software included	x	x	x
Applicable for TUS-measurements acc. to AMS2750H			x



Temperature recorder

Storage medium

Flash drive USB

?

File type:

.csv

?

Network path

?

Furnace number

1

?

Redundant archiving

1

?

Activate fault messages for archiving

0

?

Activate service mode

0

?

<<<

NTLog Comfort - Data recording via USB stick

Recording

?

automatic

?

Comment

File name

Interval [sec]

60

?

Status

<<<

File manager

Archiving settings

NTLog Comfort - Data recording online on the PC

# Nabertherm Control Center NCC

PC-based control, process visualization and process documentation software

With the Nabertherm Control Center, a PC-based control system is offered as an ideal extension for furnaces with PLC-based HiProSystem control systems. The system has proven itself in many applications with increased demands on documentation and process reliability and also for convenient multi-furnace management. Many customers from the automotive, aviation, medical technology or technical ceramics sectors are working successfully with this powerful software.



Retort furnace NR 300/08 for treatment in high vacuum with NCC in separate cabinet

## Basic Equipment

- Central operator interface in modern design
- Overview and central operation for up to 8 furnaces
- Convenient program management with 100 programs
- Simple, intuitive operation of the PC user interface
- Access management with 3 user levels and as many users as required
- Charge data input for each furnace operation
- Start times can be specified in order to pre-plan heat treatment cycles
- Tamper-proof, encrypted storage of charge documentation
- Live view of current furnace operations
- Archive with overview of performed cycles
- Search function for charge data and temperature curves of performed cycles
- Report function to assess the process as PDF or printout
- Delivery includes PC, monitor and printer



Retort furnace NR 80/11 with IDB safety concept for debinding in non-flammable protective gases with NCC in a separate cabinet

## Aviation/Automotive Design

- Documentation according to AMS2750H (NADCAP) and CQI-9
- Integration of additionally needed thermocouples according to instrumentation type as a switching condition (e.g. start "hold time")
- Instrumentation type adaptable by customer
- Choice of programmed or continuous operation
- Automatic adjustment of the monitored value for overtemperature protection of the charge
- Calibration for all elements of the measuring section in several temperature ranges
- Calendar function for SAT, IT and TUS measurements





## System Overview

With several connected furnaces:

- Overview on actual process values and messages for the connected furnaces
- Simply switching to the furnace overview by selecting a furnace

## Furnace Overview

- Clear presentation of status information and process values of the furnace/furnace system
- Display of charge information, current value and setpoint, as well as remaining time of the active program
- Direct access to live view, furnace settings and control of furnace functions



## Program Input

- Intuitive program input with plain text fields and clear symbols for the furnace functions
- Free text fields for program name and additional information
- Adjustable number of segments (by default up to 20 segments), function to insert and delete individual segments
- Preview of the setpoint curve for created program

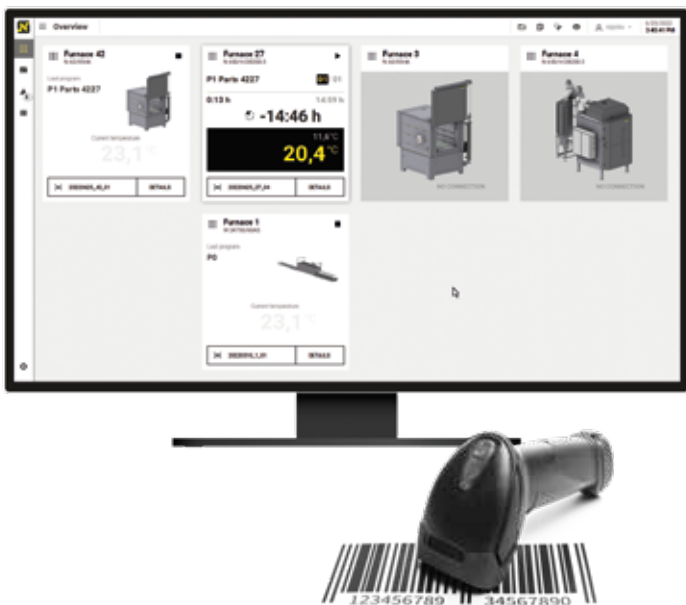
## Charge Preparation

- Information texts for guided charge data entry
- Program selection with display of the program name and additional information
- Preview of the setpoint curve for selected program
- Entry of charge data, operator ID and free text fields for additional information
- Start times can be specified in order to pre-plan heat treatment cycles



## Process Documentation

- Charge and process data is output displayed graphically as a trend, encrypted and saved on the PC in CSV format
- Documentation can be tracked by entering the charge data
- Preview of the setpoint curve for selected program
- Automatic report generation at the end of a process cycle in PDF format with charge data and temperature curve

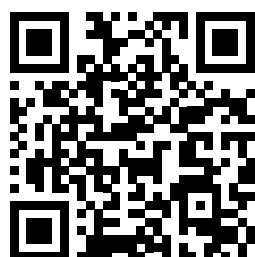


## Extension Options

- Enter charge data via barcode
- Simple data recording, ideal for changing charges
- Ensure data quality with defined charge data
- Compare charge and program to increase process reliability
- Access rights via employee cards
- Software extension with documentation according to the requirements of the Food and Drug Administration (FDA), Part 11, EGV 1642/03
- Interface to connect higher level systems (OPC-UA), SQL connection, redundant data storage
- Control from different PC workstations
- Available as panel PC or virtual machine
- PC cabinet with UPS for PC
- Further customization possible on request

You will find more information about the Nabertherm Control Center with tutorial and click dummy on our website: NCC | Nabertherm

<https://nabertherm.com/en/ncc>





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

For many years the name **Nabertherm** has been standing for top quality and durability in furnace manufacturing. To secure this position for the future as well, Nabertherm offers not only a first-class spare parts service, but also excellent customer service for our customers. Benefit from more than 75 years of experience in furnace construction.

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

**The needs of our customers always have highest priority!**



- Very fast spare parts supply, many standard spare parts in stock
- Worldwide customer service on site with its own service points in the largest markets
- International service network with long-term partners
- Highly qualified customer service team for quick and reliable repair of your furnace
- Commissioning of complex furnace systems
- Customer training in function and operation of the system
- Temperature uniformity measurements, also according to standards like AMS2750H (NADCAP)
- Competent service team for fast help on the phone
- Safe teleservice for systems with PLC controls via a secured VPN line
- Preventive maintenance to ensure that your furnace is ready for use
- Modernization or relining of older furnace systems

### Contact us:

Spare parts



[spares@nabertherm.de](mailto:spares@nabertherm.de)



+49 (4298) 922-474

Customer service



[service@nabertherm.de](mailto:service@nabertherm.de)



+49 (4298) 922-333





**The whole World of Nabertherm: [www.nabertherm.com](http://www.nabertherm.com)**

Please visit our website **[www.nabertherm.com](http://www.nabertherm.com)** and find out all you want to know about us - and especially about our products.

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

Professional Solutions for:

- Thermal Process Technology
- Additive Manufacturing
- Advanced Materials
- Fiber Optics/Glass
- Foundry
- Laboratory
- Dental
- Arts & Crafts



# Nabertherm

MORE THAN HEAT 30-3000 °C

## Headquarters

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

## Sales Organisation

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

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

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

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

**Switzerland**  
Nabertherm Schweiz AG  
Altgraben 31 Nord  
4624 Härkingen, Switzerland  
Tel +41 62 209 6070  
contact@nabertherm.ch

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

**Spain**  
Nabertherm España  
c/Marti i Julià, 8 Bajos 7ª  
08940 Cornellà de Llobregat, Spain  
Tel +34 93 4744716  
contact@nabertherm.es

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



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